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Explaining returns in property markets using Taylor rule fundamentals: Evidence from emerging markets

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A research report submitted to the faculty of Commerce, Law and Management, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Management in Finance and Investments.

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ABSTRACT

This study set out to investigate the relationship between returns in the residential property markets and two key economic variables of output and interest rates. The main focus was on the short-term rates path and how it is influenced by the Taylor rule fundamentals and in turn, its effect on the returns in the property markets within the developing countries of South Africa, Bulgaria, Lithuania and Czech Republic. A secondary focus was on building a model that can be further developed into a full forecasting model of returns in the residential property markets.

Output was found to be a strong driver of returns in the residential property markets across all four countries. Real changes in the economic activity feed into the residential property markets and drives returns. Output can be incorporated into a forecasting framework for returns in the residential property markets within these countries

The short-term rate paths within the countries studied were found to be consistent with the Taylor rule but with heavy short run deviations from the rule. Short-term rates deviated from the rule in the short run, but showed a tendency to revert to the rule in subsequent periods.

Returns and prices in the property markets were driven by the short-term rates only in two of the emerging markets. For these countries, this link between rate and returns mean there was also a link between monetary policy and returns in the property sector. Similar to the Taylor rule process, property returns in the two emerging markets were found to have short run deviations which could not be explained by interest rates and output.

For the purposes of building a fully fledged forecasting model, this model must be expanded to include other explanatory factors. Adding the risk premium as an explanatory variable could be the starting point.

DECLARATION

I, Ofentse Gumede, declare that the research report is my own work, except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in Finance & Investment at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

_____

Ofentse Gumede

Signed at _____

On the _____ day of _____ 2014

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CHAPTER 1: INTRODUCTION

1.1 Background

The housing market is a very important sector of any economy as property is one of the key asset classes for investment and shelter is a basic human need. The well-being and functioning of the economy, its financial system and society depends on this market. Assenmacher-Wesche (2008) found that shocks to prices of assets like property have a positive and significant effect on output in the 17 Organisation for Economic Co-operation and Development (OECD) countries included in the study. This dynamic was highlighted by the recent financial crisis, which began in August 2007 when problems that emanated from the housing market in the US quickly brought the entire financial system and economy of the United States (US), followed by the rest of the world, to its knees. Some scholars and commentators have blamed the situation partly on the conduct of monetary policy arguing that the authorities created a fertile environment through a very relaxed monetary policy (more than required by the fundamentals) with very low interest rates and relaxed credit conditions. Taylor (2007) discusses this at length and concludes that monetary policy prior to the crisis deviated from what was dictated by the fundamentals and therefore might have had the effect of causing the housing bubble.

Adrian and Shin (2009) assert that before the crisis, the global economy was often described as being "awash with liquidity" (p. 600) and that the monetary policy dispensation, prior to the crisis, did not take into account and respond directly to the movements and levels of prices in the housing markets, thereby letting the economic wild fire burn unchecked.

Bordo and Jeanne (2002) raised the question of whether the central banks should respond only to inflation in the goods market, or also to inflation in asset prices. They argue that the response to inflation in asset prices be considered in terms of insurance against risk of real and financial disruption induced by a later bust. This implies that monetary policy could and should be used to minimise

the risk of a financial crisis like the one we had in 2007. However, as noted by Bordo and Jeanne (2002), this would require a more complex policy rule than, for example, a standard Taylor rule.

Studies of property prices in different countries generally find them to be driven by current and lagged income growth and real interest rates. Indeed, a negative correlation between interest rates and housing prices is said to exist. In a number of European Union (EU) countries the correlation between real housing prices and real interest rates has been found to be especially high (IMF, 2000). Based on this, the accusation can be believed; the bubble that formed in the housing market before it burst in 2008 had something to do with the monetary policy decisions prior to 2008. As noted by Taylor (2007), there was indeed a deviation of monetary policy during the period 2003 to 2006, when the rates were well below what they had been in the previous two decades.

The Taylor rule approach to monetary policy decisions has gained momentum and recognition since it was introduced in 1993. Hetzel (2000) noted that Taylor deduced his rule from observed behaviour of the Federal Open Market Committee (FOMC) by emphasising two aspects of behaviour. First, the FOMC uses short-term rates as a policy instrument and second, it sets its rate based on the observed behaviour of the economy as judged by output growth and the concomitant consumer inflation rates. The Taylor rule summarises and models the monetary policy behaviour of the central banks and it has since gained recognition and been adopted by central bankers across the world. Pierdzioch, Rulke and Stadtmann (2012) find that consistency with the Taylor principle is strong for academics and Federal Reserve economists, and weak for private-sector economists. Taylor (2000) finds that for the open emerging markets with a free-floating exchange rate, the only sound monetary policy is one that is based on the Taylor rule or an adaptation thereof. Laxton and Pesenti (2002) find that simple IFB (inflation-based) rules, which place heavy weight on inflation forecasts, may perform better in small open economies than the conventional Taylor rule.

