Hysteresis without Hope: investigating unemployment persistence in South Africa

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31 May 2021

Hysteresis without Hope: Investigating Unemployment Persistence in South Africa

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May 2021

Abstract

This paper investigates hysteresis in South Africa's unemployment. First we test the presence of hysteresis in unemployment both by traditional stationarity tests and by using non-linear transformation methods to identify two further characteristics of hysteresis, namely remanence and selective memory. In the second part of the paper we estimate a simple insider-outsider model using a Bayesian VAR methodology to identify the shocks driving the unemployment dynamics. The main finding is that shocks to nominal wages and mark-up shocks as the main drivers of unemployment. Demand shocks do not play a dominant role. These results point to the difficulty of absorbing the current level of unemployment without significant positive shocks in market structure and wage setting behaviour. The strong hysteresis present in the data shows that this excessive level of unemployment can become "equilibrium": the South African labour market presents features of the worst kind of hysteresis, a hysteresis without "hope".

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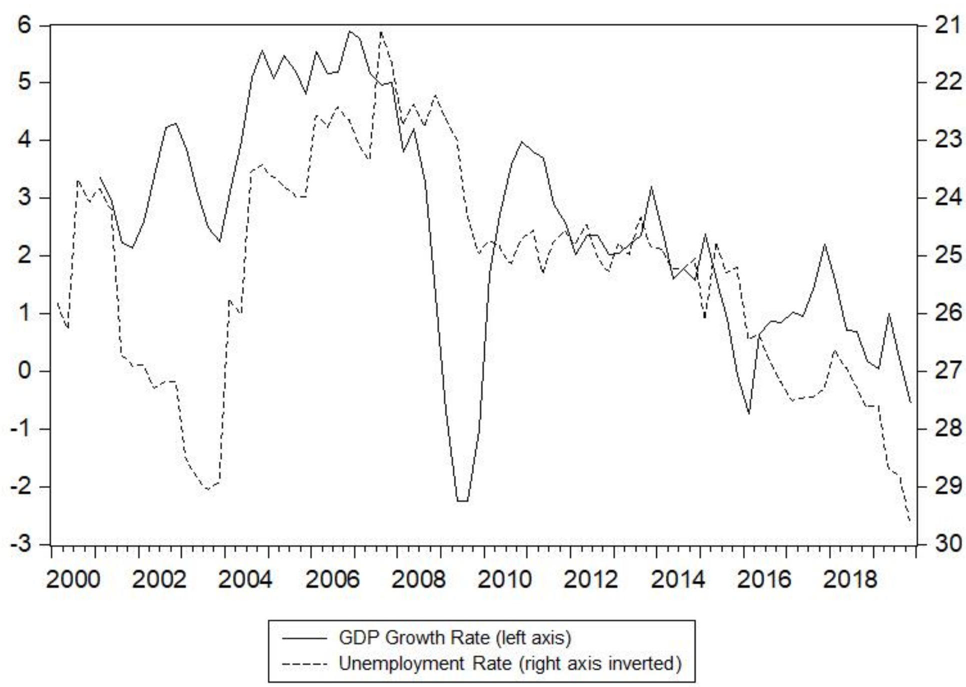
1 Introduction

Unemployment rate in South Africa has a specific dynamics: the rate has been on an upward trend for the last 10 years, going from 21.1% just before the global financial crisis at the end of 2007 to 29.6% just before the Covid-19 epidemic at the end of 2019. The pattern of unemployment follows quite closely that of GDP growth, in the 2000-2019 period. Figure 1 shows this correlation, especially after the global financial crisis when growth and unemployment enter on a negative trend. This paper studies these patterns and wants to shed some light on what is driving this double negative trends.

Figure 1: South Africa Unemployment - GDP Growth 2000-2019



The first objective of the paper is to identify if the data show the presence of hysteresis in South Africa unemployment. Hysteresis refers to the fact that a rise in the unemployment rate following a shock leads to an increase in the underlying equilibrium unemployment (O'Shaughnessy, 2011). This has fundamental implications for monetary policy because any subsequent increase in the demand of labour will generate inflationary wage and prices increases before unemployment returns to the pre-shock level. It has also implication for the model used for monetary policy as a Phillips curve specification of the relation between inflation and output gap would be wide off the mark.

Once we have determined that unemployment in South Africa is characterized by strong hysteresis, we use Bayesian VAR to identify what are the causes of this hysteresis. In particular we focus on three main determinants: shocks to nominal wages, following Blanchard and Summers (1987), shocks to mark-up by firms (Gambetti and Pistoresi, 2004) and shocks to the terms of trade through the exchange rate as a proxy for changes in costs of intermediate and investment goods affecting firms' decisions (Darby, Hallett, Ireland, and Piscitelli, 1999).

The idea of hysteresis in economics was introduced by Blanchard and Summers (1987) and has found new life after the global financial crisis to explain the persistence of economic stagnation when monetary policy is at the zero lower bound (Galí, 2015, 2020; Garga and Singh, 2021). This study follows the trend by applying the concept to the South African context. The rest of the paper is therefore set up as follows. Section 2 defines the hysteresis concept and tests for its evidence in the South African unemployment series. Section 3 is an investigation of the causes and consequences of hysteresis in unemployment in which a simple model of insiders-outsiders dynamics with hysteresis is set up. The model is later estimated using Bayesian VAR, with the results discussed in the same section. Section 4 concludes.

2 Hysteresis in unemployment: definition and evidence

The term hysteresis is widely used in economics to cover different concept of persistence in economic dynamics. For example, Galí (2020) interprets hysteresis as a long lasting deviation of unemployment from a "flexible wages" underlying natural rate of unemployment, while Garga and Singh (2021) interpret hysteresis as a permanent change in potential output, i.e. a unit root in the underlying equilibrium values. Both approaches try to mimic the unit root in unemployment or economic growth observed for many countries.

The first test for hysteresis is then a test of memory of the series, i.e. a simple unit root test. In Table 1 we report the results of Augmented Dickey-Fuller (ADF) and Phillips-Perron tests for unit root on the South African unemployment series. The tests cannot reject the hypothesis of a unit root at any confidence level, a result confirmed with any other unit root test available.

