



**The informational role of the yield spread and stock returns for
predicting future GDP in Emerging countries**

Daaliya Aafiya Maria Headlie*

Masters in Finance Dissertation

Advisor: Julio Fernando Seara Sequeira da Mota Labão, Ph.D

2016

*201401013@fep.up.pt

Bibliographical Statement

Daaliya Aafiya Maria Headlie was born on October 14th 1988. She completed her undergraduate studies in Economics with a minor in Finance at the University of the West Indies in Trinidad before joining the Masters of Finance programme at the Faculty of Economics at the University of Porto. As an Erasmus student studying in Portugal, aside from pursuing her Masters in Finance, Daaliya has actively been involved in the FEP Finance Club, where she has been a member of the Career Development, Corporate Finance and Portfolio Management team. Daaliya has also developed a strong passion for professional photography during her stay in Portugal. Upon completion of her Masters programme, Daaliya shall return to her home country to offer her services to the Trinidad and Tobago government as a means of fulfilling her undergraduate scholarship agreement as a scholarship holder.

Acknowledgements

My sincerest appreciation and gratitude for the time and effort my supervisor, Professor Julio Labão has extended throughout this journey. Professor Natercia for all of her efforts. My family and friends for their continued love, support and prayers. The FEP librarian staff for assisting and teaching me how to collect and gather the necessary data for this study. Lastly, to Erasmus Mundus and the European Commission for grating me this amazing opportunity that I would forever hold close to my heart.

Abstract

Studies over the years have explored in depth the forecasting power of the yield spread and stock returns in predicting economic growth in the US and European countries, but to a lesser extent emerging economies. This study adds to the lack of literature by examining four emerging countries, namely; Russia, China, India and Brazil over the period 1991-2015 as well as assesses whether the yield spread continues to be the leading indicator for predicting economic growth in emerging markets. The findings in our studies illustrate that the yield spread continues to be the leading indicator for predicting economic growth in Brazil and Russia. However for the case of India, the stock returns provide the better forecasts, while in China, the findings are inconclusive as none of the three forecasting models were able to outperform the random walk model. Based on these findings, the two main implications for decision makers when forecasting future GDP of a country, particularly the case for emerging markets, is to take into account the stock return variables of a country and not presume that the yield spread is always the leading indicator for predicting the future level of economic activities of a country, as it is evident in this study that in some cases the stock return possesses stronger predictive power. Furthermore, decision makers should also consider observing alternative variables when attempting to forecast future GDP since in some cases, case in point, China, neither the yield spread nor stock the returns were deemed to be fit variables to predict future economic growth.

Keywords: yield spread, stock returns, forecasting, and economic growth.

JEL: E17, O4

Resumo

Ao longo dos últimos anos, diversos estudos exploraram a capacidade do spread da curva do rendimento e das rendibilidades do mercado accionista para prever o crescimento económico, sobretudo nos EUA e nos países europeus. Os estudos incidindo sobre as economias emergentes são mais escassos. Este estudo contribui para essa literatura ao examinar quatro mercados emergentes, nomeadamente: Rússia, China, Índia e Brasil, ao longo do período 1991-2015. Pretende-se investigar se o spread da curva dos rendimentos continua a ser um indicador antecipado na previsão do crescimento económico dos países emergentes. Os resultados obtidos no presente estudo sugerem que essa variável continua a ser um indicador antecipado para prever o crescimento económico do Brasil e Rússia. No entanto, na Índia, as rendibilidades das acções proporcionam as melhores previsões enquanto que na China os resultados não são conclusivos na medida em que nenhum dos três modelos de previsão adoptados se mostrou capaz de melhorar o modelo de random walk. Com base nestes resultados, as duas implicações principais para os tomadores de decisão ao prever PIB futuro de um país, particularmente o caso dos mercados emergentes, é de ter em conta as variáveis Retorno de acções de um país e não presumir que o diferencial de rendimento é sempre o líder indicador para prever o futuro nível das actividades económicas de um país, como é evidente neste estudo que, em alguns casos, o retorno das acções possui forte poder de previsão. Além disso, os tomadores de decisão também deve considerar observar variáveis alternativas ao tentar prever o futuro PIB pois em alguns casos, caso em questão, a China, nem a propagação de rendimento nem estoque os retornos foram consideradas variáveis de ajuste para prever o futuro crescimento económico.

Palavras-chave: propagação de rendimento, os retornos das acções, previsão e crescimento económico.

JEL: E17, O4

Contents

1. Introduction.....	1
2. Literature Review.....	4
2.1 Yield curve and the real economy.....	4
2.2 Yield curve and real activity prior to the 2001 Financial crisis.....	6
2.3 Yield curve and real activity Post 2001 Financial crisis.....	8
2.4 Stock returns and real activity.....	9
3. Data, Model and Methodological framework.....	16
3.1 Data description	16
3.2 Forecasting models	18
3.3 Methodological framework	19
4. Empirical results and Analysis	20
4.1 Preliminary analysis of the data.....	20
4.2 Estimation and Out of sample forecasting.....	21
4.3 Stability analysis.....	23
4.4 Recursive out of sample forecasts.....	26
5. Discussion and Conclusion.....	29
References.....	32
Appendices.....	37
Appendix A	37
Appendix B	38

Index of Tables

Table 1: Descriptive statistics of the data.....	16
Table 2: Pairwise cross correlation analysis.....	20
Table 3: In-sample estimation.....	22
Table 4: Chow predictive failure test	24
Table 5: Recursive out of sampling forecasts	27

Index of Figures

Figure 1: Evolution of yield spread, stock returns and GDP growth.....	17
--	----

Introduction

The search for variables that encompasses forecasting information necessary to predict future real activity can be traced as far back to the NBER's ¹ ground breaking efforts in the 1930's. Over the years, studies have ranged from examining the relationship between export and economic growth (Lim, 1976), unemployment and interest rates (Bierens & Broersma, 1993) to exploring the relationship between human capital and economic growth (Gammell, 1996), all in an attempt to identify reliable leading indicators to predict future economic growth (Marcellino & Schumacher, 2010; Zhang *et al.*, 2009; Gong *et al.*, 2004; Mariano & Murasawa, 2010).

Forecasting economic growth of a given economy is pivotal. For businesses, gaining insight to the future behaviour of the real economy is important as it assists firms in meeting future demand of its goods/services. For government agencies, such information aids in making projections of budgetary surplus or deficits. Lastly, it is important for the Federal Reserve in determining the stance of current monetary policy.

In the earlier phases of research, economic series associated with the production process were often used. However in recent years, due to the forward looking nature of market participants, the use of financial variables to predict future changes has gained significant attention as the prices of these securities represent anticipations of future economic activity. The three frequently used financial variables are namely; the term structure of interest rates (Estrella & Hardouvelis 1991), the difference between the interest rates earned by commercial paper and treasury bills (Bernanke 1990; Friedman & Kuttner 1992; Kashyap *et al.* 1992), and stock returns (Moore, 1983).

Some would raise the question “with the existence of large scale macroeconomic models and with the judicious predictions of knowledgeable market observers, why should we care about the indications of one or a few financial variables?” (Estrella & Mishkin, 1996, p.2). However, according to Estrella & Mishkin (1996), policymakers and market participants can benefit in several ways by looking at a few well-chosen financial indicators as these said indicators are not only simple to calculate and interpret, but can be used to verify the forecasts of econometric and

¹ National Bureau of Economic Research

judgemental predictions, as well as eliminates the common problem of over fitting the models that often arise when using forecasting techniques that use statistical regression.

Studies over the years have explored in depth the forecasting ability of the yield spread and stock returns in predicting future growth of the US and European economy, but to a lesser extent emerging economies. The majority of existing literature has a general consensus that the yield curve is the better indicator. Estrella & Mishkin (1996) identifies the slope of the yield curve “as one of the best leading indicators of the economy in the United States” (4), while Clark (1996) describes the yield curve as “a near-perfect tool for economic forecasting” and “an economist-obviation device” (24). In recent years however, studies have begun to question whether the predictive characteristics of the yield spread in particular continue to possess as much predictive power as in the early 1980’s as parameters have changed. In addition, the reasonably low financial market liquidity and recurrent modifications of the financial structure of emerging economies suggest that financial variables such as the yield spread are unlikely to be successful predictors of future output. While given the rapidity in which stock prices become available in these markets tend to suggest stock returns may be the better indicator to forecast growth. As such, we are of the view that investigating the predictability of the stock returns and yield spread for future economic growth of emerging markets in particular is especially interesting.

The aim of this study therefore is to determine whether the yield spread continues to be the leading indicator for predicting economic growth in the context of emerging markets, or has the predictive content of the stock returns risen to be the leading indicator. Since this area of research has remained surprisingly unexplored, the goal of this study is not solely towards addressing the research question, but also hopes to add to the lack of academic literature in this area of research.

In our study, we analyse the yield spread and stock returns for four emerging markets, namely; Brazil, Russia, India and China for the period 1999-2015. Based on the findings of this study, it is concluded that the yield spread continues to be the leading indicator for predicting economic growth in Brazil and Russia. However for the case of India, the stock returns provide the better forecasts, while in China, the findings are inconclusive as none of the three forecasting models were able to outperform the random walk model.

In order to achieve the aim of this paper, the study is structured as follows: the first section presents the literature review which provides a detailed synopsis of similar studies and existing theories relating to the yield spread, stock returns and economic growth. This section is then followed by data description and the forecasting models used in this study to predict economic growth of each country. In the third section, we present the empirical results and findings. The last section entails discussing the main findings of our study, implications for decision makers as well as provides suggestions for future research.

2.0 Literature Review

2.1 Yield curve and the real economy

An exploration of the relationship between interest rates of varying maturities and the business cycle of an economy dates back to Mitchell (1913). However, the study documented by Kessel (1965) is considered to be the first literature providing actual graphical evidence of the behaviour of the term spread and the business cycle. Kessel (1965) in his study concluded that the distance between the long term and short term interest rates is generally low at the beginning of a recession, while the distance between the two rates post the cyclical trough tended to be greater. As such, by the late 1980's a number of studies had documented the yield curve as being a leading indicator of predicting future growth of an economy.

