CODERA ANALYTICS

Exchange rate pass-through in South Africa using a non-linear asymmetric cointegration approach

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1 Introduction[1]

A large proportion of the goods and services that South Africans consume are imported, so exchange rate changes play an important role in inflation dynamics and monetary policy decisions. Academic work shows that exchange rate pass-through tends to be incomplete (i.e. less than one-for-one) and asymmetric, differing depending on whether the currency appreciates and depreciates. Pass-through is usually found to be higher for tradable goods (such as fuel) and may be more delayed for goods and services with substantial domestic value added. We consider exchange rate pass-though to both headline inflation, that includes a large proportion of tradable goods and services, and core inflation, that strips some of these components out.

This note applies a non-linear cointegration approach to assess asymmetric exchange rate pass-through in South Africa. We find that it is important to control for pass-through asymmetry and that exchange rate depreciation tend to have a slightly stronger effect on inflation than appreciations for headline inflation.

2 Data and Empirical approach

This note uses a nonlinear dynamic framework that simultaneously models asymmetries in both the long-run relationship between consumer price inflation and its determinants and in the patterns of dynamic adjustment of the variables in the model. Specifically, we use the Nonlinear Autoregressive Distributed Lag (NARDL) framework of Shin, Yu, and Greenwood-Nimmo (2014) to estimate the asymmetric exchange rate pass-through to headline and core inflation in South Africa over the period January 2009 to March 2025.[2] This approach has several advantageous features that make it particularly suitable for analysing exchange rate pass-through. These include its ability to handle autocorrelation, weak endogeneity, and variables with mixed orders of integration. Moreover, it offers a simple approach for testing both the completeness and symmetry of pass-through.

We consider the impact on headline inflation, as well core inflation that excludes food, non-alcoholic beverages, fuel and energy. While one might expect a priori that exchange rate pass-through might be stronger for headline than core, electricity and food prices are not correlated with the exchange rate. The retail price of fuel in South Africa is, on the other hand, positively correlated with the USD/ZAR exchange rate, but the weight of fuel in the consumer price index (CPI) in South Africa is low, while retail fuel prices are also heavily impacted by governement-related and domestic costs (Horn et al. 2025).

We also consider other factors that affect consumer price outcomes. We include inflation expectations as this has a strong bearing on wage outcomes on South Africa (Horn et al. 2025) and therefore domestic price pressures. To control for global import price developments, we include import price inflation. We also consider models where we control for domestic demand pressures measured using the output gap.[3] We use a cubic spline to interpolate quar-

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[2] Code for the technique used is available from this Github repository.

[3] We construct a Hodrick-Prescott filter-based output gap, for more details see Codera's blog. In South Africa, a positive output gap—where actual economic output exceeds potential—typically leads to rising inflation as demand-driven pressures push up prices. This Codera blog post elaborates. All data sourced from SARB's Quar-

terly series to monthly frequency to maximise the number of data points as we have relatively short sample of core inflation from Stastistics South Africa (sourced via EconData).[4]

