

EXCHANGE RATE PASS-THROUGH TO DOMESTIC PRICES: THE CASE OF SOUTH AFRICA

Matthew Kofi Ocran*

Abstract:

This paper examines the exchange rate pass-through to import, producer and consumer prices in South Africa using monthly data covering the period 2000M1 to 2009M5. The study uses innovation accounting tools (impulse response and variance decomposition) within the framework of an unrestricted VAR to examine the degree of pass-through as well as the relative importance of a number of variables in explaining changes in domestic prices. The key findings suggest that after 1 per cent shock to nominal effective exchange rate, the level of CPI increases by 0.125 per cent, giving a pass-through elasticity of 13 per cent. However, the pass-through elasticity of producer price is 20 per cent after 24 months suggesting that favourable shocks to producer price inflation can have considerable moderating effect on CPI inflation.

Keywords: exchange rate, pass-through, domestic prices, VAR, South Africa.

JEL Classification: C32, E31, E37, F31, O52

1. Introduction

While the debate in developed countries regarding exchange rate pass-through (ERPT) has moved on from one of estimation to the task of explaining the observed low exchange rate pass-through, the discussion in most developing countries revolves around the level of pass-through. The case of South Africa is even more pertinent since the rate of inflation has fallen considerably over the years. From an average rate of 19.2 per cent in 1986 the inflation rate dropped to 9.8 per cent in 1993 and bottomed

* Department of Economics, Nelson Mandela Metropolitan University, South Summer Strand Campus, Port Elizabeth 6031, South Africa (matthew.ocran@nmmu.ac.za). The author acknowledges very useful suggestions from three anonymous referees of the journal on an earlier draft. Constructive criticisms from participants of the biennial conference of the Economic Society of South Africa in Port Elizabeth, September 2009, are also much appreciated.

out at 1.4 per cent in 2004 before peaking again at 11.5 per cent in 2008.¹ Indeed if we consider the year 2001 when the country adopted an explicit inflation targeting regime as reference point we note that the rate of inflation came down considerably until the recent upsurge associated with the commodity price super-cycle that ended in 2008. For instance, the rate of inflation on an annual basis, which averaged 6.0 per cent for the nine-year period after adoption of explicit inflation targeting, compares favourably with the high of 9.4 per cent observed for the period preceding the targeting regime.²

Given that the literature on developed countries appears to suggest that exchange rate pass-through in an environment of low inflation is more subdued, it would be interesting to ascertain the level of pass-through in South Africa over a period of low inflation. This would help deepen the literature by bringing an emerging market economy outcome to bear on the current literature, and also to indirectly contribute to the debate on the usefulness of the inflation targeting regime currently raging in the country.

Exchange rate pass-through essentially deals with the effect of a change in the exchange rate on domestic prices, be it consumer prices, producer prices or import prices. Pass-through is deemed incomplete when the effect of a unit change in the exchange rate leads to less than a unit change in a given domestic price. Campa and Goldberg (2005) argue that there are three key factors that drive the extent of exchange rate pass-through. As cited in Liu and Tsang (2008), these are: the pricing behaviour of exporters in the producer countries, the sensitivity of mark-ups to competitive conditions and existence of distribution costs that tend to widen the difference between import and retail costs. Significantly, the last two constitute a set of countervailing forces with a net effect that can impact exchange rate pass-through in one way or the other. Following the discussion above, the empirical question that comes to the fore is: what is the extent and nature of exchange rate pass-through to domestic prices in South Africa? The objective of this paper therefore is to estimate the exchange rate pass-through to domestic prices in South Africa using an unrestricted VAR model.

In general, if domestic prices respond to nominal exchange rate depreciation one-to-one then any export competitiveness that accrues from nominal depreciation would be wiped out, as the real exchange rate would not change at all (Ito and Sato, 2008). Given that the exchange rate is an instrument for managing the trade balance, the pass-through to import prices and producer prices may influence expenditure switching while high pass-through to consumer prices can bring pressure to bear on inflation levels. Increased understanding of exchange rate pass-through in the economy can aid both trade and monetary policy formulations; this constitutes the motivation for the present paper.

The rest of the paper is structured as follows: Section 2 reviews evolution of South Africa's exchange rate policy as well as developments in the consumer price inflation over the recent past. Section 3 presents a brief overview of the proximate literature on exchange rate pass-through. In Section 4, the methodology and empirical model is discussed. The key findings are then discussed in Section 5, with the conclusions and policy issues in Section 6.

1 Consumer price index for all metropolitan areas – all times; base year: 2008=100. Source: Statistics South Africa, Data Files.

2 The difference in average inflation between the two periods is found to be statistically significant at the 5 per cent level when a statistical test of the means was undertaken.

2. Evolution of Exchange Rate Policy and Recent Developments in Inflation

This section provides a concise review of the developments in exchange rate policy in South Africa over the past three or so decades as well as recent performance of inflation in the country. The discussion is mostly descriptive in nature.