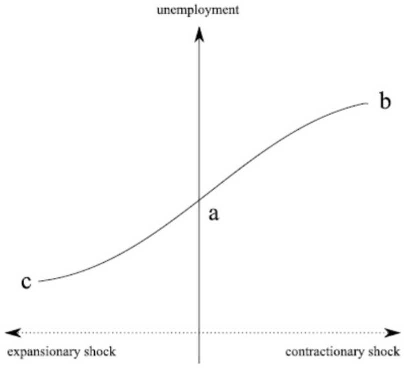
Table 1: Unit Root Tests on South Africa Unemployment 2000q1-2019q4

Null Hypothesis: Unemployment has a unit root	Adj. t-Stat	Prob.*
Augmented Dickey-Fuller test statistic	−1.384906	0.5856
Phillips-Perron test statistic	−1.457863	0.5497

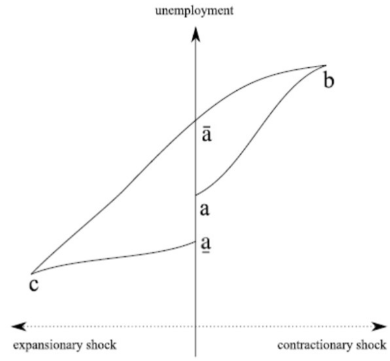
While this simple concept of hysteresis is widely applied in the literature, the term hysteresis is meant to describe systems that display not only *persistence* but also *remanence* (Cross, Grinfeld, and Lamba, 2009). Remanence implies that the application and the removal of a shock changes the equilibrium of the system. The system responds non-linearly to the application of the shock and it responds heterogeneously to shocks. In particular, the system has a "selective memory" of shocks, with some shocks having long lasting effects and some shocks being forgotten rapidly. We illustrate these properties in what follows.

First, in Figure 2 we compare what would be a typical dynamic response to a shock in a natural rate model vs a model with hysteresis. In panel (a) a contractionary shock moves unemployment from point a to point b: if the model is stationary, the shock is absorbed and unemployment goes back to point a after a certain time, depending on persistence. Expansionary and contractionary shocks will have the same dynamic effect except for a change in sign, from point a to point b.

Figure 2: Shocks and Unemployment in Natural Rate vs Hysteresis models



(a) Shocks in a Natural Rate Model

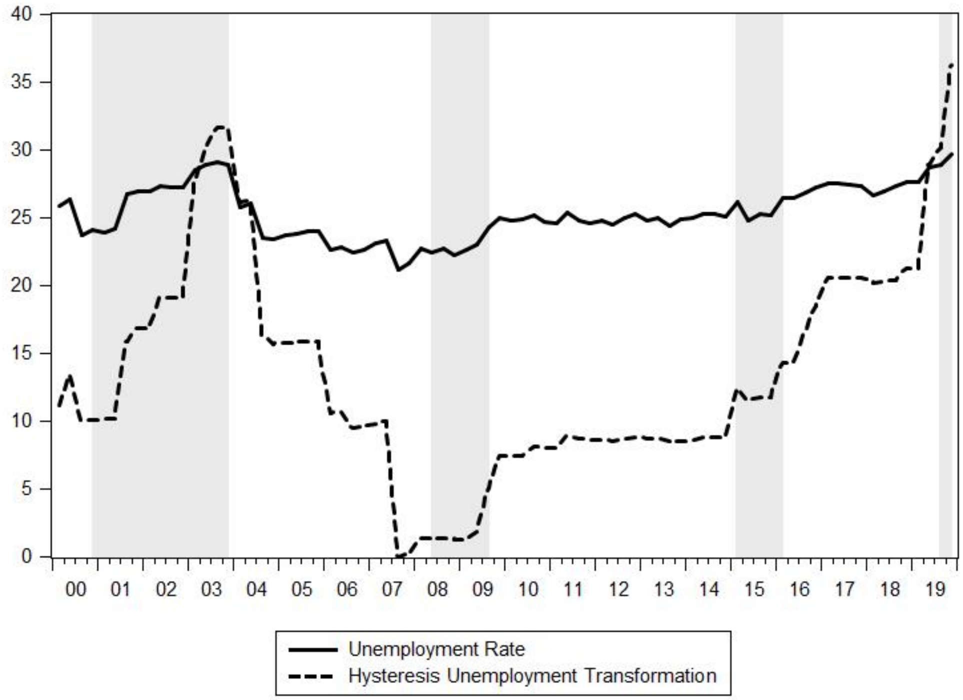


(b) Shocks with Hysteresis

Panel (b) instead shows the dynamics of unemployment in a hysteresis model. After the contractionary shock moving unemployment from a to b, the the shock has changed the fundamental properties of the system, so that the new attractor is going to be $\bar{a}$, with a permanent increase in the "equilibrium" unemployment. Notice that any shock can generate this dynamics: in particular, strong demand shocks will have a permanent effect as much as supply shocks.

Piscitelli, Cross, Grinfeld, and Lamba (2000) develop a test of strong hysteresis by identifying the dominant shocks in a series and calculating a non-linear transformation of the series where each shock is weighted for its degree of remanence. Figure 3 compares the actual unemployment series with the Piscitelli's hysteresis transformation, with the shaded area indicating the OECD South Africa recession indicator which is in fact well picked up by the index.

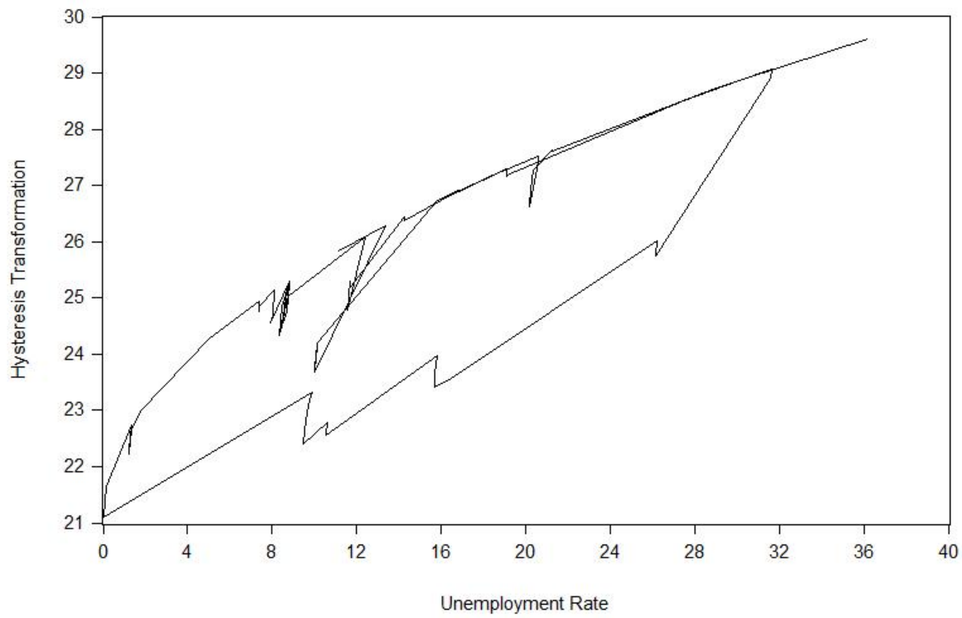
Figure 3: Unemployment rate and hysteresis transformation



The hysteresis transformation emphasizes shocks that are locally not dominated, so that the series remember selectively shocks that were relevant in changing the "equilibrium" unemployment rate. For example, the unemployment was certainly affected by the global financial crisis but it seems to pick up strongly after 2014, when the strong fiscal support after the global financial crisis reached its limits and the economy entered in the first post-crisis recession that has resulted in a continuous economic stagnation thereafter.