Most studies define the slope of the yield curve as the difference between the three month treasury securities and the five year or ten year government bonds. The two main justifications for the use of treasury securities are firstly; the convenience in accessing the data, and secondly, the pricing of the securities are not subject to credit risk premium, which in principle may vary with time and maturity. Though other types of interest rates, such as; the eurodollar, swap rates and corporate rates have been considered when attempting to construct the yield curve, the main disadvantage of using these rates are the lack of historical time series data and number of points along the yield curve.

In general, there is a positive nexus between the yield curve and output growth as it reflects market participants' expectations of the future health of an economy. A positive spread between the long term and short term interest rates indicates an increase in future economic activity, while a negative spread indicates a decline in economic activity.

Broad literature over the years have put forward three possible explanations describing the link between the forecasting ability of the yield spread and output growth. Harvey (1989) provided the first evidence of the predictive power of the yield curve in forecasting economic growth when he statistically measured the ability of the spread to forecast the future growth of consumption expenditures which was based on the maximization of the inter-temporal consumer choices. The fundamental hypothesis is that consumers have a stronger preference for stable

income during expansionary periods, and low income during recessionary periods. The underlying idea is that if there is a growing consensus of an economic recession, and investors believe that their income would decline, they will prefer to save their income to buy long term zero coupon bonds and sell the short term zero coupon bonds. According to Harvey (1989), due to cost constraints, investors might not be financially able to buy long and sell short, as such, to increase the attractiveness of the short term zero coupon bonds, the prices of the short term bonds would decrease, while the prices of the long term bond increased. The offsetting pricing behaviour of the two bonds would result in the yield curve becoming flatter or inverted. As such, analogous to modern asset pricing theory, Harvey believed that the slope of the yield curve contained information about investors' forecasts of economic growth. These findings were further confirmed in many studies throughout the 1990s.

Ferreira *et al.* (2008) extends the earlier research of Harvey (1989) using a dynamic and robust approach. Since according to Harvey (1989) the forecasting ability of the yield spread to predict future economic growth is owed to the fact that interest rates reflects investors' expectations about future economic activity, Ferreira *et al.* (2008) attempted to directly measure investors' expectations using the Economic Sentiment Indicator as a proxy of economic agents expectation for future growth for seven European countries namely; France, Germany, Italy, Netherlands, Sweden and the United Kingdom over a 12 month period for the period 1997-2002. The findings in the study suggest that the linear combination of European yield spreads explained a surprising 93.7% of the variability of the Economic Sentiment Indicator. Hence concluding that the ability of the yield spreads to capture economic agent expectations may be the actual reason for the predictive power of yield spreads.

The second explanation brought forward that justifies the nexus between the yield spread and output growth is based on the expectations hypothesis of the term structure of interest rates, which states that long term interest rates are merely a composition of average future short term interest rates. Since the long term interest rates shows the possible direction of future short term interest rates, the expectation of a down turn in the economy indicates a possibility of a reduction in future interest rates, which is interpreted as a decline in long term interest rates. According to Moneta (2005), the expected contractions in interest rates stem from monetary policy aimed at stimulating the economy, or may reflect the low returns during recessions attributable to credit

market conditions, or lower expectations of inflation as the slope of the yield curve is calculated on nominal interest rates and therefore embodies a term representing expected inflation (Moneta, 2005).

The third alternative explanation for the predictive power of the yield curve dates back to the inversion of the slope of the yield curve which preceded the US recessions in the 1990's (Mishkin, 1990a; Estrella & Hardouvelis, 1991; Estrella, 2005b). The economic justification is that the slope of the yield curve is a monetary policy indicator, and that monetary tightening results in the short-term rates increasing at a faster rate than that of the long term interest rates which also increase, but to a lesser extent to that of the current short term rate. This behaviour of the interest rates therefore leads to a downward-sloping term structure.

2.2 Yield curve and real activity prior to the 2001 Financial crisis

In the late 1990's, Fama (1990) conferred the ability of the term structure to predict real activity, however was unable to provide statistical evidence to support his stance. Laurent (1988) attempted to provide the statistical evidence by regressing the growth of real GNP on the lags of the spread between the 10 year bond rate and the federal funds rate. However, though the sum of all lagged spreads were positive, they were insignificant. The study by Estrella & Hardouvelis (1991) is considered to be the first study to empirically illustrate the usefulness of the yield curve in predicting output growth. In their study, Estrella & Hardouvelis (1991) used a simple OLS regression model, with the dependent variable being the annualized cumulative percentage change in the seasonally adjusted GNP for the quarterly period of 1955-1988. The yield spread for the period was defined as the difference between the 10 year bond rate and the 3 month treasury bill rate, with the forecasting horizon (k) varying from one quarter to eight quarters ahead. The findings in their study show that the predictive information present in the slope of the yield curve exceeded the predictive information in other leading indicators such as; lagged output growth rate, lagged inflation, and the level of real short term interest rates, as the yield curve was able to forecast future macroeconomic variables up to 6 to 7 quarters ahead.

Due to the failure of the yield spread to predict the US recession in the period 1990-1991, researchers reinvestigated the predictive of the power of the spread. Subsequent to Estrella &

Hardouvelis (1991) study, in the late 1990's Estrella & Mishkin (1996) extended their study beyond forecasting economic growth in the US, and examined the ability of the yield spread along with several other macroeconomic variables to forecast future economic recessions in the US for the period 1960-1995. As opposed to using a simple OLS regression, the study employed a probit model to predict a recessionary dummy variable. The results from their study indicated that though the macroeconomic variables contained some forecasting ability beyond a one quarter horizon, beyond two to four quarters in the future, the yield curve dominated the other variables in predicting recessions in the US (Estrella & Mishkin, 1996). Dueker (1997) confirmed these findings using a modified probit model for the same sample period for the United States. Introducing a Markov-switching coefficient variation in the model, the results in the study established the yield curve as being the best leading indicator of possible future recessions in the United States. Dueker (1997), in his study provided two rational explanations in support of the yield curve as a recession indicator; firstly, the yield curve is observable at high frequencies which can be easily interpreted, and secondly, the theoretical foundation provided by the expectation theory which highlights the forecastability of the yield curve.

Since most of the studies that examined the relationship between the yield spread and future output growth in the 90's did not extend research for countries other than the United States, Hu (1991) attempted to establish the link for international economies by employing an inter-temporal equilibrium model built on the work of Merton (1973), Lucas (1978), Brock (1982), Cox *et al.* (1985), and Breeden (1979). Applying the model to G7 industrial countries, namely; Canada, France, Germany, Italy, Japan, United Kingdom, and the United States for the period 1957-1991, the results in the study provided evidence indicating that the spread between the long term treasury bond, and the short term bond proved to be a good indicator of future economic activity, and retained additional predictive power against leading indicators such as the stock price index, lagged output growth and inflation. According to Berk & Bergeilk (2001), "one could expect that this finding should also carry over to the euro area as a whole. However, over the 1970-1998 period, the yield spread possessed only limited information on future output growth change of the euro area" (5), as such questioning the role of the yield spread as a useful economic indicator for the ECB and market participants. Kozicki (1997), confirmed this argument using a simple regression for countries such as; Japan, Australia, Germany, France, Italy, Switzerland, Canada, Sweden and United Kingdom for the period 1970-1996 and found the

term spread to possess maximum predictive characteristics over a one year period, however beyond a 4 quarter horizon, the forecasting ability of the term spread diminished as the forecasting horizon increased. These findings in recent times thus suggesting that the theoretical explanations of the relationship between the yield spread and future economic activity may not continue to remain stable over time. According to Haubrich & Dombrosky (1996), this can be attributable to a changing relationship between the yield spread and real economic activity which may have been due to “advances in technology, new production processes, changes in market organization, the way the market reacts to new information, and shifts in Federal Reserve policy” (32).

2.3 Yield Curve and Real Activity Post 2001 Financial crisis

In an attempt to determine whether the previously identified relationship between the yield spread and future real activity is indeed still present, Pace & Weber (2013) extend the previous findings of Frankel & Lown (1999), Mody & Taylor (2004) by providing new evidence on the relationship between the yield spread and real economic activity in the US. Using both quarterly and monthly data for 30 US high yield spreads for the period 1996 to 2012, the findings in their study suggest that in recent years, the high yield indexes on a broad-spectrum have not predicted economic growth and recessions in the United States for a period beyond one year. According to Pace & Weber (2013), the predictive content of the spread disappeared during the 2007–2009 global financial crisis due to either structural changes prior to the 2007-2009 financial crisis, shifts in monetary policy behaviour, or to other unconventional policy interventions that took place in the first decade of the century, as such casting doubt on the reliability of the spreads as a leading indicator of future economic growth (Pace & Weber, 2013). Subsequent to the latter study, Evgenidis & Siriopoulos (2014) review the predictive ability of the yield spread for the last three major economic slowdowns in the US for 1990, 2001, and 2007 respectively using a number of linear probit models. The findings in the study suggest that though the linear models provided modest evidence indicating the future decline in economic activity in the 1990 and 2001 in the US, similar to Pace & Weber (2013), none of the models gave any signal of the major decline in output in 2007.

Papadamou (2009) in his study examined the relationship for East European countries namely, Czech Republic, Poland, Hungary and Slovakia using a k month industrial growth model for the period 1995 to 2004. Unlike previously documented studies that use GDP growth to measure real economic activity, the study considered the growth of the industrial production index and the change of unemployment rates of the above mentioned countries in order to test the robustness of the findings. The results suggest that the interest rate spread does indeed continue to have predictive power over the 24 month and 36 month horizon. Since the yield spread explained about 43% of the variation of the growth in Czech Republic, Papadamou (2009) stated that the yield spread is a better indicator of future real growth in countries with low and stable inflation (Czech Republic) as opposed to countries characterized by high and volatile inflation (Hungary). Similarly, Gogas & Pragidis (2012) confirmed these findings for the case of EMU and non EMU countries for the period 1995-2009 using the term spread, along with unemployment rates and stock returns.