Mohanty and Klau (2004) find that most central banks in emerging markets behave in a manner consistent with the Taylor rule, which includes the exchange rate as an independent variable, and they respond more aggressively to the exchange rate than to the output or inflation gap. It is clear that the Taylor rule captures the behaviour of central banks in both the developed and developing world of today and yesteryear.

The significance of the Taylor rule in explaining the movement of economic variables has been highlighted by Molodtsova and Papell (2009) when they looked at predicting the exchange rate movements using the fundamentals of the Taylor rule and found that models that employed the Taylor rule approach where much better at predicting the exchange rate compared with other conventional models. This could mean that employing a similar model to the returns in the housing market could be of benefit.

1.2 Research objectives

This study seeks to understand how residential property prices and returns are driven by the interest rate environment and real economic activity. First, the study estimated the short-term rate path using the Taylor rule set up, and second, linked this to the prices and returns in the residential property market. This was performed to observe if and how monetary policy actions filter through to the residential property market.

This study has two main theories underpinning it. One is the Taylor rule theory and the other is the asset valuation theory, which asserts that the value of an asset (and thereby returns) is driven by its cash flows and the appropriate discount rate.

The relationship between the said variables is modelled and discussed to establish its validity.

1.3 Research questions

This study attempts to find answers to the following questions within the emerging markets context:

[1] Does the short-term rate path follow the Taylor rule process and, if so, how?

[2] Does the short-term rate influence the prices and returns in the residential property market?

1.4 Research scope

This study was limited to emerging markets, four of which were selected based on the data availability: South Africa, Bulgaria, Lithuania and Czech Republic. The US was included in the analysis merely as a reference point. The analysis was limited to variables defined by the Taylor rule theory as well as by the asset valuation theory and how these affect the prices in the respective residential property markets within each country.

The study was limited to building a model that could be used in forecasting, or as input into the building of such a forecasting model, the returns in the residential property market in each country. This study was limited to explaining and establishing the relationships between the dependant variable of returns in the property markets and the independent variables of output and risk free interest rates without attempting to test any forecasting ability.

1.5 Significance of the study

If the impact of the short-term rate on the residential property market can be understood and modelled then this framework could be useful in the following ways:

[1] First, the monetary authorities will be able to understand and quantify the impact of their actions on the residential property markets in advance. In this way, bubbles supposedly caused by interest rates, can be averted.

[2] Second, the investors in the residential property markets will be in a position to accurately forecast their returns given the path of short-term rates and output and thereby make better investment decisions.

[3] Last, the academic society will gain a deeper understanding of the valuation and price dynamics within the residential property market in order to aid development of more advanced theory and models of returns.

1.6 Structure of the paper

Chapter 2 looks at the relevant literature around the topic of property prices and monetary policy, particularly the Taylor rule. Chapter 3 develops a model of property prices and returns that incorporates the monetary policy rate effect as derived from the relevant Taylor rule model. Chapter 4 estimates the relevant Taylor rule and the property returns models and discusses the validity thereof. Finally, Chapter 5 concludes the paper with a discussion and summary of the key findings as well as recommendations.

CHAPTER 2: LITERATURE REVIEW

Since the 1980s, many studies have looked at the influence of specific macro and micro variables on the housing market. Most studies have attempted to understand interest rates, at the macro and micro level, as drivers of prices or returns in the housing market. These studies find that monetary factors like money stock, mortgage rates, credit conditions and interest rates have a significant impact on the housing market while others like Iacoviello and Neri (2010) finds that these monetary variables have a rather weak impact. Some econometric models find either insignificant or incorrectly signed coefficients of interest rates. One study looked at financial spreads instead of just interest rates. Detailed reviews of these studies follow.

Iacoviello and Neri (2010) employed a dynamic stochastic general equilibrium (DSGE) model and found that monetary factors explain less than 20 percent of the variation in housing prices and investment. Wheeler and Chowdhury (1993) looked at the residential investment expenditure using variance decomposition and found the shocks to the money stock, output and interest rates have significant effect on residential expenditure and demand. Apergis (2003) studied the impact of inflation, employment and mortgage rates on the price of new houses sold in Greece. He employed an error correcting vector autoregressive (VAR) model and found that the mortgage rate was the most influential of the three variables on housing prices. Sari, Ewing and Aydin (2007) investigated the relationship between housing starts or investments and macro-economic variables in the form of interest rates, output, money stock and employment in Turkey. They found that the monetary aggregates have much more significant impact on housing investment than employment. Gupta, Karbundi and Miller (2011) employed a 10-variable dynamic structural general equilibrium model to forecast the US real house price index as well as its downturn in the second quarter of 2006. Their study suggested that forward-looking micro-founded DSGE models of the housing market might prove crucial in forecasting turning points. They employed a DSGE model as well as different time series models to forecast out of sample. Garriga, Manuelli and Peralt-Alva (2012) of the Reserve

Bank of St Louis found that changes in interest rates and credit conditions could generate significant price swings in the property markets. They constructed a two good general equilibrium model in which housing is a composite good produced using structures and land. They also found that standard asset pricing formulas accurately describe the behaviour of house prices if the appropriate pricing kernel is used. Nobili and Zollino (2012) of the bank of Italy estimated what they called a fully-fledged structural system for the housing market in Italy. They showed that house prices react mostly to standard drivers such as disposable income, expected inflation and demographic pressures. Lending conditions, as they affected mortgage loans, were also shown to have a significant impact on housing demand and prices thereof. Furthermore, they found that since the mid-eighties house price developments in Italy have been broadly in line with the fundamentals.