Another way to assess the hysteresis characteristics is through the "hysteresis loop" that the transformation creates. Figure 4 shows how unemployment dynamics is different when unemployment is increasing vs when unemployment is decreasing, with shocks increasing unemployment stronger and more persistent.

Figure 4: South Africa Unemployment Hysteresis Loop



A simple OLS test in Table 2 compares the performances of a autoregressive specification with the generated hysteresis index in explaining unemployment.

Table 2: Hysteresis Test

Variable	Coeff.	Prob.	Coeff.	Prob.
Unemployment Rate (-1)	0.927	0	0.483	0.00
GDP Growth	-0.116	0.02	-0.189	0.00
Inflation	0.079	0.03	0.137	0.00
Hysteresis Index	-	-	0.118	0.00
Constant	1.812	0.18	11.29	0.00
Adj. R-squared	0.865		0.922	

The result confirms that the hysteresis index captures a specific characteristics of the series that in a simple autoregressive specification is lost in a generic non-stationarity. The relevance of the hysteresis specification can be seen by comparing the forecasting performance of an autoregressive model of unemployment with or without the hysteresis index.

Figure 5: Out of sample forecasting of Unemployment Rate: 2018q1 - 2019q4

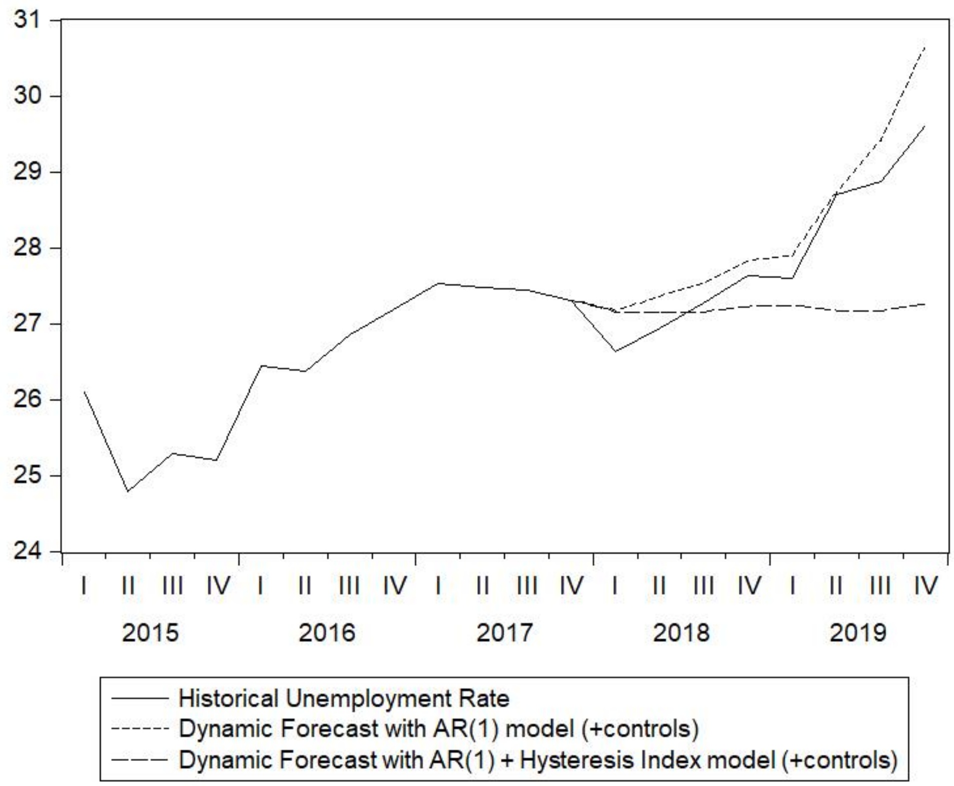


Figure 5 shows the out of sample forecasting of the unemployment rate using the model in Table 2 with or without the hysteresis index. The forecast of the simple autoregressive process simply follows a quasi random walk path, with the best forecast of expected unemployment equal to the current level of unemployment. Introducing the hysteresis index instead the model captures the continuing influence of the last strong negative shock in driving the future dynamic of unemployment.

Having confirmed the presence of hysteresis in the unemployment series for South Africa, we can now proceed with an empirical investigation of the causes and consequences of this evidence.

3 Hysteresis in unemployment: causes and consequences

3.1 The model

To shed some light on what is driving the unemployment dynamic in South Africa we use a framework developed by Maidorn (2003) and Gambetti and Pistoresi (2004) to analyse the dynamic of unemployment in Austria and Italy respectively. In particular, we consider a model where wage bargaining and productivity developments produces hysteresis in the labour and product market, with big shocks to nominal wages and productivity having long term effects on unemployment and GDP growth. We begin the model with a framework originally set up by Blanchard and Quah (1989). The model is then augmented to account for hysteresis. This allows us to define specific dynamics between the variables considered in this framework for the subsequent identification of various shocks. The model assumes imperfect competition in both product and labour markets *à* la Nickell (1988). Firms produce the same good, use the same technology and wages are uniform. They produce goods using a production function with constant returns to scale of the following form:

$$Y_t = A_t N_t \tag{1}$$

in which Y_t is the output, A_t is the labour augmented technology and N_t denotes the employment

The demand for produced goods in the economy is defined as:

$$Y_t = D_t^{\phi} \tag{2}$$

D_t denotes real aggregate demand and ϕ is the elasticity of demand.

Log linearising equations 1 and 2 yields the following:

$$y_t = n_t + a_t \tag{3}$$

$$y_t = \phi d_t \tag{4}$$

Prices are set up as a markup on the unit labour cost:

$$p_t = w_t - a_t + \mu_t \tag{5}$$

where w_t denotes the wage and μ_t is the representation of price shocks.

