INVESTIGATING PRESENCE OF ASYMMETRIC EXCHANGE RATE PASS-THROUGH TO IMPORTS AND CONSUMER PRICES IN SOUTH AFRICA-THE ROLE OF NOMINAL RIGIDITIES

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ABSTRACT

The degree of exchange rate pass-through to consumer prices is important for monetary policy. A less than 100 percent transmission of the exchange rate changes to both import and consumer prices may yield unfavourable macroeconomic outcomes such as exchange rate volatility, run-away inflation and currency substitution in the long run. This paper focused on investigating the degree of transmission of exchange rate changes on consumer prices in South Africa. The findings show that the ERPT to consumer prices in South Africa was very low at 15% for the study period. The changes in exchange rate were significant to explain domestic prices even though transmission was not 100%. Both the local and foreign producer prices were found to influence consumer prices significantly. One of the possible reason for low ERPT could be due to the pricing behavior of firms in their quest to maintain market share. The study also found that the transmission rate from import prices to domestic prices was positive but insignificant at the same level as exchange rate at 15%. This, therefore, means the study failed to find any asymmetry between import price and exchange rate on consumer prices. However, the study found that there existed an asymmetric impact of rand appreciation and depreciation on South African consumer prices. Prices tended to increase when there was depreciation and the opposite was true when there was an appreciation. In an nutshell, then, we conclude that the low ERPT to prices may be due to price-rigidities caused by the pricing-to-market behavior by firms as they seek to maintain the existing market share.

Key Words: Exchange Rate Pass-Through (ERPT), ERPT Asymmetry, Import Price, Consumer Price

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INTRODUCTION/BACKGROUND OF THE STUDY

Exchange rate movements can have material impact on consumer, import and producer prices in the domestic market. The current and more recent exchange rate movements in South Africa make it more encouraging to analyse the impact of exchange rate changes on domestic prices. One such recent study by Kabundi and Mlachila (2018) underscored the need to pay attention to the effects of exchange rate shocks to import and domestic prices. According to the South African Reserve Bank (SARB) statistics of 2018 the average dollar-rand exchange rate for January and August of 2018 were R12.2041 and R14.7797 to the dollar respectively. This represented a change of 2.58 percentage points change or 21.1 percent drop in the value of the rand against the dollar. The question one would ask is whether the local consumer prices respond to the changes of exchange rate and if so, to what degree. The SARB statistics of 2018 recorded a Consumer Price Index change (core CPI) for January to be 4 percent while that of August 2018 was 4.4 percent thereby representing a 0.4 percentage point change or a 1 percent change in CPI. The CPI percent (1 percent) change is far less than the change in the exchange rate (21.1 percent) implying an incomplete exchange rate transmission to prices. If the impact of the exchange rate change is not 100 percent, then it is partial[1] or incomplete. Such incomplete exchange rate pass-through (ERPT) has implications for economic policy.

[1] The problem with partial or incomplete ERPT is the implication it has for the transmission of shocks in the economy (Betts and Devereux, 2000). On the contrary, though, low ERPT gives the authorities peace of mind in the knowledge that any exchange rate changes will not be inflationary (Ghosh and Rajan, 2007)

To elaborate the concept of pass-through , Mann (1986) explained using equation (1) shown below:

$$\Delta P_d = \Delta C_f + \Delta M_f + \Delta E \ldots \quad (1)$$

Where ΔP_d , ΔC_f, ΔM_f, ΔE, represent changes in Rand Import prices, changes in foreign cost of production, changes in foreign profit margins and changes in the exchange rate respectively. If foreign costs are constant and if foreign profit margins adjust to offset some of the exchange rate changes, then the exchange rate pass-through will be less than 100 percent. On the other hand, if foreign costs change, profit margins may change and buffer the final effect on the import price. Equation (1) shown above indicates that it would be naive to conclude that the factors of the exchange rate pass through are all included. There are many other important factors that also affect both direction and speed of the pass-through.

In the 1990's most industrialised economies such as the United States of America (USA) and some European countries such as the United Kingdom (UK) experienced sustained low inflation rates despite the expanding economies and rising economic activities. Historically, the pass-through (PT) to consumer prices has always been lower than the PT to import prices. Goldberg and Campa (2010) reported that Australia's ERPT to import prices was 0.67 (67%) versus ERPT to consumer prices of 0.09 (9%). For Canada it was 0.65 versus -0.01, France was 0.98 versus 0.48, (UK) was 0.46 versus -0.11 and the USA was 0.42 versus 0.01. Bussière et al., (2014) found the degree of pass through to import prices for Brazil and Thailand to be 0.84, for Venezuela, 0.20 and that of Mexico, 0.65 in the long run. The results where there is low PT to consumer prices in an environment of depreciation of a currency is contrary to the standard economic paradigm (Mccarthy, 2007). This phenomenon resulted in many economists such as Campa and Goldberg (2003) trying to study the special factors that influenced low inflation rates during the period. Soon they discovered the special role played by the exchange rate as well as import prices.

In the case of South Africa there are a few studies that focused on the subject matter of exchange rate pass-through. Some of the few studies are by Parsley (2012), Karoro et al. (2009) and Kabundi and Mbelu (2016). The Rand in South Africa has not been stable for some time. There has been persistent depreciation of the rand between 2011 to 2013 and during this period there has not been significant increases in inflation (Jooste and Jhaveri, 2014). The low pass-through in South Africa, according to Jooste et al (2014) may have been caused by economic

cycle, changing monetary policy objectives and the composition of imports. The study also suggested that the price elasticity of demand for imported goods is a factor to consider when analysing the degree of exchange rate pass-through. Aron et al. (2014) estimated the degree of exchange rate pass-through to imports for South Africa using a time-varying cointegration approach. The study criticises other researches done as the data lacked sufficient structural breaks that would show pass-through degrees in the short term, medium term and long term. Like the other papers, Aron et al (2014) also found incomplete pass-through of about 30 percent for the short-term and 55 percent in the long-term. Using cross-country analysis Bussière et al., (2014) found a long run exchange rate elasticity to import prices for South Africa to be 0.5 thereby confirming other results by other scholars.

An important study by Kabundi and Mbelu (2016) focused on the indirect ERPT to consumer prices using a two-stage regression analysis. The 1st stage ERPT was examining the effect of the exchange rate changes to Import Prices and then the 2nd stage ERPT to consumer prices. Their findings were that there was ERPT asymmetry to import and consumer prices. The paper cited that the magnitude of the pass-through was higher to import prices than to consumer prices suggesting that traders were absorbing some of the exchange rate changes effects on prices, perhaps due to pricing-to-market strategies.

Parsley (2012) estimated the ERPT for South Africa using samples of final goods and services and homogenous imports. The study found a 16 percent ERPT to consumer goods with a lag of two years. Parsley (2012) found a higher ERPT to import prices of about 60 percent again showing that traders are not willing to pass the 100 percent exchange rate transmission to consumer prices. The reasons for low ERPT to consumer prices may be many and one such reason could be the inflation-targeting policies adopted by the Reserve Bank of South Africa (RBSA).

The extent to which exchange rate changes and import prices influence domestic inflation is a source of concern for monetary policy. As an example, if inflation rates in the 1990's among industrialised economies was due to lower import prices and stable exchange rates, then any reversal of policies that gave rise to this economic state of affairs would result in higher

inflation rates that would reduce the purchasing power of consumers as well as increasing cost of production for producers.

It is important to understand the degree to which nominal exchange rate (NER) changes affect domestic prices in order to draft effective monetary policies that stabilise inflation. (Hara et al., 2015) explains that exchange rate fluctuations have effect on prices through the impact they have on production costs (for example, via prices of materials) as well as transport costs. This implies that exchange rate pass-through does not only affects price stability but firms' profitability as well as households' real incomes. To this end, therefore, exchange rate pass-through is important to firms, consumers and policymakers.

The real exchange rate is important as a measure of price-competitiveness and is a key determinant of the adjustment pattern of the Balance of Payments. Empirical evidence of many studies like the ones mentioned above have indicated that nominal exchange rate changes are not fully passed through to goods prices (Devereux, 2002). This means that consumer prices are, to some extent, unresponsive to nominal exchange rate changes. The implication of the low pass-through is that the "expenditure- switching effect" (ESE) of exchange rate will be small meaning that a change in the nominal exchange rate might not lead to much substitution between domestically- and internationally-produced goods due to small or no change in the relative prices of those goods for final users.

The weak exchange rate effect on prices may result in no change in the behaviour of final purchasers of goods. This means that a huge change in the exchange rate would be required to achieve equilibrium after some shocks to the economic fundamentals. As an example, if there is a shock that reduces the supply of foreign goods, a very large home depreciation might be required in order to raise the relative price of foreign goods enough to reduce home demand sufficiently. To this end then, low pass-through of exchange rates might imply high exchange rate volatility. The high volatility of real and nominal exchange rates may be caused by local currency pricing that eliminates the pass-through from changes in exchange rates to consumer prices (Devereux, 2002). Gopinath et al.(2010) found strong evidence that nominal price rigidities result in low pass-through and hence the need to frequently adjust prices to respond to changes in the exchange rate. Frequent local price adjustments would ensure quick adjustment of fundamentals towards equilibrium if any shocks happen to the economy.

A country whose exported products show 100 percent exchange rate pass-through on the international market is price-competitive and has market power over other countries. This improves the welfare of its citizens through distribution effect. Wang and Gou (2016) pointed out that if there is asymmetry in exchange rate pass-through then this leads to asymmetric welfare effects. The welfare level of the country whose local prices show less pass-through degree than other countries experiences higher welfare levels in a world Nash Equilibrium (NE). Wang and Gou further argue that foreign monetary policy depends on the degree of home exchange rate pass-through. The conduct of monetary policy affects the frequency of price adjustment and hence the degree of exchange rate pass-through.

There are many reasons why in many economies incomplete exchange rate pass-through to inflation was found. One of the possible reasons could be that firms with market power engage in pricing-to-market (PTM) that results in the same product being sold at different prices in segmented markets (Krugman, 1986) and (Goldberg and Knetter, 1997).

Takhtamanova (2010) stated that exchange rate fluctuations actually affect the behaviour of inflation in an economy. This observation makes the exchange rate pass-through an important consideration with respect to monetary policy. An effective monetary policy demands that the monetary authorities understand the transmission mechanisms. As pointed out by Adolfson (2001), the exchange rate provides an additional transmission channel for monetary policy apart from the conventional aggregate demand channel. Adolfson (2001) argues that the Consumer price inflation (CPI) is directly linked to changes in the exchange rate through its effect on import prices. The evidence available for both large and small open economies is that there are systematic deviations from the law of one price due to incomplete exchange rate pass-through for both export and import prices (Alexius and Vredin, 1999).

Import prices are important for the performance of small open economies. The first thing is that changes in the prices of imports affect the terms of trade and therefore the trade balance (Naug et al., 1996). The next thing to happen is that domestic firms face foreign competition, and relative prices between imported and domestically produced goods and as a result are prime determinants of manufacturing output and import volumes. Price inflation in small open economies is, to a large extend, affected by the growth in prices on imported goods. Inflation targeting policies in some countries took into consideration import prices and also assuming a

complete exchange rate pass-through environment (Mccallum and Nelson, 1999)[2]. Many other researches done such as that by Adolfson (2001) and Naug et al. (1996) found that the law of one price does not hold for many countries. This means that import prices do not move immediately and in a one-to-one fashion with the exchange rate. Exchange rate movements have a minor immediate effect on consumer prices due to nominal rigidities.

