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The influence of United States monetary policy on the South African economy

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SA-TIED Working Paper #157 | January 2021

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Abstract: This paper aims to analyse the influence of spillovers into South Africa's economy from shifts in United States of America's (US) monetary policy. Often changing, the US interest rate is regarded as an important driving force of economic growth in the world, since several developing economies are strongly dependent on the activity of the US dollar and monetary policy. To fulfil the aim of this study, the model specification examines the relationship and interaction between US interest rates and South Africa's gross domestic product (GDP), oil prices, all-share index, and bond index. The results from the non-linear autoregressive distributed lag technique employed show that US monetary policy has a negative effect on South Africa's GDP in both the short and long run. The findings show that the impact of shocks caused by changes in US interest rates on South Africa's GDP is strong but short-lived.

Key words: Gross domestic product, monetary policy, non-linear autoregressive distributed lag, United States of America, interest rates, shocks, South Africa

JEL classification: E02, E12, E43, E52

Acknowledgements: The author thanks Professor Ronney Ncwadi for vital guidance during the preparation of this paper.

1 Introduction

The past few decades of globalization have seen a sharp rise in cross-border capital flows as the world has become more financially integrated. These changes have brought to light two important roles the United States (US) financial system has come to play in the globalized economy. First, according to Crowe and Beckworth (2017), the US financial system has become the main producer of safe assets for the global economy. Second, the US financial system's central bank, the Federal Reserve, has become a monetary superpower that sets global monetary conditions to a large extent (Crowe and Beckworth 2017).

Sine the US financial system is the main producer of safe assets for the global economy, this means that in acting as the 'banker to the world' the US borrows short-term from foreigners and invests long-term abroad. When this takes place, the US financial system creates the safe assets the rest of the world craves, but it cannot do so in enough volume on its own (Crowe and Beckworth 2017).

The Federal Reserve has become a monetary superpower that sets global monetary conditions to a large extent. More than any other central bank, it shapes the path of global nominal spending growth. According to Wallace (2017), even though the Federal Reserve's mandate is domestic, its influence is increasingly global.

One of the defining features of the US financial system is the role it plays in providing financial intermediation to the global economy. According to Crowe and Beckworth (2017), the US tends to borrow short-term at low interest rates from the rest of the world while investing long-term in riskier assets abroad that earn a higher yield. This shows that the US financial system provides safe, liquid assets to the rest of the world while funding economic development abroad. According to Crowe and Beckworth (2017), an author by the name of Kindleberger was the first to observe this tendency, and he dubbed the US the 'banker to the world'. Countries with relatively poorly developed domestic asset markets are more likely to hold US assets. These effects are significant and robust, whereas more traditional diversification arguments for cross-country asset holdings receive little empirical support (Crowe and Beckworth 2017).

According to Philbrick (2017), the Federal Reserve system has a powerful influence over the global economy. The Federal Reserve's dual mandate of domestic price stability and employment maximization is the central objective that drives its actions. However, as it is the central bank to the world's largest economy, the Federal Reserve's policy decisions impact on economies and markets globally. The global impact of its policies on the state of the world economy is a significant factor that the Federal Reserve must consider when making policy decisions (Philbrick 2017).

According to Wallace (2017), because of low interest rates globally since 2008, emerging markets such as South Africa have had significant inflows of investment from investors seeking higher yields in bonds and equities. The saying 'when the US sneezes, the world catches a cold' has proven to be true with the prospect of US rates doubling from one per cent to two per cent in a relatively short time frame, and never more so than for emerging economies such as South Africa. Even relatively small changes in US economic variables have a significant bearing on currencies, bonds, shares, and other financial assets. Any economic uncertainty can often lead to a sudden 'flight to quality' away from the more liquid currency in emerging market countries such as South Africa (Wallace 2017).

The US has the world's single largest economy, accounting for almost a quarter of global gross domestic product (GDP) (at market exchange rates), one fifth of global foreign direct investment,

and more than a third of stock market capitalization. Hassett and Glassman (2003) report that history has shown that it is rare for one nation to be as dominant in the world economy as the US is today. The US economy is so large that its metropolitan areas produce more than entire countries. For examples, in 2002, Chicago produced about the same as Taiwan, and Dallas the same as Saudi Arabia.

In a world that is tied together by trade, the US wins when other nations prosper—and other nations win when the US prospers. Trade is a two-way street (Hassett and Glassman 2003). The US is the single largest market for developing nations' goods. It must also be noted that with regard to developing countries, the US buys a good deal more than it sells. For example, in 2002 the Philippines sold exports worth US$11 billion to the US and bought American imports worth US$7 billion—a deficit (to the US) of US$4 billion. Not only does the US buy hundreds of billions of dollars' worth of goods produced by developing nations; it also invests heavily in those countries. According to Hassett and Glassman (2003), roughly three out of every eight dollars in foreign direct investment in Africa comes from the US—more than from any other country.

One of the major business cycle drivers in the world is US GDP growth and the US interest rate cycle. It is well known and publicized that the US is growing, and the prospect of higher interest rates in the world's largest economy in 2014 had already sent the dollar surging against most currencies, including the South African rand (Brasecke 2014). The Federal Reserve's outlook on the economy has long been the subject of intense speculation as observers have tried to divine the next change in its target interest rate. Although central banks remain players in the loan market, and are sufficiently important to be able push short-term rates up or down slightly, it is the market that ultimately determines real interest rates (Hummel 2017).

Frost and Sullivan (2018) state that after nearly a decade of slow growth and monetary policy tightening measures, developed countries have reached a turning point. Policy makers have started to pursue stimulus measures. In the US, the Federal Reserve has adopted a normalization of the balance sheet through a gradual increase in interest rates—seven times in two and a half years after December 2015 (Frost and Sullivan 2018).

2 Impact of US monetary policy on the South African economy

Many emerging markets have experienced a significant appreciation in their currencies. For example, the USD/ZAR currency pair rose from less than 10.00 in 2012 to a high of 17.00 in January 2016 as the US dollar depreciated against the South African rand. South Africa was able to leverage this increase in its currency valuation to borrow more US dollars to finance various growth initiatives and increase government spending (Kuepper 2019). The negative side is that the rand and other emerging market currencies have already started to fall amid expectations of the Federal Reserve increasing its interest rates. These dynamics make it more difficult for countries such as South Africa to repay their dollar-denominated debts, an issue also faced by many private companies (Kuepper 2019).

Kuepper (2019) states that emerging market governments have taken advantage of low US interest rates to borrow in US dollars. For example, South Africa borrowed heavily when the dollar was low, and used the proceeds to help finance its growth and budgetary needs. These dynamics have helped many emerging markets improve performance over the past several years, but the strategy may come back to haunt them if the dollar rises in value and these debts become more expensive.

South Africa has one of the largest external financing requirements in the world, which means that its currency reserves are smaller than the amount needed to service its foreign debt and pay for imports (Kuepper 2019). These dynamics may lead to a lower credit rating and higher borrowing costs going forward if the US dollar appreciates in value. Higher borrowing costs may make it more difficult to obtain the funding needed to invest in growth (Kuepper 2019).