2.1 Exchange Rate

Exchange rate regimes vary widely from country to country and even in countries from time to time. However, the two extremes in terms of policy are the freely floating and fixed regimes respectively. While the exchange rate level in the freely floating regime is entirely left to market forces, with no official direct intervention except indirectly by policy measures, the authorities may seek to keep the exchange rate fixed, as was the case prior to 1914 when the gold standard broke down. Now, between these two policy extremes there are also a number of variations or possibilities.

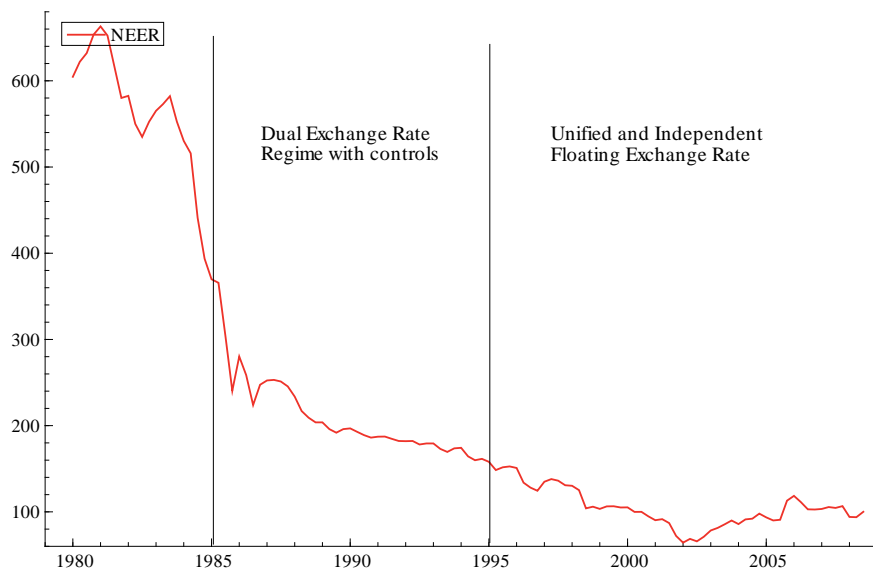
The exchange rate policy in South Africa has evolved over the years.³ For instance, up until 1979, the exchange rate was largely fixed and pegged to either the British pound sterling or the US dollar. Indeed, over the 1970s the peg even alternated between the dollar and the pound sterling a few times. As part of the exchange rate management, controls on capital flows/foreign exchange transactions were enforced.

After tightening the controls in the wake of the political turmoil of 1961 following the Sharpsville Shootings, 1976 saw a moderation of the controls when a dual currency exchange rate system was pursued (De Kock Commission, 1984 as cited in Van der Merwe, 1996). The regime provided for a financial rand, which was applied to non-resident portfolio and direct investments, and a commercial rand for all other foreign exchange transactions. The commercial rand was quasi-market determined. The Reserve Bank on a daily basis in consonance with market forces announced the commercial rand exchange rate. While the financial rand was freely floating the same cannot be said of the commercial rand. The financial rand was dropped in 1983 in an attempt to liberalise the exchange rate and as a result all controls on non-resident capital movements were removed. However, those on residents remained in place but were somewhat relaxed. Due to the difficult economic situation precipitated by the debt crisis of the mid 1980s, the financial rand was brought back in 1985 but this was again removed after 10 years (*i.e.* in 1995) when the exchange rate system was unified. Since then a gradual approach has been adopted to liberalise the exchange rate to the extent that by 2004 the exchange rate was characterised by the IMF as one of independent float.

Figure 1 presents the exchange rate developments since 1980. It is apparent that since 1980 there has been a general downward trend in the size of the NEER. However, while the fall was relatively sharp, between the pre-1985 and the 1985-1995 dual exchange rates regime the post-1995 decline was somewhat measured. On the matter of short-term variability there appear to be marked differences in the degree of variability between the period of dual exchange rate regime and that of the floating exchange rate regime.

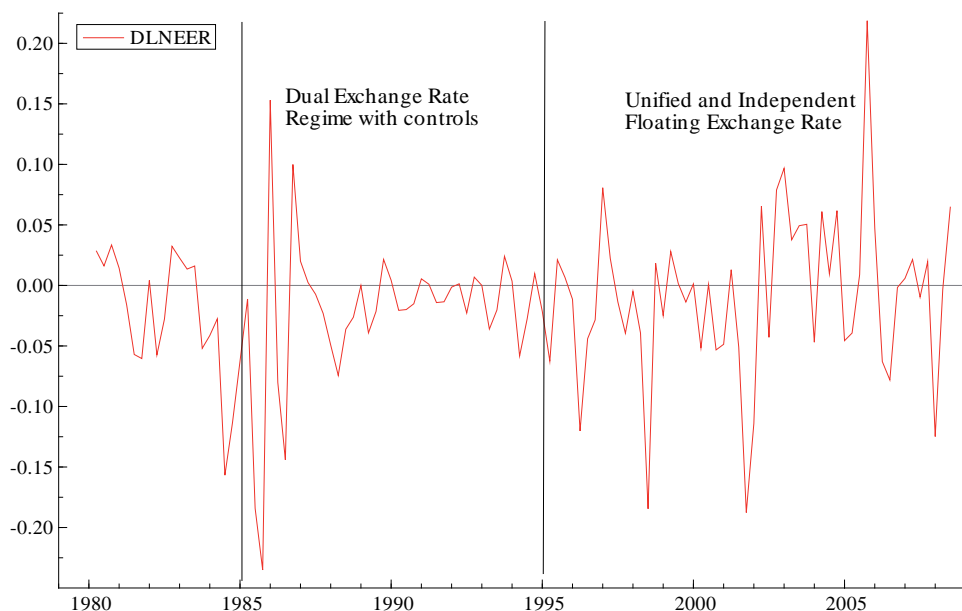
3 For a detailed description of the evolution of exchange rate policies in South Africa up to 2004, see Farrell and Todani (2004).