Drawing on empirical literature, in general, studies have found the yield spread to contain the predictive power necessary to forecast the economic growth of a country prior to the 2007-2009 financial crisis. Subsequent to the crisis however, studies have documented mixed findings pertaining to the forecastability of the spread and real activity of a country.

2.4 Stock returns and real activity

The link between stock market returns and economic growth has been an extensive area of research for the past 15 years. A common belief among researchers is that there exists a robust link between the stock market and economic activity which stems from the fundamental valuation of equity. The fundamental value of a firms stock is equated to the sum of discounted future cash flows or dividends.

$$\text{Stock Price}_t = \sum_{j=1}^{\infty} \frac{\text{Expected dividends}_{t+j}}{(1+k)^j}$$

Since expected dividends are considered to be a vital component of gross domestic product (GDP) and is also probable of being positively correlated with other components of GDP, the price increase in a firm's given stock tends to suggest an increase in future economic activity.

Similarly, since the price of equities usually decline in a recession, it is believed that if investors have low forecasts for a firm's future earnings/dividends resulting in a drop of a firm's stock price, there tends to be a growing consensus of an upcoming recession. Thus, according to Siegel (2002), "if you can predict the business cycle, you can easily beat the buy and hold strategy" (169).

According to Fama (1990), there are three possible sources that lead to variations if the stock prices reflect fundamental values: (a) shocks to expected cash flows for which future growth rates of GDP or industrial production are used as proxies; (b) shocks to discount rates; and (c) predictable return variation due to predictable variation through time in the discount rates that price expected cash flows. Similarly, Guo (2002) adopted the methodology used by Campbell & Shiller (1988) and decomposed the excess stock market returns into three components: expected return, a shock to expected future return and a shock to expected future dividend growth. According to Guo (2002), "contrary to the conventional wisdom, dividend shocks are rather weak predictors for economic activities" (19) as the dividends were only able to forecast up to a period of four quarters ahead, of which the dividend shocks only explained 2% of the GDP's growth variation, in contrast to the strong predictability features of the expected return and the shocks to expected future return which collectively explained about 13% of the variations in the growth of GDP (Guo, 2002).

Recent studies and research findings however, support the claim that stock prices are not solely driven by fundamental news, as there exists other solid theoretical explanations and empirical reasons which give motive to believe otherwise (Morck *et al.* (1990)). One possible explanation for such deviation is related to investor sentiment, in which the beliefs held by investors cannot be logically justified, thereby causing the stock price to deviate from fundamental values. According to Morck *et al.* (1990), "if the stock market were a sideshow, market inefficiencies would merely redistribute wealth between smart investors and noise traders, but since the stock market influences real economic activity, then the investor sentiment that affects stock prices could also indirectly affect real activity" (157). An alternative view held by Mills (1988), is that at times the prices of stocks may fluctuate as stock prices are susceptible to speculative bubbles. In a bubble, the stock prices are driven upwards as speculators expect to sell the stocks at a higher price in the future despite the expected future earnings remaining unchanged. The prices of the stocks continue to increase up to a point whereby investors no longer have confidence that

a price increase will continue, resulting in the burst of the bubble, in which case the stock price declines. According to Mills (1988) in such situations, the fall of the stock price is not due to lowered expectations of future earnings. Analysts over the years have attributed the October 1987 crash in the US to speculative bubbles, and not necessarily that market participants had predicted an upcoming recession.

Subsequent to the Post War era, observations of the behaviour of stock prices have revealed the stock price to be a leading indicator of future economic growth and recessions. The regression analysis used by Fama (1981) in his study not only found a positive relationship between US stock returns and the rate of growth of real GNP for the period 1950-1980, but also acknowledged its ability to forecast a measure of the average rate of return on physical capital. Fama (1981) defined his findings as “a rational expectation or efficient markets view in which the stock market is concerned with the capital investment process and uses the earliest information from the process to forecast its evolution” (555). Litterman & Sims (1983), in their study employed a ten (10) variable vector autoregressive model and found the stock market to possess noticeable forecasting features. Their study has shown that after a period of one year, stock returns and variations in business inventories were the most prominent variables that accounted for the changes in economic activity, while over a period of four years, the stock returns were solely the most significant indicator explaining the growth rate of GNP. Fama (1990) attributed this to the increasing correlation between stock returns and future economic growth rates as the length of time in which the returns are calculated increases. According to Fama (1990), “short horizon returns only explain a fraction of future production growth rates, but this fraction gets larger the longer the time horizon of returns. In other words, “annual returns should be more powerful in forecasting future production growth rates than quarterly returns and quarterly returns more powerful than monthly returns” (59). Choi *et al.* (1999) extended the previous research done by Schwert (1990) for G7 economies using both in sampling and out sampling forecasts methodologies for the period 1957 to 1966 and found similar findings. Mauro (2003) conducted a study by examining the correlation between output growth and stock returns for advanced and emerging economies and found the relationship to be statistically and economically significant, however concluded that the strength of the predictability of stock returns were dependent on a number of stock market characteristics, namely: high market capitalization to GDP ratio, large number of listed domestic companies and initial public

offerings for both advanced and emerging economies. Loflund & Nummelin (1997) on the other hand, discovered it is only after controlling for local and international business conditions for the Finnish and Swedish economy did the informational content of stock returns increased.

A considerable number of studies have documented movements in stock prices acting as an indicator of an upcoming peak in a given economy. However, according to Mills (1988), there are rigorous reasons to believe that a drop in stock prices signals future recessions. Mills (1988) in his study provided two implications of a decline of stock price on consumer spending and investment, which ultimately reduces the rate of economic growth of an economy. Firstly, the decline of a stock price has a direct impact on consumer spending as it lowers the financial wealth of stockholders, which in turn induces them to curb their spending on goods and services. Consumers that are not equity holders are also implicated, as this decline in stock prices surge a loss of confidence in the economy, causing them to become more aware of their current spending habits. For businesses, the decline in stock prices raises the cost of capital to acquire new plants and equipment, thus reducing the level of investment. According to Mills (1988), the simultaneous decline in both consumer spending and investment due to the decline in stock prices can lead to an economy growing at a slower rate, and possibly slide into a recession. Henry *et al.* (2004) extend research on the stock returns and potential down turns of an economy by employing quarterly data for 27 countries which consisted of 18 developed countries and 9 emerging economies for the period 1982-2001. Using a switching panel regression, the findings indicate the forecasting nature of stock returns to be stronger when the economy is contracting, however, in non-recessionary periods the evidence is less clear as to whether stock returns can be used to forecast the growth of a given economy. Additionally, allowing for a nonlinear effect of a recession between the stock returns and future real activity, it was discovered that unlike most studies that assume a linear relationship between the two variables, there is indeed a significant non linearity in the growth rates which they termed as a “bounce effect” which implied that output growth is usually recovered at a faster rate subsequent to a recent recession. According to Henry *et al.* (2004) failure to taken into account such nonlinearity can result in misspecification of the relationship between stock returns and growth. Analogous to these findings is the study by Domian & Louton (1997) which states, that the implicit assumption, that growth forecasted by stock return increases are symmetric to recessions forecasted by a decline in stock prices,

conflicts with traditional literature dating back to the studies of Mitchell (1927) & Keynes (1936). According to Keynes;

‘The substitution of a downward for an upward tendency often takes place suddenly and violently, whereas there is, as a rule, no sharp turning point when an upward is substituted for a downward tendency.’ (Keynes, 1936, p. 314)

Using monthly data over the period 1947-1992, the findings in their study are consistent with business cycle literature. Domian & Louton (1997) show that negative stock returns are usually followed by a sharp decline in the level of industrial production growth rates, while positive increases in stock returns results in a modest increase in industrial production growth rates. Thus suggesting that symmetric models tend to overlook information that might aid in defining the nexus between stock returns and output growth.

Aylward & Glen (2000) documented evidence from 23 countries, which includes 15 developing countries, and 8 developed countries for the period 1951-1983. The findings convey that though a strong significant predictive relationship exists for some countries, not all markets under study were able to predict future GDP growth rates using both the OLS and SUR estimation techniques, and the countries that were able to predict had a stronger relationship between stock returns and investment. Since the inability of financial indicators to predict future behaviour of the economy can be as a result of the changes of parameters, Aylward & Glen (2000) tested for shifts in the structural relationship and found that though shifts are present for the sample under study, such shifts were not prevalent nor did they account for the failure of some markets stock returns to predict future real economic activity. The failure of 11 of the countries to predict future economic growth according to Aylward & Glen (2000) may be have been due “stock markets not being sufficiently developed to perform a central role in the allocation of capital resources in the economy, statistical problems with the sample data or as a result of high variability in the time series as such masking any statistical connection” (2). Mauro (2000) carried out a similar study focusing on annual data for 8 emerging economies and 17 advanced countries, and also derived the same conclusion that stock returns were unable to forecast growth for all countries in the sample under study.

