



# The role of oil prices in the forecasts of South African interest rates: A Bayesian approach<sup>☆</sup>



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## ABSTRACT

This paper considers whether the use of real oil price data can improve upon the forecasts for the nominal interest rate in South Africa. We employ Bayesian vector autoregressive models that make use of various measures of oil prices and compare the forecasting results of these models with those that do not make use of this data. The real oil price data is also disaggregated into positive and negative components to establish whether this would improve upon the forecasting performance of the model. The full dataset includes quarterly measures of output, consumer prices, exchange rates, interest rates and oil prices, where the initial in-sample period extends from 1979q1 to 1997q4. We then perform recursive estimations and one- to eight-step ahead forecasts over the out-of-sample period 1998q1 to 2014q4. The results suggest that the models that include information relating to oil prices outperform the model that does not include this information, when comparing their out-of-sample properties. In addition, the model with the positive component of oil price tends to perform better than other models over the short to medium horizons. Then lastly, the model that includes both the positive and negative components of the oil price, provides superior forecasts over longer horizons, where the improvement is large enough to ensure that it is the best forecasting model on average. Hence, not only do real oil prices matter when forecasting interest rates, but the use of disaggregate oil price data may facilitate additional improvements.

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## 1. Introduction

Since the seminal contribution of Hamilton (1983), which investigates the effects of oil shocks on business cycles in the United States, a large number of studies across developed and developing economies have analysed the impact of oil price shocks on macroeconomic and financial variables.<sup>1</sup> Within the set of emerging economies considered, South Africa – an oil importing and inflation targeting small open economy – has featured prominently, with a large corresponding literature devoted to studying the impact of oil

shocks on macroeconomic, agricultural and financial variables.<sup>2</sup> The majority of this evidence suggests that oil price shocks significantly affect the behaviour of domestic macroeconomic variables.

The related literature on the response of central banks to oil price shocks includes the work of Bernanke et al. (1997), Hamilton and Herrera (2004), Bernanke et al. (2004) and Kilian and Lewis (2011). These studies allude to the fact that an oil price shock may contribute towards increased inflationary pressure and a decline in real output. The optimal response of the central bank would therefore depend upon its mandate and the quantitative importance of these measures of economic activity. Furthermore, when evaluating the effects of oil price shocks, Bernanke et al. (1997) suggest that increases in the Federal Funds rate that follow oil price shocks were one of the main causes of recessions. They also suggest that these recessions could

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<sup>1</sup> For a detailed literature review, the reader is referred to Balcilar et al. (2014d).

<sup>2</sup> See for example, Gupta et al. (2013), Gupta and Modise (2013), Aye et al. (2014a, 2014b), Balcilar et al. (2014a,b,c), Gupta and Kanda (2014), Ajmi et al. (2015, 2016), Chisadza et al. (2013), and de Bruyn et al. (2015), and references cited therein for earlier works.

have been avoided if the Federal Reserve had accepted higher rates of inflation over these periods.

However, Hamilton and Herrera (2004) note that an attempt to keep interest rates constant over this period, would have required an unprecedented (non-credible) policy intervention.<sup>3</sup> In a subsequent study, Kilian and Lewis (2011) suggest that the transmission of oil price shocks is relatively complex and that central bankers may need to respond to the underlying causes of these shocks. For example, the optimal response to an aggregate demand oil price shock may differ to the response that may be required to an aggregate supply shock. In terms of the literature that is relevant to South Africa, the most recent in-sample vector autoregression-based evidence suggests that the central bank would usually respond to oil price shocks when setting interest rates, in response to an anticipated increase in inflation (Aye et al., 2014b; Chisadza et al., 2013).

Against this backdrop, the objective of this paper is to test whether the evidence from in-sample explanatory investigations may be extended to test for the predictive power of oil prices in a forecasting exercise. In this case, we make use of the quarterly out-of-sample period 1998q1 to 2014q4, which includes the start of the inflation targeting era that begun in February 2000. The initial in-sample period for the estimation of the parameters in the respective models extends from 1979q1 to 1997q4. This period is used to generate the parameters that influence the subsequent forecast, which extends over eight quarters. Thereafter, the in-sample period is extended to 1998q1, before the model parameters are estimated once again to generate the second eight-step-ahead forecast. This process continues until we have the last of the eight-step-ahead forecasts that extend to the end of the out-of-sample period.

