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Macroeconomic Variables and South African Stock Return Predictability[☆]

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We examine both in-sample and out-of-sample predictability of South African stock return using macroeconomic variables. We base our analysis on a predictive regression framework, using monthly data covering the in-sample period between 1990:01 and 1996:12, and the out-of sample period commencing from 1997:01 to 2010:06. For the in-sample test, we use the *t*-statistic corresponding to the slope coefficient of the predictive regression model, and for the out-of-sample tests we employ the MSE-F and the ENC-NEW test statistics. When using multiple variables in a predictive regression model, the results become susceptible to data mining. To guard against this, we employ a bootstrap procedure to construct critical values that account for data mining. Further, we use a procedure that combines the in-sample general-to-specific model selection with tests of out-of-sample forecasting ability to examine the significance of each macro variable in explaining the stock returns behaviour. In addition, we use a diffusion index approach by extracting a principal component from the macro variables, and test the predictive power thereof. For the in-sample tests, our results show that different interest rate variables, world oil production growth, as well as, money supply have some predictive power at certain short-horizons. For the out-of-sample forecasts, only interest rates and money supply show short-horizon predictability. Further, the inflation rate shows very strong out-of-sample predictive power from 6-month-ahead horizons. A real time analysis based on a subset of variables that underwent revisions, resulted in deterioration of the predictive power of these variables compared to the fully revised data available for 2010:6. The diffusion index yields statistically significant results for only four specific months over the out-of-sample horizon. When accounting for data mining, both the in-sample and the out-of-sample test statistics for both the individual regressions and the diffusion index become insignificant at all horizons. The general-to-specific model confirms the importance of different interest rate variables in explaining the behaviour of stock returns, despite their inability to predict stock returns, when accounting for data mining.

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1. Introduction

The current uncertainties regarding the fragile global economic recovery continue to highlight the importance of accurately forecasting the path of the leading indicators of the economy. There exists wide international evidence (Gupta and Hartley, 2011) that asset prices, including stock prices, help in predicting output and inflation by acting as leading indicators (see Forni et al., 2003 and Stock and Watson, 2003 for excellent summaries in this regard). More recently, Gupta and Hartley (2011) highlight the importance of asset prices, especially stock prices, in forecasting inflation and output for South Africa. In addition, the fact that there are major (asymmetric) spillovers from the stock market to the real sector of the economy has also been depicted by a wide number of recent international studies, for example, Apergis and Miller (2004, 2005a,b, 2006), Lettau and Ludvigson (2001, 2004), Lettau et al. (2002), Pavlidis et al. (2009), Rapach and Strauss (2006, 2007) to name a few, and for South Africa by Das et al. (forthcoming). Hence, obtaining accurate predictions of stock prices cannot be understated, since if predicted accurately, the forecasts not only pave a path for relevant policy decision in advance, but can also provide important information for policy makers to appropriately design policies to avoid the impending crisis.

In a recent study, Gupta and Modise (2012a), using monthly South African data for 1990:01–2009:10, examined the in-sample predictability of real stock prices based on valuation ratios, namely, price–dividend and price–earnings ratios. The authors could not reject the hypothesis that the current value of a valuation ratio is uncorrelated with future stock price changes at both short- and long-run horizons. Realising that, since it is possible for a variable to carry significant out-of-sample information even when it is not the case in-sample (Rapach and Wohar, 2006; Rapach et al., 2005), and also the need to incorporate the role played by stock returns of major trading partners of South Africa in explaining the future path of real stock returns. Gupta and Modise (2012b) use a wide set of

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financial variables, as well as international stock returns, for analysing both in- and out-of-sample stock return predictability. They show that, with in-sample only the stock returns of the major trading partners have predictive power at certain short- and long-run horizons. For the out-of-sample, the Treasury bill rate and the term spread together with the stock returns of the major trading partners show predictive power both at short- and long-run horizons. However, when the authors accounted for data mining, the maximal out-of-sample test statistics became insignificant from 6 months onwards, suggesting that the evidence of out-of-sample predictability at longer horizons is due to data mining.

Against this backdrop of limited predictability of stock returns in South Africa based on financial variables, we follow the vast international literature (see Rapach et al., 2005 for a detailed literature review in this regard) in investigating the predictability of stock returns using macro variables. The choice of using macro variables for stock return predictability is quite natural, since these macroeconomic variables tend to influence not only the firm's expected cash flows, but also, the rate of discount for the same cash flows (Rapach et al., 2005). In addition, as indicated by Breeden (1979), Campbell and Cochrane (1999) and Merton (1973), macro variables are key state variables in intertemporal asset-pricing models and represent priced factors in Arbitrage Pricing Theory (Ross, 1976), besides playing a role in affecting future investment opportunities and consumption. Further to assessing the predictive power of individual macro variables, we combine the information from these macro variables and extract a principal component (diffusion index) to allow for a simultaneous role of the macro variables. The diffusion index effectively summarises the information from the twelve macro variables used in our analysis, which is then used to test for predictability of South African stock returns, in an attempt to verify if combining information from all the macro variables helps in improving the prediction of stock returns.