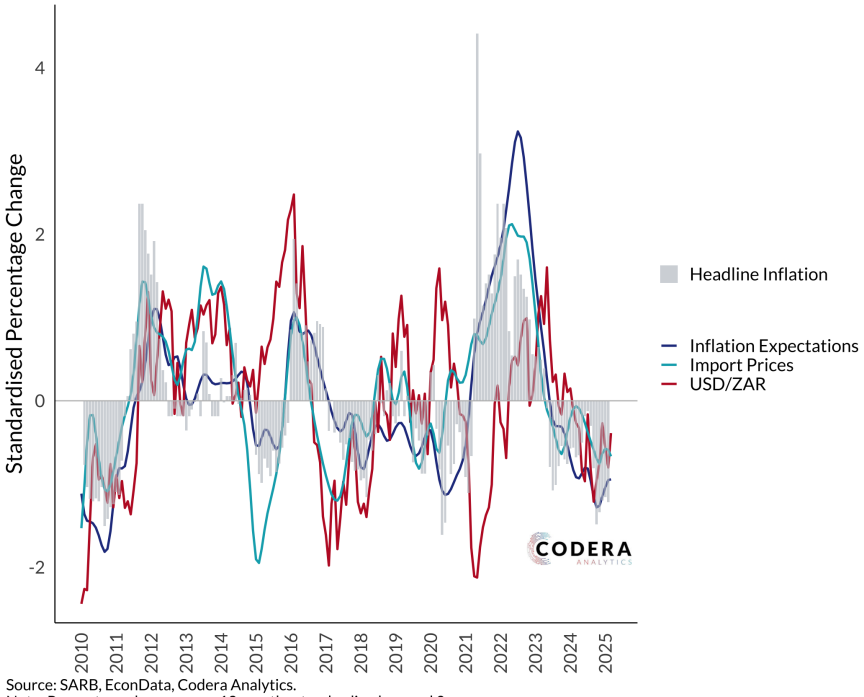
The estimated model is specified as:

$$\begin{aligned}\Delta i_t = \phi + \rho\, i_{t-1} + \theta^{+\prime} x^{+}_{t-1} + \theta^{-\prime} x^{-}_{t-1} \\ + \sum_{j=1}^{p-1} \gamma_j \Delta i_{t-j} + \sum_{j=0}^{q-1} \left(\pi^{+}_{j} \Delta x^{+}_{t-j} + \pi^{-}_{ipj} \Delta x^{-}_{t-j}\right) \\ + \alpha \boldsymbol{z_{t-1}} + \sum_{j=1}^{r-1} \psi \Delta \boldsymbol{z_{t-j}} + \epsilon_t\end{aligned}$$

where i_t denotes the inflation rate (either headline or core inflation), x_t is the USD/ZAR exchange rate, and $\boldsymbol{z_t}$ represents a vector of control variables, which includes inflation expectations, import prices, and the output gap. The maximum lag lengths are set to $p = q = r = 2$ on account of a short sample as we use the same sample for headline and core inflation.

Figures 1 and 2 plot headline and core inflation and selected determinants in standardised form to make their dynamics easier to compare. The post-pandemic spike in headline and core inflation (between 2021 and 2023), for example, occurred during a period of exchange rate depreciation, rising inflation expectations and higher import prices. Over this period there was very little domestic demand pressure on inflation.[5]

Figure 1:
Headline Inflation and selected determinants in South Africa



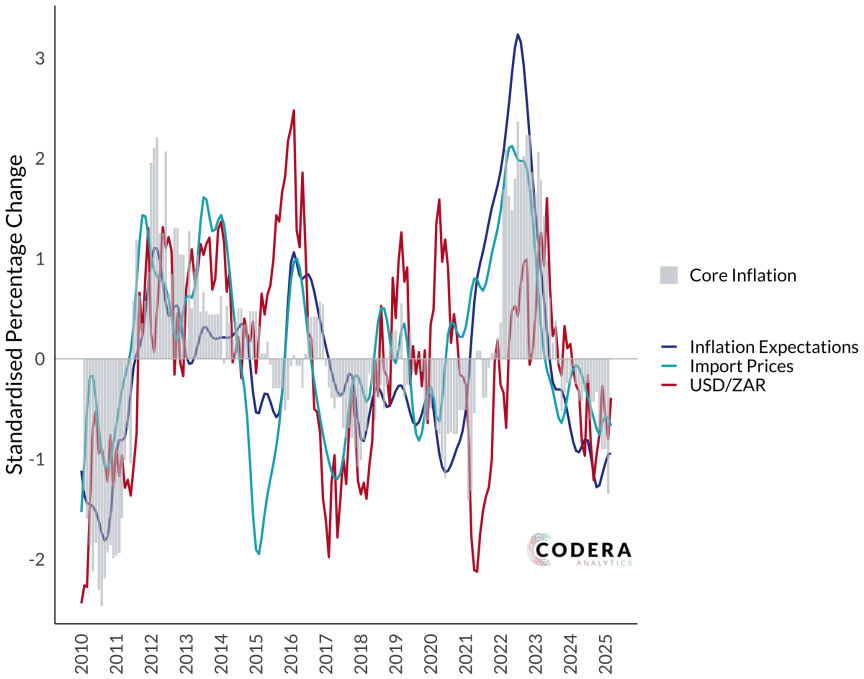
Source: SARB, EconData, Codera Analytics.
Note: Percentage changes over 12 months standardised around 0.