According to Choudhri and Hakura (2015) there is asymmetry in the exchange rate pass-through between import and export prices. While the paper found an incomplete pass-through to both import and export prices the pass-through to import prices was consistently higher than the pass-through to export prices in many countries. Economists, the world over, have traditionally made the simplifying assumption that prices of tradable goods are equal across countries when expressed in the same currency and this is the purchasing power parity condition (PPP) (Ca' Zorzi et al., 2007).

Campa and Goldberg (2003) cited that exchange rate pass-through has been seen declining in many countries across the globe in recent years, especially in the short-run. In the long-run, however, there are microeconomic price adjustments in certain industries in which case there would be reasonable degree of exchange rate transmission to local prices. Taylor (2000) attributes the low exchange rate pass-through as being due to low and stable inflation rate in many countries. This is because many countries adopt inflation-targeting policies that keep general prices rather constant despite changes in the exchange rate. Correa and Minella (2010) considered a non-linear pass-through due to activity level in the economy. In their paper they found that business cycles play a role in determining the exchange rate pass-through. When there is a boom in economic activities then the pass-through effect is higher than when there is a slump.

There have been some studies on examining whether there was any symmetric or asymmetric exchange rate changes to import prices in South Africa. Karoro et al. (2009) examined the magnitude and speed of exchange rate pass-through to import prices in South Africa. They also examined the presence of asymmetric ERPT during depreciation and appreciation episodes. Their findings were that ERPT in South Africa was high but incomplete and also that there was

[2] While this paper allows for complete exchange rate pass-through others like (Batini et al., 1999) and (Leitemo, 2002) obtained a limited and gradual pass-through via and Error Correction Mechanism (ECM) for the import prices, making them adjust slowly to fluctuations of the exchange rate.

asymmetric transmission of the exchange rate changes to import prices between the episodes of local currency depreciation and appreciation.

Problem statement

The Bretton Woods exchange rate management system introduced a fixed peg[3] system at the end of World War II to try and stabilise many economies ravaged by the war. This fixed exchange rate management system fell in the 1970s and many countries started to adopt a floating exchange rate regime. Under fixed exchange rate system some economies face a problem known as the *impossible trinity* where fixed exchange rate regime, open trade policy and monetary policy to achieve macroeconomic goals of price stability and economic growth cannot co-exist (Fischer, 2001). Because of the problems brought about by the soft peg of the Bretton Woods system, countries such a Argentina, Turkey, Brazil, Indonesia and South Africa started to abandon the fixed peg and adopted the floating system. Aron et al. (2014) pointed out that South Africa undertook trade liberalisation measures in early 1995 and later adopted a unitary floating exchange rate regime under an inflation targeting framework in 2000. The problem with a floating exchange rate and an open trade policy is that a country loses the power to insulate its own economy from external economic shocks. Exchange rate volatility is one of the shocks a country may face. Exchange rate volatility creates uncertainty and increases the trading cost for firms (Palley, 2003). Exchange rate fluctuations affect an economy through various channels such as its impact on imports, exports and capital flows (Parsley, 2012)
For a country like South Africa (SA) that has adopted inflation targeting policy, price stability objective is crucial. According to Mccarthy (2007), an exchange rate shock weakens the role of demand management policies by compromising the conduct of monetary policy and creating uncertainty in respect to its impact on domestic prices.

The problem in South Africa is that of low ERPT to consumer prices as compared to the effect on import prices. Mjanja (2018) reported that inflation has been on the decline over the years from 2000 to 2018 in South Africa despite exchange rate volatilities thereby contradicting the assumption of positive correlation between inflation and currency volatility. The adoption of the inflation targeting framework in 2000 saw the South African Reserve bank (SARB) allowing the rand to fluctuate with no interventions and this meant that the central bank did not

[3] The Bretton Woods Institutions typically adopted a soft peg rather than a bipolar view that produced corner solutions of either a hard fixed peg or flexible exchange rate system (Fischer, 2001).

have control over the impact of exchange rate changes on inflation outcomes (Kabundi and Mlachila, 2018).

Kabundi and Mbelu (2016) found that the ERPT to import was nearly complete in the early nineties while the indirect ERPT to consumer prices fell from 70 percent to 20 percent towards end of the period. A repeat calibration by Kabundi and Mlachila (2018) revealed that since 2002 to 2018 the ERPT to consumer prices in South Africa has been between 20 and 30 percent meaning that prices did not respond fully to the exchange rate changes during the period. Parsley (2012) measured the pass-through to consumer prices to be 16 percent and to import prices as 60 percent and this asymmetry can make it difficult for monetary policy makers to make decisions that can reverse the macroeconomic disequilibria. Aron et al. (2014) found a short-run time-varying EPRT ranging from 5 percent in a year to 30 percent in 6 months with a long-run pass-through of about 55 percent. This was attributed to the inflation targeting strategy to maintain inflation to a single digit of about 6 percent. When the ERPT to consumer prices is low there would be minimal expenditure-switching effect in the country and this might even result in a higher demand for foreign goods thereby creating a huge outflow of foreign currency (Forex) and eventually a negative current account balance. In order to curb this forex outflow a large depreciation is required to curtail the demand for foreign goods but ultimately this creates higher inflation in the country.

In estimating the ERPT to consumer prices Kabundi and Mbelu (2016) used a two-stage method. The first stage was to estimate ERPT to import prices and then import prices to consumer prices. The problem with this approach is that if there was any econometric problems such as heteroschedasticity in residual terms or autocorrelation then this is transmitted to the second-stage regression thereby getting spurious inferences. Again, the number of independent variables in both stages are very few and have left out potential determinants of both import and consumer prices. Theoretically, demand conditions proxied by output gap as suggested by Przystupa and Wróbel (2014), is one such important variable omitted in their estimations.

There is need to continually measure the degree of pass-through to consumer goods from time to time and to use more accurate methodologies such as Bayesian VAR and Vector Error Correction Model as well as more appropriate variables. This study, therefore aims to empirically estimate the speed and degree of exchange rate pass-through (ERPT) to imports and exports in South Africa using improved models and variables. Knowing the degree of pass-through will assist authorities to develop monetary policies that would cushion the consumers

as well as producers from the effects of surging inflation in South Africa. Some policies may be around introducing a managed-exchange rate regime so as to cushion consumers from the effects of exchange rate shocks.

Exchange rate volatility leads to currency substitution (CS) in the economy (Akinlo, 2008). Domestic money plays three traditional roles which are medium of exchange, unit of account and a store of value. When foreign money substitutes local money then it becomes a problem when monetary or fiscal policies are being implemented in the country. Currency substitution can be partial or complete. Complete CS occurs when the economy is fully using foreign currency as a medium of exchange as in the case of Zimbabwe since the fall of the Zimbabwe dollar in 2008 and partial currency substitution occurs when only a fraction of the foreign currency is used. Currency substitution may also be in form of domestic agents holding increasing foreign currency as part of money holdings.

A study by Adom (2006) found the presence of currency substitution in South Africa using a modified version of Darrat et al. (1996) model which detected CS using the instability of the domestic money demand. The model runs the regression of real money demand on a vector of variables including the exchange rate changes. If a negative parameter on the exchange rate change is negative, then this signals presence of CS. In the case of South Africa, Adom (2006) found a parameter of -0.0205 which was significant. The problem with this modified version of the Darrat et al. (1996) model is that it ignores the foreign money demand in its specification. The foreign money demand helps to capture the elasticity of substitution between local and foreign money in a robust way. The other method available to ascertain the existence of CS is the use of simple bi-variate correlation between the ratio of real domestic balances to real foreign balances and the domestic interest rate as well as the foreign interest rate. If CS exists then a negative and positive relationship exists between domestic and foreign interest rate and the money balances ratio respectively. It is better, then for a researcher to triangulate the results from the money demand instability approach with those from the real money balances ratio approach.

The challenge with higher degree of currency substitution is that it frustrates the efforts of financial authorities to measure the demand for national currency and this makes it harder to pursue robust monetary policies (Imrohoroğlu, 1994). In addition, currency substitution creates interdependence between nation states and this scenario may precipitates a financial crisis

through the contagion effect (Akinlo, 2008). The other thing about currency substitution, especially adopting the US dollar, creates dominance that leads some people to view the current monetary system as a primary bulwark for U.S. hegemony (D'Arista, 2001). This research intends to measure the extent to which exchange rate volatility, as a result of, low pass-through, would affect currency substitution. This will be useful to policy designers to craft policies that minimise local currency substitution that has the potential to create disequilibria on the money market.

Research aim and objectives

This study intends to ascertain the degree of exchange rate pass-through between import and consumer prices.

The main aim of the study is to investigate the existence of ERPT asymmetry between consumer and import prices.

The specific objectives are:

1. To empirically measure the degree and speed of transmission of exchange rate changes to import and consumer prices
2. To examine the existence of asymmetric exchange rate pass-through between between import and consumer prices.
3. To suggest policies that would reduce the degree of ERPT asymmetry between import and consumer prices with a view to circumvent the possible onset of exchange rate and inflation volatility.

Research Questions

This study seeks to answer the following questions:

1. What is the degree of exchange rate pass-through to imports and consumer prices?
2. Is there any evidence of ERPT asymmetry between imports and consumer prices?
3. Does depreciation and appreciation of the rand have asymmetric effect on consumer prices in South Africa?

Apriori assumptions about ERPT to import and consumer prices

1. There is a lower ERPT to consumer prices than to Import Prices (ie, there is ERPT asymmetry)
2. There is asymmetric effect of depreciation and appreciation on consumer prices

Significance of the study

The study of ERPT is very important for policy makers as the success of either monetary or fiscal policy depends on whether there is sufficient transmission of the exchange rate changes to consumer prices. When ERPT is incomplete it eventually triggers an exchange rate shock that ultimately increases inflation in the economy as well as possible currency substitution. This study is designed to suggest policies that can be instituted in order to avoid inflationary outcomes as well as addressing the problems of agents substituting local currency for foreign money as a result of low pass-through.

Having a clear understanding of the relationships between exchange rate changes and import and export prices will be crucial for policy in South Africa. If there is low transmission of exchange rate changes to domestic prices, then volatility in the exchange rate may take place in order to bring about a change in prices that results in equilibrium on the goods as well as on the money market. As Mccarthy (2007) puts it, a shock in the exchange rate weakens the role of demand management policies as the conduct of monetary policy is compromised. This may result in price instability in the economy. Sound economic policies will help prevent price instability in the country.

Contribution of the study

The models that previous researchers used are good and relevant but insufficient to explain the exchange rate pass-through as potentially significant control variables were left out. One of the important control variables that improves the ERPT results is the financial gap. The financial gap can come in different forms and the definition is not exhaustive. In the context of the pass-through studies the term financial gap takes the form of the difference between the sum total of the domestic and Foreign Direct Investment (FDI) in South Africa and its long-run trend

found by applying a Hodrick- Prescot Smoothening Technique[4] (HPST). The rationale behind using financial gap variable is that in determining import prices we have a number of predictors including investment gap captured by financial gap. This study, therefore endeavours to use better or improved models as well as discussing other consequences of the mis-aligned or volatile exchange rates on currency substitution which in turn, compromises on the monetary policies of the country.

Reasons for incomplete exchange rate pass-through are still vague and hence there is a need to continue the search for more factors that affect the exchange rate changes transmission to prices. Some research papers attributed an incomplete ERPT degree to local pricing as well as mark-up adjustment in response to exchange rate changes. (Choudhri and Hakura, 2015) used the producer and local currency pricing as factors of exchange rate pass-through. This research intends to adopt a different strategy and that is to focus on inflation-targeting efforts by the Reserve Bank of South Africa (RBSA) as a possible explanation of incomplete exchange rate pass-through.