Figure 1

The NEER under Different Regimes (2005=100)

Apart from the wide variations in the first five years following the re-introduction of the dual exchange rate, the last five years of the regime, 1990-1995, were characterised by relatively moderate variations as compared to the floating exchange rate regime.

Figure 2

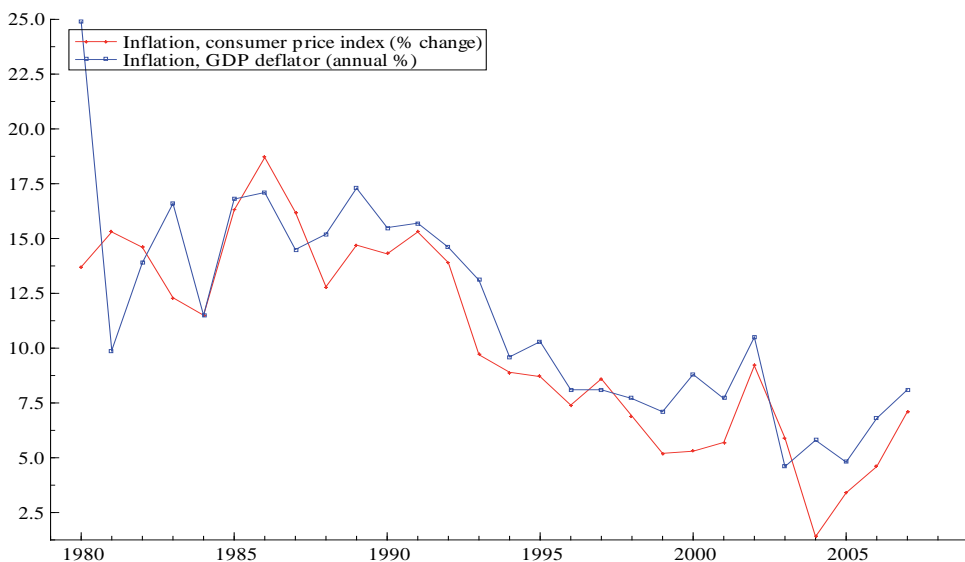
Short-Term Variability of the NEER Expressed as Percentage Change from Previous Quarter (1980:1 to 2008:3)

Recent Developments in South Africa's Inflation

Generally, the inflation level in South Africa has been on a steady decline since 1990 apart from the spike in 2002 due to economic challenges that included the large fluctuations in the external value of the rand⁴ (see Bhundia, 2002). Both the GDP deflator and CPI measures of inflation respectively have followed a downward trend. However, inflation in the country started picking up steadily from 2005 after reaching more than a 20-year low of 1.4 per cent in 2004. The average CPI inflation for 2008 was 11.5 per cent, the highest since 1992. Since 1985 both the GDP deflator and headline inflation as measured by the CPI have largely moved together until 2004 when they diverged again but the two have since come close to convergence. A look at the GDP deflator⁵ a rather broad measure of inflation also suggest a subdued inflationary trend similar to that observed in the headline inflation, CPI.

Thus from Figure 3 it can be argued that while short-run variability in the NEER increased in the post-1995 period the impact on inflation appear to have been quite subdued at least from descriptive analysis point of view. The empirical response to the question though is the subject of this paper.

Figure 3
Trends in Inflation, 1980-2007



4 For instance, the rand lost about 40 per cent of its value in the last four months of 2002.

5 The developments in domestic prices are best analysed with the CPI instead of the GDP deflator. Even though it does not take account of investment spending and external trade as in GDP deflator, it is deemed more useful for analysis of domestic price movements because it dwells on domestic consumption behaviour only. In any event, Figure 3 suggests that both measures have moved together over the past decades or so.

3. Literature Review

This section of the paper presents a brief overview of the literature regarding exchange rate pass-through (ERPT). While noting that the literature is quite extensive it is possible to make some generalisations that characterise the body of literature around ERPT. The literature may be considered at two main levels of aggregation. Again, while most studies consider ERPT at the macro level there is a substantial literature that looks at the issues at the micro level. The micro level analyses may be industry or product specific (Corsetti and Dedola, 2005). These studies examine the pass-through to import prices of different industries or products rather than dwelling on the effects at aggregate price levels.