All the studies covered thus far found a relatively strong link between rates and prices in the housing market. Case and Shiller (2003), on the other hand, found that mortgage rates had an insignificant coefficient for most of the models they ran. Mayer (2003) is also on the sceptical side noting that historical prices may have not been responsive to changes in interest rates.

Brooks and Tsolacos (2001) took a slightly unconventional approach. They set up a model for predicting housing prices using financial spreads as an explanatory variable. They employed the VAR techniques and found that adding financial spreads to the univariate models improved the out of sample forecasting power of the model.

One point of departure in the literature is the impact of the tax regime on the returns and prices in the housing market. Poterba (1984) looked at how tax subsidies affected the cost of homeownership through the interest charge paid by homeowners. He found that the acceleration of inflation, which in turn has driven up interest rates, was responsible for the boom in property prices during the period in his study. This was because of the tax deductibility of the interest charge. Poterba's (1984) model related house prices to the change in inflation and achieved 30 percent accountability.

Another point of departure is the impact of the supply side factor of construction cost and how it affected returns in the housing market. The population growth is another factor that drives returns. Case and Shiller (1990) used time series cross-section regressions to forecast the quarterly indices of existing home prices in four states in the US, using a number of independent variables. They found that, “the ratio of construction costs to price, changes in adult population and increases in real per capita income all are positively related to excess returns or price changes over the subsequent year” (p. 253).

Another angle to the literature is the investigation of the impact of borrowing constraints and costs on the prices in the housing market. McQuinn and O'Reilly (2007) propose a framework that shows that prices are driven by how much individuals can afford to borrow from financial institutions, which will depend on income and mortgage rates. They employed this approach in the Irish market and found the existence of a long run relationship between housing prices and this borrowing capacity. Iacoviello (2005) looked at the impact of borrowing constraints and nominal loans on housing prices and output. Flavin and Nakagawa (2008) looked at the importance of adjustment costs in determining housing demand. They found that adjustment costs played a role in housing consumption decisions.

Some studies took a regional view in investigating particular dynamics of the housing markets. One study found that there were regional differences in how the housing market is impacted by macro variables and another study found uniformity in the response or impact. Reichert (1990) investigated regional housing prices in the US and found that they reacted uniformly to certain national factors such as mortgage rates, which are of course driven by monetary policy. Rapach and Strauss (2009) highlighted the differences in the forecastability of housing prices across US states. They found that autoregressive models, and especially models that incorporate information from numerous economic variables, often provided relatively accurate housing price forecasts for a number of interior states during the period 1995 to 2006. Baffoe-Bonnie (1998) employed a non-structural estimation technique (VAR) to

estimate the impact of regional employment growth and mortgage rates on housing prices. He found that housing prices were very sensitive to shocks in these economic variables.

Most studies looked at the obvious variables like, tax, interest rates, output, mortgage rates, borrowing constraints, and construction costs. However, others like Brooks and Tsolacos (2001) looked at other variables, which are not obvious drivers of returns in the housing markets like financial spreads. In addition, most studies employ the VAR methodology and a few use dynamic structural general equilibrium models.

This study investigated the impact of the current short-term risk free interest rates, the expected short-term risk free interest rates and output growth on the returns in the property markets in the context of emerging markets. This study introduced a Taylor rule as a driver of the short-term rate in order to create a link to the monetary policy action.

CHAPTER 3: METHODOLOGY

It was first put forth by Williams (1938) that the price or intrinsic value (V) of any asset is equal to the present value of the future cash flows (CF) from that asset discounted back with an appropriate discount rate (R) as per the following formula:

$$V_t = \sum_{j=1}^{n} \frac{\mathrm{CF_{t+j}}}{(1+R_t)^{\mathrm{t+j}}} \qquad (1)$$

With the assumptions of a constant growth of the cash flows (g) and a perpetual holding period, the valuation equation is as follows:

$$V_t = \frac{\mathrm{CF_t}(1+\mathrm{g})}{(R_t - \mathrm{g})}$$

By taking the natural log, a linear approximation is arrived at, as follows:

$$logV_t = \log \mathrm{CF_t} + \log\,(1+\mathrm{g}) - \log\,(R_t - \mathrm{g})$$

Because g is a constant, the variability in prices will be driven by current cash flows $(\mathrm{CF_t})$ and the discount rate (R_t). Therefore, in the simple linear sense this relationship can be estimated as follows:

$$V_t = \alpha_0 + \alpha_1 CF_t - \alpha_2 R_t + \varepsilon_t \qquad (2)$$

Where:

R *= the appropriate discount rate,*

CF = cash flow from the asset,

α_0 *= constant value*

Cash flows are positively related to value while the discount rate is negatively related to value.

