University of Pretoria
Department of Economics Working Paper Series

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Working Paper: 2010-29
December 2010

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THE LONG-RUN IMPACT OF INFLATION IN SOUTH AFRICA[•]

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November 2010

ABSTRACT

This paper evaluates the hypothesis of long-run super-neutrality of money (LRSN) within the context of the South African economy. The long-run impact of inflation on the interest rate and subsequently, output is estimated by employing a trivariate structural vector autoregression model. The estimation results suggest that the hypothesis of LRSN cannot be rejected, thereby potentially supporting the arguments asserted by Sidrauski (1967).

JEL Classification: E5, E31

Keywords: money neutrality; structural vector autoregression

[•] The authors are grateful for the assistance received from Professor Mehmet Balcilar. However, any errors are solely ours.

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1. Introduction

The evaluation of the economic impact of inflation essentially examines the hypothesis of long-run super-monetary neutrality (LRSN), a hypothesis with broad support amongst many macroeconomists. The formal definition of LRSN indicates that a permanent change in the growth rate of money supply will exert no effect on the long-run level of real output or in fact any other real variable (Rahman and Toyoda, 2009) implying that exogenous permanent changes in the money growth rate will only have nominal effects as is postulated by elementary macroeconomic theory. Whilst this paper is not testing for the long-run neutrality of money (LRN), it is useful to note that this concerns a change in the level of money supply, rather than the growth rate, having no impact on real variables within the economy. Such theoretical foundations are aligned with the conventional monetarist hypothesis in which money is taken to have no real effects in the long-run (Friedman, 1969). The relationship between permanent changes in inflation, the interest rate and subsequently output can be theoretically analysed within the realm of three schools of thought.

The first school of thought stems from Sidrauski (1967) and is also aligned to the conventional monetarist hypothesis suggesting that there exists no long-run effect between permanent changes in inflation and real variables within the economy. The second effect hypothesises a positive relationship between permanent changes in inflation and real output and is generally referred to as the Tobin (1965) effect. The final theory postulated arises from studies that have found a negative relationship between permanent changes in inflation and growth, or output, and is commonly referred to as the anti-Tobin effect, rooted in the ideas of Stockman (1981) and others who have explored LRSN within the context of the cash-in-advance (CIA) and the money-in-utility (MIU) models[1].

The findings imply that for countries in which the proposition of long-run super-neutrality of money did not hold, output could be increased by a growth rate of monetary injections into the economy. On the other hand, for countries in which money is super-neutral in the long-run, this implies that increases in the money growth rate only increase the inflation level in the economy. The effectiveness of MP is thus dependent upon policymakers having a clear understanding of the relationship between money and real variables within the economy (Puah, Muzafar and Shazali, 2008). For example, the Tobin (1965) model suggests that increases in inflation will lead to increases in output; this would imply that countries experiencing hyperinflation should experience exponential increases in their output levels; empirically this has not been the case. Hence, attempting to understand the relationship between money growth and

[1] This effect can be rationalised by the assumption made, within in these models, in which money is complementary to capital (Faria and Carneiro, 2001; Stockman (1981)).

real variables within the economy is imperative as there are indeed policy implications with regard to this relationship.

The analysis under study, as mentioned, is important within the context of the estimation of policy effectiveness. The model employed is able to capture, and therefore isolate, the impact of a shock in the system upon other variables within the system. In the case of this paper, this amounts to capturing the effect of a permanent exogenous inflation shock on the interest rate and real output. Following Rapach (2003), this paper examines the long-run effect of inflation in South Africa over the period of 1960 to 2009, within the context of a contentious MP framework. A trivariate structural vector autoregression model (SVAR) is employed in order to determine the long-run impact of inflation in South Africa. Lucas (1972) has pointed out that such a test can be validly evaluated through a vector autoregression model (VAR)[2].

The literature on LRSN in developed countries is quite vast (Tobin 1965, Sidrauski 1967, King and Watson 1997, Geweke 1986, Danthine and Smith (1987), Carmichael 1982), however, for developing countries the literature is limited (Wallace 2004, Sanchez-Fung, 2010). In general, studies on LRSN have been analysed using different approaches and have included real output, the nominal interest rate and the inflation rate. The results have varied based on the methodologies employed.

Results from developed country studies are ambiguous. Fisher and Seater (1993) use a bivariate log-linear ARIMA framework in examining LRSN, placing emphasis on the importance of the order of integration between money, real output and nominal interest rate. The authors find evidence against LRSN. Geweke (1986) tests the proposition of LRSN in the USA using annual and monthly data in a time series analysis. The results provide support for LRSN with respect to output. Rapach (2003) models LRSN in fourteen industrialised countries using the inflation rate, the nominal interest rate and the real output level using a structural VAR (SVAR) model. The results suggest that the hypothesis of LRSN does not hold for the fourteen industrialised countries.