On the theoretical front there appears to be no consensus with respect to the appropriate theoretical underpinnings regarding ERPT modelling efforts. Prominent among the theoretical frameworks is the Law of One Price (LOP). Critics of the LOP have asserted the presence of price stickiness in some cases invalidates the LOP framework and that ERPT is imperfect. In the context of sticky prices, Betts and Devereux (2000) proposed the theory of local currency pricing to explain the breakdown of the PPP theory inherent in the law of one price. Others have also argued in favour of producer currency pricing. The argument here is that exchange rate changes are reflected in one-for-one foreign currency prices, *i.e.* perfect pass-through. Then there is the Phillip curve framework, which has attained popularity in recent time (*e.g.* Liu and Tsang, 2008).

The econometric tools used in estimation of ERPT have evolved over time with a number of accompanied motivations, from single equations to simultaneous equations and to a limited extent seemingly unrelated regressions (SUR). Various types of VARs are also in use. There are studies such as those that use recursive VARs, structural and unstructured VARs. The literature can also be looked at in terms of two main strands regarding characteristics based on the nature of modelling as to whether one is using a structural or reduce-form modelling effort. The first stage examines the relationship between exchange rate and import prices while the second stage looks at the pass-through from import prices to domestic prices. Nonetheless, there are a few papers that attempt to examine these stages separately without regard to the other. These papers have mostly analysed the first stage with only a handful of studies dwelling directly on the latter (Gagon and Ihrig, 2004).

The VAR approach has a marked advantage over the single equation framework; this explains the popularity of the framework in the literature (McCarthy, 2000; Hahn, 2003; Faruquee, 2006; Ito and Sato, 2006). Among the key advantages of the VAR framework is the opportunity to identify structural shocks via Cholesky decomposition of innovations. Again, while a single equation framework allows for just one domestic price index, the VAR framework makes room for a set of domestic prices, thus making it possible for an evaluation of ERPT considering a set of domestic prices within the pricing chain from the importer/producer to consumer levels. The single equation framework on the other hand is based on the assumption of causality from exchange rate to inflation and thus ignoring the possibility of reverse causality from inflation to exchange rate. Consequently in the present study we adopt the VAR approach as the analytical framework for estimation.

On the substantive matter of estimation of ERPT, most studies focusing on developed countries conclude that ERPT has fallen over the years particularly in an environment of low inflation. Consequently the bulk of the recent literature on ERPT has been aimed at explaining away the reasons underlying the seemingly low ERPT figures (Marazzi *et al.*, 2006; Campa and Goldberg, 2005; Taylor, 2000). However, in the case of emerging economies, such as South Africa, not much has been accomplished by way of research. That notwithstanding, there is a growing number of studies on emerging economies in Asia (*e.g.* Ito and Sato, 2008). While many of these have focused on individual countries a good number of them have dwelt on cross-country samples.

The present study therefore attempts to contribute to the literature on developing countries by focusing on South Africa. In terms of previous work on South Africa, Bhundia (2002) is the only study that came to our notice. Unlike Bhundia (2001) we use an extensive data series that gives a better coverage of the inflation-targeting regime.

4. Methodology

This part of the paper discusses the analytical framework, intuition and assumptions underlying the empirical model. Also discussed are the relevant data issues.

4.1 Model

Following MacCarthy (2000) and others, it is first assumed that the various prices involved in the ERPT constitute a distribution chain, hence the modelling effort is geared at modelling the various prices along the distribution chain. The assertion here is that inflation at each point or stage of the chain has several components. For instance, the expected inflation at a given point or stage is deemed to be based on the available information at the close of time $t-1$. The second and third stages are the effects of period t domestic “supply” and “demand” shocks on inflation at that phase. The effect of exchange rate shocks on inflation at a particular stage constitutes the fourth component. This is followed by the shocks of the previous stages of the distribution chain. We also have an own shock component, *i.e.* that is a particular stage’s own shock. Now, the points along the distribution chain namely, import, producer and consumer prices may be formally presented as follows:

$$\pi_t^m = E_{t-1}(\pi_t^m) + \alpha_1 \varepsilon_t^s + \alpha_2 \varepsilon_t^d + \alpha_3 \varepsilon_t^e + \varepsilon_t^m \quad (1)$$

$$\pi_t^w = E_{t-1}(\pi_t^w) + \beta_1 \varepsilon_t^s + \beta_2 \varepsilon_t^d + \beta_3 \varepsilon_t^e + \beta_4 \varepsilon_t^m + \varepsilon_t^w \quad (2)$$

$$\pi_t^c = E_{t-1}(\pi_t^c) + \gamma_1 \varepsilon_t^s + \gamma_2 \varepsilon_t^d + \gamma_3 \varepsilon_t^e + \gamma_4 \varepsilon_t^m + \gamma_5 \varepsilon_t^w + \varepsilon_t^c \quad (3)$$

Where, π^m , π^w and π^c denote import price, producer price and the consumer price inflation respectively. One important assumption at this point is that the shocks at each stage are part of the stage’s inflation that cannot be accounted for by drawing on information from period $t-1$, as well as contemporaneous information on local demand and supply variables, exchange rates and inflation at the preceding stages of the distribution chain. These shocks may be seen as having resulted from pricing

power and mark-up of firms at various stages. The third key assumption underlying the modelling effort is that imported inflation shocks do affect local consumer inflation directly and indirectly via their impacts on producer price inflation. It is also assumed that there is no room for contemporaneous feedback in the model.