For the asset under study, residential property, the cash flows are represented by the net rental income. It is assumed that rental income could be approximated by output in the following manner:

$$CF_t = Rent = \Omega\Upsilon_t \quad (3)$$

Where:

Υ = Real Output,

Ω = share of rent in total output

The appropriate discount rate (R) is a rate that is appropriate given the risk of the cash flows. Models like CAPM and those of Fama & French (1992) and Pastor & Stambaugh (2001) describe the various components of this appropriate discount rate. These models start with the risk free rate as a floor rate. That means that any asset's value is driven primarily by the prevailing risk free rate, then by all other risk factors and their factor sensitivities. The following is a general form of these types of models:

$$R_t = R_t^f + \sum_{t=1}^{\mathrm{v}} \psi_{\mathrm{t}} \times \sigma_{\mathrm{t}} = R_t^f + \rho_t \quad (4)$$

Where:

σ = risk factor

ψ = factor sensitivity,

ρ= total risk premium,

R^f *= risk free rate,*

n = number of short periods,

v = number of risk factors

Garriga et al. (2012) found that housing prices behave in a manner consistent with standard capital asset pricing models. This means that returns in the property market behave as modelled above.

It is widely accepted that a proxy for a risk free rate is a government security like a Treasury bill or Treasury bond depending on the term of the asset being valued. For a long-lived asset like property, the appropriate risk free rate is a long-term government bond, or an aggregate rate representing the long end of the yield curve.

In line with arbitrage free pricing and term structure theory, the yield of a long-term government bond is an average of the current and future short rates as follows:

$$R_t^f = \frac{1}{n}\sum_{j=0}^{n} \mathrm{E_t}\, \mathrm{r_{t+j}} \;\; = \frac{1}{n}\mathrm{r_t} + \frac{1}{n}\sum_{j=1}^{n} \mathrm{E_t}\, \mathrm{r_{t+j}} \qquad (5)$$

$$R_t^f - \frac{1}{n}\mathrm{r_t} \;= \frac{1}{n}\sum_{j=1}^{n} \mathrm{E_t}\, \mathrm{r_{t+j}} \qquad (6)$$

Where:

n = number of short periods,

E = expectations operator,

r = short-term risk free rate,

R_t^f *= long-term risk free rate*

Substituting Equations 6 into 4 produces the following equation:

$$R_t = \frac{1}{n}\mathrm{r_t} + \frac{1}{n}\sum_{j=1}^{n} \mathrm{E_t}\, \mathrm{r_{t+j}} \; + \; \rho_t \qquad (7)$$

The appropriate discount rate (R_t) is driven by the current short-term risk free rate($\mathrm{r_t}$), the expectations of the short-term risk free rate path $\mathrm{E(r_t)}$ and the total risk premium for the asset (ρ_t).

Substituting Equations 7 and 3 into 2, produces the below equation:

$$V_t = \alpha_0 + \alpha_1 \Omega \Upsilon_t - \alpha_2 \left[\frac{1}{n}\mathrm{r_t} + \frac{1}{n}\sum_{j=1}^{n} \mathrm{E_t}\, \mathrm{r_{t+j}} \; + \; \rho_t\right] + \mathrm{\varepsilon_t}$$

However, from equation 6:

$$\frac{1}{n}\sum_{j=1}^{n} \mathrm{E_t}\, \mathrm{r_{t+j}} \; = \; R_t^f - \frac{1}{n}\mathrm{r_t}$$

Therefore:

$$V_t = \alpha_0 + \alpha_1 \Omega \Upsilon_t - \alpha_2 \left[\frac{1}{n}\mathrm{r_t} + R_t^f - \frac{1}{n}\mathrm{r_t} + \rho_t\right] + \varepsilon_t$$

$$V_t = \alpha_0 + \alpha_1 \Omega \Upsilon_t - \left(\frac{\alpha_2}{n}\right)\mathrm{r_t} - \alpha_2 \left[R_t^f - \frac{1}{n}\mathrm{r_t}\right] - \alpha_2\, \rho_t + \varepsilon_t \qquad (8)$$

Equation 8 states that the prices and returns are driven positively by the current output $[\Upsilon_t]$ and negatively by the current short-term risk free rate $(\mathrm{r_t})$, the short-term risk free rate path expectations $\left[R_t^f - \frac{1}{n}\mathrm{r_t}\right]$ as well as the total risk premium (ρ_t)