Danthine *et al* (1987) analyse Sidrauski's (1967) superneutrality hypothesis under a stochastic dynamic macroeconomic framework. They incorporate uncertainty into the model arguing that an economy is continuously moving towards a steady state that cannot be achieved, and therefore an analysis of LRSN under uncertainty provides for a more in-depth analysis. The results indicate a rejection of Sidrauski's (1967) hypothesis when uncertainty is incorporated into the model, implying that growth in money supply does not affect output but only yields a change in equilibrium price.

From the handful of LRSN investigations on developing countries, the results are also ambiguous. Wallace and Shelly (2004) examine LRSN in both an aggregate and disaggregated sectoral

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[2] For this purpose of this study, a VAR model is utilised as a result of the feedback effects presumed to be present between the three variables under study.

model for Nicaragua following the Fisher-Seater (1993) methodology .The results indicate rejection of the hypothesis of LRSN both when output is aggregated and disaggregated. Wallace and Shelly (2007) examine LRSN in Mexico and conclude that the hypothesis of LRSN cannot be rejected. Sanchez-Fung (2010) tests the hypothesis of LRSN in the Dominican Republic using a cointegration approach. The author finds evidence of superneutrality of money with respect to real output.

While the study by Rapach (2003) suggests that LRSN holds for industrialised countries, studies from developing and developed countries alike indicate that the long run impact of inflation is country specific and inextricably depends on the methodology used.

The estimation results suggest that the hypothesis of LRSN cannot be rejected for the South Africa economy. Whilst there does exist evidence of non-super-monetary neutralities within the South African economy, these effects are not statistically significant as suggested by the estimation results. Within the literature, LRSN for industrialised countries is generally rejected (for example, see Atesoglu and Emerson, 2009; Rahman and Toyoda, 2008; Rapach, 2003). Rapach (2003) indicates that the results could potentially be very different for countries that have experienced high levels of inflation as Rapach's (2003) sample includes only industrialised economies, for which inflation has been relatively low. This paper is organised as follows: Section 2 describes the SVAR model used to analyse the relationship under study. Section 3 provides the data description with respect to the measures used for the inflation rate, the interest rate and real output and discusses the estimation results and robustness checks for the long-run impact of inflation on the South African economy and Section 4 concludes.

2. Empirical Methodology

Following Rapach (2003), this study exploits the impulse response functions using a structural vector-autoregressive (VAR) analysis. Structural VAR provides a convenient and powerful framework for policy analysis. This approach appears to be attractive to policy makers in that it provides a dynamic analysis of economic data based on the impulse response functions, which indicates the impact of any variable on other variables in the system. An impulse response function captures the time profile of the effect of shocks at a given point in time on the expected future values of variables in a dynamic system (Pearson and Shin, 1997). It is therefore, an essential tool in empirical causal analysis as well as allowing for the assessment of policy effectiveness. Consider the trivariate structural VAR model in inflation (INF), the interest rate (R) and output (GDP). Assuming that each variable has a single unit root leads to the following covariance–stationary vector process.

$$B\Delta y_t = A(L)\Delta Y_{t-1} + u_t \quad (1)$$

In the above equation, y_t denotes the vector of jointly determined endogenous variables; B is a 3x3 invertible matrix; $A(L)$ is a 3x3 matrix polynomial in the lag operator; Δ is the difference operator and $u_t = (u_{1t}, u_{2t}, u_{3t})$ is the vector of residuals (white-noise). This representation takes the following reduced-form, which is simpler for estimation purposes:

$$\Delta y_t = \phi(L)\Delta y_{t-1} + \varepsilon_t \qquad (2)$$

Where $\phi(L) = B^{-1}A(L)$ and $\varepsilon_t = B^{-1}u_t$.

Let $E(\varepsilon_t \varepsilon_t') = \sum_{\varepsilon}$ and $E(u_t u_t') = \sum_u$ be the variance-covariance matrices of the structural disturbances and the VAR disturbances, respectively.

Since $\varepsilon_t = B^{-1}u_t$,

$$\sum_{\varepsilon} = B^{-1} \sum_u B^{-1\prime} \qquad (3)$$

To make structural inferences from the data, the structural disturbances and hence B^{-1} must be identified. In other words, sufficient restrictions need to be provided in order to identify the structural shocks (u_t) from the reduced-form shocks (ε_t) and their variance ($\sum_{\varepsilon}$). The key assumption is that structural disturbances are contemporaneously uncorrelated (that is, $\sum_{\varepsilon}$ is diagonal (Rapach, 2003). From the infinite moving average representation of equation (2), that is

$$\Delta y_t = C(L)\varepsilon_t \qquad (4)$$

Blanchard and Quah (1989) show that the infinite-horizon response to the vector of structural disturbances can be given as follows:

$$\lim_{s \to \infty} y_{t+s} = C\varepsilon_t \qquad (5)$$

Where $C = \left[I - \phi(1)\right]^{-1} B^{-1}$

Thus, $B^{-1} = [I - \phi(1)]C$, implying that the matrix of long run effects of the reduced-form shocks, that is, $C(1)$, is related to the equivalent matrix of structural shocks. $C(1)$ is calculated from the estimated VAR.