The body of knowledge under the topic of exchange rate pass through cannot be said to be sufficient and exhaustive at the moment. The fact that it is an area that is not over-researched means that there is room to improve both the methodology and estimation results. This study will add and expand the knowledge base in this niche area of exchange rate pass-through.

The reason we measure ERPT is for economic planners to put into place policies that would counter the negative effects brought about by low exchange rate transmission to domestic prices. Inaccurate measurement of the ERPT leads to implementation of policies that may exacerbate the problems associated with low transmission of exchange rate change on prices. Good efforts have been shown by previous researchers in the area but there is need to

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[4] **Hodrick-Prescott filter** The filter helps to separate the trend from the cyclical component of a scalar time series. We assume $y_t = g_t + c_t$, where g_t is the trend component and c_t is the cycle. The trend is obtained by solving the following minimization problem

$$\min_{\{g_t\}_{t=1}^{T}} \sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=2}^{T-1} [(g_{t+1} - g_t) - (g_t - g_{t-1})]^2$$

The parameter λ is a positive number (quarterly data usually =1600) which penalizes variability in the growth component series while the first part is the penalty to the cyclical component. The larger λ the smoother the trend component.

continually look for better ways to estimate the ERPT by way of searching relevant factors and better models.

There have been a few studies on exchange rate pass-through to prices in South Africa and these are notably by Aron et al. (2014), Parsley and Farrell (2010) and a few others. This means that the research on the broad topic has not been exhaustive and there is room for further studies especially with a different paradigm. This research adopts and adapts existing models in order to improve on measuring exchange rate pass-through more accurately.

The conduct of monetary policy affects the frequency of price adjustment and hence the degree of exchange rate pass through (Devereux and Yetman, 2002). Inflation-targeting policies may be the source of price-rigidities and this has the effect of creating a *bubble* that falsely shields consumers. Many papers in the area of exchange rate pass-through did not pay much attention to the role of price-rigidities as a possible determinant of exchange rate pass-through. This research deals with such factors as price rigidities as a strong and a possible significant factor of ERPT. In doing so the research further strengthens the research focus on some of the uncelebrated but important factors that cause low ERPT.

The other contribution this research brings is the estimation models. This paper would employ multiple approach to estimation techniques such as the use of the Autoregressive Distributed Lag Model (ARDL) to capture both the short-term and long-term ERPT coefficients. This study shall also use the Bayesian Vector Autoregressive (BVAR) methodology for the purposes of capturing impulse response functions among the study variables. Existing models would be adopted and adapted by including more variables such as output gap that explain changes in domestic prices robustly. Przystupa and Wróbel (2014) adapted the standard VAR and VECM models to estimate the impact of exchange rate changes to import prices by including the output gap as well as financial gaps in their specifications.

LITERATURE REVIEW

INTRODUCTION

This chapter on literature review focuses on the genesis of the key models and theories of exchange rate pass-through as well a review of the findings by other scholars/researchers in the area of ERPT. If the Purchasing Power Parity (PPP) rule, also known as the Law-Of-One-Price

(LOOP), that stipulates that prices of similar goods or services should be the same between trading partners when expressed in the same currency holds then we would have no business studying exchange rate pass through. In reality the LOOP does not The primary aim of studying the development of the models of ERPT will be to form the basis of the models to be used in this study. Knowing the models used by other researchers and the nature of results obtained thereof is crucial for the identification of research gaps that may exist in the topic. The main model behind this study is the Mark-up Model (also known as the Pricing-to-Market model) that informs the behaviour of firms in pricing imported goods and services in the importing country. To this end, we shall also discuss both the microeconomic as well as the macroeconomic reasons for low degree of transmission from exchange rate changes to import prices and domestic prices in many countries.

The law of one price (LOOP) Theory

The pass-through idea draws its theoretical underpinning from the purchasing power parity (PPP) theory that predicts a full impact from changes in exchange rate to domestic prices. In essence PPP theory argues that any changes in exchange rates will translate into proportional movements in domestic prices. The PPP is taken as an anchor for long-run real exchange rates. According to (Rogoff, 1996) real exchange rates tend towards purchasing power parity in the very long run meaning that the speed of adjustment in the long-run is very slow. The literature on exchange rate pass-through is closely related to the literature on Purchasing Power Parity. If PPP held for tradable goods, then pass-through would be complete. Also, in a perfect competition framework with frictionless markets, pass-through would be complete because the mark-up would always be equal to zero for the exporters (Bussiere, 2013).

The problem with the theory of PPP is that in reality the idea of perfect competition is far-fetched. We have imperfect markets and therefore prices can never be the same across countries with strong trading agreements. Again, markets across the world are not without friction and the mere fact that we are dealing with countries in different geographical locations we are faced with logistical challenges such as transport costs and different labour laws all of which are factored into the prices. Trading partners with significant inflation-differentials have different prices for homogenous goods hence the LOOP tends to fail.

When the domestic price percent change is less than the percent change in the exchange rate then we have incomplete exchange rate pass-through. This has implications for monetary

policy in a small open economy. Among the many reasons for incomplete pass-through is the tendency for prices to be sticky. The conventional viewpoint is seen in the Mundell-Fleming model that was adopted and adapted by Obstfeld and Rogoff (1995) that says prices are sticky in the currency of the producer. This means there are some inherent rigidities when it comes to pricing imported goods in the importing country.

Macroeconomists have long been occupied by the need to identify the determinants of inflation and it has been known that controlling inflation is an important element of a stable and sustained growth. The determinants of inflation can be summarized into four major factors; demand-side factors, supply-side factors (cost-push), inertial factors (built-in inflation), and political/institutional-side factors The first three sources together are what (Gordon, 1997) referred to as the 'triangle model of inflation'. To this end, then, inflation can be seen as a macroeconomic as well as an institutional phenomenon.

According to Takhtamanova (2010b), there are four factors that determine the degree of exchange rate pass-through and these are: the degree of openness of the economy, a fraction of flexible-price firms in the economy, the credibility of the central bank and finally the degree of exchange rate pass-through at firm level. Generally, the ERPT rates are endogenous to the economy's monetary policies and that the lower the inflation the lower will be the extent of ERPT.

Pricing- to- Market (PTM) Theory

The Pricing to Market Theory attempts to explain why ERPT is low in most countries. Export prices may be set in terms of the foreign currency (which we call pricing-to-market), rather than in domestic currency. Sung et al. (2015) pointed out that exporters with market power implement PTM as a strategy to keep their market share on the international market. The strategy involves keeping foreign prices constant despite appreciation or depreciation of the domestic currency. When there is a depreciation of the exchange, the demand curve becomes more elastic and foreign competitors, in an attempt to secure the market-share, lower their price in foreign currency terms, implying that import prices increase by less than the magnitude of the exchange rate fall.

Exchange rate pass-through can depend on several factors which are classified into microeconomic and macroeconomic factors (Campa and Goldberg, 2003).

The first category of factors relates to the industrial structure of the economy. As an example, in the (Dornbusch, 1987) paper, pass-through depends on product substitutability, market

structure and the number of foreign firms respective to local firms. The macroeconomic environment is highlighted in the second category of factors and in particular the role of monetary policy. in this regard, one can mention in particular the contributions of (Betts and Devereux, 2000), who introduced pricing to market to the earlier model of (Obstfeld and Rogoff, 1995). The main concepts in this literature are those of local currency pricing (LCP) and producer currency pricing (PCP) which refers to exporters pre-setting their prices in the currency of the importing country or in their own currency, respectively

The problem with the PTM theory is that it is not straightforward to capture quantitatively in a regression analysis and therefore it remains largely theoretical. Factors of ERPT need to be those that can be measured and be scientifically put to test in a regression model.

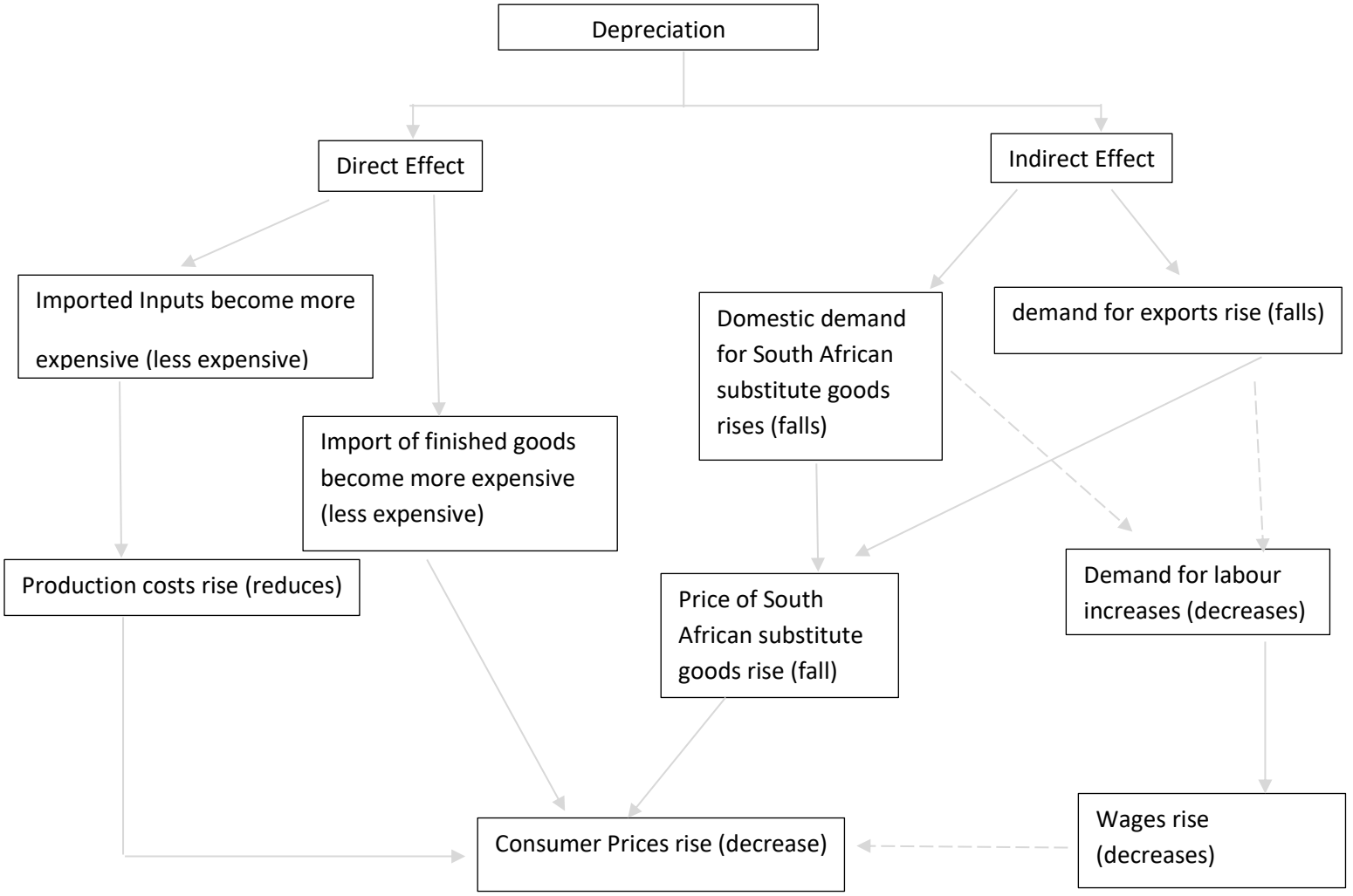
A large subset of early literature has focused on the analyses of the ERPT at disaggregated micro level (industry level) as it is more appropriate to isolate the effect of the exchange rate on prices of various products (Ghosh and Rajan, 2007). These days ERPT is also more often analysed at the aggregated macro level. such as analysing the effect of ERPT on the consumer price index, which is more relevant to monetary policy makers. This research will focus on both microeconomic and macroeconomic aspects of ERPT.