The effect of the US monetary policy normalization shock of 120 basis points has been greatest on South Africa, with impact effects ranging from minus one per cent to five per cent of GDP. After four quarters (a year), the cumulative decline in capital flows is as high as 5.7 per cent of GDP in South Africa. Central banks often must respond to actual, perceived, or anticipated events. In their efforts to achieve domestic price and financial market stability in the ever-changing internationalized economy, South African monetary authorities have increasingly become exposed to numerous challenges (Mollentze 2016).

With Trump's presidency being associated with high inflation, the US dollar was expected to take a dive, which meant the rand would become stronger. With a stronger rand, South African exports to the US would become more expensive, while US exports to South Africa would become relatively cheaper. This would have the effect of widening the balance of trade deficit for South Africa: the country would end up importing more than it exported (Monetary Library 2017).

All the above are potential consequences, and help us to understand how South Africa may be affected in the coming years.

3 Methodology and model specification

3.1 Methodology

Due to the existence of asymmetries, the relationship between variables may not be linear; hence a post-autoregressive distributed lag (ARDL) estimation will be applied, namely the non-linear ARDL (NARDL) method. NARDL will help to capture these asymmetries. Shin and Yu (2004) developed the asymmetric ARDL model using negative and positive partial sum decompositions that allow us to identify the asymmetric effect in the short and long run.

The NARDL model has some advantages over classic cointegration models. First, NARDL works efficiently even with small sample sizes. Second, the stationary test is not mandatory for NARDL (Ibrahim 2015). The NARDL model is equally efficient for variables that are stationary at level I (zero) or first difference I (one), or even fractionally integrated. However, the limitation of the technique is that it cannot be applied if any of the variables under study in each model are I (two). Shin et al. (2013) estimated NARDL models of the interest rate pass-through relationship in the USA and Germany, finding strong evidence of time-varying asymmetry. An important and relatively common finding in the literature is that the direction of asymmetry may switch between the short run and the long run. For example, a positive shock may have a larger absolute effect in the short run while a negative shock has a larger absolute effect in the long run (or vice versa). The simplicity and flexibility of NARDL renders it an ideal framework with which to model such complex phenomena.

Granger and Yoon (2002) advanced the concept of 'hidden cointegration', where cointegrating relationships may be defined between the positive and negative components of the underlying variables. Granger and Yoon demonstrated the relevance of this conceptual framework in the

context of the linkage between short- and long-term interest rates and the output-unemployment relationship, both of which are unstable or lack robust evidence of linear cointegration.

3.2 Model specification

The model specification, based on a review of the literature, is to investigate the relationship and interaction between US interest rates and South Africa's GDP, oil prices, all-share index, and bond index. The model specification is based on Iwata and Wu's (2006) study of the impact of exogenous monetary shocks on Japan. They employed a non-linear structural vector autoregression approach to estimate the effects of exogenous monetary policy shocks. Due to the non-linear behaviour of the variables chosen for this study, because of the monetary shocks that will be analysed, it is best to use a non-linear approach here. There has been limited use of the ARDL technique, and this study is the first to adopt the technique with its NARDL approach. It uses a simple multivariate framework where the link is:

$$LGDP_t = \alpha + \beta_1 LINT_t + \beta_2 ASI_t + \beta_3 BInd_t + \beta_4 OIL_t + \mu_t \quad [1]$$

$L(GDP)$ represents South African GDP, $LINT$ is the US interest rate, ASI is the all-share index, $BInd$ is the bond index, and OIL represents oil prices. This study will further discuss the steps used to estimate the series.

Table 1 provides a description of the variables 1. The data was sourced from Quantec economic indicators and World Bank and International Monetary Fund databases from 1980 to 2019.

Table 1: Description of variables

GDP	The measurement of the value of economic activity within a country. It is the sum of the market values, or prices, of all final goods and services produced in an economy during a given period (SparkNotes 2018).
Interest rate	The amount a lender charges for the use of assets, expressed as a percentage of the principal (Banton 2018).
Oil prices	The spot price of one barrel of the benchmark crude oil. The price depends upon its grade, location, and sulphur content. The price of oil can be determined with the help of a balance between demand and supply. Oil prices play an important role in the global economy (Petropedia 2018).
All-share index	A series of numbers that shows the changing average value of the share prices of all companies on a stock exchange, and which is used as a measure of how well a market is performing (Kramer 2020).
Bond index	Made up of selected bonds and used to measure the value of a part of the bond market. It can also be a useful tool to gauge the value of specific investments (Maurino 2018).

Source: author's compilation.

4 Results and findings

4.1 Unit root tests

This section presents the unit root tests, specifically augmented Dickey-Fuller (ADF) and Phillips-Perron tests.

Table 2: Unit root tests (ADF)

		Unit root test table (ADF)				
	At level	GDP	LALSINDEX	LOIL_PRICE	LSABINDEX	USA_INT
With constant	t-statistic	-4.4391	-0.1677	-0.8752	-0.7076	-4.5039
	Prob.	*0.0011*	*0.9341*	*0.7852*	*0.8328*	*0.0010*
		***	n0	n0	n0	***
With constant & trend	t-statistic	-4.4546	-4.3291	-2.1368	-2.7566	-4.6677
	Prob.	*0.0055*	*0.0077*	*0.5096*	*0.2213*	*0.0033*
		***	***	n0	n0	***
Without constant & trend	t-statistic	-3.1291	0.5812	0.3378	0.4048	-1.9957
	Prob.	*0.0026*	*0.8375*	*0.7778*	*0.7954*	*0.0452*
		***	n0	n0	n0	**
		At first difference (ADF)				
		d(GDP)	d(LALSINDEX)	d(LOIL_PRICE)	d(LSABINDEX)	d(USA_INT)
With constant	t-statistic	-7.2967	-3.9739	-5.3999	-5.2443	-5.5604
	Prob.	*0.0000*	*0.0040*	*0.0001*	*0.0001*	*0.0001*
		***	***	***	***	***
With constant & trend	t-statistic	-7.2038	-4.2310	-5.4217	-5.2315	-5.4998
	Prob.	*0.0000*	*0.0099*	*0.0004*	*0.0007*	*0.0004*
		***	***	***	***	***
Without constant & trend	t-statistic	-7.3770	-3.9799	-5.4442	-5.2740	-5.6536
	Prob.	*0.0000*	*0.0002*	*0.0000*	*0.0000*	*0.0000*
		***	***	***	***	***

Note: ***, **, and * indicate significance at 1%, 5%, and 10% respectively.

Source: author's computations using data from Table A1.

The results of the unit root tests for each variable presented in Table 2 show that in the absence of a trend term, all variables are stationary at levels except for oil prices, all-share index, and bond index in all tests, making them non-stationary variables. The US interest rate and South African GDP are thus stationary, while the rest of the variables are non-stationary. With a trend term included, the ADF and Phillips-Perron tests show that all variables are stationary except for oil prices and bond index, which are non-stationary. However, all variables are stationary I (zero) at first differences.