The baseline model that is used in this exercise employs a vector autoregressive (VAR) structure that is estimated with Bayesian techniques. This model includes measures of output, price levels, exchange rates and interest rates to generate the respective recursive forecasts. The out-of-sample ability of this model is then compared with those that make use of the same structure and estimation techniques, but where the variables are supplemented with the addition of a measure of real oil prices. The evaluation is conducted with the aid of root-mean squared-error (RMSE) statistics and measures that consider the significance of any potential improvement, to determine whether the models with information relating to oil prices would be able to improve upon the accuracy of the predictions for interest rates.

The use of Bayesian vector autoregressive (BVAR) models allows for the estimation of parameters with integrated data in level form, where the prior is appropriately specified. This procedure ensures that we do not need to transform the underlying variables to induce stationarity, as would be the case when making use of a VAR model that employs classical estimation techniques. This may avoid possible misspecification errors that could be due to the identification of a stochastic or deterministic trend. In addition, this practice does not necessitate the extraction of information relating to possible long-run relationships. Hence, when making use of an appropriate prior specification the BVAR model would account for features such as unit roots and cointegration, which we control for in this study. In addition, we also employ the recent developments that follow Giannone et al. (2015), which allow the prior to adjust to the in-sample properties of the data.<sup>4</sup>

As part of the forecasting evaluation, the information content from real oil price data is disaggregated into positive and negative components, to consider whether such disaggregation could produce

more accurate out-of-sample forecasts relative to those that use oil price data that has not been decomposed. Furthermore, we also seek to identify the component of the oil price that matters most to the forecasting performance of the model.

To the best of our knowledge, this is the first attempt at an investigation into the importance of oil price data and its components in interest rate forecasts for South Africa. The rest of the paper is organized as follows: Section 2 provides a theoretical and empirical motivation for the study, while Section 3 describes the methodology that is employed. Details of the data are contained in Section 4 and the results are discussed in Section 5. Section 6 comprises the conclusion.

## 2. Motivation

Duffee (2013) notes that there are several reasons for wanting to generate an accurate forecast of interest rates. Policy-makers seek to forecast interest rates to quantify the expectations of economic agents before deciding upon an appropriate strategy for monetary and fiscal policies. These forecasts may also be used to predict the behaviour of other related variables, such as real interest rates, inflation rates, exchange rates, and measures of macroeconomic activity. In addition, they could also be used in the construction of term-structure models that associate interest rate forecasts with the dynamics of the risk premia. Of course, numerous financial market participants would also generate interest rate forecasts to derive a trading strategy, from which they would expect to derive potential profits.

When the central bank employs an inflation-targeting framework, short-term interest rates (such as the three-month Treasury bill rate) would largely be influenced by changes to the central bank rate of interest. Hence, if the central bank expects that there will be an increase in inflationary pressure in the future, it would raise the central bank rate. One of the important factors that would influence the future rate of inflation is the price of energy, which has a significant effect on the rate of inflation.<sup>5</sup> Therefore, as the price of oil affects the price of energy and related goods, it may contain useful information that could be used to forecast the future behaviour of interest rates.

In addition to the transmission mechanism that is described above, Hamilton (2008) notes that changes in the oil price have important macroeconomic effects and that nine of the ten recent recessions in the United States were preceded by oil price shocks. Furthermore, Kaufmann et al. (2011) provide evidence which suggests that rising energy prices constrain consumer budgets and raise mortgage delinquency rates. This may encourage banks to increase the rate at which they are prepared to extend loans.

The motivation for differentiating between positive and negative oil price shocks may be found in the literature that considers the effect of price rigidities and the possibility of an asymmetric pricing mechanism. For example, Ball and Mankiw (1994) make use of a menu-cost model where positive trend inflation triggers larger price responses at the time of an upward price adjustment, rather than at the time of downward adjustments (which could also be achieved by maintaining a constant nominal price level). A similar theoretical motivation for the asymmetric price adjustment mechanism is provided in Cabral and Fishman (2012), who make use of

<sup>3</sup> In addition, they suggest that the results provided in Bernanke et al. (1997) are not robust to different specifications of the lag-length in the vector-autoregressive model.

<sup>4</sup> In this respect, the model has features that are commonly associated with hierarchical or multilevel BVAR models.

<sup>5</sup> In terms of the weights that are allocated to energy-related items in the consumption basket during 2014, transport constitutes 16.43%, which is a larger share than food and non-alcoholic beverages, while electricity and other fuels constitutes 4.18%. It should also be noted that since oil is effectively used in the transportation of most goods in the economy, any change in the price of oil would potentially influence the price of all other goods (after a brief period of time).

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