Binswanger (1999) using regressions of stock returns on real activity for the period 1953 to 1997 in the United States confirmed former results of Fama (1990) and other studies that stock returns changes can be explained by future real activity. However, when the sample period under study however is assessed for sub periods, the findings in their study suggest that from the early 1980's there has been a breakdown in the relationship between stock returns and output growth regardless of time frequency used. Binswanger (1999) thus concluded in his study, that current stock returns contain no significant information as before, however noted that it was unclear as to whether such absence of relationship was a "temporary aberration" or whether it was permanent in nature. Kwon & Shin (1999) employ a similar study for the Korean market using monthly data for the period 1980-1992. Using a vector error correction model, findings in the study established a strong cointegration with stock returns and macroeconomic variables; foreign exchange rates, trade balance, production level and money supply, thus suggesting a direct long run relationship with the latter macroeconomic variables. According to Kwon & Shin (1999) however "even though the stock price index and the production index simultaneously affect each other, in general, the stock price index is not a leading indicator for economic variables, which is inconsistent with the findings that the stock market rationally signals changes in real activities" (71). Similarly, Stock & Watson (1990) suggest that in recent years the link between the stock returns and output growth has not been stable, and that other financial variables that are predictive in nature should be considered when assessing output growth such as the yield spread between the 10 year and 3 month government bonds or between T-bills and commercial paper. As such, though in theory the stock market has been identified as a means of gaining insight to future business cycle, macroeconomic forecasters have faltered to attach any real significance to its forecasting properties due to the inconsistent findings in studies. While most tend to agree that the stock market is an important indicator in their business cycle predictions, according to Fisher & Merton (1984) "the predictive ability of the stock market is well-described by the often-quoted remark that "the market has forecast ten of the last six recessions" (57). According to Samuelson (1997), "the evident problem is that the macro-economy and the stock market are so often out of sync, causing the stock market to give misleading signals" (34).

Based on existing studies, a positive relationship has been found to exist between stock returns and the future economic activities of a country. The ability of the stock returns to forecast real

activity according to some studies however, are not solely driven by fundamental news, but can also be attributable to factors such as investor sentiment and speculative bubbles. Moreover, the ability and strength of the predictive capacity of the stock returns are dependent on factors such as the level of market capitalization to GDP ratio, number of listed domestic companies along with controlling for local and international business conditions. In cases where the stock returns were unable to predict future activities of a particular market, studies have attributed its inability to stock markets being underdeveloped, statistical problems which masks any significant connection, or a possible permanent change in the relationship between the stock returns and real activities.

3.0 Data, Model and Methodological Framework

3.1 Data description

The variables under study are; industrial production (IP), which is used as a proxy for GDP, stock returns (RET) and the yield spread (YS), where the yield spread for each of the four (4) countries are calculated by subtracting the three (3) month treasury bill rate from the ten (10) year government bond. The quarterly stock returns and yield spread were constructed by using the monthly data of each respective variable.² All three variables under study were then transformed into logs. The forecasting period analysed are one (1) quarter, two (2) quarters and four (4) quarters ahead.

The data employed in this study were obtained from the DataStream database and the OECD Economic Outlook database for the four emerging economies namely; Brazil, Russia, India and China. The data is presented in a quarterly frequency for the period 1999:1 to 2015:2.

Table 1 below presents the descriptive statistics of the variables under study, while figure 1 plots the evolution of the stock returns, yield spread and GDP growth of each of the four emerging markets to aid in visualizing the variables under study.

Table 1: Descriptive statistics of the data

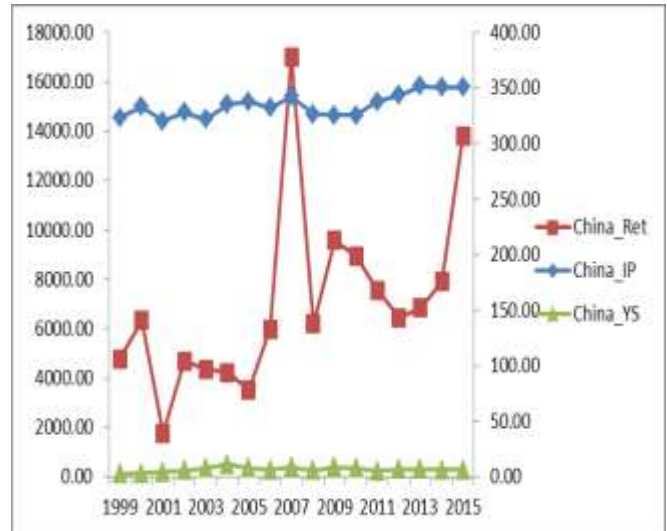
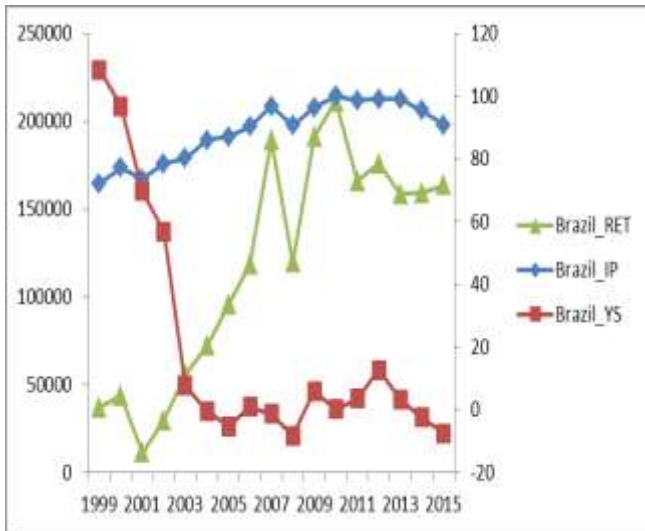
	RUSSIA_IP	RUSSIA_RET	RUSSIA_YS	CHINA_IP	CHINA_RET	CHINA_YS	INDIA_IP	INDIA_RET	INDIA_YS	BRAZIL_IP	BRAZIL_RET	BRAZIL_YS
Mean	4.507	7.661	-3.506	5.810	8.763	8.243	4.313	8.821	5.317	4.477	11.456	23.326
Median	4.561	8.205	0.738	5.807	8.767	6.937	4.362	9.072	3.672	4.498	11.686	3.464
Maximum	4.798	9.494	44.254	5.862	10.347	115.171	4.760	10.634	89.517	4.627	13.387	123.430
Minimum	4.083	5.054	-38.000	5.769	7.476	0.520	3.793	6.450	0.010	4.224	9.340	-10.047
Std. Dev.	0.183	1.011	15.089	0.025	0.470	13.564	0.308	0.840	10.919	0.118	0.768	40.128
Skewness	-0.619	-0.912	-0.332	0.515	0.244	7.580	-0.158	-0.443	7.098	-0.485	-0.488	1.308
Kurtosis	2.269	2.889	3.630	2.305	4.758	60.344	1.554	2.445	55.243	1.912	2.772	3.077
Jarque-Bera	5.682	9.184	2.305	4.243	9.158	9674.901	6.027	3.009	8059.871	5.837	2.766	18.845
Probability	0.058	0.010	0.316	0.119	0.010	0.000	0.049	0.222	0.000	0.054	0.251	0.000

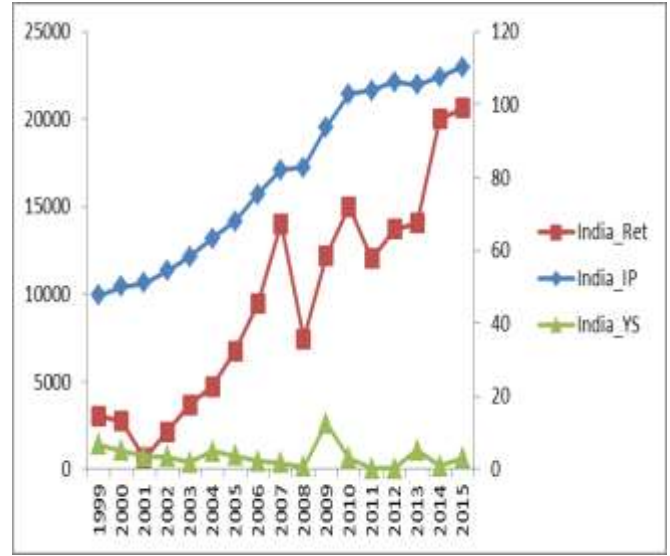
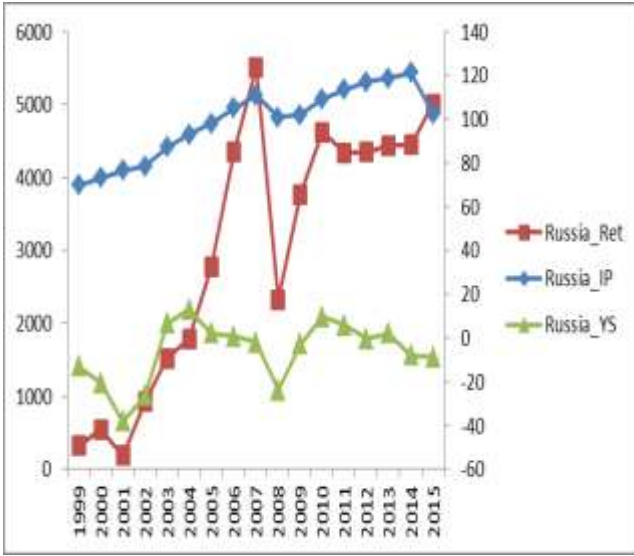
Notes: IP=quarterly industrial production, YS=quarterly yield spread, RET=quarterly stock return. Jarque Bera refers to the normality test whereby the null hypothesis H0: variable is normally distributed. The sample period is 1999:1-2015:2

² Due to unavailability of the 3month Treasury bill data for India and Russia, for the case of India Treasury bill 91 day auction was used as a proxy, while the 3 month inter-bank rate was used for the case of Russia.

The descriptive statistics in Table 1 illustrates that during the sample period under study, China recorded the highest level of quarterly industrial production growth with an average of approximately 5.8%, while India recorded the lowest of all four economies at a growth of approximately 4.3%. In terms of the yield spread, all three countries namely Brazil, India and China maintained a positive yield spread, with the exception of Russia, which had a negative yield spread of an average of -3.51%, which according to economic theory by definition, implies that on average Russia's interest environment is one where the short term debt instruments of similar credit ratings has a higher yield than that of the long term debt instruments. Most literature describes yield curves of such characteristics to be an indicator of an upcoming economic recession. It should be noted however, that though Russia was the only country that observed on average a negative yield spread, Brazil yield spread on average experienced the most level of volatility. In terms of the stock return, Brazil again recorded the highest value on average of 11.546%, with Russia having the lowest amongst all four countries under study with an average of 7.661%.