The results of the unit root tests for each variable presented in Table 3 show that in the absence of a trend term, all variables are stationary at levels except oil prices, all-share index, and bond index in all tests. This means that in the absence of a trend term, oil prices, all-share index, and bond index—unlike the other variables—have statistical properties that change over time; hence they are known as non-stationary variables. The US interest rate and South African GDP are thus stationary, while the rest of the variables are non-stationary. With a constant and trend term included, the ADF and Phillips-Perron show that the all-share index, US interest rate, and GDP are stationary, while the bond index and oil prices are non-stationary variables at levels. However, all variables are stationary at first differences.

Table 3: Unit root tests (Phillips-Perron)

		Unit root test table (Phillips-Perron)				
	At level	GDP	LALSINDEX	LOIL_PRICE	LSABINDEX	USA_INT
With constant	t-statistic	-4.4494	-0.6276	-0.8752	-0.8559	-3.8315
	Prob.	*0.0010*	*0.8525*	*0.7852*	*0.7912*	*0.0057*
		***	n0	n0	n0	***
With constant & trend	t-statistic	-4.4546	-4.6730	-2.1824	-2.7930	-3.2863
	Prob.	*0.0055*	*0.0031*	*0.4853*	*0.2085*	*0.0839*
		***	***	n0	n0	*
Without constant & trend	t-statistic	-3.0545	0.3755	0.3410	0.3578	-2.1535
	Prob.	*0.0032*	*0.7878*	*0.7786*	*0.7831*	*0.0317*
		***	n0	n0	n0	**
		At first difference (Phillips-Perron)				
		d(GDP)	D(LALSINDEX)	d(LOIL_PRICE)	d(LSABINDEX)	d(USA_INT)
With constant	t-statistic	-9.3832	-3.8881	-5.3675	-5.2286	-5.4790
	Prob.	*0.0000*	*0.0050*	*0.0001*	*0.0001*	*0.0001*
		***	***	***	***	***
With constant & trend	t-statistic	-9.0109	-4.2553	-5.3912	-5.2315	-5.6270
	Prob.	*0.0000*	*0.0093*	*0.0005*	*0.0007*	*0.0002*
		***	***	***	***	***
Without constant & trend	t-statistic	-9.5480	-3.9018	-5.4148	-5.2740	-5.5394
	Prob.	*0.0000*	*0.0003*	*0.0000*	*0.0000*	*0.0000*
		***	***	***	***	***

Note: ***, **, and * indicate significance at 1%, 5%, and 10% respectively.

Source: author's computations using data from Table A1.

The variables used in this study are a mixture of stationary and non-stationary variables, and therefore further demonstrate that the ARDL bounds cointegration test is the correct estimation technique. The test can be used irrespective of whether regressors are non-stationary, stationary, or mutually cointegrated, as opposed to the Engle-Granger and Johansen cointegration tests, which require all variables to be integrated of order one.

Having analysed the stationarity using unit root tests, this study now presents the pairwise correlation matrix in the next section.

4.2 Pairwise correlation matrix

The pairwise correlation matrix is computed to detect whether there is any collinearity among the variables used in the estimation.

Table 4: Pairwise correlation matrix

	LOIL_PRICE	GDP	LALSINDEX	LSABINDEX	USA_INT
LOIL_PRICE	1.000000				
GDP	0.162141	1.000000			
LALSINDEX	0.833622	0.202467	1.000000		
LSABINDEX	0.785695	0.338227	0.871622	1.000000	
USA_INT	0.129322	-0.409549	-0.004790	0.127137	1.000000

Source: author's computations using data from Table A1.

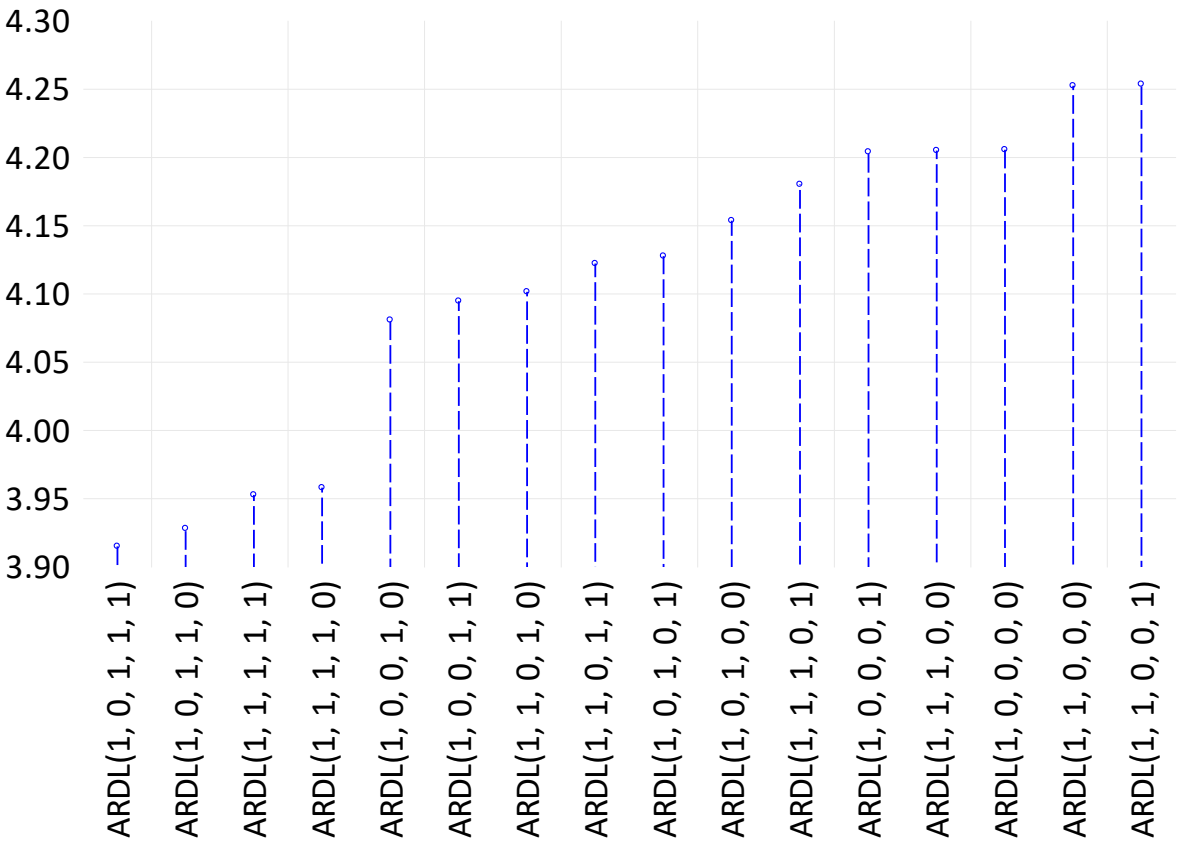
Table 4 presents the pairwise correlation matrix of the variables used in the estimation. The results of the correlation analyses show no evidence of severe multicollinearity. The correlation coefficient between oil prices and all-share index is above 0.8, which is an indication of correlation present between these two variables. This is also the case between the all-share index and the bond index, where the correlation coefficient is above 0.8. For this study, the correlation analysis is very important to determine the type of association that exists between each of the series used, which has implications for their inclusion in the model. The correlation can be safely ignored according to the reasoning by Allison (2012), who states that multicollinearity is only a problem for variables that are collinear if they are the variables of interest. In other words, as long as the collinear variables are only used as control variables and are not collinear with the variables of interest, they can still be used. The coefficients of the variables of interest are not affected, and the performance of the control variables as controls is not impaired. Among the variables for this study, GDP and US interest rates are the variables of interest. There is no correlation between the US interest rate and other economic indicators. There is also no correlation between South Africa's GDP and other economic indicators.