Direct and Indirect ERPT

Changes in the value of a local currency against major currencies have both direct and indirect effects on consumer prices. Direct effects work through two main channels of transmission which are through prices of imported finished goods and prices of imported inputs (Chabot and Khan, 2015). As the currency depreciates the prices of imported inputs and imported finished goods rise. If the rise in local prices is less than the rate of depreciation, then partial exchange rate pass-through occurs.

Fig1 below shows a typical transmission channel of the monetary policy action on consumer prices.

Fig 1



Source*: Own construction and adapted from* (Laflèche, 1997)

Although a depreciation of the currency such as the Rand is likely to increase inflation over the longer run, inflation ultimately depends on monetary policy. if monetary policy is successful in keeping long-term inflation expectations anchored near the target level then ERPT will only have a transitory direct effect on inflation rate (Chabot and Khan, 2015). The central bank can, therefore, concentrate more on persistent inflation pressures coming from the relative balance of demand and supply in the country.

Indirect effects of ERPT affect aggregate demand that may result in output gaps and so monetary policy should react to correct this as it can produce a more permanent inflation deviation. According to economic theory, exchange rate depreciation is one of the determinants of inflation (Karoro et al., 2009). It is therefore very important to have a reasonable degree of exchange rate pass-through that will not cause monetary authorities to put in place policies that are reactionary to shocks in a case of incomplete pass-through.

The standard assumption in the empirical literature is that exchange rate pass-through is both linear and symmetric, implying that (a) large and small exchange rate changes and (b) appreciations and depreciations have an effect of the same magnitude on prices, proportionally (Bussiere, 2013). This assumption is 'heroic' and far from reality as there are many factors that prohibit this scenario of homogenous effect of exchange rate changes on prices. The reality is that there are non-linearities and asymmetries in the pass-through studies.

The role of market organization, product segmentation, PTM, and competition are factors that explain why ERPT is incomplete (Froot and Klemperer, 1989). This literature is closely related to the problem of PTM behaviour. Linearity and possible asymmetry are investigated less frequently, even though the question of whether they exist is important, if not crucial. A linear response is one that means that prices react in the same way to large and small changes in the exchange rate. If domestic prices react more to, say, depreciations than to appreciations then there is asymmetry in the price reaction to the exchange rate changes and this may reflect distortions in the markets and weak competition in particular (Przystupa and Wróbel, 2014).

Empirical Literature

Evidence of Exchange Rate Pass-Through to import prices

Import prices play a crucial role in determining local prices of tradeable imported goods. It is therefore, important to investigate how exchange rate fluctuations would impact import prices. Campa and Goldberg (2003) found a positive relationship between exchange rate changes and import prices and that both LCP and PCP did not have effect on ERPT. The study, however, noted that microeconomic factors related to composition of imports play a bigger role in determining exchange rate pass-through. Another study by Hakura and Choudhri (2001) revealed that import price pass-through is mainly due to behaviour of foreign firms and may not have anything to do with home inflationary environment.

These results show that there is need to continue the search for those factors that explain ERPT to domestic prices. The message from these studies also mean that besides exchange rate changes there are a host of other factors that need to be part of the ERPT analysis.

Comunale and Simola (2016) study observed that the exchange rate pass-through was still relatively high and rapid in the Commonwealth of Independent States (CIS) countries. When the nominal effective exchange rate index declines by 1percent, the consumer price index increased by 0.12–0.13 percent. It was a positive response of prices to exchange rate changes but was still way below 100 percent transmission. Other control factors and the financial gap were significant to explain consumer price trends of the CIS countries. With respect to exchange rate pass-through asymmetry, the Comunale and Simola (2016) study used dummy variables for appreciation and depreciation interacted with the different exchange rates and found no evidence of asymmetry as the differences between their regression coefficients were not significantly different from zero. This finding which directly does not mirror the other findings shows that the results on symmetrical effects between depreciation and appreciation depends on the circumstances at hand.

Asymmetric exchange rate pass-through to import prices (Industrialised Economies)

Using Polish data and short-run dynamic equations, Przystupa and Wróbel (2014) found that the exchange rate pass-through was incomplete in the economy even in the long run. The study also found the existence of pricing to market behaviour in both the long and short runs. The research did not find strong evidence of nonlinearity in import prices' reaction to the exchange rate. The study rejected the hypothesis of an asymmetric response to appreciations and depreciations in Poland. There was evidence of an asymmetry of consumer price index responses to the output gap, direction and size of exchange rate changes and magnitude of exchange rate volatility. The asymmetry was mostly visible after exogenous shocks. The hypothesis of an asymmetric reaction of prices in a high- and low inflation environment was rejected. Przystupa and Wróbel (2014) used a model single equation regressions to capture short-term ERPT and included output gap as one of their key determinants of ERPT. This research will adopt the same approach but will also estimate both a VAR and VECM upon finding cointegrating relationships.

Goldberg (1995) and (Mann, 1986) both found asymmetries in consumer prices′ reaction to appreciations and depreciations. Goldberg and Mann used aggregate data on U.S. import prices and found industry specific evidence of incomplete exchange rate pass-through and that the

pass-through rates were different for episodes of depreciation and appreciation. Similar results were also obtained by Pollard and Coughlin (2003) when they examined the symmetry in the response of import prices in manufacturing to appreciations and depreciations as well as to the size of the change of the exchange rate in the United States, and 32 Eastern European Economics. The results showed that there was some asymmetry in response of import prices in different industries. Devereux and Yetman (2002) used a cross-section time series model to illustrate a nonlinear relation between the degree of pass-through and the inflation rate. As inflation rises, pass-through also increases, but at a decelerating rate. There was, however, no clear direction of the asymmetry across industries but that the pass-through was positively correlated with the size and change in the exchange rate.

Campa and Mínguez (2008) studied nonlinearity in import-price adjustment in the European Union (EU) using industry-level data and obtained strong evidence for the presence of nonlinearities in the adjustment toward long-run equilibrium in certain industries.
Herzberg et al. (2003), using United Kingdom (UK) aggregate data did not find any evidence of nonlinearity in the reaction of import prices. In Japan Wickremasinghe and Silvapulle (2004) found that import prices of manufacturing displayed a statistically significant difference in their adjustment to appreciations and depreciations and that the reaction to the former is larger than that to the latter. This supports the pricing-to-market theory that states that ERPT to imports is low due to reluctance by firms to increase prices in an effort to maintain the market-share.

Asymmetric exchange rate pass-through to import prices (Emerging Markets)

Emerging markets have generally registered low pass-through rates over the years. A study by (Álvarez et al., 2008) reported weak asymmetry between the reactions of import prices to appreciations and depreciations in Chile using prices from mining, agriculture and industry. They found that coefficients for depreciations are higher than for appreciations. The null hypothesis that both coefficients are equal is not rejected only marginally for capital goods. For agriculture, only depreciations are passed into import prices in Chile.
Correa and Minella (2010) investigated nonlinearities in pass-through to consumer prices in Brazil. They estimated a Phillips curve with a threshold for the pass-through and showed that the magnitude of a short run pass-through was higher when the economy was growing faster, when the exchange rate depreciates above a certain threshold, and when exchange rate volatility was lower. Pollard and Coughlin (2003) showed that more than 50% of the industries

responded asymmetrically to appreciations and depreciations. The direction of asymmetry also varies from industry to industry. Their (Pollard and Coughlin) study concluded that there were nonlinearities in response of import prices to exchange rate shocks.

8.3.2 Analytic Framework for Exchange Rate Pass-Through to Import Prices

The Mark-Up Theory (Model)

This section presents the analytical framework that underlies the econometric specification that we use to estimate ERPT to import prices. Later on we shall show models that can be used to test the hypothesis that aggregate pass-through declines with a shift in the inflation environment as well as tests of asymmetry of ERPT between appreciation and depreciation episodes. As a starting point, the approach is to use the standard specification used in the pass-through literature. We then adapt it so that it is suitable to estimate pass-through at the aggregate level.

Concerning the exchange rate pass-through to import prices, the standard specification used in literature is based on the pricing behaviour of exporting firms. The theoretical framework follows **Feenstra (1989)**, **Coughlin and Pollard (2004)** and more recently **Cheikh and Rault (2015).** The model is set in the context of price-discriminating monopolist in a partial equilibrium environment. We assume a domestic importing country importing a differentiated good Q^m from a monopolist foreign firm facing competition from a substitute good 'z' in the importing nation. We also assume good Q^m is weakly separable from the rest of goods in a consumer's utility function. Therefore $Q^m = (P^m, P^z, Y^m)$. Where p^m = import price of Q^m, P^z = price of 'z' in domestic currency and Y^m = income expenditure in the importing country.

Foreign export firm produces q^x for its own market at price p^x and with income of Y^x and therefore $Q^x = Q^x(P^x, Y^x)$. the foreign firm is the sole producer of the good 'q' but inputs can come from both countries. Factor prices in the foreign country w^* will depend on exchange rate 's'. The foreign firm's cost function will therefore be $C = C(Q, w^*(s))$ where $Q = Q^m + Q^x$. We assume costs are homogenous of degree one in factor prices and this means $C(Q, w^*(s)) = w^*(s).\phi(Q)$. The foreign firm maximises profits taking into account 'z' and Y^m as exogenous. This means the profit maximisation problem is written as:

$$\max_{p^m, p^x} \pi = p^x Q^x + p^m Q^m - w^*(s)\phi(Q) \qquad (2)$$

A simpler version of the above was suggested by Bailliu and Fujii (2004) to solve the problem $\max_q \pi = s^{-1}pq - C(q)$ which, basically, was to find a price 'p' that maximises profit given a traded quantity of 'q' and given the marginal cost of 'C'.

First order condition (FOC) of equation 12 with respect to price in foreign market , p^x gives:

$$p^x = Q^x + p^x \frac{\partial Q^x}{\partial p^x} - w^*(s)\emptyset' \frac{\partial Q^x}{\partial p^x} = 0 \quad (3)$$

And FOC with respect to domestic prices p^m we have:

$$p^m = s^{-1}Q^x + s^{-1}p^m \frac{\partial Q^m}{\partial p^m} - w^*(s)\emptyset' \frac{\partial Q^m}{\partial p^m} = 0 \quad (4)$$

Equation 13 can be re-written as:

$$p^x : \frac{\partial Q^x}{\partial p^x}\left[p^x(1 - \frac{1}{\varepsilon^x})\right] - w^*\emptyset' = 0 \quad (5)$$

Similarly, equation 14 can also be re-written as:

$$p^x : \frac{\partial Q^x}{\partial p^x}\left[s^{-1}p^m(1 - \frac{1}{\varepsilon^x})\right] - w^*\emptyset' = 0 \quad (6)$$

Where $\varepsilon^i = -\left(\frac{\partial Q^i}{\partial p^i}.\frac{p^i}{Q^i}\right)$ is the elasticity of demand with respect to price for i = x, m.

Mark-up over marginal cost is economically known as $\mu^i = \left(\frac{\varepsilon^i}{\varepsilon^i - 1}\right)$

FOC with respect to p^x and p^m become:

$$\frac{\partial Q^x}{\partial p^x}[\frac{p^x}{\mu^x} - w^*\emptyset'] = 0 \quad (7)$$

and

$$\frac{\partial Q^m}{\partial p^m}[s^{-1}\frac{p^m}{\mu^m} - w^*\emptyset'] = 0 \quad (8)$$

respectively.