Furthermore, the following error correction process is assumed:

$$V_t = V_{t-1} - \alpha_4 \varepsilon_{t-1} \qquad (9)$$

Such that:

$$V_t = V_{t-1} - \alpha_4 \left(V_{t-1} - \alpha_0 - \alpha_1 \Omega \Upsilon_{t-1} + \left(\frac{\alpha_2}{n}\right)\mathrm{r_{t-1}} + \alpha_2 \left[R_{t-1}^f - \frac{1}{n}\mathrm{r_{t-1}}\right] + \alpha_2\, \rho_{t-1}\right)$$

$$V_t = (1-\alpha_4)V_{t-1} + \alpha_4\alpha_0 + \alpha_4\alpha_1\Omega\Upsilon_{t-1} - \alpha_4\left(\frac{\alpha_2}{n}\right)\mathrm{r_{t-1}} - \alpha_4\alpha_2\left[R_{t-1}^f - \frac{1}{n}\mathrm{r_{t-1}}\right] - \alpha_4\alpha_2\,\rho_{t-1} \quad (10)$$

Equation 10 shows that current prices and returns are driven positively by the lag of output (Υ_{t-1}) and negatively by the lags of the short-term risk free rate $(\mathrm{r_{t-1}})$, the short-term risk free rate path expectations $\left[R_{t-1}^f - \frac{1}{n}\mathrm{r_{t-1}}\right]$as well as the total risk premium (ρ_{t-1})

The current short-term risk free rate (r_t) is a function of monetary policy. In line with Mohanty and Klau (2004), it is widely accepted that monetary policy in emerging markets is conducted as per the Taylor rule model. The fundamentals of the Taylor rule inform the policy rate. This policy rate will then feed directly into the short end of the bond market and into the risk free rate used for valuation in the entire market. The path of the short-term rates or the policy rate

is critical as far as it determines the risk free rate used in valuation via the models discussed (Equation 8).

The Taylor rule, which is believed to be the prevalent model of monetary policy conduct, contains inflation, output and exchange rate as the key factors driving the policy rate and therefore the short-term rates as well as the general level of rates in the economy. Mohanty and Klau (2004) find that most central banks in emerging markets behave in a manner consistent with the Taylor rule, which includes the exchange rate as an independent variable, and they respond more aggressively to the exchange rate than to the output or inflation gap.

The reaction function is adapted as follows:

$$r_t = \beta_0 + \beta_1 \pi_t + \beta_2 \ddot{Y}_t + \beta_3 \Delta e_t + \varepsilon_{tt} \qquad (11)$$

Where:

π is inflation rate,

Ÿ is the Output gap,

e is the log of the real effective exchange rate (a decrease means a depreciation and vice versa),

Δ is the 4th difference operator

Equation 11 states that monetary policy rate is driven positively by the current inflation rate (π_t) and the current output gap ($\ddot{Y}_t$). The real effective exchange rate is theoretically negatively related to the policy rate for emerging markets due to the dependence on imports of raw materials and sometimes even finished goods. A depreciating exchange rate will feed inflation and should prompt a hike in interest rates. Mohanty and Klau (2004) specified their rule with a positive coefficient but their empirical results found a negative coefficient in all the emerging market countries they studied except for one.

Furthermore, the following error correction process is assumed:

$$r_t = r_{t-1} - \beta_4 \varepsilon_{tt-1} \qquad (12)$$

Such that:

$$\varepsilon_{tt-1} = r_{t-1} - \beta_0 - \beta_1 \pi_{t-1} - \beta_2 \ddot{Y}_{t-1} - \beta_3 \Delta e_{t-1} \qquad (13)$$

Therefore, the reaction function takes the following form:

$$r_t = r_{t-1} - \beta_4(r_{t-1} - \beta_0 - \beta_1\pi_{t-1} - \beta_2\ddot{Y}_{t-1} - \beta_3\Delta e_{t-1})$$

$$r_t = (1-\beta_4)r_{t-1} + \beta_4\beta_0 + \beta_4\beta_1\pi_{t-1} + \beta_4\beta_2\ddot{Y}_{t-1} + \beta_4\beta_3\Delta e_{t-1} \qquad (14)$$

Equation 14 tells us that the monetary policy rate is driven positively by the lags of the inflation rate (π_{t-1}), the output gap ($\ddot{Y}_{t-1}$) and the changes in the exchange rate (Δe_{t-1}). In addition, the current rate is driven by its own lag (r_{t-1}).

CHAPTER 4: EMPIRICAL ANALYSIS

4.1 Model specification and estimation

For the reaction function, Equations 11 and 12 were estimated separately, instead of just Equation 14. This allowed the current effect from the lagged effect of the explanatory variables to be isolated.

$$r_t = \beta_0 + \beta_1\pi_t + \beta_2\ddot{Y}_t + \beta_3\Delta e_t + \varepsilon_{tt} \quad \text{.....Taylor Rule}$$

$$r_t = r_{t-1} - \beta_4\varepsilon_{tt-1} \quad \text{.....Taylor Rule with error correction}$$

Where:

r_t is the T bills rate,

π_t is the inflation rate,

$\ddot{Y}_t$ is the output gap (the residuals of the Hodrick-Prescott filter on the log of the real GDP),

e_t is the log of the real effective exchange rate and

Δ is the fourth difference operator

ε_{tt-1} is the lag of the error terms from the Taylor rule estimation.

