> A thesis submitted to London South Bank University in partial fulfilment for the degree of Doctor of Philosophy

> > By

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(3:173) When people said to them: 'Behold, a host has gathered around you and you should fear them', it only increased their faith and they answered: 'Allah is Sufficient for us; and what an excellent Guardian He is!'

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## Abstract

The prediction of stock market indices and issues/questions associated with such predictions, have been a challenge for several academics, business analysts and financial researchers for many years. In the main, these challenges have been addressed within developed economies; statistically using appropriately determined macroeconomic independent variables. However, much less attention has been directed to the use of such variables within developing economies. This sparse attention forms the *research background* (Chapter I) and provides partial justification for the research itself. Thus, the research comparatively focuses on both, certain developing and selected developed economies. The precise context of the research considers/compares the impact and potential/possible relationships of meaningfully selected macroeconomic variables, upon respective stock market indices of two sets of economies - BRICS (i.e. Brazil, Russia, India, China and South Africa) and five meaningfully selected developed economies (i.e. France, Germany, Japan, UK and US). Thus, a significant motivation for the research is to evaluate/test theoretical linkages and empirical relationships of selected macroeconomic variables, in terms of their predictive power vis a vis related stock market indices. The research then offers consequent policy implications/contributions. It is of benefit and significance to (*inter alia*) investors, who would welcome "early signals" when evaluating stock markets via relevant indices. In so doing, the research adds theoretical and empirical knowledge, with practical potential, to this domain. Finally, within its concluding chapter, the thesis also offers some suggestions for further research and future researchers.

Against the above background, the research addresses ten individual, but related, *objectives* (Chapter II). These objectives range from an attempt to identify the directional and potentially causal relationship between sets of selected macroeconomic variables and relevant stock market indices (*Objective 3*), through to determining dynamic relationships across sets of comparable indices (*Objective 10*).

The *literature review* (Chapter III) confirms the relative absence of relevant empirical literature within developing countries. However, related literature within developed economies does prevail. For instance, in terms of the U.S., **Domian and Louton (1997)** find evidence that stock price declines (and so of market indices) are associated with abrupt decreases in growth rates of industrial production and increases are comparably associated with mild increases in industrial production. Equally, in terms of Germany, France, United Kingdom, Sweden, Japan, Canada and United States, **Longin and Solnik (1995)** provide evidence in terms of the predictive power of macroeconomic variables related to stock prices (and by implication indices). Accordingly, the extant research literature reveals a gap. There appears to be no study that comparatively analyses the effects of the 2007-8 financial crisis between the BRICS and the five developed countries, selected for this analysis. Equally, in contrast to the present research, there appears to be no study that (as "dummy" variables) tests the effect of the US quantitative easing policy undertaken during the financial crisis, on the financial markets of BRICS and the five selected developed countries. And, therein lies some of the uniqueness and original contribution of this research.

Saunders et al. (2016) who consider the construction of research with the six "layers" of their "Research Onion" influence the *research design and methodology* (Chapter IV). Thus, with explanations provided within the thesis, the research engages with five of these "layers" as follows: philosophy - *positivist*, approach - *deductive*, strategy - *archival*, choice of method - *quantitative – but with qualitative elements*. The research time-horizon is *longitudinal*, with, respectively, the same dependent (identified stock market indices) and independent (selected macroeconomic variables) research variables being considered and analysed over a significant period of time (January 2000 to December 2015). Thus, the research data are mainly stock market indices (dependent variables) and meaningfully identified macroeconomic features (independent variables - derived from a Keran diagram), over the research period. Equally, appropriately developed variables, intended to quantitatively capture the 2008 financial crisis and the US quantitative easing are also used as dummy variables within the independent variable data set. The research data itself and its analysis, and the dependent and independent variables are identified and rationalised within the thesis. And, in this context, the research draws on, and analyses, pre-existing quantitative data stored (mainly) in the Bloomberg repository - a public database. This public accessibility obviates ethical issues relating to the access, use and storage of the research data.

The *research mathematical/statistical procedures and analyses* (Chapter V), mainly computed descriptive and inferential statistics, are developed and presented within the research, Firstly, in order to condition and/or quality control variables, appropriate pre-statistical operations (including Units Roots Tests, Correlations, Seasonal Adjustments and Log Transformations) are duly performed on quantitative data. Then, descriptive statistics (including mean, mode, median and standard deviation) are developed (primarily) in order to reveal and describe properties of the variables attached to the cases, and to be assured that the inferential statistical tests to be applied to them are, indeed, appropriate. Finally, appropriate inferential statistics are applied and determined as necessitated by individual and particular research objectives.

The *research results* (Chapter VI) and their consequent *practical and policy implications and suggestions* for further research (Chapter VII) for the ten objectives are presented and discussed within the thesis. However, restricting present consideration to only (the possibly) four most important objectives (1, 2&3 and 10) of the research, one observes as follows:

**Objective 1** identifies, in overall model terms, macroeconomic variables, which over the research period, are statistically significant when predicting the indices for the researched stock markets. The models that emerge indicate most explanatory power in terms of the Brazilian and Indian markets. This is true of the models with and without the two "dummy" variables. In terms of these models, for the BRICS markets, the two that appear to have reasonably good meaningful explanatory power (at least 70%) are the ones for Brazil and India. Whereas, for the developed markets, the only model with some meaningful explanatory power (55%) is that of Japan. In terms of these markets and the first set of models, macroeconomic variables of significance are the Exchange Rate and House Price Inflation and for the Japanese market, House Price Inflation and GDP are of significance. The insertion of the two dummy variables does not appear to reveal either of them to be significant. Thus, one could conclude that within the BRICS markets it is possible to predict using appropriate models, the relevant market index. This appears to be particularly true of Brazil and India. In terms of the developed markets, this would be possibly the case only for Japan. Therefore, policy makers should monitor and take regard for the two, as appropriate to the market (BRICS or developed), the identified macroeconomic variables.

Objectives 2 & 3 are somewhat inter-related and so are best considered together. Objective 2 identifies any statistically long-run relationship between the research set of macroeconomic variables and their relevant stock market indices. However, Objective 3 identifies the directional and potentially causal relationships between the researched sets of macroeconomic variables and their relevant stock market indices. The relevant results show that macroeconomic variables and stock price indices move together in the *long run* for all the BRICS country. However, in the long run, such relationships do not appear to be present for the developed markets/economies. Equally, in most of the developed economies, the variables move together only in the short-run – the exceptions being France and Japan. Equally, in the short-run, the results provide evidence of potentially causal relationships (between stock market indices and the relevant macroeconomic variables) in all BRICS markets. However, this is not the case for the developed markets, with the exception of Japan, where the stock market index and the Inflation Rate appear to be causally linked in the short-run. Thus, one may conclude that in the BRICS context, in the long run, the macroeconomic variables do influence stock market movements. However, this relationship is true only in the short-run for France and Japan. This supports one to conclude, in terms of the BRICS marketseconomies, there is a short-term linkage between the macroeconomic variables and their stock market indices. This relationship does not appear to be at hand within the developed economies – with the possible exception of Japan. With this knowledge, policy makers would be well advised to consider and monitor, within both BRICS and developed markets-economies, both short run and long run relationships across the relevant stock market indices and macroeconomic when developing an investment strategy. In particular, in the short run with regard to Japan, policy makers should take special account for the rate of inflation variable.

**Objective 10** seeks the determination of any dynamic relationships existing across the sets of stock market indices. In other words, it seeks to reveal any influencing across the relevant market indices themselves. The results suggest that within both sets of markets (BRICS and developed) considered, the Chinese and Brazilian appear to be most independent. Equally, the French stock market also reveals a good measure of independence. The analysis also suggests that the Brazilian index appears to much influence all the other market indices - except China. The Chinese and Brazilian markets seem to manifest some country-specific risks not shared by the other markets. The However, the Brazilian market seems to plays an important role within both BRICS and developed markets economies - suggesting some inter-linkage. Finally, the Chinese market seems to be not influenced by the other markets - especially the developed markets. As the market indices of the developed countries appear not to be cointegrated, investors and policy makers should separately consider these as two distinct investment sets when developing investment policies and take regard for their individual macroeconomic forecasted trends. In terms of the BRICS markets, investors and government officers should be aware that that these markets are noncointegrated when investment strategy is developed. For, in so doing, they will better spread investment risk. Equally, portfolio managers should maintain individual portfolios for developed and BRICS markets investments as, overall, these markets appear not to share the same risks. Finally, given the relevant isolation of the Chinese and Brazilian stock markets, portfolio managers should seize the diversification benefits they offer.

#### Key words:

BRICS versus developed economies, Keran diagram, macroeconomic variables, prediction of stock market indices, stock market indices/integration, variance decomposition analysis.

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# Clarifying Schedule of key terms and abbreviations (Page 1 of 2)

Term	Abbreviation	Clarifying Explanation						
Augmented Dickey-Fuller	ADF	A test to determine a unit root in a time series sample						
Cointegration	N/A	An econometric technique for testing the correlation between non-stationary time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated						
Consumption	CON	The ratio of the monetary value of all quantity of goods and services consumed within a given economy and the time encompassed in that period.						
Degree of Freedom	N/A	In statistics, the number of values in a research that are free to vary.						
Exchange Rate	EXC	The purchasing price of a nation's currency in another currency						
Financial Crisis	N/A	A situation in which the value of financial institutions or assets drops rapidly. A financial crisis is often associated with a panic or a run on the banks, in which investors sell off assets or withdraw money from savings accounts with the expectation that the value of those assets will drop if they remain at a financial institution.						
Emerging Markets	N/A	An economy progressing toward becoming advanced, as shown by some liquidity in local debt and equity markets and the existence of some form of market exchange and regulatory body.						
Error Correction Model	ECM	An error-correction model is a dynamic model in which "the movement of the variables in any periods is related to the previous period's gap from long-run equilibrium". It is used to elucidate the long-run and short-run relationship between variables.						
Generalised Error Distribution	GED	This is a parametric family of symmetric distributions.						
Gross Domestic Product	GDP	The monetary value of all goods and services produced within the borders of a nation in a given period						
Real Gross Domestic Product	RGDP	The real value of the GDP.						
Heteroskedasticity(GARCH)	N/A	In statistics, when the standard deviations of a variable, monitored over a specific amount of time, are non-constant. Heteroskedasticity often arises in two forms, conditional and unconditional. Conditional heteroskedasticity identifies non-constant volatility when future periods of high and low volatility cannot be identified. Unconditional heteroskedasticity is used when futures periods of high and low volatility can be identified.						
House Price Index	HPI	A measure of the price changes of residential housing, usually annually						
Inflation Rate	IFR	The percentage increase in the price of goods and services, usually annually						
Interest Rate	INR	The rate charged for the use of money						

# <u>Clarifying Schedule of key terms and abbreviations (Page 2 of 2)</u>

Term	Abbreviation	Clarifying Explanation								
Quantitative Easing	QEG	An unconventional monetary policy in which a central bank purchases government securities or other securities from the market in order to lower interest rates and increase the money supply. Quantitative easing increases the money supply by flooding financial institutions with capital in an effort to promote increased lending and liquidity. Quantitative easing is considered when short-term interest rates are at or approaching zero, and does not involve the printing of new banknotes.								
Structural Breaks	FCR	A structural break appears when we see an unexpected shift in a time series. This can lead to huge forecasting errors and unreliability of the model in general.								
Stock Market Indices	S.M.I	The gain or loss of a security in a particular period. The return consists of the income and the capital gains relative on an investment.								
Volatility		A statistical measure of the dispersion of returns for a given security or market index. It may also be seen as expression of attached risk								
Vector Error Correction Model	VECM/VAR	This adds error correction features to a multi-factor model								

# Some Research Activity of Mr Berzanna Seydou Ouattara (Author)

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- Berzanna Seydou Ouattara (2017), "Students' experience of learning bookkeeping", Eurasian Journal of Social Sciences, 5(3): 1-8
- Berzanna Seydou Ouattara (2017), "Re-examining stock market integration among BRICS countries", *Eurasian Journal of Economics and Finance*, 5(3): 109-132

# **Chapter I**

## **Research Background, Context and Thesis Structure**

## **1.0 Introduction**

The prediction of stock market indices, bubbles and movements has been a challenge for academics, business analysts and financial researchers for many years. In most studies, such challenges have been addressed by the use of macroeconomic variables (Fifield et al 2002, Patro et al 2002 and Al-Jafari et al 2011). This research seeks to determine how the stock market indices in BRICS and a set of developed countries may be predicted through sets of selected macroeconomic variables applying a range of various econometric models and techniques. It also evaluates how country specific macroeconomic variables and their related stock market indices interact with each other.

Seminal research has highlighted the existence of a relationship between stock prices and the economic indicators. For instance, the studies of **Fama and Schwert (1977), Fama (1981, 1982), and Geske and Roll (1983)** have clearly established that economic indicators – primarily inflation – have a negative relationship with share prices. It is relevant to note here that the APT model was the basis for early consideration before the introduction of the statistical models.

In the search to determine the nature of the relationship between the mix of indicators and stock prices, studies have paid attention to the interaction between macroeconomic variables and stock price returns. In addition, researchers have investigated whether the relationship is significant in the long or short-term. Along with the Cointegration Test, researchers have utilised the Granger Causality Test to determine which one of the variables leads to, as opposed to lags, the relationship. This process distinguishes between leading indicators, which are affected before any change takes place within the economy (recession or boom), and variables, which react after the changes that may happen in the economy (lagged variables). In this context, **Darrat and Dickens (1999), Dasgupta (2012) and Tangitprom** (2012) have demonstrated the existence of a causality relationship between selected sets of variables.

This chapter now goes on to the research background and context and a brief overview of the researched countries and selected stock market indices. It further details the thesis structure by presenting its precise contents per chapter and section in the last section.

### **1.1 Research Background**

Capital flows into the emerging stock markets have increased continuously following the liberalisation of these markets in early 1980s and the removal of foreign capital controls on these economies. These rapidly growing emerging markets have attracted accumulated funds from developed economies in search of higher returns and diversification termed as "return chasers" by Bohn and Tesar (1996). The economies of both emerging and developed markets are affected by or predicted on macroeconomic variables. This thesis seeks to analyse the relationship between both emerging (BRICS) and some developed (France, Germany, Japan, UK and US) economies and identifies any dynamic relationships that may exist across markets. There is currently no research that links BRICS economic markets with the selected five developed economic markets used in this research. For an effective quantitative analysis of both the BRICS and the selected developed markets, this section of the thesis uses economic tools like market capitalisation, which measures the corporate size of a country and is derived as the multiplication of current stock price by outstanding shares; trading and settlement cycle, which identifies the stock market's efficiency and its speed at settling numerous transactions; and the stock market listing agreements. Please see Appendix 1 (Volume 2, Pages 12-15) where the selected stock market indices performances and presentations are detailed. Table 1.1 presents the characteristics of the selected stock market indices in terms of performances.

		Market liquidity Value of shares traded		Turnover ratio Value of shares traded								
	Market capitalization					Listed domestic companies number		S&P/Global Equity Indices				
	\$ millions		% of GDP		% of GDP		% of market capitalization				% change	
	2010	2016	2010	2016	2010	2016	2010	2016	2010	2016	2010	2016
BRICS Economies												
Brazil	1,545,566	758,559	70	42.2	41.1	31.2	58.8	79.5	373	338	-44.3	62.6
Russian Federation	951,296	622,052	62.4	48.5	33.2	10.9	53.3	25.7	556	242	0.8	48.7
China	4,027,840	7,320,738	66	65.4	135.4	163.4	205	273.2	2,063	3,052	-6	-2
India	1,631,830	1,566,680	98.5	69.2	65.3	35	66.2	26.4	5,034	5,820	-3.9	-0.2
South Africa	925,007	951,320	246.4	322.7	73.9	136.5	30	38.4	352	303	-26.6	17.6
Developed Economies												
France	1,911,515	2,156,833	72.2	87.5	51	41	70.6	56	617	485	8.5	4.9
Germany	1,429,719	1,716,042	41.8	49.5	43.7	32.4	104.5	74.9	690	531	9.6	6.9
Japan	3,827,774	4,955,300	67.2	100.3	74.9	105.9	111.6	116.8	2,281	3,535	9.1	0.4
United Kingdom	1,868,153		65		132.2	78.6	146.4		2,105	1,858	-4.9	14.4
United States	17,283,452	27,352,201	115.5	147.3	240.7	226.6	208.4	154.8	4,279	4,331	-0.7	9.5
World	51,452,952	64,819,639	86.5	99.4	112.3	126.6	130.8	132.2	45,748	43,192		

# Table 1.1: Comparative Economic Performance of the Selected Stock Markets

This table illustrates the importance of the BRICS stock markets that represented 18% of the world market capitalisation in 2010 against 17% in 2016. Both economies addressed by this research represented 69% of the world market capitalisation in 2010 with an increase to 73% last year. The financial and economic health of the BRICS is reflected in the 5% jump from 18% in 2010 to 23% in 2016 regarding the number of domestic listed companies.

## **1.2 Research Context**

The selection of the chosen countries for the present thesis has been first inspired by the ranking as proposed by the International Monetary Fund (IMF) through its World Outlook Economic Database in which Japan makes the top 10 of developed economies. The second thought behind the selection of Japan is that the thesis wants to cover as much as region possible in the world. Japan is therefore seen as a representation of the East Asian Pacific, opposed to China which is part of the BRICS. Despite suffering economically from 2008, illustrated by a sharp decline in its real GDP by -3%, Japan remains the third leading country in terms of nominal GDP, declining to four when considering GDP by purchasing power parity. Japan selection can somehow be arguable as the country faces, due to the continuous application of unconventional policy, hard time in its economy. However, forecast and estimation demonstrate that Japan enjoyed 1% economic growth in 2016 and will benefit from 1.7% in 2018. Most importantly, this thesis selected the BRICS countries, as they have proven strong economically during the 2008 financial crisis with real GDP increasing remarkably for all of them.

Most importantly, the researcher seeks to analyse and compare/contrast sets of countries belonging to the G7 (leading economies) against the full set of the BRICS economies. However, in terms of the G7 nations this excludes two of them – Italy and Canada.

The exclusion of Italy from the set of G7 economies is made on the view that the inclusion of France, Germany and UK provides more than adequate European insight and so the inclusion of Italy is not critical. Additionally, at the time of data sourcing for the research, the Italian economy was still reverberating from the 2007-2008 Financial Crisis and there were significant data acquisition challenges for that country.

Equally, the research contends that the US alone provides a good representation of the North American economy. So, the inclusion of Canada within the research data is also not critical. Additional considerations relating to the selection of each of the countries are provided on Page 5 of the present thesis. The relevant section on the Page 5 offers a more full explanation of the matter.

On a country-by-country basis, the section of the chapter offers an economic overview of the ten selected countries to be assessed in this thesis over the last decade of the last century and first decade of this one.

## **1.2.1 BRICS Economies**

### **1.2.1.1 Brazil**

The 1990s are known in Brazilian history as years of major difficulties with the stabilisation and reform programs, which were caused mostly by the superficial nature of Brazil's administration's actions and its inability to secure political support. The administration's stabilisation plans failed mainly, because of the management errors that were coupled with defensive actions by some sections of the society directly affected by the plan.

The monthly growth rate of the GDP started rising in March 1990, after a fall of more than 80%. The political administration achieved stabilisation of the GPI at a high and slowly rising rate. The GPI rose by 19.9% in January 1991 reaching to 32% a month by July 1993. Simultaneously, the Brazilian political instability increased sharply, having negative impact on the economy. The real GDP declined by 4.0% in 1990, increased only by 1.1% in 1991

following with a decline of 0.9% in 1992. In 1993, the economy improved again, but the inflation rate was higher than 30% a month. Thus, the chances of achieving durable recovery appeared to be slim. By the end of 1993, it was widely acknowledged and accepted, that without serious and effective fiscal reforms, inflation would remain relatively high and the economy would not sustain any growth. This general acknowledgment had a significant pressure on the government to appoint a well-determined minister of finance, named Fernando Henrique Cardoso, and a high-level professional team to develop a new stabilisation plan called Plano Real. Plano Real was implemented early in 1994 with three stages as stated below:

- The introduction of an equilibrium budget mandated by the National Congress,
- A process of general indexation (prices, wages, taxes, contracts, and financial assets);
- And the introduction of a new currency, the Brazilian real, pegged to the dollar.

Overall, the Plano Real was successful despite numerous failed attempts directed to the elimination of the inflation. After a long period of instability in economic growth and development, the economic indicators that were adopted in Brazil, resulted in a certain level of economic stability, particularly since the second half of the 1990s. These policies were mainly based on parameters that were advocated by the financial institutions, such as the International Monetary Fund (IMF) and the World Bank. Several changes in both macroeconomic scenarios, particularly with the introduction of the Plano Real, and in some macroeconomic measures, such as the regime of inflation goals, fiscal responsibility law and the reduction of the debt/Gross Domestic Product (GDP) ratio, as well as in the regulatory frameworks, made the Brazilian stock market more attractive to potential international investors.

IMF-led international support program gave Brazil \$41.5 billion after Brazil's successful fiscal adjustment program and pledging progress on structural reform in November 1998.

The Brazilian Central Bank announced in early 1999 that the real would no longer be pegged to the US dollar. This devaluation helped in moderating the downturn in Brazil's economic growth in 1999, regarding which the investors had expressed concerns over the summer of 1998. The IMF's target was out beaten, when Brazil's debt to GDP ratio rose to 48% in 1999.

These measures and achievements resulted in the improvement of the conditions necessary for sustainable economic growth and made the capital market more attractive to foreign investors. These achievements also helped reassure the investors that Brazil will maintain its tight fiscal and monetary policy even with a floating currency. The economy grew 4.4% in 2000, and poverty was nearly down to 16%. In 2004, GDP growth was 5.7%, followed by 3.2% growth in 2005, 4.0% in 2006, 6.1% in 2007 and 5.1% growth in 2008. During the 2008-2010 world financial crisis, Brazilian economy was expected to slow down between a decrease of -0.5% and a growth of 0.0% in 2009. But in reality, the economic growth continued at a high rate hitting 7.5% in 2010.



Figure 1.1: IBOVESPA Trends 2000 - 2015

## **1.2.1.2 Russia**

The Russian Federation was established in 1992 with the dissolution of the Union of Soviet Socialist Republics on the 26<sup>th</sup> of December 1991. Russia moved from a centrally planned economy to a globally integrated market economy following the collapse of the Soviet Union. The policies adopted during the transition process are the following:

- Liberalisation,
- Stabilisation,
- Privatisation.

The programs of liberalisation and stabilisation were designed by Yegor Gaider, Yeltsin's deputy prime minister. His radical, market-oriented reform program is known as a "shock therapy", which was based on the recommendations of the top American economists and the IMF. The results of these policies were disastrous, with the real GDP declining by more than 40% by 1999, with hyperinflation wiping out personal savings, and crime and destitution spreading rapidly. The partial results of liberalisation included the worsening of the already apparent hyperinflation, which was the result of the monetary overhang exacerbated by the central bank, which was skeptical of Yeltsin's reforms, and printed money to finance its debt when short of revenue. The result was that many segments of the Russian industry went close to bankruptcy.

The macroeconomic stabilisation was enacted to curb the trend of inflation, which was at monthly double-digit rates as a result of the money emission. The stabilisation policy, also known as the structural adjustment, was a harsh austerity regime, which was mainly based on the adoption of tight monetary and fiscal policies, as the government sought to control the inflation. Under the stabilisation program, the government raised interest rates to record highs, let most prices float, raised heavy new taxes, sharply decreased government subsidies to industry and construction, and made massive decrease in the state welfare spending. These

policies resulted in widespread hardships, as many state enterprises were left with no orders or financing. A protracted depression came to live as a deep credit crunch shut down many industries.

The Russian government had difficulties in collecting revenues amid the collapsing economy and depended on short-term borrowing to finance its budget deficits. This resulted in the birth of the 1998 Russian Financial Crisis, and Russia became the largest borrower from the IMF with a total loan of about \$20 billion in the 1990s.

But Russia bounced back from the late 1998 financial crash at a surprising speed as a result of the devaluation of the rubble, which made the domestic producers more competitive both nationally and internationally. And between 2000 and 2002, significant amount of progrowth economic reforms were presented, which included a comprehensive tax reform that introduced a flat income tax of 13%, and a broad deregulation effort that improved the situation for both small and medium sized enterprises and firms. Between 2000 and 2008, the Russian economy also experienced a major boost from rising commodity prices. GDP grew on average 7% annually, and the disposable incomes doubled, as well as increased up to eightfold in dollar-denominated terms. The consumer credit volume increased 45 times between 2000 and 2006, which fueled a boom in private consumption and the number of people living below poverty line fell from 30% in 2000 to 14% in 2008.

Despite the efforts, the inflation remained a problem, as the Russian central bank aggressively expanded money supply to combat the rubble appreciation. However, in 2007 the World Bank declared that the Russian economy has achieved to "unprecedented macroeconomic stability". Up until October 2007, Russia maintained impressive and effective fiscal discipline with budget surpluses for each year starting from 2000.

Although the Russian banks were bitten by the global credit crisis in 2008, they didn't face any long-term damage due to the proactive and timely response of the government and the

central bank, which shielded the banking system from the effects of the credit crunch. A sharp,

but brief recession in Russia was followed by a strong recovery by the end of 2009.



Figure 1.2: RTS Trends 2000 - 2015

### 1.2.1.3 India

The 1990s are known as a historic decade in India, mainly because economic growth rates increased as policies were liberalised. It is worth mentioning that the population growth rates and fertility rates decreased, as well as the infant mortality rates also decreased. Policy reform with emphasis on liberalisation, decentralisation and private sector investment was the result of the balance of payments crisis in 1991. It aimed at increasing opportunities for both small and medium scale firms and enterprises to strengthen markets' performances and create more grass-roots level employment. The government succeeded and made notable progress with deregulation of trade and industry, as well as privatisation of both infrastructure and other inefficient state enterprises during the 1990s, which included power generation, roads, ports and airlines. The government generally maintained inflation and current account deficits through macroeconomic policies. New upcoming industries like the software development grew rapidly at the same time.

The economy developed a strong export- led growth after the first period of adjustment in the early 1990's and was little affected by late 1990s Asian Financial Crisis. However, the government's policy reform on liberalising the financial sector and reform of labour law proceeded slowly. In the 2000s the economy expanded rapidly. The Indian economy was relatively unaffected by the global economic downturn of 2008–09 as well, though growth dipped to 3.9 per cent in 2008, but grew strongly again to 8.5% in 2009 and to 10.3% in 2010.



Figure 1.3: NIFTY Trends 2000 - 2015

## 1.2.1.4 China

The 14th National Communist Party Congress in 1992 backed up Deng's renewed push for market reforms, and stated that the Chinese's key task was to create a "socialist market economy" in the 1990s. During 1993, the Chinese economy experienced some economic downturn, the inflation accelerated and investment outside the state budget declined. The economic expansion was fueled as a result of the introduction of more than 2,000 special economic zones, known as SEZs, and the facilitation of the foreign capital influx into the SEZs. The Chinese authorities called in speculative loans fearing hyperinflation, increased interest rates and re-evaluated the investment projects. This action had impacts on the inflation rate, as

it declined from over 17% in 1995 to 8% in early 1996. The Chinese economy continued to experience rapid economic growth of about 9.5% in 1996, which was accompanied by low inflation rate.

However, the Asian Financial Crisis of 1997 resulted in the slow economic growth for about three years with official growth rates of 8.9%, 7.8% and 7.1% for the years of 1997, 1998 and 1999 respectively. From 1995 to 1999, the inflation declined rapidly, thereby reflecting the implementation of tighter monetary policies and stronger measures in controlling food prices.

By the year 2000, the GDP growth rate was officially 8.0%, and had quadrupled since 1978. The Chinese economy became the second largest economy in the world with \$3,800 GDP per capita (PPP) for its 1.25 billion populations in 1999, but several indicators claimed China from maintaining the position of the second largest economy in 2000.

The Chinese legislators revealed several proposed amendments, such as a proposal to provide private property rights protection, etc., following the Chinese Communist Party's Third Plenum, held in October 2003. The amendments were directed 'to reduce the unemployment rate', 'to rebalance income distribution between the rural and urban regions', and 'to maintain economic growth, while still protecting the environment and improving social equity', which were approved by the National People's Congress in March 2004.

The 11<sup>th</sup> five-year-economic-program (2006-2010) was approved by the Fifth Plenum in October 2005, which aimed at building a "socialist harmonious society" through improved medical care, education and social security, as well as with more balanced wealth distribution. The National People's Congress on the other hand approved the 11th Five-Year Program in March 2006. The plan relatively called for conservative increase 45% in GDP and decline 20% in energy intensity (energy consumption per unit of GDP) by 2010.

The Chinese economy grew at an average of 10% per year during the period of 1990 to 2004, which is considered the highest economic growth rate in the world.

The 2007-2009 global financial crisis was warmly welcomed in China, as it launched its Economic Stimulus Plan to specifically deal with the crisis. It focused primarily on increasing affordable housing, easing credit restrictions for mortgage and SMEs, reducing taxes, as well as pumping more public investment into infrastructure development. Still, it was significantly affected by the global financial crisis of the 2007-2009, because of its export-oriented nature, which heavily depends on the international trade. However, economic-stimulus plan was hugely successful by nearly all accounts.

The Chinese water storms of 2008 and Sichuan 2008 earthquake affected the economic growth of the country, having major impact on the local and regional economies and infrastructure. The growth rates declined to 4.6% in the 2nd quarter, but recovered to 9.5% annual growth for Sichuan for the year of 2008. The 2008 Summer Olympics had minor impact on the Beijing's economic growth overall, despite closures and relocation of some factories.



Figure 1.4: SHANGHAI COMPOSITE Trends 2000 - 2015

## 1.2.1.5 South Africa

The South African economy can now claim to be one of the wealthiest economies in Africa after more than two decades from the formal end of its old apartheid regime. It has a

stable functioning democracy and the second largest economy in Africa right behind Nigeria. But the deep-rooted structure of the South African economy constraints it economic growth and development. The South African economy was in stagnation in the early 1990s, as GDP fell in 1991 and 1992, but witnessed very weak positive growth in 1993, according to the government's Central Statistical Service.

Fortunately, the economy strengthened and recovered in 1994, as its GDP was about US\$121.9 billion, which represented about 2.6% real growth over 1993. The South African economy was placed among the World Bank's upper-middle income developing countries following the rise in its averaged per capita GDP of about US\$3,010. It has an advanced industrial sector, which placed it in the first thirty largest economies in the world and a giant among the African countries in the 1990s, and it continued to experience steady economic growth.

However, the average annual growth rate of the real GDP was relatively poor between the years of 2001 and 2010, despites the strong economic growth rate from 2003 and 2007. Its unemployment rate remained above 24% of the labour force, and only 12% of the population paid any income tax in 2009.

The South African economy heavily depends on its mining sector, and, over the recent years, it has made relatively modest progress in achieving a number of key development targets and some of the Millennium Development Goals.



#### Figure 1.5: JALSH Prices Trends 2000 - 2015

## **1.2.2 Developed Economics**

## **1.2.2.1 France**

France is known as one of the most richly endowed countries of Europe with favourable climate, extensive areas of rich soil, and long-established tradition of skilled agriculture, which have created ideal conditions for a thriving farm economy. It has a good transport system, a large deposit of iron ore, a well-integrated network of power plants, important domestic reserves of natural gas and high standards of industrial workmanship. The mentioned resources resulted in the establishment of the French industrial complex, which is one of the most modern complexes in Europe.

The French GDP demonstrated 2.5% annual growth rate between the years of 1984 and 1991. But in the early 1990s, the average GDP growth rate was 2%, which is considered as a modest rate. However, the economic growth rate reached close to 3.3% in real terms in 1998. Unfortunately, the unemployment remained at 11.5%. The Socialist-led coalition of Lionel Jospin designed an economic policy that cut down the work week to 35 hours in 2000, which, along with other incentives, resulted in creation of over 40,000 new jobs in the first half of 2000 and in a decrease of unemployment rate to below 10%.

The GDP growth rate was 1% by 2002 as a result of the global economic slowdown and decline in investments. But the French export rate fueled the economy, as it was way greater than the import rate. Despite the positive export rate, the French economy could not hold its position as the world's fourth-largest economy and fell to the fifth position; the United Kingdom replaced it as the fourth.

The 2007-2008 global financial crises affected the French economy, and it experienced its worst recession in 2009 since the end of World War II, based on national statistics office publications. Its GDP shrank 2.2 per cent in 2009, which was worse than its performance in 1945. This implied that the unemployment rate rose and the employed labour force were receiving lower salaries.

However, the French GDP grew following the recovery and was about 0.9% strong in the first quarter of 2011, but shrank by 0.1% in the second quarter and remained stagnant in 2012 and much of 2013. The French economy has begun showing slow growth of about 0.3% since the end of 2013.




# **1.2.2.2 Germany**

The economic growth in Germany has been dull since the mid-1990s, as the annual average growth rate was 1.6% between 1995 and 2003 and was 1% less than that of the other EMU-countries. The dull growth in Germany forced it to lose the opportunity to further income improvements, as the pursuit of the economic growth more or less determines the growth of the per capita income, and hence, the material welfare of the society. Germany faced weak economic growth after experiencing the unification boom of the early 1990s, when the GDP grew with the rates of 5.7% in 1990 and 5.1% in 1991.

The slow growth of the domestic demand was the key factor behind the weak GDP growth rate of the German economy, particularly of the private consumption and investments in construction. This weakness was reflected on the supply side by a low contribution from employment to output growth. The long-lasting effects of re-unification were proven to play a pivotal role in both domestic demand and anaemic job sluggish growth. One of the most advanced economic regions in the world was experiencing low productivity, artificial exchange rate and an almost capital obsolete capita stock due to the re-unification program. Exchanging the East German mark by 1:1 to the West German mark and increasing wages out of line with productivity growth enhanced the weak economic performance, which resulted in a near collapse of the sectors of the economy that were exposed to both West-German and international competitions, especially the manufacturing sector, which experienced a dramatic labour shake-out and increasing unemployment rate as a result.

The German economy was also affected by the international crises, such as the 1994 Mexican crisis, the Asian crisis of 1997/98 and the oil price hike of 1999/2000, as well as the world financial crisis of 2007/08.





#### 1.2.2.3 Japan

Japanese economy is proven to be the third largest economy in the world by the nominal GDP and the fourth largest by the purchasing power parity. The economy of Japan is known as the second largest developed economy in the world with the value of its per capita GDP at \$36, 899 in 2013. The stock index of Nikkei 225 presents the top blue chip or stock market equities on the Japanese Exchange Group.

The Last Decade was described with the collapse of the Japanese asset price bubble in the early 1990s. By 1998, Japan could not stimulate enough public work projects to put an end to the economy's stagnation. The Japanese government undertook structural reform policies under pressure and desperation that intend to wring the speculative excesses from the real estates and stock markets. But these policies led Japan into a series of deflation between 1999 and 2004.

Following the collapse of the asset price bubble in the early 1990s, Japanese economic growth deteriorated steadily through the first half of the 1990s. Even though the economy rebounded briefly at the mid-decade, it has been generally weak since then. The period between 1990 through 2000 was known as the 'Lost 10 Years' or the 'Lost Decade' due to the collapse

of asset stock prices. It is also worth to mention that the period between 2000 through 2010, combined with the previous decade, is referred to as the 'Lost Two Decades' as a result of continued low prices.

Japan is still recovering from the impact of 1991 crash and other subsequent lost decades' crises, and it took it about 12 years to recover its GDP to the same levels of 1995. These lost decades made Japan lose its position as the global leader in labour efficiency and gross output. The Japanese government is burdened with a huge debt, which was mostly due to the economic stimulus that Japan employed in response to the low growth and chronic deflation, and has run a fiscal deficit since 1991. The Bank of Japan and the domestic market hold the majority of Public Debt in Japan. The sheer size of the debt demands large service payments, which is subject for concern regarding the financial health of the country.

Economist Paul Krugman (1998) argued that the lost decade in Japan is an example of a liquidity trap, which is a situation whereby monetary policy is unable to decrease the nominal interest rates, because the rates are close to zero. He revealed how massive the asset bubble was in Japan by 1990, with a tripling of land and stock market prices during the prosperous and healthy period of 1980s. The high personal saving rates in Japan enabled its firms to rely heavily on traditional bank loans for supporting banking networks as opposed to issuing bonds or stocks via the stock market to acquire funds.

The 'relaxed' relationship between banks and corporations, and the implicit guarantee of taxpayer bailout bank deposits established a significant moral hazard problem, which led to crony capitalism atmosphere and decreased leading standards. He wrote: "Japan's banks lent more, with less regard for quality of the borrower, than anyone else's. In doing so they helped to inflate the bubble economy to grotesque proportions". Krugman (1998) argued and called for an increase in inflation expectations to effectively cut down the long-term interest rates and

promote spending. His arguments and suggestions were based on a series of models in his analysis.

The Japanese found another technique to end their stagnated economy, known as the Quantitative easing technique, which was based on Krugman (1998) model. Under this technique, the Bank of Japan expanded the money supply internally to increase inflation expectations. The technique didn't seem to work at the initial stage, but by the year of 2005 the economy showed signs of recovery, as the GDP grew by almost 2.8% that year. Currently, Japan is the top export market for almost 15 trading nations in the world.



Figure 1.8: NIKKEI Trends 2000 - 2015

#### 1.2.2.4 United Kingdom

The UK economy experienced recession in the early 1990s, which was mainly caused by increased interest rates, decreased house prices and overvalued exchange rates. This early 1990s recession came after a 'boom' high economic growth period and increasing inflation. Some of the policies exercised in the United Kingdom during the 1980s primary led to the 1990-2002 recession. The policies allowed the economy to rapidly expand with no measures or consideration for inflation, which facilitated the increasing inflation rate during that period.

The policies didn't target the exchange rate, when this was detrimental to other more important objectives, like preventing a recession.

In late 1987, the stock market crashed. The government became worried of its macroeconomic implications and in order to avoid economic downturn, put interest rates at low levels. This policy led to rapid economic growth. However, the housing boom was sparked as a result of this low interest rates and the high consumer confidence. The prices of the house rose by 300% in the United Kingdom and even more in the cities like London. This house prices boom further fueled the economic boom. And by the late 1980s, the economic growth rate was 5% per year.

Despite these overheating signs, the government was very reluctant to react. This rapid economic growth implied rapid inflation rate, which eventually reached 11% in 1990s. The Chancellor Nigel Lawsc  $_x$  idmitted his failure of not realising the increasing inflation rate and regretted decreasing the interest rates in 1986. He concluded that the rapid inflation growth would have been controlled, if the UK had earlier joined the Exchange Rate Mechanism - ERM. The figure below shows the rapid growing rate of inflation during the early 1990s recession against the economic growth rate, where the oval shape labelled 'x' shows the gap between the inflation rate and economic growth rate.

The recession finally ended due to the changes in government administrations and policies. Since 1997, the Bank of England's monetary policy committee, which is headed by its governor, has been responsible for setting the interest rate at a level that is necessary to achieve the overall inflation target for the economy, which is set for each year by the chancellor. The United Kingdom enjoyed a record run of unbroken economic growth that lasted for more than fifteen years, until the global recession of the late 2000s, which originated from the United States of America. The UK economy experienced recession for the first in the final quarter of

2008 after the Great Recession since 1991. But following the recovery, the UK economy became the fastest growing economy in the G7 and in Europe.



Figure 1.9: FTSE 100 Trends 2000 - 2015

#### 1.2.2.5 United States of America

The United States of America is known as the largest and most technologically powerful economy in the world. The US estimated GDP as of Q2 2015, is \$17.914 trillion and its dollar is the most used currency in the international transactions. The USD is the foremost reserve currency in the world. The US remembers the 1990s as a period of strong economic growth, creation of steady jobs, increased productivity, low inflation rates, and a surging stock market, which led to the establishment of the combination of rapid technological changes and sound central monetary policy.

However, this prosperity was not evenly distributed for over a decade. The US economy experienced financial recession from mid-1990 to early 1991. This was mainly caused by the late 1980s and early 1990s savings and loan crisis, which is commonly known as the S&L crisis. This crisis occurred as a result of the failure of 1,043 out of the 3,234 Federal Savings and Loan Insurance Corporations (known as FSLIC), closed or otherwise resolved 296

institutions from 1986 to 1989, as well as closed or otherwise resolved 747 institutions by the Resolution Trust Corporation (RTC) from 1989 to 1995 (**Curry & Shibut (2000)**). After the US suffered from the 1989 S&L Crisis, it experienced spiked gas prices due to the Gulf War and the general run of the business cycle since 1983.

The US economy faced a series of global financial crises, such as the crises in Mexico in 1995, in Russia in 1998 and in Argentina in 1999, making the late of the 1990s as years of 'economic threat'. However, the US economy still remained resilient despite the different downturns in the stock market and distortions in its trade deficit. But the 'dot-com' bubble of 2000 affected the economy as a result of the quantitative easing policy employed by the Federal Reserve to flood the financial markets in the world with the US dollars as a preventive measure against the global economic crisis and restoration of confidence among investors, who panicked during the 1997 Asian Financial Crisis. The Federal Reserve lowered the interest rate to achieve this goal.

The US economy continued to grow, and, as its importation of oil accounted for almost 55% of consumption in the US, the prices of crude oil doubled between 2001 and 2006. In the year of 2006, the prices of the houses peaked. Simultaneously, the higher prices of the gasoline were eating into budgets of consumers resulting in late mortgage payments. The oil prices continued to rise and climbed another 50% between 2006 and 2008, as well as the bank foreclosures doubled during that period.

Apart from dampening of the housing market, the rapid growing and soaring prices of oil resulted in a decline in the US dollar value and a deteriorated merchandise trade deficit of the United States, which peaked at \$840 billion in 2008. This sub-prime mortgage crisis, the declining house prices, the tight credits, the investment bank failures and the global economic downturn pushed the US economy into a period of recession by mid-2008. A US\$700 billion Troubled Asset Relief Program, known as TARP, was established by the US Congress in

October 2008 to stabilise financial markets. In early 2009 the US Congress passed a bill, which was signed by President Barack OBAMA to provide an additional US\$787 billion fiscal stimulus that will result in job creations and speed the economic recovery. The federal budget deficit of the US reached nearly 9% of GDP in 2010 and 2011. While in 2012, the federal government reduced the spending growth, thus, making the deficit to shrink to 7.6% of GDP. The budget deficit and public debt grew due to major shifts of national resources from civilian to military purposes, because of the wars in Iraq and Afghanistan.



Figure 1.10: S&P500 Trends 2000 - 2015

In addition to **Table 1.2**, which summarise the selected economies strengths, **Figures 1.1 to 1.10** illustrate the stock market index of each country under the described economics conditions. The figures show the impact of the 2008 financial crisis on the different economies.

# Table 1.2: Comparative Economic Performance of the Selected Countries for 2015

Country	GDP US Billions	GDP Annual Growth Rate	Inflation	Unemployment Rate	Interest Rate	Balance of Trade Surplus (deficit) Local Currency (Millions)	Government Debt to GDP
				<b>BRICS</b> Countries			
Brazil	1775	-5.9%	10.67%	9%	14.25%	6240	66.23 %
Russia	1326	-3.8%	12.9%	5.8%	11%	11308	17.7 %
India	2074	7.2%	5.61%	n/a	6.75%	-11664	67.2%
China	10866	6.8%	1.6%	4.05%	4.35%	596	43.9%
South Africa	313	0.5%	5.2%	24.5%	7%	7559	50.1%
				Developed Countries			
France	2422	1.3%	0.2%	10.2%	0.05%*	-3669	96.1%
Germany	3356	2.1%	0.3%	4.4%	0.05%*	18683	71.2%
Japan	4123	0.7%	0.2%	3.3%	0%	139	229%
UK	2849	1.7%	0.2%	5.1%	0.5%	-2721	89.2%
US	17947	1.9%	0.7%	5%	0.5%	-41487	104%

Source: European Central Bank \*European Central Bank Benchmark

#### **1.3 Some Theoretical Considerations**

Chapter 3 of this thesis goes on explaining relevant theoretical implication of this research. However, the reader at this stage is presented with an early theoretical consideration which underpins the research.

The Efficient Market Hypothesis (EMH) states that it is impossible to beat the market, because asset prices already incorporate and reflect all the relevant information. This implies that current markets that are efficient have their stock prices as a reflection of all information that may affect the investment.

The EMH breaks down this information efficiency into three information level: the Weak form of information efficiency, which depicts stock prices as a full reflection of the historical stock prices; the Semi-Strong form of information efficiency, which not only incorporates the historical prices, but also includes the public information; and the Strong form of information efficiency, which states that stock prices reflect all types of information, i.e. historical, public and private information. Therefore, an efficient market is said to be a full reflection of all the available information, but the investors' risk preferences helps us to determine, how the market should fully reflect this information. So, any test of the EMH is a test of both market efficiency and investors' risk preference, which makes the EMH a not well-defined and empirically refutable hypothesis. This is where other asset pricing theories, like Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT), come into the picture.

The two aforementioned theories, CAPM and APT, are based on the fact that the market must be efficient and are built on the EMH property. The CAPM recognises that there are two types of risks, which affect the return rate of an investment; the systematic risk and unsystematic risk. The systematic risk is defined as the macroeconomic risk that affect investment outcomes, like inflation, etc., while the unsystematic risk is the firm's specific risk

that affects the firm only, like poor management, etc. The CAPM considers a single factor model, because it classifies all the macroeconomic risk factors into one single risk factor, known as 'Beta', when calculating the expected rate of return of an investment. This makes it difficult for fund managers and investors to determine, how much effect a single macroeconomic risk factor has on the investment. The APT framework solves the problem.

The APT was introduced as an alternative over the CAPM and states that identical stocks must have identical prices; otherwise a risk-less profit can be earned. This theory is a multifactor theory, because it considers and breaks down the 'Beta' in CAPM into multiple 'Betas' that capture the sensitivities of the investment to singular macroeconomic risk factors.

This research attempts to integrate a series of meaningfully selected variables from the four aforementioned theories in order to build its theoretical framework. While APT allows a linear relationship between the variables (dependent and independent), the finally selected macroeconomic variables are made from the relevant Keran diagram and so draws on the Keran Theory.

The selected macroeconomic (independent) variables are: the Real Gross Domestic Product (GDP), the Inflation rate (IFR), the Exchange rate (EXR), the total Consumption (CON), the Interest rate (INR) and the House Price (HPI) index. Two new variables are also selected to capture the impact of the 2008 financial crisis (FCR) and the influence of the quantitative easing (QEG) used in response to the crisis on the stock market indices. These two variables are treated as dummy variables. The dummy variables are explained by the CAPM, because the variables are not macroeconomic variables, but have significant impacts on investments and economic activities. The financial crisis variable contains different macroeconomic risk factors that led to the economic downfall. This property of the financial crisis can be best explained by the CAPM, as it is a single factor model and the dummy "Using macroeconomic variables in the prediction of stock market indices: A theoretical and empirical assessment within BRICS and selected developed economies." variables can be incorporated into its beta. The quantitative easing is fiscal decision that was used to tackle the financial crisis. This is also best explained by the CAPM.

"Arbitrage is the act of buying and selling an asset simultaneously, where the sale price is greater than the purchase price, so that the difference provides a riskless profit. As long as selling price exceeds buying price, traders can earn a riskless arbitrage profit. And they can continue to do so until the price differential no longer exists" (Emmery and Finnerty, 1997, Page 73).

The above authors **Emmery and Finnerty (1997, Page 440)** go on to state that "competition among people engaged in arbitrage is actually an important contributing factor to capital market efficiency. The very existence of people, arbitrageurs, who are constantly looking for arbitrage opportunities ensure that prices for a particular asset, will not differ very much among the various markets where that asset is traded. If it is easy to access both markets, then there is not much need for arbitrageurs. People making a transaction would buy or sell their assets for the best price provided by the two markets. When two markets are not easily accessed simultaneously, then it is worthwhile for arbitrageurs to incur the cost of accessing them. In doing so, they make transactions that push the two markets toward identical prices for a given asset".

Thus, Arbitrage can be seen as part of the phenomenon wherein one observes a potential to take advantage of a differential opportunity. This differential may arise as a result of various features including time, location and knowledge. For example, traders may buy a particular make of second hand car in the UK at £2,000 and sell the very same car at £5,000 in Africa, so "arbitraging" the difference between the UK Market and the relevant African market. In this case, the differential opportunity is the difference between the purchase price and a selling price of a given asset in two separate markets (the return). **Farooq et al (2005, Page 2)** state

that the notion of Arbitrage "is directly related to the law of one price, which postulates that in well-functioning, efficient financial markets, identical securities must have the same price, no matter how they are created". Therefore, the concept of arbitrage is primarily concerned with asset pricing and the intent to make the most (profit) out of a possible "mispricing" within existing possibilities.

Building from the above definition and discussion (and as elaborated on Pages 59-66 of this thesis), Arbitrage Pricing Theory is an asset pricing theory, which asserts that the return on assets can be predicted using, inter alia, sets of macroeconomic variables which serve as a representation of relevant underlying risk factors. By using arbitrage, the theory suggests that investors will seek to leverage securities prices, by identifying discrepancies or differentials between the prices of the same stock in various markets. Arbitrage Pricing Theory is then a theory, a main feature of which seeks to identify assets which are potentially "incorrectly" priced. It is for this reason that arbitrage has meaning, is used within APT, and is of consequence to this thesis.

Lastly and importantly, the **Keran Theory** forms the basis of the present research as it allows and justify the selection of the variables used in the present thesis. A more detailed description of the **Keran Theory** is offered in Chapter 3 (sub-section 3.1.5) of this thesis (page 66).

### **1.4. The Recent Financial Crisis**

This sub-chapter briefly explains the recent financial crises, as well as the Quantitative Easing policy implemented by the US government in the wake of solving the 2008 financial crisis. This is because both are thoroughly considered in the research and would be used (both) as dummy variables in the analysis chapter to assess their effect on the selected stock market indices.

### **1.4.1 The US Subprime Mortgage Crisis**

In 2008, the financial market crash soon reflected in the decline of the real economy. It is then important to understand how this housing market bubbles has originated and also consider the impact and interrealtions between stokc market indix and real economy. This section below gives a description of The US Subprime Mortgage Crisis.

The Subprime mortgage crisis was a nationwide banking emergency that coincided with the U.S. recession during December 2007 – June 2009. The subprime mortgage crisis was triggered by a large decline in the housing prices, which led to mortgage delinquencies and foreclosures, as well as the devaluation of housing-related securities. The decrease in residential investment preceded the recession, and was equally followed by declines in household spending and after in business investments. The reduction in spending was more significant in areas that had the combination of both high household debt and larger housing price declines.

The Mortgage-Backed Securities, known as MBS, and the Collateralised Debt Obligations, known as CDOs, financed the expansion of the households' debt. They initially offered attractive return rates because of the high interest rates on the mortgages, but massive defaults were caused as a result of the lower credit quality. Even though the crisis became apparent in the late of 2007, it was not until the late of 2008 that major financial institutions collapsed, which caused significant disruption in credit flow to businesses and consumers.