The other assumptions are as follows: the supply shocks are identified from the dynamics of oil price inflation; demand shocks are generated from output gap after considering contemporaneous effect of supply shocks; exchange rate shocks are obtained from the dynamics of exchange rate changes after considering the contemporaneous effects of the supply and demand shocks. These additional set of assumptions give rise to equations (4) to (6).

$$\pi_t^{oil} = E_{t-1}(\pi_t^{oil}) + \varepsilon_t^s \quad (4)$$

$$y_t = E_{t-1}(y_t) + a_1 \varepsilon_t^s + \varepsilon_t^d \quad (5)$$

$$\Delta e_t = E_{t-1}(\Delta e_t) + b_1 \varepsilon_t^s + b_2 \varepsilon_t^d + \varepsilon_t^c \quad (6)$$

Following McCarthy (2000), we introduce two more equations in the form of a central bank reaction function and a money demand equation along the lines of Christiano *et al* (1996). The reaction function establishes the relationship between short-term interest rates to the earlier identified variables since the monetary authority uses short-term interest rate as a pre-eminent policy instrument. The money demand⁶ function ties the changes in money supply to the other variables in the earlier models specified. These last two assumptions give rise to equations (7) and (8).

$$i_t = E_{t-1}(i_t) + c_1 \varepsilon_t^s + c_2 \varepsilon_t^d + c_3 \varepsilon_t^e + c_4 \varepsilon_t^m + c_5 \varepsilon_t^w + c_6 \varepsilon_t^e + \varepsilon_t^{MP} \quad (7)$$

$$\Delta m_t = E_{t-1}(\Delta m) + d_1 \varepsilon_t^s + d_2 \varepsilon_t^d + d_3 \varepsilon_t^e + d_4 \varepsilon_t^m + d_5 \varepsilon_t^w + d_6 \varepsilon_t^e + d_7 \varepsilon_t^{MP} + \varepsilon_t^{MD} \quad (8)$$

Finally, we assume that the conditional expectations inherent in equations (1) to (8) can be substituted by linear projection of the lags of the eight variables represented in the system of equations. Drawing on the above set of assumptions, we fashion a model in the form of a VAR using Cholesky decomposition. Consequently, the impulse response of PPI and CPI inflation to the orthogonalized shocks of exchange rate changes and import price inflation provide estimates of the effect of these variables on domestic inflation.

The ordering of the VAR is based on the assumption mentioned earlier regarding the distribution chain argument in terms of the pricing structure. Hence the equations enter the VAR in the following order: oil price, output gap, exchange rate, interest rate, money supply, import prices, producer price and consumer price. This may be schematically represented as:

$$\pi^{oil} \rightarrow gap \rightarrow \Delta e \rightarrow i \rightarrow \Delta m \rightarrow \pi^m \rightarrow \pi^w \rightarrow \pi^c$$

The oil price and output gap are controls for supply and domestic shocks respectively. Also assumed in the modelling effort is that causality runs from exchange rate to prices and that the extent of endogeneity increases from top to bottom of the order.

6 Additional papers that discuss the role of monetary policy in the estimation of exchange pass-through include but limited to Pigott *et al.* (1985) and Parsely and Popper (1998).

4.2 Data Issues

The paper uses monthly data from 1998M1 to 2009M5. The nominal effective exchange rate (NEER) index⁷ is used to account for the exchange rate variable. The consumer, producer and import price indices are obtained from data files of Statistics South Africa. The volume of output generated by the manufacturing sector of the economy is used as a proxy for industrial output. With the aid of the standard Hodrick-Prescott Filter for data smoothing we obtained the output gap. This is defined as the difference between potential output and actual output. The fob price of UK Brent crude was used as a proxy for the world price of crude oil. The US dollar/rand exchange rate was used to convert the crude oil price in US dollar into the rand price. While the oil price was obtained from the IMF's commodity price database, the NEER was taken from the data file of the South Africa Reserve Bank. The prime rate is used as a proxy for the short-term interest rate. Even though the policy rate, the central bank's repurchase rate would have been preferred, the series only starts in 1999M11. The choice of the prime rate is based on the assumption that, it is closely linked with the policy rate. The seasonally adjusted money supply series was also obtained from the data files of the Reserve Bank. The series represents broadly defined money supply, M3.