We move on to define the labour market component of the model. This follows the formalism first introduced by Dolado and Jimeno (1997). Therefore, the labour force evolves in log terms according to the following:

$$l_t = u_t + n_t \tag{6}$$

where l_t is the labour force and u_t denotes the unemployment. We may also define the labour force as follows:

$$l_t = \alpha(w_t - p_t) - bu_t + \tau_t \tag{7}$$

in which α and b are constant parameters, τ_t denotes a labour supply shift factor that captures changes in the participation rate and the population growth. τ_t follows a random walk in a manner similar to a_t, d_t and μ_t. As such, we may write:

$\Delta a_t = \epsilon_{st}$

$\Delta d_t = \epsilon_{dt}$

$\Delta \mu_t = \epsilon_{pt}$

$\Delta \tau_t = \epsilon_{lt}$

in which ϵ_{st}, ϵ_{dt} ϵ_{pt} and ϵ_{lt} are respectively i.i.d. uncorrelated aggregate productivity, demand and price shocks.

We assume an insider-outsider framework with hysteresis in which the targeted nominal wage w_t^* determines the actual nominal wage. In particular:

$$w_t = w_t^* + \epsilon_{wt} + \gamma_1 \epsilon_{dt} + \gamma_2 \epsilon_{pt} \tag{8}$$

$$w_t^* = arg \left\{ n_t^e = (1 - \lambda) n_{t-1} + \lambda l_{t-1} \right\} \tag{9}$$

where n_t^e is the expected employment which evolves according to the level of hysteresis prevailing in the economy, $\lambda \in [0, 1]$ denotes the hysteresis parameter, ϵ_{wt} is an i.i.d. shock to wages which also reflects the bargaining power of unions, γ_1 and γ_2 are constant parameters.

The current level of nominal wage is determined a period prior, which therefore suggests that the expected employment level is dependent on the previous period weighted average of the labour force (l_{t-1}) and employment (n_{t-1}). Two scenarios are considered in the determination of the nominal wage:

- If $0 < \lambda < 1$ The unions bargain a wage such that the expected employment level n_t^e is larger than the employment in the previous period n_{t-1}, therefore increasing the size of the workforce.

- If $\lambda = 0$, full hysteresis prevails in the economy. In this scenario, the segmentation of the labour market between insiders and outsiders emphasizes the dominant position of the former over the latter in the determination of the nominal wage. Simply put, the insiders decide the nominal wage that ensures their employability, with virtually no weight associated to the unemployed in the wage bargaining process. We assume full hysteresis in this framework in the resolution of the model.

Full hysteresis (i.e. $\lambda = 0$) suggests that the data shows no evidence of a rejection of the unit root hypothesis. This is confirmed in our investigation as evident from Table 1. We can therefore log linearise the equations and express the model as a moving average representation in first differences. This exercise assumes full hysteresis and the solved model is given by the following set of equations:

$$\Delta y_t = \phi \epsilon_{dt} \tag{10}$$

$$\Delta n_t = \phi \epsilon_{dt} - \epsilon_{st} \tag{11}$$

$$\Delta w_t = \gamma_1 \epsilon_{dt} + \epsilon_{wt} + \gamma_2 \epsilon_{pt} \tag{12}$$

$$\Delta p_t = \gamma_1 \epsilon_{dt} - \epsilon_{st} + \epsilon_{wt} + (1 + \gamma_2)\, \epsilon_{pt} \tag{13}$$

$$\Delta u_t = \frac{1}{1-b} \left[\phi \epsilon_{dt} + (1 + \alpha)\, \epsilon_{st} - \alpha \epsilon_{pt} + \epsilon_{lt} \right] \tag{14}$$

3.2 Data and Estimation

The data used for the estimation includes log of employment, real GDP, nominal wage, prices and unemployment. We cover the timeline between 2000Q1 to 2019Q4. Even though the data is available for the year 2020, we deliberately decided not to including those numbers due to the early effects of the Covid-19 pandemics on the South African economy which we did not wish to cover at this stage. Besides CPI and real GDP obtained from STATsSA, the source for the remaining variables is the South African Reserve Bank (SARB). Specifically, the data is from variables used in the Quarterly Projection Model (QPM), the SARB's main tool for forecast of macroeconomic variables and the interest rate setup. Although unemployment data is originally in a rate form, we statistically generate the equivalent level numbers.

We conduct the bayesian estimation using the BEAR (Bayesian Estimation, Analysis and Regression) toolbox on Matlab, which is a simple to use and very comprehensive tool for such an exercise. We decided to adopt a triangular factorization in this analysis. The Cholesky decomposition yields relatively similar results. We also experimented with different ordering of the variables in the estimation. The results reported are quite robust throughout with one or two exceptions which we deemed no intuitive.

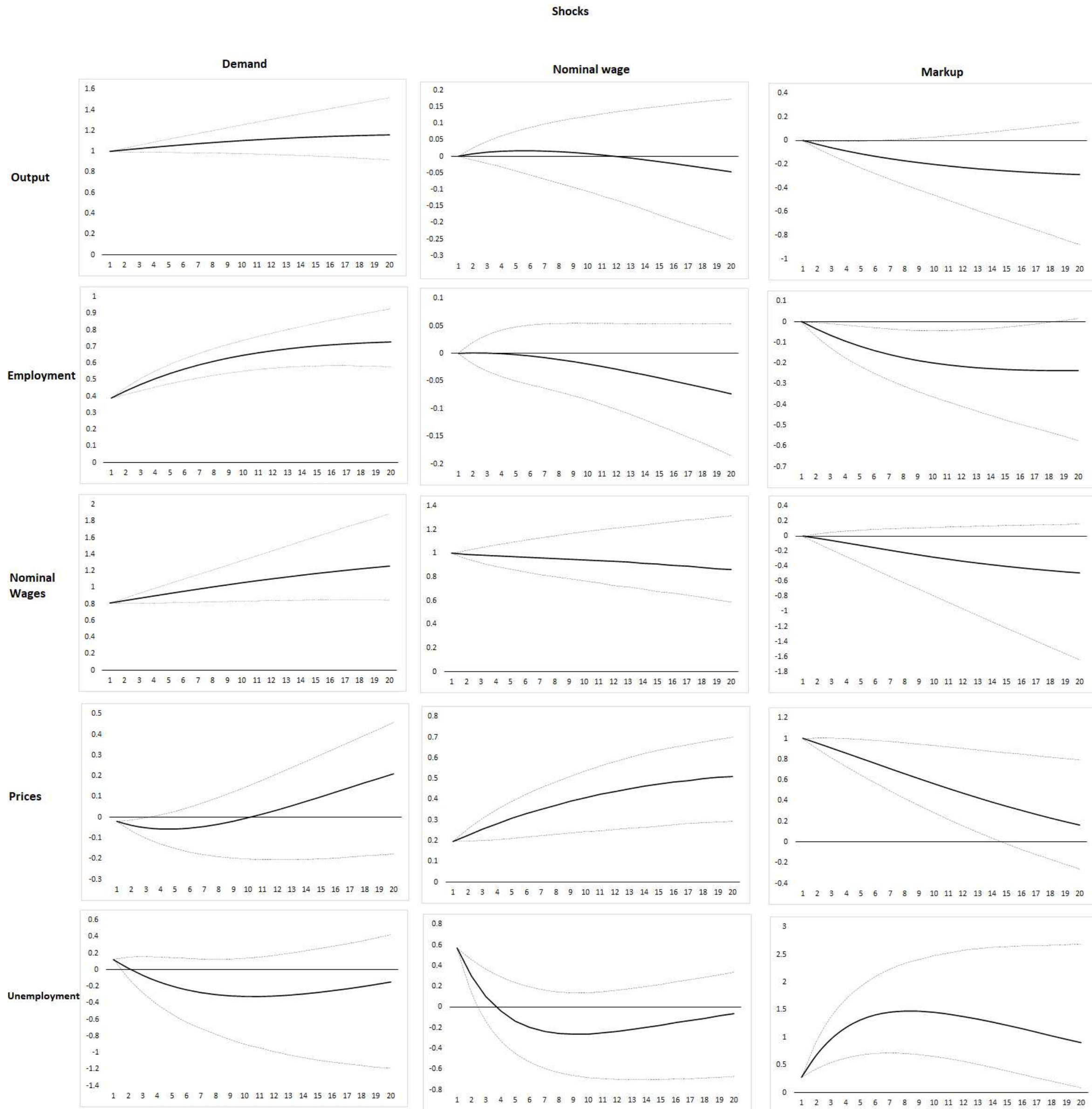
In our analysis, the aforementioned model represents the baseline framework that we estimate first before moving on to add various variables either as exogenous to the model or as endogenous components. The motivation behind this is simply to consider additional factors that may be influential to the response of core variables of the baseline framework. These 'outside' factors include the exchange rate, the terms of trade and crude oil price. We argue that the shocks emanating from these variables are the usual suspects in the South African context.

