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# Modelling the oil price–exchange rate nexus for South Africa

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ABSTRACT

This paper conducts an empirical analysis of the relationship between oil prices and exchange rates in South Africa. We model the volatility and jumps in exchange rate returns by using the GARCH autoregressive conditional jump intensity model of Chan and Maheu which models the effects of extreme news events (jumps) in returns. The empirical results show that oil price increases lead to a depreciation of the South African rand relative to the US dollar.



## 1. Introduction

The price of crude oil has continued to attract interest from economists, policy makers and businesses since the oil price shocks of the 1970s and this interest has led to a proliferation of studies that attempt to model how oil prices affect various economic magnitudes. This was largely driven by early studies such as Hamilton (1983) and Darby (1982) which showed that the recessions of the 1970s and 1980s were as a result of large increases in oil prices. One of such variables of interest is the exchange rate and the reason for this interest derives from the fact that oil prices are quoted in US dollars and thus the US dollar exchange rate is the primary channel through which changes in oil prices are transmitted to the real economy and financial markets (Reboredo, 2012). Increases in the oil price will lead to an increase in the relative price of commodities in an oil-exporting country relative

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to that of an oil-importing country. This leads to an increase in the real exchange rate of the oil-exporter (Chaudhuri and Daniel, 1998) although the magnitude of such an impact on exchange rates depends on the distribution of oil imports across oil-importing countries and on portfolio preferences of both oil-importing and oil-exporting countries (Huang and Guo, 2007).

The theoretical links between oil prices and the exchange rate have been established in the literature and two avenues have been identified through which oil prices can affect exchange rates (Bénassy-Quéré et al., 2007; Beckman and Czudaj, 2013). The first avenue, called the 'terms of trade channel', is traced to Amano and van Norden (1998a) and this focuses on oil as a major determinant of the terms of trade. The model comprises of two sectors: a tradables sector and a non-tradables sector; and both sectors have two inputs: a tradable input which is oil, and a non-tradable input which is labour. According to Bénassy-Quéré et al. (2007), if we assume that the output prices of both the tradable and non-tradable sector can change following oil price increases (while keeping the law of one price in the tradable sector), it is seen that a rise in the oil price can lead to either an appreciation or depreciation of the exchange rate. Specifically, the effect of such an oil price increase will depend on the oil intensity of both sectors in the country. In a situation where the non-tradable sector is more energy intensive than the tradable sector, both its output price and the real exchange rate will increase. Conversely, if the non-tradable sector is less energy intensive, then the exchange rate will depreciate.

The second avenue is the 'wealth transmission channel' and this is derived from the work of Krugman (1980) where attention is placed on the balance of payments (Bénassy-Quéré et al., 2007; Beckman and Czudaj, 2013). In this case the analysis centres on the tradables sector and on international portfolio choices. When the oil price rises, this translates to the transfer of wealth from oil-importing to oil-exporting countries. Ordinarily, this will lead to appreciation of the exchange rate of the oil-exporting country and depreciation of the exchange rate of the oil-importing country. However, Krugman (1980) went further and showed that the effect of such an oil price increase on the exchange rate will be determined by two factors: (i) the distribution of oil imports across oil-importers; and (ii) on portfolio preferences of both the oil-importers and oil-exporters. If OPEC imports more goods from industrial countries as a result of the wealth from higher oil prices, the direction of change of the exchange rate will depend on the countries from which OPEC imports from. If such OPEC imports come from countries other than the US, the US dollar will appreciate in the short run but not in the long run (Bénassy-Quéré et al., 2007, p. 5796).

This paper is concerned with conducting an empirical investigation into the effect of oil prices on South Africa's exchange rate. Our study contributes to the literature in two main ways. Firstly, South Africa is an oil-importing country and thus, the results from this study will give an indication whether the theoretical predictions and empirical results from advanced oil-importing countries of the effect of oil price increases on the exchange rate hold for an emerging economy in Africa. Secondly, we make use of GARCH-jump models in examining the relationship between oil prices and exchange rates in South Africa. Chan and Maheu (2002) showed that ordinary GARCH models only account for smooth persistent changes in volatility and do not capture the discrete jumps in asset returns. Thus, they only capture the effects of normal information on asset returns and fail to examine the effects of extreme news or abnormal information arising from for example, earnings surprises, market crashes, political issues, financial crisis or terrorist attacks (Chan and Maheu, 2002; Kao et al., 2011). To address this issue and adequately model jumps, we make use of the GARCH autoregressive conditional jump intensity model of Chan and Maheu (2002) and Maheu and McCurdy (2004).

The rest of this paper is organised as follows: the next section conducts a review of literature into the oil price–exchange rate nexus. Section 3 presents the data and methodology while the empirical results are presented in Section 4. The results of robustness tests are presented in Section 5 and Section 6 contains the conclusions and policy implications.

## 2. Literature review

This section reviews empirical studies that have been conducted into the oil price–exchange rate nexus. Many early empirical studies were conducted for advanced economies and these used cointegration and causality analysis. A number of such early studies found that oil price increases lead to an appreciation of the