Equations 7 and 8 can each be expressed as follows:

$$p^x = w^*\emptyset'.\mu^x \quad (9)$$

$$p^m = w^*\emptyset'.\mu^m \quad (10)$$

The equations 9 and 10 show that the profit maximisation solution to a foreign monopolist leads to a conclusion that each market price is determined by market-specific mark-up, μ^i, over the marginal cost $w^*\emptyset'$.

Our primary focus is on equation 10 that tells us that the import price depends on three factors, which are the bilateral exchange rate, the marginal cost and mark-up. What is also important to note is that the exporter's marginal cost and mark-up change independent of the exchange rate. The size of ERPT elasticity is determined through the 2nd order conditions for profit

maximisation. We assume marginal costs are constant and therefore $w^{*}\emptyset'' = 0$. ERPT elasticity can be written as:

$$ERPT = \frac{\partial p^m}{\partial s}.\frac{s}{p^m} = \frac{1+\eta^{w^*s}}{1-\eta^{\mu m}} \geq 0 \quad (11)$$

Where $\eta^{w^*s} = \frac{\partial w^*}{\partial s}.\frac{s}{w^x} \leq 0$ and

$\eta^{\mu m} = \frac{\partial \mu^m}{\partial p^m}.\frac{p^m}{\mu^m} \leq 0$ are elasticities of input prices with respect to exchange rate as well as of mark-up with respect to prices of the importing country respectively.

Equation 11 gives us the message that if the exporting firm uses only inputs from its country and therefore not relying on the exchange rate ($\eta^{w^*s} = 0$) and that there is constant mark-up ($\eta^{\mu m} = 0$) then ERPT = 1 and that is 100% transmission of exchange rate changes to local prices. Extreme sensitivity is when ERPT = 0 and this is when $\eta^{w^*s} = -1$. This means that in our estimation of the ERPT the coefficient of the exchange rate should be bounded between 0 and 1. To conclude on this theoretical underpinning we state that as exporters adjust their mark-ups the pass-through tends to be incomplete. The mark-up also depends on the macroeconomic fundamentals of the importing country. If there is high inflation then the mark-up sensitivity increases leading to higher ERPT.

The empirical model to be used in this research is motivated by the analytical framework discussed above. We also take cognisance of the fact that there are other factors that also explain mark-up of the firm.

As stated above, there are several factors that affect the mark-behaviour of the exporting firm and it is crucial that we include these in our estimation of ERPT to avoid bias.

Factors like demand shocks in the importing country can change the exporter's mark-up (Bailliu and Fujii, 2004). It is therefore crucial to take into account these other factor when estimating the ERPT.

As a result, a log-linear, reduced-form equation from equation 10 is expressed below:

$$p_t = \beta + \delta s_t + \tau w_t + \eta y_t + \varepsilon_t \quad (12)$$

Where w_t, y_t are measures of the exporter's marginal cost and the importing country's demand conditions, respectively. The coefficient δ, ultimately is the measure of exchange rate pass-through.

Equation (12) gives the basic framework used to estimate the exchange rate pass-through to import prices. The same model can be modified to investigate the existence of symmetric or asymmetric impacts of exchange rate episodes such as depreciation and appreciation as well as during high or low values of the exchange rates using an established threshold. The model below is for sector-specific ERPT to import prices and is motivated by (Pollard and Coughlin, 2003).

$$\Delta lnP_{i,t}^{imp} = \beta^{i}{}_{1}\Delta lne_t + \beta^{i}{}_{2}\Delta lnP_t^i + \beta^{i}{}_{3}\Delta lnP_t^{*i} + \beta^{i}{}_{1}\Delta lndd_t^i + \varepsilon_t \qquad (13)$$

In the equation above *dd* is the domestic demand, *P* and P^* are the domestic and foreign marginal costs, proxied by domestic and foreign PPIs. All variables excluding exchange rate are sector specific. To investigate the asymmetric effect of the exchange rate to import prices we introduce and construct dummies shown below:

$$A_t = \begin{cases} 1 \; if \; \Delta lne_t < 0 \\ 0 \; otherwise \end{cases}, \; D_t = \begin{cases} 1 \; if \; \Delta lne_t > 0 \\ 0 \; otherwise \end{cases} \qquad (14)$$

A and *D* are dummies standing for appreciation and depreciation (of the rand respectively). If $\Delta lne < 0$ then it means local residence now pay less number of South African Rands to get a unit of the US dollar, and the opposite is true. This study also focuses on analysing the behaviour of the import prices when there are episodes of high and low exchange rate changes that are akin to volatility. To do this we introduce a threshold for exchange rate changes below which we declare a low change (L) and above which we declare a high change (H). In their study, Pollard and Coughlin (2003) did a sector specific study and used an exchange rate threshold of 3%. In this study, due to the volatility nature of the Rand, we shall use a threshold of 4% and as a result we get the following dummies:

$$L_t = \begin{cases} 1 \; if | \; \Delta lne_t| < 4\% \\ 0 \; otherwise \end{cases}, \; H_t = \begin{cases} 1 \; if \; |\Delta lne_t| \geq 4\% \\ 0 \; otherwise \end{cases} \qquad (15)$$

The component $\beta_1 \Delta lne_t$ is first replaced by $\beta_{1A} A^i{}_t \Delta lne_t + \beta_{1D} D^i{}_t \Delta lne_t$ and then secondly replaced by $\beta_{1L} L^i{}_t \Delta lne_t + \beta_{1S} S^i{}_t \Delta lne_t$. This creates more exogenous variables in the determination of the pass-through to import prices. In the end, however, this allows us to ascertain if there is asymmetric exchange rate pass-through when faced by small and large changes to the exchange rate as well as during depreciation and appreciation.

A priori assumptions about the parameters:

We expect a negative relationship between the exchange rate change and import price change. The study assumes that both local and foreign marginal costs (PPIs) increase import prices just as the rise in domestic demand.

Research Methodology

This section deals with the research philosophy that guides the research methodology. It also deals with the models that study shall use as well as description and nature of the variables to be used including data sources. This research departs from existing studies by using an eclectic econometric approach that includes the Phillips Curve (PC) framework to analyse the relationship between exchange rate and inflation. A Generalised Methods of Moments (GMM) model will be applied to a linearised Constant Elasticity of Substitution (CES) function in analysing ERPT to import, consumer and producer prices. VAR and VECM estimation shall be employed in order to study the effect of shocks on variables through impulse response functions. The study's main thrust, though, is to analyse the effect of the exchange rate changes to import prices in South Africa.

Definition of variables

Below are variables that are going to be used in the estimation of the ERPT, Currency Substitution and other various statistical analysis.

1. *CPIsa* = Calculated as a composite figure from weighted specific price indices of a typical consumer basket with 2010 as a base year.
2. *CPIusa* = Calculated as a composite figure from weighted specific price indices of a typical consumer basket in the USA with 2010 as a base year.
3. *IMPORT_PRICE* = Import Prices (Border Import Price Index)
4. *PPIsa* =Local Marginal Cost (domestic PPI) = This is the local cost of production index
5. PPIusa = exporter's marginal cost which is, in effect, the foreign producer price index
6. f^{gap} = financial gap measured as the difference between the actual foreign direct investment (FDI) and the Hodrick-Prescott filtered real FDI.
7. GFCF = Gross Fixed Capital Formation in South Africa
8. *EXCHRATE* = Exchange Rate (with the USA) = Number of local units per USD

9. y^{gap} = Real GDP gap measured as the difference between the real GDP its potential GDP calculated as the long-term trend. The long-term trend is basically the Hodrick-Prescott (HP) filtered real GDP using a lambda (smoothening coefficient) value of 1600.

Models Specification

Exchange rate pass-through specifications

Equation (12) under the analytical framework presented earlier is used to motivate the econometric specification that we use to investigate the link between exchange rate changes and import prices. This research will modify the standard pass-through specification in equation (12) and also adapt it to reflect the fact that we have other factors that affect import prices. The following regression model, in the spirit of the Przystupa and Wróbel (2014) model, shall be used:

$$lnIMPORT\_PRICE = \phi_0 + \phi_1 lnEXCHRATE + \phi_2 lnPPIusa + \phi_3 lnCPIsa + \phi_4 y_t^{gap} + \varepsilon_t \quad (16)$$

PPIusa= marginal cost of production in a foreign country, $CPIsa$ domestic prices and y_t^{gap} is GDP gap.

We also estimate the augmented version of equation (12) to capture the exchange rate pass-through to prices of consumer goods. An additional variable called financial gap (f^{gap}) has been added to equation (12). This is done to check if there exist ERPS symmetry to import prices and consumer prices with both output and financial gaps as control variables.

$$\text{lnCPIsa} = \beta + \delta lnEXCH - RATE + \tau lnPPIusa + \eta y_t^{gap} + \varphi f_t^{gap} + \alpha lnIMPORT - PRICE + \varepsilon_t \quad (17)$$

Where PPIusa is exporter's marginal cost which is the foreign producer price index.

The Bayesian Vector Autoregressive model (BVAR)

Short-term dynamics among variables are better captured through a VAR. VAR models generalize the univariate autoregressive model (AR) by allowing for more than one evolving

variable. This type of a model helps us to see the persistence of certain variables (lagged) on current values. The other good reason for using a VAR is that a VAR is seen as a 'Black Box' in which no assumptions are made about the exogeneity or endogeneity of variables. The results tell the story. Unfortunately, due to the many coefficients the VAR results cannot be relied upon for policy prescriptions though they can tell us the persistent impact a policy can have on macroeconomic variables.

The general VAR model is shown below:

$$\begin{pmatrix} Y_{1t} \\ Y_{2t} \\ \vdots \\ Y_{pt} \end{pmatrix} = \begin{pmatrix} a_{11}^{1} & \cdots & a_{1p}^{1} \\ \vdots & \ddots & \vdots \\ a_{p1}^{1} & \cdots & a_{pp}^{1} \end{pmatrix} \begin{pmatrix} Y_{1t-1} \\ Y_{2t-1} \\ \vdots \\ Y_{pt-1} \end{pmatrix} + \begin{pmatrix} a_{11}^{2} & \cdots & a_{1p}^{2} \\ \vdots & \ddots & \vdots \\ a_{p1}^{2} & \cdots & a_{pp}^{2} \end{pmatrix} \begin{pmatrix} Y_{1t-2} \\ Y_{2t-2} \\ \vdots \\ Y_{pt-2} \end{pmatrix} + \cdots +$$

$$\begin{pmatrix} a_{11}^{p} & \cdots & a_{1p}^{p} \\ \vdots & \ddots & \vdots \\ a_{p1}^{p} & \cdots & a_{pp}^{p} \end{pmatrix} \begin{pmatrix} Y_{1t-p} \\ Y_{2t-p} \\ \vdots \\ Y_{pt-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{pt} \end{pmatrix} \qquad (18)$$

Following the above presentation a VAR(p) can be written as $\mathbf{Y = X\Gamma + u}$

Where $\mathbf{X} = [X_1, ..., X_T]'$, $Xt = [Y'_{t-1}, Y'_{t-2}, \ldots, Y'_{t-p}]'$, $\mathbf{Y} = [Y_1, ..., Y_T]'$, $\mathbf{u} = [\varepsilon_1, \varepsilon_2, \ldots \varepsilon_T]'$ and $\Gamma = [A_1, ..., A_p]'$.