terly Bulletin and EconData.

[4]There are, of course, many other factors that could matter for exchange rate pass-through such as global commodity prices, transport costs (or supply chain disruptions), or domestic competition. As our focus is on a comparison between pass-though to core compared to headline inflation, we are constrained in the number of controls we can consider.

[5]See this Codera blog post.

Figure 2:
Core Inflation and selected determinants in South Africa



Source: SARB, EconData, Codera Analytics.
Note: Percentage changes over 12 months standardised around 0.

3 Estimation Results

The results confirm that there is a long-run cointegrating relationship between the variables (see Table 1). To assess whether the long-run pass-through of USD/ZAR changes to inflation are asymmetric, we conduct a Wald test for the null hypothesis $H_0 : \beta^+ - \beta^- = 0$, where the long-run coefficients are defined as $\beta^+ = -(\frac{\theta^+}{\rho})$ and $\beta^- = -(\frac{\theta^-}{\rho})$. The Wald test follows an asymptotic distribution (χ^2_1). For both headline and core inflation, the null of symmetry is rejected in models with control variables. However, in the models where only USD/ZAR is included (that is, without controls), the test fails to reject the null, indicating no significant difference between the effects of appreciation and depreciation. For core inflation, the evidence of asymmetry becomes stronger when basic controls are included, and even more pronounced when the output gap is added.

Table 1: Model Diagnostics

Cointegration and Asymmetry Tests	
TEST	P-VALUE
Headline and USD/ZAR only	
rho = 0	0.00
Wald Test	0.46
Headline and basic controls	
rho = 0	0.00
Wald Test	0.00
Headline and controls, incl output gap	
rho = 0	0.00
Wald Test	0.00
Core and USD/ZAR only	
rho = 0	0.00
Wald Test	0.40
Core and basic controls	
rho = 0	0.00
Wald Test	0.07
Core and controls, incl output gap	
rho = 0	0.00
Wald Test	0.03

3.1 Headline Inflation

Table 2 presents the estimated long-run exchange rate pass-through from USD/ZAR movements to both headline inflation in South Africa. Figures 3 to 5 also plot cumulative dynamic multipliers for each model specification.

When only the USD/ZAR exchange rate is included as an explanatory variable, a 10% appreciation of the rand is associated with a 1% reduction in headline inflation. This estimate, however, is statistically insignificant at 10% level. However, when controlling for import prices, inflation expectations, and the output gap, the statistical significance of the long run relationships increase and the estimated pass-through increases slightly to 0.11. The long-run implies a 1.1% reduction in inflation for a 10% appreciation.

For depreciation, a 10% weaker rand leads to a 0.1% increase in headline inflation when only USD/ZAR is included, which is insignificant. However, once controls are added, the pass-through rises to 0.12 (a 1.2% increase in inflation following a 10% depreciation), and becomes statistically significant at the 5% level.

Overall, our estimates are in the same ballpark as the SARB's most recent exchange rate pass-through estimates which average 10.8 percent since 2013 (11.5 percent in 2024Q4, SARB 2025).