If most of the variables were above 0.8, then it could be said that there was severe multicollinearity, but that is not the case.

4.3 Akaike information criterion (AIC)

Figure 1 shows the estimation of out-of-sample prediction errors and thus the relative quality of the statistical models for the given data set. The AIC allows us to test how well the model fits the data set without overfitting it.

Figure 1: AIC



Source: author's computations.

The AIC compares the quality of a set of models, ranking each option from best to worst (Glen 2015). The choice of lags used this study is ARDL (1,0,1,1,1). A lower AIC value indicates a better fit. Lower AIC indicates a more parsimonious model relative to a model fit. This means that the model has great explanatory predictive power. Using AIC, the choice of lags at ARDL (1,0,1,1,1) is the best model for the series; it also shows that there is the right number of predictors needed to explain the model well.

While some of the variables (all-share index, oil prices, and bond index) are integrated of order one, that is, I, some other variables in the model are stationary at their levels (GDP and US interest rates). The unit root test results mean that the choice of NARDL is suitable for the analysis. There is no assumed linear relationship between the variables, as seen from the results of unit root testing in Tables 2 and 3. Therefore, this study adopts the NARDL estimation technique.

4.4 NARDL

This study employs the NARDL modelling approach to cointegration, based on the standard theoretical and empirical literature on the relationship between interest rates and GDP. This approach allows simultaneous testing of the short-run and long-run non-linearities through positive and negative partial sum decompositions of the predetermined explanatory variables. NARDL is the preferred estimation technique due to its ability to explain the cycles in the data collected, specifically the US interest rate cycles. When presenting NARDL, the first thing that needs to be done is the bounds test. The results of the bounds test are presented in Table 5.

Table 5: Bounds test cointegration results

F-statistic	Critical values					
	1%		5%		10%	
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
7.581365	3.06	4.15	2.39	3.38	2.08	3

Source: author's computations using data from Table A1.

The results of the NARDL bounds test presented in Table 5 compute that the F-statistic is greater than the critical values at the one per cent, five per cent, and ten per cent levels. This suggests that the null of no long-run relationship is rejected, meaning that there exists a long-run association between the variables. This implies that there is cointegration among the series in the model. The existence of cointegration among the series helps us to analyse the short-run and long-run relationships of the factors that affect South Africa's GDP.

Now that we have established that there is evidence of a long-run relationship, Table 6 presents the long-run estimates.

Table 6: Long-run estimates

	Levels equation			
	Case 2: restricted constant & no trend			
Variable	Coefficient	Std error	t-statistic	Prob.
US_INT_POS	-0.337828	0.295984	-1.141374	0.2641
US_INT_NEG	-0.222188	0.367672	-0.604310	0.5509
LALSINDEX	-1.041571	0.785150	-1.326589	0.1962
LOIL_PRICE	-0.684177	0.800708	-0.854465	0.4007
LSABINDEX	15.02428	3.878173	3.874062	0.0006
C	-56.93184	16.13652	-3.528136	0.0016

Source: author's computations using data from Table A1.

Table 6 presents the results of the long-run estimates. The estimated results reveal that US interest rates affect GDP in an asymmetric manner in the long run. The asymmetric effect of the US interest rate is captured by US_INT_POS and US_INT_NEG, indicating positive and negative changes in the US interest rate respectively. The estimated coefficients of the positive and negative asymmetric changes are negative and statistically insignificant. If we look at the response of the dependent variable—that is, GDP—to the positive changes in the independent variable, when the US interest rate increases (which is the positive change), then GDP will decrease. Therefore, an increase in US interest rates is associated with a 0.337828 per cent decrease in South Africa's economic growth. The response of the dependent variable (GDP) to negative changes in the US interest rate is negative: for every one-unit decrease in the US interest rate, South Africa's GDP increases by 0.222188. This is because there is a negative relationship between the response of GDP and a decrease in the interest rate. When US interest rates decrease, GDP goes in the opposite direction, because of the negative sign in the coefficient -0.222188. According to these results, the US interest rate has a negative impact on South Africa's GDP when the US interest rate shows a positive change. Similarly, when the US interest rate increases, the South African economy experiences negative economic growth. This shows that US interest rates have a depressive impact on South Africa's GDP when the interest rates are increased. This conclusion reflects the findings by Bhattarai et al. (2017), who concluded that an unanticipated increase in US uncertainty on average sharply depreciates the local currency of emerging market economies and leads to a decline in their local markets, an increase in long-term interest rate spreads, and a capital outflow from those emerging market economies.

The results obtained indicate that US interest rates affect South Africa's GDP in an asymmetric and non-linear manner. The implication is that the negative relationship between US interest rates and South Africa's GDP is specific to a determined period. The US interest rate proves to be statistically insignificant for cases where US interest rates are either positive or negative; this means we fail to reject the null hypothesis. This proves once again that there is a long-run relationship between US monetary policy and South Africa's GDP. These results leave open the question why the US interest rate has a continuous depressive impact on South Africa's economic growth. South Africa's import commodities include machinery, equipment, chemicals, petroleum products, and more recently an increase in food materials, especially from the agriculture sector. The overall size of imports and exports as a percentage of the South African economy points to the fact that South Africa is a very open economy. The South African economy is still dependent on the import of more than half its inputs, which makes it susceptible to the vagaries of external shocks, especially from US interest rate movement.

The all-share index in the long run has a negative effect on the economy and is statistically insignificant. Oil prices in the long run are also found to be statistically insignificant. The bond index, on the other hand, is positive and statistically significant in the long run.

Table 7: Short-run estimates

Error correction model regression				
Case 2: restricted constant & no trend				
Variable	Coefficient	Std error	t-statistic	Prob.
D(USA_INT_POS)	-1.219540	0.244397	-4.990005	0.0000
D(LALSINDEX)	0.343332	0.821515	0.417925	0.6794
D(LOIL_PRICE)	2.392913	0.941754	2.540911	0.0174
D(LSABINDEX)	-3.176970	4.831648	-0.657533	0.5166
CointEq (-1) *	-1.010368	0.125017	-8.081855	0.0000

Source: author's computations using data from Table A1.