Substituting B^{-1} into equation (3) yields:

$$[I - \phi(1)]^{-1} \sum_{\varepsilon} [I - \phi(1)]^{-1'} = C \sum_{u} C' \quad (6)$$

Structural disturbances can therefore be separated from the reduced-form (VAR) disturbances allowing structural inferences to be made from the data. If the variables considered in this paper were cointegrated, this, in itself, would imply certain long-run restrictions. However, the cointegration tests presented in the results section suggest that cointegration is not present. Therefore, three identifying restrictions are imposed on $C(1)$ based on economic theory.

As in Blanchard and Quah (1989), the structural shocks are identified by assuming the following recursive equation:

$$\lim_{s\to\infty} \begin{pmatrix} INF_{t+s} \\ R_{t+s} \\ GDP_{t+s} \end{pmatrix} = \begin{pmatrix} c_{11} & 0 & 0 \\ c_{21} & c_{22} & 0 \\ c_{31} & c_{32} & c_{33} \end{pmatrix} \begin{pmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{pmatrix} \quad (7)$$

The coefficient c_{ij} captures the long run response of the i^{th} variable in y_t to a unit change in the j^{th} element of the vector of structural shocks, u_t .

The first structural shock u_{1t} is the inflation shock corresponding to central bank monetary policy. The second structural shock u_{2t} is the preference shock related to household preferences for present versus future consumption. The last structural shock u_{3t} represents the technology shock.

The first two restrictions ($c_{21} = 0$ and $c_{13} = 0$) are related to the second and third structural shocks. The implication of these restrictions is that long run inflation is only affected by its own shock. This is consistent with the monetarist hypothesis in which long run money growth and inflation rates are determined exogenously by the monetary authority. This implies that permanent changes in inflation arise solely from permanent changes in money growth. In other words, the central bank can still react to preference and technology shocks by adjusting the rate of money growth in the short-run.

The third restriction ($c_{23} = 0$) is derived from the assumption of the neoclassical growth model that a permanent shock to the level of technology leaves the long-run real interest rate unchanged. Rapach (2003) explains that a positive technology shock leads to an increase in real interest rate in the short-run since the marginal productivity of capital rises. However, this positive technology shock also decreases the marginal productivity of capital due to diminishing returns. In equilibrium, the two resulting opposing forces from the positive technology shock therefore disappear leaving the real interest rate unchanged. This restriction is invalid in endogenous growth models which assume that GDP is integrated in second order (GDP ~I(2)). However, the results of unit root test (see Table 2) suggest that GDP ~I(1); thereby invaliding the endogenous growth assumption.

Note that there is no restriction on the long-run nominal interest rate and real output responses to the preference shock, u_{2t} A preference shock, interpreted as a decrease in the saving rate, is expected to decrease the steady-state capital stock level and hence the real output level, as well as to increase the real interest rate. Also, because of the restriction on the long-run inflation rate response to a preference shock ($c_{12} = 0$), the real interest rate permanently increases by the same amount as the nominal interest rate in response to a preference shock.

Recall that the model assumes structural disturbances to be contemporaneously uncorrelated and the zero restrictions $c_{12} = c_{13} = c_{23} = 0$ are consistent with a Cholesky decomposition. Thus, only the lower triangular of the matrix in equation (7) remains, which allows for the identification of the following six long run multipliers: $c_{11}, c_{21}, c_{22}, c_{31}, c_{32}, c_{33}$ .The long-run interest rate and real output responses to an inflation shock are respectively $c_{21} - c_{11}$ and c_{31} . While the LRSN hypothesis suggests that $c_{21} - c_{11} = 0$ (which is also the Fisher effect) and $c_{13} = 0$. The Mundell-Tobin effect holds for $c_{21} - c_{11} < 0$ and $c_{31} > 0$.