A proximate cause of the subprime mortgage crisis was the increase in subprime lending. The lower-quality subprime mortgages, originated during a given year, increased from the historical 8% or lower range to approximately 20% from 2004 to 2006, with much higher rates in some parts of the U.S (**Michael Simkovic, 2009**). A high percentage of these subprime mortgages, for example over 90% in 2006, were adjustable-rate mortgages. **Zandi (2010)** argued that these two changes were part of a broader trend of lowered lending standards and

higher-risk mortgage products. The U.S. households further became increasingly indebted, with the ratio of debt to disposable personal income increasing from 77% to 127% in 1990 and at the end of 2007 respectively.

As the U.S. housing prices fell steeply after peaking in mid-2006, borrowers found it more difficult to refinance their loans. Mortgage delinquencies soared, as the adjustable-rate mortgages began resetting at higher interest rates thereby resulting in higher monthly payments. Securities backed with mortgages, including subprime mortgages, which were widely held by the global financial firms, lost most of their value. Michael Simkovic (2009) further argued that investors globally, also reduced the purchases of mortgage-backed debt and other securities drastically, as part of a decline in the capacity and willingness of the private financial system to support lending.

The US and European growth rate slowed down, and credits were tightened around the world because of the concerns about the soundness of U.S. credit and financial markets. This subprime mortgage crisis had significant negative impacts on the US and European economies. It pushed the US economy into deep recession during 2008 and 2009 with nearly nine million jobs lost, which was approximately 6% of the workforce. The GDP was estimated to have lost about 40% in 2007 and housing prices declined to about 30% on the average. The stock market was estimated to have lost roughly 50% by early 2009.

The U.S. stock market had recovered to its pre-crisis peak in early 2013, but the housing prices have remained near their low point and the unemployment remained elevated. The US economic growth still remained below pre-crisis levels and European economies continued to struggle with crisis that elevated the unemployment, as well as severe banking impairments estimated at €940 billion between 2008 and 2012.

#### **1.4.2 The United States Housing Bubble**

The present sub-section gives details on the United Stated Housing bubbles which has originated from the US subprime crisis.

The Housing Bubble was an economic bubble that affected many parts of the United States housing market in over half of American states. Housing prices peaked in early 2006 and started to fall in 2006 and 2007, and finally reached new lows in 2012. Case-Shiller home price index reported the largest price drop in its history on the 30<sup>th</sup> of December 2008. **Holt** (2009) argued that the credit crisis that resulted from the housing bubble burst was the primary cause of the US recession of 2007–2009. According to the **Bill Moyers Journal of 2007**, *"increased foreclosure rates in 2006–2007 among U.S. homeowners led to a crisis in August 2008 for the subprime, Alt-A, collateralised debt obligation (CDO), mortgage, credit, hedge fund, and foreign bank markets".* 

Scholars, like **Laperriere (2006)**, argue that any collapse of the U.S. housing bubble not only has direct impacts on house valuations, but also on the nation's mortgage markets, real estates, home builders, home supply retail outlets, Wall Street hedge funds, which are held by large institutional investors, and foreign banks, increasing the risk of a nationwide recession.

The US President George W. Bush and the Chairman of the Federal Reserve Ben Bernanke announced a limited bailout of the U.S. housing market for homeowners, who were unable to pay their mortgage debts. This announcement happened due to the concerns about the impacts of the collapsing housing and credit markets on the larger U.S. economy. The influence of the housing bubble on the US economy is described in the previous sub-chapter.

### **1.4.3 The Great Russian Recession**

The immediate consequence of the financial market crisis in the US was the "great recession" from 2009 which is presented here.

The crisis in the financial markets of Russia and the economic recession were compounded by the political fears after the war in Georgia. Urals heavy crude oil price plummeted and lost more than 70% of its value since its record peak of US\$147 on the 4<sup>th</sup> of July 2008 before rebounding moderately in 2009. The World Bank was supporting the view that the Russia's strong short-term macroeconomic fundamentals prepared it better in dealing with the crisis compared to other emerging economies. But Russia's underlying structural weaknesses and its high dependence on a single commodity price made the impact more significant than would otherwise be the case.

The Russian foreign exchange reserves (FXR) fell by \$210 billion from their peak to \$386 billion from July 2008 to January 2009, as the central bank employed a gradual devaluation policy to tackle the sharp devaluation of the rubble. From August 2008 to January 2009, the ruble weakened 35% against the dollar compared to the onset of the crisis. However, reserves started to grow steadily, as the ruble stabilised in January throughout 2009, reaching to a year-long high of \$452 billion by the year's-end.

The Russian economy emerged from the recession in the third quarter of 2009 after experiencing two quarters of record negative growth. Its GDP contracted by 7.9% for the whole year of 2009, which was slightly less than the prediction by its economic ministry of 8.5%.

#### **1.5 Quantitative Easing**

As solution to the above described financial and economic crisis, The United States government has introduced unconventional fiscal policy such as the Quantitative Easing. This concept is described in the present section.

The Bank of England defines quantitative easing as 'an unconventional form of monetary policy, where a Central Bank creates new money electronically to buy financial assets, like government bonds. This process aims to directly increase private sector spending in the economy and return inflation to its target'.

In other words, the quantitative easing (**QE**) is a type of a monetary policy that is used by the central banks in stimulating the economy, when the standard monetary policy becomes inefficient and ineffective. This policy is implemented by the central bank through buying financial assets from the commercial banks and other financial institutions, thereby raising the financial assets' prices and lowering the interest rates, while simultaneously increasing the money supply. This is a unique policy and is different from the normal buying and selling of the short-term government bonds that aims to keep the inter-bank interest rates at a specific level. Expansionary monetary policy does not normally work, when the short-term interest rates approach to zero. In such circumstances, monetary authorities must utilise the quantitative easing policy to further stimulate the economy. They do this by buying assets with longer maturity than the short-term government bonds, which results in lowering the longer-term interest rates further out on the 'yield curve'.

Quantitative easing policy helps in ensuring the inflation rate not to fall below a targeted rate. Some of the risks of quantitative easing include the policy being more effective than intended in acting against deflation, which leads to higher inflation in the longer term because of the increase in money supply, or the policy not being effective enough, if banks fail to lend out the additional reserves.

The US Federal Reserve, the International Monetary Fund and other several economists agree that the quantitative easing undertaken during the 2007-2008 global financial crises has mitigated some of the economic problems. The IMF further stated that the policies contributed to the improvements in the market confidence and the bottoming-out of the recession in the G7 economies in the second half of 2009.

Economists, such as Martin Feldstein, argued that QE2 led to an increase in the stock market in the second half of 2010, which in turn contributed to the increase in consumption and the US strong economy performance in the late of 2010.

Former Federal Reserve Chairman Alan Greenspan calculated that there was "very little impact on the economy", as of July 2012. Federal Reserve Governor, Jeremy Stein also said that measures of quantitative easing, such as large-scale asset purchases "have played a significant role in supporting economic activity". According to Neil Irwin, senior economic correspondent at The New York Times, "Quantitative easing by the US Federal Reserve likely contributed to: lower interest rates for corporate bonds and mortgages; helping support housing prices; higher stock market valuation in terms of a higher price-earnings ratio for the S&P 500 index; increased inflation rate and investor's expectations for future inflation; higher rate of job creation; and higher rate of GDP growth. In the UK, as a result of the 2008 financial crisis, several macroeconomic indicators had a change in their patterns a consequence of the recession. United Kingdom retails sales, especially the furnishing and DIY sectors, collapsed. As many businesses suffered negative changes in their sales and profitability, securing bank support from continuing trading became almost impossible. The Unemployment rate increased specially among the youth (18-24 years old). Decline in retails and rise in unemployment means decrease in government revenue worldwide which is also illustrated with a fall in GDP. Table **1.3.** presents several, but not all, major macroeconomic variables that have reflected changes in the economic trends worldwide.

# Table1.3: List of Macroeconomic Variables impacted during the 2008 Financial Crisis(1/2)

	BRAZIL						GDP				
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change
Interest Rate	14.77	11.79	12.74	9.50	10.13	11.76	8.26	8.57	11.13	13.23	
Balance of Trade*	46.5	40	25	25.3	20.1	29	19.4	2.3	-3.9	19.7	
Exchange Rate	2.17	1.93	1.83	1.99	1.76	1.67	1.96	2.18	2.36	3.00	
Governement Revenue*	858.66	949.23	1115.88	1130.60	1401.92	1536.49	1671.12	1838.97	1877.48	1679.31	
HPI	471.37	539.89	562.05	560.04	601.58	612.11	616.00	677.52	740.24	778.15	
Inflation Rate	4.0475	3.815	5.735	4.765	5.155	6.705	5.32	6.265	6.4575	8.51	
Real GDP	83.6	88.7	93.3	93	100	102.7	99.7	95.1	95	93.2	16%
Total Consumption	364054	407189	464377.5	516258.3	585041.5	658975.5	737416	819012.5	886857	913947	
Unemployment*	9.23	8.1	7.3	7.2	5.67	5.2	4.93	4.7	4.57	7.4	
	RUSSIA										
Interest Rate	11.59	10.22	10.94	11.17	7.98	8.12	8.08	8.25	8.25	8.26	
Balance of Trade*	163.40	152.20	200.50	134.30	168.20	211.00	207.50	212.30	211.20	160.80	
Exchange Rate	27.04	25.48	25.07	31.88	30.46	29.34	31.03	32.01	39.52	58.00	
Governement Revenue*	10625.81	13368.26	16169.10	13599.72	16031.93	20855.37	23435.11	24442.69	26766.08	26494.09	
HPI	594.00	857.05	1186.33	1136.48	1256.42	1013.69	1081.18	1109.88	897.22	662.02	
Inflation Rate	9.69	9.00	14.09	11.72	6.88	8.48	5.07	6.78	7.82	16.02	
Real GDP	90.90	98.60	103.80	95.70	100.00	104.30	107.90	109.30	110.00	109.00	6%
Total Consumption	3282.33	4054.40	5045.92	5300.74	5960.84	6856.66	7818.75	8734.32	9579.77	9436.23	
Unemployment*	6.77	5.80	7.13	8.03	6.90	6.27	5.13	5.50	5.20	5.70	
				•	IN	DIA					
Interest Rate	7.25	7.75	6.50	4.75	6.25	8.50	8.00	7.50	8.00	6.75	
Balance of Trade*	-53.10	-78.30	-126.00	-92.40	-123.80	-161.60	-192.10	-150.60	-140.40	-125.80	
Exchange Rate	45.27	41.17	43.94	48.38	45.62	46.89	53.39	58.81	61.09	63.52	
Governement Revenue*	8734.51	10952.53	11095.65	11995.66	14650.84	16853.63	19703.36	22018.07	23876.36	27882.87	
HPI	NA	41612800	14405257	19854337	15858279	8311128	7922663	6908373	9392832	7930058	
Inflation Rate	6.01	4.92	8.66	2.39	9.57	9.47	7.54	6.31	3.84	-1.83	
Real GDP	72.20	78.90	84.20	91.50	100.00	106.30	112.10	119.00	127.30	137.30	35%
Total Consumption	5787.07	7032.91	8137.09	9318.13	10848.72	12847.17	14678.81	16263.87	17980.59	19603.65	
Unemployment*	5.00	4.60	5.90	10.30	10.40	9.10	8.30	7.70	5.90	4.80	
CHINA											
Interest Rate	5.87	6.78	7.04	5.31	5.40	6.35	6.26	6.00	5.93	5.30	
Balance of Trade*	177.50	261.90	297.00	198.10	184.50	157.90	230.70	259.20	382.50	593.90	
Exchange Rate	7.96	7.58	6.93	6.83	6.76	6.45	6.30	6.14	6.17	6.21	
Governement Revenue*		314.466	324.86	508.38	634	643.1	830.7	949.24	1075.51	1228.2	
HPI	104.89	369.64	283.76	406.53	347.63	315.57	315.47	364.10	363.29	737.89	
Inflation Rate	1.46	4.76	5.90	-0.68	3.32	5.42	2.66	2.62	1.99	1.36	
Real GDP	66.00	75.30	82.60	90.40	100.00	109.50	118.10	127.30	136.60	146.00	45%
Total Consumption	8426.88	9994.56	11549.78	12682.53	14619.27	17661.16	19856.18	21976.15	24153.68	NA	
Unemployment*	4.10	4.00	4.20	4.30	4.10	4.10	4.10	4.05	4.09	4.05	
					SOUTH	AFRICA					
Interest Rate	7.66	9.66	11.63	8.21	6.34	5.50	5.25	5.00	5.63	5.72	
Balance of Trade*	58	69.6	80.8	63	91.4	108.9	99.6	96.2	92.2	81.4	
Exchange Rate	6.81	7.03	8.25	8.31	7.30	7.24	8.20	9.76	10.87	11.95	
Governement Revenue*	520.00	600.11	663.27	663.02	729.49	814.53	877.72	967.35	1052.53	1146.01	
HPI	466.0732	534.886	561.9388	557.8622	600.5294	611.0587	613.3204	672.8734	735.2683	774.7801	
Inflation Rate	4.63	7.10	10.97	7.17	4.28	4.99	5.66	5.75	6.05	4.29	
Real GDP	90.40	95.50	98.90	97.20	100.00	102.50	105.10	108.10	109.90	111.30	7%
Total Consumption	1116107	1264700	1393185	1461188	1576132	1737339	1864247	NA	NA	NA	
Unemployment*	25.50	23.00	21.90	24.20	24.00	23.90	24.50	24.10	24.30	24.50	
		*	Macroeocn	omic variabl	es not used	in the curre	ent research	1 <b>-</b>			
	years shaded dark yellow are years of the recent financial crisis 2007 to 2011										

# Table1.3: List of Macroeconomic Variables impacted during the 2008 Financial Crisis(2/2)

	FRANCE					GDP Change					
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Change
Interest Rate	2.787	3.850	3.852	1.230	1.004	1.255	0.879	0.545	0.160	0.052	
Balance of Trade*	33578	35382	32944	29848	33718	35718	36879	36637	37495	37692	
Exchange Rate	0.80	0.74	0.68	0.73	0.75	0.72	0.78	0.76	0.75	0.88	
Governement Revenue*	929.44	966.67	994.08	961.73	992.23	1046.58	1085.57	1119.89	1141.98	1165.30	
HPI	100.81	107.56	108.09	99.40	102.50	106.93	105.83	103.20	101.40	99.56	
Inflation Rate	1.69	1.48	2.82	0.08	1.54	2.10	1.96	0.87	0.51	0.00	
Real GDP	98.50	100.80	101.00	98.10	100.00	102.10	102.30	102.90	103.80	104.90	1%
Total Consumption	169759	1799894	222129.9	235448.1	232305 5	240607.5	227292	238525.2	2265761	204732	
Unemployment*	8 37	7 47	7 73	9.53	9.2	9 37	10.1	10.2	10.43	10.23	
chenquoyment	0.07	,	1.10	7.00	GERN	IANY	10.1	10.2	10.15	10.25	
Interest Rate	2 79	3.85	3.85	1 23	1.00	1.25	0.88	0.54	0.16	0.05	
Balance of Trade*	10.80	10.50	7.30	12.50	12.60	12.50	12.20	13.80	18.40	18.40	
Exchange Rate	1.25	1.36	1.48	1.38	1 34	1 39	1 29	1 32	1 34	1 14	
Covernement Revenue*	1028 50	1080.81	1111.69	1090.92	1110.32	1182 70	1220.85	1259.03	1308 34	1354.27	
HPI	104.42	104 19	107.10	106.95	107.30	110.03	113.24	116.98	120.41	124.62	
Inflation Rate	1 58	2 30	2.63	0.32	1 10	2.07	2.01	1 50	0.01	0.28	
Baal CDR	07.50	100.70	101.80	0.52	100.00	102.70	104.20	1.50	106.20	108 20	20/
Total Consumption	228111.20	225160.60	287422.00	207024 10	201929 70	216171.00	202462.50	210522.40	207272.00	280282.40	3/0
	10.07	255109.00	20/433.90	50/954.10 8.10	501656.70 7.40	5101/1.90	502402.50	519552.40	507272.00	200203.40	
Unemployment*	10.07	8.30	7.03	8.10	/.40 IAD	0.83 94 N	0.85	0.85	0.37	0.30	
L. (D.)	0.14	0.54	0.47	0.11	JAP		0.09	0.07	0.07	0.05	
Interest Rate	0.14	0.54	0.47	0.11	0.09	0.08	0.08	0.07	0.06	0.05	
Balance of Trade*	67.70	92.10	19.50	28.70	/5.80	-32.50	-8/.40	-117.80	-122.10	-23.20	
Exchange Rate	20.09	20.49	102.88	95.75	8/.1/	79.40	80.12	97.96	22.65	22.14	
Governement Revenue*	29.98	30.48	30.11	29.08	28.81	29.77	30.36	31.22	32.65	33.14	
HPI	8.11	8.65	6.16	5.15	5.79	5.81	6.48	10.29	9.10	9.31	
Inflation Rate	0.24	0.06	1.38	-1.34	-0.70	-0.27	-0.04	0.35	2.73	1.46	
Real GDP	100.90	102.60	101.50	96.00	100.00	99.90	101.40	103.50	103.70	104.90	-3%
Total Consumption	293395	294089	292131	282934	285473	282750	287547	NA	NA	NA	
Unemproyment 4.03 3.03 4.07 3.2 3 4.47 4.17 3.87 3.3 3				3.27							
	UNITED KINGDUNI Interest Pate 4.64 5.52 4.62 0.63 0.51 0.51 0.51 0.50 0.50 0.50										
Interest Rate	4.64	5.52	4.62	0.63	0.51	0.51	0.51	0.50	0.50	0.50	
Balance of Trade*	-65.00	-76.20	-85.00	-52.00	-63.70	-40.30	-52.90	-55.70	-60.50	-49.60	
Exchange Rate	1.86	2.01	1.84	1.57	1.54	1.61	1.59	1.57	1.65	1.53	
Governement Revenue*	507287	537573	564778	516470	549425	577716	596629	622243	634076	660327	
HPI	580.07	634.72	579.88	522.70	538.24	524.23	521.36	545.67	593.57	631.86	
Inflation Rate	2.317	2.340	3.607	2.182	3.307	4.474	2.841	2.566	1.456	0.079	
Real GDP	97.90	100.40	100.00	95.80	100.00	101.50	102.80	104.80	108.00	110.40	1%
Total Consumption	214594.60	228738.10	242756.40	229068.50	238888.90	248386.50	257894.10	265955.10	275829.10	278812.30	
Unemployment*	5.47	5.20	6.20	7.83	7.90	8.43	7.83	7.27	5.87	5.13	
					UNITED	STATES					
Interest Rate	5.02	5.00	1.88	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Balance of Trade*	-61.59	-57.15	-42.46	-37.98	-40.82	-49.46	-38.07	-34.81	-42.64	-41.13	
Exchange Rate	1.27	1.39	1.49	1.41	1.32	1.38	1.30	1.33	1.30	1.09	
Governement Revenue*	1562.19	1634.31	1517.26	1144.26	1288.55	1488.03	1586.62	1765.50	1916.87	2059.03	
HPI	370.39	376.26	359.18	338.69	323.93	312.10	310.63	322.11	339.74	353.61	
Inflation Rate	3.24	2.86	3.85	-0.34	1.64	3.16	2.07	1.46	1.62	-0.08	
Real GDP	98.90	100.60	100.30	97.50	100.00	101.60	103.90	105.60	108.10	110.90	1%
Total Consumption	54.75	51.32	58.23	63.63	64.41	62.97	62.09	64.47	64.48	70.99	
Unemployment*	4.43	4.8	6.87	9.93	9.5	8.63	7.8	6.93	5.7	5	
			* Macroeocr	omic variabl	es not used i	in the currer	nt research				
years shaded dark yellow are years of the recent financial crisis 2007 to 2011											

#### **1.6 Thesis Structure**

To allow logical flow and clear understanding of the research, the present thesis is structured. This research abides to the scientific commonly used structure. The thesis, overall, attempts to be fully consistent with the presentational and textual requirements and standards of a UK-university doctoral thesis as suggested by Seiler (2004), Fisher et al (2004) and Oliver (2014). Following Quilan (2011), this research is also built around four frameworks namely the conceptual framework (adopted research theoretical framework in the next chapter), the theoretical, methodological and analytical frameworks are unfolded in the next chapters of this research. This thesis comprises seven chapters in a logical order as described below.

Chapter 1 presents the research background, context, and thesis structure; Chapter 2 discusses the research aim, questions, objectives and hypotheses developments, and Chapter 3 presents the overall literature review relevant to the research. Chapter 4 identifies the research conceptual framework and design. Chapter 5 explains the mathematical framework and analysis procedures used in the research, Chapter 6 presents the results and an interpretation of them, and, finally, Chapter 7 briefly summarises the research, discusses the policy implications and suggests further related research possibilities.

#### **1.7 Chapter Summary**

This chapter explained the research background, its context as well as the thesis structure. The observed selected stock market indices and countries' economies were briefly discussed while the thesis structure is presented is more detail in the last section. This chapter mainly set out the research environment. Building on the present chapter, Chapter 2 goes on to present the research aim, questions, and more importantly development of the research hypotheses.

### Chapter II

# Research Motivations, Aim, Questions, Objectives and Hypotheses Development

#### **2.0 Introduction**

The present chapter covers the research motivations and significance, the thesis aim and objectives as well as the hypotheses development per objectives as stated in the thesis. It explains the linkage and gives the theoretical support that underlines each ten objectives.

#### 2.1. Motivations, Relevance and Significance

# **2.1.1 Research Motivations**

This sub-chapter explains the focus of the research and the primary motivational considerations that underpins it.

The motivation for this research is borne out of the need to make significant contributions to the existing growing body of the literature on theories that explain and analyse the economic relationship between the macroeconomic variables and the stock market indices. There is a need to investigate important emerging capital markets (Brazil, Russia, India, China, and South Africa) and significant developed economies (US, UK, Germany, Japan and France) both theoretically and empirically, and to comparatively test the impact of macroeconomic variables on each individual country's stock market index.

It is also important to understand how various policies of both home and other countries, occurrence of crisis, can affect the financial markets of various individual developing and developed countries in a bid to propose new indicators that may better explain or help to predict the dynamics of the stock market indices.

I am personally motivated to carry out this research because I desire to be able to provide necessary guides and quality advice to both local and foreign investors by identifying

early warning mechanism that can help understand and predict the behaviour of the stock market indices. I also desire to be able to work with policy makers in helping policy makers decide on the fiscal and monetary policies that will improve their economies.

# 2.1.2 Research Significance and Relevance

With regards to the preceding studies, this research is relevant and significant, as it seeks to investigate and analyse the degree of predictability of the stock market prices using macroeconomic variables as predictors, and to fill some existing gaps in the literature by offering detailed and explanatory evidence of a possible linkage or relationship between stock market prices and some selected macroeconomic variables within the emerging countries (Brazil, Russia, India, China and South Africa - the BRICS countries) and the developed countries (US, UK, France, Germany and Japan) - a domain within which virtually, no significantly evaluated empirical evidence is currently available.

#### 2.2 Research Overall Aim

The research aims to complete the existing body of the literature by developing fresh theory that will provide an explanation to the relationship between the stock market indices and meaningful associated macroeconomic variables. Primarily, the thesis aims to contribute to the knowledge in relation to the development of models that will provide insight into the prediction of stock market indices for BRICS and some leading developed economies.

### 2.3 Research Questions, Objectives and Hypotheses

The objectives are designed so that the overall aims of this thesis can be achieved. The ten research objectives are stated in the following table with their corresponding research questions and hypotheses also stated within **Table 2.1**.

# Table 2.1: Research Objectives with Corresponding Questions and Hypotheses (1 out of 2)

	Questions	Objectives	Generalised Hypotheses		
1	Which (if any) of the selected sets of macroeconomic variables are statistically significant when predicting the relevant stock market indices?	To determine sets of macroeconomic variables that are statistically significant when predicting relevant stock market indices	"That the identified stock market indices and the selected sets of macro-economic variables have a statistically significant dependent relationship when predicting them within the": A – Individual BRICS countries B – Individual Developed countries		
2	Which (if any) of the selected sets of macroeconomic variables have a statistically significant long run influence on their relevant stock market indices?	To identify any statistically significant long run relationship and - or linkage between selected sets of macroeconomic variables and their relevant stock market indices	"That the identified sets of macroeconomic variables have a significant consistent and cointegrative long-run relationship with their relevant stock market indices within the": A – Individual BRICS countries B – Individual Developed countries		
3	Where applicable, what is the directional and potentially causal relationship between the selected sets of macroeconomic variables and their relevant stock market indices?	To identify the directional and potentially causal relationship between sets of selected macroeconomic variables and their relevant stock market indices	"That the selected sets of macroeconomic variables significantly "Granger cause" stock market indices within the": A – Individual BRICS countries B – Individual Developed countries		
4	Which intensities of the volatility of the selected macroeconomic variables statistically significantly influence the relevant stock market indices?	To determine intensities of the volatility of selected macroeconomic variables on their relevant stock market indices	"That there is a statistically significant relationship between the intensities of the volatility of each macroeconomic variable, it relevant SMI and that of the comparable variable within the": A – Individual BRICS countries B – Individual Developed countries		
5	How effective are VAR or VECM models compared to GARCH models when predicting relevant stock market indices.	To determine the comparable effectiveness of the VAR or VECM models as compared to GARCH models when predicting relevant stock market indices	"That when assessing stock market indices changes VEC and VAR models have equal predictive power with GARCH models within the": A – Individual BRICS countries B – Individual Developed countries		

# Table 2.1: Research Objectives with Corresponding Questions and Hypotheses (2 out of 2)

	Questions	Objectives	Generalised Hypotheses		
6	In what significant manner has the 2008 financial crisis had a reactive effect on relevant stock market indices?	To determine any significant reactive effect of the 2008 financial crisis on relevant stock market indices	"That in terms of stock market indices, the 2008 financial crisis had a significant depressive effect within the": A – Individual BRICS countries B – Individual Developed countries		
7	In what significant manner has the (US) quantitative easing monetary policy applied during the 2008 financial crisis appears to have had an impact on the relevant stock market indices?	To determine the impact of the (US) quantitative easing monetary policy during the 2008 financial crisis on the relevant stock market indices	"That in terms of stock market indices, the quantitative easing policy exercised in the US during the 2008 financial crisis had a significant and strengthening impact within the": A – Individual BRICS countries B – Individual Developed countries		
8	What is the nature of the association (if any) between and across the relevant stock market indices?	To determine the nature of association (if any) between and across the relevant stock market indices	"That in terms of stock market indices, there is a significant consistent corresponding association and across within the": A – Individual BRICS countries B – Individual Developed countries		
9	In what manner do the selected macroeconomic variables dynamically relate to the relevant stock market indices?	To determine any dynamic relationship between the relevant stock market indices and the selected macroeconomic variables	"That there is a dynamic relationship between the relevant stock market indices and selected macroeconomic variables in the": A – Individual BRICS countries B – Individual Developed countries		
10	In what manner do the relevant stock market indices dynamically relate across sets of themselves?	To determine any dynamic relationship across sets of relevant stock market indices.	"That there is a dynamic relationship across the relevant stock market indices themselves within the": A – Individual BRICS countries B – Individual Developed countries		

# 2.4 Hypothesis development

The arguments relating to the hypotheses being examined within the research essentially focus on Stock Market Indices (SMIs). Accordingly, the hypotheses focus on the SMIs within the two sets of countries stated below. They are all grounded in one or more of the following three theories – Arbitrage Pricing Theory (APT), Capital Asset Pricing Model (CAPM) and the Efficient Market Hypothesis (EMH). The two sets of countries, both of which contain five countries, are:

- Set A: BRICS Countries (Brazil, Russia, India, China and South Africa),
- Set B: Developed countries (France, Germany, Japan, UK and USA).

Thus, the hypotheses, the arguments of which are described below, are in effect, designed for each of the countries included within the above-mentioned sets of countries. While each individual hypothesis is indeed addressed in the thesis, the arguments relating to each of the hypothesis are consciously not referred here. The reason behind this is that despite each hypothesis is generically essentially the same, it nevertheless has its own and distinctive country focus.

#### **2.4.1 Variable Selection Techniques (Objective 1)**

APT puts forth the idea that several factors, including both the macroeconomic and the microeconomic factors, determine the return on an investment, with particular attention being attributed to the macroeconomic variables. APT has an intrinsic advantageous empirical strength over the CAPM, as it permits its users to choose those elements or variables that appear to provide the best explanation for the particular sample at hand (**Groenewold and Fraser**, 1997). In the present context, this enables a researcher to select and use those "mixes" of macroeconomic variables that best suit and explain the variations in the specified SMI. Accordingly, by taking into consideration the preceding argument, Objective 1 seeks "*to determine sets of macroeconomic variables that are statistically significant when predicting* 

*relevant stock market indices*". Such a determination enables to predict the stock market indices return within the selected countries. Thus, for this objective, **Hypothesis 1** is formulated as follows:

"That the identified stock market indices and the selected sets of macro-economic variables have a statistically significant dependent relationship when predicting them within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries*.

# **2.4.2** Relationship Macroeconomic variables and Stock Market – Cointegration (Objective 2)

The APT model considers the risk, as attached and intrinsic to various macroeconomic variables, to be operationally relevant when determining possible future financial returns. Thus, it follows that each set of these variables manifest a unique risk profile. And on that basis, the APT model, in effect, evaluates the individual risk profiles.

Again, under the APT model, two identical investments or two different investments with identical risk factor exposures would have the same common factor returns, implying that the common factor of a long-short portfolio of the two investments would be zero. In other words, the two investments are integrated. Furthermore, if the integration of the specific returns of the investments is stationary, then the two investments themselves would be co-integrated.

Thus, a key consideration must first be the determination of the fact and/or the degree of co-integration across the variables contained within the risk profile. So, one could argue that when the variables within a risk profile are cointegrated, then the risk is more or less likely to be provoked. Thus, for applying the APT considerations, it becomes necessary to determine whether the variables contained within the risk profiles are cointegrated by themselves or not.

Considering the above-mentioned argument, Objective 2 therefore sets out "to identify any statistically significant long run relationship and - or linkage between selected sets of macroeconomic variables and their relevant stock market indices". This objective also assesses whether the consistently selected macroeconomic variables have the same Cointegration linkage with the relevant SMI. Accordingly, **Hypothesis 2** is stated as follows:

"That the identified sets of macroeconomic variables have a significant consistent and cointegrative long-run relationship with their relevant stock market indices within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries*.

# 2.4.3 Causal Relationship between Macroeconomic Variables and Stock Market (Objective 3)

Using the theoretical justification of co-integration as detailed in the argument for Objective 2, Objective 3 seeks "*to identify the directional and potentially causal relationship between sets of selected macroeconomic variables and their relevant stock market indices*". And if such a relationship is revealed, then in which direction and which causal manner (if at all) it is observed. In order to determine mentioned causal effects, the Granger-Causality test is used to test for predictive causality. Therefore, **Hypothesis 3** is developed as follow:

"That the selected sets of macroeconomic variables significantly "Granger cause" stock market indices within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries.* 

# **2.4.4** Volatility of Macroeconomic Variables in Stock Market (Objective 4)

APT supports the idea that several factors determine the return on an investment, with particular attention to macroeconomic variables. It also suggests that a linear relationship exists between these variables. Thus, determining the volatility of these variables is also subject of

consideration. The volatility of the relevant macroeconomic variables could help investors and fund managers to appropriately predict SMI movements. If however, stock market volatility itself influences volatility of the macroeconomic variables, then stock market volatility could be seen as a leading indicator of future macroeconomic volatility. On the other hand, if stock market volatility does not influence macroeconomic volatility, then stock market volatility would be irrelevant as an indicator in predicting the volatility of the macroeconomic variables. With such arguments in mind, Objective 4 aims "to determine intensities of the volatility of selected macroeconomic variables on their relevant stock market indices". Therefore, **Hypothesis 4** is formulated as follows:

"That there is a statistically significant relationship between the intensities of the volatility of each macroeconomic variable, its relevant SMI and that of its comparable variable within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries.* 

### 2.4.5 Use of VAR and GARCH to Explain Stock Market (Objective 5)

Again, APT supports the idea that several variables – particularly the macroeconomic ones, can determine SMI. APT also supports the fact that a linear relationship exists between such variables. Thus, if one assumes that an Ordinary Least Square (OLS) mathematical formulation is a reasonable expression of that relationship, then, the models could be constructed using VAR/VECM and GARCH approaches, and if so, it becomes interesting to know whether these alternatives approaches have equal predictive power. The present Objective 5 is defined as follows: "determine the comparable effectiveness of the VAR or VECM models as compared to GARCH models when predicting relevant stock market indices". Therefore, **Hypothesis 5** is formulated:

"Using macroeconomic variables in the prediction of stock market indices: A theoretical and empirical assessment within BRICS and selected developed economies." "That when assessing stock market indices' changes, VEC and VAR models have equal predictive power when compared with GARCH models within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries*.

# 2.4.6 Effects of 2008 Financial Crisis on the Economy (Objective 6)

The CAPM considers two types of risks: Systemic and Unsystemic risks. Macro-risks of economic, financial and political nature are particularly reflected within the Systemic risk. Thus, one can argue that the financial crisis of 2008 would have incorporated many of such kind of risks. However, one must accept the fact that additional new variables may have significantly influenced Stock Market Indices in the period thereafter. If so, the 2008 financial crisis would likely have effected in a "structural break" in the relevant market data and this would be reasonably manifest. Accordingly, Objective 6 is "to determine any significant reactive effect of the 2008 financial crisis on relevant stock market indices" by introducing the 2008 financial crisis as a dummy variable. Against such argument, **Hypothesis 6** is stated as follows:

"That in terms of stock market indices, the 2008 financial crisis had a significant depressive effect within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries*.

# 2.4.7 Effects of the US Quantitative Easing Policy on the Economy (Objective 7)

Recognising that CAPM accepts an inter-play of endogenous and exogenous variables, it becomes of interest to determine the impact and intensity of particular variables. One of such exogenous variables could likely be the "Quantitative Easing" action of the US government,

injected into its monetary policy during the 2008 financial crisis. Thus, by taking into account this argument, Objective 7 seeks "*to determine the impact of the (US) Quantitative Easing monetary policy during the 2008 financial crisis on the relevant stock market indices*". To this end, the variable of Quantitative Easing is introduced as a dummy variable, and thus, **Hypothesis 7** is stated as follows:

"That in terms of stock market indices, the Quantitative Easing policy exercised in the US during the 2008 financial crisis had a significant and strengthening positive impact within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries.* 

# **2.4.8 Financial Market Interaction or Integration (Objective 8)**

The CAPM incorporates systemic risks, such as political or economic ones. With the globalisation of the world economy, such risks must include comparable risks emanating from other parts of the world. Concurrently, the EMH argues that for markets to be efficient, they should take regard for all relevant information including those relating to systemic risk. This can be done by investigating the level of information efficiency (EMH) that is incorporated into the stock prices, and what impact a macroeconomic risk variable of one country has on another country, thereby affecting the stock prices of various stock markets. Thus, Objective 8 seeks "to determine the nature of association (if any) between and across the relevant stock market indices". One way to discover the possibility of any form of interaction among the selected stock markets is to investigate factors that could affect the individual stock market prices. With this argument in mind therefore, **Hypothesis 8** is presented as follows: "That in terms of stock market indices, there is a significant consistent corresponding association within and across the":

A – Individual BRICS countries,

*B* – *Individual Developed countries*.

# 2.4.9 Effects of Shocks from Macroeconomic Variables to Stock Market & Reverse (Objective 9)

APT assumes multiple values of risk, each specific to particular variables. Equally, the theory provides for a multi factor model, where each individual macroeconomic variable can be evaluated through its distinct impact on the relevant SMI and other associated variables. One such variable is the extent of a markets' "shock" rating. Indeed, one market's "shock rating" may have a significant impact on other stock markets in other countries. Against this argument, Objective 9 is an attempt "to determine any dynamic relationship between the relevant stock market indices and the selected macroeconomic variables", by evaluating the volatility and assessing its singular impact on the relevant stock markets. Employing the preceding arguments, **Hypothesis 9** is stated as follows:

"That there is a dynamic relationship between the relevant stock market indices and selected macroeconomic variables in the":

A – Individual BRICS countries,

*B* – *Individual Developed countries*.

#### **2.4.10 Effects of Shock between Stock Market Indices (Objective 10)**

The CAPM recognises the impact of external risks on asset valuations. Such risks would certainly include political and economic risks. And with the globalisation of the world economy, it would not be unreasonable to suggest that the SMI in country "A" may have a significant impact on that of the country "B". Against such argument, Objective 10 is "to determine any dynamic relationship across sets of relevant stock market indices". Therefore,

Hypothesis 10 is stated as follows:

"That there is a dynamic relationship across the relevant stock market indices themselves within the":

A – Individual BRICS countries,

*B* – *Individual Developed countries*.

# **2.5 Chapter Summary**

This chapter discusses the research motivations, significance, aim, questions, the ten objectives defined in the scope of the current research, as well as the theoretical arguments lying as a base for each of the objective, which also provide ground for the development of the relevant hypotheses. The hypotheses are focused on the stock market indices of the two sets of countries; the BRICS countries and the selected developed countries and are based on the following theories; the Arbitrage Pricing theory (APT), the Capital Asset Pricing Model (CAPM) and the Efficient Market Hypothesis (EMH) and, those are presented further in the next chapter.

Thus, the hypotheses are designed to empirically test the aforementioned theoretical framework in evaluating the relationships between the stock market indices and the relevant macroeconomic variables, as well as the linkages among the stock market indices themselves, both in the long and short-term basis, to assess the predictive power of the models, to estimate the response of the stock market indices to the structural breaks, such as the financial crisis and the quantitative easing policy, and to evaluate the dynamic relationship among the selected variables. The chapter revealed that the thesis is based on ten distinct questions, which are appropriately stated and tabled above. The next chapter discusses the review of the literature by covering the theoretical, terminological and empirical aspects of the literature.

#### **Chapter III**

# A Critical Review of Relevant Research Literature

### **3.0 Introduction**

The previous two chapters laid out the research background, context, motivations, aim, objectives and questions. Chapter two was an opportunity to presents the theoretical foundation of each ten objectives of this research. The purpose of this chapter is to review and discuss the relevant theoretical, terminological and empirical frameworks that underpin and support the stated aims and objectives to this research. This chapter critically explains the theoretical aspect of the existing literature that is related to this current research. This chapter also revisits the terminological and empirical literature on analysing the factors influencing the variation of stock prices in the financial markets. Specifically, this chapter focuses on the nature of the relationship between macroeconomic factors and price movements. It begins with a review of a number of theories on the determination of prices in the financial markets. Importantly, the literature review has started by using the traditional approach to reviewing the literature and following the "snow balling" approach. This is how the initial literature has been captured. Secondly, the systematic review has also been used, setting clear parameters to the search such as: timeframe (1995-2015), types of journal (Sciences Direct, Eurasian publications, etc.). The combination of the two approaches allows the researcher to identify cited and mentioned authors in the thesis but also to take benefit from authors not cited in the thesis, but who have indirectly contributed to it and stated in the bibliography.

This chapter is divided into sub-chapters that explain the contextual comments related to this research, present existing research theories, which are EMH, CAPM and APT, as well as explain the adopted theoretical framework. The second section of this chapter explain the "Using macroeconomic variables in the prediction of stock market indices: A theoretical and empirical assessment within BRICS and selected developed economies." terminology that are used in the research. Furthermore, it gives the critical review of relevant literature linked to the ten objectives of this research, the literature gaps, and finally the

# 3.1 Research Related Theories

summary of the whole chapter.

The research considers the Efficient Market Hypothesis, the Capital Asset Pricing Model and the Arbitrage Pricing Theory to address the research questions as defined in the previous chapter. Among the existing reliable theories, the following theories are highly recognised: the efficient market hypothesis (EMH), capital asset pricing model (CAPM) and arbitrage pricing theory (APT). Thus, this sub-chapter presents the theoretical background of the EMH, CAPM and one of the most prominent asset pricing theories, the APT theory.

### **3.1.1 Efficient Market Hypothesis (EMH)**

**Eugene Fama (1965)** was first to develop the efficient market hypothesis (EMH) at the University of Chicago. He famously demonstrates that stocks are fairly priced to reflect existing information in an active market. This theory has influenced the behaviour of investors, who trade securities under the assumption that the purchase price is lower than what the security is worth to them. The Efficient Market Hypothesis advocates that all the available information about the value of a company or a firm are fully reflected or incorporated in the stock prices, hence the possibility of earning extra profit by using this information is zero.

Random walk hypothesis, as introduced by a French mathematician **Louis Bachelier** in **1900**, states that stock prices are random, and the dynamics of or changes in the stock prices are like the steps taken by a "drunk", and therefore are unpredictable. This is why the EMH is sometimes referred to as the Random Walk Theory (RWT). The EMH states that the prices already reflect all the available information about a stock and adjust rapidly to new information. This information contains historic prices, other types of information, as well as future
expectations, which are unknown. The latter seeks to explain the EMH's feature of the RWT by positing that the new information drastically and significantly moves the stock prices, and this new information is unknown and occurs at random, making future movements in stock prices unknown and moving randomly.

Moreover, it is impossible to outperform the market by picking undervalued stocks and selling overvalued stocks, as the EMH also states that there are no undervalued and overvalued stocks that generate abnormal profits in the market.

Furthermore, the EMH also assumes that the information is widely available to all investors and fund managers and is used to analyse the economy and markets, when making trading decisions. Events, such as major lawsuits, accidents, labour strikes, etc., are generally unpredicted, have major impact on stock prices and occur at random, but when they occur, they are quickly broadcasted to investors, and the investors quickly react to any new available information.

Basically, one can say that the EMH is a full reflection of all available information, implying that abnormal profit is unattainable regardless of the investment strategies employed.

The EMH can formally be explained through the following equation:

### $\mu t *= \mu t$ (3.1)

The left-hand side represents a set of relevant information that is available to the investors at a given time "t". The right-hand side is the set of available information that is used to price assets at a given time "t". The equivalence of these two sides implies that the market is efficient and the EMH is true.

**Fama (1970)** distinguishes between three different forms of market efficiency, which are based on the level of information available to or used by the market. These three forms are described below:

- i. The Weak Form Efficiency asserts that the current price of the stock fully reflects or incorporates information that is contained the historic price only. This means that extra income cannot be earned using investment strategies that are solely based on the historic prices only. This implies that the mechanisms of the technical analysis cannot work, since they rely exclusively on the past historic trading data to forecast the future price movements. In orders words, it means that today's asset prices fully incorporate all relevant history or past information, i.e. trading volume, security dividends, etc.
- ii. **The Semi-Strong Form Efficiency** states that the current asset prices not only incorporate information related to historic prices, but also extend to public information, such as news, accounting reports, company management, analysts' recommendations, patents, products of the company, etc. The public information also relates to the company's performance, macroeconomic factors, expectations, such as GDP, interests rates, exchange rates, etc.
- iii. **The Strong Form Efficiency** extends the information to further include the private information that is held by corporate insiders, such as fund managers and executives of the corporation. This makes the aforementioned form of the EMH the strongest, as it includes all the information already contained in the two previous forms (the historic prices and the public information), as well as additional private information.

**Fama (1991)** stresses that the EMH and its forms are mostly used as guidelines rather than facts. It is costly, as **Alshogeathri (2011)** suggests to undertake a research of the strong form of a market, as the acquisition of the private information requires more financial inputs.

From an economic standpoint, an efficient stock market assists with the efficient allocation of economic resources. For instance, if the shares of a financially poor company are not priced correctly, new savings will not be used within the financially poor industry. In the world of the EMH, the level of asset price fluctuations, or volatility, fairly reflects underlying economic fundamentals. Along these lines, **Levich (2001)** argues that policymaker's interventions may disrupt the market, and cause it to be inefficient. In the literature, the three forms of the EMH are usually used as guidelines rather than strict facts (**Fama, 1991)**. Besides, most empirical studies have examined the EMH in its weak or semi-strong forms, partly because the strong form is difficult to measure, and there is a high cost associated with acquiring the private information (**Timmermann and Granger, 2004**).

### **3.1.2 Capital Asset Pricing Model (CAPM)**

The notion of risk is one of the main findings of **Markowitz (1952)**. **Sharpe (1964)** extends the work of **Markowitz (1952)** by developing a Capital Asset Pricing Model (CAPM) for the determination of the required rate of return on an investment. CAPM indicates that the return on an investment and the risk involved in assimilated action evolve concomitantly. CAPM takes into account two types of risk: systematic risks and unsystematic risks. Specifically, the innovation of the model of **Sharpe (1964)** is the introduction of the concept of beta, which is a measure of the systematic risk. CAPM considers systematic risk to be the only risk influencing the level of return on an asset. Thus, the model rejects the notion of unsystematic risk as suggested by **Markowitz (1952)**, finding it irrelevant.

CAPM is based on a series of assumptions stated below:

- i. The investor is only interested in the variance and the mean of the investment return.
- ii. Investors cannot influence the market.
- iii. The cost of access to information is equitable and fair for all investors.

- iv. There is no levy of tax or commission to pay.
- v. Each investor is intellectually capable of analysing and interpreting information as it arrives.

Lintner (1965), Mossin (1966) and Black (1972) each propose a single factor model as an extension of Sharpe's (1964) model, grounded on the idea that only the systematic risk factor should be used to calculate the risk of the assets (beta), rather than the unsystematic risks, which should not affect the decision of the investor.

However, certain assumptions emanating from CAPM, considered being inconsistent with the reality, led researchers to develop an alternative way to approach CAPM; one which takes into account the reality of the financial market and incorporates several other risks affecting assets returns.

The Capital Asset Pricing Model (CAPM) is a model, developed by William F. Sharpe and John Lintner, used to determine the theoretical required rate of return using the beta and the market return of an investment to its expected risk. The CAPM classified risk into two types; Systematic and Unsystematic Risks. The **Systematic Risk (Undiversifiable Risk)** is also known as the market risk and is considered to affect all classes of investments. This type of risk could be either economic or political or be a natural disaster. One significant type of systematic risk is inflation, which results in lower real return of investments. The **Unsystematic Risk (Diversifiable Risk)** is a company specific risk that affects only the company, such as management crisis, etc. This type of risk can be minimised by investing in different sectors, in different companies or in different asset classes, such as bonds and stocks, with negative correlation coefficients resulting in highs of assets being offset by the lows of these negative correlated assets. This implies that the total risk of an asset equals the sum of the systematic risk and the unsystematic risk.

The CAPM only considers the asset's sensitivity to the Undiversifiable or Systematic risk, often represented as the Beta ( $\beta$ ), and suggests that the investor's cost of equity capital is determined by the Beta. The equation for the CAPM is:

$$rt = rf + rp$$
 (3.2)  
 $rt = rf + [\beta * (rm - rf)]$  (3.3)

Where rt is the required return, rf is the risk-free rate, rp is the risk premium, rm the market return and  $\beta$  the systemic risk.

The 'Beta\* (**Market Return – Risk-Free Rate**)' in the equation is the required return on stocks above the risk-free rate, as stocks normally have certain amount of risk. Hence, this term is referred to as the **risk premium** of stocks. This **risk premium** is the return on the stock to compensate investors for the additional risk of holding stocks over holding risk-free treasury. As different stocks have different level of volatility, the risk premium also differs. If the Beta is greater than one (1), the risk premium increases, and if the Beta is less than one (1), then the risk premium decreases (direct relationship). But when the beta equals to one (1), the risk premium of the stock equals to the risk premium of the market.

In summary, the CAPM considers two types of risk that affect investment performance in the capital market. These two risks are the systematic and the unsystematic risks. But, as the unsystematic risk can be diversified away, the CAPM incorporates only the systematic risk in its model and names it Beta. This Beta represents the degree of sensitivity of an investment to macroeconomic factors. Under the CAPM model, the entire macroeconomic risk factors or variables are classified under one single 'Beta', thereby making the CAPM a single factor model.

### **3.1.3** Arbitrage Pricing Theory (APT)

The Arbitrage Pricing theory, unlike CAPM, considers the unsystematic risks. This model shows how the price of a stock is determined in reference to multiple risks. The arbitrage price theory (APT) is developed by **Ross (1976)**, and is a generalisation of the model of **Sharpe (1964)**. While CAPM suggests that only a single factor influences the stocks, APT supports the idea that several factors determine the return on an investment, with particular attention to macroeconomic forces. **Ross (1976)** proposes a new approach to determine the price of a stock, and asserts that the return on an investment is a linear combination of macroeconomic factors. The model is presented as follows:

$$R_t = R_f + \beta X + \varepsilon, (3.4)$$

where  $R_t$  is the return on an asset at a determined time,  $R_f$  is the risk-free interest rate or expected return at a given time,  $\beta$  is the measure of the sensitivity of the stock to each economic factor, X is a vector of the predetermined economic factor or systematic risks and  $\varepsilon$ , the errors term, is the unsystematic risk associated with the asset that cannot be diversified.

Moreover, it is important to underline that, as in case of CAPM, the APT model also assumes that over the long run, systematic risk becomes the main factor influencing the stock return. It also embraces the assumption of CAPM that investors are fully diversified. However, unlike CAPM, the APT theory develops a linear relation between the factors influencing the stock and the return on it. According to the APT theory, every asset bears the influence of a particular group of factors and reacts differently to each of the factors.

The Arbitrage Pricing Theory is the law of one price, as it states that a risk-less or riskfree profit can be earned, if only two identical products are sold at different prices in the market. This can be done by buying the item or stock at a low price and selling it at a higher price. This

process continues until the price discrepancy disappears. The law of one price applies to both the return and the risk of a stock, because if there are two stocks or a portfolio of stocks that are not identical, but have identical return and risk, then they should cost the same. This coheres with the CAPM, as it states that the expected return on a stock or an asset is proportional to its risk.

The APT puts emphasis on the systematic risk of an investment, as it is derived from macroeconomic factors, which significantly affect the overall economic activities of the state, e.g. inflation, interest rates, etc. However, the systematic risk is an undiversifiable risk and cannot be eliminated through diversification, resulting in investors investing in stocks and assets that have an expected return commensurate with their systematic risk. Since the beta measures the different sensitivities of assets to systematic risk, a factor beta can be calculated for each of the different types of the macroeconomic risk factors illustrating the percentage change in the expected return for a unit change in each of the macroeconomic risk factors. These factor betas can be solved through regression analysis of historical changes in the expected rate of return for a given change in the systematic risk factor.

The expected return under the APT model in case of one macroeconomic risk factor can be calculated as stated below:

$$E(R_1) = R_f + b_1 F_1, (3.5)$$

Where  $E(R_1)$  is the expected return for the '1' security,  $R_f$  is the proportion of the riskfree security,  $F_1$  is the risk premium for the macroeconomic factor '1' and  $b_1$  is the degree of the sensitivity of the return compared to a unit change in the risk factor ( $b_1F_1$ =risky asset).