For the property price returns function, Equations 8 and 9 were estimated separately, instead of just Equation 14. Again, this allowed the current effect from the lagged effect to be estimated. Equation 8 and 9 are represented as follows:

$$\Delta v_t = \alpha_0 + \alpha_1\Delta\Upsilon_t - \alpha_3 r_t - \alpha_2\left[R_t^f - \frac{1}{n}r_t\right] + \varepsilon_t \quad \text{.....Property Returns}$$

$$\Delta v_t = \Delta v_{t-1} - \alpha_4\varepsilon_{t-1} \quad \text{.....Property Returns with error correction}$$

Where:

(v_t) is the log of the property price index,

Δ is the 4th difference operator,

Υ_t is the log of real GDP,

r_t is the Treasury bills rate,

R_t^f is the Treasury bonds rate,

n is the maturity of the treasury bonds rate,

ε_{t-1} *is the lag of the error terms from the Property Returns equation estimation.*

The following should be noted regarding the coefficients of the estimated equation in relation to Equation 8.

$$\alpha_1 = \alpha_1 \Omega \qquad \alpha_3 = \frac{\alpha_2}{n} \qquad \alpha_2 = \alpha_2 \qquad \varepsilon_t = -\alpha_2 \, \rho_t + \varepsilon_t$$

The total risk premium will be part of the residuals in the estimated equation. A priori, a high possibility of serial correlation can be expected due to this variable not being specified on its own in the estimated model. Multicollinearity can also be expected due to the relation between the explanatory variables.

4.2 Data

The following emerging market countries were selected for this study and the following property market indices were sourced from the BIS (Word Bank) database.

- *South Africa*: A seasonally adjusted residential property market index covering all sectors of the market was used. This index covers both new and existing properties between 80 and 400 square metres within the country. Prices are based on total purchase price in respect of approved mortgage loan applications. The index is calculated on a monthly basis.
- *Bulgaria*: Non-seasonally adjusted residential property market index covering existing flats within district centres (big cities), which are comparable by predefined characteristics that remain unchanged for the entire reporting period. Price per square metre is used as a measuring unit. The index is reported quarterly.
- *Lithuania*: Non-seasonally adjusted residential property market index, covering all types of dwellings (houses and flats), new and existing, in the entire country. Price per square metre is the measuring unit. The index is reported quarterly.
- *Czech Republic*: Non-seasonally adjusted residential property market index covering all existing multi-dwellings (apartment buildings/houses).

Price per cubic metre is the measuring unit. The index is reported quarterly.

The US was used as a reference point and a seasonally adjusted residential property market index covering all types of existing dwellings in the entire country was used. It is also called the repeat sale index and it is reported monthly.

Additionally, quarterly data samples were sourced from the IMF database for the following variables.

- *TBills rate*: Average YTM/Auction rate on Treasury bills.
- *Treasury bonds rate*: Average YTM rate on 10-year government bonds.
- *Real effective exchange rate index*: US dollar direct quote exchange rate for Lithuania.
- Real GDP index - seasonally adjusted from source or adjusted using Eviews.
- *Consumer Price Index*: an indicator of the level of prices in the economy.

4.2.1 Data transformation

- Property market, CPI, Real Effective Exchange Rate (REER) and Real GDP indices were converted to returns by taking natural logarithms and then taking the fourth difference.
- TBills and Tbonds rate were not transformed in any way, except for converting to decimals.
- For Bulgaria, Lithuania and Czech Republic, the real GDP index was not adjusted for seasonality from the source. Eviews was used to adjust these indices for seasonality.
- For Lithuania the US dollar exchange rate was used in place of the real effective exchange rate.

4.3 Results analysis and interpretation

Tables 1 and 2 present the results of the Taylor rule estimation.

Table 1: Taylor rule

	South Africa	Bulgaria	Lithuania	Czech Rep	USA
β_0	0.070***	0.031***	0.006	0.014***	0.005
β_1	0.493***	-0.028	0.794***	0.333**	1.333***
β_2	0.510***	-0.009	-0.47***	0.141	0.099
β_3	-0.044*	0.159**	-0.031***	-0.044	0.092***
R-Squared	36%	12%	56%	48%	60%
(Prob)F -Stat	0.000	0.110	0.000	0.001	0.000
DW stat	0.127	0.243	0.741	0.721	0.212
N	131	51	46	28	130
Period	1981Q1 - 2013Q3	2000Q1 - 2012Q3	2002Q1 - 2013Q2	2005Q1 - 2011Q4	1981Q1 - 2013Q2

Note: *** Significant at 1% level ** Significant at 5% level. * Significant at 10% level.