As per Rapach (2003), the following two long-run derivatives can therefore be defined:

$$LRD_{R,INF} \equiv \lim_{K \to \infty} (\partial R_{t+k} / \partial u_{1t}) / (\partial INF_{t+k} / \partial u_{1t}) = c_{21} / c_{11} \tag{8}$$

and

$$LRD_{GDP,INF} \equiv \lim_{K \to \infty} (\partial GDP_{t+k} / \partial u_{1t}) / (\partial INF_{t+k} / \partial u_{1t}) = c_{31} / c_{11} \tag{9}$$

The LRSN conditions become $LRD_{R,INF} = 1$ and $LRD_{GDP,INF} = 0$ while the Mundell-Tobin effect changes to $LRD_{R,INF} < 1$ and $LRD_{GDP,INF} > 0$. The estimates of $LRD_{R,INF}$ and $LRD_{GDP,INF}$ are reported in the results section.

3. Estimation Results

This section begins with a description of the measures used for the variables employed within the analysis, that is the interest rate, the inflation rate and real output and then proceeds to discuss the results of the various unit root tests carried out in order to investigate the stationarity properties of the data. Section 3.3. discusses the results of the cointegration test conducted whilst section 3.4. is concerned with assessing as to whether there are any structural breaks contained within the data used. This paper then progresses onto analysing the estimation results of the impulse response functions generated by the SVAR and lastly, section 3.6. illustrates the sensitivity analysis of the model.

3.1. Data

This study uses South African quarterly data[3] for inflation, the interest rate and output from the period 1960 to 2009. The data are drawn from the International Monetary Fund's International Financial Statistics (IFS) and South Africa Reserve Bank (SARB). Inflation is measured as the rate of change of the Consumer Price Index (CPI) rather than the Gross Domestic Product (GDP) deflator. Within the context of a small open economy, CPI is a better indicator of inflation as it takes into account foreign inflation.

Given the relationship between inflation and output, an accurate measurement of output is also dependent on the measurement of inflation. A rise in the price level "inflates" the measurement of GDP growth, thereby miscalculating the real growth level of the economy. Therefore, a more meaningful measurement of the growth of output is real GDP. Furthermore, in order to account for risk-free government securities, the Treasury Bill Rate (TBR) is used as an approximation of the interest rate. The sampling period extends from the last quarter of 1960 to the fourth quarter of 2009 for interest rate and real output whilst for the CPI data, it begins from the last quarter of 1959 and extends to the first quarter of 2010.

[3] The estimation results were also conducted using annual data for the period 1960 to 2009. The VAR was, however, unstable. Therefore, this study uses quarterly data as all the roots of the VAR were found to be inside the unit circle indicating that the VAR was stable. The estimation results using annual data are available upon request.

3.2. Unit root test

The selected approach assumes the presence of a permanent (stochastic) component in the level of inflation, the interest rate and real output. Unit-root tests could not reject these assumptions. Table 1 reports the results of the Augmented Dickey-Fuller (ADF), DF-GLS and Phillips-Perron (PP) tests, all of which has the null hypothesis of non-stationarity. None of the tests can reject the non-stationarity at the 5% level for any of the series. The real GDP and the interest rate are consistent with the hypothesis that the process is I(1), while price level and the inflation rate are consistent with I(2) and I(1) hypotheses. The results in Table 1 suggest that the data are informative concerning the impact of permanent changes in inflation. Therefore, it is reasonable to carry an empirical investigation of the super-neutrality propositions predicated on integrated processes.

TABLE 1

Unit Root Test Results, Quarterly Data

	Intercept			Trend and intercept		
Variable	ADF	DF-GLS	PP	ADF	DF-GLS	PP
Inflation	-0.53	5.08	0.57	-1.74	-0.43	-2.04
Interest rate	-2.52	-1.79	-2.18	-2.91	-2.84	-2.29
Real output	-1.76	3.68	-1.64	-2.20	-0.99	-2.28

NOTE: The figures were compared with critical values at 5% level of significance.

It is also important to determine whether the variables of the VAR equation need to be detrended. Therefore, we run a VAR with a constant, a linear trend and the lag order of four, selected using the Akaike Information Criterion (AIC) by sequential testing for each variable, initially selecting a maximum lag length of eight. If the t-statistic corresponding to the trend is greater than 1.645 in absolute value, the variable should be detrended before entering the VAR. The results indicate that no detrending is necessary. The t-statistics of the trend are -1.162, -0.56 and -1.076 for the individual equations of inflation, the interest rate and real output respectively.

3.3. Cointegration test

As indicated King and Watson (1997), the results from models with unit root identifying restrictions must be interpreted with some caution. While unit root tests suggest that the variables are non-stationary in levels, it is still possible that a stationary linear combination of these levels can be found. If the variables in y_t are cointegrated, error-correction mechanisms are needed to properly estimate Equation (2). Mitchell (2000) asserts that the reduced rank VAR provides misleading inferences about the long run impulse response when the data are "nearly" cointegrated. So based on a stable VAR under the assumption of a linear determinist trend in the data with intercept and no trend in the cointegration equation, we test for cointegration using Johansen and Juselius (1990) approach. The results reported in Table 2 support no evidence of cointegration of the variables considered.