If we let $\gamma = vec(\Gamma)$, then the VAR can be rewritten as

$$\mathbf{Y}_t = (I_n \otimes X'_t)\boldsymbol{\gamma} + \boldsymbol{\varepsilon_t} \qquad (19)$$

The vector Γ represents the VAR coefficients. The term **Y** represents a vector of all the variables in equations 18 to 19 that include $IMPORT\_PRICE$, CPIsa, PPIsa, $PPIusa$, y_t^{gap}, f_t^{gap}, and $EXCHRATE$

Data Sources

Most of the variables to be used in this study will be sourced from the International Financial Statistics (IFS) as well as from the Word Bank Database including verification with South African sources such as the Reserve Bank of South Africa (RBSA) and Statistics South Africa.

1. CPI (Domestic) to be sourced from IFS (index 2010 = 100) and Statistics South Africa (SSA)
2. Bilateral Exchange Rate (with the USA): IFS database and defined as national currency per USD, period average as well as the Reserve Bank of South Africa (RBSA)

3. Local Marginal Cost (domestic PPI): IFS and RBSA
4. GDP (for calculation of output gap) : IFS as well as the RBSA including SSA
5. Domestic and Foreign Money Demand: IFS and World Bank Dataset
6. Local and foreign interest rates (these are six-months Treasury Bill rates) from the IFS
7. Quality of Money (local and foreign): to be calculated using error terms from an Autoregressive Scheme of the inflation variable)
8. Output Gap is calculated as the difference between the real GDP its potential GDP calculated as the long-term trend. The long-term trend is basically the Hodrick-Prescott (HP) filtered real GDP using a lambda (smoothening coefficient) value of 1600.
9. The study shall use quarterly data from 1995 to 2017.

Estimation Techniques

The contribution of the study mentioned the use of an eclectic approach to estimation of ERPT and one of these methodologies involves the use of GMM approach to capture the exchange rate pass-through to Import, Consumer and Producer prices, BVAR and the VECM.

The case for Bayesian Vector Auto-Regressive (BVAR) and the Vector Error Correction (VECM) model

Variables normally show some level of dependency on their past values. It is this dependency of variables on their lagged values that warrants the use of a Bayesian Vector Autoregressive (BVAR) model. The VAR of the Bayesian type is essential in capturing the econometric dynamics among the variables and to study the association among variables through the decomposition of their variances (VD) as well as looking into the responses of variables to innovations that are introduced in the system through Impulse Response Functions (IRF). The BVAR is better than the traditional VAR in the sense that it is more effective than the no-Bayesian model when analysing short periods.

The other reason why a BVAR will be used is that model allows for analysis further along the pricing chain (to producer and consumer prices) than can be done in their single equation model. Choudhri and Hakura (2015) used similar techniques as in this study to examine pass-through to import, producer, and consumer prices in the non-US G7 countries. Furthermore, the BVAR is good when we consider the New Keynesian Phillips curves (NKPC) in which the additional lags of inflation capture the inflation persistence. This is the backward-looking phenomenon that is captured by a BVAR.

Having established the unit-root statuses of the variables it is important to also capture the short-term and the long term-term relationships that exist among the variables. This is done through the use of the VECM.

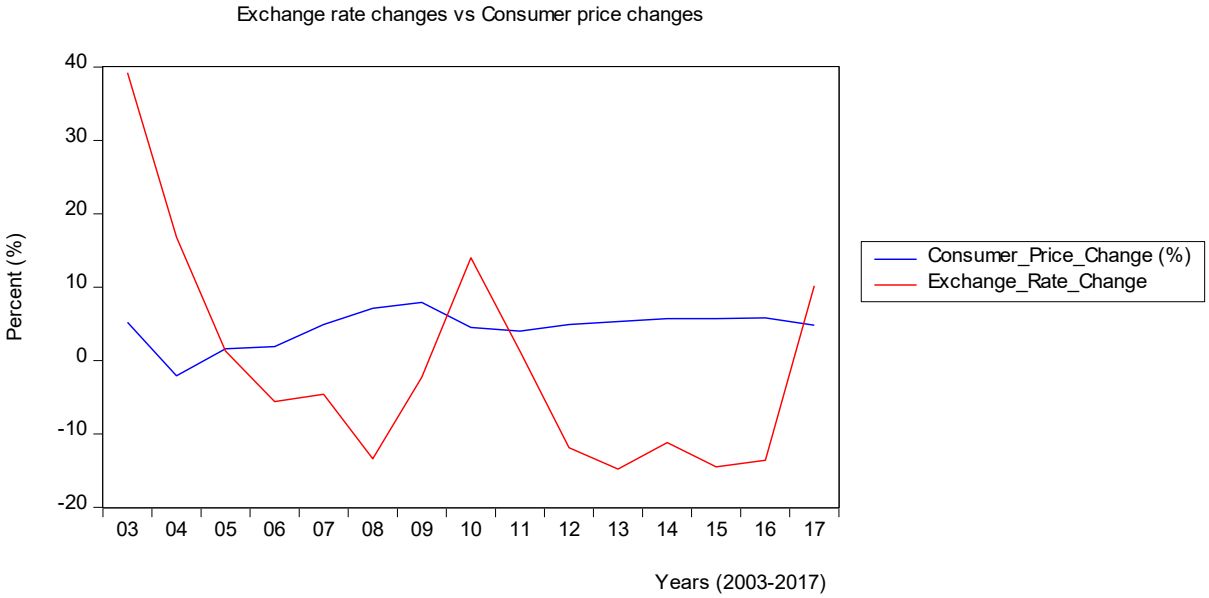
This study uses the Vector Autoregressive (VAR) and Vector Error Correction Model (VECM) to capture the dynamic relationship between the dependent and the independent variables over time as well as capturing the degree and speed of exchange rate pass-through to import prices.

In terms of the variables this research will, in addition to the usual output gap, bring on an important variable called the financial gap as an extra control factor to explain exchange rate pass-through. This variable is informed by the fact that any large difference between the actual and the expected financial resource has implications for the cost of production and hence the consumer prices. For examining the effect of exchange rate pass-through to import and export prices the study shall make use of the CES model. Since the CES itself is difficult to make use of in regressions, we shall use the 2^{nd} degree Taylor Expansion to obtain a corresponding linear model. In the spirit of the (Choudhri and Hakura, 2015) this study shall estimate a simple regression model as well as a VAR model in order to understand the dynamics among variables over a period of time.

Traditionally, exchange rate pass-through is measured by regressing changes in published import price indexes on changes in trade-weighted exchange rate indexes along with other explanatory variables (Gagnon et al., 2014). Many studies of the pass-through effect are based on short-run dynamic equations; such estimates have been made for Poland by (Przystupa and Wróbel, 2014). This paper estimates a long-run reaction of import prices to the exchange rate. If variables are cointegrated then limiting the analysis to the short run reduces the information content. On the other hand, cointegration analysis requires a data span sufficient for inferences on equilibrium levels of the variables. Our analysis covers a twenty-two -year period —the first quarter of 1995 to the last quarter of 2017—which makes our conclusions more credible.

Estimating the asymmetry of exchange rate pass-through relies on an even smaller number of observations, as our sample must be divided into two subsamples that reflect two different states—appreciation and depreciation, or big and small changes of the exchange rate. Due to the large sample that we are going to use our results are expected to be more accurate and reduces chances of them being spurious.

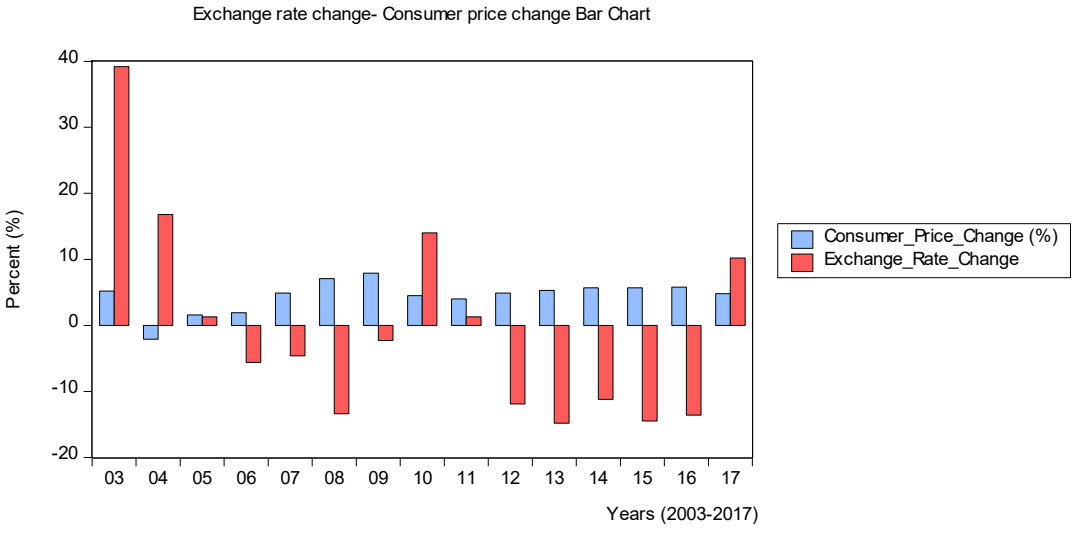
Fig 2



Source: Author's own construction using SARB Data

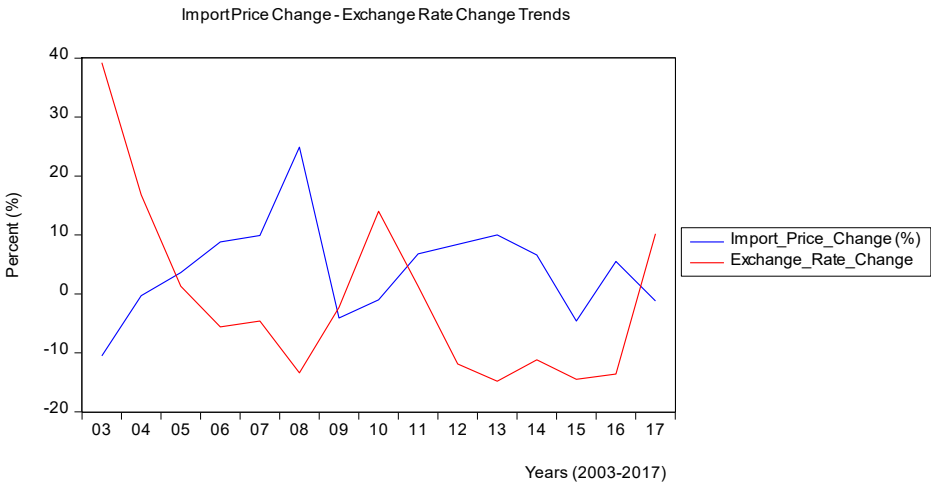
Fig 2 shown above, shows the trends of exchange rate changes and consumer price changes from 2003 to 2017 for South Africa. Though there have been significant fluctuations of the exchange rate the consumer prices did not follow suit thereby showing that prices did not really respond to changes in exchange rate. The Bar Chart shown in Fig 3 indicates that, even though in South Africa, prices would go up when there was a depreciation of the currency (increase in percent) or fall when there was an appreciation (decrease in percent) this was not significant; again corroborating the message from Fig 2.