Figure 1: Plots the evolution of the yield spread, stock returns and GDP growth for the four emerging markets for the period 1999-2015.





3.2 Forecasting Models

Following the methodology used by Estrella & Hardouvelis (1991), Estrella & Mishkin(1997), Haubrich & Dombrosky (1996), Bonser-Neal & Morley (1997), Kozicki (1997) and Dotsey (1998), the three forecasting models used in this study to analyze the predictive capacity of the yield spread and stock returns to predict economic growth for the four emerging markets for the period 1999-2015 are as follows:

$$X_{t+k} = \alpha + \beta_1 YS_t + u_{t+k} \quad (1)$$

$$X_{t+k} = \alpha + \beta_2 RET_t + u_{t+k} \quad (2)$$

$$X_{t+k} = \alpha + \beta_1 YSt + \beta_2 RETt + u_{t+k} \quad (3)$$

The models setup can be characterized as follows; model (1) assesses the informational content present solely in the yield spread, whereby model (2) solely takes into consideration the informational content present in the stock returns. Lastly, model (3) considers both the informational content present in both the yield spread and stock returns in order to determine whether including data from both variables improves forecasts.

In the study, GDP growth is denoted by X , the yield spread by YS , the stock returns by RET and the error term of the regression denoted by u . The forecasting period of interest is represented by k . In the study we focus on one quarter, half of a year and one year forecasts ($k=1, 2, 4$). An underlying conservative assumption of the three forecasting models is that all the relevant information pertaining to the foreseeable future already exists in the financial market data, as such, no additional lags of the independent variables are introduced into the models.

3.3 Methodological Framework

The study adopts a three step empirical approach. The first step involved a pairwise cross correlation analysis to determine the degree of association between the variables under study. The data under observation was then split into two samples, namely the in-sample estimation period and the out of sample period to undertake the necessary forecasting. The in-sample estimation period consisted of data from 1999:1 to 2009:4, while the out of sample period consisted of data for the period 2010:1 to 2015:2. Upon identifying the samples, the third step involved undertaking a stability analysis using the Chow predictive failure test and the Andrews Quandt test to test for structural breaks within the sample. This was then followed by the evaluation of the out of sample forecasts generated by the E-views software.

4.0 Empirical Results and Analysis

4.1 Preliminary analysis of the data

An initial assessment of the level of the correlation between stock returns, yield spread and GDP growth for the BRIC emerging economies was undertaken using a pairwise cross correlation analysis for the period 1999:1-2015:2.

In line with the economic literature, a priori assumption is that there exists a positive nexus between the financial variables under study and GDP growth. In the study, we therefore tested these relationships to solidify the assumption.

Table 2: Pairwise cross correlation analysis test

	Brazil_lpt-k			
	K=0	K=1	K=2	K=4
Brazil_Ret	0.747***	0.747***	0.747***	0.748***
Brazil_YS	-0.797***	-0.798***	-0.797***	-0.796***

Notes: *** significant at 1% level

	Russia_lpt-k			
	K=0	K=1	K=2	K=4
Russia_Ret	0.766***	0.756***	0.749***	0.742***
Russia_YS	0.569***	0.508***	0.536***	0.504***

Notes: *** significant at 1% level

	India_lpt-k			
	K=0	K=1	K=2	K=4
India_Ret	0.810***	0.804***	0.796***	0.791***
India_YS	-0.421***	-0.428***	-0.433***	-0.152***

Notes: *** significant at 1% level

	China_lpt-k			
	K=0	K=1	K=2	K=4
China_Ret	0.310***	0.274**	0.252**	0.244**
China_YS	0.223*	0.227*	0.236**	0.244**

Notes: *** significant at 1% level

** significant at 5% level

* significant at 1% level

The results above in table 2 illustrates that the stock returns for all four emerging economies had the highest and most significant correlations with GDP growth of their respective countries. The results further confirm the a priori assumption that a positive relationship exists between stock returns and GDP growth for all four countries. Though there existed a statistically significant correlation between the yield spread and GDP growth for the four emerging economies, a positive yield spread was not present in all cases. A negative correlation is found to be present

between the yield spread and GDP growth for Brazil and India, which can be translated as, increases in GDP growth led to a decline in the yield spread. Such findings are similar to the study of Mehl (2009) which also found a negative correlation between the yield spread and industrial production growth for emerging economies such as India, Hungary and Korea for the period 1996-2005 which he attributed to high levels of industrial production growth volatility, changes in the risk premia, long-lasting and progressive productivity shocks, and a lack of liquidity in the domestic debt market which interferes with the information signals incorporated in security prices. Moreover, while China maintained a positive correlation between the yield spread and GDP growth, the correlation was quite low.

Furthermore, in the results presented, it is also evident that with the increase of lag length, the correlations between the financial market variables and GDP growth declined.

In general however, these findings from the preliminary correlation analysis provide evidence in line with the literature that there exists predictive capacity of stock returns, and brings forward the question, does the yield spread continue to be the leading indicator for predicting economic growth of economies, particularly in the case of emerging economies.

4.2 Estimation and out of sample forecasting

The statistical tests of a forecasting model generally involves the splitting of the sample period into two periods, the in-sample period, which is used for the initial parameter estimation of the model, and the out of sample period which is used to evaluate the forecasting performance generated by the selected model. According to White (2000), empirical evidence based on out-of-sample forecast performance is generally considered more trustworthy than evidence based on in-sample performance which can be more sensitive to outliers and data mining. Moreover, according to Diebold & Rudebusch (1991), “out of sample forecasts also better reflect information available to the forecaster in real time” (603). As such, in recent years, such observations have led many researchers and forecasters to consider the out of sample performance as the crucial test of a forecasting model.

Our first step towards forecasting therefore required splitting the data in two forecasting periods, that is the in-sample period and the out of sample period. The in-sample period uses data from

1999:1 to 2009:4 to obtain initial parameter estimates for the three forecasting models, while the out of sample period uses data from 2010:-1 to 2015:2.

In-sample estimation

In the study, we assumed that all the relevant information pertaining to future economic growth is already reflected in the stock returns and yield spread, as such, no additional lags on the independent variables are specified in the model. The Newey West test was applied to correct for serial correlation and heteroskedacity on standard errors of the estimates (Stock & Watson, 2003 and Junttila & Kinnunen, 2004).

Table 3: In-sample estimation

Russia

	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	X(t+1)	X(t+1)	X(t+1)	X(t+2)	X(t+2)	X(t+2)	X(t+4)	X(t+4)	X(t+4)
Constant	4.468 [0.041]***	4.241 [0.029]***	4.269 [0.023]***	4.471 [0.039]***	4.252 [0.026]***	4.275 [0.022]***	4.481 [0.038]***	4.266 [0.026]***	4.289 [0.019]***
YS	0.005 [0.001]***		0.002 [0.001]***	0.005 [0.002]***		0.002 [0.001]***	0.005 [0.002]***		0.002 [0.001]***
Ret		8.820 [8.022]***	8.060 [7.016]***		8.521 [7.036]***	7.89 [6.071]***		8.161 [7.016]***	7.512 [5.822]***
Adj. R squared	0.266	0.803	0.826	0.238	0.814	0.832	0.245	0.818	0.841

China

	Model 1	Model 2	Model 3	Model1	Model 2	Model 3	Model 1	Model 2	Model 3
	X(t+1)	X(t+1)	X(t+1)	X(t+2)	X(t+2)	X(t+2)	X(t+4)	X(t+4)	X(t+4)
Constant	5.785 [0.007]***	5.787 [0.007]***	5.791 [0.007]***	5.724 [0.067]***	5.731 [0.069]***	5.729 [0.063]***	5.791 [0.007]***	5.737 [0.068]***	5.735 [0.066]***
YS	0.007 [0.003]**		0.004 [0.003]	5.787 [0.007]		0.007 [0.007]***	0.004 [0.003]***	0.007 [0.007]	0.004 [0.003]
Ret		0.008 [0.227]			0.008 [0.007]	0.006 [0.003]			0.007 [0.007]
Adj. R squared	0.066	0.037	0.000	0.037	0.028	0.053	0.000	0.022	0.015

India

	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	X(t+1)	X(t+1)	X(t+1)	X(t+2)	X(t+2)	X(t+2)	X(t+4)	X(t+4)	X(t+4)
Constant	4.238 [0.092]***	1.823 [0.321]***	1.876 [0.365]***	4.229 [0.091]***	1.872 [0.307]***	1.911 [0.350]***	4.227 [0.089]***	1.962 [0.277]***	1.979 [0.315]***
YS	-0.064 [0.062]		-0.016 [0.023]	-0.055 [0.060]		-0.013 [0.022]	-0.042 [0.057]		-0.006 [0.019]
Ret		0.275 [0.037]***	0.272 [0.040]***		0.270 [0.035]***	0.267 [0.039]***		0.261 [0.032]***	0.260 [0.035]***
Adj. R squared	0.033	0.785	0.783	0.019	0.783	0.780	0.003	0.800	0.795

Brazil

	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	X(t+1)	X(t+1)	X(t+1)	X(t+2)	X(t+2)	X(t+2)	X(t+4)	X(t+4)	X(t+4)
Constant	4.487 [0.021]***	4.277 [0.019]***	4.343 [0.017]***	4.487 [0.021]***	4.283 [0.017]***	4.343 [0.017]***	4.486 [0.021]***	4.293 [0.014]***	4.340 [0.017]***
YS	-0.002 [0.000]***		-0.001 [0.000]***	-0.002 [0.000]***		-0.001 [0.000]***	-0.002 [0.000]***		-0.001 [0.000]***
Ret		1.720 [1.420]***	1.270 [1.190]*		1.690 [1.307]***	1.280 [1.119]***		1.610 [1.090]***	1.291 [1.190]***
Adj. R squared	0.672	0.864	0.939	0.650	0.873	0.941	0.596	0.892	0.943

Notes: The period of estimation is 1999:1 to 2009:4. The values in brackets [] are the Newey West corrected standard errors, where *** represents the 1% significant level

Upon assessing the in-sample estimation results, the explanatory power, measured by the adjusted R square on average was generally better than the stock returns and the yield spread model. Furthermore, of the two independent variables, the yield spread was statistically significant 14 out of the 24 cases, while the stock returns variable was statistically significant 18 out of the 24 cases, thus being the most important variable in terms of statistical significance. The statistical findings of the yield spread are quite surprising since most studies have found the yield spread to be the single most important variable with regards to statistical significance.