TABLE 2

Cointegration rank statistics: Sample: 1960Q1 to 2009Q4

	Maximum Eigenvalue		Trace	
	Statistic	Critical value (5%)	Statistic	Critical value (5%)
$H_0 : r_1 = 0$	13.24	21.13	23.29	29.79
$H_0 : r_2 = 1$	9.74	14.26	10.04	15.49
$H_0 : r_3 = 2$	0,30	3.84	0.30	3.84

3.4. Instability tests

To test the null hypothesis of no structural change in the parameters of the VAR equation, the SupF statistic of Andrews (1993) and the ExpF and AveF statistics of Andrews and Ploberger (1994) are used as well as the Cumulative sum of squares (CUSUM) test. In effect, CUSUM test has reasonable size and power properties when applied to dynamic models with finite samples (Rapach, 2003).Table 3 provides the p-value for each statistic, generated using the "fixed regressor bootstrap" procedure. As pointed out Hansen (2000), the p-values from the fixed regressor bootstrap procedure exhibit substantially better size properties for the SupF statistic than the p-values delivered by Andrews (1993). The trimming parameters allow for a break anywhere between 15% and 85% of the sample.

This range covers various shocks experienced by the economy, such as: the political uncertainties and unrest within the country due to apartheid, the subsequent economic sanctions, the decolonisation of potentially unstable border countries, the democratic transition that occurred in the early 1990s; the oil price shocks of 1973 and 1978; the impending exchange range interventions as a result of the dual exchange rate system pursued by the South African Reserve Bank (SARB), the collapse of the Bretton Woods system and the subsequent changes in monetary policy; the Rubicon speech and the imminent adoption of inflation targeting in 2000 by the SARB in order to increase the possibility of sustainable economic growth within South Africa (Du Plessis, Smit and Sturzenegger, 2008; Ludi and Ground, 2006)[4]. As indicated by the results reported in Table3, there is relatively little evidence of structural change barring the growth equation[5], where all the three tests agree. However, on using the CUSUM test, we find no evidence of structural break as indicated in Figure 1.

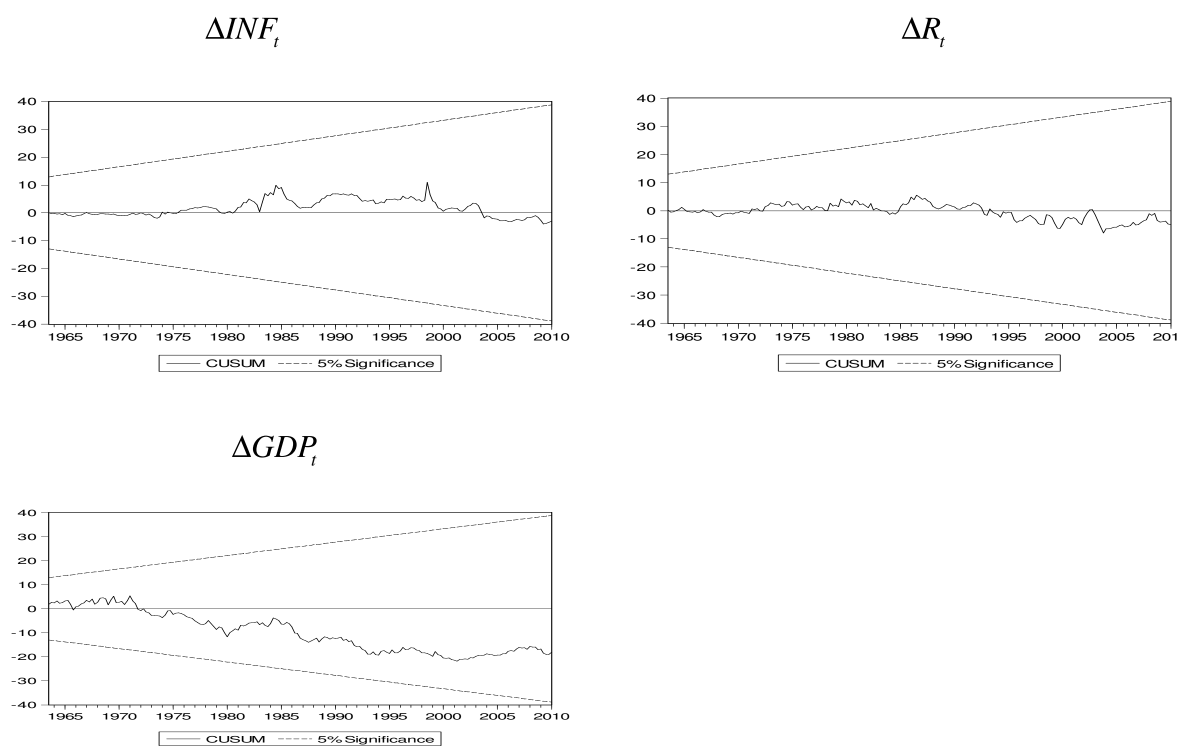
TABLE 3

Parameter Instability Tests

	ΔINF_t	ΔR_t	ΔGDP_t
SupF	0.957	0.088	0.006
ExpF	0.896	0.184	0.008
AveF	0.844	0.241	0.015