Fig 3



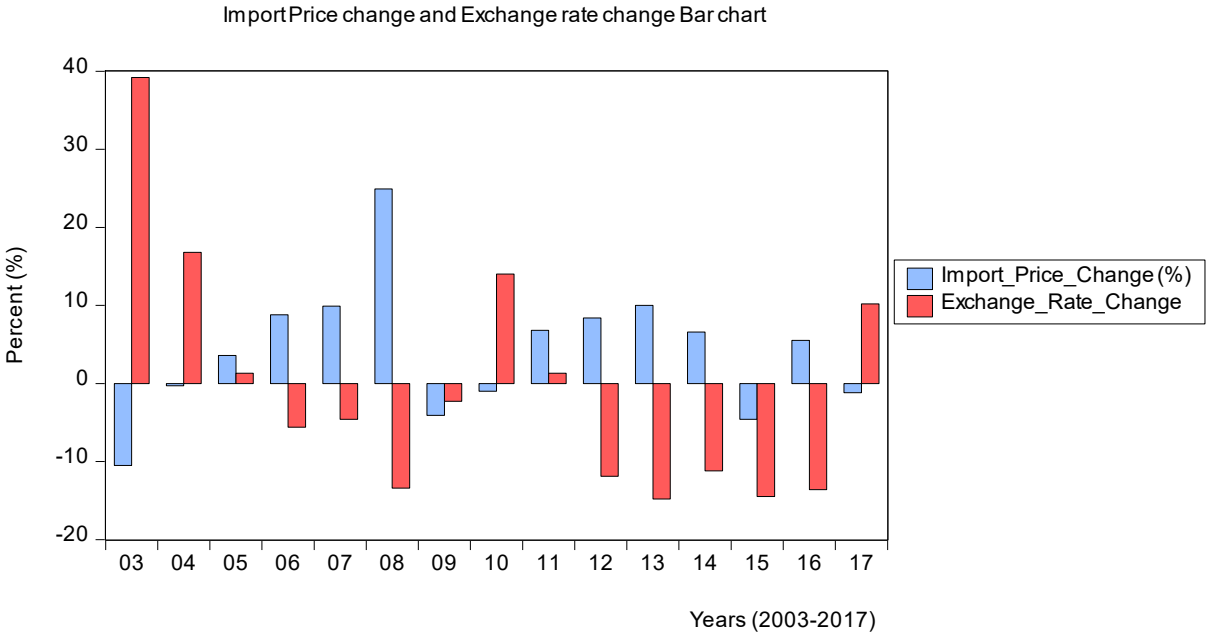
The two graphs below illustrate the profiles of Exchange rate changes and Import price changes from 2003 to 2017. One can see that import price changes reacted with exchange rate changes over time as is expected. The bar chart in Fig 5 makes the relationship much clearer.

Fig 4



Source: Author's own construction using SARB Data

Fig 5



Source: Author's own construction using SARB Data

Descriptive statistics

Descriptive statistics are brief coefficients that summarize a given data set, which can be either a representation of the entire or a sample of a population. These descriptive statistics are used to describe the basic features of the data in a study. Each descriptive statistic is a summary statistic that quantitatively describes or summarizes features of a collection of information.

Descriptive statistics are broken down into measures of central tendency such as mean and median and measures of variability such as variance, standard deviation and range. In this paper, we shall also include other secondary statistics such as the Jargue - Bera statistic for tests of normality. Testing for normality is crucial for making sure statistical inferences can be relied upon.

Descriptive Statistics Table

VARIABLE	MEAN	MEDIAN	JARQUE-BERA	p-Value of J-B statistic
LNCPISA	3.414472	3.629660	3.188322	0.203079
LNCPIUSA	4.304027	4.335852	2.600204	0.272504
LNEXCHRATE	6.118074	6.415604	2.666297	0.263646
LNFDI	12.00163	12.64448	4.412737	0.110100
LNGDP	14.52542	14.44505	4.049602	0.132020
LNGFCF	12.73453	12.57119	4.167679	0.124451
LNPPISA	3.776009	3.888754	2.391255	0.302514
LNPPIUSA	4.312913	4.235844	3.197553	0.202144

Source: Author's own analysis

Each of the variables in the table above shows that the mean and the median are approximately equal to each other and that probably means the series are all normally distributed.

Jarque-Bera Normality Tests

H0: The Data Are Normally Distributed; Ha: The Data Are Not Normally Distributed

Decision rule: Reject H0 if p-Value < 5%

In the above case all p-Values are larger than 5% and therefore we fail to reject the null hypothesis and conclude the data are normally distributed and therefore no outliers.

Bivariate Correlation Coefficient Table

Correlations & Probabilities	lnCPISA	lnCPIUSA	lnEXCHRATE	lnFDI	lnGDP	lnIMPORT_PI	lnPPISA	lnPPIUSA
lnCPISA	1							
lnCPIUSA	0.996 (0.00)	1						
lnEXCHRATE	0.976 (0.00)	0.969 (0.00)	1					
lnFDI	0.939 (0.00)	0.960 (0.00)	0.927 (0.00)	1				
lnGDP	0.919 (0.00)	0.947 (0.00)	0.890 (0.00)	0.975 (0.00)	1			
lnIMPORT_PI	0.991 (0.00)	0.996 (0.00)	0.978 (0.00)	0.968 (0.00)	0.953 (0.00)	1		
lnPPISA	0.997 (0.00)	0.998 (0.00)	0.974 (0.00)	0.952 (0.00)	0.942 (0.00)	0.995 (0.00)	1	
lnPPIUSA	0.937 (0.00)	0.962 (0.00)	0.893 (0.00)	0.961 (0.00)	0.990 (0.00)	0.958 (0.00)	0.956 (0.00)	1

Source: Own Analysis

The table above shows correlation coefficients between pairs of variables. All pairs are significantly correlated with one another. The significant correlation between the South African Consumer Price Index (CPI) and that of the United States of America (USA) is not surprising as these two countries are strong trading partners and to some degree, the significant correlation is a sign of the Purchasing Power Parity rule applying to some degree. The degree of linearity between exchange rate and the South African consumer prices is very high and significant and so is the same between exchange rate and import prices.

Unit Root Testing

Variable	ADF-Test (in levels)	ADF-Test (in 1st Difference)	Phillips-Peron Test (in levels)	Phillips-Peron Test (in 1st Difference)	Probability Value
lnCPISA	Statistic: -2.61 5% Critical: -2.94	Statistic: -1.33 5% Critical: -2.95	Statistic: -6.91 5% Critical: -2.94	Statistic: -1.71 5% Critical: -2.94	0.603 0.000
lnCPIUSA	Statistic: -5.98 5% Critical: -2.94	Statistic: -5.41 5% Critical: -2.94	Statistic: -5.40 5% Critical: -2.94	Statistic: -5.38 5% Critical: -2.94	0.000 0.000
lnEXCHRATE	Statistic: -2.19	Statistic: -4.52	Statistic: -2.43	Statistic: -4.32	0.009

	5% Critical: -2.94	5% Critical: -2.94	5% Critical: -2.94	5% Critical: -2.94	0.016
lnIMPORT_PI	Statistic: -2.89	Statistic: -5.02	Statistic: -6.67	Statistic: -4.95	0.002
	5% Critical: -2.94	5% Critical: -2.94	5% Critical: -2.94	5% Critical: -2.93	0.003
lnPPISA	Statistic: -4.18	Statistic: -3.82	Statistic: -4.22	Statistic: -3.82	0.006
	5% Critical: -2.94	5% Critical: -2.94	5% Critical: -2.94	5% Critical: -2.94	0.000

Variables lnCPIsa and lnImport_prices show unit root using the ADF test but the Phillip-Peron tests show the series are stationary in their levels. In these cases, the unit root result could due to low statistical power of the ADF test especially in situations where the tasted parameter is close to the value in the null hypothesis. The final verdict, therefore, is that lnCPIsa and lnImports are both stationary in their levels going by the stronger Phillip-Peron test. The variable lnexchrate was found to be non-stationary in level using both the ADF and the Phillip-Peron tests. Because lnexchrate is the main determinant of price we include it in OLS and GMM regression models despite it being non-stationary in levels.

OLS Regression Results

Dependent Variable: LNCPISA

Variable	Coefficient	t=statistic	Probability value
LNEXCHRATE	-0.157259	-2.758847	0.0094
LNIMPORT_PRICE	0.153585	1.721568	0.0945
LNPPISA	1.247360	18.73258	0.0000
LNPPIUSA	-0.938360	-7.555868	0.0000
APPDEP	-0.040201	-2.768291	0.0092
C	3.149663	5.710495	0.0000

R-squared value = 0.9986 & Adjusted R-squared = 0.984

Regression results show that when exchange rate changes by 100% then the consumer prices change by 15% only showing evidence of incomplete exchange rate pass-through to prices. The results show that when there is a depreciation (percent increase in exchange rate) the consumer prices increase. Similarly, increase in import prices only results in less transmission to domestic prices. The other result tells us the fact that prices respond more to domestic producer prices . The negative on the Appreciation/Depreciation variable mean that when appreciation increases price levels decrease.

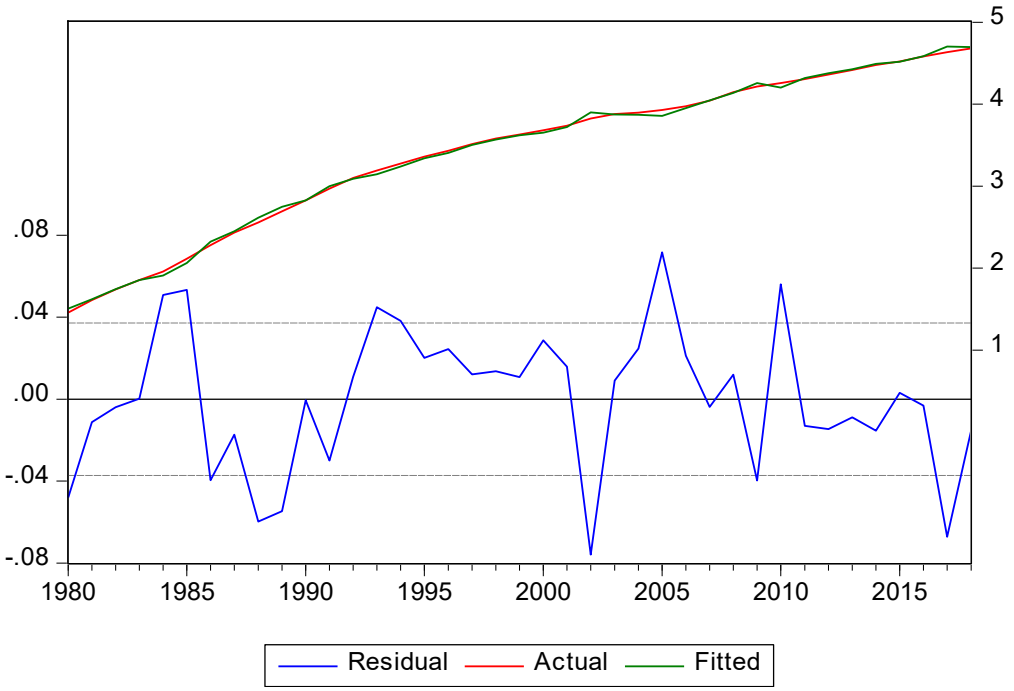
Test for serial correlation

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	1.025759	Prob. F(2,31)	0.3704
Obs*R-squared	2.420743	Prob. Chi-Square(2)	0.2981

Since the probability values of the test statistics are all larger than the 5% level of significance we conclude that there is no serial correlation among the residual terms. This means absence of autocorrelation and hence non-spurious regression results.

Goodness-of Fit Graph (the lnCPIsa model)



The above Residual, Actual and Fitted graph shows that our model is a goof fit. The fitted values closely trace out the actual values. The Goodness-of-Fit graph confirms the high values of the F-statistic and R-squared and its adjusted value.