The APT, being a multi-factor model, is the law of one price, as it shows where riskfree profits can be earned, if two identical goods are sold for different prices. The APT breaks down the systematic risk into multiple factors resulting in multiple Betas as opposed to the

single factor model of the CAPM with just one single Beta. This research concludes that the APT assumes the markets to be frictionless and competitive, and that the large number of financial asset returns (excess) can be modelled as a linear function of a small number of factors plus an idiosyncratic term.

### **3.1.4** The Development of CAPM & APT from the Markowitz Theory

The theories discussed in the previous sub-chapter, especially the CAPM and the APT, were developed as extensions of the Markowitz theory based on its 'efficient frontier' and 'asset risk'. This sub-chapter briefly discusses the establishment of the Markowitz theory, also known as the Modern Portfolio Theory, and how other theories were developed from it.

The Modern Portfolio Theory, as developed by Harry Markowitz in 1952, is the basis on which almost all the other recent portfolio diversification models and asset theories are developed. The Modern Portfolio Theory, commonly known as the Markowitz theory, asserts that the stock market returns are represented by normally distributed random variables with their variances and standard deviation indicating the quantifiable risk (Markowitz, 1999).

Investors were still aware of the benefits of diversifying their portfolio to minimise their risks while still preserving an adequate amount of returns prior to the 'birth' of Markowitz theory. **Markowitz (1952)** formalises the problem of choosing an investment portfolio by assuming that the investor optimises his investments by taking into account not only the expected return on the portfolio, but also the risk measured by the variance of profitability. An equity portfolio that offers a couple of better risk-returns individually can illustrate this.

A low correlation between individual stocks leads to a better relationship between the risk and return. The theory of **Markowitz (1952)** is considered a tool to identify a portfolio that guarantees a return on an investment at a given level of risk. It also supports the idea that

if an investor holds two risky assets, it is possible to reduce the portfolio risk lower than the average attached to the individual assets.

Markowitz theory further clarifies that an asset's risk refers to the possibility that the actual future returns will be different from the expected returns, or the probability that unexpected events will occur. His theory also innovates that the measurement of the risk related to an asset is attached to the standard deviation (variance) of the asset. **Markowitz's (1952)** model explains that investors are inclined to choose a portfolio that minimises the variance of the portfolio return at a given level of expected return, or maximises the expected return given a specific level of risk (the variance). Hence, the Markowitz model is known as the "mean-variance model". It assumes that investors are efficient and risk averse. He further illustrates that the portfolio selected depends mainly on the investor's risk-return utility function. Therefore, investors choose portfolios only for a single period of investment and focus on the mean and variance of their investment return, meaning they choose a portfolio at time t-1, which produces a stochastic (determined randomly) return at time t.

Finally, Markowitz qualifies risk into systematic and unsystematic. The systematic risk is caused by factors affecting the markets as a whole (interest rates, inflation, etc.), and the unsystematic risk is the risk the is unique to the firms (strikes, losses in operation etc.).

Sharpe (1964) and Lintner (1965) developed Markowitz model, which depends on the trade-off between the risk and return, and introduced their model, the CAPM, with two additional assumptions, which are the following; availability of the borrowing and lending at a risk free rate; and the homogeneity of the investors' expectations, which implies that all investors have similar expectations resulting in the estimation of identical probability distributions for future returns. This means that the CAPM theory incorporated all the

"Using macroeconomic variables in the prediction of stock market indices: A theoretical and empirical assessment within BRICS and selected developed economies." assumptions of Markowitz theory. Thus, the CAPM is built on the notion of risk, which identified by Markowitz theory.

The CAPM theory assumes that the risk-return profile of a portfolio can be optimised. An optimal portfolio showcases the lowest possible risk level for a given return. The optimal portfolio must comprise of each and every asset, since each additional asset introduced into the portfolio further diversifies the portfolio. Hence, all such optimal portfolios, that is, one for each level of return, comprise the efficient frontier. Thus, a portfolio of assets is considered 'efficient', if it has the best possible expected rate of return at its given risk rate, which is represented by the standard deviation of the portfolio's return.

The **Figure 3.1** below shows risk-return trade-off for all the combinations of assets. Every possible combination of risky assets is plotted in the risk–expected return space, and the collection of all such possible portfolios defines a region in this space. This region or space is the opportunity set, in case the possibility to hold a risk-free asset is absent. The positively sloped top boundary portion of the hyperbola is known as the "efficient frontier", as illustrated by Markowitz theory. In case of the presence of the risk-free asset, the opportunity set becomes larger and its upper boundary, which is the efficient frontier, becomes a straight-line segment emanating from the vertical axis at the value of the risk-free asset's return and tangent to the risky-assets' only opportunity set as illustrated in **Figure 3.1** 



Figure 3.1: Risk-Return Trade-off

The mentioned discussion summarises how the CAPM developed using the Markowitz theory. The CAPM developed further by incorporating two additional assumptions and building on the notion of the 'systematic risk' identified by the Markowitz's theory. Several of the CAPM assumptions have been criticised, for example 'there are no taxes and no transaction costs', for not complying to the reality. In addition, the assumption of homogeneous expectations has also been criticised; because investors are believed to have divergent expectations, apply various investments holding periods, differ in respect of their decision-making processes, etc. The Capital Asset Pricing Model has run into several other roadblocks, such as **Roll's (1977)** suggestion that the CAPM is not a testable scientific theory. He further argues that a plethora of empirical anomalies that provide empirical evidence indicate that the usual market proxies are not mean-variance efficient.

**Ross (1976)** introduces the Arbitrage Pricing Theory (APT) as an alternative to the CAPM. The APT has the potential to overcome CAPM's flaws and weaknesses because it requires more realistic and fewer assumptions to be generated by a simple arbitrage argument. Its explanatory power is potentially better than that of the CAPM, since it is a multifactor model. The APT's core idea is that only a small number of systematic risk factors affect the long-term average returns of securities. As a multi-factor model, the APT allows an asset to have many measures of systematic risk rather than just one, as illustrated by the CAPM theory. Each of this risk measures captures the sensitivity of the asset to the corresponding pervasive factor.

If the factor model holds exactly and assets have no specific risk, then the law of one price implies that the expected return of any asset is a linear function of the other assets' expected rate of return. Elsewhere, arbitrageurs would be able to create a long-short trading strategy that would generate positive profits at no initial costs. **Gilles and Leroy (1990)** argue that the APT relates the expected rate of return on a sequence of primitive securities to their factor sensitivities, suggesting that factor risk is critically important in asset pricing. The APT captures some of the non-market factors that cause securities to move together. It rests on the hypothesis that the equity price is influenced by limited and non-correlated common factors and by a specific factor that is totally independent from the other factors. **Groenewold and Fraser (1997)** believed that the main empirical strength of the APT is the freedom that it gives the researcher to select whatever factors provide the best explanation for the particular sample at hand.

Summarising, it is worth mentioning that in spite of its shortcomings, the MPT has established itself as the father of the modern financial theory and practice. The main arguments of MPT is that the market is difficult to beat and those, who successfully beat it, are the ones,

who effectively and efficiently diversify their portfolios and take above-average investment risks. The model is just a tool, perhaps the biggest hammer in one's financial toolkit. Markowitz theoretical conclusions have become the springboard for the development and establishment of other theories and analysis in the field of the portfolio theory. Please see **Appendix 2** (volume 2, page 16-17) where the various multiple factor models are presented.

### **3.1.5 Keran Theory**

The variables selection is this thesis follow the **Keran (1970)** theory which is described in this sub-section. **Keran's (1970)** theory is formed of two types of variable: endogenous and exogenous. The crucial difference between an endogenous and an exogenous variable in an econometric model is that exogenous variables are not systematically affected by changes in the other variables of the model, especially by changes in the endogenous variables. In other words, the endogenous variables are known to be dependent variables, while the exogenous variables are known as the independent variables.

The **Keran's (1970)** graph presented on the next page, extrapolates the idea that government policies affect endogenous variables that will also influence stock prices. Justification, theoretical and empirical methods of the selected variables will be the subject of the chapters below. The diagram presents four exogenous variables, namely corporate tax, changes in spending, changes in nominal money and potential output. The endogenous variables comprise eight variables.



The **Keran (1970)** variable selection theory is a perfect guide to this research, as it has illustrated how external and internal information or factors affect the overall performance of the stock market through the above diagram.

According to **Dritsaki (2005)**: "The most important thing in selecting macroeconomic variables is to preserve that those variables would objectively reflect not only the general situation in the country's economy but also the financial status of the country".

It is widely accepted that the business cycle and stock returns are closely linked. Previous studies have presented the business cycle in terms of frequent variations in the level of economic activity over a certain period of time. They have also divided the business cycle into stages such as expansion; peak; contraction; trough; recovery. The duration of the business cycle should last for a period of between three and five years. However, studies have demonstrated that expansions will last around 44.8 months, while recessions will be of around 11 months. The theory behind the business cycle is that anyone, who can determine macroeconomic variables capable of detecting change in the business cycle, can use them as good indicators of stock price volatility. **Anderson and Carlson's (1970)** initial model was aimed at framing the possible linkage between macroeconomic variables and stock prices. Their work has been extended by **Keran's (1970)** model, showing the stock price diagram as presented by **Keran (1970)**.

### **3.2.** Adopted Theoretical Framework

The EMH is said to be a full reflection of all available information, and investors' risk preferences help us to determine how the market reacts to this information. Thus, any test of the EMH is a test of both market efficiency and investors' risk preferences; this makes the EMH not well defined and empirically refutable hypothesis. This is where other asset pricing theories, like CAPM and APT, come into the picture. These two theories are based

on the fact that the market must be efficient, and are built on the EMH property. The CAPM, being a single factor model, makes it difficult for fund managers and investors to determine how much effect a single macroeconomic risk factor has on the investment. This problem is solved by the APT framework. The APT is introduced as an alternative to CAPM and states that identical stocks must have identical prices, otherwise a risk-less profit can be earned. Moreover, the APT is a multifactor model.

This research hypothesises the selected developed economies to be at the 'semistrong form' of the EMH, as it is obvious that historic prices and public information about a company's stock are available to every investor, but the private information may be delayed. The research also hypothesises that the five BRICS countries, used in this research, proved to be at the 'weak form' of the EMH, because countries like South Africa, India etc., with high level of corruption and manipulation of public information by companies and even by government offices, make it impossible for the market to be at the same level of market efficiency as it is for the developed countries. This implies that the research will focus only on the 'weak form' and 'semi-strong form' of the EMH market efficiencies.

The aforementioned hypotheses are also tested through the variance ratio test for random walks, which examines the predictability of time series data by comparing the variances of differences of the stock market indices over different intervals. The variance ratio tests are carried out under different sets of null hypothesis assumptions: the strong assumption of the random walk being i.i.d. Gaussian with constant variance, i.e. homoskedastic random walk hypothesis, as well as heteroskedastic random walk hypothesis with weaken i.i.d. assumption allowing for fairly general forms of conditional heteroskedasticity and dependence (the martingale null). The wild bootstrap approach is also applied. The results of the tests (**Appendix 3, Volume 2, pages 18-27**) indicate that we "Using macroeconomic variables in the prediction of stock market indices: A theoretical and empirical assessment within BRICS and selected developed economies." strongly fail to reject the null hypothesis of a random walk in case of all the developed countries, complying with the assumptions of semi-strong efficiency.

For the BRICS countries, we strongly fail to reject the hypothesis of a random walk for Brazil, India and South Africa, but reject the joint hypothesis (through maximum |z|statistic) and individual hypothesis with lag 2 for Russia, and all the joint hypotheses and individual hypothesis with lags 5 and 10 for China. Thus, the results also comply with the assumption of the weak form of the efficiency.

Going further, this segment of the thesis concludes that all the four theories – EMH, CAPM, APT and Keran Theory have certain common characteristics of importance for this research. These common characteristics are: The Weak Form of EMH, the Semi Strong Form of EMH, the Systematic Risk (Beta), known as the risk factor described in the CAPM, and the APT and the Keran Theory for the selection of the indicated macroeconomic variables are linked with stock price fluctuation.

However, this research does not use all the features of EMH and CAPM, but applies the whole structure of the APT along with the Keran Theory. The Strong Form of the EMH is not relevant here, as the research hypothesised that the market cannot be strongly efficient. Furthermore, the microeconomic characteristic of the CAPM, the unsystematic risk, is also not relevant to this research, as the research is based on the macroeconomic scale. Building on the APT, which allows for the use of several macroeconomic variables as risk factors, the researcher employs the Keran Theory as a theoretical means or base for the selection of the utilised macroeconomic variables. This is because, the Keran Theory, unlike some other financial economics theories, has a direct link to stock price fluctuations and so to stock market indices. The VENN diagram, **Figure 2.2** considering these four theories on the next page, presents the interaction between and across each of them.



### **3.3 Review of Terminologically Relevant Literature**

Much of the terminology used within the current thesis scope are well known to the reader but clarification and specification of the terms in use are useful here. It is also important to give a theoretical explanation on how the variables have been selected and what those selected variables are. The central terms used in the thesis are: macroeconomic indicators and stock market index.

### **3.3.1 Selected Variables and Definitions**

The selected six macroeconomic variables of this research based on **Keran's 1970** theory are explained in the next sub-chapters. The key roles of these variables in influencing the stock markets, studied by different researchers, are also briefly discussed in the following sub-chapters. The chosen macroeconomic variables have been selected through the Kieran diagram. The purpose of the diagram is to demonstrate which set of macroeconomic variables have direct impact on the stock prices. Unemployment, which has been left out in the current thesis do not have such a direct impact on stock price fluctuation as well as government revenue. However, it is good to mention that this variable has been one of the main affected indicator during the financial crisis.

### **3.3.1.1 Gross Domestic Product (GDP)**

The interest shown in GDP by researchers can be traced back to as far as the seventies, when interest in macroeconomic variables was developed. GDP is the mathematical representation of the aggregate output in the economy. The formula is as follows:

### GDP = Cons + Gou + (Exp - Imp) (3.6)

As it is illustrated in the formula, the GDP is broken down into the following elements: consumption (Cons); investments (Inv); government spending (Gou) and external balance of

trade (the difference between the country's exports and imports). Economic theorists support the idea that consumption is by far the most critical and important element of the equation.

To reach the real value of GDP, two adjustments, exports – imports, representing the demand for domestic goods, must be included in the equation. The last adjustment consists of adding any changes in the national business inventories to obtain an accurate GDP measure.

According to **Keran (1970),** GDP and stock prices are closely related. The output of an economy, such as GDP, is a non-policy-influencing variable among exogenous variables, meaning that government policy will not directly affect the level of the economy's output. However, GDP will bear the influence of changes in price levels. The consequence of this interaction between GDP and price levels will be that it impacts on the interest rate level, which in turn will influence the stock price. This graph acknowledges a clear relationship between GDP and stock prices.

**Dritsaki (2005)** advises that research should preferably include variables that reflect the real situation in a country's economy. Many studies have demonstrated that GDP represents the economic output of a country. For information, some researchers use industrial production as a proxy measure of GDP.

**Hess (2003)** uses several macroeconomic variables, including the GDP, as independent variables in the Swiss context. He uses the cointegration technique to analyse the relationship between the macroeconomic elements and the stock market. His results highlighted the importance of GDP in predicting the stock price. His technique also demonstrates that the role of GDP is even determinant when it comes to industries such as metallurgy, utilities and electricity.

Elsewhere, in Australia, **Chaudri and Smiles (2004)** also studied the impact of GDP on stock prices. In addition to GDP, their studies included money supply (M3), the world oil

price index and consumption. They demonstrated a long-term relationship between the indicated variables, but documented a weak relationship between the Australian stock market and these variables.

In 2006, Gan et al., in New Zealand, documented a long-term relationship between money supply (M1), short-term interest rates, long-term interest rates, inflation rates, exchange rates, the consumer price index, the domestic retail oil price and GDP. They used the Granger Causality Test to show that the New Zealand economy is not driven by the New Zealand stock index.

Earlier, **Thorthon (1993)**, using four macroeconomic variables, and applying the causality test, found that GDP and money supply are driven by stock prices, and that stock price volatility finds its justification with the effect of GDP on stock prices. These existing studies show how relevant the GDP is as a macroeconomic variable. For the current research perspectives, the real GDP is considered. This variable, as indeed, all other selected macroeconomic variables evaluated within this research, has been identified by **Kieran (1970)** as one that has a significant impact on stock market prices and stock market indices.

### 3.3.1.2 Inflation Rate (IFR)

Inflation originates from the output of the economy. The changes within an economy's production will influence changes in price levels, which in turn will affect either real corporate earnings, decreasing companies' profits, then reducing the stock price, or bring changes in price levels affecting the interest rate, which has an inverse linkage to the price of stocks. As explained by **Defina (1991)**, inflation negatively influences companies' revenue due to an increase in their costs.

Abdullah and Hayworth (1993) documented the existence of a positive relationship between stock prices and inflation in the United States. They applied the VAR model, the

Granger Causality Test and the FEVD analysis in their studies. Mukherjee and Naka (1995) also expected to see a linkage between inflation and stock prices. They used Japanese data to conclude that inflation and the Japanese index were integrated for the entire sample. They applied the Johansen cointegration test and the Vector Error Correction model.

**Errunza and Hogan (1998)** studied the nature of the relationship between stock prices and macroeconomic variables in Italy, the UK, France, Germany, Switzerland, the Netherlands and Belgium. Among the dependent variables the inflation rate was also under scrutiny. They emphasised that the results here contradicted most of the US studies in the field regarding monetary and real-factor macroeconomic variables. Inflation was positively and significantly linked to the selected countries' stock indices.

**Ratanapakorn and Sharma (2007)** used inflation, among many other factors, in the US context, and discovered that inflation is positively related to the US stock index. They applied the Johansen cointegration test along with the FEVD.

**Maghayereh (2003)** used Jordanian stock market data along with the interest rate, inflation, domestic exports, industrial production and foreign reserves as independent variables. There was clear evidence that the Jordanian stock index was cointegrated with the inflation rate.

Earlier, **Muradoglu et al. (2000)** also used inflation along with the interest rate, the exchange rate and industrial production as independent variables in analysing a mixture of developed and emerging countries. They developed their research using the Granger Causality Test, and found that the relationship between stock returns and selected macroeconomic variables depends on the effect of the country's integration with the world, as well as on the size of the country's market.

Using the Japanese and American data, **Humpe and Macmillan (2009)**, applying the cointegration test, the causality test and the impulse response function, were able to say that inflation and stock prices negatively relate to the US market, but are positively linked to the Japanese stock market. This variable, as indeed, all other selected macroeconomic variables evaluated within this research, has been identified by **Kieran (1970)** as one that has a significant impact on stock market prices and stock market indices.

### **3.3.1.3 Exchange Rate (EXR)**

The exchange rate is an important factor in the fluctuation of share prices. Movements in the exchange rate are important elements to be understood by the researcher, as such variations in the exchange rate will lead to price inflation, causing the reduction of consumption and also lower profits operated by companies. Following **Keran's (1970)** diagram, the exchange rate is a component of the exogenous variable called change in the nominal money. From this variable, two ways exist for the exchange rate to impact the share prices. First, the change in nominal money can influence change in real money, which is directly linked to the interest rate. The interest rate will then influence the share prices. This relationship between the interest rate / share prices is described as an inverse relationship. Another way for the change of nominal money to influence share prices is its effect on the overall level of spending. This overall level of expenditure will affect the consumer, as well as the company, as it is mentioned above. Companies particularly will experience a fall in nominal gain, which will adversely affect corporate profits. A company's share price will therefore reflect this variation in the exchange rate.

**Darrat (1990)** used money supply, interest rate, inflation, exchange rates, fiscal deficits and real income in the Canadian context. He used the Granger Causality Test to conclude that

all monetary policy instruments' information is fully incorporated into stock prices, meaning that rates of exchange and interest are linked to Canadian stock price changes.

Another example is in the work of **Gan et al. (2006)**, who used New Zealand data. They employed money supply, short-term interest rates, long-term interest rates, inflation, the consumer price index, exchange rates, the domestic oil price and its gross domestic price to conclude that there was evidence suggesting a long-term relationship between the New Zealand index and all variables under examination. **Gan et al. (2006)** used the cointegration test to support their findings.

In Singapore, **Maysami et al. (2004)** also studied the impact of the exchange rate on the stock price index. Their method was the Johansen cointegration technique. They used money supply, long-term interest rates, short-term interest rates, the consumer price index, the exchange rate and industrial production. The most important finding was that all selected variables have a long-term relationship both on the stock market index and on the property index within the Singapore stock market.

**Ibrahim (2006),** in Malaysia, also showed interest in the exchange rate. With this variable he associated bank loans, interest rates and the price level output, concluding that there is no significant relationship between the exchange rate and the Malaysian main index. **Ibrahim (2006)** applied the impulse response function analysis to arrive at this conclusion.

Finally, in India, **Ahmed (2008)** used the cointegration technique on money supply, overnight interest rates, the exchange rate and stock prices to conclude that there is no relationship between the exchange rate and stock prices within the Indian context. This variable, as indeed, all other selected macroeconomic variables evaluated within this research, has been identified by **Kieran (1970)** as one that has a significant impact on stock market prices and stock market indices

### **3.3.1.4 Total Consumption (CON)**

Consumption is defined as the acquisition of goods and services. Consumption is an essential component, defined in the mathematical representation of gross national product. According to the theory of **Keran (1970)**, consumption is an integral part of the output of the economy. The level of consumption is linked to income and expectations. If expectations are low, the consumer trends will decline, which will lead to a fall in consumption.

According to economic theory, an increase in consumption influences financial market prices in two ways, first, through an increase in economic output, and second through an increase in corporate earnings and profit, enabling an increase in stock prices, as opposed to rises in the interest rate, which causes a drop-in share prices. On its turn, the central bank determines which factors will be dominant, through the action it takes to deal with the consumption. It is clearly established by economic theory that a relationship exists between share prices, consumption, the production economy and interest rates.

Consumption has been the centre of research interest as well. As mentioned earlier, **Chaudri and Smile (2004)** used consumption as an independent variable in their research within the Australian context. Using a Johansen Cointegration test, along with an impulse response function and the forecast error variance decomposition analysis, they concluded that consumption and the stock index are related in the long run.

**Gjerde and Saettem (1999)** have also empirically tested the effect of consumption on stock prices. Using the VAR model technique, they found that consumption was not significant on its own to predict the Norwegian stock market index.

**Hassan and Javed (2009),** using a battery of independent variables, including consumption, found evidence of a long-term relationship between consumption and stock price return in Pakistan. They used cointegration test and the test of Toda Yamamoto to construct

their findings. This variable, as indeed, all other selected macroeconomic variables evaluated within this research, has been identified by **Kieran (1970)** as one that has a significant impact on stock market prices and stock market indices.

### **3.3.1.5 Interest Rate (INR)**

It has already been established that there is a relation between stock prices and interest rates. The relation is described as inverse between the two variables. In Keran's diagram, interest rates as an endogenous variable are directly linked to stock prices. Interest rates' effect on stock price can arise from two sources: the economy output level and changes in nominal money. As explained previously, economic output will affect price levels, which will in turn affect the interest rate level. The second source is the change in nominal money, which will affect the interest rate through the change in real money, or through changes in total spending, which affect real output. Interest rates will, then, in both ways contribute to fluctuations in stock prices.

The inverse relationship between stock prices and interest rates is explained by the fact that stock prices reflect the present value of future cash flow to investors. We have learnt from **Gordon's (1959)** model that, for the calculation of the present value of a stock, we need to determine the risk-free interest rate added to a risk premium, which determines the risk of the asset – the systematic risk as stated in the CAPM. The discounted dividends at the risk-free rate and risk premium rate are actually the actual value of the stock. If the risk-free rate decreases, the value of the stock will increase. Also, the demand for goods, which influences the cost of living, is related to the interest rate. Less demand means less consumption and less profits for companies. An increase in the interest rate will have an impact on corporate earnings, as this will increase the cost of debt, lowering corporate profits.

However, the literature instructs that the interest rate was already the centre of attention even before the critical work of **Fama and Schwert (1977)**, who affirmed that macroeconomic variables can explain stock returns. Stone (1974) developed a model called the two-index model, which was an extension of Sharpe's (1964) single model. In his model, he incorporated the interest rate so as to measure the impact of the debt market. Later, **Lynge and Zumwalt** (1980) empirically tested the two-index model. They concluded that the interest rate influences returns within the commercial banking industry. In contrast to **Lynge et al.'s (1980)** work, **Joseph and Vezos (2006)** concluded that the interest rate alone is not enough to explain commercial banks' stock prices. They used the EGARCH approach to research the volatility of stock returns.

**Park and Choi (2011)** extended the examination of the interest rate's effect on the insurance industry. They discovered that insurance companies' stocks are impacted by the interest rate.

Empirically, researchers have used different proxies to the interest rate. As such, yields on government securities, central banks' key policy rates and treasury bills were used as proxies for the interest rate. **Prather and Bertin (1999)** showed evidence that discounted rate changes can predict stock price returns.

The method used here is to research events techniques, which aim to detect the effects of announcements on stock behaviour. **Li, Iscan and Xu (2010)** studied the effect of policy shock on stock returns. They used Canada's overnight rate and the US's federal fund rate as independent variables. Their finding was that monetary policy in the US is more influential on stock price than in Canada. However, in both countries, the effect of monetary policy is significant.

**Durham's (2003)** conclusion was that stock returns and monetary policy have a weak but significant relationship. He used sixteen countries' data to reach his conclusion. The discount rate was again used as a proxy for the interest rate.

Also, it was found by **Chang et al. (2011)** that the federal fund rate, another proxy for the interest rate, has little impact on stock price returns.

**Zafar et al. (2008),** using the GARCH model in the Pakistani context, along with the 90 days T-bill rate, found that market returns have a negative, significant relationship with the interest rate, suggesting that the interest rate would be a good predictor of price variation. This variable, as indeed, all other selected macroeconomic variables evaluated within this research, has been identified by **Kieran (1970)** as one that has a significant impact on stock market prices and stock market indices

### **3.3.1.6 House Price Index. (HPI)**

House prices can be located in the changes in price level within Keran's graph. The diagram implies that changes in house prices will directly affect the interest rate in this case. We now know that an increase in the interest rate coincides with a drop in the value of stock prices. House prices are also determinant factors in many work-predicting bubbles. The change in house prices can also influence stock prices through changes in real output, also linked to the interest rate.

Li and Hu (1998) employed the daily returns of the Dow Jones industrial index, the Russell 100 and 200 indexes and the S&P500 index to analyse how a number of macroeconomic variables, including house prices, react to macroeconomic announcements. They concluded that there is a possibility that the selected indices can be affected by construction operations. **Baffoe-Bonnie (1998)** also suggests that macroeconomic variables

influence the housing market. They used the VAR model to analyse the interaction between house prices and other elements of the economy.

**Chen and Patel (1998)** also looked at the effect of house prices on the economy. They analysed the influence of house prices on macroeconomic variables such as the interest rate, construction costs, housing completion, the stock market index and household income in the Taipei context. They concluded that house prices are driven by the selected macroeconomic variables.

**Ortok and Terrones (2005)** demonstrated the effect of house prices on macroeconomic variables and underlined that the opposite effect between the two variables was insignificant.

**Gupta and Kabundi (2010)** found that those monetary policy shocks and house prices were related. House price inflation negatively reacts to monetary shock. **Meidani et al (2011)**, covering 18 years of data in the Iranian context, used house prices, GDP and the consumer price index as variables. He developed the theory, using Granger Causality, that house prices changes are caused by GDP and CPI. However, there is no evidence of Granger Causality of real house price changes affecting the consumer price index.

Finally, **Yahyazadehfar and Babaie** (2012) noticed that not many studies focused on the effect of house prices on macroeconomic variables in emerging countries. The current area of interest will be relevant in the search for adequate macroeconomic variables affecting stock returns. In this present research, the GDP deflator as a representation of the GDP variable is preferred. This variable, as indeed, all other selected macroeconomic variables evaluated within this research, has been identified **by Kieran** (1970) as one that has a significant impact on stock market prices and stock market indices.

### **3.4 Critical Review of Empirical Literature Based on the Objectives**

In the previous sections, the theoretical and terminological review of the literature were discussed. This present section covers the critical and relevant empirical review of the literature. Please note that the empirical review is done on the objective per objective basis as defined by the thesis. The literature relating to the prediction of stock market indices using macroeconomic variables is not of recent origin. The literature is both multi-country and multi-variables. The following discussions reveal more recent literature on an objective-by-objective basis. However, the key seminal literature is presented in **Table 3.1**.

### **3.4.1 Variables Selection Techniques (Objective 1)**

The search for meaningful macroeconomic variables that can help predict stock market index changes is still going on. The below selected literatures link to objective 1 of the thesis as these researches also focus on understanding which variables are indicated in predicting stock market index changes.

For the last four decades, financial economists have focused on understanding the linkage between macroeconomic variables and stock market prices. Enough significant literature investigating the relationship between stock market returns and different sets of macroeconomic and financial variables, across the stock markets of different economies and over a range of different time horizons currently exists. Existing financial and economic theories provide a number of models that provide a framework for the research of this relationship.

The Arbitrage Pricing Theory is one way of linking macroeconomic variables to stock market returns (**Ross, 1976**), as multiple risk factors are used to explain the asset returns in this theory. Early empirical studies on the APT focused on individual security returns, but the theory can be used in an aggregate stock market framework as well, where a change in a given

macroeconomic indicator or variable could be seen as the variable reflecting the change in an underlying systematic risk factor that influences future returns. Most of the empirical researches based on the APT theory, estimating the linkage between the macroeconomic variables and the stock market returns, are characterised by modelling the short-run relationship between the mentioned variables in terms of first differences by assuming trend stationarity.

Generally, different studies and papers currently exist that investigated and analysed the existence of significant relationships between the stock market returns and the macroeconomic variables, such as the industrial production, inflation, interest rates, GDP, the yield curve and the risk premium.

**Roll et al (1980)** use the APT to examine the effect of thirty securities on the macroeconomic variables in the American context. They found that the returns on the selected stocks are strongly explained by three out of the six macroeconomic variables under scrutiny.

Scientists have used different macroeconomic variables to understand the fundamentals behind the relation between the stock prices and the macroeconomic variables. The current debate is on the accurate determination of the macroeconomic variables that really have an impact on the stock price fluctuations. Their interest remains in how to capture the expected returns knowing that the stock prices appear to vary with the business cycle. This issue brings to the fore the question, whether the key macroeconomic variables play a vital role in describing the stock fluctuations and the above-mentioned excess stock returns.

Chen et al (1986), cited by Humpe and Macmillan (2007), emphasise the issue of selecting relevant variables; they stress that a researcher should thoroughly consider both the empirical and theoretical literature before choosing the variables to be studied. Researchers should be aware that the macroeconomic variables have unequal power, as revealed by the

economic theories, so implying that they should select only those variables that have an impact on the stock price returns (**Dritsaki**, **2005**).

An alternative approach of the APT theory is the Discounted Cash Flow or Present Value Model (PVM). This model relates the stock market returns to the future expected cash flows and the future discount rate of these cash flows. Again, all the macroeconomic variables that affect the future expected cash flows or the discount rate of these cash flows are considered to have an impact on the stock market returns or prices. One of the advantages of the PVM model over the APT is that it can be used to focus on the long-run relationship between the macroeconomic variables and the stock markets. **Campbell and Shiller (1988)** estimate the relationship between the stock prices, earnings and expected dividends, and reveal that a long-term moving average of earnings predicts dividends, and the ratio of this earnings variable to the current stock price is important in stock returns prediction over several years. They concluded that these facts make stock prices and returns too volatile to accord with a simple PVM.

**Choo et al (2011)** have found that selected macroeconomic variables have not impact on the Japanese stock market. They used 12 years of data along with the GARCH technique. The intent of the paper was to investigate the behaviour of Japanese stock market with regard to macroeconomic variables. They used the NIKKEI 225 as dependent variables and gold, crude oil and exchange rate as independent variables.

# Table 3.1: List of Seminal Authors and Associated Theories

Title	Authors	Focus of the Study	Independent and Dependent Variables	Statistical Methods	Findings	Linkage to the Current Study	Selection of Relevant Theory
Portfolio selection	Markowitz, H. (1952)	To maximize portfolio expected return for a given amount of portfolio risk	stock return	MPT model	Markowitz portfolio theory: the theory supports that risk-averse investors can construct portfolios to optimize or maximize expected return based on a given level of market risk, emphasizing that risk is an inherent part of higher reward	Consider stock return variables. However, the theory acknowledges only asset risk excluding other risk such as macroeconomic variables used in the study.	
A Simplified Model for Portfolio Analysis	Sharpe, W.F (1963)	To extend Markowitz' work on the second of the three stages of portfolio analysis	stock return (annual return for 96 stocks on the New York stock exchange from 1940 -1951)	Diagonal model	The paper is an extension of the Markowitz (1952) theory. It also acknowledges the existence of risk related to the asset. The main finding is the single factor (risk) called beta factor representing a single risk for the entire market	Use stock return as variables. The main linkage with the current study is that is consider the existence of other factor as the representation of the market risk (e.g. macroeconomic variables)	Among the cited theories. The APT is the
Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk	Sharpe, W.F. (1964)	To construct a model that describes the relationship between risk and expected return.	stock return	MPT model	CAPM supports that investors are compensated in two ways which are risk and time value of money. The model also innovate with the risk free, beta and market premium concepts	Consider the existence of risk other than market risk.in the idea of the single factor, macroeconomic element is possible influence of stock price return. The present study use both stock return and macroeconomic variables	channel through which the present thesis is framed. The contention is that stock price returns are influenced by market environment and that a linear relationship exists between stock returns and the selected macroeconomic variables.
Equilibrium in a Capital Asset Market	Mossin, J. (1966)	To investigate the properties of a market for risky asset	stock returns	MPT model	the paper shows that that a "market line" in the sense discussed above can be derived from the conditions for general equilibrium (if it exists), also Second, the fact that the market line is a straight line means that the rate of substitution between per dollar expected yield and per dollar standard deviation of yield is constant, i.e., for any two individuals r and s	Consider that existence of risk other than risk related to the asset only. It has per Sharpe (1964) acknowledge that the existence of a market risk (e.g. macroeconomic variables)	
Arbitrage Pricing Theory	Ross, S.A (1976)	To develop the arbitrage model of capital asset pricing	stock returns and external risk factors to the market such Inflation	Multiple regression	The paper demonstrated that stock price returns are influenced by other factors which are not market related factors. The model develops a linear relationship between stock price returns and the factors representing risk. Simply, it allows the selection of whatever factors that provide a better explanation of variation in stock market prices.	Consider elements outside the stock market environment. Precisely, the paper considers macroeconomic variables as a possible factor representing risk to the stock markets.	

## **3.4.2** Relationship Macroeconomic variables and Stock Market – Cointegration (Objective 2)

This selected literature is important and linked to the second objective of this research as it successfully identified some statistical relationship or linkages between macroeconomic variables and the stock market indices using similar tests like Cointegration as within this research.

**Granger (1986)** and **Engle and Granger (1987)** argue that the validity of a long-term equilibrium between variables can be examined using the co-integration techniques. These techniques have been applied extensively to estimate the long-run relationship between the macroeconomic variables and the stock prices in a number of different studies, such as Nasseh and Strauss (2000). Their analysis revealed the existence of a significant long-run relationship between the domestic and the international economic activities in France, Italy, Germany, UK, Netherlands and Switzerland and the corresponding stock prices. Particularly, they discovered large positive coefficients for consumer price index and industrial production index, but smaller positive coefficients for short-term interest rates and business surveys of manufacturing. The only negative coefficients found in the results of their analysis refer to the long-term interest rates.

Further revelations from the research of **Nasseh and Strauss (2011)** outline that the European stock markets are highly integrated with the German stock market, and that the industrial production, the stock prices and the short-term rates in Germany have positive impact on the other European stock markets' returns, such as France, UK, Italy, the Netherlands and Switzerland.

In Africa, specifically in Ghana, Adam and Tweneboa (2008), using the exchange rate as an independent variable and the Accra stock exchange main index as a dependent variable,

affirm that the exchange rate is important in the Ghanaian context to predict the stock returns. **Ratanapakorn and Sharma (2007)** focus on the long-term and short-term relationship between the stock market returns and the following macroeconomic variable; the money supply, the industrial production, the inflation, the exchange rate, the short-term and the long-term interest rates. They use fourteen years of monthly data starting from 1975, and employ the Johansen co-integration procedures in their analysis. They find that the S&P500 and long-term interest rates are negatively linked, while a positive relation exists between the US stock price and the inflation, the industrial production, the money supply, the short-term interest rates are negatively linked.

Interestingly, the research highlights that, in the long run, the selected Granger variables influence the stock prices, whereas there is no evidence of this in the short-term. Finally, by applying the variance decomposition techniques they discovered that American stock prices are exogenous variables in relation to the macroeconomic variables within the research.

**Purnomo et al (2012)** examine the Indonesian economy, which was particularly hit hard by the 1998 financial crisis. Policymakers at the time believed that the Indonesia's economy was vulnerable to capital flight in reaction to the foreign shocks. **Purnomo et al (2012)** argue that the influence of domestic and foreign source shocks on the Indonesian stock market is very important for prudent management of the country's macroeconomics. They examine both the short- run and the long-run relationships between domestic and foreign source shocks to the Jakarta Composite Stock Market Index (JCI). Their research shows evidence that the JCI is co-integrates with several domestic macroeconomic variables. They further estimate an error correction model to identify the long-run equilibrium relationship between the JCI and the domestic and foreign source macroeconomic shocks. They reveal that the Indonesian-dollar

exchange rate has bidirectional impacts on the JCI. They also illustrate that the JCI is cointegrates with the stock market indexes of several other Southeast Asian stock markets.

However, their analysis does not find any co-integration among the JCI and the U.S. and the Japanese stock markets. They suggest that the JCI is affected by regional stock markets and not by the US stock markets. They conclude in their research that policy makers and investors should use regional stock markets as the primary factors to consider, but they also acknowledge that the US stock market may have indirect influence on the Indonesian stock market.

Considering the IBOVESPA and a few economic variables, such as the exchange rate, the country's risk, the nominal short-term interest rates, the inflation and the industrial production, from January 1995 to January 2010, **Da Silva and Coronel (2012)** employ cointegration to understand the long-term relationship between those variables. The researchers document that IBOVESPA is positively and negatively linked to GDP and inflation and exchange rates respectively. They also emphasise that IBOVESPA90% explained by its own volatility, while 5% is due to the country's risk variable.

**Thornton (1998)** analyses the dynamic long and short run relationships between real M1, interest rates, real income, and real stock prices in Germany. He collected data for the period of 1960 to 1989 and utilises the Johansen cointegration test and Granger - causality tests in his model. His results indicate that the real stock prices have positive significant wealth effects on the long-run demand for M1, as well as the presence of a unidirectional Granger - causality effect from the interest rates to the real stock prices.

**Gan et al. (2006)** utilises the Johansen's (1990) cointegration approach, Granger causality tests, and impulse response analysis in his research to determine whether the New Zealand Stock Index is a leading indicator for a set of seven selected macroeconomic variables.
These macroeconomic variables include the inflation rate, the short-term interest rate, the longterm interest rate, the exchange rates, MI, GDP, and the domestic retail - the price of oil. They use monthly data from January 1990 to January 2003. Their analysis reveal evidence of the existence of a long run relationship between New Zealand's stock index and all the seven macroeconomic variables used in the model.

**Maysami et al. (2004)** also investigate the relationship between composite stock index of Singapore, its three sector indices, which includes the finance index, the property index, and the hotel index, and a set of selected macroeconomic variables. They utilise a monthly data from January 1989 to December 2001. They apply Johansen's cointegration test model. The macroeconomic variables used in their model include IP, CPI, proxies for long and short-run interest rates, the money supply (M2), and exchange rates. The results indicate that the Singapore's stock market and the property index has a significant long-run relationship with all macroeconomic variables used in the analysis.

On the other hand, the finance sector index shows a significant relationship with the macroeconomic variables in the analysis with the exception of the real economic activity and the money supply. The hotel index indicates no significant relationship with the money supply and the short and long-term interest rates, but reveals significant relationships with all the other macroeconomic variables included in the analysis. The result questions the efficiency of Singapore's market; it reveals that the stock prices do not promptly incorporate all information available in the market.

**Vuyyuti (2005)** investigates the Indian stock price index's relationship with the interest rates, the inflation rate and the exchange rate, as well as the real sector is used as a proxy for industrial production. He used Johansen's cointegration approach to examine causality and cointegration among variables. The monthly data covers the period from 1992 to 2002. The

results support long-term equilibrium between the real sector and the financial industry. Also, the Granger Causality Test demonstrates unidirectional causality relationship between the financial sector and the real sector of the Indian economy.

Jefferis and Okeahalam (2000) are concerned with the impact of domestic and foreign economic indicators on the selected African markets, among which is South Africa. The data covers a 10-year period from 1985 to 1995. They select the exchange rate, the interest rate and GDP as domestic macroeconomic variables, while the US real GDP and interest rate represents the foreign variables. The dependent variable is the stock market index. They use the cointegration approach to question the long and short-term linkage between the variables. They conclude that the local and foreign interest rates have a negative impact on the stock returns. Besides, they found that in the long run only the GDP has relationship within the four countries' stock market indices. Finally, the GDP and the exchange rate have a positive linkage with the stock returns.

**Moolman and Du Toit (2005)** show interest in the South African stock market returns, employing the Johansen cointegration method to investigate the long- and short-term relationship of the stock market returns with the economic indicators. Interestingly, they include the South African economy as a dummy variable in their model. Their research finds a short-term relationship between the interest rates, the exchange rate, the S&P500 index, the gold price, the forward-looking expectation of investors, the risk premium and the JALSH/FTSE. The GDP is found to be highly significant in predicting JALSH/FTSE returns.

Recently, **Yunus (2012)** analyses the dynamic relation between the stock market, the property market and a few macroeconomic variables. He selects certain countries in America, Europe, Australasia and Asia. The main finding is that the property market cointegrates with its respective stock market. Also, there are findings to evidence the cointegration between the

property market and the select economic variables in the long run, while the economic output has an impact on the property market in the short-term. He also shows the existence of a positive relationship between the GDP, the money supply and the inflation, while the stock prices are negatively affected by the interest rate. He used quarterly data from January 1990 to December 2007. The Johansen cointegration is also applied as a methodology to develop the aforementioned results.

The discussed literature is important and is linked to the second objective of this research, as it successfully identified some statistical relationships or linkages between the macroeconomic variables and the stock market indices using similar cointegration tests in their research model.

# **3.4.3** Causal Relationship between Macroeconomic Variables and Stock Market (Objective 3)

The research referenced below uses the same causality (Granger) theory upon which the third objective of identifying causal relationship variables is based. This makes it relevant and linked to the third objective of this research.

**Ituzer and Tas (2012)** consider the multivariate GARCH model to research the bidirectional causal linkage between Turkey's, the Czech Republic's, Brazil's and India's stock market indices and the macroeconomic volatility. The selected macroeconomic variables are the consumer price index, the industrial production, the money supply and the interest rate. The monthly data covers the period from 1992 to 2010. The overall results provide evidence of causality effect between the economic variables and the stock returns, specifically for the inflation, the industrial production, the short-term interest rates and the money supply.

For the Brazilian market, the research finds that the presence of bidirectional causality between the stock prices and the short-term interest rates. **Argawal et al. (2010)** investigate

the relationship between the Indian – US dollar exchange rate and the NIFTY index. They also apply an analysis of the causal relationship between the selected variables. The research uses daily data from October 2007 to March 2009. The selected variables are not normally distributed as per test statistics; they employ in their work the Unit Root Tests, as well as Correlation and Granger Causality tests. They document a unidirectional relationship from the NIFTY index to the exchange rate. **Iltuzer and Tas (2012)** conclude that in the Indian context there is no causal relationship between the stock prices and the specific macroeconomic variables used in their research, and they propose looking for other variables not contained in their work to explain how macroeconomic variables can impact the Indian stock market returns.

In the Indian context, **Ahmed (2008)** also tries to understand the causal relationship between the stock price and the macroeconomic variables by selecting quarterly data regarding the industrial production index, the money supply, the interest rate, the foreign direct investment, the exports earnings, the NIFTY and the Sensex indexes from March 1995 to March 2007. He employs the Johansen cointegration approach, and uses the Toda Yamamoto Granger Causality Test to investigate the long-term relationship among variables, and the variance decomposition test with the impulse response function to analyse the short-term linkages. He concludes that a long-term relationship exists between the variables. However, the relationships are not identical between the economic variables and the NIFTY and SENSEX.

**Okunev, Wilson and Zurbruegg (2000)** look at the dynamic relationship between the S&P500 and the house prices for a period covering from 1972 to 1998. They employ the linear and the non-linear causality tests. The linear test results indicate the existence of a unidirectional relationship between the real estate and the S&P500 index. The opposite is

observed in the non-linear causality test, where a strong unidirectional relationship is proven from the American index to the real estate market.

Asprem (1998) investigates the causal relationship between the asset portfolios, the stock indices and the macroeconomic variables in ten European countries, including Germany. He uses the employment, the inflation, the imports, the US yield curve, the money supply and the interest rates among the macroeconomic variables. He shows that a strong relationship exists between the macroeconomic variables and the stock prices, especially in Germany, UK and Holland. He employs quarterly data for all the variables from 1968 to 1984.

**Malliaris and Urrutia (1991)** also uses the S&P500 index as a dependent variable to analyse its linkage with a few macroeconomic variables, among which the economy output is measured along with industrial production and the money supply. Their monthly data covers a period of nineteen years. They used the Granger Causality Test to build their conclusions. Importantly, they discover that S&P500 is driven by the money supply (M1), while the relationship between S&P500 and the industrial production is dominated by the US index. The main conclusion in this research is the existence of causal relationships among the selected variables.

Causality between selected variables is the centre of the research conducted by **Darrat and Dickens (1999)**. They select identical variables to those in the research of **Malliaris and Urrutia (1991)**, which are S&P500, the industrial production and the money supply. They document a multivariate cointegration model and an error correlation model. Above all, they justify the existence of integrated and causal relationships among the variables, which was a major innovation. Another contribution is the addition of the inflation and the interest rate into their models, with the consequence of producing a much more accurate predicting model. They

also conclude that the stock market is a leading variable with regard to the economic output and the monetary policy.

Mahmood and Dinniah (2009) analyse long and short-term multivariate causality relationships between six select stock prices from Asia-Pacific countries, including Japan, and economic variables. The monthly data covers nine years, from January 1993 to December 2002, and the independent variables are the foreign exchange rate, the industrial production and the consumer price index. The results suggest the existence of a long-term relationship between the selected variables in case of Japan and three other countries. short-term linkages are also identified, except for Thailand and Hong Kong. They stress the importance of developing an accurate relationship between the stock price returns and the macroeconomics variables, which allows the investors to make more precise decisions in terms of their investments.

Abdullah and Hayworth (1993) also combines several statistical approaches in order to analyse causality between S&P500 and the inflation, industrial production, short-term interest rates, long-term interest rates, the trade deficit, money supply and budget deficits. The results, derived from the vector autoregression, the Granger Causality Test and the impulse response analysis, confirm that the stock prices are determined by all the variables except for the industrial production. They also find positive relation between S&P500, inflation and money growth. However, the trade deficits, the budget deficits and the interest rates are negatively linked to S&P500.

**Thornton (1993)** examines the lead-lag relationships between the UK stock prices represented by the Financial Times Stock Exchange 100 index (FTSE 100), and the selected macroeconomic variables, which included the real GDP and two definitions of the money supply - the monetary base (M0) and the broadest definition of the money supply (M5). He

used quarterly data from the period of 1963 to 1990. The Granger causality tests results indicated the following four linkages:

- i. the stock prices tend to lead M5;
- ii. the stock prices tend to lead the real GDP;
- iii. feedback effects are identified between M0 and M5 volatility and the stock price volatility;

iv. the real GDP tends to lead the stock price volatility.

Thornton (1993) suggests that the causal relationship among the real and the monetary variables of the UK is not statistically significant, which is in contrast to the literature on the US economy.

**Hashemzadeh and Taylor (1988)** analysed the relationships between the S&P 500, the money supply (M1), and the return on Treasury bills of the United States. They utilised the **Granger (1969)** and **Sims's (1972)** causality tests using weekly data from the week ending January 2, 1980 to July 4, 1986. Their results revealed the existence of the relationship between M1 and the S&P 500, but the relationship between the S&P 500 and the Treasury bills of the US is not conclusive. Their results also showed that the causality relationship appeared to start with the Treasury bills of the US first, and then moved to the stock prices, and not the other direction. They suggested that U.S. Treasury bills and M1 are not highly successful in predicting the changes in the stock prices. Their finding actually implied that the stock prices of the United States incorporate all the information available in the stock market.

**Darrat (1990)** utilises Akaike's Final Prediction Error (FPE) criteria in conjunction with the multivariate Granger causality tests in his analysis. He examines whether the changes in the Canadian stock returns are predicted by several economic variables, which includes real income, exchange rates, the money base, interest rates, interest rate volatility, inflation, and

fiscal deficits. He uses monthly data from January 1972 to February 1987. His results reveal that the current stock prices in Canada fully incorporate all the available information from monetary policy instruments. The results also indicate that the stock returns are Granger-caused by the lagged changes in fiscal deficits.

The discussed researches used the same causality (Granger) theory on which the third objective of identifying causal relationship between the variables is based. This makes it relevant to the third objective of this research.

# **3.4.4** Volatility of Macroeconomic Variables in Stock Market (Objective 4)

These are important research, as are much linked into the Objective 4 of investigating volatility of some selected macroeconomic variables in the markets.

**Dhakal et al (1993)** also show interest in the US stock market predictability. They employ the VAR approach to evaluate the nature of the linkage between S&P500 and a few macroeconomic variables, including price level, real output, money supply and short-term interest rates. They use monthly data from 1973 to 1991. The volatility of the US stock market is the main focus point of the research. The results identify the following: share price volatility triggers output fluctuations; the VAR models indicates that share price changes are directly affected by money supply; the inflation rate and the interest rate indirectly impact on the price of the stocks.

**Stone and Ziemba (1993)** look at Japanese stock prices. They pay special attention to the effect of land prices in Japan on Japanese stock returns. They find that the volatility of stock prices is higher than the Japanese land prices. They also find that both prices correlate, and that the land returns are driven by the stock prices. Monetary policies also have an impact on the stock price according to their research. As such, quantitative easing and monetary tightening positively and negatively affect the stock price returns respectively.

**Morelli (2002)** analyses the volatility of the FTSE100 using the GARCH model approach. He uses monthly data covering a twenty-eight-year period. He concludes that the selected variables are not able to explain the FTSE100 volatility, recommending that different variables need to be explored in assessing the UK index volatility. These are important researches as they are obviously linked to the objective of investigating volatility of some selected macroeconomic variables in the markets.