The error correction model is applied in NARDL to evaluate short-run asymmetric effects. The short-run estimates are presented in Table 7. The error correction model coefficient is statistically significant and negative. The short-run results suggest a negative relationship between US interest rates and South Africa's GDP. The findings also indicate that the US interest rate slows down economic growth (GDP) not only in the short run but also in the long run when the US interest rate has a positive change (where DUSA_INT_POS has a coefficient of -1.219540). The estimated coefficient of the positive asymmetric change is negative and statistically significant. The bond index is negative in the short run; this may be an indication that investments take time to affect the economy fully, and that is why the bond index is found to have experienced a positive impact in the long run, when the investments may have fully infiltrated the economy.

The all-share index is positively related to GDP in the short run but then becomes negatively related to GDP in the long run. The prices of shares change frequently, and shares are purchased quite quickly, so there is a regular exchange. People with shares will see a fall in their wealth. If the fall in the long run is significant, it will affect their financial outlook. The Federal Reserve has raised its benchmark interest rate nine times since the end of 2015 (Hu et al. 2019). This has led to capital outflows and asset depreciation in many emerging market economies. Movements in the stock market can have a profound economic impact on economic consumers (Hu et al. 2019).

The results show that the US interest rate has a long-run relationship with South Africa's economic growth, and also has a great impact on the all-share index, bond index, and oil prices. Further, the effects of US interest rate uncertainties in the short and long run are asymmetric. These variables have important policy implications for improving the performance of South Africa's economy. The important policy implications of this study include strengthening the performance of the domestic economy, and attracting export-oriented investments, which will contribute to export growth and increasing foreign investment portfolios. These are considered important policy measures to improve South Africa's GDP.

Following the short-run and long-run estimates, which have shown a negative relationship between the dependent variable (GDP) and its independent variables, this study will now present diagnostic tests in the next section.

4.5 Diagnostic tests

The Breusch-Godfrey serial correlation LM test results presented in Table 8 show that there are no problems of serial autocorrelation.

The results of the heteroscedasticity test are shown in Table 9. They reveal no heteroscedasticity present in all variables. This indicates that the model is good enough for the study of cointegration among the variables.

In the results from the normality test illustrated in Figure 2, the null hypothesis states that the data follows a normal distribution, due to the fact that the p-value is 0.128247, which is greater than the significance level of 0.05. The decision is that we fail to reject the null hypothesis. Therefore, the data used for this study follows a normal distribution.

Table 8: Breusch-Godfrey serial correlation LM test

F-statistic	1.419767	Prob. F (2,24)	0.2614
Obs*R-squared	3.914477	Prob. Chi-Square (2)	0.1412

Note: null hypothesis: no serial correlation at up to two lags.

Source: author's computations using data from Table A1.

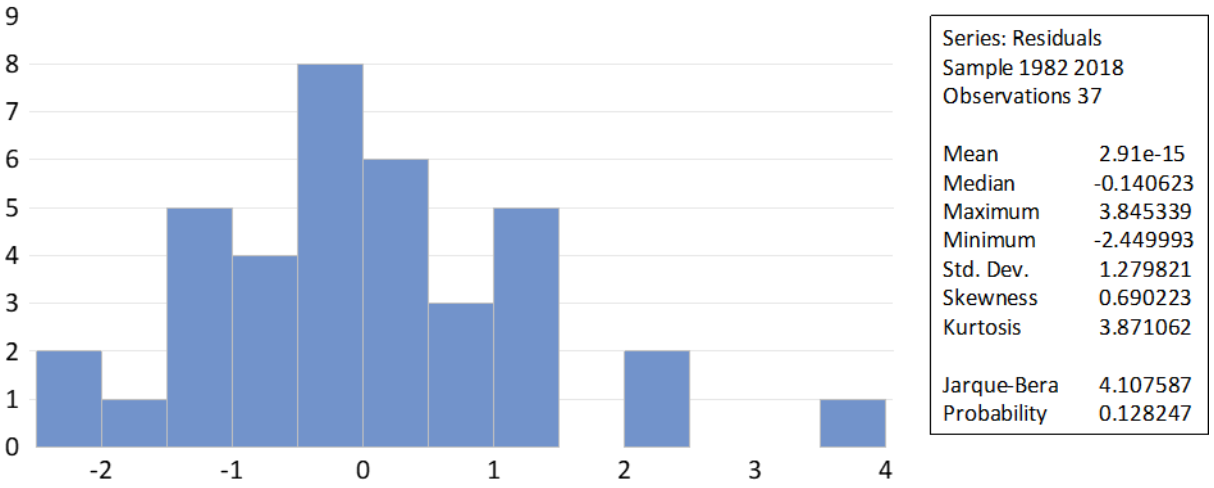
Table 9: Heteroscedasticity test: Harvey

F-statistic	0.841729	Prob. F (10,26)	0.5947
Obs*R-squared	9.048934	Prob. Chi-square (10)	0.5275
Scaled explained SS	7.213787	Prob. Chi-square (10)	0.7051

Note: null hypothesis: homoscedasticity.

Source: author's computations using data from Table A1.

Figure 2: Normality test

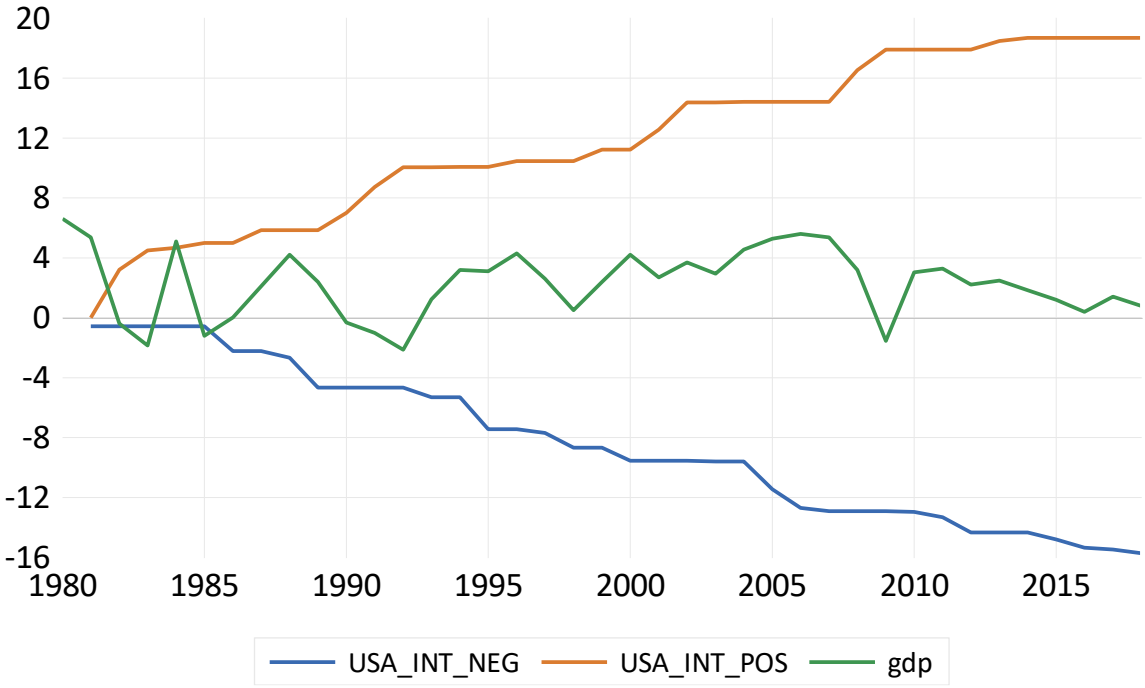


Source: author's computations using data from Table A1.