4.3 Stability Analysis

Forecasts based on empirical regressions are built on the underlying assumption that the estimated parameters of the model remain fixed during the sample period. According to Estrella *et. al* (2003) “if the assumption of parameter consistency does not hold, this is likely to cause severe consequences for forecasting performance” (630).

Due to the fact that applied forecasting models rarely are very structural and are not derived from deep structural parameters, instability becomes an empirical issue which should be tested in practice as stressed by Estrella *et al.* (2003).

Considering the turbulent period of our sample study which covers the early 2000s recession and the 2007 financial crisis, it is crucial that the stability of the model be tested. In our study, two stability tests were employed, namely the Chow break test and Andrews Quandt test.

The basic idea when using the Chow predictive failure test is to split the data into sub periods, estimate the models for each of the sub periods and for the entire sample, then compare the residual sum of the squares (Kuosmanen & Vataja, 2011). Using the Chow test to test for known structural breaks, the in-sample period was therefore divided into two parts. The first stability test part covers data spanning from 1999:1 -2002:4 to take into account the early 2000s recession, while the full sample period tests for structural breaks owing to the 2007 financial crisis.

Table 4: Chow predictive failure test

RUSSIA

IP	Term Spread Model		Stock Return Model		Mixed Model	
	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4
t+1	1.134[0.356]	20.766[0.000]	2.153[0.162]	4.755[0.014]	0.391[0.762]	5.149[0.004]
t+2	0.067[0.935]	20.987[0.000]	1.847[0.207]	4.651[0.015]	0.064[0.977]	5.385[0.003]
t+4	0.103[0.920]	21.556[0.000]	1.498[0.280]	4.289[0.021]	0.051[0.983]	6.025[0.002]

CHINA

IP	Term Spread Model		Stock Return Model		Mixed Model	
	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4
t+1	3.515[0.066]	0.915[0.480]	0.180[0.837]	3.848[0.029]	2.404[0.134]	7.920[0.000]
t+2	9.919[0.004]	0.927[0.404]	0.378[0.694]	4.020[0.026]	13.580[0.001]	7.647[0.000]
t+4	7.264[0.015]	1.040[0.363]	3.218[0.094]	4.020[0.026]	10.638[0.008]	6.936[0.000]

INDIA

IP	Term Spread Model		Stock Return Model		Mixed Model	
	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4
t+1	0.676[0.532]	104.880[0.00]	1.740[0.220]	80.696[0.000]	1.620[0.269]	14.294[0.000]
t+2	0.372[0.700]	104.287[0.000]	1.461[0.227]	79.385[0.000]	1.271[0.365]	14.669[0.000]
t+4	0.047[0.954]	101.881[0.000]	1.879[0.382]	78.093[0.000]	1.192[0.418]	17.732[0.000]

BRAZIL

IP	Term Spread Model		Stock Return Model		Mixed Model	
	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4	1999:1-2002:4	1999:1- 2009:4
t+1	9.973[0.003]	18.449[0.000]	7.608[0.008]	5.687[0.006]	3.898[0.048]	30.632[0.000]
t+2	9.676[0.004]	18.881[0.000]	5.986[0.019]	5.539[0.007]	4.511[0.039]	31.624[0.000]
t+4	2.970[0.108]	19.053[0.000]	3.023[0.105]	5.342[0.009]	1.189[0.390]	33.114[0.000]

Notes: The P-values are in parentheses, and the bolded figures represent statistically significant results at the 1% significant level

The results in table 4 illustrates that despite the decline in the level of economic activity due to the early 2000s recession, countries such as Russia, Brazil and India's three models remain stable. Instability however is found to be present for China's yield spread model for the period 2001:4 owing to the various structural reforms that occurred in China on December 11th 2001 when the Chinese economy officially became a member of the World Trade Organization.

Furthermore, for the entire sample period, it is evident that the 2007 financial crisis resulted in instability for all three forecasting models for all countries again with the exception of China's yield spread model. As such, it is safe to suggest that the instability of the models were not as result of the early 2000's recession but the 2007 financial crisis.

The onset of the 2007-2008 financial crisis has transformed economies worldwide, with emerging markets being no exception. The Andrews Quandt test was therefore employed to identify an unknown structural break for the forecasting period 2010:1 to 2015:2. It is found that while Russia's three models remain stable, Brazil, India and China models are unstable. (See App. A). For the case of China, a structural break is found both in the year 2011 and 2012. The potential reasons for the structural break in China are attributed to; increased borrowing costs that occurred twice in 2011, implemented measures to prevent increase in asset prices, strained local government finances along with saturated non-performing loans in the banking system. The 2014 housing glut, soaring debt and overcapacity in many industries are the main reasons for the latter structural break that occurred in China. For the case of India, the 2014 structural break is accredited to the severe levels of industrial production volatility, the continuous increase of interest rates by the Reserve Bank of India (RBI) to reduce the level of inflation and a loss of momentum on the varying reforms. Moreover, the structural break that occurred in Brazil in 2014 is owed to the economy being faced with realignment of regulated prices, exchange rate depreciation and a decline in the level of investment along with experiencing two consecutive

quarters of contraction, which according to economic theory, is generally deemed as an economy facing a recession.

4.4 Recursive out of sample forecasts

In our study, the out of sample forecasts were conducted recursively. Data for the period 1999:1-2009:4 were used to estimate and obtain forecasts for the period 2010:1, 2010:2 and 2010:4. The model was then estimated throughout 2010:1 to compute forecasts for 2010:2, 2010:3 and 2011:1 and so on. A formal comparison of the forecasting models for each country was employed by calculating and evaluating the Root Mean Squared Error (RMSE) and the Median Absolute Percentage Error (MdAPE) statistics to identify the forecasting model that generates the lowest RMSE and MdAPE, since such a model would be deemed the best forecasting model.

These statistics were obtained using the following formulas:

$$RMSE = \sqrt{\frac{1}{n} \sum_{j=1}^n (y_j - \hat{y}_j)^2}$$

$$MAPE = \frac{\sum_{t=1}^n \frac{|A_t - F_t|}{|A_t|}}{n}$$

Where A_t and y_j are the actual values, \hat{y}_j and F_t are the forecasted values and n is the number of observations.

Along with the three forecasting models namely; the yield spread model, stock returns model and the mixed model, an autoregressive model is also analysed in our study and used as a benchmark for comparison purposes, since according to Estrella (2005) “outperforming the random walk can be regarded as the minimum requirement for successful forecasts” (8).

$$Random\ walk\ model: X_{t+i} = X_t + u_{t+i} \quad where\ i=1,2, 4$$

Table 5: Out of sample recursive forecasts

RUSSIA

IP Forecast horizon	YS Model	Ret Model	Mixed model	Random walk
t+1	0.097	0.389	0.396	0.452
t+2	0.100	0.384	0.353	0.399
t+4	0.108	0.115	0.164	0.244
\sum RMSE	0.305	0.888	0.913	1.095
\sum MdAPE	6.069	11.59	11.829	12.341

CHINA

IP Forecast horizon	YS Model	Ret Model	Mixed model	Random walk
t+1	0.010	0.012	0.012	0.014
t+2	0.374	0.554	0.556	0.064
t+4	0.716	0.213	0.212	0.249
\sum RMSE	1.100	0.779	0.780	0.327
\sum MdAPE	16.663	11.264	11.225	9.673

INDIA

IP Forecast horizon	YS Model	Ret Model	Mixed model	Random walk
t+1	0.755	0.497	0.750	0.891
t+2	0.695	0.466	0.697	0.844
t+4	0.295	0.406	0.230	0.551
\sum RMSE	1.745	1.369	1.677	2.286
\sum MdAPE	29.278	21.323	23.193	29.969

BRAZIL

IP Forecast horizon	YS Model	Ret Model	Mixed model	Random walk
t+1	0.121	0.405	0.286	0.431
t+2	0.122	0.355	0.255	0.412
t+4	0.110	0.104	0.091	0.289
\sum RMSE	0.353	0.864	0.632	1.132
\sum MdAPE	7.692	10.795	7.843	12.322

Notes: The bolded figures represent the model that had the lowest RMSE (Root Mean Squared Error) of the out of sample forecasts for the four models under observation. The random walk model is specified as $X_{t+k} = X_t + u_{t+k}$. MdAPE represents the Mean Absolute Percentage Error

In the out of sample forecasts presented in table 5 above, each quarter forecasts for each model can be read across the rows, while the total forecastability of each model is assessed by adding the RMSE's for each forecasting quarter diagonally. Similarly, the MdAPE for each quarter is obtained (see Appendix B) and the sum of each model's MdAPE, for each forecasting quarter is presented across the column of the table.

The forecasting results illustrate that for the case of Russia, the yield spread provided the best forecasts in comparison to the return, mixed and random walk model, as the yield spread model presented the lowest RMSE's and MdAPE's for all the forecasting quarters. The random walk model provided the worst forecasts; as all three forecasting models under study were able to outperform the model. China's forecasting results were rather interesting. None of the forecasting models in totality were able to outperform the random walk model. As such, by looking at both the RMSE and MdAPE, the random walk model provided the better forecasts. However, upon closer inspection, when looking at each models forecast for 1 quarter and 4 quarters ahead, it can be seen that the yield spread model provided the better forecast when forecasting 1 quarter ahead, and the mixed model, provided the better forecast 4 quarters ahead. In comparison to the yield spread and mixed model, the return model was unable to outperform the random walk model at any forecasting quarter. According to Aylward & Glen (2000), the predictive capacity of stock returns does not exist for all markets and this may be due to "stock markets not being sufficiently developed to perform a central role in the allocation of capital resources in the economy, statistical problems with the sample data or as a result of high variability in the time series as such masking any statistical connection" (2).