Table 2: Taylor Rule with error correction

	South Africa	Bulgaria	Lithuania	Czech Rep	USA
β_4	-0.079***	-0.117*	-0.280*	-0.434***	-0.012
R-Squared	91%	86%	55%	78%	97%
DW stat	1.098	1.595	2.364	2.159	1.279

Note: *** Significant at 1% level ** Significant at 5% level. * Significant at 10% level.

For South Africa, all the coefficients and the constant of the Taylor rule are statistically significant at a 10 percent significance level. All the coefficients took the correct sign in line with the theory. The data seemed to fit well suggesting that indeed the Taylor rule could explain the path of the short-term rates in the South African economy, exactly 36 percent of the variation in the Tbill rates could be explained by the Taylor rule.

Furthermore, there was evidence of error correction as indicated by the significance of the error correction coefficient (β_4) at the 10 percent level. With error correction, the predictive power was significantly improved from 36 percent to 91 percent.

For Bulgaria, not only were the inflation and output gap coefficients insignificant at the 10 percent level but they also took on the wrong sign. This suggests that

this country is not responding to inflation and/or output in its monetary policy. All the signs are totally opposite of what was expected and very low predictive power was seen, with only 12 percent of the variation in rates explained by the model. The entire regression was insignificant at the 10 percent level with Prob (F-stat) of 11 percent.

With error correction, only 55 percent of the variation was explained with a significant error correction coefficient. The overall fit was very weak for Bulgaria suggesting that monetary policy is driven more by fundamentals or factors other than those of the Taylor rule. Only the exchange rate was significant, however its sign was wrong.

For Lithuania, all the coefficients were significant at a 10 percent level with only the constant showing as insignificant. The model explained 56 percent of the variation in the T-bills rate. However, the sign of the output gap coefficient was inconsistent with theory. The error correction model did not improve the predictive power even though the coefficient is significant at 10 percent. The Taylor rule model seemed to fit well for Lithuania with one major exception, the output gap took on the wrong sign.

For the Czech Republic, the signs of all the coefficients were correct but the output gap and the exchange rate coefficients are insignificant at the 10 percent level. Only 48 percent of the variation in TBills rate was explained. The error correction model explains 78 percent of the variations in the TBills rate with a significant coefficient at the 10 percent level.

For the US, a developed country, only the inflation and the exchange rate coefficients were significant at the 10 percent level with the inflation coefficient taking on a relatively high value of 1.333. The output gap coefficient is insignificant at the 10 percent level. In addition, the exchange rate coefficient took on the wrong sign. This model explains 60 percent of the variation in the TBills rate, suggesting a better fit than the others, but still with similar problems of wrong signs. Unlike the emerging markets, there was no evidence of error correction as the respective coefficient was insignificant at the 10 percent level.

In summary, South Africa and Lithuania were the only countries that showed current responsiveness of the short-term rates to all the Taylor rule fundamentals, although Lithuania had coefficient sign issues. Bulgaria only responded to the exchange rate but the coefficient had the wrong sign. Czech Republic responded only to inflation while the US responded to both inflation and the exchange rate. The error correction process is significant for the emerging market countries but not so for the USA.

Tables 3 and 4 present the results of the property market returns regression.

Table 3: Property Returns

	South Africa	Bulgaria	Lithuania	Czech Rep	USA
α_0	0.098***	0.267***	0.059	-0.156***	-0.001
α_1	1.150***	3.441***	2.268***	1.450***	1.629***
α_3	-0.090	1.633	1.825	3.873***	0.443
α_2	-0.088	-6.980***	-2.344	2.216	-0.396
R-Squared	13%	74%	67%	83%	27%
(Prob)F -Stat	0.000	0.000	0.000	0.000	0.000
DW stat	0.121	0.605	0.501	1.007	0.114
N	131	51	46	28	130
Period	1981Q1 - 2013Q3	2000Q1 - 2012Q3	2002Q1 - 2013Q2	2005Q1 - 2011Q4	1981Q1 - 2013Q2
Note:	*** Significant at 1% level		** Significant at 5% level.		* Significant at 10% level.

Table 4: Property Returns with error correction

	South Africa	Bulgaria	Lithuania	Czech Rep	USA
α_4	-0.066***	-0.124	-0.218***	-0.251	-0.002
R-Squared	88%	90%	84%	89%	94%
DW stat	0.742	0.443	1.617	0.642	0.650
Note:	*** Significant at 1% level		** Significant at 5% level.		* Significant at 10% level.

For South Africa, all the signs are consistent with the asset valuation theory. However, only GDP was found to be a significant driver of returns in the residential property market. This suggested that neither the current risk free rate nor the current expectations of the future short-term rates were key drivers of the current returns in the residential property. The predictive power was weak with only 13 percent of the variation explained.