4.6 GDP relationship

Figure 3 shows that GDP has frequently fluctuated above zero per cent but under four per cent since 1980. However, there are evident shocks from US interest rates that have caused GDP to decrease below zero per cent, which means that in those instances South Africa was experiencing negative growth. For example, in the period between 2007 and 2008, the global financial crisis was still in full effect. South Africa reflects this dip in the economy, even reaching below zero per cent due to the interest rate activities/shock. South Africa's GDP shows a recovery after the financial crisis shock.

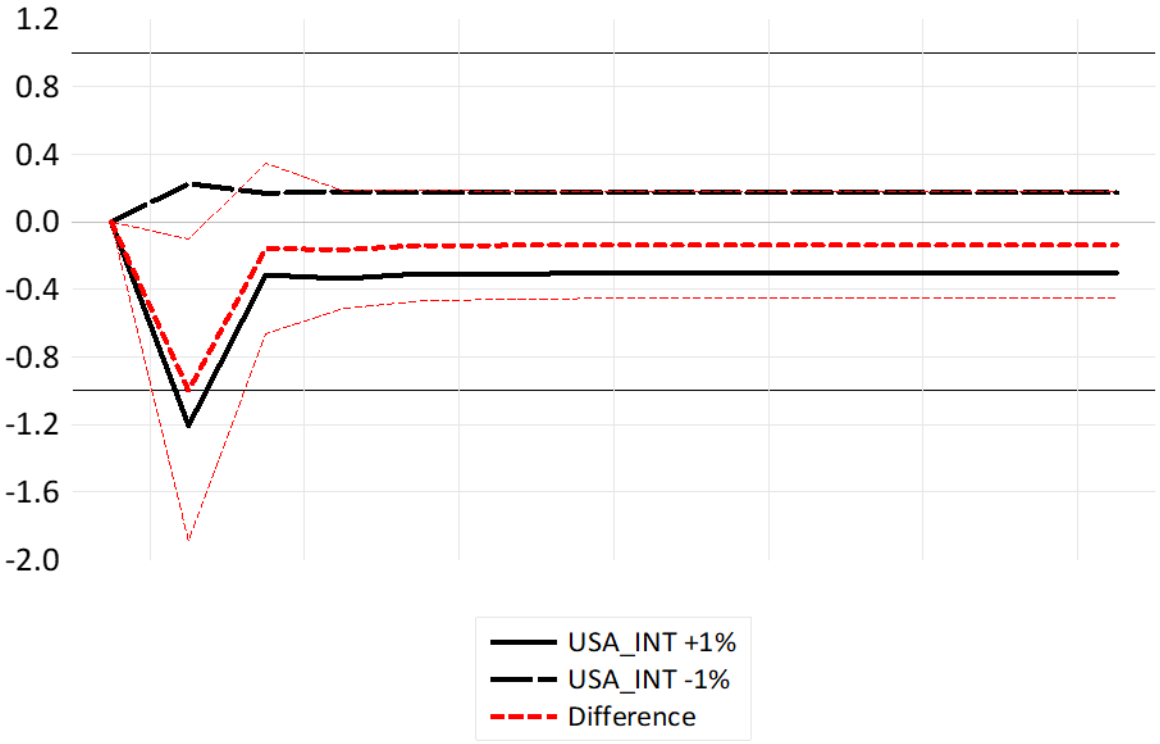
Figure 3: GDP relationship



Source: author's computations using data from Table A1.

4.7 Multiplier

Figure 4: Multiplier



Source: author's computations using data from Table A1.

The use of the NARDL approach also offers the opportunity to quantify the responses of South African economic growth (GDP) to positive and negative US interest rate shocks for the asymmetric dynamic multipliers illustrated in Figure 4.

The difference line is below 0.0, and there is an evident gap between the lines that shows there is an asymmetric relationship between US interest rates and South Africa's GDP. There is also a huge dip in the multiplier. This plunge also shows the reaction of South African GDP in the midst of a global financial crisis.

4.8 Conclusions from the results

The preceding sections have provided empirical results examining the influence of US interest rates on South Africa's GDP. They have also presented the pairwise matrix. The NARDL estimation technique has revealed that US monetary policy has a negative effect on South Africa's economy in both the short and long run. The findings show that the impact of the shock from a change in US interest rates on GDP is strong but also short-lived (as also supported by Figure 4). This can also be described as the interest rate causing a glitch in the economy in a certain time period.

These empirical results show a long-run relationship between a US monetary policy tool (interest rates) and South Africa's economic activity (GDP). The effects of the interest rate on GDP and between the interest rate and the bond index are asymmetric in the short and long run. The interest rate has a negative impact on the bond index in the short run. The interest rate risk essentially means that bond owners will have their returns affected to varying degrees based on the amount of fluctuation experienced in interest rates.

In light of the pairwise correlation matrix, oil prices are found to be correlated with the all-share index. These results are supported by the research findings by Lescaroux and Mignon (2008), who studied the influence of oil prices on economic activity and other macroeconomic and financial variables. These authors' empirical results found numerous cointegrating relationships for oil-importing countries. The causality generally ran from oil prices to macroeconomic and financial variables. For oil-importing countries, the relationship was negative, meaning that an oil price increase leads to a decrease in share prices. There is causality from GDP to oil prices. In the case of GDP and share price series, the impact of an increase in oil prices is always negative. Lescaroux and Mignon (2008) also concluded that the causality for share prices is negative and always runs from oil prices to stock markets.

The results also suggest that South Africa's GDP may actually be more greatly affected by inflation than by US monetary policy; hence the South African Reserve Bank focuses strongly on inflation targeting. However, the effect of interest rate changes shows in the decrease in the inflow of foreign investments. That is why the GDP change is only a glitch in the system (economy). There is no gigantic impact experienced. In terms of the all-shares index, when the US interest rate increases, there is a shift in the numbers displayed by the all-share index, which could be from the Top 40 choosing to invest elsewhere or spreading their portfolio into the US (when interest rates rise) but not fully removing their investments from South Africa. The volatility of the all-share index shows that a rapid fall in share prices does not necessarily mean the economy is doing badly, although it does influence monetary policy. South Africa is one of the most vulnerable economies to a removal of external liquidity, given the relatively low foreign exchange reserves, negative current accounts, and large amounts of maturing external debt.

A fall in the stock market in the long run makes other investments more attractive. That means that investors will find it more attractive to go into safer investment options such as government

bonds, because these investments offer a better return in times of uncertainty; hence the empirical results also present the bond index as having a positive impact (outcome) in the long run. However, higher US interest rates improve the relative yield attractiveness of US government bonds, and leave emerging countries vulnerable to the flight of money from foreign investors seeking higher yields.