Before undertaking the empirical analysis we examined the statistical properties of the data by testing for unit root to ascertain whether or not the series was stationary. The ADF test statistic was used in the unit root analysis. The results are presented in the table below. The results show that all the variables are non-stationary in levels but stationary in their first differences except the output gap variable.

Table 1
Unit Root Test Results

Variable	ADF Test	
	Levels	First Difference
Oil Price	-1.89	-3.895**
Output gap	-3.22*	-3.22*
Exchange Rate	-1.71	-5.06**
Import Price	-1.37	-4.59**
Producer Price Index	-0.23	-5.19**
Consumer price Index	1.06	-5.64**
Interest rate	-1.56	-3.76**
Money supply	1.58	-5.70**

Note: *** denotes 1 per cent level of significance and for ** 5 per cent level of significance.

7 The rand NEER is computed using the trade weights of South Africa's main trading partners. The weights are: 34.82 for the euro area; US, 14.88; China, 12.49; UK, 10.71; Japan, 10.12; Switzerland, 2.83; Australia, 2.04; Sweden, 1.99; India, 2.01; Hong Kong, 1.48; Singapore, 1.40; Brazil, 1.37; Israel, 1.11 and Zambia, 0.80 (SARB (2008)).

Because the variables are stationary in their first differences, it means the variables are integrated with order one [I (1)]. Enders (2004) suggests⁸ that we differentiate the variables that enter the VAR only if they are not cointegrated. However, our test for cointegration suggested that the I (1) variables are indeed cointegrated.⁹ Hence we do not difference the variables that enter the unrestricted VAR. Before the estimation we also determined the appropriate lag length to use in the estimation. Here we use a battery of statistics. An inspection of the various tests indicated lag three as the optimal lag length (see table below).

Table 2

Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1905.464	NA	5.20e-21	-29.67912	-29.54544	-29.62481
1	1998.907	176.6657	2.12e-21	-30.57667	-29.64085*	-30.19644*
2	2036.879	68.23008	2.06e-21	-30.60748	-28.86952	-29.90134
3	2080.360	74.05483*	1.85e-21*	-30.72438*	-28.18429	-29.69233
4	2103.357	37.01022	2.31e-21	-30.5212	-27.17898	-29.16324
5	2134.869	47.76116	2.55e-21	-30.45108	-26.30673	-28.76721
6	2166.258	44.63043	2.86e-21	-30.37903	-25.43254	-28.36924
7	2199.571	44.24436	3.17e-21	-30.33705	-24.58843	-28.00136
8	2232.688	40.87831	3.60e-21	-30.292	-23.74124	-27.63039

* indicates lag order selected by the criterion.

LR: sequential modified LR test statistic (each test at 5 per cent level).

FPE: Final prediction error.

AIC: Akaike information criterion.

SC: Schwarz information criterion.

HQ: Hannan-Quinn information criterion.

5. Main Findings

As mentioned in Section 3, the model is estimated with the aid of VAR involving eight variables: oil price, output gap, exchange rate, consumer price, producer price, import price, short-term interest rate and money supply. The implementation of the model is such that the reduced form residuals from the VAR are orthogonalised using a Cholesky decomposition to identify the structural shocks with the variables in the order given above. The Model is estimated over the period 2000M1-2009M5 (113 months). Following McCarthy (2000) we use innovation accounting techniques (*i.e.* impulse response functions and variance decompositions) to ascertain the degree of pass-through from exchange rate fluctuations to domestic inflation and also to figure out the importance of the various variables in explaining fluctuations in the domestic prices. These exercises are undertaken over a 24 month-time horizon.

⁸ See Enders (2004) pp. 288 for the consequences of differencing the variables used in the VAR analysis when they are cointegrated.

⁹ The cointegration test statistics are not reported for the sake of brevity.

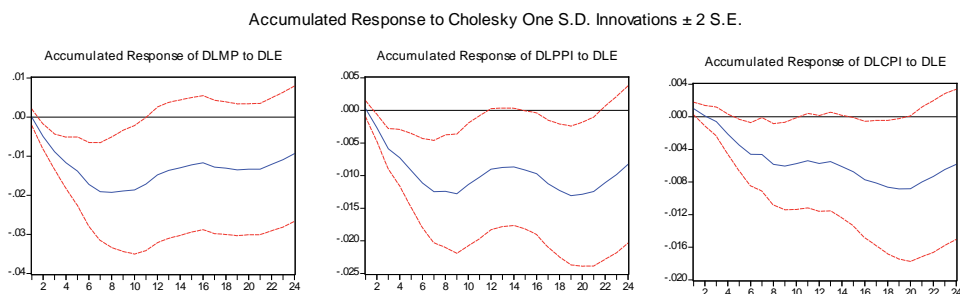
5.1 Response to Exchange Rate Shocks

Panel 1 shows the responses of the import price index, the PPI, and the CPI to an exchange rate shock. In this model the exchange rate shock is examined given past values of all variables as well as current values of oil prices and the output gap. The solid line in each graph indicates the estimated response while the broken lines describe a two-standard error confidence band around the estimate. The general observation here is that import prices respond more rapidly to exchange rate shocks as compared to the other two domestic prices, PPI and CPI. However, between the two, PPI is also ahead of CPI.