Other stream of researches, investigated the impact of macroeconomic indicators or variables on the volatility of stock market return. The studies consider the conditional variances of the financial data by focusing on the importance of volatility in evaluating securities, designing monetary policies, managing risk and making investment decisions.

These studies are motivated by the introduction of **Engle's (1982)** model of autoregressive conditional heteroscedasticity, commonly known as ARCH, as well as the GARCH model designed by **Bollerslev (1986)** and other sub-extensions of these models. **Schwert (1989)** is one of the pioneer researchers, who examine the relationships between the volatility of the U.S. stock market and the volatility of real and nominal macroeconomic variables and activities. He uses monthly data from 1857 to 1987 and concludes that volatility of macroeconomic variables and activities, which are measured by changes in real output and inflation, do not help in predicting the volatility of the stock and bond returns.

However, Engle's test results show evidence that financial assets' volatility is useful in predicting future macroeconomic volatility. His findings supported his claim that the speculative assets' prices should react quickly to new information about economic activities and events.

**Muhammad and Rahman (2008)** analyse the long-run and short-run dynamic impacts of the broad money supply (M2) and the price of oil on the S&P 500 in the US. They employ

monthly data from January 1974 to April 2006 and adopt the Granger causality tests, vector error correction models and Johansen cointegration tests in their econometrics model. Their results are in favour of the three variables being cointegrated. The vector error-correction model results from their analysis reveal no causal relationships in the long run although feedback relationships exists in the short run. The results further indicate that the current volatility of the stock market in the US is fueled by its past volatility, as well as the negative monetary and oil price shocks that initially depressed the stock market in the US.

**Choo et al. (2011),** utilising the GARCH procedure, investigate the behaviour of the Japanese stock market's volatility with respect to macroeconomic variables. They use the gold price, the exchange rate, and the CDO and NIKKEI data from 1997 to 2000. They reveal that the selected macroeconomic variables have no impact on the volatility of Japanese stock returns, and that GARCH models yield the best results.

Cited by **Alshogeathri (2011)**, **Kapital (1998)** adopts Lee's (1994) GARCH-X model to analyse the U.S. stock market volatility, and the effects of short-run deviations between stock prices and a set of selected macroeconomic fundamentals, which are the consumer prices, the exchange rate, the money supply, the income and the real oil prices. Monthly data from January 1978 to December 1996 is applied. His analysis shows that the macroeconomic variables have a positive and significant effect on the volatility of the stock market in the United States.

Liljeblom and Stenius (1997) examine whether the changes that occur in the stock market volatility are attributed to time-varying volatility of a set of selected macroeconomic variables in Finland. The selected macroeconomic indicators or variables are CPI, Money Supply (M2), industrial production, and a trade variable represented by the export price index divided by the import price index. The data covers the period of 1920 to 1991. Their results show that, with the exception of the growth of stock market trading volume, the VAR estimates

indicate a predictive power effect form the direction of the volatility of the stock market to macroeconomic volatility and from the direction of the macroeconomic volatility to the volatility of the stock market.

Léon (2008) analyses the effects of the volatility of the interest rate on the volatility of the stock market return in Korea. He uses weekly return data from January 31, 1992 to October 16, 1998. His model estimates two GARCH (1,1) models; one excluding the interest rates, and the other including the interest rates in both the conditional mean and variance. His results indicate significant negative relationship between the conditional market returns and the interest rates. But the results for the conditional variance show a positive, but insignificant relationship with the interest rates compared to the other studies documented in the United States' market. His results further revealed that the interest rates have strong predictive power for the stock returns in Korea, but weak predictive power for the volatility. These revelations imply that the Korean stock market investors should adjust their portfolios in response to changes in monetary policy.

# **3.4.5 Use of VAR and GARCH to Explain Stock Market (Objective 5)**

Again, the selected below researches are relevant to the fifth objective of this research as they used similar methods to achieve their objective. Objective 5, briefly explained in previous chapters, is concerned with the use of the VAR, VECM and GARCH models to explain the relationship between the stock market returns and the macroeconomic variables.

Previously, **Asgharian et al (2013)** employ the GARCH-MIDAS approach to examine whether information contained in macroeconomic variables can help to predict short-term and long-term components of return variance. For the research, they use the S&P500 index along with seven macroeconomic variables, which are the unemployment rate, the growth rate in the industrial index, the inflation, the exchange rate, the default rate, the slope of the yield curve

and the short-term interest rates. They apply data from January 1991 to June 2008. The research concludes that the GARCH-MIDAS forecast is superior to the traditional GARCH-model. It is also visible from the results that macroeconomic information not only significantly enhances the forecast ability of the model in the long run, but also improves the model's accuracy in terms of prediction, when data is collected on a daily basis.

**Kim and Moreno (1994)** apply the VAR model methodology, and draw three main conclusions from their studies. First, they find that the banking industry has an impact on Japanese stock returns. Secondly, the fluctuations in the NIKKEI price are subject to the fluctuations in the Japanese banks' lending. Finally, the historical correlation between the NIKKEI and banks' lending is not steady over the entire period selected for the research. The data covers the period from January 1970 to May 1993.

**Verma and Ozuna (2005)** select four South American countries, namely Brazil, Mexico, Argentina and Chile, for their analysis. They analyse the influence of the macroeconomic variables on the stock prices within the Latin context. They employ the VAR technique to construct the model. For each country, they select the money supply, the CPI, the interest rate and the exchange rate (local currency / US). They show that Brazil's, Mexico's and Argentina's stock returns demonstrate high, while Chile demonstrates low volatility. They also find that the exchange rate is the only variable having impact on the individual stock prices in the four countries. Overall, the results provide little evidence suggesting strong linkage between the selected variables.

In the wake of **Verma and Ozuna (2005), Abugri (2008)** also investigates Brazil, Mexico, Argentina and Chile. He explores the global and domestic impact of the macroeconomic variables on Latin stock price returns, as well as their role in explaining the returns across the selected countries. The VAR approach is employed for the analysis. The

results present positive coefficients for all four models. It is also found that the domestic macroeconomic shocks have differing effects within each of the Latin markets.

**Ituzer and Tas (2012)** consider the multivariate GARCH model to research the bidirectional causal linkages between Turkey's, the Czech Republic's, Brazil's and India's stock market indices and the macroeconomic volatility. The selected macroeconomic variables are the consumer price index, the industrial production, the money supply and the interest rate. The monthly data covers the period from 1992 to 2010. The overall results provide evidence of causality effect between the economic variables and the stock returns, specifically for inflation, industrial production, short-term interest rates and money supply. For the Brazilian market, the research finds the presence of bidirectional causality between the stock prices and the short-term interest rates.

**Hondroyiannis and Papapetrou (2001)** examine the dynamic relationships in the Greek economy between the stock returns and a set of macroeconomic indicators. The macroeconomic variables consist of IP, interest rates, real oil price, exchange rates, as well as the real foreign stock returns are represented by the S&P 500. They employ a multivariate VAR model and use monthly data from January 1984 to September 1999. Their findings reveal that the stock returns did not lead to changes in the real economic activity, and that the macroeconomic activity and the foreign stock market changes only partially explain the stock market movements. The changes in oil prices, however, explain the stock price movements and has a negative effect on the macroeconomic activity.

**Federova and Pankratov (2010)** explore the influence of macroeconomic factors on the Russian stock market. The authors employ the EGARCH model to research the relationship between the Russian stock index and the following macroeconomic variables; the GDP, the exchange rate, the Euro / dollars ratio, the net capital movement and the Brent oil free-market

index. They conclude that the volatility of the Russian index is mainly explained by the oil prices and the US dollar exchange rate.

**Hsing (2011)** uses the real output, the government deficit, the money supply, the interest rates, the nominal effective exchange rate, the inflation rate, the world interest rate, the world stock market index and JALSH. He employs the Exponential GARCH as per Nelson's (1991) work. He finds that the South African index is positively influence by the GDP growth, the money supply to GDP ratio and the US stock market index, while is negatively impacts by the GDP deficit ratio, the interest rate, the exchange rate, the inflation and the US government bond yield.

Gjerde and Sættem (1999) employ the VAR model using monthly data from 1974 to 1994 to analyse the relationship between the stock market returns and a set of selected macroeconomic variables in Norway. The selected variables include the consumption, the IP, the interest rates, the inflation, the OECD industrial production index, the foreign exchange rate, and the price of oil. Their findings are consistent with **Humpe and Macmillan's (2009)** findings about the U.S. and Japanese stock markets. **Gjerde and Saettem (1999)** develop several significant links between the stock market returns and the selected macroeconomic variables. Their results reveal that the changes in the real interest rate influences both the stock returns and the inflation, and the stock market reacts significantly to the changes in the oil prices. The stock market of Norway also showcases a delayed reaction to changes in the domestic real activity.

Mukherjee and Naka (1995) analyse the effects of the selected six macroeconomic variables on the Japanese stock market. They employ Johansen's (1991) co-integration tests and vector error correction model (VECM) for their analysis. The six selected macroeconomic variables are the inflation, the exchange rate, the IP, the money supply, the long - term

government bond rate and the call money rate, as well as they apply the Tokyo Stock Exchange index using a sample period spanning from January 1971 to December 1990. The findings reveal that the macroeconomic variables are integrated with stock prices for the whole sample period examined, as well as for two additional sub-periods that are also analysed.

**Abdullah** (1998) analyses the impacts of the changes of the following six macroeconomic variables; M1, the budget deficits and surpluses, IP, the consumer price index (CPI), and the long-term interest rate, on the stock returns of UK, which is a proxy of the London share price index. He employs **Sims (1980) forecast error variance decompositions** in his analysis. His analysis reveals that the money growth variability accounts for about 22.82% and 19.53% of the variance in interest rates and stock returns respectively. This implies that the money growth variability contributes to the uncertainness associated with the returns on investments in stocks and other financial assets. The other macroeconomic variables, included in the model, are statistically significant in explaining the variance of the UK stock returns.

**Chaudhuri and Smiles (2004)** examine the relationship between the Australian real stock price index and the real measures of aggregate economic activity represented by macroeconomic variables, which includes the broadest money supply (M3), the GDP, the private personal consumption expenditures, and the world oil price index. They apply the **Johansen's (1990)** methodology, impulse response function analysis and forecast error variance decomposition in their analysis using quarterly data from 1960 to 1998. The results reveal the evidence of a long-run relationship between all the variables. The results of the error correction model indicate the existence of a relationship between the real returns and the changes in the real macroeconomic variables, along with deviations from the observed long-run relationships. But, the IRF and VDC analyses show weak evidence for the relationship

between the Australian real stock price index and all the selected variables included in their analysis.

**Funke et al (2002)** inspect the German market by using a set of economic variables; they study the impact of the news regarding the macroeconomic variables on stock prices in the US and Germany. They use the GARCH procedure along with daily data from January 1997 to June 2002. They conclude that the state of the economy plays a crucial role in stock price volatility. Regarding the German context, they find that international and local news regarding macroeconomic variables impact identically the German stock price fluctuations.

# **3.4.6 Effects of 2008 Financial Crisis on the Economy (Objective 6)**

The below literatures are relevant as they investigate the effects of the 2008 financial crises on the economy which is the central element within objective 6.

The global economy has suffered numerous financial crises during the last decades, and the most recent economic and financial crisis developed starting from July 2007 in the United States. The crisis is directly related to the mortgages called "subprime", with variable interest rates, granted to the U.S. households with modest incomes. The mortgage brokers are attracted by large commissions and encouraged buyers with poor creditworthiness to accept housing mortgages with small or no down payments. The dramatic decrease in housing prices coupled with the increase in interest rates has made the payment almost impossible for many households resulting in many foreclosures.

This combined housing price and interest rate trend captured the whole US financial market through the chain of the mortgage-backed securities resulting in a contagion effect and thereby causing insolvency and bankruptcy of several US financial institutions or organisations. Furthermore, the recent financial crisis turned from the financial crisis on a local specific market segment (sector loans) into a global financial and economic crisis at an

extremely rapid pace spreading to other international economies through the contagion effect and generating considerable financial and economic losses (Aka, 2009).

Artus et al. (2008) argues that the crisis spread largely due to the securitisation of mortgage loans made by the U.S. financial institutions, who marketed such complex and opaque instruments directly on the international financial markets in the form of assets specialised in investment vehicles. Due to the globalisation of the world economies and the narrowness of the interconnections of international financial markets, the mortgage crisis in the U.S. led to a rapid contagion through certain channels and became a global economic and financial crisis that affected both the developed and the emerging countries and led to difficult international economic situations that are characterised by drastic decline in GDP and high fiscal costs. The financial crisis also prompted liquidity crisis in banks and a sharp depreciation of stock market returns of the key financial centres.

**Chong (2011)** analyses the effects of the recent financial crisis on the American stock exchange and reveals that the S&P500 index dividend yield is affected significantly and negatively after the bankruptcy of the U.S. investment bank Lehman Brothers.

Aweda (2013) investigates the short- and long-term causal relationship between the FTSE100 and a few macrocosmic variables such as the money supply, the industrial production index, the short-term interest rates, the exchange rate, the unemployment rate and the consumer price index. The research also considers the impact of the 2008 financial crisis by incorporating a dummy variable representing the crisis in analysis. The results reveal that it takes longer for the stock market returns to recover their long-term equilibrium in the UK than in the US. Moreover, the FTSE100 and industrial production, short-term interest rates and unemployment rate have no significant relationship with one another in the short-term. The discussed literature

is relevant to our research as it also investigates the effects of the 2008 financial crises on the economy.

**Junkin (2011)** investigates the effect of the financial crises and the macroeconomic variables on the stock prices for South Africa. He uses monthly data for the period 1995 to 2010, which is composed of the consumer price index, the money supply, the price of Brent crude oil, the industrial production, the US GDP, the exchange rate, the treasury bills and finally the dummy variable representing the East Asian crises of 1998 as independent variables. The results show that South African stock returns are highly impacted by the macroeconomic variables. Inflation is found to have a positive relationship with all the selected indexes, except for the industrial index, where the relationship is estimated as negative. Past financial crises had a significant effect on certain sectors of the economy, especially on the pharmaceutical industry.

The 2008 financial crisis also negatively affected the FTSE100 index, a European index as pointed out by **Neaime (2012)**, who argues that the British stock market highly correlates with the U.S. and French stock markets. This index is characterised by low yield and high volatility in the late 2000s due to its direct exposure to the impact of the crisis.

**Kassim et al. (2011)** investigate the influence of the financial crisis on the Malaysian stock exchange, and concludes that during the crisis period the stock prices are characterised by high volatility and significantly negative stock returns as a result of the high correlation degree between the Malaysian and the American Stock Exchanges.

**Neaime (2012)** analyses and concludes that the Saudi stock market has not been affected by the financial crisis. This analysis is explained by the closed and regulated market, as well as by the establishment of appropriate mechanisms of foreign exchange reserves and strong fiscal stance.

Other international stock markets are also affected by the financial crisis; the Tokyo Stock Exchange is one of the victims as well. After experiencing a period of economic growth from the mid-2000s, the Nikkei 225 index declined with the spread of the subprime crisis on the global scale.

**Naoui et al. (2010)** investigate the influence of the 2008 financial crisis on stock prices of ten different emerging markets, which are Argentina, Korea, Brazil, Hong Kong, Indonesia, Malaysia, Taiwan, Mexico, Shanghai and Singapore, and the American market. Their analysis is based on the correlation between the stock markets, and employs the DCC GARCH (1.1) model (Dynamic Conditional Correlation GARCH) to analyse the effects of the contagion of the subprime crisis on the stock markets. Their empirical results classify the markets into three groups depending on the degree of correlation of these markets with the U.S. stock market. The first group includes markets with strong correlation, while the second includes countries with average correlation and the third set of countries have low correlation. They conclude that the financial crisis negatively affects the developed stock markets of the first and the second groups, but the third group did not seem to be significantly affected by the financial crisis.

Witt and Setastion (2010) also explain the causes and the transmission channels of the financial crisis. They employ daily data of eighteen countries' stock market indices and divide them into two stages, the pre-crisis period and the crisis period. The data estimation of their model is based on the DCC GARCH methodology. Their empirical results show that banks' stability is a key factor for the spread and strengthening of the external shocks on the financial markets. They reveal that the significant increase in the correlation between the markets may lead to negative impacts on the stock returns. The reason is the instability of the international banking system.

**Kassim et al. (2011)** analyse the effect of the subprime crisis on the Malaysian stock market. Their analysis involves both the benchmark and the sectorial indices, such as finance, manufacturing, property, consumer and industrial products. They use sample periods before and during the 2007 sub-prime crisis. They consider the relationship between the Malaysian stock market and the Japanese and U.S. stock markets. They focus on the Malaysian stock exchange during the financial crisis by examining the integration with the Japanese and American Stock Exchanges. Their results indicate that the markets are very volatile with significant negative stock returns, which is reflected through the high correlation of the Malaysian stock exchange with the U.S. stock market during the financial crisis.

**Kim et al. (2011)** examine the impact of the financial crisis on five emerging Asian countries, which are Korea, Taiwan, Thailand, Indonesia and Philippines. They estimate dynamic conditional correlations of financial asset returns across countries by an array of multivariate GARCH models. The estimation results reveal the emerging Asian markets to be very vulnerable and fragile. They agree that this result confirms the existence of the financial contagion around the collapse of Lehman Brothers in September 2008.

**Mohd Sidek and Abdul-Rahman (2011)** analyse the impact of the 2008 financial crisis on five Asian stock markets as well, which are Malaysia, Singapore, Thailand, Philippines, and Indonesia, for empirically testing their performances during this period. They reveal in their analysis that the financial crisis has negative impact on the stock prices in the sample markets. They conclude that these results indicate the importance of the financial channel, which includes the stock market, in the transmission of shocks from the U.S. economy into Asian economies.

**Chong (2011)** also investigates the impact of the subprime crisis on the US stock market volatility and performance. He employs the GARCH and ARMA processes in his model

and uses daily data of S&P 100 for a sample period of 2006 to 2009, which is divided into three periods. These three periods: the pre-crisis period of 2006 to 2007; the period of crisis from 2007 to 2008; and the post-crisis period of 2009 to 2010; are studied in order to compare the US stock market index performance and volatility in different times. His results indicate that the American financial market is the most sophisticated market, and is mostly exposed to the shocks of the financial crisis. The negative stock returns, record during the crisis, are due to the volatility and shocks caused by the bankruptcy of Lehman Brothers in 2008.

**Chihi-Bouaziz et al. (2012)** consider the contagion impact of the American stock market on the other developed stock markets. They employ a DCC multivariate GARCH model and divided the sample period into three periods: the full period; the pre-crisis period and the crisis period. The results reveal that all the return series are simultaneously in the same regime, which proves the possibility of the existence of contagion between markets. Their results also indicate Volatility spillovers only in the full period and during the crisis. They find the increasing correlation to be highly significant in the developed countries' markets during the crisis period, which is a clear sign of crisis contagion.

**Neaime (2012)** examines the transmission channels of the global financial crisis on the MENA region. The researcher employs the GARCH, TARCH and ARCH-M models in her analysis. The sample consists of daily observations of the national indices of the US (S&P 500), UK (FTSE 100) and France (CAC 40), as well as the 7 MENA major stock market indices, which are Egypt (EGX 30), Jordan (Amman Stock Exchange), Morocco (MADEX), Kuwait (Kuwait Stock Market Index), Saudi Arabia (Tadawul all Stock Index), Tunisia (Tunindex) and the UAE's Dubai Financial Market General Index (DFMGI: IND). The researcher uses sample data for the period of January 1, 2007 to December 31, 2010.

The examination of the results shows that most countries in the region are affected, as they are correlated with the developed countries that are mostly affected by the financial crisis, with the exception of the Tunisia and Saudi Arabia, which are less affected due to the establishment of appropriate mechanisms of foreign exchange reserves and strong fiscal stance. The results further reveal that the stock markets of Dubai, Egypt, Jordan, and Kuwait are highly correlated with the U.S. stock market, while Tunisia and Morocco are highly correlated with the French stock market, with the exception of Saudi Arabia, which has a weak correlation with the developed equity markets.

**Rachdi et al (2013)** examine the effects of the global financial crisis on the stock market return using the daily returns of the Tunindex Tunisian index during the sample period of 2005 to 2010. The results indicate that the crisis has no direct impact on the Tunisian stock market, even though Tunindex was affected only during the late 2008 and early 2009. This, in fact, implies that the Tunisian stock indexless was affected by the crisis. The results further reveal that at the beginning of 2009 the index recovers its losses by recording an annual increase in its return as a result of its low market integration, as well as the international financial policy and mechanisms undertaken. This means that the Tunisia Stock Exchange is safe from the financial crisis, which is due to its low correlation with the U.S. financial market, the establishment of appropriate mechanisms of foreign exchange reserves, and the strong fiscal stance.

# **3.4.7 Effects of the US Quantitative Easing Policy on the Economy (Objective 7)**

The below selected researches are in line with seventh objective of this study as they consider the potential effect of the quantitative easing, a fiscal and monetary policy, on stock market indices.

Aweda (2013) estimates the statistical long-term and short-term causal relationship between the US S&P500 index and six macroeconomic variables, namely the industrial production, the short-term interest rates, the exchange rate, the consumer price index, the unemployment rate and the money supply. They apply the cointegration test, and document a significant relationship between the stock market index and the selected macroeconomic variables. Interestingly, they document that Quantitative Easing or Large-Scale Assets' Purchases adopted by the Federal Reserve had a positive impact on the S&P500 stock market returns. This is in line with the seventh objective of this research.

**Kurihara (2006)** investigates the effects of quantitative easing and the relationships between the macroeconomic variables and the stock prices in Japan. He concludes that the Bank of Japan's policy designed for overcoming the recession and deflation has been effective.

Japan experienced an unprecedented recession and deflation for more than a decade and has employed aggressive fiscal policy under severe budget constraints in the 1990s with exception of 1995 to 1997. The Bank of Japan enforced unprecedented monetary policy that declined the interbank interest rate to the nearest zero to overcome the unfavourable economic situations. The Bank of Japan adopted the "zero interest rate policy" from February 1999 to August 2000, as it decided to "flexibly provide ample funds and encourage the uncollateralised overnight call rate to move as low as possible" in February 1999 to avoid the possible intensification of deflationary pressure and to ensure that the economic downtown would come to a halt.

In April 1999, the Bank of Japan subsequently declared its commitment to the "zero interest rate policy" until deflationary pressures dispelled. Fjiki and Shiratsuka (2002) argue that the policy is intended to stabilise interest rates by influencing the market expectations regarding the future course of the monetary policy actions. The introduction of the "zero

interest rate policy" created an economic recovery atmosphere. But the Bank of Japan halted the "zero interest rate policy" and encouraged the uncollateralised overnight interest call rate to increase on average. This decision of the Bank of Japan caused the economy to decline again. The Bank of Japan then adopted a more aggressive monetary easing policy on the 19<sup>th</sup> of March 2001. It decided to increase the outstanding balance of the current accounts at the Bank by one trillion yen to around 5 trillion yen. This act or policy execution is known as the quantitative easing. The main operating target for money market operations changed from the uncollateralised overnight call rate to the outstanding balance of the current account at the Bank of Japan. There have been increases in the target of the current account balance since then with the current upper limit level of 30-35 trillion yen.

Under the new procedures, the BOJ provides ample liquidity, and the uncollateralised overnight call rate is determined in the market at a certain low level below the ceiling set by Lombard-type lending facilities. However, there has been debate and dispute over the effectiveness of the quantitative easing and whether the current economic recovery is as a result of the quantitative easing.

# **3.4.8** Financial Market Interaction or Integration (Objective 8)

The below authors and researches shares much with the intentions of Objective 8 which focus on understanding stock market integration in the context of the selected countries. Therefore, are of present relevance for the presence thesis.

**Stulz (1981)** says that stock markets can be integrated "if assets with perfectly correlated returns have the same price, regardless of the location in which they trade." However, **Jorion and Schwartz (1986)** define a fully integrated market as 'a situation, where investors earn the same risk-adjusted expected return on similar financial instruments in different national markets'; this implies that the arbitrage profit becomes impossible to achieve.

Financial market integration gives opportunities to firms, corporations and investors to allocate some share of their portfolio in other countries stock markets, which may increase the portfolio's expected return without increasing the risk. This is one benefit of the international diversification as investors and firms can allocate some of their wealth in other foreign markets. Hence, the understanding of the importance of the international stock market correlations in the current growing global economy has become a vital instrument for investors, who wish to receive diversification benefits on the global basis.

However, in order to have an efficient and effective international portfolio diversification, these institutional and individual investors must determine the stock price fluctuations and behaviours of the potential international stock markets, as well as identify the stock prices that move together. Hence, they investigate and analyse the correlation structure and the interdependencies among the share prices of the international stock market.

Even though there already exists some literature that provides mixed evidence on the inter-relationship of major stock price indexes in the world, a few or no literature exists on uncovering the stock market integration between the selected sample of the countries discussed in this current research. Thus, this is a potential gap in the existing literature body that the current research is proposed to fill.

**Everaert and Pozzi (2014)** investigate the financial market integration for sixteen different European countries. They use a panel of stock market monthly returns over a sample period of 1970 to 2012. This period is crucial to this research, as it contains the sample research period for this current research, which is from 1990 to 2010. Their analysis is based on an international CAPM with local investments equity. The risk premiums are decomposed into a country-specific and a common European component. **Abiad et al (2008)** argue that most European economies implement financial reforms from the 1980s onward.

Some of these financial reforms are related to interest rates, liberalisation, credit and capital control relaxation, and banking and securities market reforms. **Everaert and Pozzi** (2014) argue that the European countries became almost fully liberalised in the 1990s as a result of the implementation of the reforms. They use the Bayesian estimation of a dynamic factor model with time varying factor loadings and stochastic volatilities in their analysis.

The analysis allows an explicit focus on time to varying financial market integration in Europe. Their analysis involves the correction of the financial market integration for a potential volatility bias. The results reveal an increase in stock market integration in all European countries over the sample period. But different countries illustrate different evolution; some countries experience modest increases, while others experience more rapid integration. The results further reveal that the stock market integration follows a rapid increasing trend in case of financial liberalisation. The analysis also indicates that the increasing trend in financial market integration ends in almost all the countries after the global financial crisis of 2007. Moreover, their research suggests that the level of the financial market integration as expected for the European Union member and Euro area, was neither higher nor stronger compared to non-European members and non-Euro areas. Thus, they conclude that the geographical proximity and the similarity of economic conditions may have been the important catalyst of financial market integration rather than the European economic and monetary unification. Hence, the increase in financial integration may have occurred mainly due to the globalisation of the world economies for the European countries despite the European political leaders' efforts to improve European market integration through European market and monetary unification.

Nikkinen et al (2006) also investigate the degree of integration of the global stock market economy with US macroeconomic news announcements. Both investors in U.S. and non-U.S. stock markets are interested in those news releases.

The general importance of the analysis is that the response to this news by the stock market investors is expected to vary across economic regions due to differences in dependence on international trade, market size, foreign ownership and the industrial and economic structures. Nikkinen et al (2006) analyse the behaviour of GARCH volatilities around ten important scheduled U.S. macroeconomic news announcements on 35 different local stock markets, which are divided in six regions. Their results indicate that the G7 countries, the European countries other than G7 countries, as well as the developed and emerging Asian countries are closely integrated with respect to the U.S. macroeconomic news. They further reveal that the Latin America and Transition economies are not influenced by the U.S. news. Their results support and are in line with the earlier studies, such as those by Bekaert and Harvey (1995) and Rockinger and Urga (2001) concluding that the market integration is high among the major stock markets, while some emerging markets are segmented. This implies that the international investors can acquire and obtain diversification benefits by investing in those segmented emerging regions or economies.

**Arshanapelli and Doukas (1993)** investigate the linkages and dynamic interactions among the specific stock market movements. They use co-integration theories from previous studies to provide new method of testing these interactions among financial markets. Their sample period is based on the post-October 1987 period. Their analysis is in contrast to other previous studies, which discovers strong interdependence among the national stock prices prior October 1987.

However, **Arshanapelli and Doukas (1993)** results reveal the Nikkei index to be the only exception. The results further indicate that the US stock market considerably impacts the German, French and the English markets in the post-crash period of 1987. They also find that the German, English and French markets' responses to the US stock market innovations is consistent with the view of the cross border informational efficient stock markets. They finally conclude that the performance of the equity market has no linkage with the stock market during the pre and post October period.

**Tripathi and Sethi (2012)** examine the short-run and long-run inter-linkages of the Indian stock market with the following advanced emerging markets; Brazil, Hungary, Taiwan, Mexico, Poland, and South Africa, over the period ranging from January 1, 1992, to December 31, 2009. They show that the short-run and long-run inter-linkages of the Indian stock market with other markets have increased over the research period. Unidirectional causality is found in most cases.

Agrawal (2000) concludes in his research that there is a lot of scope for the Indian stock market to integrate with the world market after having discovered a correlation coefficient of 0.01 between India and other developed markets. By utilising the Granger causality relationship, multiple and fractional co-integration model in their analysis, Wong, Agarwal and Du (2005) reveal that the Indian stock market is integrated with the matured markets of the World. Nathand Verma (2003) also tests for co-integration between the Nifty, STI and Taiex, but they discovered no evidence in favour of the co-integration.

**Raj and Dhal (2008)** by utilising the correlation tests, the vector error correction (VECM) and cointegration models in their analysis to gauge the integration of India's stock market with the global markets, such as the United States, Japan, the United Kingdom, Singapore and Hong Kong. They investigate the presence of co-integration by using a sample

period of 1993 to 2008 and sub-periods of 1993 to 2002 and 2003 to 2008 with different viz., weekly and daily data sets. Their empirical results show the presence of international integration of the Indian stock market in terms of US dollars, but not in terms of local currency; a discovery that is attributable to investment decisions of foreign investors. Their correlations result of daily stock price indices and returns suggest a strengthening of the Indian stock market integration with global and regional markets in the more recent period since 2003. Their results further reveal the evidence of differential effects of regional and global stock markets on the Indian stock market in both the long run and the short run.

The size of the coefficients of the long-run co-integration relation indicates that the Indian market's dependence on global markets, such as the US and the UK, is substantially higher than that of Singapore and Hong Kong. The innovation analysis in the VECM model for the more recent period indicates that the international market developments at both regional and global levels together could account for the total variation bulk in the Indian stock market.

**Palamalia et al (2013)** argues that over the last three decades, the degree of integration of the stock markets around the world increased significantly as a result of market liberalisation, rapid technological progress, and financial innovations. They argue that these financial and economic activities created new investments and financing opportunities for businesses, firms and investors around the world. They investigate the stock market integration among major stock markets of emerging Asia-Pacific economies, viz., India, Hong Kong, Malaysia, Taiwan, Singapore, South Korea, Indonesia, Japan and China. They employ the **Johansen and Juselius (1990)** multivariate co-integration test, Granger causality/Block exogeneity Wald test based on VECM approach, and variance decomposition analysis in their model to investigate the dynamic linkages between the stock markets. Their co-integration test results indicate the existence of a well-defined long-run equilibrium relationship among the

major stock markets. This implies that common force existed, such as arbitrage activity, which brings these stock markets together in the long run.

These findings are consistent with **Jang and Sul (2002)** and **Choudhry and Lin (2004)** studies, as their studies also reveal the presence of a significant long-run relationship between the emerging Asian equity markets. **Palamalia et al (2013)** applies Granger causality/Block exogeneity Wald test based on VECM and variance decomposition analysis, and the results indicated the existence of the stock market interdependencies and dynamic interactions among the selected emerging Asia-Pacific economies. This means that investors are able to gain feasible benefits from international portfolio diversification in the short run. They conclude that the benefits of exposure of the long-term diversification to these international markets might be limited, and the short-run benefits might exist as a result of the substantial transitory fluctuations.

# **3.4.9 Effects of Shocks from Macroeconomic Variables to Stock Market & Reverse (Objective 9)**

The below research relates to Objective 9 of this research as they study the dynamic effects of shock from macroeconomic variables on the stock market and vice versa. Important researches are used to highlight previous findings in the field.

**Iglesias and Haughton (2011)** employ the structural VARs to examine the interaction between the monetary policy and the stock market. Their sample countries include Jamaica, Barbados and T&T. They tested for interaction between the macroeconomic variable and the stock markets for the sample countries both individually and jointly as the Caribbean countries. They collected annual data for Jamaica, T&T and the Caribbean, but used annual and monthly data for Barbados due to the constraints of data availability. Their results reveal negative effects of positive monetary policy shock on stock prices in Jamaica, Barbados, T&T and the

Caribbean using the annual data. The results also show that an increase in the interest rates decreases the expected future dividends payable on stocks, which decreases its present value. This particular result of the effect of monetary policy shock on the stock market has been backed up by other studies, such as those by **Bjornland and Leitemo (2009)**, which discovered a negative relationship between the monetary policy shock and the stock prices in the US.

**Iglesias and Haughton (2011)** further reveal that an increase in Treasury bill rate, due to a monetary policy shock, causes an immediate rise in prices in three sample countries individually and jointly. Other studies like **Bjornland and Leitemo (2009)** illustrate that this usual price puzzle is no surprise as it exists also in the US. They further reveal that the annual output in Jamaica and T&T fell as a result of a contractionary monetary policy. They further argue that for Barbados and the Caribbean jointly, an increase in the annual output occurs due to an increase in the interest rates. However, the results for the monthly analysis of Barbados reveal a decrease in the output in the first three months right after a positive monetary policy shock. Their research show that the stock price shock impacted the Treasury bill rate positively in Barbados, Jamaica, T&T and the Caribbean, as well as the magnitude of a monetary policy shock effect on the stock prices in the US is smaller, mainly due to different economic sizes and structures.

Li et al (2010) evaluate the economic significance of the stock prices in the transmission to domestic monetary policy shocks. They use Canada and the United States as their sample economies, and incorporated the stock prices into empirical monetary business-cycle models that featured open and closed economies respectively. They employ macroeconomic theories to impose short-run restrictions on the structural VAR models and to identify impulse reactions, which provide valuable economic insights. Their analysis reveals that the U.S. stock market declined by about 4% within seventeen months after the shock, and

Canada's stock market declined by about 0.8% within four months after the shock in response to an unanticipated 25 basis points rise in the interest rate. They further illustrate that these differences in the two different stock markets are mainly due to the different dynamic reaction of domestic short-term interest rates to monetary policy shocks. Canada's stock market response to the interest rate is rapid, but not very persistent, whereas United States' response is prolonged.

Their model acknowledges the differences in both trade and financial market openness between the two sample economies and the results showed that US monetary policy shocks have significant impact on the Canadian stock prices and contribute substantially to their volatility, but at a small pace. They note that the contribution of the external demand shocks to Canadian stock price volatility is very small. Li et al (2010) further suggests that the incorporation of the wealth effects into the empirical open economy's monetary business-cycle models is important in understanding the transmission of the monetary policy shocks on the stock markets, but their analysis did not include real estate and other forms of wealth.

**Sadorsky (1999)** analyses the effects of the oil price shocks, IP, and the interest rate on U.S. stock market returns using VAR model in his analysis. He uses monthly data from January 1947 to April 1996, and his results indicate that the positive oil shocks depress real stock returns, as well as the stock returns have a positive effect or influence on IP and interest rates. His research further reveals the evidence that the impact of the price of oil on the U.S. stock market returns is not constant over time, when compared to the impact of interest rate changes. He concludes that after 1986, particularly, the oil price movements explain a large portion of the forecast error variance in real stock returns. This relates to the last objective of the current research as they research the dynamic effects of the shock from the macroeconomic variables on the stock market and vice versa.

**Belgacem and Lihiani (2012)** find evidence of a direct reaction of French and German investors to some common, as well as specific macroeconomic news. They apply the GARCH technique to investigate the impact of US scheduled macroeconomic announcements on the French and German domestic markets. They use CAC40, DAX and S&P500 as dependent variables, while the consumer price index, unemployment, industrial production, gold price, PPI, CCE, HSS, TBE and MFG are used as explanatory variables.

# **3.4.10 Effects of Shock between Stock Market Indices (Objective 10)**

The selected researches below relate to the last Objective of this research as they study the dynamic effects of shock between stock market indices.

Lambertides et al (2013) study the impact of illiquidity shocks on the stock market return co-movement by extending the smooth transition conditional correlation model. They argue that the firms with shocks experiences that increase illiquidity are less liquid than the firms with shock experiences that decrease illiquidity. This is because shocks that increase illiquidity have no statistical impact or influence on co-movement. However, shocks that reduce illiquidity lead to a decrease in co-movement and this pattern becomes stronger as the illiquidity of the firm rises. Lambertides et al (2013) believe that this discovery is consistent with increased transparency and improvement in the efficiency of prices. They reveal that a small number of firms experienced double illiquidity shock. For these firms the first shock, an increase in illiquidity reduced co-movement, while a fall in illiquidity increased co-movement, and the second shock partly reverses these changes, as an increase in illiquidity is associated with an increase in co-movement and a decrease in illiquidity is associated with a decrease in co-movement. They argue that their results 'have important implications for the construction of portfolios, as well as for the measurement and evolution of market beta and the cost of capital, as it suggests that investors can achieve higher returns for the same amount of market

risk because of the greater diversification benefits that exist'. They also find illiquidity, friction, firm size and the pre-shock correlation to be associated with the magnitude of the correlation change.

**Bessler and Yang (2003)** examine nine major stock markets' dynamic structures. They employ an error correction model and directed acyclic graphs (DAG). The results from the DAG representation prove a structure of causality in contemporaneous time among these markets. They also apply the innovation accounting techniques and built on the contemporaneous structure and the estimated error correction model. The results from this test indicate that the Japanese stock market is among the most highly exogenous, while the Canadian and French stock markets are among the least exogenous in their nine selected stock markets. According to their results the United States stock market is highly influenced by its own historical innovations, as well as by the innovations of the stock markets of UK, Switzerland, Hong Kong, Germany and France. They further conclude that, in the long run, the US stock market is the only one that has a consistent strong effect on the price movements in other major stock markets.

**Soydemir (2000)** investigates the transmission patterns of stock market returns movements between developed and emerging market economies. They estimate a four-variable VAR model. They consider underlying economic fundamentals and trade links as possible determinants of differences in the transmission patterns. Their results of the impulse response functions and variance decomposition analysis indicate that there existed significant links between the stock markets of the USA and Mexico, but weaker links between the markets of the USA, Argentina, and Brazil. Their results also show that differences in the patterns of the stock market responses are consistent with the differences in trade flows. They further indicate that the shock response of the emerging markets to the US market lasts longer than the shock

response of a developed market, such as the UK, to the US market. They argue that the individual emerging markets has no form of impact on the US stock market, but rather their combined effects on the US stock market is statistically significant. They conclude that their findings could be linked to the differences in the information processing speed and to the institutional structure governing the stock market. They suggest that the transmission of the stock market movements is in accord with underlying economic fundamentals rather than with the irrational contagion effects.

Hammoudeh and Malik (2007) investigate the volatility and shock transmission mechanism among U.S. equities, global crude oil market, and the equity markets of Kuwait, Saudi Arabia, and Bahrain. They employ a multivariate-GARCH model in their research and use daily data over a sample period February 14, 1994 to December 25, 2001. Their results show that the equity markets of Kuwait, Saudi Arabia and Bahrain are influenced by the volatility of the world oil market. The results show that significant volatility spills over from the Saudi Arabia stock market to the oil market. They further revealed that the US equity market indirectly influenced the volatility in the three Gulf stock markets, emphasising the important link between the investments made by Gulf investors in the U.S. and in each of the three Gulf stock markets.

Sheng and Tu (2000) also examine the linkages among twelve Asia-Pacific stock markets before and during the Asian Financial Crisis period. They employ co-integration tests and variance decomposition analysis in their research. The Johansen (1988) multivariate co-integration and error-correction tests' results demonstrate evidences in support of the presence of co-integration relationships among the national stock market indices during the Asian Financial Crises and not before the crises. They further reveal that, during the crisis, the relationship within the South-eastern Asian countries seems stronger than that of within the

North-eastern Asian countries. The variance decomposition results reveal that the 'degree of exogenity' for all the stock market indices has been reduced, which implies that none of the countries are 'exogenous' to the financial crisis. Their Granger causality test results suggest that the US stock market still 'caused' some Asian markets during the period of crisis, thereby reflecting the US stock market's persisting dominant role.

**Diebold et al. (2009)** provide in their research a simple and intuitive measure of interdependence of asset returns and/or volatilities of nineteen global equity markets. They particularly formulate and examine precise and separate measures of *spillovers of returns* and *spillovers of volatility*. Their framework facilitates the research of both the crisis and non-crisis periods. This includes trends and bursts in spillovers and both turn out to be empirically significant. Their results find striking evidence of divergent behaviour in the dynamics of spillovers of returns vs. spillovers of volatility, as the return spillovers display gently increasing trend but no bursts, whereas volatility spillovers shows no trend but clear bursts.

**Phylaktis and Ravazzolo (2002)** employ **Kasa's (1992) methodology** to analyse the potential inter-relationships amongst the trending behaviour of the stock price indices of a group of Pacific-Basin countries, Japan and US, using the sample period from 1980 to 1998. Their analysis indicates that the international investors have opportunities to diversify their portfolio by investing in most of the Pacific Basin countries, since short-run benefits exist because of the substantial transitory fluctuations. The results also reveal that while the US stock markets played a small by its magnitude role, the Japanese markets played a more significant role, however, neither Japan, nor US has any unique impact on the Pacific Basin stock markets. There are also other studies on how stock markets of one country influence the stock markets of other countries. **Ghosh, Saidi, and Johnson (1999)** investigate, whether nine Asia-Pacific markets are separately co-integrated with either the US or Japanese stock market. Their results
suggest that some markets are co-integrated with the US, some with the Japanese market, and the rest are not co-integrated with either of the selected economies. They use daily data over a sample period of only nine months in 1997. **Sheng and Tu (2000)** disclose that the cointegration relationship among the twelve Pacific nations, which includes Taiwan and the US, did not exist in the stock markets before the Asian financial crisis of 1997. Their variance decomposition analysis further indicates that none of the sampled economies has the exogenous characteristics that verify the existence of the contagion effect during the financial crisis. At the same time, the causality tests indicate that the US indices are the leading factors influencing the other nations' stock market performance.

Through employing the Vector Auto-Regression (VAR) model to examine and analyse the causal relationship and shock response, **Nagayasu (2001)** discovers that Thailand's currency crisis has contagion effect on the industrial indices in Philippine's stock market via foreign exchange rate. **Yang and Lim (2002)** conduct an empirical research of nine East Asian stock markets over a sample period of January 1990 to October 2000. They discover some evidence of short-term linkages. Their results indicate that there is a significant difference between the sub-periods of pre- and (during/) post-Asian crisis, with an overall improvement of correlation coefficients for each pair of markets from the pre-crisis to the post crisis period, except for Taiwan and Malaysia. It is worth mentioning that their results capturing the long run period proved the opposite; the existence of the evidence of co-movement among East Asian stock markets, as the absence of co-integration in the post-crisis period rules out the existence of a long-term equilibrium trending relationship among the East Asian markets. **Kiran and Mukhopadhyay (2002)** conduct further research, as they employ a two-stage GARCH model and an ARMA-GARCH model to capture the mechanism by which NASDAQ daytime returns influence both the mean and conditional volatility of Nifty overnight returns. **Ignatius (1998)** 

compares the returns on the BSE Sensex with those of the NYSE S&P 500 Index and reveals no evidence of integration between them. **Appendix 4 (volume 2, pages 28-43)** presents the tabular summary of the empirical literature review.

# **3.5 Select Literature on the Countries of This Research**

There have been several studies in the past that try to investigate and analyse the degree of response of the stock market to the fluctuations in the macroeconomic variables, or in other words, the effect of the macroeconomic variables on the stock market. The next sub-chapter of this research highlights the studies and researches that are conducted on the selected economics used in this research. The selected sample countries or economies used in this analysis are classified into BRICS and DEVELOPED economies.

## **3.5.1 Researches Related to the BRICS Economies**

Several studies have been conducted in the emerging markets. However, few focused on the BRICS economies as main scope which coincide with the present thesis and are cited below.

**Gupta (2011)** investigates the dynamic economic relationship among the emerging countries particularly BRIC countries. His attempt to enumerate the inter-relationship or integration between these BRIC countries shows that the economies of India, Russia, and China Granger causes the Brazilian economy, moreover Russia does not granger cause the Indian economy, while Indian economy granger causes the Russian economy. **Sharma et al. (2013)** also premeditate the Inter-linkages between Brazilian, Russian, Indian, Chinese, and South African stock markets. They use the benchmark indices of these countries stock exchanges and reveal that all the BRICS stock markets are influenced by each other.

Agrawalla and Tuteja (2007) disclose evidence of the existence of a stable long run equilibrium relationship between the India's economic growth and its stock market

developments. **Hosseini et al (2011)** reveal in their analysis that both long and short run relationship between macroeconomic indicators and stock market indices exist in China and India, and they apply the following macroeconomic variables; crude oil prices, money supply and industrial production.

There are various recent studies that investigate the relationship between the macroeconomic variables and the South African stock market as an emerging economy. **Yu Hsing (2011)** investigates and analysed the effects and impacts of some selected macroeconomic variables on the South African stock market index. He employs the exponential GARCH (Nelson, 1991) model in this analysis and reveals that the real GDP growth rate has a positive impact on the South African index. The ratio of the money supply to GDP and the U.S. stock market index positively influences the South African index, as well. But government deficit ratio to GDP, the domestic inflation and the real interest rate, as well as the nominal effective exchange rate and the U.S. government bond yield have negative effects on the South African stock index. **Hsing (2011)** further concludes that the government or economic policy designers for the South African economy must pursue economic growth, fiscal prudence, a higher ratio of the money supply to GDP, a lower real interest rate, depreciation of the rand, and/or a lower inflation rate in order to achieve and maintain a robust stock market.

Jefferis and Okeahalam (2000) examine the interaction between the stock market prices and some selected economic variables for three African countries, which are South Africa, Zimbabwe and Botswana. Their studies for the South African economy indicate the existence of a positive impact of the real GDP and the real exchange rate on the stock market of South Africa, but disclose the negative influence of the long-term interest rate on the South African index. Alam and Uddin (2009) confirm this result, as they also examine the

relationship between stock prices and interest rates for 15 countries. For the South Africa economy, their results show that changes in stock prices are significantly influenced by the changes in interest rates, implying that the South African stock market is significantly influenced by the interest rates.

Tabak (2006) analyses the dynamic relation between the stock prices and the exchange rate as the macroeconomic variable in Brazilian economy, and his analysis indicates that there is no long-term relationship between the two variables. Mensi et al (2014) investigate the dependence structure between the emerging stock markets of the BRICS economies and other global factors, such as the S&P 500 index, the commodity markets, the global stock market uncertainty and the US economic policy uncertainty that may influence the global market. They use quantile regression approach in their model. Their results show that the BRICS stock markets exhibit signs of asymmetric dependence with the global stock market and this dependence has not changed since the onset of the recent global financial crisis.

Other studies like **Chinzara and Aziakpono (2009)** and **Chinzara (2011)** focus on the relationship between the macroeconomic uncertainty and the South African's stock market volatility. Both studies indicate that the uncertainty of the macroeconomic variables and activities significantly influence the performances of the South African stock market. **Chinzara and Aziakpono (2009)** conclude that there is a significant linkage between the South African stock market volatility and those of Chinese, Australian and US markets. This implies that market integration exists between the South African market and some major international markets, and, thus, the crisis and other volatilities in these markets can be transferred to the South African market.

The effects of inflation, as a macroeconomic variable, on the South African index has been discussed by other notable scholars like Alagidede and Panagiotidis (2010) and

**Chatrath et al (2010).** Both studies agree that the stock prices are not affected by the permanent changes in inflation rate in the long run, and that any deviation or changes in stock prices in the short run is adjusted towards real stock prices in the long run. This implies that in the long run stock prices are a hedge against inflation.

**Bhattacharya et al (2001)** analyse the causal relationship between the Indian stock market and three macroeconomic variables. They use the Granger causality analysis on the following macroeconomic variables: exchange rate, foreign exchange reserves and trade balance. The research suggests that no causal linkage or relationship existed between the stock prices and the three selected macroeconomic variables analysed in their model.

**Ray Sarbapriya (2012)** employ a simple linear regression model and Granger causality test in his research to measure the relationship between the Indian foreign exchange reserves and stock market capitalisation. His analysis reveals that causality is unidirectional and runs from foreign exchange reserve to stock market capitalisation. The results further indicate that foreign exchange reserves positively influence the Indian stock market capitalisation.

## **3.5.2** Research Related to Selected Developed Countries

In the developed countries context, major and important studies have taken place. Few of them are presented below as this present thesis also investigated some selected developed economies.

**Talla (2013)** investigates the effects of changes in selected macroeconomic variables on the Stockholm Stock Exchange (OMXS30) index. The researcher employs the unit root test, Multivariate Regression Model computed on Standard Ordinary Linear Square (OLS) method and Granger causality test to estimate the relationship in her analysis using monthly data for a sample period of 1993 to 2012. The estimated regression coefficients and t-statistics results disclose that both inflation and currency depreciation have significant negative impacts on the

stock prices. The results further indicate that the interest rates are negatively related to the stock price changes, but not significant enough as in case of inflation and exchange rate. The research concludes that the money supply, on the other hand, has positive relationship with the stock prices, however, the impact is not significant. **Choo et al (2011)** investigate the macroeconomics determinants or indicators that affect the Nikkei 225 Index volatility. They employ the GARCH (1, 1) model in their analysis. Evidences from their research suggest that uncertainty in the macroeconomics variables does not explain the Nikkei 225 Index volatility.

**Mahedi (2012)** investigates the long-run relationship and the short-run dynamics among the macroeconomic variables and the stock returns of German and UK economies. He utilises the Johansen Co-integration test in his model to indicate the co-integrating relationship between the macroeconomic variables and the stock prices. After he used the error-correction model to investigate the short-term and long-term casual relationships and individually examined them.

For the German economy, the results indicate that the short-run causality runs from the stock returns to inflation, from money supply to stock returns and from industrial production to stock returns. The long-run causality, on the other hand, runs from inflation to stock returns and from exchange rate to stock returns. There is only one both short-run and long-run relationship, which is directed from the stock returns to industrial production.

For the UK economy, his research reveals that the short run causality runs from stock returns to T-bill, from stock returns to money supply, from stock returns to exchange rate, from exchange rate to fifteen stock returns and stock returns to industrial production. While the long run causality runs from inflation to stock returns. The results further reveal that both short-run and long-run causal relationships run from stock returns to inflation, from money supply to stock returns and from industrial production to stock returns. These results indicate the

existence of the short-run interactions and the long-term causal relationship between the German and UK stock markets and the macroeconomic determinants.