NOTE: The numbers are *p*-value for the three test statistics for the null hypothesis of stable parameters in the equation.

FIGURE 1: Cumulative sum of squares test for structural break



[4] For a more detailed discussion of these events and the resulting repercussions, see the authors cited as well as Strydom, 2000 and Stals, 1997.

[5] The break is identified in the third quarter of 1982, which, in turn, lies in between the abolishment of the fixed exchange rate and the financial rand. Note a dual exchange rate system was introduced to South Africa in 1979: the financial rand was a free-floating market-based currency for capital transactions, whilst the commercial rand was artificially held at higher levels to attract foreign investment.

3.5. Impulse responses

As in Rapach (2003), the impulse response bands are generated following the Monte Carlo bootstrap procedure. From the vector of VAR residuals, we construct 1000 new time series of residuals with the lag order chosen by the AIC. Pseudo-samples are then constructed using the VAR coefficients and the historical initial Δy_t values. For each of the 1000 pseudo-samples, the structural VAR is re-estimated. The $LRD_{R,INF}$ and $LRD_{GDP,INF}$ are therefore stored to create empirical distributions, which are then used to construct 90% confidence intervals. Note that the confidence bands are constructed following the modified percentile method described in Davidson and Mackinnon (1993).

TABLE 4

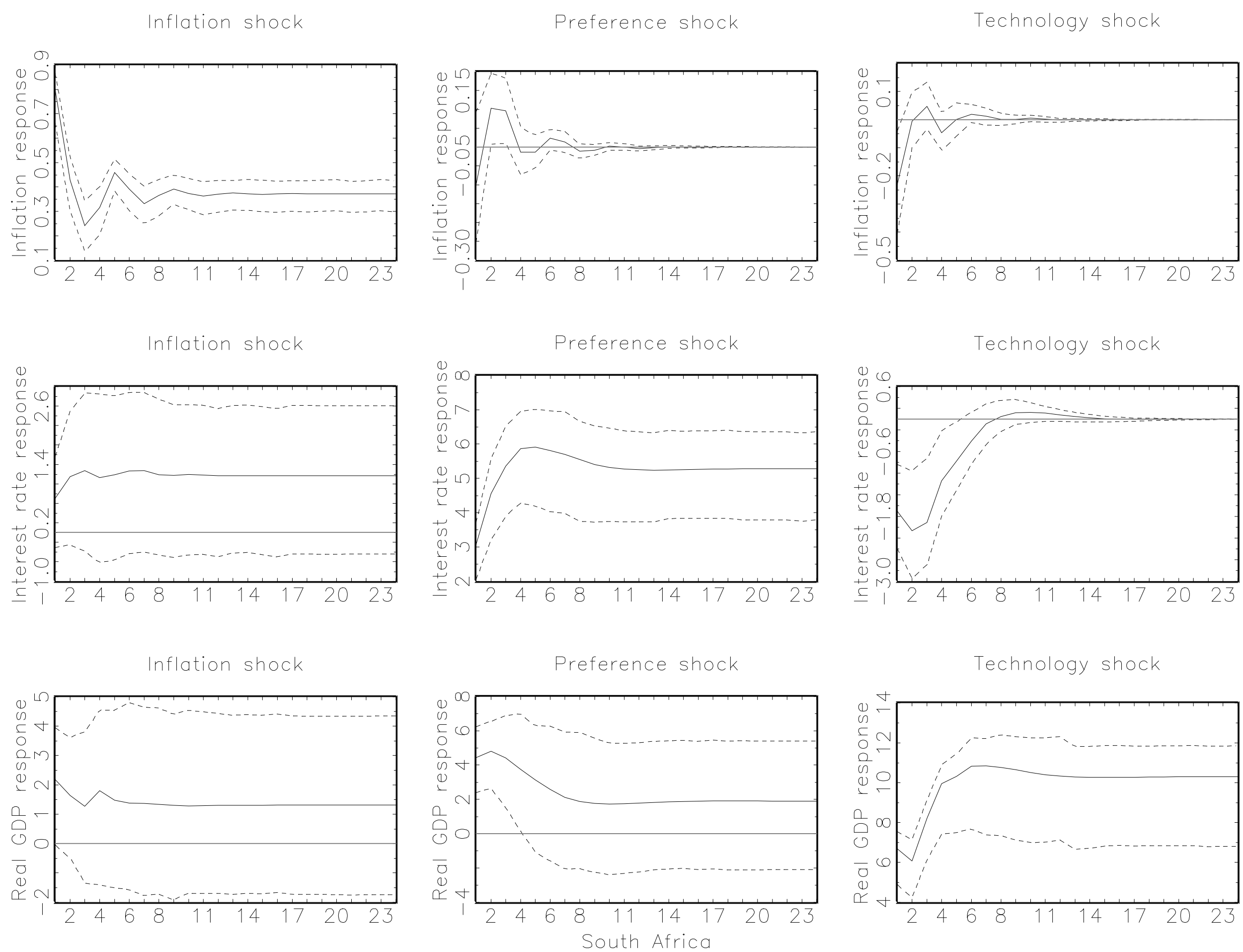
Long-Run Derivatives Estimates, Quarterly data