The initial impact of an exchange rate appreciation on import prices is negative as suggested by the literature and remains so for the entire 24-month horizon. The response peaks at 0.02 per cent by the 7th month and then drops back to 0.01 per cent by the 24th month. The response to the exchange rate shocks was mostly statistically significant. In the case of the PPI, the response does not appear to be stable. First, it reaches a peak at less than 0.015 per cent, receding to 0.010 per cent in the 15th month, before reaching nearly 0.015 per cent by the 20th month. It should be noted, however, that the changes in the extent of response is marginal. The accumulated response of CPI to shocks from the exchange rate appears to be relatively smaller as compared to the other two domestic prices. However, while the response in the second month was statistically insignificant responses from the 6th month were all statistically significant even though the responses were in themselves still marginal.

Figure 4

Response of Domestic Price Indices to 1 per cent Increase in Exchange Rate



This is indeed consistent with the distribution chain assumption underlying domestic pricing outlined earlier in the paper (see Figure 4 above).

Estimation of the Pass-Through Elasticity

Using the impulse response function, we can derive the cumulative pass-through coefficient by dividing the cumulative response of each price index after m months by the exchange rate shock after m months. The exchange rate pass-through elasticity at time t , $ERPT_t$ is therefore defined as:

$$ERPT_t = \frac{P_{t,t+m}}{E_{t,t+m}}$$

where P is the cumulative change in price level after m periods and E cumulative change in the exchange rate at time, $t = 0$. The numerator represents the percentage change in the level of the CPI between period 0 , when the initial exchange rate shock occurs, and time t . The denominator is also the percentage change in the nominal effective exchange rate at time 0 .

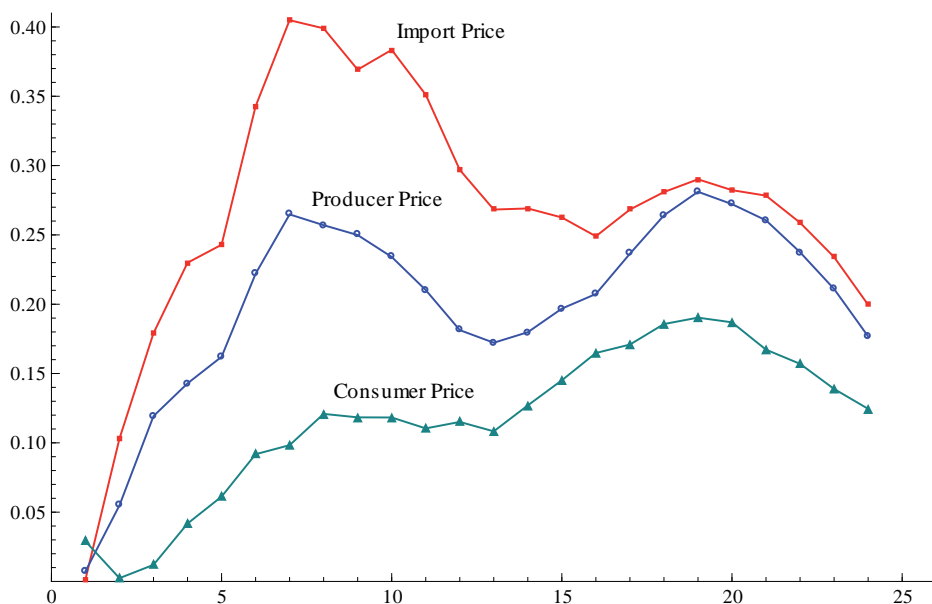
The exchange rate shocks get through to consumer prices gradually while the effect on import prices is more pronounced and prompt. The impact on producer price is between the other two domestic prices in terms of magnitude. Interestingly, the outcomes here appear to be consistent with the findings from Bhundia (2002). While in Bhundia’s paper the pass-through to consumer price inflation peaks at 12.3 per cent after eight quarters (24months), here we attained a pass-through of 12.5 per cent in 24 months. However, what is most insightful is the fact that the pass-through to producer price has fallen significantly from 72 per cent after 24 months in the Bhundia paper to 20 per cent in the present work after a peak of 40 per cent after 7 months.

Table 3
Time Profile for ERPT Elasticity for Domestic Prices

Period	Import Price	Producer Price	Consumer Price
After 3 months	0.179	0.119	0.012
After 6 months	0.343	0.222	0.092
After 7 months	0.404	0.265	0.098
After 8 months	0.399	0.257	0.121
After 12 months	0.297	0.181	0.115
After 24 months	0.199	0.177	0.125

The figure below shows the comparative time profile of the exchange rate pass-through seen in all three domestic prices over 24 months (or 2 years).