The Chow-Breakpoint Test

Chow Breakpoint Test: 1994
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 1980 2018

F-statistic	8.527989	Prob. F(6,27)	0.0000
Log likelihood ratio	41.45788	Prob. Chi-Square(6)	0.0000
Wald Statistic	51.16793	Prob. Chi-Square(6)	0.0000

The results of the Chow-Breakpoint test shows that the regression coefficients are not stable across the two periods 1980 -1994 and then 1995 to 2018. This could be due to policy shift of the new Government different from the previous regime. This means we should estimate two different samples provided we have a reasonable sample size, which at present moment could not be collected.

GMM Regression of lnImport Price

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEXCHRATE	0.720753	0.034299	21.01394	0.0000
LNPPIUSA	1.534591	0.135787	11.30147	0.0000
APPDEP	0.061104	0.036707	1.664617	0.1049

C	-7.281525	0.448409	-16.23858	0.0000

R-squared	0.991337	Mean dependent var	3.739005
Adjusted R-squared	0.990595	S.D. dependent var	0.939086
S.E. of regression	0.091073	Sum squared resid	0.290302
Durbin-Watson stat	0.398408	J-statistic	4.541768
Instrument rank	5	Prob(J-statistic)	0.033077

The GMM output reveals that a 100% change in the exchange rate results in 72% change in the import prices. In this regression we notice that when the rand depreciates against the dollar the import prices rise and theory supports this outcome. Results also show that appreciation or depreciation of the rand does not significantly explain import prices. Import prices respond more positively to increases in foreign costs of production (lnPPIusa).

Autoregressive Distributed Lag Model (ARDLM)

Dependent Variable: LNCPISA
Method: ARDL
Dynamic regressors (2 lags, automatic): LNEXCHRATE LNIMPORT_PRICE LNPPISA LNPPIUSA APPDEP
Fixed regressors: C
Number of models evalulated: 486
Selected Model: ARDL(2, 2, 2, 2, 0, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNCPISA(-1)	1.416569	0.253545	5.587040	0.0000
LNCPISA(-2)	-0.407775	0.172543	-2.363319	0.0274
LNEXCHRATE	0.003912	0.039992	0.097825	0.9230
LNEXCHRATE(-1)	0.069651	0.047933	1.453099	0.1603
LNEXCHRATE(-2)	-0.125054	0.043894	-2.849011	0.0093
LNIMPORT_PRICE	0.110627	0.063197	1.750511	0.0940
LNIMPORT_PRICE(-1)	-0.200555	0.082374	-2.434692	0.0235
LNIMPORT_PRICE(-2)	0.158131	0.087531	1.806581	0.0845
LNPPISA	0.275319	0.095207	2.891781	0.0085
LNPPISA(-1)	0.019866	0.123104	0.161378	0.8733
LNPPISA(-2)	-0.311186	0.143914	-2.162302	0.0417
LNPPIUSA	-0.090306	0.117312	-0.769797	0.4496
APPDEP	0.006760	0.009245	0.731163	0.4724
APPDEP(-1)	0.011363	0.008753	1.298217	0.2077
C	0.470506	0.473501	0.993674	0.3312

R-squared	0.999886	Mean dependent var	3.516118
Adjusted R-squared	0.999814	S.D. dependent var	0.851724
F-statistic	13815.89	Durbin-Watson stat	1.965685
Prob(F-statistic)	0.000000		

Interpretation of regression results

The first lag of lnCPIsa is significant showing the persistence of past consumer prices on future prices. Exchange rate effect on prices is also persistent but is not significant factor. Producer prices in South Africa persistently and significantly affects consumer prices. The asymmetric effect of exchange rate on prices is present but is not significant according to the ARDL results. The results indeed show that prices decrease when the rand appreciates and does the opposite when there is a depreciation.

Dependent Variable: LNIMPORT_PRICE
Method: ARDL
Dynamic regressors (2 lags, automatic): LNEXCHRATE LNPPIUSA APPDEP
Fixed regressors: C
Number of models evalulated: 54
Selected Model: ARDL(2, 1, 1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNIMPORT_PRICE(-1)	1.087217	0.154849	7.021125	0.0000
LNIMPORT_PRICE(-2)	-0.206352	0.122390	-1.686014	0.1029
LNEXCHRATE	0.462756	0.076582	6.042632	0.0000
LNEXCHRATE(-1)	-0.351205	0.112027	-3.134994	0.0040
LNPPIUSA	0.978168	0.246304	3.971379	0.0005
LNPPIUSA(-1)	-0.914589	0.223260	-4.096523	0.0003
APPDEP	-0.011082	0.024601	-0.450457	0.6558
APPDEP(-1)	0.025418	0.018376	1.383175	0.1775
C	-0.506286	0.710766	-0.712310	0.4822

R-squared	0.998607	Mean dependent var	3.834536
Adjusted R-squared	0.998209	S.D. dependent var	0.864696

Interpretation of regression results

The ARDL results show the persistence of previous import prices on future import prices. We also noticed the persistent but not significant impact of foreign producer prices (lnPPIusa) on future import prices in South Africa. Past appreciations and depreciations do not have a persistent effect of future import prices in this case.

Serial correlation test in the residuals of the ARDL model

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.305297	Prob. F(2,26)	0.7395
Obs*R-squared	0.848984	Prob. Chi-Square(2)	0.6541

The ARDL results can be trusted as the probability of the F-test statistic is larger than the 5% level of significance. This means our regression results are not spurious.

Lag length selection criteria (for VAR Estimation purposes)

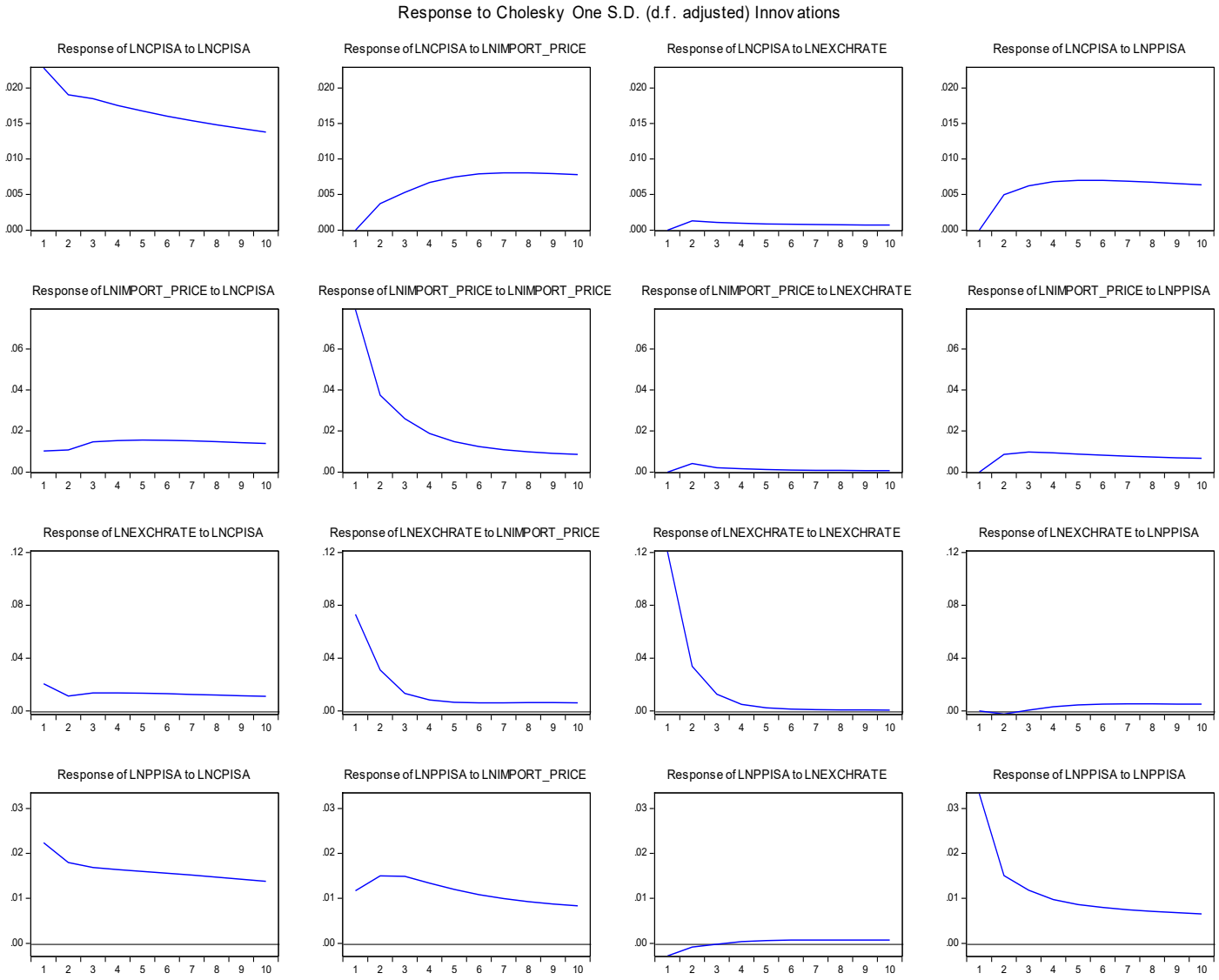
VAR Lag Order Selection Criteria
Endogenous variables: LNCPISA LNIMPORT_PRICE LNEXCHRATE LNPPISA
Exogenous variables: C
Date: 05/18/19 Time: 18:41
Sample: 1980 2018
Included observations: 34

Lag	LogL	LR	FPE	AIC	SC	HQ
0	59.26780	NA	4.55e-07	-3.251047	-3.071475	-3.189808
1	262.0591	345.9381	7.76e-12	-14.23877	-13.34091	-13.93258
2	291.2793	42.97088*	3.72e-12*	-15.01643	-13.40028*	-14.46528*
3	302.9317	14.39411	5.38e-12	-14.76069	-12.42625	-13.96458
4	321.0275	18.09581	5.99e-12	-14.88397	-11.83125	-13.84291
5	342.5432	16.45320	6.68e-12	-15.20842*	-11.43742	-13.92240

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The optimal number of lags to include in estimating a Vector Autoregressive Model (VAR) is two (2). This ensures results that are water-tight and convey statistical inferences that can be trusted.

Impulse Response Functions



Interpretation of the Impulse Response Functions.

Domestic consumer prices respond very well to a one-standard deviation shock to both import prices as well as to domestic producer prices. This means that when either import prices or producer prices were to suddenly increase this will produce a positive knee-jerk response of the consumer prices in South Africa. The response graphs also show that consumer prices do not respond very well to a shock in the exchange rate. This response supports the fact that there is low exchange rate pass-through to consumer prices in South Africa. Import prices respond positively but not very much to shocks in the exchange rate as the effect does not persist at high levels.

Conclusion and recommendations

The OLS regression results show that the degree of transmission of exchange rate to domestic prices in South Africa is very low at 15%. Domestic prices respond more to producer price indices rather than to changes in the exchange rate. Results also tell us that foreign prices such as the foreign CPI and PPI play a significant influence on the local prices in South Africa. The results also support findings from other studies that suggest that declines in pass-through may be due to changes in the consumer basket or to changes in pricing behaviour of firms.

Results show that there is exchange pass-through asymmetry to consumer prices and import prices. The exchange rate change has a higher impact on import prices than on consumer prices in South Africa for the study period. There was also evidence of significant asymmetric effect of appreciation and depreciation on consumer prices in South Africa. Results indicate that when there is a depreciation consumer prices tend to increase and the opposite is true when there is an appreciation. However, the asymmetric effect is not significant.

Based on the findings of the study it is recommended that authorities should continue to pursue inflation-targeting policies to ensure that the local currency does not depreciate to levels that can cause significant increases in consumer prices. Since producer prices significantly affected the domestic consumer prices it may be prudent to cushion producers by way of production subsidies.

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