To the best of our knowledge, this is the first study to employ a wide array of macroeconomic variables, drawn from the extant literature, to examine both in-sample and out-of-sample stock return predictability in South Africa in the context of a predictive regression framework—the empirical workhorse used in forecasting stock returns. Besides, standard macroeconomic variables like the inflation rate, money stocks, aggregate output, (un) employment rate, interest rates, and term spreads on bonds, we also consider world oil production and the refiner acquisition cost of imported crude oil to capture the impact developments on both the demand- and supply-sides of the global oil market, following the suggestions of Peersman and Van Robays (2009). The authors indicate that the underlying source of the crude oil price shift is crucial in determining the exact repercussions on the real and financial sectors of the economy. Although focusing on the US, Kilian and Park (2009) also show that the response of stock returns may differ greatly depending on whether the increase in the price of crude oil is driven by demand or supply shocks in the oil market.

Our time series data covers the in-sample period of 1990:01 to 1996:12 and the out-of-sample period of 1997:01 to 2010:06, with the latter covering the Asian financial crisis, South Africa's decision to move to an inflation targeting regime in 2000, the currency crisis in 2002, and finally the US sub-prime crisis. For in-sample predictability, we use the *t*-statistic corresponding to the slope coefficients in a predictive regression model. For the out-of-sample period, we use the MSE-F and the ENC-NEW test statistics developed by Clark and McCracken (2001) and McCracken (2004). To account for data mining—since both the in-sample and the out-of-sample test statistics are subjected to data mining when one uses a large number of predictors (Inoue and Kilian, 2002)—we compute appropriate critical values for all the test statistics using a data-mining-robust bootstrap procedure. We also use a methodology that combines in-sample general-to-specific model selection with tests of out-of-sample forecasting ability to assess the importance of macro variables in explaining the behaviour of stock returns.

Our in-sample results show that most of the interest rate variables, included in our analysis, have short-run predictive ability, whilst, the world oil production and money supply have some predictive power at certain horizons. For the out-of-sample period, the change in the inflation rate exhibits very strong predictive power over the medium- to long-run horizons. Other variables that show some predictive ability—although very weak—are the relative Treasury bill rate, term spread, narrow money supply growth, relative money market rate and the world oil production. As we are using monthly data to predict stock prices, it is crucial that the data used is of the same vintage, since data revisions may be detrimental in discerning causal relationships between different time series. In light of this, we decided to put together a real-time version of our data set. Amongst the 12 predictors that we used, only four (industrial production, narrow money, broad money and real effective exchange rate) of them underwent constant revisions. We found that the forecast performance of these four predictors deteriorated both in- and out-of-sample compared to the fully revised data available for 2010:6. For the diffusion index predictive regression model, the in-sample predictive power is only obtained for 1-month-ahead, 3-month-ahead, 6-month-ahead and 24-month-ahead horizons. In case of the out-of-sample forecasting exercise, predictability is only noticeable for the 3-month-ahead and the 6-month-ahead horizons. When investigating the predictive ability of a number of macro variables, concerns about data mining arise naturally. To guard against data mining, we use appropriate critical values, for both our in-sample and out-of-sample tests. It is interesting to note that when accounting for data mining, both the in-sample and the out-of-sample test statistics for the individual macro variables and the diffusion index lack the predictive ability at all horizons; suggesting that data mining is strongly evident in our results. The findings for the model that combines the in-sample general-to-specific model selection with tests of out-of-sample forecasting ability show that interest rates contain important information about the stock return behaviour in South Africa, despite their inability to predict stock returns for the in-sample and out-of-sample periods. The remainder of the paper is organized as follows: Section 2 describes the econometric; Section 3 discusses the data and the results obtained from the models, whilst, Section 4 summarises our core findings and concludes.

2. Econometric methodology

2.1. In-sample predictability

Following Campbell and Shiller (1998) and Rapach and Wohar (2006), amongst others, we used a predictive regression framework to analyse stock return predictability. The predictability framework takes the form,

$$y_{t+1}^{k} = \alpha + \beta \cdot z_t + \gamma \cdot y_t + \mu_{t+1}^{k} \tag{1}$$

where y_t is the log real return to holding stock from period $t-1$ to period t, $y_{t+1}^{k} = y_{t+1} + \ldots + y_{t+k}$ is the real stock returns from period t to $t+k$, z_t represents the fundamentals used in predicting future real stock returns and μ_{t+k}^{k} is the error term. When $\beta = 0$ (our null hypothesis) then the variable z_t has no predictive power for future stock returns, whilst under the alternative hypothesis ($\beta \neq 0$), z_t is assumed to have predictive power for future returns. Inoue and Kilian (2002) recommend using a one-sided alternative hypothesis if theory makes strong predictions about the sign of β in Eq. (1), as this increases the power of in-sample tests. Similar to Rapach et al. (2005), for the macro variables that we consider, theory does not always make strong predictions as to the sign of β, so we use a two-sided alternative hypothesis. Following Lettau and Ludvigson (2001) as well as Rapach et al. (2005), we include a lagged stock return term in Eq. (1) as a control variable when testing the predictive ability of z_t. The partial autocorrelation function

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