3.3 Estimation analysis

3.3.1 Baseline scenario

We begin with the baseline scenario with no exogenous shocks included. We report in this section the responses of the variables of interest only which include: output, nominal wages, price and unemployment. We consider demand, nominal wages, markup and labour shocks. Figure 6 reports such results.

Figure 6: Impulse Responses

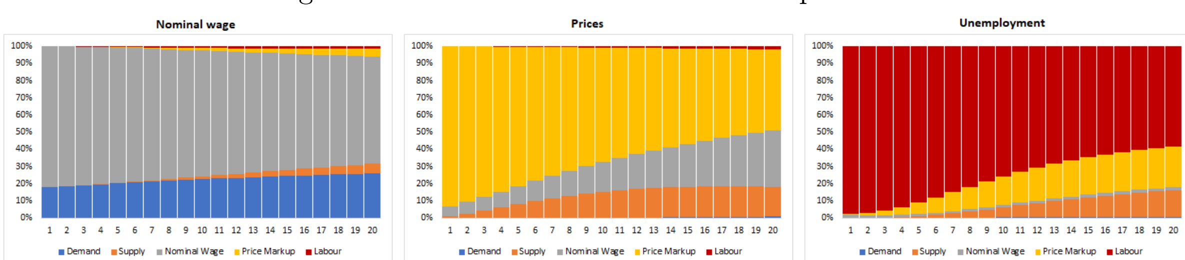


A demand shock increases output, employment and nominal wages with persistent effects. Although employment increases, there is no significant effects on unemployment. A tentative explanation lies in the increase in nominal wage that acts as a shock absorber. A demand shock expands the size of the labour force, and although employment rises, this does not necessarily translate into a decrease in unemployment simply because the insiders benefit from higher wages. This finding is even more peculiar when considering the response of the variables to a wage shock. An increase in nominal wages does not have a significant impact on output and employment. However, it persistently increases prices while unemployment rises on impact. Finally, a markup shock quasi permanently reduces employment and as a mirror effect, it raises unemployment with a long lasting impact.

These findings are in line with prior expectations and have been long debated in the South African literature. The structural nature of the unemployment is founded upon three main pillars: nominal wages, prices and employment. An increase in wages due to the high bargaining power of labour unions reduces the employable pool while keeping the insiders safe. As a response, firms pass on this increase to the workers through a raise in prices given firms' monopolistic structure in South Africa, inevitably translating into high and persistent unemployment. This hysteresis effects is further emphasized by the considerable skill gap prevailing in the labour market.

The forecast error variance decomposition (henceforth FEVD) consolidates these results. This exercise investigates the contributions of all considered shocks in this scenario to a one-step forecast error variance of each variables. We report the results in Figure 7 with a focus on nominal wage, prices and unemployment.