Table 2: Long-Run USD/ZAR Pass-Through Estimates for Headline Inflation

Long-Run Estimates for Headline Inflation Cumulative 12-month USD/ZAR passthrough	
EFFECT	ESTIMATE
Basic controls, incl output gap	
Depreciation	0.12
Appreciation	−0.11
Basic controls	
Depreciation	0.09
Appreciation	−0.08
USD/ZAR only	
Depreciation	0.01
Appreciation	−0.10

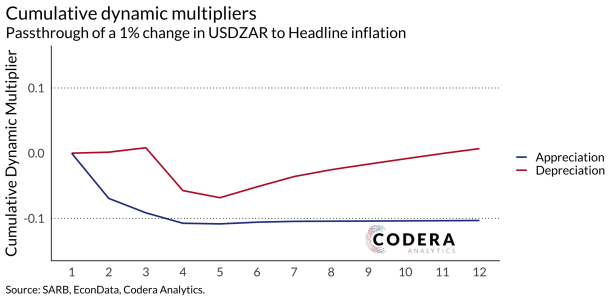


Figure 3: Headline Inflation and USD/ZAR

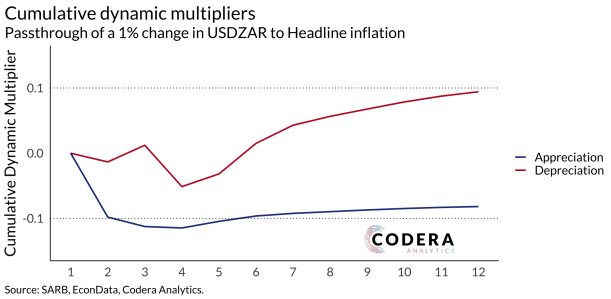


Figure 4: Headline Inflation and basic controls

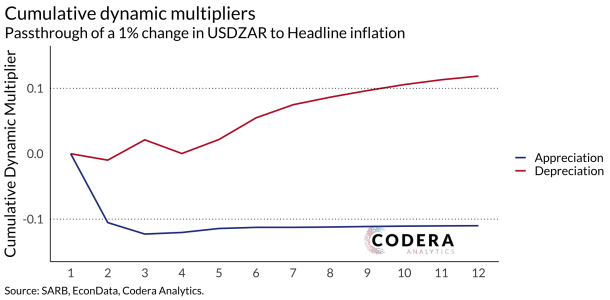


Figure 5: Headline Inflation and basic controls, incl output gap

3.2 Core Inflation

Table 3 presents the estimated long-run exchange rate pass-through from USD/ZAR movements to core inflation in South Africa. Figures 6 to 8 plot cumulative dynamic multipliers for each model specification.

The exchange rate pass-through to core inflation is found to be more pronounced than for headline inflation. With no additional controls, a 10% appreciation in USD/ZAR is associated with a 1.9% decline in core inflation (pass-through estimate of 0.19), though this estimate is also not statistically significant. However, once basic controls (import prices and inflation expectations) are introduced — and especially when the output gap is added — the estimated long-run pass-through increases to between 0.25 and 0.28, and becomes statistically significant at the 5% level. In the case of depreciation, the estimated pass-through to core inflation is smaller than the appreciation pass-through when only basic controls are included, but still statistically significant, and greater than the corresponding effect on headline inflation.

The results suggest that there is asymmetric pass-through for core inflation, with the inflationary effects of depreciation slightly weaker than the effects of appreciation. This is surprising as most research suggests that asymmetry tends to be skewed towards depreciations, as cost-push inflation pressures tend to be associated with a weaker currency. It is possible that our result may reflect limitations in our model specification, such as insufficient controls for domestically-determined pressures affecting core inflation, and short sample. Other possible explanations could be that controls are needed to capture changes in product market competition and mark-up dynamics.