5 Summary

The aim of this study was to present the influence of US monetary policy on South Africa's GDP. Among the five transmission mechanism channels identified in transmission mechanism theory, the interest channel transmits itself much more rapidly to the real economy than other channels. It is against this background that the US interest rate channel was hypothesized to have a bearing on the South African economy.

The research findings confirmed that while there is a significant positive long-run relationship between US monetary policy (interest rate) and the South African economy (GDP), there is a strong robust negative relationship between oil prices and interest rates in the short run. In addition to this, the results obtained indicate that US interest rates affect South Africa's GDP in an asymmetric and non-linear manner. This negative relationship between the two variables is specific to a determined period. As the US increases its rates, it exposes South Africa's GDP, all-share index, and oil prices to negative growth in the long run. The results also show that there is a negative relationship between the bond index and interest rates in the short run. As interest rates increased in the past, there was a decrease in the bond market, which indicates there was an outflow of capital from the bond market, meaning that investors found other attractive interests in which to place their investments. This resulted in a simultaneous negative impact on GDP.

6 Conclusion and recommendations

6.1 Conclusion

The findings of this study show that there is a direct influence of US monetary policy on South Africa's GDP. Most studies of the role of US monetary policy have only investigated the emerging economies' collective reaction to any changes in the US interest rate; none have gone through the in-depth impact on the South African economy specifically. The present study was an attempt in this direction.

When an economy as large as the US changes its interest rates, the movement of investment funds is disruptive. This is also confirmed by Walker (2019): Federal Reserve policy has an impact through financial markets by affecting currency exchange rates, interest rates, and international flows of investment money. This leads to the possibility of large amounts of money leaving emerging market economies, which might lead to a new financial crisis in those countries.

Another impact of US policy changes on South Africa is on the value of the rand. This study shows that a US interest rate increase has a depressive impact on South Africa's economy. For example, when the dollar appreciates, oil prices for oil-importing nations are extremely high. When the dollar is stronger, it costs other countries more in their domestic currencies to buy dollar-priced goods. This does not only apply to American exports—lots of commodities, including oil, are priced in US dollars. When coupled with a higher oil price, it is expected that an overall price increase in retail goods and services (financial) will filter through to the South African consumer.

The results of this paper hint that South Africa's GDP is less sensitive than expected to US interest rate changes. As US policy decisions have come into effect in the US economy, South Africa has been able to recover quickly from shocks in the global economy and financial market. During the financial crisis of 2008 and 2009, South Africa experienced a decrease in its GDP and all-share index for the period.

For foreign investors to invest in South African bonds, they need to have confidence that the capital invested in the bonds will be paid back. When the rand falls, it directly affects foreign investor sentiment in the long term; this may result in outflows from South African bonds, and less investment in the country overall. The country will then end up with lower tax revenue and increased budget deficits.

Central banks in developing countries are making strides in modernizing their policy frameworks and better adapting them to the problems that their economies face. Nonetheless, significant challenges remain: to develop financial systems and accelerate financial inclusion, to enhance the effectiveness of monetary policy, and to further expand the institutional and operational capacities of central banks.

With regard to bringing the monetarist approach into the conversation as a stabilization policy for South Africa, the monetarist view that changes in the money stock are a primary determinant of changes in total spending and should be given major emphasis in economic stabilization programmes has received growing interest in the past few years. The roots of the South African Reserve Bank's orthodox monetary policy are three decades old. Historically, the late 1980s witnessed a sharp turnaround from counter-cyclical to pro-cyclical monetary policy. Interest rate management does not only aim to keep money inside the country. In orthodox hands, a monetarist perspective considers money supply the driver of internal prices. The monetary and financial management of South Africa's economy has been characterized by extremely high interest rates, capital flight, supervisory laxity, deregulation, corporate corruption, and excessive financial speculation (Bond 2019).

With the many critical factors that South Africa's economy is facing, monetary actions measured by changes in the money stock may play a strategic role in increasing economic growth. Sustaining a stabilization policy requires monitoring business cycles and movements in the benchmark of interest rates as we need to control unexpected changes in demand. This stabilization policy may also be used to soften or prevent widespread unemployment. Creating a steady pace of economic growth and keeping prices steady should be the long-term road to prosperity, specifically because the global economy is becoming more and more advanced.

6.2 Recommendations

Policy makers should generate some policies that increase the inflow of capital and portfolio investments in support of the Ramaphosa presidency mandate to secure an exponential amount of foreign investment in the country. Such policies and strategies may include other policies, such as capital management techniques to deal with any possibility of capital outflow. The South African Reserve Bank may need to have multiple targets and constraints, meaning it may need to implement several tools of monetary policy, and some new ones in addition. According to Epstein (2003), the South African Reserve Bank should consider exploring asset allocation strategies to encourage banks to lend more to high employment-generating uses, and capital control techniques to manage balance-of-payment problems.

References

Allison, P. (2012). 'When Can You Safely Ignore Multicollinearity?' *Statistical Horizons*. Available at: https://statisticalhorizons.com/multicollinearity (accessed August 2019).

Banton, C. (2018). 'Interest Rate'. *Investopedia*. Available at: www.investopedia.com/terms/i/interestrate.asp (accessed October 2019).

Bhattarai, S., A. Chatterjee, and W. Yong Park (2017). 'Global Spillover Effects of US Uncertainty'. Working Paper 331. Dallas: Federal Reserve Bank of Dallas, Globalization and Monetary Policy Institute. https://doi.org/10.24149/gwp331

Bond, P. (2019). 'SA's Monetary Policy Needs a Serious Overhaul'. *Mail & Guardian*. Available at: https://mg.co.za/article/2019-06-11-sas-monetary-policy-needs-a-serious-overhaul/ (accessed October 2019).

Brasecke, E. (2014). 'US Interest Rates: How They'll Affect SA'. *Sanlam Investment Management*. Available at: www.sim.sanlam.com (accessed August 2019).

Crowe, C., and D. Beckworth (2017). 'The International Impact of the Fed When the United States Is the Banker to the World'. In M.D. Bordo and J.B. Taylor (eds), *Rules for International Monetary Stability*. Stanford, CA: Hoover Institution Press.

Epstein, G. (2003). 'Alternative to Inflation Targeting Monetary Policy for Stable and Egalitarian Growth: A Brief Research Summary'. Working Paper. Amherst: University of Massachusetts, Political Economy Research Institute.

Frost, L., and D. Sullivan (2018). 'Monetary Policy Normalization in the United States: Meeting Market Expectations or Proving to Be Hawkish?' *Frost & Sullivan*. Available at: ww2.frost.com/frost-perspectives/monetary-policy-normalization-in-the-united-states-meeting-market-expectations-or-proving-to-be-hawkish/ (accessed October 2019).

Glen, S. (2015). 'Parsimonious Models: Definitions, Ways to Compare Models'. *Statistics How To*. Available at: www.statisticshowto.com/parsimonious-model/ (accessed October 2019).