**Humpe and Macmillan (2009)** utilise the framework of a standard discounted value model and examine the influences of a selected number of macroeconomic variables on the Japanese and US stock prices. They employ the cointegration analysis in their model to determine the long-term relationship between industrial production, money supply, the consumer price index, long-term interest rates and the stock prices in the US and Japanese economies.

For the US, their analysis reveals that the data are consistent with a single co-integrating vector, where stock prices are positively related to industrial production, but negatively related to both the consumer price index and the long-term interest rate. They further reveal that an insignificant positive relationship existed between the US stock prices and the money supply. However, for the Japanese data, they found two co-integrating vectors. For the first vector, the stock prices are influenced positively by the industrial production, but negatively by the money supply. While for the second co-integrating vector, the industrial production is negatively influenced by the consumer price index and the long-term interest rate. They conclude that the contrasting results may be the result of the slump in the Japanese economy during the 1990s and consequent liquidity trap.

**Park and Ratti (2008)** examine the effects of oil price shocks on the US economy and thirteen other European countries. They argue that oil price shocks have a statistically significant impact on the real stock returns contemporaneously. Their sample period is composed from January 1986 to December 2005. Their analysis reveals that for many European countries, except for the U.S., an increased volatility of oil prices significantly depresses the real stock returns. But the impact of the oil price shocks to variability in real

stock returns in the U.S. and most other countries is greater than the impact of interest rate. They further reveal that a rise in the real oil price is associated with a significant rise in the short-term interest rate in the U.S. and in eight among thirteen European countries within a month or two.

Other studies have been conducted on the developed economies to test and determine the degree of the influence the macroeconomic variables had on the stock market returns. One such kind of a research is done by **Apergis and Miller (2009)**. They investigate how explicit structural shocks, that characterise the endogenous character of oil price changes, influence the stock-market returns using a sample of eight countries, which are Australia, Canada, France, Germany, Italy, Japan, the United Kingdom and the United States. They employed a vector error–correction or vector autoregressive model to decompose oil-price changes into three components. These three components are: oil-supply shocks, global aggregate-demand shocks and global oil-demand shocks. Their analysis showed that international stock market returns do not react significantly to oil market shocks. This implies that some effects exist, but they are small in magnitude.

**Graham et al (2003)** investigate the relative importance of scheduled U.S. macroeconomic news releases for stock valuation in different economies. Their research focuses on eleven macroeconomic announcements selected on the basis of the previous literature and the Bureau of Labour Statistics classifications of major economic variables or indicators. Their analysis indicates that five of the eleven announcements significantly influence the stock valuation. These five macroeconomics news reports are the Employment Report, NAPM (manufacturing), Employment Cost Index, Producer Price Index and Import and Export Price Indices, and from the mentioned announcements, the Employment Report and NAPM (manufacturing) had the greatest influence. The time of the announcement is

measured by days from the beginning of the month to the release day and has a moderating impact on the relationship between macroeconomic announcements and its importance. **Appendix 5 (volume 2 pages 44-46)** present the tabular summary of the critical literature per set of selected country.

# **3.6. Evaluation of Prior Literature**

Literature focused in the field of linking stock market indices to macroeconomic variables, tends to be predominant within the developed economies. Indeed, their dynamic relationship has been the focus of several studies in the US, the UK and several other developed economies. For example, **Chen et al. (1986)** evaluate these variables within the US context. However, such research differs in terms of their formulated hypotheses and applied methodology. These differences enable one to classify and determine the research (chronologically) as follows:

- Research that focuses on the integration of both sets of variables: stock prices and macroeconomic variables. (Longin and Solnik (1995));
- Research that focuses on the predictive power of macroeconomic variables regarding stock prices. (Domian and Louton (1997));
- Research that investigates the long and short-term linkage between stock price returns and macroeconomic variables; (Humpe and Macmillan (2009))
- Research that seems to be much more directed towards examining the volatility of stock price returns. (Chong (2011))
- Research that concentrates on the determination of the economic factors that affect stock prices, (Yahyazadehfar and Babaie (2012))
- Research that analyses structural breaks using the two sets of variables, based on the linkage between stock price returns and macroeconomic variables. (Aweda (2013)).

The particularity of this present research benefits from each of the above-cited studies, leading to the identified literature gap, discussed in the next sub-chapter.

The review of the literature allows us to note the existence of prior studies that have employed varying theoretical models, coupled with varying methodological stances. The review also enables one to shed more light on the association and the relationship between stock prices and macroeconomic variables. Indeed, insights into and an understanding of the relationship between stock returns and macroeconomic indicators is crucial for both the governments and the policy-makers, as well as for the academic world. Additionally, such prior literature has contributed towards the development of a theory that can more accurately explain the relationship between economic indicators and stock prices. Currently, much interest is being directed towards the development of statistical models that can explain fluctuations in the stock price index for a particular country.

However, it is clear from the literature that the interest of researchers has varied over time. Earlier researchers focused on the type and the number of macroeconomic variables to use. Some researchers used either one macroeconomic variable or two (at most) to understand the relationship between the level of share prices and economic indicators. As an example, **Comincioli (1995)** studies the relationship between GDP and share price returns. In the same vein, **Gallegati (2005)** prefers a single factor model, using industrial production in order to understand the nature of the relationship between individual macroeconomic indicators and stock prices.

Later, Angela (2008) considered it of more benefit using two economic indicators, namely the oil price and GDP. At the opposite end, some studies use a larger number of economic indicators, according to the observation made by Tursoy et al. (2008). For instance, the research by Naceur et al. (2007), who employ ten economic indicators, can be cited.

However, it is worth noting that the question of the choice of economic indicators remains pertinent. Therefore, it is essential to make a selection of variables that could have an impact in determining the volatility of the stock prices. **Pilinkus and Boguslauskas (2009)** strongly recommend choosing a range of indicators that are directly linked to share price.

Another issue to be considered in the literature is the methodology used in the range of relevant research. Fama (1981) and Schwert (1990) highlight the APT as the theory potentially capable of explaining fundamental linkages between share price volatility and macroeconomic variables. However, modern techniques such as VECM/VAR have assumed a prominent place in the methods used to research the relationship between the economic indicators and stock prices. Particularly, cointegration tests have been used by researchers to understand the relationship between levels of share price changes and economic indicators. Abdullah and Hayworth (1993) and Chaudhri and Smiles (2004) use this technique to demonstrate the presence of integration between the variables. Makan and Saakshi (2012) have recently used the method of cointegration to determine the relationship between the economic indicators and stock price returns.

Furthermore, ARCH or GARCH models have also been widely used in their generalised form, with EGARCH and GARCH-M as extensions of the models. These models are used to capture the volatility of stock price movement. For example, the studies of **Kutan and Aksoy** (2003) and **Alshoggeathri (2011)** implement the procedure of ARCH to research and understand the volatility of the share price movements. Thus, the question of the volatility of the share price over the economic indicators is addressed through the use of the aforementioned models.

Of equal note is the fact that the literature demonstrates the interest that previous researchers have in building dynamic models, such as VAR or VECM. Such models are

developed on the basis of cointegration between macroeconomic variables and stock price indices. The literature review also shows that the techniques of cointegration and the VAR / VECM are used simultaneously. For example, **Hess (2003)**, combines cointegration and VECM in Switzerland in order to understand the effects of the macroeconomic variables on the stock price. The current research will also highlight the relationship between the stock price returns and the macroeconomic variables.

Finally, studies (Moraduglo et al (2000); Wenshwo (2002); Keug et al (2006) and Humpe and Macmillan (2009)) have also drawn comparisons between developed and lessdeveloped countries, either together or in contrast. Multiple studies (Moraduglo et al (2000); Wenshwo (2002); Keug et al (2006) and Humpe and Macmillan (2009)) are carried out in this scope, but they tend to contradict each other. The question of the relationship between stock prices and economic indicators has been substantively examined via market indices of developed countries. But these research suggest it is difficult to support with confidence the fact that the same is true within emerging or less-developed countries. And, it is this gap that gives impetus to the present research.

Several researchers have employed comparative methods. For example, **Moraduglo et al. (2000)** analyse 18 countries in their research (Greece, Korea, Argentina, Brazil, Chile, Colombia, India, Indonesia, Jordan, Malaysia, Mexico, Nigeria, Pakistan, Philippines, Portugal, Turkey, Venezuela and Zimbabwe). They use macroeconomic variables, such as interest rates, inflation, exchange rate and industrial production. Each country is represented by the main index in the local financial market. Using the Granger Causality Test, they conclude that the size of the market is essential when less-advanced economies are studied. **Wenshwo (2002)** uses the GARCH method to make a comparative research of Hong Kong, Singapore, South Korea, Taiwan and Thailand. The results show that there is a significant

relationship between the variables. **Keug et al. (2006)** focus on the United States and Singapore, using the cointegration test technique accompanied by the Granger Causality Test. They conclude that the macroeconomic variables and the share price index in the United States have a significant relationship in the long-term. **Humpe and Macmillan (2009)** have more recently studied two developed markets, Japan and the United States. They present similar results for the two advanced countries.

Thus, this present research is being developed as a comparative research between five leading developed countries, namely the United States, the United Kingdom, France, Japan and Germany, and the first five emerging economies (called BRICS), which are Brazil, Russia, India, China and South Africa. It is important to recall the literature search reveals that no other research has undertaken a comparative analysis of the ten selected countries examined in this research, with reference to the theory that suggests a linkage between share price returns and the economic indicators.

Today, with this in-depth tour of the literature, it is contended that the focus of recent research has been on trying to understand, whether the various financial crises have an impact on the determination of the stock prices. **Aweda (2013)**, who focuses on the effect of the crises on the US and the UK stock prices, documents that there is a significant impact of the 2008 crisis on the stock markets of the mentioned countries. The second new element in the literature has been to evaluate the impact of monetary or fiscal policy on the stock price returns or the stock market. Again, **Aweda (2013)** concludes that monetary policies, like quantitative easing, have an effect on the change in the stock prices in UK and US.

Finally, the literature review identifies that much attention is given to the relationship that exists between the financial markets. Researching the influence of one market on the other, or the interactions between them, has become a major issue for understanding the linkages

among the markets. **Tripathi and Sethi (2012)** review the interaction that exists among the financial markets of India, Brazil, Hungary, Taiwan, Mexico, Poland and South Africa. They demonstrate the existence of an interaction between the Indian market and the other markets in the research. Also, **Palamalai et al. (2013)**, who seek to explore the interaction among the selected financial markets, namely India, Malaysia, Hong Kong, Singapore, South Korea, Taiwan, Japan, China and Indonesia, conclude that the linkage between the selected financial markets is more effective in the short-term rather than in the long-term, therefore advising the investors to focus on defining portfolios on a short-term basis.

The current research also takes into account the aforementioned point, and highlights the existence of possible interactions within the financial markets selected for the research purposes.

### **3.7 Research Gaps**

Thus, having reviewed the identified literature, this research seeks to address an identified literature gap. An appropriately comprehensive literature review undertaken by the author suggests that there appears to be no study that comparatively takes regard for and/of the effects of the 2007-8 financial crisis between and across the BRICS and the five developed countries selected for this analysis in terms of their individual stock market indices. Accordingly, (inter alia), it analyses the effects of the 2007-8 financial crisis between the emerging BRICS and the five developed countries, selected specially for this analysis. Concurrently, the research tests the effects of US quantitative easing policy, undertaken during the crisis, on the financial markets of BRICS and the five selected developed countries. Equally, there appears to be little substantive research that analyses market integration between the developed countries and BRICS. In doing so, this research will be of importance to researchers, students and other investors.

Further, there appears to be very limited (or no) comparative research on the effects of US House Prices, applying the Error Correction Model, on the stock market indices of BRICS and developed countries. In doing so, this research breaks "new ground".

Finally, one observes that research that efficiently and effectively compares and studies the 2 sets of countries, which are the BRICS (Brazil, Russia, India, China and South Africa) and the five developed countries (USA, UK, Germany, Japan, and France), in a single research, analysed in this research appear to be absent.

As such, the current research tends to cover and effectively fill the aforementioned literature gaps. The adopted theoretical framework and the methodological approach/techniques used in the research are designed to comparatively investigate the financial markets indices of the BRICS and the selected developed countries.

In general, the literature reviewed in this thesis has a linear basis. However, one must not disregard other literature, which does not have a linear basis. In recognition of this, important nonlinear literature review has been reviewed and commented upon in the columnar table immediately following.

### **3.8 Chapter Summary**

The present chapter has helped expose and review important theoretical, terminological and empirical literature related to the research. It has allowed the researcher to reveal the research gaps and to give justifications on the potential contributions flow from the thesis. The current chapter also paves the way to develop the research design and methodology of the research. This is done in the next chapter, which describes the research design and methodology and details the overall methodological framework of the research.

No.	Authors	Years	Title	Country	Period	Stat.Test	Dep.Var	Ind. Var (s)	Author's objective	Results	Relevance to my
1	Ciner	2001	Energy shocks and financial markets: nonlinear linkages	US	09.10.1979 - 20.03.1990	- Linear Granger causality test - Nonlinear Granger causality test	S&P500	Oil prices	To examine linear and nonlinear the dynamic linkages between oil prices and the stock market.	The paper concluded that oil shocks affects stock index returns	Dynamic linkage
2	Hyde and Berin	2005	Nonlinear influences in the relationship between stock returns and the macroeconomy	Belgium, Canada, France, Germany, Ireland, Japan, UK and US	2.1980 – 12.2001	Smooth Transition Regression (STR) model	Stock market of selected countries	Short-term interest rate, long-term interest rate, inflation, exchange rate, industrial production growth and oil prices.	To examine the presence of nonlinear influences in the relationship between stock returns and the macroeconomy for eight selected countries	The paper evidences the presence of multiples regimes, except for Belgium. On the nonlinear basis, the research founds that interest rate and inflation are strong determinant of stock returns.	Use of stock indices and macroeconomic variables
3	Chuang et al	2009	Nonlinear market dynamics between stock returns and trading volume: empirical evidences from Asian stock markets	Hong Kong, Singapore, Taiwan and Korea	2.2002 – 12.2006	Smooth Transition Autoregressive (STAR) Models	Stock market of selected countries	Percentage change in trade volume	To examine whether there exist any nonlinear dynamic in Asian stock markets	The paper supports the presence of nonlinear dynamic between stock returns and trading volume.	Dynamic linkage

Table	3.2:	<b>Tabular Summary</b>	of Non-Linear	Dynamic	Linkages (1/2)
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No.	Authors	Years	Title	Country	Period	Stat.Test	Dep.Var	Ind. Var (s)	Author's objective	Results	Relevance to my
											research
4	Yilanci and Bozoklu	2015	Analysis of symmetric and asymmetric nonlinear causal relationship between stock prices and exchange rates for selected emerging market economies	Brazil, China, India, Russia, South Africa and Turkey	01.2000 – 09.2011	ADF, Mackey- Glass Model, Symmetric and Asymmetric causality, nonlinear causality	Stock market of selected countries	Exchange rates	To investigate the symmetric and asymmetric nonlinear causal relationship between exchanges rates and stock prices in the selected countries	Little evidence is provided regarding symmetric causality while the asymmetric causality provide strong evidences for the causal relationship	BRICS economies
5	Sakemoto	2017	The nonlinear dynamic relationship between stock prices and Exchanges Rates in Asian countries	Indonesia, Korea, Japan, Hong Kong, Malaysia, Philippines, Singapore and Thailand	2.11.1995 – 30.12.2013	ADF, Nonparametric Granger Causality Test and EGARCH Filter	Stock market of selected countries	Exchange rates	To explore nonlinear dynamic relationships between stock prices and exchange rates in Asian countries.	The paper found that the main source of nonlinearity is the volatility effects and these were substantial during the financial crises.	Dynamic linkage
6	Sumuya et al	2018	Econometrics testing on linear and nonlinear dynamic relation between stock prices and macroeconomy in China	China	01.1992 – 03.2017	Linear Granger causality, nonlinear Granger causality	China Stocks market	GDP, Inflation, Balance of trade, import and export trade, money supply, Li Keqiang index, Fixed assets investment, Above-scale industrial added value	To investigate the nonlinear and dynamic causal relationship between stock prices and macroeconomy	Results demonstrated that the nonlinear dynamic Granger is much stronger than linear Granger Causality	Dynamic linkage

Table 3.2: Tabular Summary of Non-Linear Dynamic Linkages (2/2)	Table	3.2:	Tabular	Summary	of Non-Line	ear Dynamic	Linkages	(2/2)
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# **Chapter IV**

## **Research Design and Methodology**

# 4.0 Introduction

Econometrics is described as the statistical manipulation and interpretation of economic data through the use of statistical software developed specifically for that purpose. Gujarati and Porter (2010, Page 1) state that "econometrics may be defined as the social science in which the tools of economic theory, mathematics, and statistical inference are applied to the analysis of economic phenomena". More related to the present thesis, Brooks (2002, Page 1) defines financial econometrics as "the application of statistical techniques to problems in finance. Financial econometrics can be useful for testing theories, determining asset prices or returns, testing hypotheses concerning the relationship between two variables, examining the effect on financial markets of changes in economic conditions, forecasting futures values of financial variables and for financial decision making".

In terms of the "**methodology of econometrics**", **Hoover (2005, Page 38)** states "it is not the study of particular econometric techniques, but a meta-study of how econometrics contributes to economic science. As such it is part of the philosophy of science". In this thesis, a comprehensive review of the literature, in terms of particular econometric techniques has been conducted. In that sense, the "ology" or philosophical science of the methods of several econometric techniques has been undertaken. And, in so doing, a form of meta-study has been undertaken. Accordingly, one can support the view that that the building of statistical models which use economic data in a particular organised manner and set of rules, accords with, and

takes regard for, the methodology of econometrics. **Hoover (2005, Pages 22-34)** distinguishes five main econometric methodological approaches which are:

- 1. The Cowles Commission
- 2. Vector Autoregressions
- 3. The LSE Approach
- 4. Calibration
- 5. Textbook Econometrics.

While four of the above econometric methodological approaches have not been applied in the present thesis, it does employ the Vector Autoregressions methodology, within which times series are an important feature. In relatively simple terms, Vector AutoRegression (VAR) is an econometric stochastic process that is utilised to explain the linear interlinkage between multiple time series and is duly employed within this research.

The previous chapter critically discussed prior relevant research issues and areas related to the objectives of this thesis. It presented some theoretical arguments such as EMH, CAPM and APT that underpin this research. In doing so, it discussed findings and results from prior relevant research that either support or negate such theoretical arguments. This chapter presents in some detail, an explanation of the research design and the methodology adopted in conducting this research. It also presents significant detail on the data relevant to this research. Furthermore, the chapter outlines the research paradigms, the epistemological and ontological positions adopted in the research strategies and approaches.

Precisely, this chapter presents key insights into the framework, design and methods of the research and is divided into several sub-chapters that discuss the research design, philosophy, approach, strategies, research choices and time horizon. It further presents and

discusses the variables used in the research, as well as the theoretical framework applied for selecting those variables.

### 4.1 Type of Research

This research is predominantly empirical in its context and the research paradigm employed is essentially positivist. The positivist objectives of this research have been established to test the hypothetical propositions in order to either accept or reject particular theoretical implications that emerge upon analysis of the data.

# 4.2 Conceptual Framework

This chapter of the research discusses the predominant conceptual research themes from the perspective of possible theoretical framework underpinning it. The main philosophical stance that influences the inductive or deductive approach, adopted when designing the empirical methodology is also discussed to demonstrate the philosophical stance of this research and the belief as to how knowledge is derived. The view of the world is critical in every research as it determines the outcome from a set of choices that are made in analysing a particular research and the expected outcomes of the research.

## 4.3 Research Design

The research design adopts a structural stance that is similar to the one suggested by **Saunders et al. (2016).** These authors provide an overall framework to use when conducting research. They use a six feature 'menu' to effectively and appropriately design their research. It is commonly referred to as the 'Research Onion'. This 'research onion', as developed by **Saunders** *et al.* (2016), illustrates the key issues that must be addressed when developing a research exercise. Similar to an onion, The **Saunders et al (2016)** 'research onion' consists of various layers and each layer of the onion describes or demonstrates a particular stage and/or issue of the research process. The 'research onion' provides a substantial and an effective

progression through which a research methodology can be established. **Bryman (2012)** argues that the usefulness of the 'research onion' lies in its adaptability feature for almost any type of research methodology and it can be used in a variety of contexts. A diagram of this 'research onion' is presented in **Figure 4.1** on the next page.



**Figure 4.1: Adapted Research Onion** 

Source: Author – Adapted from Saunders et al (2016)

Every aspect or stage of the overall process of this research was considered and the precise nature of every stage was pondered over and appropriately determined according to the **Saunders et al. (2016)** model. In analysing and evaluating the relevant aspects of this research,

its specific aims and objectives were considered. Thus, the research presents a schematic representation of various research choices used in this research. The position of this research is designed in accordance with the **Saunders et al. (2016)** and is discussed in the following sub-chapters:

### 4.3.1 Research Philosophy

The philosophical stance adopted by the research is **positivism**. This is because the research is grounded in the belief that much certainty is conveyed in quantified numbers and this is captured through the quantitative data used in the research. This enables more than a certain measure of objectivity and generates more confidence and the positivism associated with high objectivity.

In addition, as one can only have a limited knowledge related to the time and social environment in which one lives; a generalisation of emergent knowledge, results or findings, is possible and should be considered. Research philosophies germane to this thesis are now considered in terms of 'interpretivism', 'positivism' and 'critical realism'.

### 4.3.1.1 Positivism

Ayer (1959) and Saunders et al (2012) agree that positivism is the epistemological thinking and the philosophies of science. They believe that these scientific philosophies hold that the scientific method is the best approach in uncovering the process by which both physical and human events occur. Thus, his thesis seeks to demonstrate and develop the empirical phenomena of the relationships between selected macroeconomic variables and some selected developed and developing countries through the testing of stated theories. The procedures and process adopted in this thesis are all virtually replicable as the result of the positivistic nature of the thesis.

# 4.3.1.2 Interpretivism

The ontological view of every qualitative research is that of multiple realities. **Guba** (1997) argues that in such a research approach, the researcher shapes the reality of the undertaken research or observation as he partakes in his investigations. Qualitative research envisages that the undertaken research or observation usually has multiple meanings and implications to various observers and this makes it subjective in nature. However, qualitative research recognises that the research design is shaped by the researcher's own view and inclination as to how knowledge is perceived. Such research allows for the exhibition of different pathways and the selection of a suitable pathway for the research. **Clarke (1998)** believes that this however, depends on the nature of the enquiry and that of the data required in facilitating the research. This research accordingly, employs empirical evaluation of the determination of the impacts of the macroeconomic variables on stock markets. Even though the research is empirical in nature, it is still subjective as a result of the degree of subjectivism that is employed in determining its objectives and the data used for this analysis.

# 4.3.1.3 Critical Realism

Both **Bhaskar (1989) and Losch (2009)** conclude that Critical Realism is complementary to both positivism and interpretivism. This is an analytical approach that may include both qualitative research and quantitative research. Methodological pluralism is a principal feature of critical realism. **Biesta and Burbules (2003)** argue that the complementary nature of the paradigm envisages articulation of methodological emancipation from monomethods that restrict a researcher towards only one particular research philosophy.

Critical Realism can be said to be a modern philosophical approach that combines the natural and social sciences, so as to derive an understanding and explanation of a research or phenomenon that has gained momentum. The philosophical approach of this research presents

an opportunity to establish a richer understanding of the phenomenon or research under observation through a critical realist stance. However, **Parahoo (1997)** revealed that this approach is tempered by the criticism from various philosophers who argue that in a deductive line of enquiry, and the qualitative aspects of a predominantly quantitative approach, brings the researcher is brought too close into the proximity of the observation and this may weaken objectivity.

## 4.3.2 Research Approach: Inductive vs. Deductive

Empirical theory facilitates and enables the development and execution of a wellbalanced structural research through an empirical approach, or by providing the theoretical basis for a qualitative approach. In research, there are two broad methods of reasoning which are often referred to as the *Inductive* and *Deductive* approaches (Saunders et al, 2016).

**Deductive** approach is method of reasoning that starts from the more general to the more specific. Deductive method of reasoning is often referred to as a "<u>top-down</u>" approach. This 'top-down' approach involves theory testing, where a set of hypothetical positions are developed on numerical data basis. This data ultimately accepts or rejects the hypothesis being tested. **Monette et al (2005)** argues that this reasoning approach presents an axiomatic approach to thinking about the phenomena under observation, the application of these axiomatic principles to some specific cases are enabled where principles are apparently true.

Inductive approach, on the other hand, is the reasoning that works on the basis of some specific observations to broader generalisations. This approach is often referred to as a 'bottom-up' approach. Under this approach, tentative propositions are developed from which theories are potentially generated. **Babbie (2010)** suggests that "specific observations offer possibility of patterns, similarities and regularities that allow formulation of tentative propositions (inductivism) that can be tested and theoretical propositions developed to offer further

explanations." **Bernard (2011)** argues that the Inductive research "involves the search for pattern from observation and the development of explanations i.e. theories, for those patterns through series of hypotheses". Therefore, one can say theories are not tested in inductive studies (even though, they may underpin a research) at the beginning of the research. However, the researcher is free in altering the direction of his research after the research process has commenced.

The methodological approach applied within the present research is **deductive**. This is because it employs theories (EMH, CAPM and APT) as bases for the development of research hypotheses. However, while the research employs hypotheses testing (deduced from theory) it also remains sensitive to the development of potential fresh theory that may inductively better explain the dynamics of the relevant stock market indices.

## **4.3.3 Research Strategy**

The strategy employed in order to conduct the research is **archival** as it draws on and analyses pre-existing data stored in archives. The main archive for much of the research data is the Bloomberg repository - a publicly available database. Using such publicly available data has obviated issues relating to obtaining, using and storing research data in an ethical manner Archival strategy involves the acquisition of data already generated and present in the public domain. This strategy enables the recognition, categorisation and conversion of records into data and this data is then analysed with qualitative or quantitative methods.

The information is recorded in different forms that provide detailed descriptions of activities or events and multiple levels of evidence. **Mullen (2001)** agrees that the archival research strategy enables the addressing of issues of timing, allowing series of sequences to be established or developed. Thus, this implies that the archival strategy allows the research to investigate and examine past events and address changes in them over several time periods.

This research uses data that already exists in the public domain, which are derived from various sources such as annual reports. Issued by recognised stock exchanges and official department of national governments.

### 4.3.4 Research Choices

The research is primarily quantitative but has shades of **qualitative** features as well. This is because the collected historical data (macroeconomic variables and financial market indices), are analysed using appropriate statistical software giving a significant quantitative character to the research. Nevertheless, a quantum of the data is **qualitative** in nature (e.g. review of the relevant extant literature). And, as the research uses both numeric and nonnumeric data, one might conclude that in fact, **a mix of quantitative and qualitative** methods are employed.

## 4.3.5 Research Time-Horizon

In relation to the time span, the research is essentially **longitudinal**. This is because fundamentally same variables (stock market indices and selected macroeconomic variables) are considered over a significant period of time (15 years – 2000 to 2015)

## 4.3.6 Research Data Variables

Three types of variables; stock market index variables, macroeconomic variables and dummy variables, are used in this research. They are briefly discussed in following subchapters. When an analysis is to be done, the ideal is to compare like with like. If using monthly data, this should be used consistently. The thesis has selected a timeframe where all the date are obtained. To get consistent data, it became necessary to use only monthly data rather than weekly or daily. In addition, the chosen timeframe of this research, 2000-2015, takes heed for the need to capture pre-crisis, crisis and post-crisis period information within in the research data.

The stock market is only one aspect of the economy. The real economy may often be much different from the health of the stock market as reflected by its index. This is because the economy embraces several dimensions, which the stock market does not and cannot do. Further, while the technicality of numbers is important, the numbers alone will likely not necessarily capture the total reality of economic life. Equally, the use of stock market indices as a representation of a given economy is a composite of only the "biggest and best" companies within the economy. As such, they are just a potential economic reflection of what is likely to prevail within the relevant economy.

Given the above, the degree of representativeness of each market index is indeed debateable and cannot be the same across all the selected countries. This is due to the fact that the structure of reasonably developed economies are likely to be different from those of the BRICS economies. In the context of the G20 set of countries and their respective stock market, **Pradhan (2018)** employs a VAR model for testing Granger causalities and finds the presence of both unidirectional and bidirectional causality between development of stock market and per capita economic growth. Accordingly, the researcher recognises that the selected market indices are only one option – there could be others. Indeed, in terms of the BRICS economy, one could easily argue that innovations (changes), performances and globalized impacts are possibly not fully reflected in share prices.

Thus, to a degree, one could argue that stock market indices are not necessarily the very best representation of an economy - as share prices are not always the best measure of its value to investors. However, they are possibly the most optimal, taking regard for all the preceding. Nevertheless, an assumption made for this research is that the selected stock market indices are a practically fair and a reasonably wholesome representation of the economies under review.

With the exception of the Japanese market index (NIKKEI 225), all the selected indices for the research are the relevant market value weighted index (also called a capitalisationweighted index) which is a price-weighted index. The exception for Japan is occasioned by the fact that at the time of data collection, the Japanese TOPIX capitalisation-weighted index was not being computed nor made publicly available. In addition, one is well served by referring to Pages 153-154 of the present thesis, where more full explanations of the selection of the relevant stock market indices are provided.

### **4.3.6.1 Stock Market Indices Data - (Dependent Variables)**

The choice of the indices in the present study has been based on index ranking (only senior/primary index are included); and on the market capitalisation when assessing the various indices. As such, the FTSE100 alone represents about 81% of the entire market capitalisation of the London Stock Exchange. Therefore, the research concluded that focus on the FTSE 100 only would be more than adequate to reveal any appropriate determinants. And it was decided that further focus on the FTSE 250 or FTSE 500 would not produce comparable results. The same reasoning has been adopted for the others selected market indices. In the US, SP500 has been preferred because it is comprised of 500 large companies from a vast number of industries. In addition, the SP500 is market-value weighted with the inclusion of greater sample of US stocks. The NIKKEI225, the DAX and CAC40 have been selected within the same approach. In the BRICS context, particularly in the Indian context, NIFTY is formed of the 50 biggest firms while the SENSEX is composed of only 30 companies; giving NIFTY the largest market capitalisation. The IBOVESPA, RTS, SHAMCOMP and JALSH also are the main indices in the selected country in term of market capitalisation. By choosing the BRICS and the five developed countries, the thesis seeks to compare both types of economies, detect similarities and conflicts in term of economic structure. This is because, the nature of the developed

countries is very likely radically to be different from the BRICS countries. In the expectation that these two groups are different, the thesis ultimately seeks to compare both types of countries and identify key distinctive features of each of them.

The Selected Stock Market Indices (Dependent variables) per country are stated in the table below. Relevant monthly values for the period **January 2000 to December 2015** (15 years) will be used. **Table 4.1** present the various stock market indices of this research below:

Country	Stock Market Index
Brazil	IBOVESPA
Russia	RTSI
India	NIFTY
China	SHCOMP
South Africa	JALSH
France	CAC 40
Germany	DAX
Japan	NIKKEI 225
United Kingdom	FTSE 100
United States	S&P 500

Table 4.1: Dependent Variables- Stock Market Indices

# 4.3.6.1.1 Brazil – BOVESPA

The Bovespa is a Brazilian stock exchange located at São Paulo, Brazil. It was founded on the 23<sup>rd</sup> of August 1890 by Emilio Rangel Pestana and is known as the "Bolsa de Valores de São Paulo" (São Paulo Stock Exchange, in English). The Brazilian Mercantile and Futures Exchange (BM&F) merged with the São Paulo Stock Exchange (Bovespa) on May 8, 2008, creating *BM&FBOVESPA*. This made it the world's second largest stock market.

### 4.3.6.1.2 Russia – RTS

RTS index stands for 'Russia Trading System' and was introduced on the 1<sup>st</sup> of September 1995 with a total base value of 100. The RTS is a free float capitalisation weighted index with 15% restrictive cap on all the stocks. The RTS Index or RTSI is made up of the 50

largest Russian stocks which are traded on the Moscow Exchange in city of Moscow, Russia. It is usually traded and valued in the US dollars. This is one of the few indices that are calculated in the US dollar outside of United States. The RTS Information Committee reviews the stocks list every three months.

## 4.3.6.1.3 India – NIFTY

Nifty 50, or CNX Nifty Index or simply Nifty, is India's National Stock Exchange benchmark of stock market index for the Indian equity market. It was formerly known as the S&P CNX Nifty Index, but is renamed now following the expiration of agreement between IISL and Standard and Poor' Financial Service on the 31<sup>st</sup> of January 2013. Nifty is owned and managed by the India Index Services and Products (IISL), which is owned wholly by the subsidiary of the NSE Strategic Investment Corporation Limited. IISL's licensing and marketing agreement for co-branding equity indices with Standard and Poor's was valid till 2013 and the CNX stands for CRISIL NSE Index. The CNX Nifty Index is a free float market capitalisation weight index.

# **4.3.6.1.4 China – SHANGHAI COMPOSITE INDEX**

The Shanghai Stock Composite Index is a capitalisation weighted index. It is traded on the Shanghai Stock Exchange in the city of Shanghai in China. It was developed on the 19<sup>th</sup> of December 1990 with a base value of 100. Investors tend to as a tool to gauge the health of the entire Chinese economy even though it was created to track the performance of China's largest companies.

## 4.3.6.1.5 South Africa – JALSH/FTSE

The FTSE or JSE All Share Index (JALSH – Johannesburg all share) is the most important stock index in South Africa as it includes all listed companies on the Johannesburg

Stock Exchange. The FTSE covers 99% of the market capitalisation and trading volume on the South African's stock exchange. The FTSE is a market capitalisation weighted index.

### **4.3.6.1.6 France – CAC40**

The CAC40 is a French benchmark of the stock market index. CAC40 stands for "Cotation Assistée en Continue" in French and it represents the measure of market capitalisation weighted index for the 40 most important and significant values of the 100 highest market caps on the Euronext Paris, which was formerly known as the Paris Bourse. The CAC40 is one of the main national indices of the pan-European stock exchange group known as Euronext. The CAC40 index's weighting system changed to free float market cap only for totally being dependent on the total market capitalisation on the 1<sup>st</sup> of December 2003. This index is reviewed by the independent Index Steering Committee quarterly.

# 4.3.6.1.7 Germany – DAX

The DAX known as *Deutscher Aktienindex* in German is a German stock index. It is known as the blue chipstock market index that consists of the 30 major German companies that trade on the Frankfurt Stock Exchange. DAX measures the performances of Prime Standard's 30 largest German companies in terms of market capitalisation and book volume order.

## 4.3.6.1.8 Japan – NIKKEI 225

Nikkei 225 commonly known as Nikkei or Nikkie Index is a stock market index for the Tokyo Stock Exchange in Japan. The Nikkei stock index is reviewed once every year. It was also known as the "Nikkei Dow Jones Stock Average" from the year 1975 to 1985.

## 4.3.6.1.9 United Kingdom – FTSE 100

The FTSE 100 is one of the most known indexes in the world. The FTSE stands for the Financial Time Stock Exchange. It is a share index of the 100 companies listed on the London

Stock with the highest market capitalisation that began on the 3<sup>rd</sup> of January 1984. The index share prices are market capitalisation weighted.

### 4.3.6.1.10 United States – S&P 500

The S&P 500 is an American stock market index, which is based on the market capitalisations of 500 large companies listed on the NYSE or NASDAQ. The NYSE stands for New York Stock Exchange located in Wall Street, in New York City. It is known as the world's largest stock exchange, and the market capitalisation of its listed companies was valued at US\$19.69 trillion as of May 2015. NASDAQ is the second-largest exchange in the world by its market capitalisation, leaving behind only the NYSE.

The ten selected stock markets undertaken in this research have free float market capitalisation weighted indices.

## **4.3.6.2** Selected Macroeconomic Data – (Independent Variables)

All the variables used are similar and consistent across countries. They have all been selected from the same source, so the calculation method is identical. The Real GDP has been preferred to any other types of GDP as this reflect a better level of economic activity. The six-selected macroeconomic (Independent) variables in the context of the current research are:

- 1. Gross Domestic Product (GDP),
- 2. Inflation rate (IFR),
- 3. Exchange rate (EXR),
- 4. Total Consumption (CON),
- 5. Interest rate (INR) and
- 6. House Price (HPI) index.

### 4.3.6.3 Dummy Variables

In an attempt to capture additional originality, the research recognises that variables not previously considered may also be of relevance. To do so, it computes and employs two dummy variables. The dummy two variables are used to capture the impact of the financial crisis of

2008 as well as the influence of the quantitative easing (monetary policy) employed as a response to the crisis in this research. This research considers the following dummy variables:

### **4.3.6.3.1 Dummy Variable for Quantitative Easing (QEG)**

The dummy variable is equal to 1 for the period from November 2008 to June 2010 and October 2010 to June 2010; and equals to 0 for the periods January 2000 to October 2008, July 2010 to September 2010 and July 2011 to June 2015. This research considers the quantitative easing policy decided in the US as a remedy to the crisis and the effect of this measure on the US and the other countries will be represented through this variable.

### **4.3.6.3.2 Dummy Variables for Structural Breaks (FCR)**

Considering the financial crisis has started from the first quarter of 2007 to the end of 2010, this research developed the second dummy variable as follow: January 2000 to February 2007 and January 2011 to June 2015 = 1 and March 2007 to November 2010 = 0. This variable will be the representation of the credit crunch crisis effect on the selected countries.

# 4.3.7 Research Data Sources

The research data consist of selected stock market indices (dependent variables) and meaningful identified macroeconomic variables (independent variables) covering 15 years of data from (January 2000 to December 2015). The data source for all the variables is the Bloomberg Professionals (www.bloomberg.com). Appropriately considered variables, intended to quantitatively capture the 2008 financial crises and the US quantitative easing, are also used in the research as dummy variables within the independent variable data set. The selected dependent (stock market indices) and independent variables (selected macroeconomic variables) are both presented along with the dummies variables in the Table 4.2 on the next page:

Independent Variables For all Economies											Dep	ende	nt Va	riable	8		
GDP	IFR	EXR	CON	INR	IdH	CRI	QEG	BRICS Economies					DEV	/ELO	PED I	Econo	mies
Country Specific GDP	Country Specific IFR	Country Specific EXR	Country Specific CON	Country Specific INR	Country Specific HPI	2008 Financial Crisis	US Quantitative Easing	Brazil – Ibovespa	Russia - RTS	India - NIFTY	China – Shanghai	South Africa – JALSH	France – CAC 40	Germany - DAX	Japan – Nikkei 225	United Kingdom – FTSE 100	United States – SP500

### Table 4.2: Summary Table of the Selected Variables

# 4.4 Validity of the Research

Previous studies have been done using similar methodology that has provided useful outcomes assuring validity to the current research (refer to the Literature review chapter – Page 52 to page 141).

# 4.5 Reliability of the Research

Data for the research are derived from secondary sources (IMF and Bloomberg websites). Data from these sources are highly commendable and efficient. Also, widely used statistical methods are employed and are not subject to observer bias. Therefore, there are no valid threats to the reliability of the outcomes in this research. (See methodology chapter – Page 142 to pages 156). The next chapter provides a tabular analysis of the individual Objectives of the research and it indicates key methodological considerations for each of them. This is done in order to ensure the reliability and validity of the research.

# 4.6 Limitations of the Research

Some constraints and limitations do however affect the outcome of the research:

- i. House price data: it appears from data collection that the representation of the housing market differs from one country to another. In addition to this, the length of data is different and most of the BRICS countries house price data do not cover the period **from 2000 to 2015.**
- ii. The length of the time studied: research will cover the period **2000 to 2015** because of unavailability of data, before 2000, for certain countries, i.e., South Africa. This could have been extended to developing countries, which will give another aspect of the investigation.

## 4.7 Personal Ethical Statement of the Researcher

Since all the data are publicly available, no issues regarding ethical concerns have arisen. Nevertheless, the researcher has abided by the London South Bank University Code on Ethics<sup>1</sup>. LSBU website is <u>https://my.lsbbu.ac.uk/page/research-degrees-ethics</u>

# 4.8 Chapter Summary

This chapter discussed the research design and methods relevant to this research. It detailed much explanation of the research design and philosophy that permeates the research process, its tools, methods, techniques and the strategy used to address the research questions and hypothesis. It discussed the theoretical and conceptual basis of this research and explained the research philosophies that influence the research design employed. It also discussed issues relating to the research strategy utilised, as well as how the research objectives are to be accomplished in regard to research choices, time-horizon, the data used and its analysis according to Saunders et al (2012). These authors have established a well-balanced structural and systematic approach in generating new knowledge described as the 'Research Onion'

<sup>&</sup>lt;sup>1</sup> LSBU Code of Practice by the London South Bank University Research Ethics Committee – Available at https://my.lsbu.ac.uk/assets/documents/regulations/ethical-code-of-practice-for-research-involving-human-participants(Word%2098KB).doc

analogy. This 'Research Onion' has provided a basis for the research design, its construction and development. Furthermore, the Kieran diagram (please see page 71) was applied as a framework for variable selection and discussion.

The next chapter presents the types of the tests and models in the light of the ten objectives of this research and interprets their meaning.
# **Chapter V**

# Mathematical and Statistical Procedures Analyses

# **5.0 Introduction**

The previous chapter discussed the research design and methodology adopted in constructing this research. It also presented the variable selection framework (using the Keran diagram) and discussed each of the selected variables in detail. The chapter also outlined the research paradigms, its epistemological and ontological positions and the research strategies and approaches adopted. This chapter presents the various models, tools, techniques, and hypotheses applied, when estimating the relationship across the selected variables and satisfying the requirements of the ten objectives.

In terms of techniques employed, the OLS regression, VAR/VECM and GARCH models, Granger causality tests, Johansen-Juselius co-integration analysis, as well as Impulse Response Function and Variance Decomposition Analysis are described and their use within the present research explained within the chapter. The statistical tests and other techniques employed for analyses used within the thesis are also explained and clarifications offered. Finally, the residual hypothesis tests are also described for testing the validity of the models used.

Quantitative research such as the present is much enabled by mathematical procedures and statistical tests and exercises. Thus, to better appreciate why and how particular mathematical procedures or statistical analyses have been employed, it is necessary to first have an understanding of their nature and then, with that understanding, one can be better guided as to how they have been employed within the research. Accordingly, the following paragraphs devote themselves firstly to an explanation of each of the mathematical procedures

and/or statistical exercises used, and this is then supported by a brief explanation as to how each has been used within the present research. The Eviews statistical software is used for assessing the regressions and carrying out the tests mentioned below. The variables for this research have been considered in chapter IV. As stated, this chapter seeks to illuminates details regarding the mathematical procedures and statistical analyses used to achieve the research objectives. In some cases, the quantitative variables have to be duly "prepared" before they are used within the statistical procedures. Accordingly, prior to revealing these procedures, some clarifications are first offered for these "data preparation" exercises. The following sections provide brief details as to both these features, first in terms of "data preparation" exercises and then in terms of the "statistical tests and procedures themselves". However, even before discussion these two matters, it is more important to present the critical research model, as it is this model that effectively underpins some of its major segments.

Parametric models have certain parameters or limitations placed on them. Only when these parameters are respected, may they be appropriately used (**Degeling et al, 2017**). In general, these parameters refer to certain features (particularly normality of distribution) of the statistical data (**Fatthi, 2011**). However, when the volume of data being analysed is fairly large and (possibly) substantially longitudinal, as in the present situation, then statisticians invoking mainly the Central Limit Theorem<sup>2</sup> conclude that because of that magnitude and intensity, the data employed will very likely possess the parameters required for the use of parametric tests.

 $<sup>^{2}</sup>$  A statistical proposition to the effect that the larger a sample size, the more closely the sampling distribution of the mean will approach a normal distribution. This is true even if the population from which the sample is drawn is not normally distributed. A sample size of 30 or more usually will result in a sampling distribution of the mean that is very close to a normal distribution. The central limit theorem explains why sampling error is smaller with a large sample than with a small sample and why we can use the normal distribution to study a wide variety of statistical problems.

Accordingly, due to the large volume/size of the data collected and analysed in the present research, parametric methods are likely more appropriate for use than nonparametric methods. Equally, non-parametric models would have been suitable if the thesis were looking into the probability of an event happening or if measurement of phenomena was the focus. However, this is not the case. For the thesis investigates potential relationships between the selected dependent and independent variables. A further, reason for the use of parametric methods is that the researcher has transformed the data and a certain distribution is expected from the transformation. Based on such thinking, the thesis employs only (in most instances) parametric tests and methods. The adopted model of the present thesis is provided below:

# **5.1 Mathematical Framework**

Linear models are a mathematical attempt to describe a relationship between two or more variables with the intent to fit a linear equation to observed data. In the linear model context, variables used are distinguished between dependent and explanatory (or independent) variables. Thus, a linear model is one in which all terms are either the constant or a parameter multiplied by an independent variable. Such models are linear in the parameters, which have to be estimated (but not necessarily) in the independent variables themselves.

Nonlinear models are those that do not follow the above form. In other words, a nonlinear model is any model, which does not require or adhere to the assumptions of the linear model, primarily that the dependent variable equals a constant plus parameters in a linear form. Nonlinear regressions do not require linearity within the model. Thus, one is advised to use a nonlinear regression when the variables being studied do not fit a linear model.

The theoretical justification of the use of linear models within this research arises from the ATP which states that there is potentially a linear relationship between stock price and macroeconomic variables (the systematic risk factors). When these variables are duly

transformed, this allows one to develop the assumption that the dependent variable (stock market index) equals, together with the constant, the sum of the duly parameterised independent variables (macroeconomic variables). Another reason for putting aside the use of nonlinear models is that such models do not produce R-square and related p values - both required for analytic purposes.

In order to construct the models and test the predictive ability of the variables, the following predictive regression is estimated using OLS:

## R = f(GDP, IFR, EXR, CON, INR, HPI) (5.1)

where R is equivalent to the country stock return, while Real GDP, IFR, EXR, CON, INR, HPI are the variables selected and presented in the previous chapter. If the financial crisis of 2008 and the quantitative easing are found to be significant in explaining the returns, then the model will be extended to:

# R = f(GDP, IFR, EXC, CON, INR, HPI) (5.2)

The OLS regression in equation assumes a linear relationship between the predictor variables and future returns. This is in accordance with the vast majority of literature within the subject of predictability of stock returns and therefore no other patterns are investigated in this thesis. **Wohar and Rapach (2005)** offer an alternative explanation for the pattern of predictability, which is based on non linearities in the underlying data generating process. Non linearity is not part of this thesis.

Now that major aspects of the model have been presented and briefly discussed, it is appropriate to return to the matters referred to previously.

# **5.2 Data Preparation Exercises**

In order to make the data available to the inferential statistics described below, the thesis have used the following procedures: Interpolation, Seasonal adjustments, log transformation and unit roots tests. **Interpolation** procedure is used to construct missing figures (data) from the range of collected data from the Bloomberg repository. This allows the researcher to work on a full dataset. Because the thesis believe that time effects needs to be incorporated in the data set, **Seasonal Adjustments** procedure is use to ensure that data reflects are free from seasonal patterns such as bank holiday or natural disasters. It is relevant in the present study because one of the issue to be analysed is the trend of the selected variables. To ensure that the obtained model are linear (the OLS assumption), the thesis proceeds to the **log transformation** of the data. This is ensure that skewness in the data are reduced. The last data preparation technique which is the **unit roots test** is fully described in the sub-chapter below:

# **5.3 Test of Stationarity or Unit Roots Tests**

A unit root test tests whether a time series variable is non-stationary as the stationarity level of a series strongly influences its behaviour and properties. For example, the persistence of shocks will be infinite for non-stationary series. Therefore, before doing any analysis as stated below, it is necessary to test the stationary of the series. For this purpose, two such test -i.e., the Augmented Dickey – Fuller (ADF) test (Dickey and Fuller, 1979) and the Philips – Perron (PP) test (Philips and Perron, 1988) are used to infer the stationarity of the series. If the series are non-stationary in levels and stationary in differences, then there is a chance of cointegration relationship between the series.

# **5.3.1Augmented Dickey Fuller Test (ADF)**

An Augmented Dickey–Fuller test (ADF) is an augmented version of the **Dickey– Fuller (Year)** test, used for a more complicated and larger sets of time series models. The

statistic used in the test is a negative number and the more negative the number is, the stronger the hypothesis that there is a unit roots at some level of confidence is rejected. Eviews carries the ADF test by using the following equation:

 $\Delta y_t = \alpha y_{t-1} + x'_t \delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \dots + \beta_p \Delta y_{t-p} + \vartheta_t, (5.3) \text{ where}$ 

 $\alpha$ - coefficient of  $y_{t-1}$  to be estimated,

 $x_t$  – optional exogenous regressor consisting of a constant, or a constant and trend,

 $\delta$  – coefficient of  $x_t$  to be estimated,

 $\beta_t$ - coefficients to be estimated,

p - lag order of AR (p) process

 $\vartheta_t$ - white noise.

The formulation of the ADF allows for higher-order autoregressive processes when the lags of the order p are included. This implies that the lag length p must be determined when applying the test.

The null hypothesis is  $H_0$ :  $\alpha = 0$ , against the alternative of  $H_1$ :  $\alpha < 0$ . The null of a unit root existence is rejected in case  $\alpha$  is negative and significantly different from zero, implying that the series are stationary – I(0). The null is rejected in case t-statistic value is lower than its critical value and the p-value is less than say 5% (for the current analysis 5% significance level is taken into consideration). If the null is not rejected, meaning that the series are nonstationary, then they must be differenced to become stationary and tested again.

When performing the ADF test there is an issue whether to enter the exogenous variable  $x_t$  in the model, i.e. should the regression include intercept, or intercept with trend or neither of them. On one hand, regression with intercept and trend is a more general case. On the other hand including irrelevant regressors in the model will decrease the power of the test to reject

the null hypothesis of a unit root. For avoiding spurious results, the ADF tests are run with all the three aforementioned cases.

# **5.3.2 Phillip – Perron Test (PP)**

The Phillips–Perron test is a unit root test that is used to test the null hypothesis that a time series is integrated of order 1 in time series analysis. **Davidson and MacKinnon (2004)** report that the Phillips–Perron test performs worse in finite samples than the augmented Dickey–Fuller test.

The test regression for the PP test is as below:

$$\Delta y_t = \alpha y_{t-1} + x'_t \delta + \epsilon_t, (5.4)$$
  
With  $\varepsilon_t = I(0)$ .

Here again, Eviews allows to choose a regression with intercept, intercept with linear trend or neither. Like the ADF test, we have run the PP test with all the mentioned cases. **Phillips and Perron's** test statistics can be viewed as **Dickey–Fuller (Year)** statistics that have been made robust to serial correlation by using the **Newey–West (1987)** heteroskedasticity-and autocorrelation-consistent covariance matrix estimator. One advantage of the PP tests over the ADF tests is that the PP tests are robust to general forms of heteroskedasticity in the error term. Another advantage is that the user does not have to specify a lag length for the test regression.