Likewise, one would expect core inflation to respond more slowly to exchange rate changes than headline inflation, so it may seem counterintuitive that the estimated pass-through to

core inflation is found to be larger. There is, however, some precedent of higher core pass-through estimates than for headline in South Africa. Using a pre-pandemic sample, Miyajima (2019) obtains pass-through estimates of 12 percent for headline and 19 percent for core inflation for a sample between 2003 and mid-2018, with the core estimates falling if a sample from starting in 2005 is used.[6]

As argued in Horn et al. (2025), this core inflation measure, used by SARB for policy communication and forecasting in its main forecasting model, may not be a good measure of domestically-determined inflation pressures. This measure, for example, does not perform well at predicting future inflation dynamics and excludes several domestically-determined components. Alternative measures of underlying inflation may better capture non-tradable or domestically-driven inflation pressures.

Lastly, these estimates are likely affected by the relative volatility of headline inflation and the short sample period for which comparable data are available.

Table 3: Long-Run USD/ZAR Pass-Through Estimates for Core Inflation

Long-Run Estimates for Core Inflation

Cumulative 12-month USD/ZAR passthrough

EFFECT	ESTIMATE
Basic controls, incl output gap	
Depreciation	0.18
Appreciation	−0.28
Basic controls	
Depreciation	0.15
Appreciation	−0.25
USD/ZAR only	
Depreciation	0.12
Appreciation	−0.19

[6] Note that Miyajima (2019) uses the nominal effective exchange rate and controls that include unit labour costs, an HP-filtered output gap and foreign producer prices.

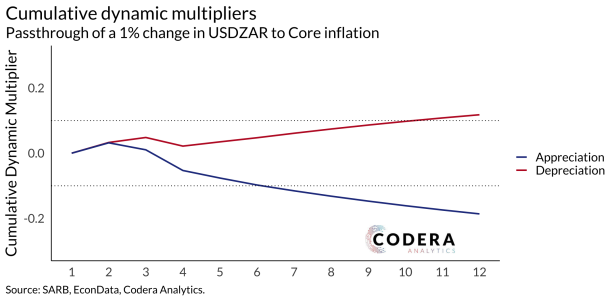


Figure 6: Core Inflation and USD/ZAR

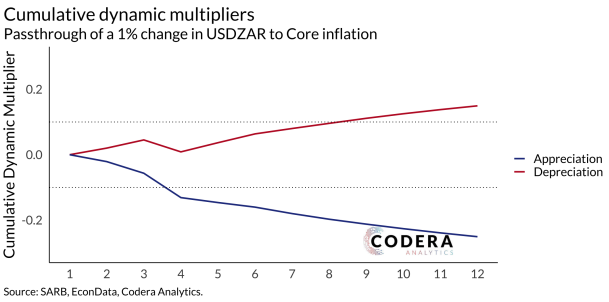


Figure 7: Core Inflation and basic controls

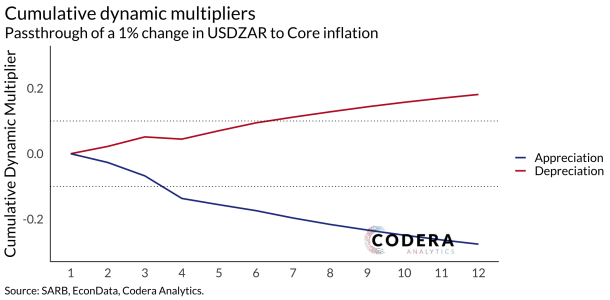


Figure 8: Core Inflation and basic controls, incl output gap

4 Conclusion

The extent to which changes in the exchange rate pass-through to prices is crucial in assessing the appropriate monetary policy stance. The SARB must understand how quickly and fully rand changes pass-through to inflation to appropriately set interest rates to achieve its inflation target. Overall, our pass-through estimates are in the same ballpark as the SARB's most recent exchange rate pass-through estimates. However, the asymmetries that we document could be considered to refine the calibration of models of monetary policy transmission.

There are a range of measurement choices requiring deeper robustness checks and also a range of potential extensions of this research, including extending the time series sample using alternative core inflation measures, including measures of market conditions that affect retailer margins, or considering the role of market power and price discrimination in international markets.[7]

[7] This Codera blog post suggests a potential option of an alternative core measure or this Codera policy paper.

References

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