Granger, C.W., and G. Yoon (2002). 'Hidden Cointegration'. Working Paper. San Diego: University of California, Department of Economics. Available at: www.sciencedirect.com/science/article/pii/S1018364718304841 (accessed June 2019).

Hassett, K.A., and J.K. Glassman (2003). 'Understanding the Role of the United States in the Global Economy'. *AEI*. Available at: www.aei.org/articles/understanding-the-role-of-the-united-states-in-the-global-economy/ (accessed May 2019).

Hu, B., S. Wu, and Q. Pan (2019). 'The Impact of US Interest Rate Hike on Emerging Market Economies and the Belt and Road Initiative'. *China and World Economy*. https://doi.org/10.1111/cwe.12283

Hummel, J.R. (2017). 'Central Bank Control Over Interest Rates: The Myth and the Reality'. Mercatus Working Paper. Fairfax, VA: George Mason University.

Ibrahim, M.H. (2015). 'Oil and Food Prices in Malaysia: A Nonlinear ARDL Analysis'. *Agricultural and Food Economics*. https://doi.org/10.1186/s40100-014-0020-3

Iwata, S., and S. Wu (2006). 'Estimating Monetary Policy Effects When Interest Rates Are Close to Zero'. *Journal of Monetary Economics*. https://doi.org/10.1016/j.jmoneco.2005.05.009

Kramer, L. (2020). 'How Is a Company's Stock Price and Market Capitalization Determined?' *Investopedia*. Available at: www.investopedia.com/ask/answers/how-companys-stock-price-and-market-cap-determined/ (accessed April 2020).

Kuepper, J. (2019). '5 Ways a Fed Rate Hike Could Impact Emerging Markets'. *The Balance*. Available at: www.thebalance.com (accessed November 2019).

Lescaroux, F., and V. Mignon (2008). 'On the Influence of Oil Price in Economic Activity and Other Macroeconomic and Financial Variables'. Working Paper 2008-05. Paris: CEPII. Available at: http://cepii.fr/PDF_PUB/wp/2008/wp2008-05.pdf (accessed August 2019).

Maurino, R. (2018). 'What Is a Bond Index?' *Financial Pipeline*. Available at: www.finpipe.com/what-is-a-bond-index/ (accessed March 2019).

Mollentze, S. (2016). 'The Monetary Transmission Mechanism in South Africa'. *Financial Markets Journal*. Available at: http://financialmarketsjournal.co.za/oldsite/6thedition/printedarticles/monetarytransmission.htm (accessed August 2019).

Monetary Library (2017). 'How Trump's Economic Policies Might Affect South Africa'. *Finance and Insurance*. Available at: www.bizcommunity.com/Article/196/516/157883.html (accessed October 2019).

Petropedia (2018). 'Oil Price'. Available at: www.petropedia.com/definition/7902/oil-price (accessed March 2019).

Philbrick, L. (2017). 'United States Monetary Policy as a Determinant of Capital Flows to Emerging Market Economies: A Study on Portfolio Investments to the BRICs Countries'. *Creative Thought Matters*. Available at: http://creativematter.skidmore.edu/econ_studt_schol (accessed June 2019).

Shin, Y., and B. Yu (2004). 'An ARDL Approach to an Analysis of Asymmetric Long-Run Cointegrating Relationships'. Mimeo. Leeds: Leeds University Business School.

Shin, Y., B. Yu, and M. Greenwood-Nimmo (2013). 'Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework'. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1807745

Snowdon, B., and H.R. Vane (2005). *Modern Macroeconomics: Its Origins, Development and Current State*. Cheltenham: Edward Elgar Publishing.

SparkNotes (2018). 'Measuring the Economy'. Available at: www.sparknotes.com/economics/macro/measuring1/section1/ (accessed April 2019).

Walker, A. (2019). 'Why the Fed's Interest Rate Move Matters'. *BBC World Service*. Available at: www.bbc.com/news/business-49733118 (accessed September 2019).

Wallace, R. (2017). 'How Does The US Interest Rate Cycle Affect You?' *Nedbank Investment Group*. Available at: https://nww.nedgroupinvestments.co.za/content/NGISingleSiteContent/Local/Individual-Investor.render.json?path=/content/NGISingleSiteContent/Local/IndividualInvestor/learn-more/insights/q2-2017/how-does-the-us-interest-rate-cycle-affect-you- (accessed July 2019).

Appendix

Table A1: Data for the five variables used in this study

Year	ALSINDEX	OIL_PRICE	SABINDEX	USA_INT	GDP
1980	17848.85	105.585	143.4794	-1.895833	6.621
1981	14179.18	102.0525	136.1977	-2.4675	5.361
1982	10509.52	94.7825	128.916	0.743334	-0.383
1983	6839.86	84.8625	121.6344	2.018333	-1.847
1984	3170.19	83.05	114.3527	2.213334	5.099
1985	1003.28	83.385	107.071	2.5225	-1.211
1986	1474.33	53.5275	110.1725	0.8775	0.018
1987	2047.41	58.945	117.465	1.726666	2.101
1988	1592.83	44.995	110.505	1.2775	4.2
1989	2316.9	54.085	109.525	-0.718335	2.395
1990	2694.16	70.305	112.955	0.450833	-0.318
1991	2870.43	59.6725	112.99	2.170833	-1.018
1992	3064.09	58.1075	123.365	3.488333	-2.137
1993	3480.7	51.77	133.1925	2.850834	1.234
1994	4905.98	47.4575	123.2275	2.878333	3.2
1995	5036.07	50.725	122.125	0.743333	3.1
1996	6142.56	60.655	124.67	1.14	4.3
1997	6231.11	58.1575	131.945	0.8925	2.6
1998	5849.24	40.4425	127.22	-0.089167	0.5
1999	6610.3	53.895	134.215	0.666667	2.4
2000	7812.73	85.385	142.265	-0.206669	4.2
2001	8908.3	73.4025	158.695	1.130001	2.7
2002	10140.73	74.855	154.1325	2.944167	3.7
2003	8845.91	86.6525	170.935	2.8875	2.949
2004	11114.68	114.475	170.985	2.925	4.555
2005	14900.74	162.83	178.5475	1.076667	5.277
2006	21628.19	194.98	173.47	-0.172501	5.604
2007	28452.39	218.855	167.975	-0.39	5.36
2008	26962.06	293.32	159.8175	1.739167	3.191
2009	23323.9	184.7625	159.6375	3.096666	-1.538
2010	28509.12	238.6125	164.0125	3.039167	3.04
2011	31848	333.5675	163.5075	2.684166	3.284
2012	35262.35	335.405	172.0734	1.6625	2.213
2013	42057.11	326.38	171.7137	2.243333	2.485
2014	49231.35	297.73	164.5463	2.451667	1.847

2015	51960.08	157.49	164.8002	2.003333	1.194
2016	51568.44	130.73	155.3841	1.446667	0.399
2017	55045.68	162.7375	156.7963	1.328333	1.415
2018	56114.94	213.0825	164.3858	1.078333	0.787

Source: author's compilation based on data from Quantec, World Bank, and International Monetary Fund for 1980–2018.