Evaluating India's forecasts however provides enough evidence to suggest that the return model is the most significant model when forecasting GDP growth in India as the model provided the lowest RMSE's and MdAPEs in comparison to the other models. Assessing each forecasts for each horizon, the return model provided the best forecast for the 1 quarter and 2 quarter horizons, however for the fourth quarter, the mixed model provided the better forecast. Though India's yield spread model was able to outperform the random walk model, it was not able to provide forecasts better than the return model or the mixed model.

5.0 Discussion and Conclusion

In our study, we examined the stock returns and the yield spread of four emerging economies namely; Brazil, Russia, India and China to add to this unexplored area of research as well as to determine whether the predictive capacity of the yield spread continues to be the best leading indicator to predict economic growth of these economies. We therefore undertook a correlation analysis test to examine the degree of correlation between the two financial variables, and discovered that the stock returns variable for all four economies had the strongest correlation with GDP growth for their respective countries. Furthermore, based on the in-sample estimation results, additional evidence was prone to suggesting that the stock returns might be the leading indicator as the adjusted R square not only had greater explanatory power, but also had higher cases of statistical significance in comparison to the yield spread. The statistical findings of the yield spread are quite surprising since most studies have found the yield spread to be the single most important variable with regards to statistical significance (Kuosmanen & Vataja, 2011, Estrella & Mishkin, 2006 and Haubrich & Dombrosky, 1996).

Due to the empirical issue of basing forecasts on unstable regression models, checking the stability of the forecasting models became imperative. In our study, the Chow break failure test was used to test for the structural break owing to the early 2000's recession and the 2007 financial crisis, and the Andrews Quandt test to identify unknown structural breaks post the financial crisis period. The results suggest that instability of the forecasting models are indeed present, however this was found to be attributed to the 2007 financial crisis and not as a result of the early 2000's recession for all three emerging economies with the exception of China's yield spread model. The Andrews Quandt structural break test showed that during the forecasting period, all four countries experienced structural breaks between the years 2011 and 2014, we therefore went on to provide possible reasons for the structural breaks each country faced.

Subsequent to evaluating the RMSE and the MdAPE's forecasts which was necessary to identify the best forecasting model, it was found that for the case of Russia and Brazil, the yield spread continues to be the best leading indicator to predict economic growth in comparison to the stock returns variable in spite of the stock returns having a higher level of correlation, and more cases of statistical significance. The findings for India however suggest that the stock returns are the

better indicator to predict economic growth up to 3 quarters ahead, however beyond that period; the mixed model provides the better forecasts. The extent of the predictive capacity of the stock returns for the case of India is in line with the findings of earlier studies, which states that the stock return variables can predict up to one quarter to two quarters horizons.³ The findings in our study differs however as previous studies state that beyond that timeframe, the slope of the yield curve emerges as the clear choice⁴ and not the mixed model as our study illustrates. The findings in China have been inconclusive, but not surprising. From the initial correlation analysis test, the results indicated a low level of correlation with both the stock returns and the yield spread with the level of economic growth. Furthermore, the in-sample estimation results indicated that with reference to the level of statistical significance, only the first quarter and fourth quarter yield spread models were statistically significant. In other words, none of the stock returns models for any of the forecasting horizons were significant. Additionally, when looking at the mixed models, the stock returns variable continues to be insignificant. As such, based on the forecasts evaluation, though the yield spread provided the better forecasts for the first quarter in China, and the mixed model for the fourth quarter, overall none of the three forecasting models, that is the yield spread model, stock returns model and mixed model were able to outperform the random walk model which was used as a benchmark in our study. In other words, since the random walk model provided the lowest RMSE and MdAPE forecasts for all three forecasting models, according to economic theory, such forecasting model is deemed to be the best model.

Based on these findings, the two main implications for decision makers when forecasting future GDP of a country, particularly the case for emerging markets, is to take into account the stock return variables of a country and not presume that the yield spread is always the leading indicator for predicting the future level of economic activities of a country, as it is evident in this study that in some cases the stock return possesses stronger predictive power. Furthermore, decision makers should also consider observing alternative variables when forecasting future GDP as in some cases, case in point, China, neither the yield spread nor the stock returns were deemed to be

³ Estrella, A., & Hardouvelis, A. G. (1991). The term structure as a predictor of real economic activity. *The Journal of Finance*, 46(2), 555-576.

⁴ Estrella, A., & Mishkin, F. (1996). The predictive power of the term structure of interest rates in Europe and the United States: Implications for the Euro Central Bank. *European Economic Review*, 1375-1401.

fit variables to predict future economic growth as both variables were unable to outperform the benchmark forecasting model.

One main limitation of this study is the lack of data in terms of both financial data and previous studies that could have been used for comparison purposes to examine the stock returns and the yield spread for the case of emerging markets. Studies in the past have examined the predictive ability of the yield spread in the case of advanced and emerging markets, but no study to date have examined both the stock returns and yield spread variables collectively to identify the better variable to predict economic growth in the context of emerging economies. As such, there does not exist any literature that can be used for evaluation purposes to examine the predictive capacity of the financial variables pre and post financial crisis. In addition, due to the lack of financial data for these markets, the time period under study is relatively short.

For future research, I suggest taking into consideration the stock volatility of the stock markets in these emerging markets since it is generally known that stock market volatility is linked to the uncertainty of the level of economic activity of a country, and that volatility moves counter-cyclically, that is, when stock prices are falling and there is a down turn in the economy, there exists a high level of volatility. Thus according to Siegel (2002), the stock market volatility seems to be related to the general health and future state of the real economy.

References

- Breedeen, D. (1979). An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities. *Journal of Financial Economics*, 7, 265-296.
- Aylward, A., & Jack, G. (2000). Some international evidence on stock prices as leading indicators of economic activity. *Applied Financial Economics*, 10, 1-14.
- Berk, M., & Bergeijk, P. V. (2001). On the information content of the yield curve: Lessons from the Eurosystem. *Kredit und Kapital*, 28-47.
- Bernanke, S. B. (1990, November/December). On the predictive power of interest rates and interest rate spreads. *New England Economic Review*, 51-68.
- Bierens, J. H., & Broeresma, L. (1993). The relationship between unemployment and interest rate: Some international evidence. *Econometric Reviews*, 12, 217-256.
- Binswanger, M. (1999). Stock returns and real activity: Is there still a connection? *Applied Financial Economics*, 379-387.
- Brock, W. (1982). Asset prices in a production economy. *National Bureau of Economic Statistics*, 1-46.
- Campbell, J., & Shiller, R. (1988). Stock prices, Earnings and Dividends. *The Journal of Finance*, 43(3), 661-676.
- Choi, J., Hauser, S., & Kopecky, K. (1999). Does the stock market predict economic activity? Time series evidence from the G-7 countries. *Journal of Banking and Finance*, 23, 1771-1792.
- Clark, K. (1996). A near perfect tool for economic forecasting. *Fortune*, 134(2), 24-26.
- Cox, J., Ingersoll, J. E., & Ross, S. (1985). An Intertemporal General Equilibrium Model of Asset Prices. *Econometrica*, 53(2), 363-384.
- Dar, A. B., Samantaraya, A., & Shah, F. (2014). The predictive power of the yield spread: Evidence from wavelet analysis. *Springer*.
- Diebold, X. F., & Rudebusch, G. (1991). Forecasting Output with the composite leading index. *Journal of American Statistical Association*, 86, 603-610.
- Domian, L. D., & Louton, A. D. (1997). A threshold autoregressive analysis of stock returns and real economic activity. *International review of Economics and Finance*, 6, 167-179.
- Dotsey, M. (1998). The predictive content of the interest rate term spread for future economic growth. *Economic Quarterly*, 84.

- Dueker, J. M. (1997). Strengthening the case of the yield curve as a predictor of US recessions . *Federal Reserve Bank of St. Louis Review*, 41-51.
- Estrella, & Mishkin. (1996). The yield curve as a predictor of US recessions. *Federal Reserve Bank of New York, Current Issues in Economics and Finance*, 2(7), 1-6.
- Estrella, A. (2005a). Why does the yield curve predict output and inflation? *The Economic Journal*, 722-744.
- Estrella, A. (2005b). The yield curve and recessions. *The International Economy*.
- Estrella, A., & Hardouvelis, A. G. (1991). The term structure as a predictor of real economic activity. *The Journal of Finance*, 46(2), 555-576.
- Estrella, A., & Mishkin, F. (1996). The predictive power of the term structure of interest rates in Europe and the United States: Implications for the Euro Central Bank. *European Economic Review*, 1375-1401.
- Estrella, R. A., & Schich, S. (2003). How stable is predictive power of the yield curve? Evidence from Germany and the United States. *The Review of Economics and Statistics*, 629-644.
- Evgenidis, A., & Siriopoulos, C. (2014). Does the yield spread retain its forecasting ability during the 2007 recession? A comparative analysis. *Applied Economics Letters*, 21(12), 817-822.
- Fama, E. (1981). Stock returns, real activity, inflation and money. *American Economic Association*, 71(4), 545-565.
- Fama, E. (1990). Term structure forecasts of interest rates, inflation and real returns. *Journal of Monetary Economics*, 59-76.
- Ferreira, E., Serna, M.-I., Navarro, E., & Rubio, G. (2008). Economic Sentiment and Yield Spreads in Europe. *European Financial Management*, 14(2), 206-221.
- Fisher, S., & Merton, R. C. (1984). The Role of the Stock Market. *Macroeconomics and Finance*, 57-108.
- Frankel, J., & Lown, C. (1994). An indicator of future inflation extracted from the steepness of the interest yield curve along its entire length. *Quarterly Journal of Economics*, 517-530.
- Friedman, B. M., & Kuttner, K. (1992, June). Money, income, prices and interest rates. *American Economic Review*, 82, 472-492.
- Gammell, N. (1996). Evaluating the impacts of Human Capital, Stocks and accumulation on economic growth: Some new evidence. *Oxford Bulletin of Economics and Statistics*, 58.
- Gogas, P., & Pragidis, I. (2012). GDP trend deviations and the yield spread: the case of 8 EU countries. *Journal of Economics Finance*, 226-237.