Figure 7: Forecast Error Variance Decomposition



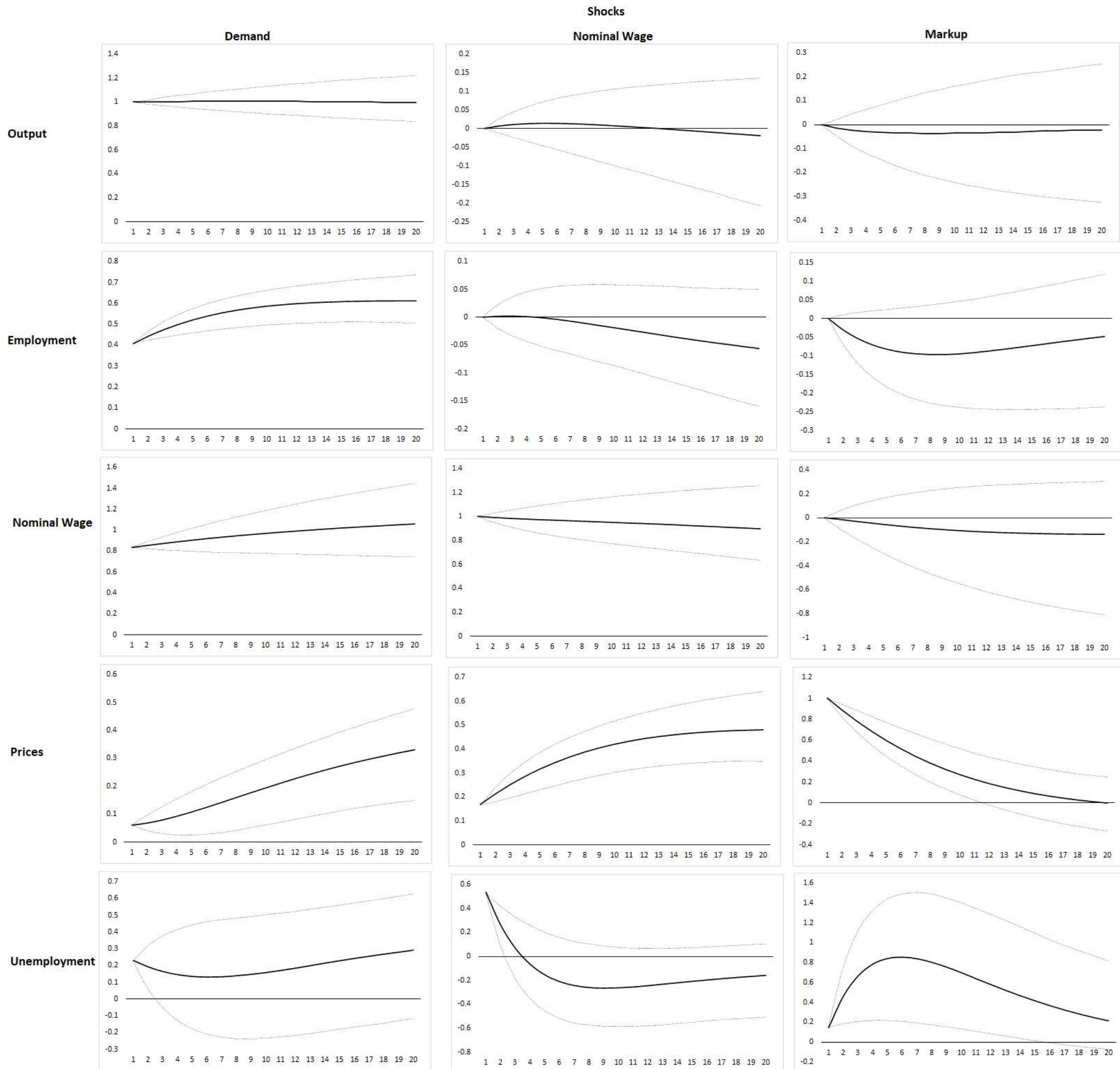
About 80 percent of nominal wage forecast error variance is explained by nominal wage shocks. They remain important in the foreseeable horizon. The only additional and significant contributor is the productivity shock but the impact is relatively low in comparison. This finding emphasizes the rigid nature of wages which is consistent with the South African literature. The FEVD for prices displays a different story. Markup shocks explain for more than 90 percent of forecast error variance. However, this percentage reduces significantly as the forecast horizon expands, with contributions from mainly nominal wage shock and productivity shock gaining in size. A similar observation is picked up for unemployment with markup shocks contributing more to its forecast error variance as the horizon increases. This finding confirms the strong network between nominal wage, prices and unemployment explains for the structural nature of the latter. The effects of an increase in nominal wage are transferred to prices which ultimately results in persistently high unemployment.

3.3.2 Experimental scenarios

In this section we experiment with different versions of the baseline framework. First we control for exogenous variables. Later on, these same variables will be endogenous to the framework which has the advantage of assessing their impact on the baseline scenario. This is mainly motivated by our wish to account for external shocks in our analysis and by the significance of those shocks to the South African economy. Additionally, our choices are also influenced by the robustness of these variables in estimating the historical decomposition of the core model[1]. We begin with the inclusion of the exchange rate as an exogenous. Fig 8 reports the impulse responses to a devaluation shock.

[1]The historical decomposition of the baseline framework is available in the Appendix

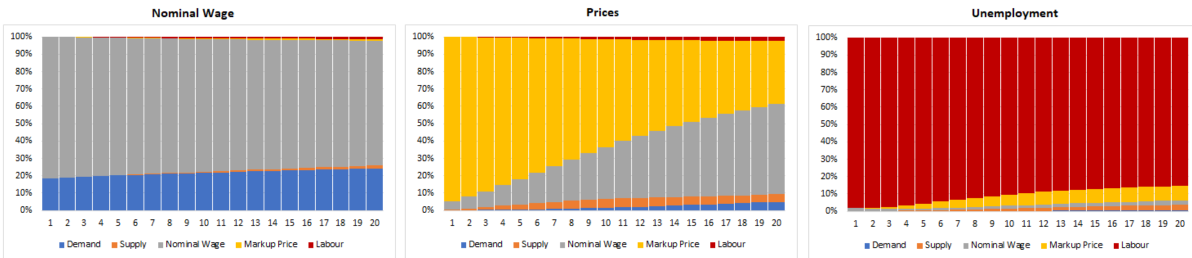
Figure 8: Impulse Responses - Exogenous: Exchange Rate



This scenario has the advantage of improving the estimation of the output gap in the historical decomposition[2]. This is achieved while keeping the findings in the baseline scenario fairly unchanged as shown in Fig 8 for the impulse responses and in Fig 9 for for the FEVD. Noticeably however, nominal wage shocks grow in bigger proportion in explain forecast error for prices while the effects of markup shocks in unemployment is relatively subdued compared to the baseline as the forecast horizon increases.

[2]See Appendix

Figure 9: Forecast Error Variance Decomposition - Exogenous: Exchange Rate



We find similar results when using oil price and exchange rate as exogenous variables and when we control for both oil price with the terms of trade. However, we couldn't find any conclusive results with the terms of trade as the single exogenous variable[3].

The next scenarios involve including the previously exogenous variables as endogenous to the framework. The findings can be summarized as follows:

- Similar to the baseline scenario, adding more endogenous variables without controlling for exogenous ones lead to a non-convincing estimation of the output gap in our opinion.

- Controlling for each exogenous variable or a combination of some in a six variables setup yields different results. Regardless of the extra exogenous variables, some results are robust. Therefore, a combination of oil price with terms of trade as exogenous to the model has results similar to the baseline when we focus to the link between nominal wages, prices and unemployment (i.e. nominal wage and markup shocks explain for the hysteresis effect on unemployment). However, combining oil price with the exchange rate subdues the long lasting effect of a markup shock on unemployment. It is important to highlight that when convergence occurs, it does so after a considerable amount of time has elapsed.