Figure 5
Estimated Cumulative Exchange Rate Pass-Through



5.2 Variance Decomposition

The error forecast variance decomposition essentially shows the proportion of the movements in a sequence due to its own “shocks” as compared to shocks to other variables in the system. If shocks from other variables in the system do not account for any part of the variance of a given variable at all forecast time horizons, it means the variable is exogenous. On the contrary, if the shocks from the other variables in the system account for all the error forecast variance decomposition, then the variable we are dealing with is entirely endogenous (Enders, 2004). In practice, it is not uncommon for a variable to explain almost completely its entire forecast error variance, particularly at short horizons and relatively smaller proportions at longer horizons. Thus the variance decomposition provides insight into the relative importance of each of the random innovation in affecting the variables in the VAR.

As an additional effort to help ascertain relative importance of exchange rate shocks on the various domestic prices we sought to use variance decomposition to help separate the variations in the domestic prices, into the component shocks to the VAR.

Following the discussions above, it can be observed that though changes in the exchange rate are important in explaining changes in all three domestic prices: the effects appear to be subdued as compared with oil price shocks (see column 3 in Tables 4, 5 and 6). While the role of the exchange rate seems bigger in the producer price index, the effect on consumer prices is relatively muted. What is significant though is

the preeminent role played by supply shocks (due to changes from world oil prices) in the various domestic prices (see column 1 of Tables 4, 5 and 6).

Table 4

Variance Decomposition of Import Price Inflation

Period	Oil price	Output gap	Exchange rate	Interest rate	Money supply	Import Price	Producer Price	Consumer Price
1	1.62	0.14	0.16	0.21	0.37	97.49	0.00	0.00
3	27.60	1.51	8.87	0.56	1.97	54.64	4.63	0.21
6	25.24	3.52	9.76	0.56	2.56	50.14	7.17	1.05
12	24.89	4.07	9.91	0.67	2.76	49.34	7.29	1.07
24	24.91	4.07	9.93	0.68	2.76	49.26	7.31	1.08

Table 5

Variance Decomposition of PPI Inflation

Period	Oil price	Output gap	Exchange rate	Interest rate	Money supply	Import Price	Producer Price	Consumer Price
1	7.67	0.12	0.10	0.00	0.92	1.01	90.18	0.00
3	18.85	1.95	11.88	0.03	0.94	8.40	55.58	2.38
6	18.69	2.72	13.05	0.19	1.09	9.83	51.71	2.71
12	18.51	3.22	13.17	0.28	1.27	9.85	50.99	2.70
24	18.54	3.22	13.18	0.28	1.27	9.86	50.94	2.70

Table 6

Variance Decomposition of CPI Inflation

Period	Oil price	Output gap	Exchange rate	Interest rate	Money supply	Import Price	Producer Price	Consumer Price
1	4.36	0.43	3.62	2.95	0.00	1.68	3.23	83.72
3	8.03	0.71	5.12	8.77	2.34	1.79	5.49	67.75
6	8.76	0.75	7.50	8.28	2.21	3.18	6.03	63.49
12	9.08	0.94	7.94	8.08	2.21	3.37	6.35	62.01
24	9.08	0.95	7.95	8.08	2.21	3.37	6.36	61.97

It is worth noting the importance of short-term interest rate in explaining variations in the CPI. Interestingly, the impact of interest rate changes more than doubles after 3 months as the share of the variance decomposition increases from 3 per cent to almost 9 per cent. The demand shocks from the output gap play a modest role in explaining variations in each of the domestic prices (see columns 5 to 7 in Tables 4, 5 and 6). In sum, it may be argued that while exchange rate pass-through to domestic prices is significant but small, oil price shocks have a bigger role for explaining variation in all domestic prices.

6. Conclusions

This paper sought to investigate the exchange rate pass-through to domestic prices including CPI, with the aid of innovation accounting techniques within the framework of an unrestricted VAR that incorporates a distribution chain. The findings provide evidence of a link between external factors and consumer price inflation. Nonetheless, as far as the effect of exchange rate shocks is concerned the impact on consumer price inflation, a major focus of monetary policy, is very modest. That notwithstanding some other insights is obtained. For instance, the effect of oil price shocks seems to be more pronounced at each domestic price level, to the extent that it is even at par with short-term interest rates in explaining fluctuations in the consumer price inflation. While the pass-through coefficient for consumer price inflation (12.5 per cent after 24 months) is not very different from the figure of 12.3 per cent obtained by Bhundia (2002), there are stark differences between the values for the PPI. We had 19 per cent against Bhundia's 72 per cent, suggesting that the pass-through to PPI has reduced considerably over the years, particularly over a period of relatively low inflation. Now, given the closeness of the values between the PPI and CPI pass-through, it can be argued that favourable shocks to producer price inflation can have substantial moderating effect on CPI inflation and vice versa. Again, given the relatively low inflation regime of the period 2000-2009 and the associated low ERPT, it may be argued that the volatility of the rand does not pose any serious threat to inflation. It is therefore suggested that, the Reserve Bank focuses on price stability and not be unduly worried about the volatility of the rand.

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