- Gong et. al. (2004). Estimating the Romer Model for the US and Germany. *Oxford Bulletin of Economics and Statistics*, 66, 147–164.
- Guo, H. (2002). Why are stock market returns correlated with future economic activities. *The Federal Reserve Bank of St. Louis.*, 19-34.
- Harvey, C. R. (1991). The term structure and world economic growth. *The Journal of Fixed Income*, 7-19.
- Haubrich, J., & Dombrosky, M. A. (1996). Predicting real growth using the real yield curve. *Economic Review*.
- Havey, C. R. (1989). The real term structure and consumption growth. *Journal of Financial Economics*, 305-333.
- Hu, Z. (1991). The yield curve and real activity. *International Monetary Funds Palgrave Macmillan Journals*, 781-886.
- Kashyap et al. (1993). Monetary policy and credit conditions: Evidence from the composition of external finance. *American Economic Review*, 83, 79-98.
- Kessel, A. R. (1965). The cyclical behaviour of the term structure of interest rates. *National Bureau of Economic Research Occasional Paper*, 91.
- Keynes, M. (1936). The general theory of employment, interest and money. *Macmillan*.
- Kozicki, S. (1997). Predicting real growth and inflation with the yield spread. *Economic Review*.
- Kwon, C. S., & Tai, S. S. (1999). Cointegration and causality between macroeconomic variables and stock market returns. *Global Finance Journal*, 10, 71-81.
- Laurent, R. (1988). An interest rate based indicator of monetary policy. *Federal Reserve Bank of Chicago Economic Perspectives*, 3-14.
- Lim, D. (1976). Export instability and economic growth: a return to fundamentals. *Oxford Bulletin of Economics and Statistics*, 311-322.
- Litterman, R., & Sims, C. (1983). Money, Real Interest Rates, and Output: A reinterpretation of Postwar U.S. Data. *Econometrica, Econometric Society*, 53, 129-156.
- Loflund, A., & Nummelin, K. (1997). On stocks, bonds and business conditions. *Applied Financial Economics*, 7, 137-146.
- Lucas, J. (1978). Asset prices in an exchange economy. *Econometrica*, 46(6), 1429-1445.
- Marcellino, M., & Schumacher, C. (2010). Factor MIDAS for Nowcasting and Forecasting with ragged edge data: A model comparison for German GDP. *Oxford Bulletin of Economics and Statistics*, 72(4), 0305-9049.

- Mariano, S., & Murasawa, Y. (2010). A Coincident Index, Common Factors, and Monthly Real GDP. *Oxford Bulletin of Economics and Statistics*, 27-46.
- Mauro, P. (2003). Stock returns and output growth in emerging and advanced economies. *Journal of Development and Economics*, 71, 129-153.
- Mehl, A. (2009). The yield curve as a predictor and emerging economies. *Springer*.
- Mills, L. (1988). Can stock prices accurately predict recessions. *Business Review*, 1-12.
- Mishkin, F. S. (1990a). The information in the longer maturity term structure about future inflation. *Quarterly Journal of Economics*, 105(3), 815-828.
- Mitchell, W. (1913). *Business Cycles*. University of California, Press.
- Mitchell, W. (1927). Business Cycles: The Problem and Its Setting. *National Bureau of Economic Research*, 1-60.
- Mody, A., & Taylor, M. (2004). Financial predictors of real activity and the financial accelerator. *Economics Letters*, 167-172.
- Moneta, F. (2005). Does the Yield Spread predict Recessions in Euro Area? *International Finance*, 263-301.
- Moore, H. (1983). Business Cycles, Inflation and Forecasting.
- Morck, R., Shleifer, A., & Vishny, R. (1990). The Stock Market and Investment: Is the market a slideshow? *Brookings Papers on Economic Activity*, 157-214.
- Olan, H., Olekalns, N., & Thong, J. (2004). Do stock market returns predict changes to output? Evidence from a non-linear panel data model. *Empirical Economics*, 527-540.
- Pace, D. (2013). High yield spreads, real economic activity and the financial accelerator. *Economics Letter*, 346-355.
- Papadamou, S. (2009). Yield spreads and real economic activity in East European transition economies. *Applied Economics Letters*, 16, 531-537.
- Samuelson, A. P. (1999). Summing upon Business Cycles: Opening Adress in Beyond Shocks, "What causes Business Cycles?".
- Schwert, W. (1990, September). Stock returns and Real activity: A century of Evidence. *Journal of Finance*, 155(4), 1237-1257.
- Stock, J. H., & Watson, M. W. (1990). Business cycle properties of selected U.S. economic time series. *National Bureau of Economic Research Working Paper*, 3376.
- White, H. (2000). *Asymptotic theory for Econometricians*. San Diego: Academic Press.

Zhang et al. (2009). Research on problems in Chinese economic cyclical fluctuations. *Institute of Economics China Academy of Social Sciences*.

Appendix A: Andrews Quandt Test

Russia

IP	YS Model t+1	Ret Model t+1	Mixed Model t+1	YS Model t+2	Ret Model t+2	Mixed Model t+2	YS Model t+3	Ret Model t+3	Mixed Model t+3
Max LR	1.989[0.730]	1.938[0.747]	1.994[0.664]	2.180[0.665]	2.925[0.432]	1.408[0.845]	2.103[0.691]	3.086[0.389]	0.929[0.977]
Break date									
Ave LR	1.455[0.189]	1.1749[0.294]	1.099[0.335]	1.257[0.258]	0.801[0.519]	0.733[0.615]	1.283[0.248]	0.557[0.727]	0.373[0.948]

India

IP	YS Model t+1	Ret Model t+1	Mixed Model t+1	YS Model t+2	Ret Model t+2	Mixed Model t+2	YS Model t+3	Ret Model t+3	Mixed Model t+3
Max LR	6.883[0.019]	13.665[0.004]	4.898[0.035]	3.524[0.289]	112.822[0.000]	1.015[0.962]	1.786[0.799]	123.096[0.000]	1.075[0.949]
Break date	2011 Q2	2011 Q2	2011 Q2		2014 Q2			2014 Q2	
Ave LR	3.248[0.012]	3.140[0.039]	3.222[0.003]	1.776[0.114]	28.775[0.000]	0.631[0.706]	0.403[0.846]	33.461[0.000]	0.446[0.886]

Brazil

IP	YS Model t+1	Ret Model t+1	Mixed Model t+1	YS Model t+2	Ret Model t+2	Mixed Model t+2	YS Model t+3	Ret Model t+3	Mixed Model t+3
Max LR	29.431[0.000]	12.592[0.000]	25.009[0.000]	27.351[0.000]	11.522[0.000]	19.755[0.000]	29.431[0.000]	10.066[0.001]	17.537[0.000]
Break date	2014 Q2	2014 Q3	2012 Q2	2014 Q2	2014 Q4	2012 Q2	2014 Q2	2014 Q4	2012 Q2
Ave LR	18.836[0.207]	3.847[0.005]	16.731[0.000]	17.418[0.003]	3.019[0.017]	14.107[0.000]	18.836[0.020]	3.051[0.016]	12.647[0.000]

China

IP	YS Model t+1	Ret Model t+1	Mixed Model t+3	YS Model t+2	Ret Model t+2	Mixed Model t+2	YS Model t+3	Ret Model t+3	Mixed Model t+3
Max LR	3.850[0.397]	10.052[0.025]	25.368[0.000]	2.910[0.572]	8.649[0.049]	7.420[0.012]	3.658[0.429]	11.261[0.014]	6.472[0.027]
Break date		2011 Q2	2011 Q2		2014 Q4	2012 Q2		2014 Q4	2014 Q4
Ave LR	1.051[0.321]	3.613[0.026]	4.847[0.001]	1.003[0.340]	2.445[0.073]	4.813[0.001]	1.615[0.167]	2.148[0.097]	3.802[0.005]

Notes: Max LR= The Andrews Quandt maximum LR F- statistic for the structural break test. Break date= The period in which a structural break is present according to the Andrews Quandt test. The bolded figures represent the dates that are statistically significant. The values in parentheses are the p-values. 1,2 and 4 represent the quarterly forecast horizons

Appendix B: Medians of the absolute percentage error of each quarter

RUSSIA

IP Forecast horizon	YS Model	Ret Model	Mixed model
t+1	1.899	4.865	4.93
t+2	1.986	4.679	4.459
t+4	2.184	2.046	2.44
MdAPE	6.069	11.59	11.829

CHINA

IP Forecast horizon	YS Model	Ret Model	Mixed model
t+1	0.150	0.202	0.201
t+2	6.068	7.497	7.466
t+4	10.445	3.565	3.558
MdAPE	16.663	11.264	11.225

INDIA

IP Forecast horizon	YS Model	Ret Model	Mixed model
t+1	10.781	9.028	9.008
t+2	10.039	7.863	7.699
t+4	8.458	6.302	4.616
MdAPE	29.278	23.193	21.323

BRAZIL

IP Forecast horizon	YS Model	Ret Model	Mixed model
t+1	2.642	4.869	3.205
t+2	2.655	3.675	2.706
t+4	2.395	2.251	1.932
MdAPE	7.692	10.795	7.843

Notes: MdAPE represents the Median Absolute Percentage Error