Under these tests the null hypothesis is that the variables are not stationary or got unit root against the alternative hypothesis that variables are stationary. As to how exactly ADF abd PP are employed, is explained in more detail within the thesis (Sub-chapter 5.10.3 Page 177).

The following paragraphs now discuss and illuminate the statistical test used for the analysis of data within the research. These tests are:

- 1. Regression
- 2. Cointegration Techniques
- **3.** Error Correction Model (ECM)
- 4. Granger Causality Tests
- 5. LR Test
- 6. GARCH Model

# 5.4 Regression Analysis

The regression analysis is a statistical technique which helps to estimate the relationships among variables. This technique is used to understand how the typical value of the stock returns (dependent variable) changes when any of the macroeconomic variables (independent variables) vary with other variables remaining fixed. When focusing on the relationship between a dependent and independent variable, the analysis is composed of many techniques for modelling and analysing several variables.

Regression analysis specifically helps in understanding how the typical value of the dependent variable (or 'criterion variable') changes or varies when any one of the independent variables varies; while others (independent) variables are held fixed. This analysis commonly estimates the conditional expectation of the dependent variable given the independent variables; this gives the average value of the dependent variable when the independent variables are fixed. The estimation target is known as a function of the independent variables called '**regression function'**. Regression analysis characterises the variation of the dependent variable around the regression function which is described by a probability distribution. It mathematical expression is as below:

$$y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_i$$
, for  $i = 1, 2, \dots, n$ . (5.5)

Where  $y_i$  equals the stock returns of a specific country,  $\beta$  is the coefficient of individual independent variables and  $\varepsilon$  is the representation of the error term.

As is generally always appropriate, in this research, multiple regression is used to investigate the possible association of selected independent variables (i.e. specified macroeconomic statistics) with a specified dependent variable (i.e. identified stock market indices). In part, the research seeks to understand the nature of, and intensities relating to, relationships between the identified stock market indices and the selected macroeconomic variables. Thus, given the association-seeking nature of Objective 1, Multiple Regressions lend themselves to its fulfilment and are performed in fulfilment of it. As to how exactly such multiple regressions are employed, is explained in more detail within the thesis (Sub-chapter 5.10.5.1- Page 178).

# **5.5.** Cointegration techniques

**Engle and Granger (1987)** have formulated the co-integration concept and proposed a formal test for co-integration known as the Engle and Granger two-step method. In a case of more than two variables, **Johansen and Juselius (1990)** proposed a method that captures the existence of more than one co-integration and the number of co-integration among variables. In practical term Var and Co-Integration are used together to arrive at findings. When variables are integrated in the same order, we can apply the Johansen Juselius maximum –likelihood method of co-integration to obtain the number of co-integrating vectors or equations.

# 5.5.1 Johansen Cointegration Test

Johansen Test is a statistical procedure for testing cointegration when we have more than two variables. This test allows more than one cointegration relationship and it is more generally applicable than the Enger – Granger test. The mathematical expression of the Johansen test is as below:

 $y_t = \mu + A_1 y_{t-1} + \dots + A_p y_{t-p} + B x_t + \varepsilon_t$ , (5.6) where

 $y_t$  – non-stationary I(1) variables,

 $\mu - (nx1)$  vector of constant,

 $\rho$  - maximum lag included in the model,

 $x_t$  – deterministic variables

 $\varepsilon_t$ - innovations

A, B – coefficients to be estimated.

This can be written in the form of the error correction model assuming cointegration of order p. The above-mentioned equation can be transformed to the following form:

$$\Delta \mathbf{y}_{t} = \mathbf{\Pi} \mathbf{y}_{t-1} + \sum_{i=1}^{p-1} \Gamma_{i} \Delta \mathbf{y}_{t-i} + \mathbf{B} \mathbf{x}_{t} + \boldsymbol{\varepsilon}_{t}, (5.7) \text{ where:}$$
$$\mathbf{\Pi} = \sum_{i=1}^{p} A_{i} - I, \ \Gamma_{i} = -\sum_{j=i+1}^{p} A_{j}$$

If the rank of the matrix  $\Pi r < k$ , implies that there exists k x r matrices with rank r (denote them  $\alpha$  and  $\beta$ ), such that the following conditions are met:  $\Pi = \alpha \beta'$  and  $\beta' y_t$  is stationary I(0), although  $y_t$  is not-stationary, where r is the number of the cointegrating vectors (cointegrating relations). Thus,  $\Pi = \alpha \beta'$  or the existence of r cointegrating vectors hypothesis is considered.

The Johansen cointegration proposed two tests statistics through the VAR model that are used to identify the number of cointegration vectors, namely, the **Trace Test** and the **Maximum Eigen Value Test** statistic.

**Trace Test:** its null hypothesis is that the number of cointegration vectors is r=r\*<k, vs. the alternative that r=k and testing proceeds sequentially for r\*=1, 2, etc. and the first non-rejection of the null is taken as an estimate of r. Its **formula (5.8)** can be written as:

$$Trace = T \sum_{i=r+1}^{n} (1 - \lambda i), r = 0....n-1$$
 (5.8)

**Maximum Eigen Value Test:** its null hypothesis is as for the trace test but the alternative is r=r\*+1 and, again, testing proceeds sequentially for r\*=1, 2, etc., with the first non-rejection used as an estimator for r. Its **formula (5.9)** can be presented as:

# $\lambda max = TLOG(1 - \lambda r + 1), r = 0.....n-1$ (5.9)

While multiple regressions are certainly very helpful, they are inadequate when considering non-stationary time series variables. Moreover, disregarding such non-stationarity may well lead to spurious regressions, which would lead to spurious regressions. This could suggest the presence of relationships within the variables even when there is none. To overcome this possibility, researchers often employ tests to detect the presence of "cointegration" when considering (ostensibly) non-stationary time series. This is achieved by appropriately "differencing" the time series and then evaluating to see if the differenced series is indeed stationary. If this is so, then the two series are deemed to be, in the long-run, cointegrated and cointegration is present. In this context, the Johansen Cointegration Technique is frequently used to help determine if selected dependent variables and independent variables "move together" or are "cointegrated" in the long-run (in certain instances this may be a function of the variables being affected by the same underlying risk factor). Accordingly, if two sets of variables are cointegrated, then there is the distinct possibility of both a long-run and a short-run relationship between them. On the other hand, if there is (little or) no cointegration, then one might conclude that the variables are possibly linked only in the shortrun. Objective 2 seeks to form a view on precisely such a "conjointness" or "moving togetherness" and so it is appropriate to use a cointegration technique. For, if within the research variables, there is a long-run conjointness or "cointegration" between variables, then one may reasonably conclude that the independent variables subsume and-or assume risks for the dependent variables. Further, one should look even more closely at that relationship. I

cointegration does not exist, then it may be those variables move together only in the short-run - or simply do not substantively affect each other. Fulfilment of Objective 8 requires the use of the JCT to investigate if particular markets share the same risk(s) across the long-run and/or short-run. In addition, if cointegration is present, these markets may potentially share the same (or similar) risks. If so, this should/would influence the investment strategy of investors when seeking to risk spread and/or share. The JC technique is used to fulfil (inter alia) Objectives 2 and 8. As to how exactly, is explained in more detail within the thesis (**Sub-chapter 5.10.5.2-Page 179**).

# 5.6 Error Correction Model (ECM)

The Error Correction Model is not itself a model that corrects errors in models, rather it directly estimates the speed at which a dependent variable—Y—returns to equilibrium after a change in an independent variable—X. The error correction model is a theoretically-driven approach and it is useful for estimating both short-term and long-term effects of one-time series on another.

The Vector Autoregression (VAR) model is a generalised version of the Autoregressive (AR) form used to describe dynamic interrelationships (or linear interdependence) that may be present amongst and within time-series lists of variables. It is a statistical model that allows for one or more evolving variable(s) and tends not to require detailed prior knowledge of the potentially relevant variables. However, one must develop operative list(s) of variables that can be hypothesised in terms of the intertemporal effect of each variable upon each other variable. Thus, it is a general framework used to describe the dynamic interrelationship across stationary variables. However, stationarity is conditional to its use. Therefore, if the variables do not initially reflect stationarity, they must be appropriately adjusted or "corrected" to, possibly, and

then enable the somewhat "corrected" – i.e. the Vector Error Correction Model (VECM) to emerge.

Thus, the VECM is just a special case of the VAR, with variables that are appropriately "corrected" to reflect stationarity in terms of their differences. The VECM can also take regard for cointegrating relationships among the variables of interest. As is usual, this research first assumes the traditional APT assumption - i.e. a linear relationship between stock market indices and macroeconomic variables and so initially undertakes the equally traditional OLS regression.

However, taking regard for the stationarity issues described, these models are then developed further employing GARCH and VECM techniques. As to how exactly they are developed is explained in more detail within the thesis (Sub-chapter 5.9.5.1 - Page 176). For additional assurance, validation of the VECM models is undertaken using robustness tests such the Correlogram (Q) Square Test, the Normality (Jacques Bera) Test, the Arch Test, the Portmanteau Autocorrelation Test and the Breusch-Pagan-Godfrey Heteroscedasticity Test. An exposition of these tests are provided within the thesis (**Sub-chapter 5.11 - Pages 184-185**).

Within a dynamic system, an Impulse Response (IR) or Impulse Response Function (IRF) is the output of that system when it is stimulated by a brief input signal, called an impulse. More generally, an Impulse Response is the reaction of any dynamic system in response to some al change external to it. In any event, the impulse response describes the reaction of the system as a function of time (or of another independent variable that is parameterised) within thedynamic system.

In terms of the present research, Objective 9 seeks that evaluation in terms of specified macroeconomic variables to identified stock market indices, while Objective 10 seeks to determine that evaluation in terms of identified stock market indices to the specified

macroeconomic variables. As to how exactly such multiple regressions are employed, is explained in more detail within the thesis (Sub-chapter 5.10.5.1- Page 178).

While the IRF concerns itself with only a brief input signal at a single point in time, the Forecast Error Variance Decomposition (FEVD) concerns itself with similar impulses but over different periods of time and in relation to changing variables. Thus, FEVD lends itself to evaluation over a period or a few varying periods. Accordingly, with this additional feature, this test is applied in terms of Objective 9 taking regard for the specified macroeconomic variables in relation to the identified stock market indices and the reverse in terms of Objective 10, i.e. the identified stock market indices in relation to the specified macroeconomic variables. Both techniques are derived from the VAR/VECM models.

# 5.7 Granger Causality Test

The Granger test investigates whether including lags of one variable have predictive power for another variable. This causality test implies that X causes Y if Y can be forecasted by including past data or information of X in the analysis or model rather than using only Y's past data or values. It is worth mentioning that the concept of causality in the Granger test does not imply that the changes in one of variable, cause changes in another variable, as the term is employed in the context of policy discussions. This test the existence of predictability among variables under observation. For example, the causality test can be utilised to determine if shocks to the supply of money influences movements in stock market prices or vice versa. Granger causality relationship is based on two principles which are:

- 1. The cause does happen prior to its effect.
- 2. The cause does have unique information about the future values of its effect.

Based on this two assumptions or principles of the Granger causality, the mathematical formula for the Granger causality can be presented as follows:

$$\mathbb{P}[Y(t+1) \in A|\mathcal{L}(t)|] \neq \mathbb{P}[Y(t+1) \in A|\mathcal{L}_{-X}(t)|]$$
(5.10)

where Prepresents probability, A is an arbitrary non-empty set, and  $\mathcal{L}(t)$  and  $\mathcal{L}_{-X}(t)$  denote the information available as of time t in the entire universe, and that in the modified universe X is excluded respectively. If the above hypothesis is true, we say that X Granger causes Y.

# 5.7.1 Granger Causality Test based on VECM

The analysis will be done following the Granger Representation Theorem, which states that if a set of variables is co-integrated, then there exists a valid error correction representation of the data, in which the short-term dynamics of the variables in the system are influenced by the deviation from the long-term equilibrium. In a VECM, short run causal effects are indicated by changes in other differenced explanatory variables. The long run relationship is implied by the level of disequilibrium in the cointegration relationship, that is, the lagged error correction term.

The long – run relationship is to be found in the Error Correction Term (ECT) and the Wald  $x^2$  test statistic is used for the short-run. This analysis will be followed while analysing causal relationship between stock returns and macroeconomic variables and also when this research will be analysing causal relationship between stock returns selected for the present research.

# 5.7.2 Wald Test

The Wald test is a parameter statistical test that is named after the Hungarian statistician Abraham Wald. The Wald Test is used to test the true value of a parameter that is based on a sample estimated from a situation, where a relationship within or between data items is expressed as a statistical model with parameters that are estimated from a sample. This Wald test can either be used to test a single hypothesis on multiple parameters, or test jointly multiple

hypotheses on single/multiple parameters. The Wald Test can be presented in a mathematical format. Assuming $\hat{\theta}_n$  is a sample estimator of P parameters (i.e.,  $\hat{\theta}_n$  is a Px1 vector), that is supposed to follow asymptotically a normal distribution with covariance matrix V;  $\sqrt{n}(\hat{\theta}_n - \hat{\theta}_n)$ 

$$(\theta) \stackrel{D}{\rightarrow} (0, V).$$

The test of Q hypotheses on the P parameters is expressed with a Q x P matrix R:

$$H_0: R\theta = r, (5.11)$$
$$H_1: R\theta \neq r.$$

The test statistic is:

$$(R\widehat{\theta}_n - r)' \left[ R\left(\frac{\widehat{\nu}_n}{n}\right) R' \right]^{-1} (R\widehat{\theta}_n - r) \xrightarrow{D} \chi_Q^2, (5.12)$$

where  $\hat{V}_n$  is an estimator of the covariance matrix.

# 5.7.3 Pairwise

The Pairwise Granger causality test is used for estimating the short-term causation between the variables.  $X_t$  granger causes  $Y_t$ , if it contains past information that helps to predict  $Y_t$ , and if  $Y_t$  cannot be better explained by its past values. The simple bivariate casual model consists of the following pair of regressions:

$$X_{t} = \sum_{i=1}^{m} a_{i}X_{t-i} + \sum_{i=1}^{m} b_{i}Y_{t-i} + \varepsilon_{t}, (5.13)$$
$$Y_{t} = \sum_{i=1}^{m} c_{i}X_{t-i} + \sum_{i=1}^{m} d_{i}Y_{t-i} + \vartheta_{t}, (5.14) \text{ where}$$
$$X_{t}, Y_{t} - \text{stationary time series with zero means,}$$

 $\varepsilon_t$ ,  $\vartheta_t$  – uncorrelated white noise series.

For  $X_t$  to cause  $Y_t c_i$  should not be equal to zero, and for  $Y_t$  to cause  $X_t b_i$  should not be equal to zero. Thus, we test the null hypothesis of  $H_0$ :  $b_i = c_i = 0$ . In case both coefficients are

significant, we have feedback relationship between the variables. The Granger causality test is run illustrating the F statistic and its p-value.

The Granger Causality Test seeks to determine if, within two variables within a time series there is "causality". However, in this context, the term "causality" might be better termed as a form of "precedence" – i.e. one particular variable consistently preceding another particular variable. Such precedence is termed Granger Causality (after initial proponent Late Professor Clive Granger). In the thesis, both the Granger Causality (and Pairwise) tests are used in order to help detect and understand any short-term relationships that may exist between relevant macroeconomic variables and stock market indices. It is conducted in the context of (inter alia) Objective 3 of the research. As to how exactly, is explained in more detail within the thesis **(Sub-chapter 5.10.5.3 - Page 180)**.

# 5.8 LR Test

The LR test is applied in the research to test whether the inclusion of the dummy variables in the model, which is the unrestricted model, is significant. The formula of LR statistic is as follows:

$$LR = (T - m)(ln|\Sigma_r| - ln|\Sigma_{ur}|) \sim \chi^2(q), (5.15)$$

where  $\Sigma_r$  – determinant of the residual covariance matrix for the restricted model,

 $\Sigma_{ur}$  – determinant of the residual covariance matrix for the unrestricted model,

# T – number of observations,

m – number of parameters in each equation of the unrestricted system + constants,

q – degrees of freedom, equal to the number of dummies \* number of equations.

If the LR test statistic is higher than the chi-square critical value, we reject the null hypothesis of "no effect of dummy variables". If the LR test value is lower than the chi-square critical value, we then fail to reject the null hypothesis of "no dummy variables effect".

The Likelihood-Ratio (LR) Test is used to compare the "goodness of fit" between two statistical models. Traditionally, one of the two models is considered to be the "null" model and the other to be the "alternative" model. The test attempts to determine how many more times likely the data are than under the contrasting model. In other words, the test results in a Likelihood Ratio (LR) (and its computed logarithm) can then be stated as probabilities (p values) which can then be compared to a critical value to decide whether one should reject the null model.

In fulfilling Objectives 6 and 7, the research seeks to investigate the impact of the inclusion of two dummy variables (the 2008 "Financial Crisis" and the related "Quantitative Easing") by testing hypotheses that include the dummy variables and assess how, if at all, they influence the relevant market. Usage of the LR Test lends itself to the present research and context, which (inter alia) seeks to evaluate the impact of these two dummy variables within the selected economies. As to how exactly these two dummy variables are employed is explained in more detail within the thesis (Sub-chapter 5.10.5.6 - Page 183).

# **5.9 GARCH Model and Analysis**

**Engle (1982)** developed the model, which captures time-varying volatility that determine stock markets and become popular in financial research. Bollerslev (1986) proposed the generalised form of the model, in which the concept on conditional variance is captured. This is known as the GARCH model and it is used as a variance equation to be simultaneously estimated with the normal regression model in the mean equation. The technique eliminates

conditional heteroskedasticity problems and makes the interpretation of the results in the mean equation more valid. The different models are described below:

# 5.9.1 GARCH Model

GARCH is a statistical model, which estimates the volatility of stock returns. This method is used by researchers to help determine which stock returns have the potential of generating higher returns. It is also used to forecast futures stock returns. The mathematical expression of the model is illustrated below:

$$y_i = \alpha + \sum \beta_j x_{ij} + \varepsilon_i, (5.16)$$
$$h_t = \omega + \alpha \varepsilon x_{t-1}^2 + \beta h_{t-1} + \vartheta_t. (5.17)$$

Where  $h_t$  is the conditional variance of the residuals from the mean equation,  $\alpha \varepsilon x_{t-1}^2$ represents the ARCH term and  $h_{t-1}$  represents the GARCH term. The coefficient of the ARCH term is referred to the short-term volatility, while the coefficient of the GARCH term is referred to the long- term volatility.

# 5.9.2 Mean Equation

The mean equation (5.18) is expressed using the selected variables as stated below:

Stock ret: 
$$C_1 + C_2GDP + C_3INR + C_4EXR + C_5IFR + C_6CON + C_7HPI + \varepsilon$$
  
Stock ret:  $C_1 + C_2GDP + C_3INR + C_4EXR + C_5IFR + C_6CON + C_7HPI + C_8FCR + C_9QEG + \varepsilon$  (5.19) when adding the dummies variables.

Where  $C_1$  is the constant,  $C_2$  to  $C_9$  represent the coefficients,  $\varepsilon$  represents the residual, as well as the stock return is specific to each of the selected countries.

# **5.9.3 Variance Equation: GARCH (1, 1)**

The residuals derived from mean equation are used for estimating the variance equation as stated below:

$$h_{t:}C_8 + C_9h_{(t-1)} + C_{10}e_{(t-1)}^2$$
 (5.20)

Or with dummies variables, we will have:

# $h_{t:}C_{10} + C_{11}h_{(t-1)} + C_{12}e_{(t-1)}^2 + C_{19}FCR + C_{20}QEG$ (5.21)

Where  $h_t$  is the variance of the residuals (error terms) derived from (5.20 -5.21). It is also known as current day's variance or volatility of stock return, C8 is the constant,  $e^{2}(t-1)$  is the previous period's squared residual derived from equation (5.20-5.21). It represents the ARCH term. Real GDP to HPI are the selected exogenous variables. Equation (5.3) and (5.4) are GARCH (1, 1) model as they have one ARCH term ( $e^{2}(t-1)$ ) and one GARCH term (h(t-1)). In other term, it refers to first order ARCH term and first order GARCH term. Both will be estimated simultaneously.

In the mean equation (5.2), the impact of the dummy variables is taken through the residual series. The influence has tested for the individual stock market indices showing that the impact of the crises and the quantitative easing on the volatilities of the stock market indices.

The Autoregressive Conditional Heteroscedasticity (ARCH) and the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) models are econometric tools used in the analysis of time series data – particularly those related to financial applications, both conditions that prevail within the present research. These models are particularly helpful when seeking to analyse and forecasting volatility and associated risk, pursuits that also prevail within the present research. Whereas standard OLS regression models generally assume homoscedasticity (and the absence of heteroscedasticity); that is not true of, or required, when employing ARCH and GARCH models.

Accordingly, without being constrained by the possible limitation of homoscedasticity being present in the analysed data, this thesis employs these models to evaluate how historic data for the relevant macroeconomic variables may affect the selected stock market indices.

Within the thesis, ARCH & GARCH models (tools) are also used to help forecast future trends of the researched stock market indices. They are used in the context of (inter alia) Objective 4 of the research. As to how exactly they are used is explained in more detail within the thesis (**Sub-chapter 5.9.5.4 - Page 181**). For additional assurance, validation of the GARCH models is undertaken using robustness tests such the Correlogram Square (Q) Test, the (Jacques Bera) Normality Test, the Arch Test, the Portmanteau Autocorrelation Test and Breusch-Pagan-Godfrey Heteroscedasticity Test. An exposition of these tests is provided within the thesis (**Sub-chapter 5.11 - Pages 184-185**).

## **5.10 Analysis of Data**

The research methodology is designed to cover analysis under the Regression Technique, the VAR/VECM model, the GARCH, etc., and country per country data are adopted in the thesis. The reason behind this choice is that the house prices selected in this research differ from one country to another. A comparative method along with data, covering 2000 to 2015 period, collected from selected stock markets indices and macroeconomics variables are used to address the needs of all the objectives in the research. A time series data is justified for this thesis as it shows a trend and allows knowledge to be learned and phenomena to be observed overtime. The reason for this is embedded in the overall aim of the research, which is to identify and examine the relevant macroeconomic variables that have "predictive" relationship with stock market returns. Please note that all tests are done with 5% of significance level. It is important to stress that the data have been treated before being used for analysis. Interpolation procedure as provided by Eviews software had permitted to replace missing figures in the data for certain independent variables such as consumption in India or house price index in Japan. Also, to remove any cyclical seasonal movements such as bank holidays effect from the data, with the view of obtaining the approximate correct trend, the

present research has seasonally adjusted all the data through the in-built programme Census X-12 offered in the Eviews package. Finally, the log-values of all data has been used in the entire thesis. The log transformation is used to make extremely skewed distributions less skewed; especially when a relationship between variables needs to be describe as in the present research. This can be critical both for making patterns in the data more interpretable and for helping to meet the assumptions of inferential statistics. Finally, it is important to inform that the present analysis could have been done sector by sector, but this is not the purpose of the thesis, which seek to analyse impact of selected macroeconomic variables on an entire market. As such, the research has consistently desisted from undertaking a sectorial classification and analysis. As this would not have contributed additional meaning of further evidence within the context of this research and its objectives.

# 5.10.1 Lag Selection

The weakness of the Johansen cointegration approach is that it is sensitive to the lag length. The lag length should be determined before performing the test. Taking into account the fact that this research uses monthly data, the chosen maximum lag length is four (12) when performing VAR model in levels for the first time (Run the VAR model for lag length 1 to 12). After the maximum lag length is chosen based on the lag selection criterion within the VAR model. The Eviews displays the following lag selection criteria:

- LR: sequential modified LR test statistic (each test at 5% level)
- FPE: Final prediction error,
- AIC: Akaike information criterion,
- SC: Schwarz information criterion and
- HQ : Hannan-Quinn information criterion

The five criteria are widely used in the literature as stated by Enders (2010). The final lag is decided based on the VECM obtained. The thesis approach is to try all critical lags until a model with no residual is obtained.

# **5.10.2 Descriptive Statistics**

Descriptive statistics are used to describe and inform about properties of the population. The mean, the median, the standards deviation, the skewness, the kurtosis, etc., are estimated in this analysis with more sophisticated analysis to follow. The Jarque-Bera test and its probability value, for testing the hypothesis of the series having normal distribution, are also evaluated and analysed. The test computes the skewness and kurtosis and compares them with those of the normal distribution.

# 5.10.3 Unit Roots Tests Analysis

As we deal with the time series data, the unit root tests are applied for estimating the level of stationarity of the selected variables. The ADF and PP tests are applied. The null hypothesis tests the existence of a unit root, which can be rejected in case t-statistic value is lower than its critical value and the p-value is less than 0.05. In case ADF and PP test results contradict each other, the KPSS (Kwiatkowski, Phillips, Schmidt, and Shin) Test is used as an alternative source. The KPSS test differs from the ADF and PP tests in that the series is assumed to be trend stationary under the null hypothesis. Here, the level of stationarity is taken, where the KPSS tests complies with either the ADF or the PP test results.

# 5.10.4 Correlation Analysis

The correlation test is employed for evaluating how the selected variables are affecting each other. The closer the correlation coefficient to 1 in its absolute value, the higher is the level of the relationship. The correlation coefficient close to zero implies no association between the variables. The sign of the coefficient shows the direction of the association,

meaning that the positive correlation indicates that an increase in one variable will be followed by an increase in the other correlated variable, and the opposite. It should be noted here that correlation alone cannot be used for making conclusions, as the correlation coefficients are upward biased in case the series are heteroskedastic. Moreover, correlation tests are used for short-term implications and do not necessarily imply causation. Thus, causality and cointegration tests are applied for further analysis, as described above.

# 5.10.5 Data Analysis per Objective

The research methodology is designed and analysed to suit each of the ten objectives of this research and to provide solutions to the research questions, as well. This chapter briefly explains the models and tests used to analyse each objective of the research.

# **5.10.5.1 Multiple Regressions (Objective 1)**

Multiple regression method is employed to establish the relationship between the stock market index and the macroeconomic variables in the present research. To perform the multiple regression analysis, we state a research hypothesis first. Here, the hypothesis is the following: *"stock market index and macroeconomic variables are significantly related"*. The next step for the research is to determine the **null hypothesis**, which is described as follows in the current thesis: *"Stock market return and selected macroeconomic variables are not significantly related"*. In the analysis, we consider Type 1 error and the probability of error level is 5%. A test of significance is used to address the question above.

# $Y = a + b_1 + b_2 GDP + b_3 IFR + b_4 EXR + b_5 CON + b_6 INR + b_7 HPI$ (5.22)

Where Y is the value of the Dependent variable (stock returns), a is the intercept,  $b_1$ -  $b_6$  are the Slopes (Beta coefficients) for the Independent variables. The p-value for each term tests the null hypothesis that the coefficient is equal to zero, which implies that there are no effects or statistically significant relationships. A low p-value with the value < 0.05 indicates that the

null hypothesis can be rejected. Otherwise, a larger (insignificant) p-value suggests that changes in the independent variables are not associated with changes in the dependent variables. Besides testing the individual significance of the selected macroeconomic variables on the relevant stock market indices, the overall significance of the model is also tested through the R-squared ratio and p-value of the F-statistic.

Overall, the R-squared ratio greater than 60% is considered effective for the model validity, but sometimes a model may be selected with slightly lower R-squared ratio, but with significant F-statistic and t-statistics. The F-statistic shows the overall significance of all the independent variables through testing the null hypothesis of the coefficients of all the independent variables simultaneously being equal to zero. In case the p-value of the F-statistic is lower 0.05, the null hypothesis is rejected indicating overall significance of the model. It is also worth to mention that in case of comparing two models (for example, with and without dummy variables), Akaike and Schwartz information criteria can also be used for selecting the appropriate model.

These criteria assess the relative estimate of the information lost, when candidate models are used to represent the relationships between the selected data, thus, the lower the mentioned criteria, the better.

# 5.10.5.2 Johansen Cointegration Procedure (Objectives 2 and 8)

**Johansen and Juselius (1990)** multivariate cointegration approach and VECM/VAR procedure will be considered to analyse the dynamic relationship between the stock markets returns and macroeconomic variables primarily, as well as between the stock market returns in the later analysis. Johansen and Juselius test allows more than one cointegration relationship and is generally more applicable than the Enger – Granger test. The two sets of Johansen procedure known as the Trace and the Maximum Eigenvalue tests are used under this objective.

For the Trace test, the null hypothesis is that the number of cointegrating vectors is  $r^* < k$ , vs. the alternative that  $r^*=k$  and testing proceeds sequentially for  $r^*=1$ , 2, etc. and the first non-rejection of the null is taken as an estimate of r.

For the Maximum Eigenvalue Test the null hypothesis is the same as for the trace test, but its alternative is r=r\*+1 and, again, testing proceeds sequentially for r\*=1, 2, etc., and the first non-rejection is used as an estimator for r. For analysing the results of the mentioned tests, the p-value is considered. The first non-rejection is found at the point, where the p-value exceeds 0.05, which indicates the number of the cointegrating vectors. The existence of the cointegrating vectors shows the existence of the long-run relationship.

Under the mentioned tests, if the variables are found to be cointegrated of the same order then a VECM approach is followed. VECM contains information about the long-run and the short run relationship among variables. If the variables are not cointegrated, we proceed with the VAR model instead of the VECM, which only contains information on the short – run relationship. The model validity is assessed based on the value of R-squared ratio, for which again 60% minimum estimation is considered, as well as sometimes a model may be selected with slightly lower R-squared ratio, but with significant F-statistic and t-statistics. The hypothesis and the p-value assessments of the F- and t-statistics are the same as discussed in the previous point. Also, the Wald test is applied for assessing the overall significance of the cointegrated vectors in the VECM model, for which the assessment is done based on the Fstatistic and its p-value.

# 5.10.5.3 Granger Causality Test Based on VECM (Objective 3)

Here, the analysis is done following the Granger Representation Theorem, which states that if a set of variables is cointegrated, then there exists a valid error correction representation of the data, in which the short-term dynamics of the variables in the system are influenced by

the deviation from the long-term equilibrium. In a VECM, short run causal effects are indicated by changes in other differenced explanatory variables, where the significance of the variables is checked through the t-statistic's p-value. The long run relationship is implied by the level of disequilibrium in the cointegration relationship, that is, the lagged error correction term. The long – run relationship is to be found in the Error Correction Term (ECT) and the Wald  $x^2$  test statistic is used for the short-run. Going further the VEC Granger Causality/Block Exogeneity Wald Tests and the Pairwise Granger Causality tests are applied for estimating the causal relationship between the selected variables. This analysis are followed while analysing causal relationship between stock returns and macroeconomic variables, as well as analysing causal relationship between the stock returns selected for the present research. The existence of the causal relationship is verified when the corresponding p-value of the Wald  $x^2$  test statistic in case of the VEC Granger Causality/Block Exogeneity Wald Tests and of the F-statistic in case of the Pairwise Granger Causality tests is lower 0.05. For the final conclusion of the existence of the causal relationship the results of the aforementioned two tests should comply.

# 5.10.5.4 GARCH Model (Objective 4)

In the present thesis, the three types of distribution used, when estimating the GARCH model, are: normal Gaussian distribution, student's t distribution with fixed dt and generalised error distribution (GED). This will lead to three different GARCH models. The model selection is done based on the R-squared value, AIC and Schwartz Criteria, as well as the model residual diagnostics. First the model robustness is analysed through checking the residual diagnostics described in section 5.10, after the best model is selected based on the higher R-squared ration and lower AIC and Schwartz Information Criteria. The significance level of the selected macroeconomic variables, as well as the ARCH and GARCH terms, is verified through the corresponding p-value being lower 0.05.

# 5.10.5.5 VECM/VAR and GARCH models (Objective 5)

This research uses the VAR/VECM or GARCH models to develop forecasting models in the research. The static and dynamic forecasting tools from the Eviews7 Software are the two forecast methods used. The dynamic forecasting are calculated forecasts based on previously forecasted values to further forecast of a variable, while the static forecast uses the actual data or values to make a new forecast. The forecasting error is the difference between the actual model and the forecasted model for both - dynamic and static approaches of forecasting. The smaller the difference between the forecasted results and the actual results, the more reliable is the forecasted method, which is the particular regression (VAR or GARCH). The forecast error estimations are displayed in the forecast evaluation table as Root Mean Squared Error (standard deviation of forecast errors) and Mean Absolute Error, which depend on the scale of the dependent variable. The forecast evaluation table also displays the Mean Absolute Percent Error and Theil Inequality Coefficient, which are scale invariant. The Theil Coefficient accepts values in (0,1) interval with 0 value indicating a perfect fit. Three other statistical measures are also presented in the forecast evaluation table: Bias proportion, Variance proportion and Covariance proportion.

The Bias Proportion assesses how far is the mean of the forecast from the mean of the actual series. The Variance proportion evaluates how far is the variance of the forecast from the variance of the actual series. And finally, the Covariance proportion measures the remaining unsystematic forecasting errors. By the way, Bias Proportion + Variance Proportion + Covariance Proportion = 1. If the forecasts are good, the Bias and Variance proportions should be small.

# 5.10.5.6 LR Test Using VAR/VECM Models (Objectives 6 and 7)

The LR test is employed to analyse whether financial crisis of 2008 and the quantitative easing, i.e. the fiscal policy decided in the US during the crisis, affect the selected market indices. If the dummy variable effects are found to be significant, then the significant exogenous variables will be added in the model. For detailed description of the LR test refer to sub-chapter 5.7. Also, it is worth to note that the LR test is performed under the VAR/VECM model of a specific country. The LR test tests the null hypothesis of "no dummy variables effect" against the alternative hypothesis of "there is effect of dummies variables". If the LR test value is greater than chi-square critical value, we reject the null hypothesis and conclude that there is an effect of dummies variables, meaning that financial crisis and quantitative easing have effect on the stock market index of the relevant country.

# 5.10.5.7 Impulse Response Function and Forecast Error Variance Decomposition (objectives 9 and 10)

Finally, under the VAR analysis, the research uses Variance decomposition analysis and Impulse response function to assess to what extent the shocks to certain variables are explained.

The impulse response function is applied for estimating the impact of the one-time one standard deviation shock to one of the innovations on the current and future values of the selected variables. The shock to one of the variables directly influences that same variable, as well as is spread to the other variables because of the dynamic nature of VAR model. In this context, as the error terms or the innovations are generally correlated and, thus, share some common factors, usually transformation is applied to make them uncorrelated. This means that the ordering of the variables has an important implication in the analysis, and Cholesky ordering is applied in the scope of this research paper.

Extending the analysis further, variance decomposition is applied for estimating the relative importance of each random innovation to the variation of the selected variables. Thus, while the Impulse response function shows the effects of shocks on the adjustment path of the variables, the forecast error variance decomposition measures the contribution of each type of the shock to the forecast error variance. Both these computations are very useful in assessing how shocks to economic variables reverberate through a stock market system.

# 5.11 Models Robustness and Validation Tests

The model robustness and validation analysis applies to the models built under the VAR procedure and the GARCH procedure. To be the preferred model, the residuals of the model must be normally distributed with no autocorrelation and/or heteroskedasticity issues (although the on-compliance to the normal distribution is not considered a serious issue by many econometricians). The various tests used for analysing the residual diagnostics are presented below.

In the validation process, the researcher has first applied rigorous statistical hypothesis testing with the view to validate the assumption of consequence within the relevant VAR/VECM and GARCH models. Secondly, the statistical significance of these models, together with their required parametric assumptions and their residuals are verified using the diagnostic checks as elucidated in the next paragraph.

The residuals are tested through the use of statistical tests including the Ljung-Box **(Ljung and Box, 1978)** statistics test, partial autocorrelation and correlation. The Jarque-Bera **(Jarque and Bera, 1987)** test is also used to confirm normal distribution. The ARCH test has also been carried out in order to ensure that residuals are free from ARCH effects. Further, such validation also ensures that serial correlation and heteroscedasticity are not to be found in the final and accepted models. Importantly, the researcher has ensured that added lag values

attached to the models are both adequate and significant. Finally, significance testing of the estimated parameters in the models, in general, shows that all are significant at 5% level according to the tests used. When their related tests (in terms of residuals, hypotheses tests, re-estimated parameters) and the statistical significance of the models themselves have been considered, only then are to be considered the relevant variables duly validated and seen to be duly appropriate. All this is undertaken in order to ensure that only appropriately validated emergent models are duly put forth for further evaluation and statistical consideration.

# 5.11.1 Correlogram square residual (Q test)

The Correlogram displays the autocorrelations and partial autocorrelations of the equation residuals up to the specified number of lags. It is used for assessing the existence of the autocorrelation among the residuals. The last two columns reported in the correlogram are the Ljung-Box Q-statistics and their p-values. The Q-statistic at lag p is a test statistic for the null hypothesis that there is no autocorrelation up to order p, against the alternative hypothesis that there is autocorrelation. If the p-value is lower than 0.05, we reject the null hypothesis, implying that there is autocorrelation among the residuals. With higher than 0.05 p-values we fail to reject the null implying that no autocorrelation is observed among the residuals.

# **5.11.2 Normality Test (Jarque – Bera test)**

The Jarque - Bera test is used for testing the normality of the residuals. The test statistic measures the difference of the skewness and kurtosis of the residuals with those from the normal distribution. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed as  $\chi^2$  with 2 degrees of freedom. The p-value is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null hypothesis. Thus, a small probability value (< 0.05) leads to the rejection of the null hypothesis of a normal distribution.

# 5.11.3 ARCH test (Arch test)

Here the null hypothesis tests that there is no ARCH effect up to order q in the residuals against the alternative hypothesis that there exists ARCH effect. Eviews reports two test statistics; the F-statistic is an omitted variable test for the joint significance of all lagged squared residuals, while the Obs\*R-squared statistic is Engle's LM test statistic, computed as the number of observations times the  $R^2$  from the test regression. The exact finite sample distribution of the F-statistic under the null hypo null is not known, but the LM test statistic has  $\chi^2(q)$  distribution. Here again, we reject the null hypothesis if the p-value is lower than 5%.

# 5.11.4 Portmanteau Autocorrelation Test

The test computes the multivariate Box-Pierce/Ljung-Box Q-statistics for the residual serial correlation up to the specified order. Eviews reports both the Q-statistics and the adjusted Q-statistics. Under the null hypothesis of no serial correlation up to lag h, both statistics are approximately distributed as  $\chi^2(k^2(h-p))$ , where p is the VAR lag order.

# 5.11.5 Breusch-Pagan-Godfrey Heteroskedasticity Test

The Breusch-Pagan-Godfrey test tests the null hypothesis of no heteroskedasticity against the alternative hypothesis of heteroskedasticity. The Obs\*R-squared statistic is used here, which has  $\chi^2$  distribution with degrees of freedom equal to the number of independent variables. The null is rejected if the p-value is lower than 5%. **Table 5.1** presents the analysis of individual objective indicating key methodological considerations for each objective.

# 5.12 Chapter Summary

This chapter discussed the mathematical framework used for completing the research, as well as the analysis procedure of the data used. Different models and tests are explained under the veil of the research objectives and how results of this tests and models determine the acceptance or rejection of a hypothesis.

As the research uses time series data, the unit root tests are applied and discussed for assessing the stationarity level of the selected variables. The ADF and PP tests are presented in this scope. The Jarque-Bera test of normality is analysed, which assesses the existence of the normal distribution among the variables by comparing the skewness and kurtosis of the series to those of the normal distribution.

The assessment of the Objective 1 is implemented through the use of the multiple regression analysis, which evaluates the influence of one of the selected macroeconomic variables on the stock market index holding the other macroeconomic variables constant. Objectives 2 and 8 carry similar analysis by applying the Johansen and Juselius co-integration tests using both the Trace Test and the Maximum Eigenvalue Test statistics. In case of finding co-integration relationship among the selected variables the VECM medel is selected, on the other case the VAR model is applied.

Objective 3 is based on the VAR/VECM analysis for assessing the long-term equilibrium relationship (if applicable) and the short-term effects of the selected endogenous variables on the stock market indices, as well as Granger causality tests are applied for assessing the short-term causal relationships between the selected variables.

Objective 4 uses the GARCH model for evaluating the conditional volatility of the residuals. The best VECM and GARCH models, selected according to the described model robustness criteria, are used for applying further forecasting techniques to evaluate the requirements of Objective 5.

The Objectives 6 and 7 deal with the LR test assessment for analysing whether the financial crisis and the quantitative easing, selected as dummy variables, affect the stock market indices. And finally, the Objectives 9 and 10 deal with the impulse response and variance

decomposition analysis for assessing the impact of shocks to certain variables on the stock market indices, as well as the magnitude of those shocks.

The next chapter analyses the results of all the models evaluated and the hypothesis tested, which are presented and discussed in the current chapter.

# Table 5.1: Tabular Analysis of Individual Objective Indicating key Methodological Considerations for Each Objective (Page 1 of 2) \*

	Objectives as Stated	Hypothesis	Statistical	Statistical Expressions	Special Remarks		Independent Variable (Monthly)					Monthly) Dependent Variables (Monthly)															
	5	51	Tests	Generalised and Illustration Model	Period: 1995 – 2010 = 15 years	Р						ĸ	Ċ		F	BRICS	5				DEV	VELO	PED				
				Only	Quarters Data p=0.05	GD	H	EX	CO	N	Ħ	FC QE															
1	To determine sets of macroeconomic variables that are statistically significant when predicting relevant stock market indices	"That the identified stock market indices and the selected sets of macro- economic variables have a statistically significant dependent relationship when predicting them within the": A – Individual BRICS countries B – Individual Developed countries	Multiple Regression	$\begin{split} Y_i &= \beta RGDP + \beta_1 IFR + \beta_2 EXR + \\ \beta_3 CON + \beta_4 INR + \beta_5 HPI + \dots, \beta_n xn + \\ \epsilon i \text{ for } I &= 1, 2, n. \text{ Where } \beta \text{ is the coefficient of the variables, } \epsilon i \text{ the constant and } Yi \text{ a country specific index.} \\ & Illustration only - Brazil: \\ Bovespa: \beta RGDP + \beta IFR + \beta EXR + \\ \beta CON + \beta INR + \beta HPI + \epsilon i \end{split}$	The analysis considers type 1 error. <i>p</i> value and <i>R</i> square are used in the analysis.											N/	'A										
2	To identify any statistically significant long run relationship and - or linkage between selected sets of macroeconomic variables and their relevant stock market indices	"That the identified sets of macroeconomic variables have a significant consistent and cointegrative long-run relationship with their relevant stock market indices within the": A – Individual BRICS countries B – Individual Developed countries	Cointegration test: Trace test and Maxi-Eigen Test	$Y_t = \mu + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \cdots + A_p Y_{t-p} + \varepsilon t.$ Where <i>Yt</i> is a vector containing <i>n</i> variables, all of which are integrated of order one and the subscript <i>t</i> denotes the time period. $\mu$ is an $(nx1)$ vector of constants, $Ap$ is an $(n \times n)$ matrix of coefficients where $\rho$ is the maximum lag included in the model, and $\varepsilon t$ is an $(nx1)$ vector of error terms.	The Trace and the Eigenvalue tests are performed. When the $p$ value of the tests statistics is less than 5%, we reject the null hypothesis of no Cointegration among variables. But if the tests are more than 5% we accept the existence of cointegrated equations among variables. Under these tests, if the variables are found to be cointegrated of the same order then a VECM approach should be followed. VECM contains information about the long-run and the short run relationship among variables. If the variables are not cointegrated, we proceed instead of the VECM to the VAR model which only contain short – run relationship information	mestic Product	on Rate ge Rate	mption	st rate	stic Product						SITE INDEX	Н			2	E100	9					
3	To identify the directional and potentially causal relationship between sets of selected macroeconomic variables and their relevant stock market indices	"That the selected sets of macroeconomic variables significantly "Granger cause" stock market indices within the": A – Individual BRICS countries B – Individual Developed countries	Error Correction Model and Wald test	ECM: $\triangle$ Stock return: $\sum \alpha_0 RGDP + \sum \alpha_1 IFR + \sum \alpha_2 EXR + \sum \alpha_3 CON + \sum \alpha_4 INR + \sum \alpha_5 HPI + Z^*EC1_{(t-1)} + Z_2^*(FCR) + Z_3^*(QEG) + \varepsilon 1t$ . Where $\alpha$ is the coefficient of the model.	If the variables are found to be cointegrated, the research can specify an error correction model and estimate it using standards methods and diagnostic tests. VECM contains information about the long-run and the short run relationship among variables. If the variables are not cointegrated, instead of the VECM the research used VAR model which only contain short – run relationship information.	y Specific Real Gross Do	Country Specific Inflatio	Country Specific Inflatior Country Specific Exchang	Country Specific Consu	Country Specific Interes	Intry Specific Gross Dome	iable	able	Brazil-BOVESPA	Russia-RTSI	India-NIFTY	a-SHANGHAI COMPOS	South Africa-JALS	France-CAC40	Germany-DAX	Japan-NIKKE1225	United Kingdom-FTSI	United States-SP50				
4	To determine intensities of the volatility of selected macroeconomic variables on their relevant stock market indices	"That there is a statistically significant relationship between the intensities of the volatility of each macroeconomic variable, its relevant SMI and that of the comparable variable within the": A – Individual BRICS countries B – Individual Developed countries	GARCH Under (3) assumptions: Normal distribution, GED and student test	$      _{Yi} = \alpha + sum (\beta jxji) + \epsilon i, \\ Ht = \omega + \alpha \epsilon x^2 (t-1) + \beta h (t-1) + vt \\ Where ht is the conditional variance of the residual from the mean equation,                                    $	The study will apply three assumptions as done in most the empirical work on GARCH model: the normal distribution, student's t-distribution and the generalised error distribution (GED).	Count						Cot	08 Financial Crisis as a Dummy Var	antitative Easing as a Dummy Vari				Chi									
5	To determine the comparable effectiveness of the VAR or VECM models as compared to GARCH models when predicting relevant stock market indices	"That when assessing stock market indices changes VEC and VAR models have equal predictive power with GARCH models within the": A – Individual BRICS countries B – Individual Developed countries	Static and Dynamic forecasting under VAR/VECM model	The analysis will be done by developing static and dynamic forecast – statistical computation	Statistical computation will be used to implement the dynamic and the static forecast for GARCH or VECM models.							20	Qu														

Table 5.1: Tabular Analysis o	f Individual Obiective India	ating kev Methodolog	ical Considerations f	for Each Obiect	tive (Page 2 of 2) $*$

	Objectives as	Hypothesis	Statistical	Statistical Expressions	Special Remarks	Independent Variables (Monthly)								De	epende	nt Va	'ariables (Monthly)							
	Stated		Tests	Generalised and Illustration Model Only	Period: $1995 - 2010 = 15$ years Quarters Data p=0.05	GDP	IFR	EXR	CON	INR	IdH	FCR	QEG		ł	BRIC	S			DE	VEL	<b>JPED</b>	)	
6	To determine any significant reactive effect of the 2008 financial crisis on relevant stock market indices	"That in terms of stock market indices, the 2008 financial crisis had a significant depressive effect within the": A – Individual BRICS countries B – Individual Developed countries "That in terms of stock	LR test under VECM/VAR model	LR = (T-m) (Ln ( $ \Sigma r $ - Ln ( $ \Sigma u $ ) - $x^2(q)$ . Where m = number of parameters of	The null hypothesis is: No effect of dummies variables. If LR value is greater than the chi square distribution table value, then the null hypothesis is rejected. Otherwise, it is accepted at 5% significance. Please note that the research determines two equations (models). With the dummies(u) and the other without the dummies (r)	Domestic Product	flation Rate	change Rate	onsumption	nterest rate	Domestic Product	ı Dummy Variable	Jummy Variable	SPA	IS	ΓΥ	IPOSITE INDEX	HSH	240	AX	31225	FTSE100	SP500	
	impact of the (US) quantitative easing monetary policy during the 2008 financial crisis on the relevant stock market indices	market indices, the quantitative easing policy exercised in the US during the 2008 financial crisis had a significant and strengthening impact within the": A – Individual BRICS countries B – Individual Developed countries		each equation, $\Sigma$ = determinant of the residual covariance matrix. Q = number of determinant * number of equation.		Country Specific Gross	Country Specific I	Country Specific Ex	Country Specific Co	Country Specific I	Country Specific Gross I	2008 Financial Crisis as a l	Quantitative Easing as a	Brazil-BOVF	Russia-RT	India-NIF <sup>-</sup>	China-SHANGHAI COM	South Africa-J	France-CA(	Germany-D	Japan-NIKKI	United Kingdom-	United States-	
8	To determine the nature of association (if any) between and across the relevant stock market indices	"That in terms of stock market indices, there is a significant consistent corresponding association and across within the": A – Individual BRICS countries B – Individual Developed countries	Cointegration tests, VAR/VECM procedure, wald tests	$Y_t = \mu + A_1Y_{t-1} + A_2Y_{t-2} + A_3Y_{t-3} + \dots + A_pY_{t-p} + \varepsilon t$ . Where $Yt$ is a vector containing $n$ variables, all of which are integrated of order one and the subscript $t$ denotes the time period. $\mu$ is an $(nx1)$ vector of constants, $Ap$ is an $(n \times n)$ matrix of coefficients where $\rho$ is the maximum lag included in the model, and $\varepsilon t$ is an $(nx1)$ vector of error terms.	The stock markets indices are the dependent and independent variables. Countries will be changed over as dependent variables to access their relationship with the other markets. VECM/VAR procedure is implemented. Please see Objectives 2 and 3.	BOVESPA, SHANGHAI COMPOSITE INDEX, CAC 40, DAX, NIFTY, NIKKEI 225, RTSI, JALSH, FTSE100, NYSE																		
9	To determine any dynamic relationship between the relevant stock market indices and the selected macroeconomic variables	"That there is a dynamic relationship between the relevant stock market indices and selected macroeconomic variables in the": A – Individual BRICS countries B – Individual Developed countries	Impulse Response Function and Variance Decomposition under VAR/VECM model	Statistical expression N/A. however, the relevant tools within Eviews7 applied to the appropriate variables will be used	The impulse response function allows examining current and future behaviour of a given variable following a shock to another variable within the system while variance decomposition analyse short run variation.	Country Specific Gross	Country Specific Inflation Rate	Country Specific Exchange Rate	Country Specific Consumption	Country Specific Interest rate	Country Specific Gross Domestic Product	N/	'A											
10	To determine any dynamic relationship across sets of relevant stock market indices.	"That there is a dynamic relationship across the relevant stock market indices themselves within the": A – Individual BRICS countries B – Individual Developed countries	Impulse Response Function and Variance Decomposition under VAR/VECM model	Statistical expression N/A. however, the relevant tools within Eviews7 applied to the appropriate variables will be used	The stock market indices are used in term as dependent and independent. i.e for the BRICS below: Bovespa = RTS + NIFTY + SHANGHAI Composite + JALSH. In terms, each index will be dependent variables for the analysis purpose. Identical	N/A																		
## **Chapter VI**

## **Research Results**

## **6.0 Introduction**

The previous chapter presented a detailed description of the mathematical framework used for analysing the ten objectives set for this research. It also provided details of the analysis procedures of the data used. In particular, the ADF and PP tests that evaluate the level of stationarity of the time series data are presented, and the Jarque-Bera test was described. This test evaluates the hypothesis relating to the existence of a normal distribution among the data series. Further, the OLS regression techniques, VAR/VECM and GARCH models that estimate the linear relationship among the selected variables were presented.