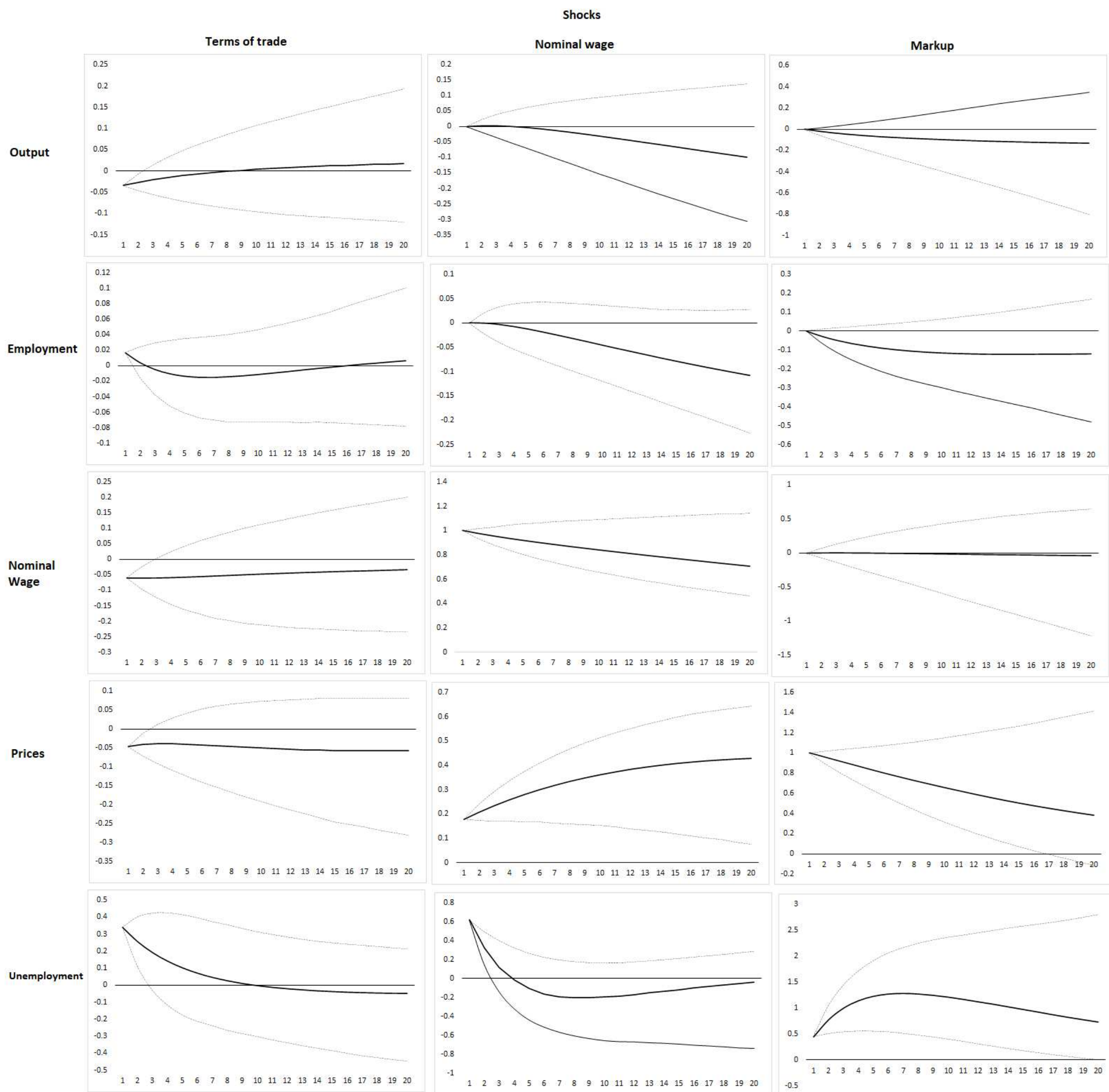
- The forecast error variance decomposition results remain robust throughout.

To illustrate the summarized findings, we report the case of the terms of trade added to the baseline framework as an endogenous variable. Crude oil price (Federal Reserve Bank of St Louis database) is used as an exogenous variable. We choose the terms of trade over the

[3]All results are available upon request

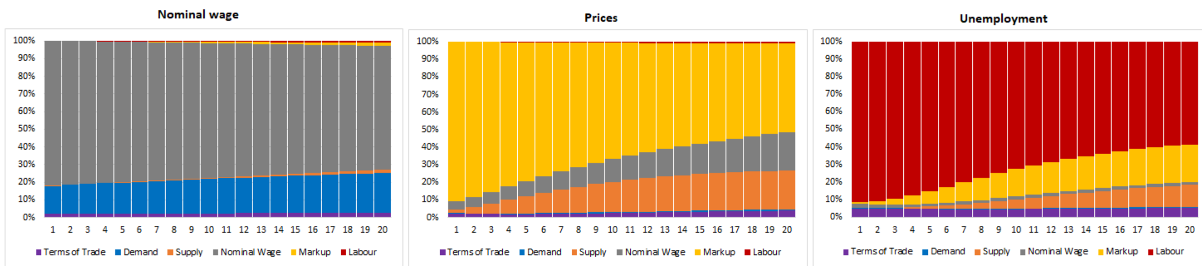
exchange rate based on two criterion: the marginal likelihood and the Deviance Information Criterion (DIC). Figure 10 reports the impulse responses.

Figure 10: Impulse Responses - Baseline with Terms of Trade



A terms of trade shock does not very significantly impact the variables except for an increase in unemployment that is however short lived. Nevertheless, the responses to nominal wage and markup remain barely unchanged from the findings the baseline framework. This robustness is confirmed with FEVD in Figure 11 with the only difference being the contribution of terms of trade shocks in explaining unemployment. However, it is worth noticing that the contribution of terms of trade shocks in unemployment forecast error remain constant over the forecast horizon.

Figure 11: Forecast Error Variance Decomposition - Baseline with Terms of Trade



It is therefore evident from this analysis that in the South African context there is a strong connectivity between nominal wages, prices and unemployment. This is exacerbated by the high bargaining power of workers combined with the significant skill gap in the labour market that tend to favour skilled insiders when the economy emerges from a recession, therefore keeping the unemployment consistently high. Considering the monopolistic structure of firms in the economy makes matters worse because of their constant ability in transferring the cost of increasing wages to workers through an increase in prices. The evidence of hysteresis in unemployment shows the importance of reassessing the context in which policy in general is conducted in South Africa, but particularly how forecast is dealt with. The forecast error variance decomposition shows consistent evidence of the importance of how the variables interact with each. Ignoring the strong network between nominal wage, inflation and unemployment is bound to yield bias forecast results which by ricochet will influence bias policy decision in the context of an inflation targeting regime. In short, ignoring the importance of these variables in the specification of the Phillips curve may yield flawed definition of the inflation target and that of the output gap. Although the findings of this analysis gives us a different view on the importance of understanding further the labour market and its complex interconnectivity with other prominent sectors in the functioning of the South African economy, it remains evident that our knowledge of the labour market at a macroeconomic level remains limited. Unemployment is a defining characteristic of the South African economy and as such, a further investigation of the matter is required.