	Estimates	90% Confidence bands
$LRD_{R,INF}$	3.154	[-1.559, 6.963]
$LRD_{GDP,INF}$	3.527	[-5.671, 11.31]

The $LRD_{R,INF}$ point estimate is 3.154 indicating that the nominal interest rate adjusts by more than three times to a permanent unit increase in inflation in South Africa. Moreover, as provided in Figure 1 below, the "over-adjustment" of the nominal interest rate to an inflation shock is not permanent as $LRD_{R,INF}$ is not significant (the confidence bands is quite wide and contain opposite signs). Similarly, the $LRD_{GDP,INF}$ estimate is positive (3.527) but not significant, signalling that a permanent increase in inflation leads to a more than proportionate transitory increase in real output in South Africa. As indicated in Figure 2, the confidence bands are wide enough to suggest that the long run derivatives estimates are insignificant. The set of impulse responses reported in Figure 2 suggest, however, that the structural shocks have been correctly identified.

For instance, the inflation rate impulse responses to a technology shock are typically negative at shorter horizons and the positive real output impulse responses to a preference shock are not significant at a longer horizon. This, of course, indicates the presence of a long-run Fisher effect. Thus, LRSN cannot be rejected for South Africa. Note that the results indicate no support for the inflation-tax model in this country, which predicts an increase (respectively decrease) in the long-run interest rate (and subsequently output) to a permanent increase in inflation as well as a falling real interest rate in the country. The findings in this paper confirm the evidence that the non-superneutralities present in industrialized countries (Rapach, 2003) are absent for the case of South Africa.

FIGURE 2: Dynamic-impulses response functions of the SVAR system



3.6. Robustness checks

The major critique of the present application is that the estimates obtained through infinite-horizon identifying restriction in structural VARs can be unreliable for finite samples (Faust andLeeper, 1997). Lastrapes (1998) shows that this critique can be addressed by comparing the impulse responses across different identification horizons. If the dynamic properties of the structural VAR change little when the restrictions are imposed at long but finite horizons, then the original results are robust. To account for this critique, the structural VAR is re-estimated with the identifying restrictions imposed at the 12-quarter, 36-quarter and 60-quarter horizon. The estimation results which superimpose the infinite impulse response (see Figure 3(a) and 3(b)) do not depend critically on the identifying restrictions being imposed at the infinite time horizon. Figure 3(a) and Figure 3(b) illustrate the corresponding impulse response functions for the nominal interest rate and real output to a unit inflation shock. The interest rate and real output responses to a unit inflation shock are very close for the finite time horizons selected. Thus, imposing the zero restrictions at any finite horizon does not restrict the long-run properties of the VAR in a strict sense.