The previous chapter also described the Granger Causality tests in order to show how they may be used to test the existence and the direction of the causal linkages between the stated variables. Equally, the Johansen-Juselius cointegration tests that evaluate the existence of the long-term cointegration among the variables were detailed. The previous chapter also presented the LR test. This test is used to evaluate the effect of structural breaks through the use of dummy variables. Finally, the impulse response and variance decomposition analysis were described. These are used for assessing the response of the selected stock market indices to one standard deviation shock to each variable, as well as the magnitude of the response.

The chapter itself is made up of sections. The first reveals and discusses the "preliminary results". The second section is devoted to a presentation/description of relevant "descriptive statistics" (which include the correlations between relevant variables). The third and most informative section of the chapter devotes itself to the presentation and discussion of

the results for the statistical/mathematical preparations for each of the appropriately relevant objective and this is done on an individual objective-by-objective basis.

The chapter ends with some concluding remarks derived from key findings of the current research.

#### **6.1 Preliminary Results**

## **6.1.1 Unit Roots Tests**

As it is described in the previous chapter, the ADF and PP tests are applied for assessing the level of stationarity of the data series. When performing the unit root tests there is an issue whether to include the exogenous variable in the model, i.e. should the regression include intercept, or intercept with trend or neither of them. On one hand, regression with intercept and trend is a more general case. On the other hand, including irrelevant regressors in the model will decrease the power of the test to reject the null hypothesis of a unit root. Thus, for avoiding spurious results, we have run the ADF tests with all the three aforementioned cases.

The test results are presented in **appendix 6 (Volume 2, pages 47-53), Appendices 6.1 and 6.6** Summarising the results of the ADF and PP tests, most of the selected variables are not stationary at level, but become stationary after the first difference. Thus, those variables are integrated of order one – I (1). Some variables are found to be I (0) or I (2).

There are some cases, when ADF and PP test results contradict each other, so as the KPSS (Kwiatkowski, Phillips, Schmidt, and Shin) Test is used as an alternative source. The KPSS test differs from the ADF and PP tests in that the series is assumed to be trend stationary under the null hypothesis. **Appendix 6.7 (Volume 2, page 53)** shows the results of the three tests for the variables having contradictions between ADF and PP test results. The stationarity level is selected based on the compliance of the KPSS test result to either the ADF or the PP test results. In those cases, when the KPSS test cannot confirm the stationarity level, the

following strategy is applied: run model under ADF and PP test results separately and choose the one with better residual diagnostics.

#### **6.1.2 Descriptive Statistics**

Appendix 7 (Volume 2, pages 54-58) illustrate the descriptive statistics of the selected variables by countries.

The Jarque-Bera Test is used for estimating whether the selected variables follow normal distribution. The null hypothesis of the Jarque-Bera test is a joint hypothesis of the skewness being zero and the excess kurtosis being zero. If the p-value is greater than 5%, we fail to reject the null hypothesis of a normal distribution, so the data are consistent with having skewness and excess kurtosis equal to zero and, thus, follow normal distribution. As it is illustrated in **Appendix 7 (Volume 2, pages 54-58)**, the hypothesis of the normal distribution is rejected for most of the series at 5% significance level.

Regarding the kurtosis, almost all the data series have value greater than 3, meaning that the distributions are said to be leptokurtic, having tails that asymptotically approach zero more slowly than those of the Gaussian normal distribution, and therefore more outliers are produced and the probability of the extreme values is higher, since the outlier is more likely to fall within a leptokurtic distribution's fat tails. The variables that have the highest kurtosis for almost all the selected countries are the following macroeconomic external variables: GDP, INR, CON and somehow IFR. It is also worth to mention that the stock market indices of the selected countries have low kurtosis value, but higher than 3.

Referring to the skewness, it is worth mentioning that all the stock market indices have negative skewness, which is in the interval of (-1, 0). NIFTY and SHCOMP have negative skewness close to zero. Negative skew indicates that the tail on the left side of the probability density function is longer or fatter than the right side. Conversely, positive skew indicates that

the tail on the right side is longer or fatter than the left side. It is also worth to mention that GDP has positive and IFR has negative skewness for all the selected developed countries, and INR has negative skewness for all the BRICS countries.

## **6.1.3** Correlation Tests results

Appendices 8.1 to 8.10 (Volume 2, pages 59-61) illustrate the level of correlation between the stock market indices and the macroeconomic variables per selected countries.

Negative high correlation is estimated between the stock market indices and exchange rates in all BRICS countries, excluding China. SHCOMP of China has positive high correlation with the HPI. Positive high correlation also exists between Nifty and Indian HPI, as well as the exchange rate and house price index are negatively correlated in India. In case of the selected developed countries, a strong positive correlation exists between the GDP and Consumption in France, Germany and UK, (EU countries). Japanese NIKKEI is positively correlated with Japanese HPI. And finally, there exists some positive high correlation between the exchange rate and consumption in US.

# 6.2 Mathematical Outcomes (Results) per Research Objectives

# 6.2.1 Variable Selection Techniques (Objective 1)

The objective of this section is to determine the sets of macroeconomic variables that are statistically significant in predicting relevant stock market indices. For this purpose, the research employs OLS analysis to estimate how the stock market indices of a specific country will be affected by the variations of the macroeconomic and/or the dummy variables of the relevant country. The OLS results and residual diagnostics are presented in Appendix 9 (Volume 2, pages 62-91).

#### **BRICS** Countries – OLS Analysis:

**Appendix 9.1 (volume 2, pages 62-64)** in **Appendix 9 (Volume 2, pages. 62-91)** summarises the results of the OLS regression for Brazil. As we see, in both cases of running the regression, without and with the dummy variables, two macroeconomic variables are found to be statistically significant at 5% significance level – the exchange rate and the house price index. Furthermore, it is worth mentioning that according to the correlation analysis, high negative correlation is estimated between the IBOV and exchange rate, which is in compliance with the negative sign of the coefficient of exchange rate in the regression equation. The R-squared, Akaike info and Schwarz criteria are close for both of the regressions. The residuals are normally distributed with no serial correlation and heteroskedasticity issues for both of the regression models. Thus, one may **accept** the **Hypothesis 1** developed in Chapter 3, that the IBOV and the following selected macroeconomic variables; EXR and HPI, have a statistically significant relationship.

**Appendix 9.2 (Volume 2, pages 65-67)** summarises the results of the OLS regression for Russia. As we see, in both cases when running the regression with and without the dummy variables, two macroeconomic variables are found to be statistically significant at 5% significance level – the exchange rate and the interest rate.

According to the correlation analysis, high negative correlation is estimated among the RTS and exchange rate, which is in compliance with the negative sign of the coefficient of exchange rate in the regression equation. The R-squared, Akaike info and Schwarz criteria are close for both of the regressions. The residuals have no serial correlation and heteroskedasticity issues for both of the regression models. The residuals for the model with dummy variables are normally distributed, as we fail to reject the null of normal distribution at 5% significance level, but we reject the null hypothesis of normal distribution for the model without dummy variables.

Thus, the model with dummy variables is acceptable. As the R-squared of the model is low, close to 0.40, but the other characteristics are satisfactory, we may **accept** the **Hypothesis 1** developed in Chapter 3, that the RTS and the aforementioned selected macroeconomic variables have statistically significant relationship.

Appendix 9.3 (Volume2, pages 68-70) summarises the results of the OLS regression for India. As we see, in both cases when running the regression with and without the dummy variables, three macroeconomic variables are found to be statistically significant at 5% significance level – the exchange rate, consumption and house price index. According to the correlation analysis, high negative correlation is estimated among the NIFTY and exchange rate and high positive correlation is found between NIFTY and HPI, which are in compliance with the negative and positive sign of the coefficients of exchange rate and house price index in the regression equation correspondingly. The R-squared, Akaike info and Schwarz criteria are close for both of the regressions. In case of the model with dummy variables we reject the null hypothesis of no serial correlation among the residuals, thus the model without dummy variables is preferable, for which the residuals are normally distributed with no serial correlation and heteroskedasticity issues. Thus, we may **accept** the **Hypothesis 1** developed in Chapter 3, that the NIFTY and the following selected macroeconomic variables; EXR, CON and HPI, have statistically significant relationship.

**Appendix 9.4 (Volumes 2, pages 71-73)** summarises the results of the OLS regression for China. As we see, in both cases when running the regression with and without the dummy variables, two macroeconomic variables are found to be statistically significant at 5% significance level – the interest rate and house price index. According to the correlation analysis, high positive correlation is found between SHCOMP and HPI, which is in compliance with the positive sign of the coefficient house price index in the regression equation. The R-

squared, Akaike info and Schwarz criteria are close for both of the regressions. For both of the models, with and without dummy variables, we reject the null hypotheses of normal distribution, no serial correlation and no heteroskedasticity among the residuals at 5% significance level. Thus, the OLS models fail to predict the Chinese stock market index through the selected macroeconomic and/or dummy variables. So as, we **reject** the **Hypothesis 1** developed in Chapter 3, that the SHCOMP and the selected macroeconomic variables have statistically significant relationship.

**Appendix 9.5 (Volumes 2, pages 74-76)** summarises the results of the OLS regression for South Africa. As we see, in case of running the regression with and without the dummy variables the only macroeconomic variable that is significant at 5% significance level is the exchange rate. According to the correlation analysis, high negative correlation is estimated among the JALSH and exchange rate, which is in compliance with the negative sign of the coefficient of exchange rate in the regression equation. The R-squared, Akaike info and Schwarz criteria are close for both of the regressions. The residuals are normally distributed with no serial correlation and heteroskedasticity issues for both of the regression models. As the R-squared for both of the models has low value 0.43, but the other characteristics are satisfactory, we may **accept** the **Hypothesis 1** developed in Chapter 3, that the JALSH and the aforementioned selected macroeconomic variable have statistically significant relationship.

#### Developed Countries – OLS Analysis:

**Appendix 9.6 (Volume 2, pages 77-79)** summarises the results of the OLS regression for France. As it is illustrated in the table, no one of the selected macroeconomic variables is statistically significant in predicting the French CAC for the two models with and without the dummy variables. The t-statistics have high p-value, meaning that we fail to reject the hypothesis of the separate coefficients being equal to zero. The F-statistic, which is used to test

the hypothesis of all the coefficients jointly being equal to zero, has also high p-value, thus again we fail to reject the null hypothesis. And finally, the R-squared is very low. Regarding the residual diagnostics, we reject the null hypothesis of normal distribution. Thus, the OLS model fails to properly describe the relationship between the CAC and the selected macroeconomic variables. So as, we **reject** the **Hypothesis 1** developed in Chapter 3, that the CAC and the selected macroeconomic variables have statistically significant relationship.

It is worth mentioning, that no correlation is observed between the CAC and selected macroeconomic variables based on the correlation analysis as well.

**Appendix 9.7 (Volumes 2, pages 80-82)** summarises the results of the OLS regression for Germany. As we see, in both cases of running the regression with and without the dummy variables, two macroeconomic variables are found to be statistically significant at 5% significance level – the GDP and the consumption. It is worth mentioning that according to the correlation analysis, no correlation is observed between the DAX and macroeconomic variables, but high positive correlation is estimated among the GDP and consumption.

The R-squared, Akaike info and Schwarz criteria are close for both of the regressions. The R-squared has very low value. The p-value of the F-statistics is high for both of the models, 0.2 and 0.34 for models without and with dummy variables correspondingly. This means, that overall all the macroeconomic variables jointly do not describe the DAX, as we fail to reject the null of all the coefficients jointly being equal to zero. The residuals have no serial correlation and heteroskedasticity issues for both of the regression models, but we reject the null hypothesis of normal distribution. Thus, the OLS model fails to properly describe the relationship between the DAX and the selected macroeconomic variables. So as, we **reject** the **Hypothesis 1** developed in Chapter 3, that the DAX and the selected macroeconomic variables have statistically significant relationship.

**Appendix 9.8 (Volume 2, pages 83-85)** summarises the results of the OLS regression for Japan. As we see, in both cases of running the regression with and without the dummy variables, two macroeconomic variables are found to be statistically significant at 5% significance level – the GDP and the HPI. It is worth mentioning that according to the correlation analysis, high positive correlation is estimated among the NIKKEI and HPI. The R-squared, Akaike info and Schwarz criteria are close for both of the regressions. The residuals have serial correlation issue for both of the models. So as the model fails to properly describe the relationship between the NIKKEI and macroeconomic variables. Thus, we **reject** the **Hypothesis 1** developed in Chapter 3, that the NIKKEI and the selected macroeconomic variables have statistically significant relationship.

**Appendix 9.9 (Volume 2, pages 86-88)** summarises the results of the OLS regression for UK. As it is illustrated in the table, no one of the selected macroeconomic variables is statistically significant in predicting the UK FTSE 100 for both of the models with and without the dummy variables. The t-statistics have high p-value, meaning that we fail to reject the hypothesis of the separate coefficients being equal to zero. The F-statistic has also high p-value, thus again we fail to reject the hypothesis of all the coefficients jointly being equal to zero. And finally the R-squared is very low. Regarding the residual diagnostics, we reject the null hypothesis of normal distribution. Thus, the OLS model fails to properly describe the relationship between the FTSE100 and the selected macroeconomic variables. So as, we **reject** the **Hypothesis 1** developed in Chapter 3, that the FTSE100 and the selected macroeconomic variables have statistically significant relationship.

It is worth mentioning, that no correlation is observed between the FTSE 100 and selected macroeconomic variables as well.

Appendix 9.10 (Volume2, pages 89-91) summarises the results of the OLS regression for the US. As it is illustrated in the table, no one of the selected macroeconomic variables is statistically significant in predicting the US S&P 500 for both of the models with and without the dummy variables. The t-statistics have high p-value, meaning that we fail to reject the hypothesis of the separate coefficients being equal to zero. The F-statistic has also high p-value, thus we fail to reject the hypothesis of all the coefficients jointly being equal to zero. And finally, the R-squared is very low. Regarding the residual diagnostics, we fail to reject the null hypothesis of normal distribution at 5% significance level, but the hypothesis can be rejected at 10% significance level. No issues regarding the serial correlation and heteroskedasticity is observed among the residuals. The OLS model fails to properly describe the relationship between the S&P500 and the selected macroeconomic variables. So as, one may **reject** the **Hypothesis 1** developed in Chapter 3, that the S&P500 and the selected macroeconomic variables have statistically significant relationship.

It is worth mentioning, that no correlation is observed between the S&P 500 and selected macroeconomic variables as well.

To summarise, it is worth mentioning that for most of the BRICS countries, namely Brazil, Russia, India and South Africa, the exchange rate is found to be statistically significant with 5% significance level in predicting the stock market index of the relevant country. Besides, high negative correlation exists between the stock market index and the exchange rate in the countries. The house price index is also significant in predicting the index value for Brazil and India (high positive correlation also exists between NIFTY and HPI), interest rate for Russia and consumption - for India. Moreover, the residuals of one or both of the models, with and without dummy variables, satisfy the main assumptions regarding the normal distribution, no serial correlation and no heteroscedasticity. Referring to China, despite the

regression models found that the interest rate and the house price index are statistically significant, the residuals of both of the models fail to satisfy the above-mentioned assumptions of residual diagnostics, and thus, the OLS estimators cannot be valid in prediction the behaviour of SHCOMP. The implication may be that Chinese stock markets are found to be the most independent among the other BRICS markets and, thus, do not respond similarly to the selected macroeconomic variables. Economically, China is the largest country in the BRICS and enjoys the highest credit rating and share of global GDP, which puts it in a strong position, especially among the BRICS countries.

Referring to the developed countries, it is worth mentioning that no significant relationship is found for any of the selected macroeconomic variables for France, UK and US. By the way, the residuals in the regression models have issues regarding the normal distribution. The residual in the regression models for Germany and Japan have issues regarding the normal distribution and serial correlation correspondingly. Thus, we may conclude that the stock market indices of the developed countries can be predicted by other factors not studied in this research, and China, the largest economy among the BRICS, "stands" close to the developed countries.

## 6.2.2 Relationship Macroeconomic variables and Stock Market – Cointegration (Objective 2)

The objective of this section is to identify any statistically significant long run relationship between the selected sets of macroeconomic variables and their relevant stock market indices. Thus, the Johansen and Juselius tests are run for estimating the co-integration or the long-run relationship among the selected macroeconomic variables and their relevant stock market indices. The maximum lag number is selected based on the higher lag indicated by the lag selection criteria, after the model is run and in case the results are not satisfactory the next highest lag is selected and another model is run with this lag (the results of the lag

selection criteria are presented in **Appendix 10 (Volume 2, pages 92-96)**. As it is illustrated in the table below, there is a long-run relationship among the stock market indices and the selected set of macroeconomic variables for all the BRICS countries, as well as for France and Germany among the developed countries. The variables are not integrated at the same order for Germany, UK and US, so as no cointegrative long-rum relationship can be observed for those countries through running the Johansen-Juselius tests. Please see **Table 6.1** on the next page.

Country	Number of co-integrating vectors	Number of co-integrating vectors		
	trace test	maximum eigenvalue test		
Brazil	4 CEs	4 CEs		
Russia	4 CEs	4 CEs		
India	6 CEs	4 CEs		
China	4 CEs	3 CEs		
South Africa	5 CEs	5 CEs		
France	4 CEs	2 CEs		
Germany	Variables are not integrated at the same level.			
Japan	3 CEs	1 CEs		
UK	Variables are not integrated at the same level.			
US	Variables are not integrated at the same level.			

Table 6.1: Johansen-Juselius Co-integration Test Results

The test determines only the number of cointegrating stationary vectors, and not what they look like. It is therefore necessary to test which variables form the cointegrating vector(s) are significant. If a variable is not in the vector it will have a parameter of zero. Thus, the further analyses are carried through Vector Error Correction Model.

The VECM has co-integration relations, which are added into the model, so as to ensure the long-run behaviour of the endogenous variables to converge to their co-integrating equilibrium relationships, simultaneously allowing for short-run adjustment dynamics. The cointegration term is also known as the "error correction term", since the deviation from longrun equilibrium is corrected gradually through a series of partial short-run adjustments.

As we are dealing with the time series data, the above-mentioned long-term relationship can be described as the long-run "average" relationship, implying that the actual values of the cointegrated variables are somehow above or below the equilibrium indicated by the equation. This deviation is captured by the error term, which should be stationary as we claim that the cointegrated relationship does not change over time, and if we deviate from this relationship in one period, it is likely that we will correct this deviation over the following periods. Thus, in order to achieve this effect, the error or the "deviation from long run relationship" of the previous period is included in the model, and its coefficient provides information on how quickly this deviation is "corrected":

The summary results of the VECM models are presented in the **Appendices 11.1 – 11.7** in **Appendix 11 (Volume 2, pages 97-105).** The only issue among the residual diagnostics is found for the VECM model evaluating the influence of the endogenous variables on Brazilian stock market index. Here we reject the null hypothesis of residuals having normal distribution, which is considered as minor issue. For detailed presentation of the hypotheses on residual diagnostics also refer to **Appendix 11 (Volume 2, pages 97-105).** 

## **6.2.2.1 VECM Model Analysis for BRICS countries**

Referring to the **Brazilian** stock market, all the four cointegrated equations, as indicated by the Trace and Maximum Eigenvalue Tests, are significant. The Wald test is run for estimating the null hypothesis of all the coefficients of the cointegrated equations jointly being equal to zero, and the results indicate that the coefficients are jointly statistically significant. Thus, all the tests indicate the existence of a long-term equilibrium relationship between the selected endogenous variables and the IBOV. The R-squared ratio is high, greater than 60%, and the F-statistic is significant. With only a minor issue regarding the normal distribution of

the residuals, the VECM model is considered valid in prediction the Brazilian stock market index.

For the **Russian** market, the coefficients of the cointegrated equations are not separately statistically significant, but according to the Wald test results they are jointly significant, meaning that there is a long-term relationship among the selected variables. Based on the model and residual diagnostics, the VECM model is considered valid in predicting the RTS.

The same picture is observed in **Indian** stock market, the coefficients of the cointegrated equations are not separately statistically significant, but according to the Wald test results they are jointly significant, indicating long-term relationship among the selected variables. The VECM model is valid for estimating the relationship between the selected endogenous variables and NIFTY based on its high R-squared value, significant F-statistic and good residual diagnostics.

Regarding the **Chinese** stock market, only one of the four cointegrated equations, indicated by the Trace Test, is statistically significant, but the Wald test results state that all the cointegrated equations are jointly significant at 5% significance level. Here the R-squared is 0.46, but as the other model and residual diagnostics are of a good quality, the model may be used for describing the relationship of the endogenous variable on the stock market index.

In case of **South African** stock market, only one of five CEs, identified by the Trace and Maximum Eigenvalue Tests, is significant, but here also the Wald test states the overall joint significance of all the five CEs. It is worth mentioning here that the p-value of the F statistic is high 0.10, meaning that all the coefficients both for the long-term and short-term relationships are not statistically significant at 5% significance level but are significant at 10% significance level. Thus, the VECM model can be considered valid in predicting the JALSH by 10% significance level.

## **6.2.2.2 VECM Model Analysis for Developed countries**

Referring to **French** market, the coefficients of the two CEs, indicated by the Maximum Eigenvalue Test, are significant. The Wald Test also shows the joint significance of all the two CEs, but F-statistic has high p-value stating that jointly all the coefficients are not significant and do not accurately describe the relationship, as well as the R-squared is 0.32. Thus, the VECM model cannot be applied for predicting the CAC.

Finally, for **Japan** two of the three CEs, indicated by the Trace Test, are significant. Based on Wald Test results all the three CEs are jointly significant. The model has high R-squared ratio, significant F-statistic and good residual diagnostics for being considered valid in describing the relationship among the endogenous variables and NIKKEI.

Thus, based on the aforementioned analysis, it can be concluded that we may **accept** the **Hypothesis 2** defined in Chapter 3 regarding the existence of the significant cointegrative long-term relationship between the selected macroeconomic variables and the individual BRICS countries, as well as Japan among the selected developed countries.

# 6.2.3 Causal Relationship between Macroeconomic Variables and Stock Market (Objective 3)

The objective of this section is to identify the directional and potentially causal relationship between sets of selected macroeconomic variables and their relevant stock market indices.

# 6.2.3.1 Short Run Effects of VECM Models

BRICS Countries: For the Brazilian stock market, all the selected macroeconomic variables are found statistically significant in describing the IBOV in the short run. In case of Russian market, the following macroeconomic variables; EXR, IFR and CON, are estimated to be statistically significant in predicting the RTS for the short run. Referring to India, the

macroeconomic variables, having short-term significant impact on NIFTY are GDP and IFR. For China, GDP and CON are found significant in having short-term influence on SHCOMP. And finally, in case of South African stock market, the short-term significant impact is observed with the following macroeconomic variables; GDP, CON, HPI.

Developed Countries: Only the VECM model run for Japan is valid for consideration, The and the only macroeconomic variable having significant short-term influence on NIKKEI is IFR.

An interesting finding of VECM analysis is that the short-term effects of the selected macroeconomic variables may be positive for one country, but negative for another. The shortterm impacts and their direction are summarised in Table 6.2 presented below. For example, DLOGGDP is significant for Brazilian, Chinese, Indian and South African stock markets, and an increase in GDP will negatively impact the stock market indices of the first two countries, which, by the way, does not comply with the theory, and positively the last two countries. Increase in Inflation rate will positively impact the stock market indices of Brazil, Russia and Japan, again a contradiction with the theory, and negatively the Indian stock market index. Increase in Consumption, one of the main components of the GDP, will have a positive impact on Brazilian and Chinese stock indices and negative impact on Russian and South African indices, which is not in line with the theory. It is worth mentioning that GDP, Inflation and Consumption are found significant for four countries out of six. The HPI and Exchange Rate are significant only for two countries' stock markets, and the INR for one. An inverse impact is assessed between the Interest Rate and the stock market indices of Brazil, which is in compliance with the theory. Regarding the Exchange Rate, negative relation is observed for the Brazilian stock market and positive for Russian stock market. In Brazil and South Africa, the increase of the Housing Prices will result in the decrease in the stock market index.

<u>Variables</u>								
	BRAZIL	RUSSIA	INDIA	CHINA	SOUTH AFRICA	JAPAN		
DLOGGDP	-		+	-	+			
DLOGINR	-							
DLOGEXR	-	+						
DLOGIFR	+	+	-			+		
DLOGCON	+	-		+	-			
DLOGHPI	-				-			

Table 6.2: Direction of the Statistically Significant Short-Term Effects of the Macroeconomic

## 6.2.3.2 VAR Model Analysis

As the there is no long-term relationship among the endogenous variables in Germany, UK and US, the VAR model is applied for assessing the short-term influence of the selected variables on the stock market indices of the relevant countries.

The only variable that is found significant to describe the German stock market index (DLOGDAX) is DLOGGDP (-7). The R-squared is low 0.25 and the F-statistic is not significant, thus we fail to reject the null hypothesis of the joint significance of all the variables. The residuals of the model have also issues regarding the normal distribution. Thus, it may be concluded that the selected endogenous variables are not statistically significant in describing the German stock market index.

Referring to UK, DLOGIFR (-5), DLOGIFR (-7), DLOGCON (-8) and DDLOGHPI (-2) are statistically significant in predicting the UK stock index. Here, again, the R-squared is low 0.38 and the F-statistic is not significant. The residuals do not comply with normal distribution, as well. So, the same conclusion can be driven, that the selected endogenous variables are not statistically significant in describing the UK stock market index.

Finally, regarding the US, DLOGINR (-3), DDLOGHPI (-1) and DDLOGHPI (-6) are significant in describing the US stock market index. Similar issues observed in Germany and

UK are valid here. Thus, the same conclusion can be driven; the selected endogenous variables are not statistically significant in describing the US stock market index.

In summary, a general conclusion can be driven from the VAR/VECM model analysis that the models run for the BRICS countries are valid to be used in describing the change in the stock market index of the relevant country. Some exception can be done for the South Africa, for which the F-statistic is significant at 10% significance level. Regarding the developed countries, the models run for the most selected countries, excluding Japan, fail to predict the stock market index of the relevant country, meaning that the relationship between the stock market indices and the macroeconomic variables is not apparent and other factors have high influence on the stock market index, thus, the theory is not supported by the numbers.

Another important conclusion is that, according to the Wald test results; there is a significant long-run relationship among the selected endogenous variables for all the BRICS countries. In case of the developed countries, long-term relationship is also observed for France and Japan. But, as the overall model run for France has "poor" quality, Japan is the only developed country left indicating the long-term equilibrium relationship.

## 6.2.3.3 Causality Analysis

VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality Tests are applied in order to find short run linkages and casual relationships between the selected variables. The results are summarised in **Appendices 12.1-12.4**. (Volume 2, pages 106-109), where "+" sign indicates the existence of causal effect, and "-" sign indicates no causal relationship. For detailed Eviews output refer to **Appendices 12.5-12.24** (Volume 2, pages 110-118)

#### 6.2.3.3.1 Granger Causality Analysis for BRICS countries

In case of **Brazil**, the results of both of the tests are very contradictory. The results of the VAR Granger Causality/Block Exogeneity Wald Tests imply that most of the macroeconomic variables, excluding the exchange rate, cause the IBOV, which comply with the results of the VECM model (excluding the exchange rate). By the way, there is bidirectional causation between the IBOV and the following macroeconomic variables: interest rate, inflation and consumption. The block of "all" macroeconomic variables also is significant in causing the IBOV. On the contrary the Pairwise Granger Causality Test indicates that the macroeconomic variables do not have any causal effect on IBOV. Both tests reflect causal relationship from IBOV to interest rate.

For **Russia**, VAR Granger Causality/Block Exogeneity Wald Tests' results indicate causal effect from exchange rate to RTS and from RTS to inflation. The block of "all" macroeconomic variables also is significant in causing the RTS. The Pairwise Granger Causality Test results found causal relationship from GDP to RTS, from inflation to RTS, as well as from HPI to RTS. There is no mismatch of the causal relationships between the two tests, so as we cannot be confident on the identified causal effects.

Referring to India, the only causal relationship, identified by the VAR Granger Causality/Block Exogeneity Wald Test, comes from inflation to NIFTY, which also complies with the Pairwise Granger Causality Test results. According to the Pairwise Granger Causality Test causal relationship is also observed from exchange rate to NIFTY and from NIFTY to interest rate. According to VAR Granger Causality/Block Exogeneity Wald Test, the block of "all" macroeconomic variables is significant in causing the NIFTY.

Related to China, VAR Granger Causality/Block Exogeneity Wald Test indicates causal effects from SHCOMP to inflation and to HPI. The Pairwise Granger Causality test

shows causal relation from GDP to SHCOMP and from HPI to SHCOMP. Again, no compliance of identified causal relationships is observed between both of the tests. Thus, we cannot be sure, on identified causal effects by single tests.

In case of **South Africa**, VAR Granger Causality/Block Exogeneity Wald Test has found causal relations from JALSH to inflation and to HPI. But the Pairwise Granger Causality test has found no causal effects between the macroeconomic variables and the stock market index. Thus, we cannot be sure on the validity of found causal relationships.

### 6.2.3.3.2 Granger Causality Analysis for Developed countries

Referring to **France**, VAR Granger Causality/Block Exogeneity Wald Test results show only bidirectional causal relation between the HPI and CAC, and the Pairwise Granger Causality test results indicate only unidirectional causal effect from CAC to HPI, consumption, inflation, exchange rate and GDP. Thus, we may conclude that there exists causal relationship **from CAC to HPI**, as both test results comply here.

Related to **Germany**, no causal effects are identified by VAR Granger Causality/Block Exogeneity Wald Test. The Pairwise Granger Causality Test indicates causal relation from DAX to GDP and to exchange rate. But no conclusion can be made because of the mismatch between the identified causal effects for the two tests.

Regarding **Japan**, VAR Granger Causality/Block Exogeneity Wald Test shows causal relation only from inflation to NIKKEI, and no causation is found by the Pairwise Granger Causality Test, and thus, no conclusion can be made.

In case of **UK**, according to VAR Granger Causality/Block Exogeneity Wald Test, GDP and inflation cause FTSE, and FTSE causes exchange rate. Pairwise Granger Causality Test implies causation from FTSE to GDP, interest rate and exchange rate. Both tests are in compliance in indicating that **FTSE100 causes the exchange rate**.

Finally, for the **US**, VAR Granger Causality/Block Exogeneity Wald Test illustrates causal effect from HPI to S&P500 and from S&P500 to interest rate. The block of "all" macroeconomic variables is found significant in causing the S&P500. Pairwise Granger Causality Test results in unidirectional causal relations from interest rate and exchange rate to S&P 500 and from S&P500 to HPI, as well as bidirectional causal effects between S&P500 and consumption. Again, no compliance is observed between the found causal relations.

Summarising the results of the granger causality analysis, we may conclude that overall, we **reject** the **Hypothesis 3** defined in Chapter 3 that the selected macroeconomic variables significantly granger cause the relevant stock market indices. The only exception is in case of Indian stock market, where the IFR granger caused the NIFTY.

## 6.2.4 Volatility of Macroeconomic Variables in Stock Market (Objective 4)

The objective of this section is to determine intensities of the volatility of selected macroeconomic variables on their relevant stock market indices. Thus, the ARCH/GARCH models are designed to model and forecast the conditional variance/volatility, where the variance of the dependent variable is modelled as a function of its past values, as well as of independent or exogenous variables. The research applies GARCH (1,1) aiming to model the volatility of the stock market indices and the factors affecting the volatility (conditional variance) of those indices. The significant ARCH term implies, that previous day's stock market index information has influence on today's stock market index volatility. The significant GARCH term implies, that previous day's volatility impacts today's volatility and shows the long-term volatility. In case both ARCH and GARCH terms are significant, an implication is made that stock market volatility is influenced by its own shocks, meaning by its own ARCH and GARCH factors. Thus, the model predicts today's stock market volatility by forming a weighted average of a long-term average (the constant),

the forecasted variance from last period (the GARCH term), and news about volatility observed in the previous period (the ARCH term). If the stock market return was unexpectedly large in either direction of upward or downward, the result will be an increase of the estimate of the variance for the next period.

The results of the model are summarised in Appendices 13.1 – 13.10 (Volume 2, pages 120-208). For the Eviews output of the GARCH (1,1) model also refer to Appendix 13 (Volume 2, pages 120-208).

The GARCH model is run using three types of distributions; Normal distribution, Student t distribution and Generalised Error Distribution (GED). Thus, before analysing the results, it is worth to select the model among the three types of distributions of normal, Student t and GED. The models are selected based on the higher R-squared value, lower Akaike and Schwarz criteria and the residual diagnostics. Regarding the residual diagnostics, all the models do not have any significant issues of heteroskedasticity or the autocorrelation. Some issues of normal distribution among the residuals are observed for all the models run for Russian, Chinese, French and Germanise stock market indices.

#### 6.2.4.1 GARCH Model Analysis for BRICS Countries

Comparing the R-squared ratios of the models, it is worth mentioning that only **Brazil** (0.70) and **India** (0.83-0.85) among the BRICS countries have higher ratios (greater than 0.60). For those countries, the higher R-squared complies with the lower Akaike and Schwarz criteria and preference is done through **the model with normal distribution**. It is worth mentioning that India has also good residual diagnostics with high R-squared in case of the VECM model. Brazil has only slight issue concerning the normal distribution of the residuals, which is not considered a serious problem, as estimators are still supposed to be consistent / efficient. Thus,

Brazilian and Indian stock market indices can be used for applying further forecasting techniques.

In case of **Brazil**, the following macroeconomic variables are found statistically significant; EXR and HPI, as well as the GARCH term is significant implying that today's volatility bears the influence of the previous day's volatility. Similar picture is observed for the GARCH model run using the normal distribution for the **Indian** stock market as well.

The GARCH (1,1) model estimated for the **Chinese** stock market has higher than 50% (but lower than 60%) R-squared ratio, which also can be considered for assessing the influence of the volatilities and independent variables on SHCOMP. The higher R-squared selects the model with normal distribution, and the Akaike and Schwarz criteria select the model with Student's t distribution. As the R-squared does not differ much, the model with Student t distribution may be considered with lower Akaike and Schwarz criteria. But, it is worth to stress here, that there is an issue regarding the normal distribution among the residuals. From the macroeconomic variables INR, CON and HPI, as well as the GARCH effect in the variance equation are assessed as statistically significant for describing the SHCOMP and its volatility correspondingly.

The other BRICS countries, Russia and South Africa, have lower R-squared – 41% and 43% correspondingly, and, thus, somehow lower predicting power. In case of the VECM model, higher R-squared is observed in the model for Russia compared to China with good residual diagnostics. And the VECM model run for the South Africa has higher R-squared compared to the GARCH models, but the F-statistic is significant at 10% significance level.

In case of **Russia**, the model with GED is considered the best one based on the higher R-squared and lower Akaike information criteria. For the mentioned model the EXR, IFR and

CON among the macroeconomic variables, as well as the GARCH effect are found statistically significant.

For **South Africa**, the model with normal distribution is considered as best one based on Akaike and Schwarz information criteria. The Exchange Rate among the macroeconomic variables, as well as the ARCH and GARCH effects are statistically significant for describing the JALSH and its volatility correspondingly.

Thus, for all of the BRICS countries the GARCH effect is found significant, and the ARCH effect is also significant for South Africa.

Summarising the BRICS countries, the models estimated for Brazilian and Indian stock market indices have high predicting power, and thus can be used for further forecasting analysis. As the best model is selected the one with normal distribution, the models assessed for both countries stock markets show that exchange rate and house price index are statistically significant in predicting the dependent variable, as well as the GARCH term is also significant, implying that today's volatility bears the influence of the previous period's volatility.

## 6.2.4.2 GARCH Model Analysis for Developed Countries

Referring to the selected developed countries, the GARCH (1,1) models run for all the countries, except for Japan, have close to zero R-squared ratio, thus, failing to describe any relation among the variables. **Japan** has an R-squared ratio of 0.55 with no issues regarding the residual diagnostics. As in case of the China, the model with Student-t distribution is selected for assessing the possible impact of the selected variables on the Japanese stock market index. In this case, the HPI among the macroeconomic variables, as well as the ARCH term and the GARCH term in the variance equation are statistically significant.

The GARCH model is also run including exogenous dummy variables, for assessing the impact of the quantitative easing and the financial crisis. But the most dummy variables are found not

significant in describing the stock market index. The only significant dummy variable is found the QEG influencing the conditional variance of the Chinese stock market index. It is also worth mentioning that the R-squared and residual diagnostics are close to those of estimated by the GARCH model without the dummy variables. Thus, the GARCH model excluding the exogenous dummy variables is selected for further analysis and implications. The Eviews output of the GARCH models including the dummy variables is presented in the **Appendix 14** (Volume 2, pages 210-299).

#### 6.2.4.3 VECM/VAR vs. GARCH Model Comparative Analysis

Summarising the results of the VECM/VAR and GARCH models, both models have similar implications for both the BRICS and the selected developed countries. The models run for the Brazilian and Indian stock market indices have high predicting power, and thus, can be used for further forecasting. The models for the rest of the BRICS countries have pretty good quality for describing the impact of the selected variables on the stock market indices of the relevant countries, but because of slightly lower R-squared ratio, are not appropriate for further forecasting. The GARCH term is found statistically significant for all the BRICS models measuring the impact of last period's forecast variance.

The same implication can be done for the selected developed countries: both VECM/VAR and GARCH models fail to be valid for the selected developed countries, except for the Japan. In this case the model has quite good predicting power, but fails to be used for forecasting because of slightly lower R-squared value. ARCH and GARCH terms are statistically significant in predicting the Japanese stock market index, implying that the stock market index volatility is influenced by its own shocks.

Thus, summarising the overall results, one may **accept** the **Hypothesis 4** defined in Chapter 3 regarding the existence of a statistically significant relationship between the

volatilities of the previous period and the current term volatility of the stock market indices for nearly all the BRICS countries, as well as Japan among the selected developed countries. It is worth mentioning here that the GARCH models run for Russia and South Africa have low R-squared ratios – 41% and 43% correspondingly.

## 6.2.5 Use of VAR and GARCH to Explain Stock Market (Objective 5)

The objective of this section is to determine the comparable effectiveness of the VAR/VECM models compared to GARCH models when predicting relevant stock market indices. As the models run for Brazilian and Indian stock market indices describe the relationship of the selected variables with high accuracy, meaning that the models have greater than 60% R-squared and good residual diagnostics, forecasting tools are applied for those countries.

As the models also include lagged dependent variables, both the static and the dynamic forecasting are run, and the Theil Inequality Coefficient, as well as the Bias and Variance Proportions are considered for assessing their predicting power. The Theil Inequality Coefficient varies between (0,1) scale, and the closer the value of the coefficient to zero, the better the forecast fits to the reality. The Bias Proportion indicates how far is the mean of the forecast from the mean of the actual series. Similarly, the Variance Proportion indicates how far is the values of the Bias and Variance Proportions are close to zero, it is observed perfect fit to the actual series.

**Appendices 15.1 – 15.8 (Volume 2, pages 300-303)** show the results of the forecast for Brazilian and Indian stock markets using both the VECM and GARCH models. The graphs show the forecast sample together with 2 standard error bands, as well as the forecast of the variance for the GARCH model.

In case of the Brazilian stock market, as it is observed from the graphs for VECM model forecasts, the confidence error bands widen dramatically towards the end of the forecast sample for the dynamic forecasting, which is the result of using the forecast values of the lagged dependent variables. The forecast errors tend to compound over time and compose larger error bands as we go further out in the forecast sample. On the other hand, the static forecasts are one-step ahead forecasts and use the actual values of lagged dependent variables for performing the forecasts. When comparing the forecast evaluation indicators for the dynamic and static forecasts, the static forecast model shows better fit to the actual series, which is the result of using the actual lagged values for performing the forecasts. Both the static and the dynamic forecast models have close to zero Theil Inequality Coefficients, Bias and Variance Proportions, and, thus show perfect fit to the actual series. Similar implication can be made for the forecast models concerning the Indian stock market index.

The GARCH model forecasts have similar forecast evaluation indicators both for dynamic and static models for the Brazilian and Indian stock market indices. For Brazilian market, the variance forecast of the dynamic model shows some rapid declining trend and stabilises since the year of 2006, while it is observed fluctuating trend in case of the static model. In case of the Indian market, the variance forecast of the dynamic model illustrates gradual decline for the whole forecast period, while a rapid decline followed by fluctuations with some declining trend is observed for the static model. Thus, the dynamic GARCH forecast model shows better fit for both of the countries.

Comparing the VECM and GARCH forecast models, it is worth mentioning that VECM forecasts outperform the GARCH model and show better fit to the actual series. So, we can **reject** the **Hypothesis 5** defined in Chapter 3 indicating that the VEC/VAR models have equal

predictive power when compared with the GARCH models for the Brazilian and Indian stock markets.

# 6.2.6 Effects of 2008 Financial Crisis and US Quantitative Easing Policy on the Economy (Objective 6 & 7)

*Objectives six and seven are aimed to assess and analyse the impact of the 2008 financial crisis and the US quantitative easing monetary policy exercised during the crisis on the relevant stock market index*. The LR test is used for assessing the effect of the dummy variables, meaning the effect of the financial crisis and the quantitative easing, on the stock market indices of the relevant countries. Based on the results of the LR test, a decision is made to take the VECM/VAR model including or excluding the dummy variables.

The LR test results are summarised below in **Table 6.3**. As it is illustrated in the table, the dummy variables, i.e. the financial crisis and quantitative easing, have effect on the stock market indices of Brazil, Russia, China and South Africa among the BRICS countries, as well as France, Japan and UK among the selected developed countries. Thus, the dummy variables should be included in the VECM/VAR models of the aforementioned countries.

	LR test value	Chi square critical value	effect on the stock market index					
BRICS Countries								
Brazil	26.09	23.68	Yes					
Russia	32.47	23.68	Yes					
India	17.55	23.68	No					
China	33.18	23.68	Yes					
South Africa	37.41	23.68	Yes					
Developed Countries								
France	31.81	23.68	Yes					
Germany	17.20	23.68	No					
Japan	27.65	23.68	Yes					
UK	28.31	23.68	Yes					
US	20.64	23.68	No					

Table 6.3: LR Test Results

The VECM/VAR model results, including the dummy variables based on the LR test results, are summarised in **Appendices 16.1 – 16.7 (Volume 2, pages 304-312).** 

## 6.2.6.1 BRICS Countries

The VECM model results, for **Brazilian** market, are summarised in **Appendix 16.1** in **(Volume 2, pages 304-312)**. All the variables that are significant for both models of including and excluding the dummies, are highlighted in bold, the new variables that are found significant when adding the dummy variables are shown in red colour. From the two dummies included in the model, the financial crisis - FCR is found statistically significant at 5% level. The new model has similar high R-squared ratio and significant F-statistic. Regarding the residual diagnostics, again the new model has an issue with normal distribution, which is assessed as a minor issue.

Similar results and residual diagnostics for both of the models, excluding and including the dummies, are observed is case of **Russian** stock market. From the two dummies, the financial crisis - FCR is statistically significant at 5% level for Russian market index as well. It is also worth to mention that one of the co-integrated equations is found to be statistically significant for the new model with dummies, as well as the GDP is also found statistically significant with the new model. However, the CON is not significant for the new model.

Referring to **China**, the new model with dummies has similar R-squared, lower 50%, similar significant F-statistic. The residual diagnostics mostly comply, except for that the new model has some issue regarding the normal distribution of the residuals, which is not supposed as a serious issue. It is also worth to mention that no one of the dummy variables is found to have significant impact on the Chinese stock market index. The CON is fount not significant for the new model.

Concerning **South Africa**, the two models, without and with the dummies, have similar R-squared, F-stat with 10% significance level and similar residual diagnostics with no issues found. No one of the dummy variables is found to have significant impact on the South African stock market index.

## **6.2.6.2 Developed Countries**

Referring to the selected developed countries, especially in case of **French** and **Japan** stock markets, we got similar results regarding the model and residual diagnostics for both of the models excluding and including the dummy variables. The new model run for French market fails to describe the relationship, but has high predictive power for the Japanese market. All the dummies are found to be insignificant both for French and Japanese stock markets. In case of **UK** stock market, the VAR model is used, as no co-integrated relations were found. Here, the following variables are found significant: DLOGIFR (-7), DLOGCON (-8), DDLOGHPI (-1) and DDLOGHPI (-2), most of which comply with the previous model excluding the dummies effect. R-squared, F-stat and residual diagnostics comply with the first model as well. It is also worth to mention that the dummy variables fail to be significant, as well as the model itself fails to describe the relationship and has low R-squared and insignificant F-statistic.

In summary, the LR test results indicate that the dummy variables have effect on most of the BRICS stock markets, excluding India. But the results of the VECM model, including the dummy variables, show that <u>only</u> one of the selected two dummy variables, the financial crisis, has an impact <u>only</u> on the stock market indices of Brazil and Russia. Moreover, the financial crisis has positive impact on the Brazilian stock market, and negative impact on the Russian stock market indices, which implies that Brazilian stock market, is somehow an outsourcing destination from the international financial markets.

Regarding the selected developed countries, the LR test results are significant only for French, Japanese and UK stock market indices. But, the models run for French and UK markets have insignificant F statistic and low R-squared, and thus, cannot be considered. For the Japanese stock market, the model has high predictive power, but the dummy variables are insignificant as opposed to the LR test results.

Thus, we may **accept** the **Hypothesis 6** defined in Chapter 3 that the 2008 financial crisis had a significant depressive effect on the stock market index of **Russia**. Regarding Brazil the 2008 financial crisis had a significant, but positive (not depressive) impact on the relevant stock market index. The hypothesis is rejected for the other countries, as the FCR was found to be insignificant.

Regarding **Hypothesis 7**, stating that the quantitative easing policy exercised in the US during the 2008 financial crisis had a significant and strengthening impact on the relevant stock market indices; it can be **rejected** as the variable is assessed to be insignificant for all the selected countries.

## 6.2.7 Financial Market Interaction or Integration (Objective 8)

The objective of this section is to determine the short and long-run nature of association between and across the relevant stock market indices.

Appendix 17.1 (Volume 2, page 313) summarises the descriptive statistics of the stock market indices. The Jarque-Bera statistic has p-value lower than 5% for most of the indices, except for NIKKEI, meaning we reject the null hypothesis of normal distribution for all the index series, except for NIKKEI. As an additional point, the skewness of NIKKEI is very close to zero and the kurtosis is close to 3, as is supposed to be for normally distributed series.

The other indices have negative skewness in the interval of (-1,0), except for the S&P500, which indicates that the tail on the left side of the probability density function is

longer or fatter than the right side. And the S&P500 has positive skewness in the interval of (0,1), thus, the tail on the right side is longer or fatter than the left side. Regarding the kurtosis, all the indices have a value lower than 3, which means that the distribution is slightly flat (platykurtic) relative to the normal distribution. This implies low probability of the extreme values, since the outlier is less likely to fall within a platykurtic distribution's short tails.

Appendix 17.2 (Volume 2, page 314) illustrates the correlation between the selected stock market indices. As we see from the table, there is high correlation between the stock market indices of the selected developed countries, except for CAC and S&P500, for which the correlation ratio is slightly lower 0.56. Strong correlation is also observed between the individual stock market indices of BRICS countries and DAX. The stock market indices of BRICS countries also are highly correlated, except for RTS and SHCOMP, for which the correlation ratio is 0.51.

Further, the Johansen-Juselius co-integration test is applied for assessing the existence of the long-term relationship or co-integration among the stock market indices. By the way, most of the lag selection criteria indicate one lag (refer to the **Appendix 17.3 (Volume 2, page 315)**. The results of the Johansen-Juselius tests, both the Trace test and the Maximum Eigenvalue test, are presented in **Appendix 17.4** in **appendix 17 (Volume 2, page 316**). As we see, both tests have found one co-integrated equation, meaning that there exists long-run association among the stock market indices, and thus, the VECM model can be applied for evaluating this relationship.

The E-views output of the VECM model is presented in **Appendix 18.1 (Volume 2, page 317**). All the VECM models, evaluating the impact of all the other stock market indices to the index of a particular country, have very low R-squared value. Moreover, we fail to reject the null hypothesis of all the coefficients jointly being equal to zero for most of the models,

except for the ones assessing the influence of the other stock market indices on the **RTS and NIKKEI.** In case of **Russian** stock market, the co-integrated equation, responsible for the longtern impact, and the IBOV, assessing the short-term effect from IBOV to RTS, are found statistically significant based on their t-statistics. The R-squared is found very low - 0.12. Regarding the residual diagnostics, there is an issue of heteroscedasticity (for residual diagnostics refer to **Appendix 18.2 (Volume 2, page 318**). Thus, the model fails to describe the relationship of the stock market indices to RTS. In case of **Japanese** stock market, the cointegrated equation, responsible for the long-tern impact, and the SHCOMP and CAC, assessing the short-term effect from the mentioned indices to NIKKEI, are found statistically significant, based on their t-statistics. The R-squared is again low - 0.13. Here we have an issue of heteroscedasticity among the residuals as well. Thus, this model also fails to predict the association among the stock market indices and Japanese index accurately. Thus, an overall conclusion can be made that the VECM models, evaluating the relationship between and across the all selected stock market indices, are not appropriate and cannot be taken into consideration.

The short-run causal relationships are evaluated through applying the VEC Granger Causality/Block Exogeneity Wald Tests, as well as the Pairwise Granger Causality Tests. The E-views outputs are presented in **Appendices 19.1 and 19.9 (Volume 2, pages 320-328)**. Based on VEC Granger Causality/Block Exogeneity Wald Tests results IBOV is statistically significant in causing RTS, NIFTY and CAC, as well as CAC and SHCOMP are significant in causing NIKKEI. According to the Pairwise Granger Causality Test results:

✓ IBOV granger cause RTS, NIFTY, DAX and NIKKEI,

✓ S&P500 granger cause IBOV,

✓ CAC, DAX and FTSE100 granger cause RTS,

✓ NIFTY granger cause DAX and NIKKEI,

- ✓ DAX and NIKKEI granger cause SHCOMP,
- ✓ JALSH granger cause DAX and NIKKEI,
- ✓ FTSE100 granger cause JALSH,
- ✓ CAC and DAX granger cause NIKKEI.

If we combine the results of the VEC Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality Tests results, it can be concluded that causal relationship exists from IBOV to RTS and NIFTY, as well as from CAC to NIKKEI.