With error correction, the predictive power of the model jumped to 88 percent. This suggested that there was a strong lagged relationship between the short-term rates (and the government policy rate) and returns in the South African property sector

For Bulgaria, both GDP and the rate expectations coefficients were significant and carried the correct signs. The short-term rate coefficient was insignificant and carried the wrong sign. Again, this means there was no current relationship between property market returns and monetary policy or TBills rate. However, there was a relationship between output, expectations of the short-term rates path and the returns in the property sector. The predictive power of the model as a whole was good with 74 percent of the variation being explained. This figure jumps to 90 percent with error correction suggesting that there was a further lagged relationship between the dependant and independent variables but the error correction coefficient was found to be insignificant suggesting otherwise.

For Lithuania, like South Africa, only current real GDP was a significant driver of current returns in the Lithuanian property market. Current TBills rate and monetary policy showed no evidence of their influence on the current returns in the residential property market. The model explained 67 percent of the variation in returns. With error correction, 84 percent of the variation was explained by the model. This suggested that there was a strong delayed or lagged relationship between the dependant and independent variables in the model.

For the Czech Republic, unlike the other countries under study, the Tbill rate coefficient here was significant together with the real GDP coefficient suggesting a current relationship between short-term rates and returns in the property market. However, the Tbill rate coefficient carried the wrong sign and was not in line with the valuation theory. This sign is suggesting that a higher short-term rate would result in higher valuations (or demand) and high returns. Good predictive power for this model was evident with 83 percent of the current variation explained in the explanatory variables but the error correction

coefficient was insignificant at the 10 percent level suggesting that there was no lagged relationship between the variables.

For the US, only current real GDP was a significant driver of the current returns in the residential property market. There was no significant current relationship between the property market returns and either the short-term rate (TBills rate) and/or the short-term rate expectations. There was also no evidence of error correction in the returns in the US property market meaning that there was no lagged relationship between the returns and the valuation variables.

In summary, with four of the emerging markets countries studied here, there was no current and significant link between the short-term risk free rates (TBills rate) and the returns in the property market. For one country, the Czech Republic, the current short-term rates drove the current returns in the property market but not in a direction that was consistent with valuation theory, it indeed exerted an opposite influence to what would be theoretically correct. Current expectations of the future short-term rates drove the current returns only in Bulgaria. Current output proved to be a significant driver of current property market returns in all the countries.

For two of the four emerging countries, the property returns showed evidence of error correction implying that there was a lagged link between the returns and the valuation variables. Lagged values of the explanatory variables including the short-term interest rates were found to influence the returns. In the long run, the prices and returns seemed to follow the valuation theory with a tendency of reverting to the intrinsic value implied by rates as well as output. The rest of the countries did not show this error correction tendency.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

Only the South African data seemed to fit well and cleanly with the Taylor rule theory. The rest of the countries in this study showed a good fit with the Taylor rule but with problems of wrong signs and insignificant coefficients, suggesting that the current monetary policy is not driven entirely by the current values of the Taylor rule fundamentals or in a manner consistent with theory. The short-term rates will therefore deviate in the short term from what is deemed fundamentally correct, as per the Taylor rule. However, there was evidence of error correction in the short-term rates indicating that any short-term deviations from the rule were corrected in subsequent periods. It can therefore be concluded that monetary policy is driven by the Taylor rule fundamentals, but more strongly by their past and not current values. Further investigation could be carried out to understand the current drivers of the current short term rates.

Current real GDP proved to have a strong and positive influence on the returns in the residential property markets across all countries. As was expected, increased economic activity translates to increased cash flows in the form of rent and thereby increased valuation and returns for investors in the residential property market. This is consistent with valuation theory, the higher the cash flows the higher the valuation and returns.

Current values of the short-term rates did not appear to be significant drivers of the property market returns for most countries in the study. Only one country, the Czech Republic, showed a relationship between the said variables, but this relationship was positive instead of negative and this goes against the theory and model as derived in the methodology. Current expectations of the short-term rates path were found to have no impact on the current property market returns in all but one of the countries. Only in Bulgaria, these expectations affected current property market returns.

The error correction process found that returns in only two countries, South Africa and Lithuania, showed the tendency to correct past deviations from what is fundamentally correct according to the intrinsic valuation theory.

Both the current short-term risk free rates and expectations thereof are weak drivers of current returns in the property markets, whereas current output is a strong driver of these returns. However, two of four emerging markets in this study show a strong tendency of the returns to revert to their intrinsic value in subsequent periods. This shows that the valuation relationship, as per Williams (1938), between returns or prices and the interest rates, holds in the long run but still with short run deviations being observed in these two emerging markets.

In summary, this study finds that the monetary policy rate path is consistent with the Taylor rule but there are strong short-term deviations. Furthermore, the returns in the residential property markets are influenced by the past short-term rates and therefore monetary policy. This is evident in some emerging markets but is not the case for others.

The estimated model developed in this study is incomplete because the total risk premium and other factors driving returns are not included in the estimation as explanatory variables. For those markets where returns are influenced by the short-term rates, this model can serve as a basis to build an even better model of returns.

Where a relationship between returns in the property markets and interest rates was found, the monetary authorities in these countries should carefully consider the impact of their actions (rate setting) on the property markets so as to be able to avert any possible bubbles forming.

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