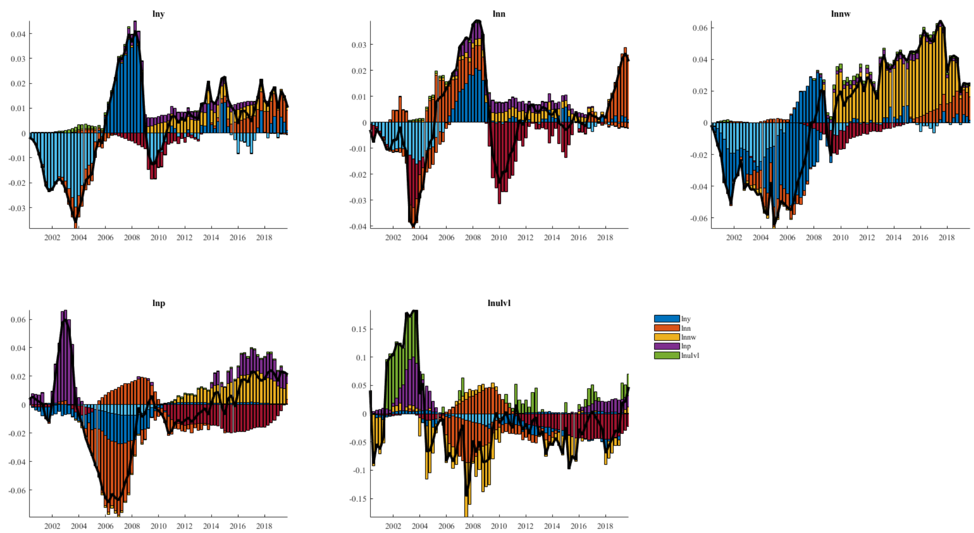
4 Conclusion

This paper investigates the presence of hysteresis in the South African labour market as an explanation of the structural unemployment prevailing in the economy. The uses a simple model of insider-outsider dynamics with hysteresis, which is later estimated using Bayesian VAR. The model assumes full hysteresis, an assumption we could only make if the unemployment rate series showed evidence of a unit root. We find it to be the case for South Africa. Additionally, the baseline scenario shows that an increase nominal wage has permanent inflationary effects, while a price markup shock induces a long lasting effect on unemployment. These results associated with a relatively non responsive employment to shock indicate the main culprit in explaining high persistent unemployment in South Africa. The findings are consolidated by the forecast error variance decomposition in which nominal wages shocks contributes significantly in explaining inflation forecast errors, and markup shocks become prominent contributors to unemployment forecast errors as the horizon increases. This is robust when controlling for additional exogenous and endogenous variables. Our results are in line with the literature that explains persistence in unemployment after an adverse shock through the linkages between nominal wages and prices. Specifically, workers benefiting from an increase in nominal wages via the bargaining power of labour unions, bear the inflationary cost transfer to them by firms operating in a monopolistic environment. This has important implications for the conduct of monetary policy in South Africa. Particularly, a specification of the Phillips curve that ignore the network link nominal wages and prices to unemployment is bound to yield flawed or simply biased results.

Appendix

Historical decomposition

Figure 12: Baseline



lny: Demand shock, lnn: Supply shock, lnnw: Nominal wage shock, lnp: Markup shock, lnulvl: Labour shock. Any other colour represents variations in the data that exogenous and those not explained by the model.

Figure 13: Baseline with exogenous exchange rate

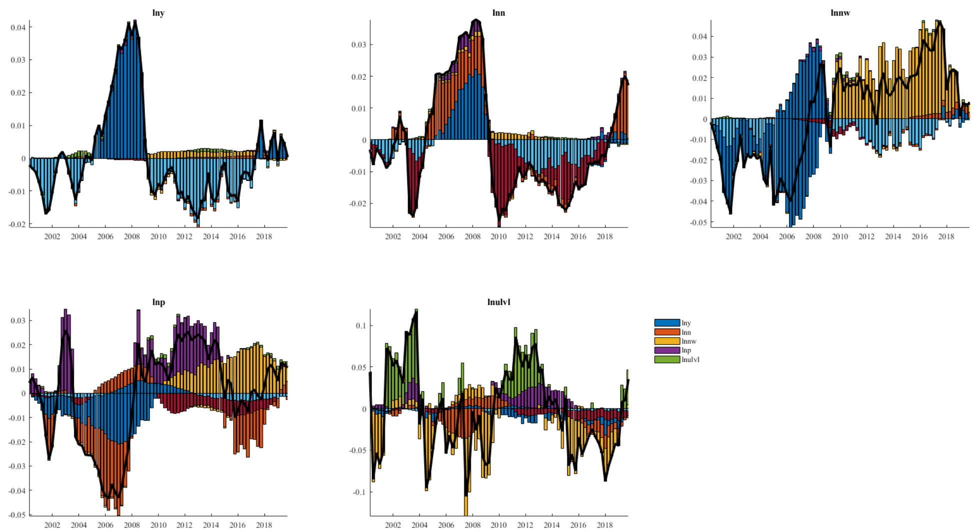
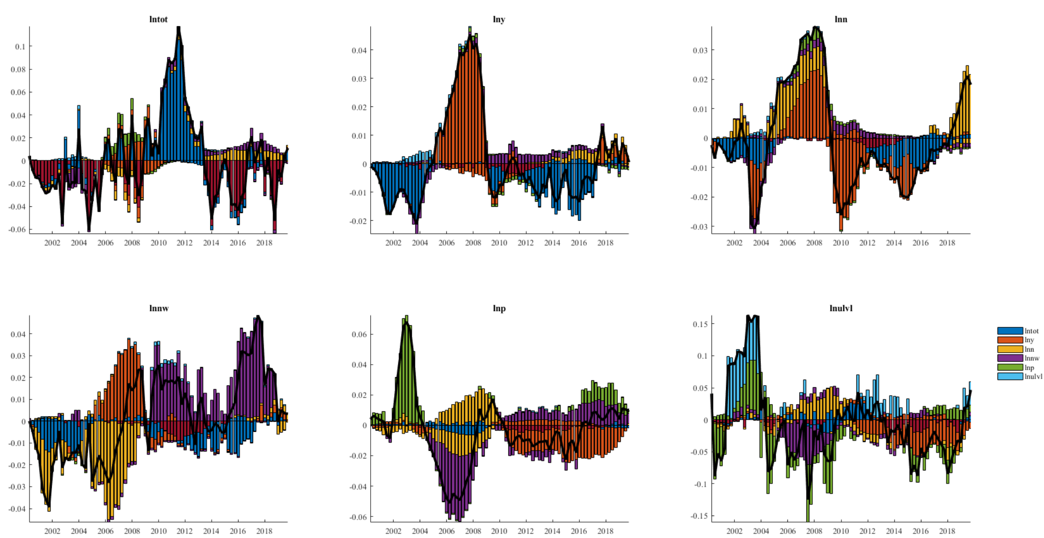


Figure 14: Baseline with endogenous terms of trade



lntot: Terms of trade shocks

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