FIGURE 3(a): Interest rate response to a unit inflation shock

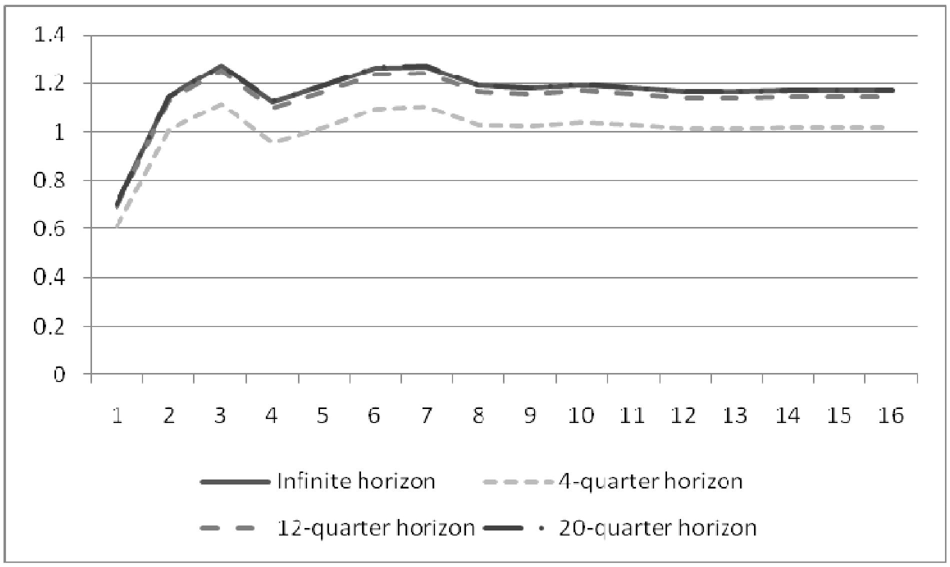
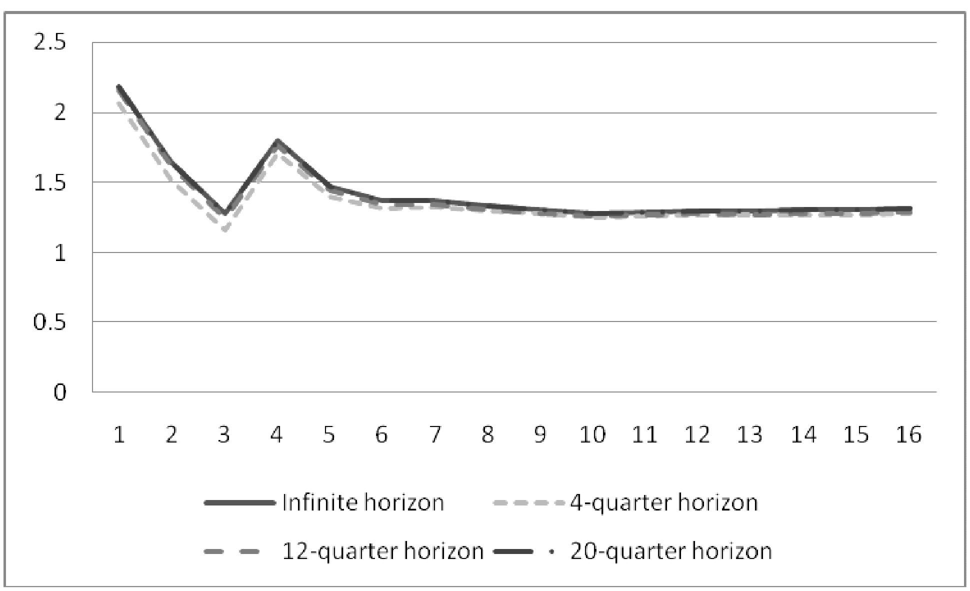


FIGURE 3(b): Real output response to a unit inflation shock



4. Conclusion

The theoretically postulated long-run relationship between inflation, the interest rate and real output is varied and thus, the examination of the relationship empirically becomes inexorably important. This paper investigates the impact of permanent exogenous change in inflation on the long-run real level of output and the long-run real interest rate for South Africa using quarterly data spanning from 1960 to 2009. The estimation results indicate that the notion of LRSN cannot be rejected for the South African economy over the period indicated.

Whilst the results indicate that the interest rate and real output level respond positively to a unit permanent increase in inflation more than proportionately (greater than three times to unit permanent increase in inflation), these results are not significant when evaluated using the trivariate structural autoregression model. The finding of the statistical insignificance of the results for the South African economy is supported by both the impulse response functions derived as well as the long-run derivative estimates, thus being possibly indicative of a Sidrauski (1967) effect in which money is assumed to be neutral in the long-run. The sensitivity analysis of the results obtained are robust to the imposition of the identifying restrictions for the SVAR at different finite horizons as the dynamic properties of the VAR do not change substantially upon imposing these restrictions, thereby indicating that the long-run properties of the VAR are not restricted. Simply stated, the long-run inferences made from the impulse response functions are valid.

The results further support the notion that there are no significant long-run Phillips curve trade-off effects as increasing levels of inflation should lead to increased levels of output, as per the Tobin (1965) model. Establishing the presence of LRSN within an economy has important policy implications as it assists in the conduct and effectiveness of MP. In the case of South Africa, whilst there does exist evidence of LRSN within the economy implying that changes in the growth rate of money affect the level of real output and the real interest rate in the long-run, these effects are not statistically significant, as mentioned. Thus, the results imply that money growth is only able to significantly affect the level of inflation within the economy.

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