As the VECM models, that capture the association of all the stock market indices, fail to describe the relationship among those indices properly, the same procedure is applied for BRICS and selected developed countries separately to assess the association among the stock market indices for per each group.

## **6.2.7.1 Stock Market Index Interrelationships – BRICS Countries**

The Johansen-Juselius Test results (**Appendix 20.1 (Volume 2, page 329**), both the Trace Test and the Maximum Eigenvalue, indicate no co-integration, implying no long-run association among the stock market indices of the BRICS countries. Thus, the VAR model is applied for evaluating the relationship of those indices. The Eviews output of the VAR model is presented in **Appendices 20.4-20.5 (Volume 2, page 335-337**). The lag selection criteria results are presented in **Appendix 20.2 (Volume 2, page 330**). The 8<sup>th</sup> lag is selected based on the LR test results.

Analysing the VAR model results, it is worth mentioning that the R-squared ratios for all the models, assessing the impact of the lagged indices on the index of a certain BRICS countries, are close to 30%. The F-statistic is insignificant for all the models, except for the one assessing the influence of the lagged stock market indices on IBOV, for which the DLOGIBOV (-2), DLOGIBOV (-3), DLOGRTS (-8), DLOGNIFTY(-2), DLOGNIFTY(-4),

DLOGSHCOMP(-2), DLOGSHCOMP(-3) and DLOGJALSH(-8) are found statistically significant based on their t-statistics. It is also worth to mention that there is no issue regarding the residual diagnostics, meaning that the residuals are normally distributed, with no autocorrelation or heteroscedasticity issues.

VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality tests are applied for assessing the short-term causal relationships between the BRICS stock market indices. The Eviews outputs are presented in **Appendices 20.5 and 20.6 (Volume 2, pages 336-338**). Based on the VAR Granger Causality/Block Exogeneity Wald Tests the following indices are found statistically significant in causing another BRICS stock market index: IBOV and JALSH cause NIFTY, RTS causes SHCOMP and JALSH, feedback relationship is found between the IBOV and RTS. The Pairwise Granger causality tests results show that IBOV granger cause RTS and NIFTY, which complies with the results of the VAR Granger Causality/Block Exogeneity Wald Tests. Thus, based on the two test results, we may conclude that IBOV granger cause RTS and NIFTY.

## 6.2.7.2 Stock Market Index Interrelationships – Developed Countries

The Johansen-Juselius Trace and Maximum Eigenvalue Tests (**Table 21.1** in **appendix 21 (Volume 2, pages 339)** are run for assessing the level of co-integration among the stock market indices of the selected developed countries. As it is illustrated in Table 21.1, the Trace Test indicates 3 co-integrated equations, while the Maximum Eigenvalue Test shows no co-integration at 0.05 level. Both VECM and VAR models are run, based on the results of the co-integration tests, and the model with better diagnostics is selected – the VAR model. The Eviews output of the VAR model is presented in **Appendices 21.3-21.4** in (**Volume 2, page 340-344**). The lag selection criteria results are presented in in **Appendix 21.2 (Volume 2, page 340)**. The 6<sup>th</sup> lag is selected based on the LR test results.

Analysing the VAR model results, it is worth mentioning that the R-squared ratios of all the models have low values (the lowest is 15% and the highest is 23%), as well as the F-statistic of all the models is insignificant. The VAR model has some issue regarding the normal distribution of the residuals. Thus, we can conclude that the VAR model fails to describe the association among the stock market indices of the selected developed countries.

VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality tests are applied for assessing the short-term causal relationships between the BRICS stock market indices. The Eviews outputs are presented in **Appendix 21.5 (Volume 2, pages 345)**. Based on the VAR Granger Causality/Block Exogeneity Wald Tests results, only the block of "all" stock market indices are significant in causing the NIKKEI. According to the Pairwise Granger Causality Test results, CAC granger causes NIKKEI, as well as there is a feedback relationship between FTSE100 and DAX. Thus, the both causality test results do not comply.

## Please see Appendix 21.6 (Volume 2, Page 346)

Summarising, it can be mentioned that the VECM/VAR models fail to predict the relationship among the stock market indices properly.

Causal relationships are found only from IBOV to RTS and to NIFTY from the BRICS countries, which complies with the results of all the causality tests.

Thus, we may **reject** the **Hypothesis 8** defined in Chapter 3 that there is a significant consistent association within and across the stock market indices for both the BRICS and the selected developed countries.

# 6.2.8 Effects of Shocks from Macroeconomic Variables to Stock Market & Reverse (Objective 9)

The objective of this section is to determine any dynamic relationship that exists between the relevant stock market indices and the selected macroeconomic variables. For this purpose, the impulse response and variance decomposition analysis are carried out.
The impulse response of each of the BRICS and the selected developed countries' indices to a one-time shock to one of the innovations is analysed. The results are presented in **Appendices 22.1 – 22.10 (Volume 2, pages 347-351)**, which show the impulse responses for 10 periods/quarters ahead. It is worth mentioning here that the different ordering of the variables may result in different estimations for Cholesky decomposition of the innovation matrix. The Cholesky ordering is the log value of the index of the certain country, LOGGDP, LOGINR, LOGEXR, LOGIFR, LOGCON and LOGHPI of the relevant country. The figures illustrate the impulse responses of the stock market index and selected macroeconomic variables of a specific country to the corresponding market shock of the relevant country and the dynamic relations among the index and the macroeconomic variables 10 periods ahead.

For stationary VARs, the impulse responses should die out to zero as time pass, which is observed in the figures in **Appendix 22 (Volume 2, pages 347-351**).

# 6.2.8.1 Impulse Response Analysis: BRICS Countries

*Brazil*: As it is illustrated in **Appendix 22.1 (Volume 2, page 347**), the response of the Brazilian stock market index to positive one standard deviation shock to its own innovations is very high and positive for the first period and gradually dies to zero as time pass. The response of IBOV to the shocks of the selected macroeconomic variables is zero for the first period. The response of IBOV to **GDP** increases rapidly till the 3<sup>rd</sup> period and stays positive with some fluctuations till the end of the 10<sup>th</sup> period. The response of IBOV to **INR** decreases steadily till the 4<sup>th</sup> period and stays negative with slight fluctuations till the end of the 10<sup>th</sup> period. It is worth mentioning that the magnitude of the response is higher to one standard deviation shocks to other macroeconomic variables is low. The response of IBOV to EX is slightly negative during the 2<sup>nd</sup> period with some increasing low positive trend till the end of the 10<sup>th</sup> period. The response of IBOV to EX is slightly negative during the

of IBOV to IFR is low and positive till the 6<sup>th</sup> period, after which it starts to decrease up to having slight negative value during the 10<sup>th</sup> period. The response of IBOV to CON is slightly high and positive during the 2<sup>nd</sup> period with declining trend and negative values since the 7th period. Finally, the response of IBOV to HPI is low positive with declining trend from 2<sup>nd</sup> till 4<sup>th</sup> periods, with negative low values after then.

<u>*Russia*</u>: As it is illustrated in Appendix 22.2 (Volume 2, page 347), the response of the Russian stock market index to positive one standard deviation shock to its own innovations is very high and positive during the first four periods, after which starts to decline gradually till the end of the 10<sup>th</sup> period. Here, the highest magnitude of the response is observed to one standard deviation shock to EX and IFR. The response of RTS to **EX** is positive with increasing trend till the 5<sup>th</sup> period stabilising with slight fluctuations for the 6-10<sup>th</sup> periods. The response of RTS to **IFR** is low negative till the 3<sup>rd</sup> period, having declining trend and getting high magnitude till the 10<sup>th</sup> period. Low positive and/or negative responses are observed to shocks to other macroeconomic variables.

India: As it is illustrated in Appendix 22.3 (Volume 2, page 348), the response of the Indian stock market index to positive one standard deviation shock to its own innovations is very high and positive during the first period with declining trend till the 8<sup>th</sup> period and stabilising with low negative values during the last two periods. The highest magnitude of the response of NIFTY is observed to one standard deviation shock to GDP, CON and in some aspects to EX. The response of NIFTY to shock to GDP is positive with increasing trend till the 5<sup>th</sup> period, where it reaches to its maximal value, and declining trend after on till the 10<sup>th</sup> period. The response to the shock to CON is high and negative from the 4th to 7<sup>th</sup> periods, with low positive and negative values during the first and last three periods. The response of NIFTY to the shock to EX is low negative till the 4<sup>th</sup> period with rapid increase during the 5<sup>th</sup> period

and positive stable trend till the end of the 10<sup>th</sup> period. Low positive and/or negative responses are observed to shocks to other macroeconomic variables.

*China*: As it is illustrated in **Appendix 22.4** (Volume 2, page 348), the response of the Chinese stock market index to positive one standard deviation shock to its own innovations is very high and positive with increasing trend during the 10 periods. Comparably higher magnitude in response of SHCOMP is observed to one standard deviation shock to EX and CON, which is positive with increasing trend till the end of the 10<sup>th</sup> period. It is worth mentioning that SHCOMP is mostly impacted by its own shocks than by the shocks of the selected macroeconomic variables, the magnitude of which increases as time passes.

South Africa: As it is illustrated in Appendix 22.5 (Volume 2, page 349), the response of the South African stock market index to positive one standard deviation shock to its own innovations is very high and positive with slight declining trend till the end of the 10<sup>th</sup> period. High magnitude of response of JALSH is observed to one standard deviation shock to INR, which is negative with decreasing trend.

# 6.2.8.2 Impulse Response Analysis: Developed Countries

<u>France</u>: As it is illustrated in Appendix 22.6 (Volume 2, page 349), the response of the French stock market index to positive one standard deviation shock to its own innovations is very high and positive during the 10 periods. It is observed a rapid decline and increase during the 3<sup>rd</sup> and 4<sup>th</sup> periods, followed by a stable trend till the end of the 10<sup>th</sup> period. Comparably higher magnitude in response of CAC is observed to one standard deviation shock to IFR and GDP, which have negative declining trend till the end of the 10<sup>th</sup> period. It is worth mentioning that CAC is highly impacted by its own shocks than by the shocks of the selected macroeconomic variables.

<u>Germany</u>: As it is illustrated in Appendix 22.7 (Volume 2, page 350), the response of the German stock market index to positive one standard deviation shock to its own innovations is very high and positive for the first period, with sharp decline during the second period and with close to zero value after on. It is also worth to mention that the response of DAX to the shocks to the selected macroeconomic variables is not significant.

*Japan*: As it is illustrated in **Appendix 22.8 (Volume 2, page 350**), the response of the Japanese stock market index to positive one standard deviation shock to its own innovations is very high with slight fluctuations for the 10 periods. High magnitude of the response of NIKKEI is observed to one standard deviation shock to EX and IFR. The response of NIKKEI to EX is positive with increasing trend till the 5<sup>th</sup> period stabilising with slight fluctuations for the 6-10<sup>th</sup> periods. The response of NIKKEI to **IFR** is low negative till the 3<sup>rd</sup> period, having declining trend and getting high magnitude till the 10<sup>th</sup> period. Low positive and/or negative responses are observed to shocks to other macroeconomic variables.

<u>UK</u>: As it is illustrated in **Appendix 22.9** (Volume 2, page 351), the response of the UK stock market index to positive one standard deviation shock to its own innovations is very high and positive for the first period, with sharp decline during the second period and close to zero value after on. It is also worth to mention that the response of FTSE100 to the shocks to the selected macroeconomic variables is not significant.

<u>US</u>: As it is illustrated in **Appendix 22.10 (Volume 2, page 351**), the response of the US stock market index to positive one standard deviation shock to its own innovations is very high and positive for the first period, with sharp decline during the second period and close to zero value after on. It is also worth to mention that the response of S&P500 to the shocks to the selected macroeconomic variables is not significant.

The impulse response functions evaluate the impact of a shock on the stock market index or the macroeconomic variables of a specific country to the stock market index of the relevant country in the VAR/VECM models, whereas the variance decomposition separately estimates the variation in the index of a specific country into the component shocks to the VAR/VECM, showing the relative importance of each random innovation in affecting the stock market indices. The results of the variance decomposition are summarised in Appendices 23.1 – 23.10 (Volume 2, pages 352-355). The S.E. column shows the forecast error, which is the result of the variation in the current and future values of the innovations to each stock market returns in the VAR/VECM model. The rest of the columns indicate the percentage of the forecast variance due to each innovation, which implies that the sum of each row is 100%. Here again the variance decomposition can change significantly in case of changing the order of variables. The ordering of the variables is the following: the log value of the index of the selected country, LOGGDP, LOGINR, LOGEXR, LOGIFR, LOGCON and LOGHPI of the relevant country.

## 6.2.8.3 Variance Decomposition Analysis: BRICS Countries

**Brazil**: As it is illustrated in **Appendix 23.1 (Volume 2, page 352)**, after 10 periods about 73% in the innovations originated in the stock market of Brazil are affected by the selected macroeconomic variables compared to the 0% for the first period. From the mentioned 73%, 49% is due to GDP and 13% to INR. Thus, Brazilian stock market explains about 27% of its own innovation after 10 periods compared to the 100% of the first period.

<u>*Russia*</u>: As it is shown in **Appendix 23.2 (Volume 2, page 352**), after 10 periods about 58% in the innovations originated in the stock market of Russia are affected by the selected macroeconomic variables compared to the 0% for the first period, from which 29% is due to

EX and 21% to IFR. Thus, RTS explains about 42% of its own innovation after 10 periods compared to the 100% of the first period.

<u>India</u>: As it is seen in Appendix 23.3 (Volume 2, page 352), after 10 periods about 77% in the innovations originated in the stock market of India are affected by the selected macroeconomic variables compared to the 0% for the first period, from which 37% is due to GDP, 11% due to EX and 11% to CON. Thus, NIFTY explains about 23% of its own innovation after 10 periods compared to the 100% of the first period.

<u>China</u>: As it is illustrated in Appendix 23.4 (Volume 2, page 353), after 10 periods about 28% in the innovations originated in the stock market of China are affected by the selected macroeconomic variables compared to the 0% for the first period. The highest impact on the SHCOMP is observed for the CON – 10%, and somehow for the EX – 8.5%. Thus, the Chinese stock market is highly impacted by its own innovations; more than 72% after 10 periods compared to the 100% of the first period.

<u>South Africa</u>: As it is shown in Appendix 23.5 (Volume 2, page 353), after 10 periods about 40% in the innovations originated in the stock market of South Africa are affected by the selected macroeconomic variables compared to the 0% for the first period, from which 26% is due to INR. Thus, JALSH explains more than 60% of its own innovation after 10 periods compared to the 100% of the first period and is also highly impacted by its own innovations.

## 6.2.8.4 Variance Decomposition Analysis: Developed Countries

<u>France</u>: As it is shown in Appendix 23.6 (Volume 2, page 353), after 10 periods about 22% in the innovations originated in the stock market of France are affected by the selected macroeconomic variables compared to the 0% for the first period. High impact on the CAC has IFRIT – 12%, and also some 5% impact is due to GDP. Thus, CAC is highly impacted by its own innovations – 78% after 10 periods.

<u>Germany</u>: As it is illustrated in Appendix 23.7 (Volume 2, page 354), the German stock market is highly affected by its own innovation after 10 periods – more than 83% of DAX is still explained by its own innovations after 10 periods vs. 100% of the first period. The combined influence of the selected macroeconomic variables is lower 17%, and the weight of the separate macro variables is lower than 5%.

<u>Japan</u>: As it is illustrated in **Appendix 23.8** (Volume 2, page 354), after 10 periods about 41% in the innovations originated in the stock market of Japan are affected by the selected macroeconomic variables compared to the 0% for the first period. From the mentioned 41%, 20% is due to EX and 13% to IFRIT. Thus, Japanese stock market explains about 60% of its own innovation after 10 periods compared to the 100% of the first period.

<u>UK</u>: As it is shown in **Appendix 23.9** (Volume 2, page 354), after 10 periods about 30% in the innovations originated in the stock market of UK are affected by the selected macroeconomic variables compared to the 0% for the first period, from which the highest percentage - 12% is due to IFR. Thus, FTSE100 is also highly impacted by its own innovations; 70% after 10 periods compared to the 100% of the first period.

<u>US</u>: As it is shown in Appendix 23.10 (Volume 2, page 355), after 10 periods about 29% in the innovations originated in the stock market of US are affected by the selected macroeconomic variables compared to the 0% for the first period. No one of the selected macroeconomic variables has an impact greater 7%. Thus, S&P500 is mostly explained by its own innovation – 71% after 10 periods compared to the 100% of the first period.

In conclusion, it is worth mentioning that the results of the impulse response and variance decomposition analyses also illustrate that the stock market indices of the developed countries are highly influenced and explained by their own innovations, which is estimated 70-

80%. An exception is Japan, for which about 60% of NIKKEI is explained by its own innovations.

Referring to BRICS countries, it is worth mentioning that Chinese stock market index is highly affected by its own innovations compared to the stock markets of the other countries for which the effect of some of the selected macroeconomic variables is more significant.

Thus, we **reject** the **Hypothesis 9** defined in Chapter 3, stating that there is a dynamic relationship between the relevant stock market indices and the selected macroeconomic variables, for all the developed countries, with some **exception** of **Japan**, for which the EXR and somehow the IFR have some significance. We **reject** the mentioned hypothesis for **China** as well. And for the **other BRICS countries**, we may **accept** the hypothesis. Mainly, significant dynamic relations are found for Brazil – GDP (49%) and somehow INR (13%), Russia – EXR (29%) and IFR (21%), India – GDP (37%), EXR and CON (11% each), South Africa – INR (26%).

## 6.2.9 Effects of Shock between Stock Market Indices (Objective 10)

The purpose of this section is to determine any dynamic relationship that exists across the sets of relevant stock market indices.

Similar analysis of the impulse response and variance decomposition is done here as well, where the variables are only the selected stock market indices. **Appendix 24.1** in **(Volume 2, page 356)** presents the combined graph of all stock market indices for 10 periods ahead. It illustrates the responses of all the stock market indices to the shocks of other ones and the dynamic relations of the selected indices. The Cholesky ordering is LOGIBOV, LOGRTS, LOGNIFTY, LOGSHCOMP, LOGJALSH, LOGCAC, LOGDAX, LOGNIKKEI, LOGFTSE100 and LOGSP500.

As it is illustrated in the figure, the response of the **IBOV** to positive one standard deviation shock to its own innovations is high, positive and stable for all the 10 periods. The response of IBOV to the shocks of the other indices is insignificant. The response of **RTS** to the one standard deviation shock of its own innovations is also high, positive and stable for the 10 periods ahead. It is also observed significant positive response of **RTS** to the shocks of IBOV and slight negative response to the shocks of S&P500. Referring to **NIFTY**, high, positive and stable response is seen to the shocks of innovations of its own market and Brazilian stock market. The response of **SHCOMP** to positive one standard deviation shock to its own innovations is very high, positive and stable for all the periods. The response of SHCOMP to the shocks to other indices is insignificant. Regarding the **JALSH**, the response to the one standard deviation shock to the innovations of its own and Brazilian market is high, positive and stable for the 10 periods. Slight response is also observed to the shocks of Russian and Indian stock markets. As it is seen, the responses of the BRICS stock market indices are mostly significant to the one standard deviation shocks to the innovation shocks to the innovations of the indices of the same BRICS countries.

The response of **CAC** to the one standard deviation shock to the innovations of its own and Brazilian market is high, positive and stable for the 10 periods. Slight response is also observed to the shocks of South African and Indian stock markets. The magnitude of the response of **DAX** to the shock of the innovations of IBOV, followed by CAC, is higher compared to the magnitude of the response to the shocks to its own innovations. Referring to NIKKEI, the response to one standard deviation shock to its own innovations is high, positive and stable for all the periods. Higher positive response with increasing trend is observed to the shocks to the innovations of IBOV. The magnitude of the response of **FTSE100 and S&P500** to the shock of the innovations of IBOV, followed by CAC, is higher compared to the

magnitude of the response to the shocks to their own innovations, as is the case with DAX. Thus, as we see, the stock market indices of Germany, UK and US, for which no long run relationship was observed depending on the macroeconomic variables of the relevant countries, have higher magnitude of response to the shocks of the innovations of IBOV, followed by CAC, compared to the shocks to their own innovations.

The impulse response analyses are also carried separately for the BRICS and the selected developed markets. The results are summarised in Appendices 24.2 and 24.3 in (Volume 2, pages 357-358).

## **6.2.9.1 Impulse Response Analysis: BRICS Countries**

As it is illustrated in **Appendix 24.2 (Volume 2, page 357**), the response of the **IBOV** to positive one standard deviation shock to its own innovations is very high for the first period, then drops significantly to zero and fluctuates around it till the end of the 10<sup>th</sup> period. The response of the **RTS** to the shock to its own innovations is also high for the first period, then drops close to zero starting from the second period and fluctuates around it. High positive response of RTS to the shocks to the innovations of IBOV is also observed during the first and second periods with declining trend. The response of **NIFTY** to the one standard deviation shock to its own innovations is also high during the first period, then drops rapidly during the second period and fluctuates around zero till the end of the 10<sup>th</sup> period. Some high magnitude of response of NIFTY to the shock of the innovations of IBOV and RTS is also observed during the first two periods. **SHCOMP** responds significantly only to the shock to its own innovations with high magnitude of response during the first period, which declines sharply to zero and fluctuates around slight positive magnitudes till the end of the 10<sup>th</sup> period. And finally, the response of **JALSH** to the shocks to its own innovations is again high and positive during the first period, sharply declining to zero starting from the second period and fluctuating around

zero till the end. JALSH also responds to the shock to the innovations of IBOV significantly, as well as to RTS and NIFTY with low magnitude.

## **6.2.9.2 Impulse Response Analysis: Developed Countries**

The impulse responses of the stock market indices of the developed countries to the shocks to their innovations are illustrated in **Appendix 24.3 (Volume 2, page 358)**. The response of the **CAC** to positive one standard deviation shock to its own innovations is very high for the first period, then drops significantly to zero and fluctuates around it till the end of the 10<sup>th</sup> period. **DAX** responds to the shocks to the innovations of CAC with higher magnitude than to the shocks to its own innovations. The response of the **NIKKEI** to positive one standard deviation shock to its own innovations is high for the first period, then drops significantly to zero and fluctuates around it till the end of the 10<sup>th</sup> period. Again, as in case of DAX, higher magnitude of response of **FTSE100** and **S&P500** is observed to the shocks to innovations of CAC than to their own innovations during the first period, which rapidly drops to zero and fluctuates around it till the end of the 10<sup>th</sup> period.

Appendices 24.4 - 26.5 (Volume 2, pages 359-367) illustrate the results of the variance decomposition analysis of the all indices, and well as per groups of indices of BRICS and developed countries.

Considering the **Appendix 24.4 (Volume 2, page 359-364**), which presents the results of the variance decomposition analyses of all the selected indices; it is worth mentioning that IBOV and SHCOMP are highly impacted by their own markets. RTS, NIFTY and JALSH, as well as CAC and NIKKEI, are highly affected both by their own and by the Brazilian markets. The DAX, FTSE100 and S&P500 are explained mostly by the innovations of Brazilian and French stock markets.

## 6.2.9.3 Variance Decomposition Analysis: BRICS Countries

As it is illustrated in **Appendix 24.5 (Volume 2, page 365-367**), after 10 periods about 22% in the innovations originated in the stock market of Brazil are affected by the stock markets from other countries of BRICS compared to the 0% for the first quarter. Thus, IBOV is mostly affected by its own market. The RTS is affected by its own market – 58%, as well as by the Brazilian stock market – 25% 10 periods ahead. NIFTY is impacted 46% by its own market, 31% by the Brazilian and 11% by Russian stock markets 10 periods ahead. SHCOMP is highly affected by its own market – 80% 10 periods ahead. And finally, JALSH bears the impact of its own – 38% and Brazilian markets – 33%, as well as Russian – 14% and Indian – 12% markets. Thus, Chinese and Brazilian stock markets are the most intendent markets among the BRICS countries.

## **6.2.9.4 Variance Decomposition Analysis: Developed Countries**

As it is illustrated in **Appendix 24.6 (Volume 2, page 366-367**), the CAC is highly impacted by its own market – 86%. NIKKEI is also highly affected by its own market – 63%, as well as by the French market 28%. DAX, FTSE100 and S&P500 are more impacted by the French market (50-70%) 10 periods ahead, than by their own markets.

Summarising, it must be noted that the Chinese and Brazilian stock markets are the most independent markets; French stock market is also considered as independent from the other stock markets. One should note here, that in case of analysing by using the all stock markets, the Brazilian market highly impacts all the other stock market except for the Chinese stock market. This can be the effect of the Cholesky ordering of the stock market indices. Thus, the French stock market can be considered independent, as well as the Japanese stock market may also be considered as independent, because of not bearing the impact of the French market when considering all the stock market indices. Similarly, the independent nature of the

Brazilian stock market may also be the result of Cholesky ordering. So as, we can be sure that the Chinese stock market is independent from the other countries' stock markets.

Thus, we may **reject** the **Hypothesis 10** defined in Chapter 3, stating that there is a dynamic relationship across the relevant stock market indices for Brazil and China among the BRICS countries, as well as for France and Japan among the developed countries. Some relationship is found from Brazilian market to Russian stock market, from Brazilian and Russian to Indian, and from Brazilian, Russian and Indian to South African stock markets among the BRICS countries, as well as from French stock market to German, UK and US markets.

## **6.3 Chapter Summary**

The current chapter discusses the results driven from the models used for assessing the relationships within and across the selected macroeconomic variables and the stock market indices, as well as among the stock market indices themselves.

As we deal with time series data, the ADF and PP test are first applied for evaluating the level of stationarity of the selected variables. In case of contradiction between the ADF and PP test results, the KPSS test is applied as an alternative source.

The Jarque-Bera test is applied and the results indicate that we reject the null hypothesis of normal distribution for most of the series at 5% significance level.

Based on the correlation test results, high correlation ratios are estimated between the stock market indices of the BRICS countries and at least one of the selected macroeconomic variables. Specifically, negative high correlation is assessed between the stock market indices and EXR in all BRICS countries, except for China. SHCOMP of China is highly positively correlated with the HPI. Similarly, positive high correlation is also observed between the Nifty and Indian HPI, implying that the EXR and HPI are negatively correlated in India. In case of

the selected developed countries, it is worth mentioning that the stock market indices of the developed countries are not significantly correlated with any of the selected macro variables, excluding the Japanese NIKKEI, which is positively correlated with the HPI. But strong positive correlation is found between the GDP and Consumption in France, Germany and UK, as well as some positive high correlation is estimated between the Exchange Rate and Consumption in the US.

**Objective #1**: The aim of the section is to determine sets of macroeconomic variables that are statistically significant in predicting relevant stock market indices. The OLS model is applied for this purpose. For the most countries included in BRICS, especially for Brazil, Russia, India and South Africa, the EXR is found to be statistically significant with 5% significance level in predicting the stock market index of the relevant country, which, by the way, also complies with the correlation test results. The HPI is found significant in predicting the index of Brazil and India (compliance with the correlation results in case of India). The INR is found statistically significant in predicting the Russian stock market index, and the CON is significant in describing the Indian stock market index. Referring to China, the OLS model fails to predict the behaviour of SHCOMP through the macroeconomic and dummy variables, as the residuals are not normally distributed with serial correlation and heteroskedusticity issues.

In case of the developed countries, no statistically significant relationship is estimated for French, UK and US stock markets. In general, the OLS models run for the aforementioned countries fail to predict the relationship among the selected variables properly. Moreover, the residual in the regression models for Germany and Japan have issues regarding the normal distribution and serial correlation correspondingly.

Thus, a general conclusion can be made, that the selected macroeconomic variables and/or the dummy variables fail to describe the stock market indices of the developed countries, implying that other factors need to be considered in this aspect. Another implication is that China acts more like a developed country than an emerging one. This can be explained by the fact that China is the largest and mostly independent country among the BRICS countries.

The present thesis and **Dritsaki (2005)** show similarity as both demonstrate statistically significant evidence of a relationship between stock markets indices and particular macroeconomic variables. However, U.S. results from **Campbell and Shiller (1988), Chen et al (1986), Gallegati (2005), Humpe, and Macmillan (2007)** support the view that macroeconomic variables do explain changes in the stock market. These results are contrary to those determined in the present thesis.

**Objective #2**: The objective is to identify any statistically significant long run relationship between the selected sets of macroeconomic variables and their relevant stock market indices. Thus, the Johansen-Juselius cointegration test is applied and the results indicate that long-run relationship is found among the stock market indices and the selected set of macroeconomic variables for all the BRICS countries, as well as for France and Japan among the developed countries. Similar tests cannot be implemented for the other developed countries because of the variables not being integrated at the same order.

For the stock markets of the countries having demonstrated long-term cointegrated relationship, BRICS countries, French and Japan, VECM model is applied. And VAR model is used for the other ones. Based on the model and residual diagnostics, the VECM models run for the BRICS countries can be used in predicting the stock market index of the relevant country. What refers to the developed countries, the models are valid for estimating the relationship among the selected variables only for Japan, and for the other developed countries

they fail to predict the stock market index, meaning that other factors exist that have high influence on the stock market index of the developed countries.

Another important conclusion that is derived from the VECM model analysis is that there exists a significant long-run relationship among the selected endogenous variables for all the BRICS countries and Japan, according to the Wald test results.

Maysami et al (2004) and Moolman and Du Toit (2005) and Nasseh and Strauss (2000) studies supported evidence of relationship between stock market and macroeconomic variables in the emerging countries. This is similar to the present thesis, where in BRICS countries stock market and macroeconomic variables have proven relationship. This is not the case of Yunus (2012) and Ratanapakora and Sharma (2007) who have opposed results to the current thesis as they supported existence of long-run relationship between macroeconomic variables and stock markets.

**Objective #3**: The aim is to identify the directional and potentially causal relationship between sets of selected macroeconomic variables and their relevant stock market indices.

Significant short-term impacts from the VECM models are found between the following macroeconomic indices and the relevant stock market indices: RGDP, INR, EXR, IFR, CON and HPI to IBOV; EXR, IFR, CON to RTS; GDP, IFR to NIFTY; GDP, CON to SHCOMP and GDP, CON, HPI to JALSH, as well as IFR to NIKKEI. In this regard, it should be noted that impact of the aforementioned macroeconomic variables is positive *(existence of causality between the variables. Otherwise negative for one country)*, but negative for another, meaning the theory is not always justified by the real life statistics.

Through the scope of the Objective 3, the granger causality analyses are also implemented and the results indicate causation from IBOV to INR, from IFR to NIFTY, as well as from CAC to HPI and from FTSE100 to EXR.

The present results of this thesis is similar to those of Mahmood and Dinnah (2007), Ahmed (2008) and Shabaz (2008). However, the present research and Argawal et al (2010) and Iltuzer et Tas (2012) do not share similarities.

**Objective #4**: The purpose is to determine intensities of the volatility of selected macroeconomic variables on their relevant stock market indices. So as the GARCH (1,1) model is used here. The results showed that the GARCH effect is statistically significant for all of the BRICS countries implying that today's stock market index volatility bears the impact of the previous day's volatility, and the ARCH effect is significant for South Africa, meaning that today's volatility is also impacted by the previous day's stock market index information. Both the ARCH and the GARCH effects are significant for the Japanese stock market as well, implying that the stock market volatility is influenced by its own shocks. Here, again as in case of the VECM models, the GARCH models run for the developed countries are not appropriate, excluding Japan.

Finally, The GARCH model is also assessed through including exogenous dummy variables and the results state the impact of the 2008 financial crisis and the quantitative easing policy adopted by the US on the volatility of the stock market indices, are not significant.

The thesis shows that the GARCH model is not enough in determining volatility in most of the developed economies while critical to do the same in the BRICS. This is opposed to **Kapital (1998) and Choo et al (2011)** works. Similarity in terms of results is to be found with the following authors **David and Morelli (2002)**, **Morelli (2002) and Leon (2008)**.

**Objective #5**: Aims to determine the comparable effectiveness of the VAR/VECM models compared to GARCH models when predicting relevant stock market indices. The VECM and GARCH models have high R-squared ratio (>60%) only for Brazil and India. Thus, the forecasting techniques are applied for those countries' stock market indices. The predicting

power of the forecasts is evaluated using the Theil Inequality Coefficient, as well as the Bias and Variance Proportions. The results suggest that the VECM forecasts outperform the GARCH forecast model, and, thus, have better fit to the actual series.

The similarity with Asgharian et al (2013), Abugri (2008), Federova et al (2010), Hsing et al (2011) and Hondroiannis et al (2001) is that they all try to analyse predictive power of selected macroeconomic variables on selected stock markets. However, the thesis is unique in comparing.

**Objective #6 & #7**: These objectives are directed to assess and analyse the impact of the 2008 financial crisis and the US quantitative easing monetary policy exercised during the crisis on the relevant stock market index. For this purpose, the LR test is applied. The results suggest that the aforementioned structural breaks have influence on the stock market indices of the following countries: Brazil, Russia, China, South Africa, as well as France, Japan and UK, and, thus, should be included in the VAR/VECM models. So, the new models, including the dummy variables, are assessed, and the results indicate that only one of the selected two dummy variables - the FCR, has impact only on the stock market indices of Brazil and Russia. By the way, the financial crisis has positive impact on the IBOV, and negative impact on the RTS. Thus, we may conclude that Brazilian stock market is somehow an outsourcing destination from the international financial markets. Regarding the selected developed countries, only the model run for the Japanese stock market, has high predictive power, but the structural breaks are found insignificant as opposed to the LR test results.

The research suggests that the aforementioned structural breaks have influence on the stock market indices Brazil, Russia, China, South Africa, France and Japan. This is similar to the work of Aweda et al (2014), Neaime (2012), Bong-Han Kim et al (2012). However,

**Rachidi et al (2013)** has contradictory results where the 2008 financial crisis do not have effect on the Tunisian stock market.

**Objective #8**: The Objective 8 is defined to determine the short and long-run nature of association between and across the relevant stock market indices. Before running the models, the correlation between the stock market indices is evaluated. The results suggest that high correlation exists between the stock market indices of the selected developed countries, excluding CAC and S&P500. High correlation is also observed between the individual stock market indices of BRICS countries and the German DAX. Referring to the stock market indices of BRICS countries, they are found to be highly correlated as well, excluding the RTS and SHCOMP.

The Johansen-Juselius tests found one co-integrated relationship among all the stock market indices, but the VECM models estimated turned out to be not appropriate for assessing the relationship among those stock market indices.

Granger causality analyses are also implemented for all the stock market indices, with the results indicating causal impact from IBOV to RTS and NIFTY, as well as from CAC to NIKKEI.

Similar analyses are also implemented through the stock market indices of the BRICS countries, as well as of the developed countries. In case of the BRICS countries, the Johansen-Juselius test results found no cointegration among the indices, but the VAR model fails to describe the relationships among the BRICS indices. Only in some aspects the model is valid for the IBOV. The granger causality analyses showed short-term causal linkage from IBOV to RTS and NIFTY.

The Johansen-Juselius Trace and Maximum Eigenvalue tests indicate three and zero cointegration among the stock market indices of the developed countries correspondingly, so

as the VECM and VAR models are run and the best model is selected based on the model and residual diagnostics – the VAR model. Anyway, the VAR model fails to describe the association among the stock market indices of the selected developed countries. And finally, no causal linkages are found among the indices of the developed countries.

Thus, the VECM/VAR models are not appropriate to predict the association among the stock market indices accurately. Moreover, causal relationships are found only from IBOV to RTS and to NIFTY from the BRICS countries, which complies with the results of all the causality tests.

The present thesis evidenced that VECM/VAR models are not appropriate to predict the association among the stock market indices accurately. However, **Palamalai et al (2013)**, **Raj et al (2008)** found a well-defined long-run between selected countries using a VECM/VAR approach which is not similar to the above mentioned results. It is also important to mention that **Tripathi et al (2012)** found long-run relationship between stock market, which is also similar to the present results.

**Objective #9**: The purpose is to determine any dynamic relationship that exists between the relevant stock market indices and the selected macroeconomic variables. Thus, the impulse response function and the variance decomposition analysis are applied.

The results illustrated that the stock market indices of the developed countries are highly influenced and explained by their own innovations. Again, an exception is Japanese NIKKEI, which is explained 60% by its own innovations, besides the EXR and IFR among the macroeconomic variables also have high influence.

Regarding the **BRICS countries**, only the **Chinese** stock market index is highly affected by its **own innovations** and the stock market indices of the other countries also bear the effect of some of the selected macroeconomic variables: IBOV - GDP and somehow INR,

RTS – EXR and IFR, NIFTY – mainly GDP, somehow EXR and CON, and finally JALSH – INR.

The present thesis supports that stock markets of developed country are the main drivers of stock price changes. In the BRICS context, China stand alone as close to the developed economies while the other BRICS countries stock markets changes in relation with certain macroeconomic variables. This is similar to **Iglesias et al (2011)** findings. While the results are opposed to those of **Sardosky (1999)**, **Li et al (2007) and Balgacem et al (2012)**.

**Objective #10**: The purpose is to determine any dynamic relationship that exists across the sets of relevant stock market indices. Again, the impulse response and variance decomposition analysis are used. The results showed that Chinese stock market is the most independent market among the BRICS countries.

The thesis evidenced that Chinese and the Brazilian stock markets are the most independent markets along with the French market. Arshanap (1993) and Gosh et al (1999) studies are not similar to the present research while Phylaktis et al (2002) and Yang et al (2004) are similar to the present thesis.

**Appendix 25 (Volumes 2, pages 368-377)** compares present results with some selected previous researches. The following chapter is concerned with research conclusions and policy implications to policy makers, governments and academics.

# **Chapter VII**

# **Research Conclusions and Policy Implications**

## 7.0 Introduction

This chapter presents the research conclusions and policy implications. These are detailed per objectives as developed in this research. The present chapter will present ten distinctive contributions of use for governments, policy makers and academics.

#### 7.1 Research Summary

This research was totally focused on the stock market indices of the two sets of countries; the BRICS countries and the developed countries, of France, Germany, Japan, UK and US are selected in the scope of this research. Ten objectives were identified for research analysis, and hypotheses were statically tested using arguments related to one or more of the following three theories: The Arbitrage Pricing Theory (APT), the Capital Asset Pricing Model (CAPM) and the Efficient Market Hypothesis (EMH). Given the laid-out objectives, appropriate hypotheses are designed for each of the stock market indices of the aforementioned countries.

Accordingly, a wide range of econometric models were used and hypotheses were tested for serving to the purposes of the ten objectives set for this research.

First, as time series data is considered, the stationarity level of the selected data series was assessed, followed by an analysis of several descriptive and inferential statistics and tests. The OLS regression, VAR/VECM and GARCH models were applied for assessing the relationship of the selected variables on the stock market indices. The Johansen-Juselius cointegration tests were used for evaluating the existence of the long-run cointegrated association among the set of macroeconomic variables and the stock market indices of the

relevant countries, as well as among the selected stock market indices themselves. The shortterm causal effects between the used variables are identified through using the VAR Granger Causality/Block Exogeneity Wald Tests and the Pairwise Granger Causality Tests. The GARCH model is applied for estimating the impact of the volatility of the stock market indices. The importance of the dummy variables – the structural breaks is assessed by using the LR test. Finally, the impulse response and the variance decomposition analyses are applied for evaluating the dynamic relations among the selected variables. The summary results, as well as the conclusions identified per stated objectives are presented in the sub-chapter below.

# 7.2 Conclusions on Research Analysis

## 7.2.1 Conclusions on the Preliminary Results

Before summarising the results and the conclusions driven per objective, some initial consideration regarding the properties of the data series, used in this research, is presented.

*Unit Root Tests:* The ADF and PP tests are employed for assessing the level of stationarity of the data series. Based on the results of the mentioned tests, most of the selected variables are found to be integrated of order one – I (1). Some variables are found to be I (0) or I (2). Some cases are observed, where the ADF and PP test results contradict each other. For those cases, the KPSS test is applied as an alternative source, and the stationarity level is selected based on the compliance of the KPSS test result to the ADF or PP test results.

*Descriptive Statistics:* The descriptive statistics of all the variables are also analysed, as well as the Jarque-Bera test is applied for assessing whether the variables have normal distribution. In this regard, it is worth mentioning that the kurtosis of almost all the data series is greater than 3. This means that the distributions are leptokurtic with tails that asymptotically approach to zero more slowly than those of the Gaussian normal distribution. So as more outliers are produced and the probability of the extreme values is greater, as the outlier is more

likely to fall within a leptokurtic distribution's fat tails. From the selected macroeconomic variables, the ones that have the highest kurtosis for almost all the selected countries are GDP, INR, CNS and somehow IFR. It is also worth to note that the stock market indices of the selected countries have low kurtosis value, but higher than 3.

*Correlation Analysis:* The correlation analysis is applied for assessing the magnitude and direction of correlation between the selected variables. The most important findings here are the following:

- Negative high correlation is observed between the SMIs and Exchange Rates for all BRICS countries, excluding China,
- SHCOMP is positively highly correlated with the HPI, the same is true for Nifty and Indian HPI,
- NIKKEI is positively correlated with Japanese HPI.

As we see here, there exists high correlation between the stock market indices of the BRICS countries and at least one of the selected macroeconomic variables. The stock market indices of the developed countries are not significantly correlated with any of the selected macro variables, excluding the Japanese NIKKEI, which is positively correlated with the HPI. But there exists some level of correlation between some of the selected macroeconomic variables per developed countries. It is also worth to mention that high positive correlation is observed between the GDP and CON for France, Germany and UK, which is in compliance with the theoretical implication that consumption is a determinant factor of the GDP.

# 7.2.2 Conclusions on Research Objectives

Objective 1 -to determine the sets of macroeconomic variables that are statistically significant in predicting relevant stock market indices: For this purpose, the OLS analysis is carried out to estimate how the stock market indices of a specific country will change in

response to the variations of each of the selected macroeconomic and/or the dummy variables of the relevant country, while holding the other macro variables constant.

The following macroeconomic variables are found statistically significant in predicting the stock market index of the relevant country:

## **BRICS** Countries:

- Brazil, IBOV EXR and HPI (EXR complies with the correlation test results),
- Russia, RTS EXR and INR (EXR complies with the correlation test results),
- India, NIFTY EXR, CON and HPI (EXR and HPI comply with the correlation test results),
- China, SHCOMP INR and HPI (HPI complies with the correlation test results),
- South Africa, JALSH EXR (also complies with the correlation test results).

Regarding the Chinese stock market, the OLS models run fail to describe the relationship between the macroeconomic variables and SHCOMP, as the residuals are not normally distributed with serial correlation and heteroscedasticity issues.

# **Developed Countries:**

- France, CAC no statistically significant macroeconomic variable is found,
- Germany, DAX GDP and CON (high positive correlation is estimated among the GDP and CON for Germany),
- Japan, NIKKEI GDP and HPI (HPI complies with the correlation test results),
- UK, FTSE100 no statistically significant macroeconomic variable is found,
- US, S&P500 no statistically significant macroeconomic variable is found.

It is worth mentioning that the OLS models fail to properly describe the relationship between the CAC and the selected macroeconomic variables of France, DAX and the selected

macroeconomic variables of Germany, the FTSE100 and the selected macroeconomic variables of the UK, and the S&P500 and the selected macroeconomic variables of the US.

The residuals are found to be serially correlated for both of the OLS models, including and excluding the dummy variables, estimated for the Japanese stock market index.

In summary, for most of the BRICS countries, namely Brazil, Russia, India and South Africa, the exchange rate is assessed to be statistically significant with 5% significance level in predicting the stock market index of the relevant country. It is also worth to mention that high negative correlation is observed between the stock market index and the exchange rate for the mentioned countries. The HPI is found significant in predicting the index value for Brazilian and Indian stock markets. Worth to note that high positive correlation is estimated between NIFTY and HPI. The interest rate is significant in predicting the RTS and the consumption for NIFTY. Referring to the validity of the models, the residuals of one or both of the models, including and/or excluding the dummy variables, satisfy the main assumptions regarding the normal distribution, no serial correlation and no heteroscedasticity, and, thus, can be taken into consideration. Referring to China, the residuals of both of the models fail to satisfy the model robustness diagnostics, so as; the OLS estimators cannot be valid in prediction the SHCOMP. This can be explained by the fact that China is considered the largest and mostly independent country in the BRICS and enjoys the highest credit rating and share of the global GDP. The mentioned argument puts it in a strong position, relative to the BRICS countries, thus some properties of the developed countries may be attributed to China.

Referring to the developed countries, it is worth mentioning that the OLS models fail to predict the stock market indices based on the selected macroeconomic variables. Thus, we may conclude that the stock market indices of the developed countries can be described by

other factors not studied in this research, and China, the largest economy among the BRICS countries, "stands" close to the developed countries.

*Objective 2 – to identify any statistically significant long run relationship between the selected sets of macroeconomic variables and their relevant stock market indices.* The Johansen-Juselius cointegration test is applied for assessing the existence of the long-term relationship between the selected macroeconomic variables and the stock market indices of the relevant countries. Based on the test results, long-run relationship is observed among the stock market indices and the selected set of macroeconomic variables for all the BRICS countries, as well as for France and Japan among the developed countries. As the variables are not integrated at the same order in case of Germany, UK and US, no cointegrative long-run relationship can be observed for the stock markets of those countries by applying the Johansen-Juselius cointegration tests.

For all the countries, where the variables are found to be co-integrated based on the Johansen-Juselius test results and, thus, indicate long run relationship, the VECM model is run for estimating both the long-term relationship and the short-term effects of the time series. All the BRICS countries, as well as France and Japan among the developed countries are in the mentioned category. For Germany, UK and US the VAR model is applied for evaluating the relationship of the selected macroeconomic variables and the stock market index of the relevant country. The VECM models run for the BRICS countries are found to be valid to be used for predicting the change in the stock market index of the relevant country. Some exception can be done for the South Africa, where the F-statistic is significant at 10% significance level. In case of the developed countries, the VAR/VECM models run for the most selected countries, with the exception of Japan, are not appropriate for predicting the stock market index of the relevant country, implying that the linkage between the stock market indices and the

macroeconomic variables is not guided by the theory, and other factors can be identified to have significant influence on the stock market index especially for the developed countries. So, the theory is not justified by the statistical implications.

According to the Wald test results; significant long-run relationship is observed among the selected endogenous variables for all the BRICS countries, as well as Japan among the developed countries.

# Objective 3 - to identify the directional and potentially causal relationship between sets of selected macroeconomic variables and their relevant stock market indices.

The macroeconomic variables found to have short-term effects on the stock market indices of the relevant countries based on the VECM model analysis are the following:

## **BRICS** Countries

- Brazil, IBOV GDP, INR, EXR, IFR, CON and HPI,
- Russia, RTS EXR, IFR, CON,
- India, NIFTY GDP, IFR,
- China, SHCOMP GDP, CON,
- South Africa, JALSH GDP, CON, HPI,

# **Developed** Countries

• Japan – IFR.

It is worth mentioning here that the short-term effects of the selected macroeconomic variables are found positive for one country, but negative for another, which implies that theoretical justifications are not always supported by the statistics.

Going further, the VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality Tests are applied in order to find short run linkages and casual relationships between the selected variables. It is worth mentioning here, that we will adopt the existence of

the causal relationship in case both of the mentioned tests state the existence of that linkage. The results of the causal relationships implied by both VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality Tests are illustrated below:

#### **BRICS** Countries

- from IBOV to INR,
- from IFR to NIFTY.

#### **Developed** Countries

- from CAC to HPI,
- from FTSE100 to EXR.

Thus, as it is observed from the causality analysis, the only causal relationship that is run from a macroeconomic variable to the stock market index and is observed by both VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality Tests is from IFR to NIFTY, which also complies with the VECM model short-term effect.

Summarising the findings of VECM/VAR models, it is worth mentioning that the models run for estimating the relationship between the endogenous variables and the stock market indices of the relevant countries are valid in case of the emerging BRICS countries, but cannot be applied for assessing the linkages regarding the developed countries. The only exception is Japan, among the developed countries, for which several justifications can be considered. For example, Japan may be not as much developed as the other selected EU countries or the US. If we consider the GDP (PPP) per capita ranking based on the International Monetary Fund or the World Bank statistics, Japan is below the other selected developed countries. Another reason may be that Japan is not as active in the international politics as the other selected developed countries, for example Japan is not included as a permanent member in the UN Security Council, etc.

*Objective 4 - to determine intensities of the volatility of selected macroeconomic variables on their relevant stock market indices*. For this purpose, the GARCH (1,1) model is used to model the volatility of the stock market indices and the factors affecting the volatility of those indices. The model has an ARCH and GARCH term in its variance equation, estimating the impact of the previous day's stock market index information (the ARCH term) and the previous day's volatility (the GARCH term) on the today's stock market index volatility, and showing the short-term and the long-term volatilities correspondingly. The GARCH model is run through three types of distributions; the Normal distribution, the Student t distribution and the Generalised Error Distribution. Thus, for finding out the best model, the following selection criteria are used: R-squared, Akaike information and Schwarz information criteria, as well as the residual diagnostics.

The models run for **Brazilian** and **Indian** stock markets display high, greater than 60% R-squared ratio with good residual diagnostics, and, thus, can be applied for employing further forecasting techniques. The GARCH models with the Normal distribution are assessed as the best models with significant **EXR** and **HPI** macroeconomic variables and **GARCH term** for the both stock market indices: IBOV and NIFTY.

For China, the model with Student's t distribution is taken for analysis with the following significant macroeconomic variables; INR, CON and HPI, as well as the significant GARCH effect.

For Russian stock market the EXR, IFR and CON among the macroeconomic variables, as well as the GARCH effect in the variance equation are found statistically significant.

And for the South African market the Exchange Rate among the macroeconomic variables, as well as the ARCH and GARCH effects are statistically significant.

It is worth to note that the R-squared ratio is low 41-43% in case of Russia and South Africa.

All the GARCH models run for the **developed markets** are of a poor quality with close to zero R-squared ratio, thus fail to describe the relationship among the variables properly. The only exception here is Japan, as was the case with the VECM model. The model with Studentt distribution is selected as the best one for assessing the possible impact of the selected variables on the NIKKEI. Here, the HPI among the macroeconomic variables, as well as the ARCH term and the GARCH term in the variance equation are statistically significant.

The GARCH model analysis is extended by including exogenous dummy variables, in order to evaluate the impact of the quantitative easing and the financial crisis on the volatilities of the stock market indices. Most of the dummy variables are found not significant in describing the volatility of the stock market index. The only significant dummy variable is found the QEG influencing the conditional variance of the Chinese stock market index. Besides, the R-squared ratio and residual diagnostics do not vary essentially from those estimated by the GARCH model excluding the dummy variables. Thus, we may conclude that the GARCH model excluding the exogenous dummy variables can be selected for further analysis and implications.

Summarising, the GARCH effect is found statistically significant for all of the BRICS countries, and the ARCH effect is significant for South Africa. Both the ARCH and the GARCH effects are significant for the Japanese stock market as well.

As both the ARCH and GARCH terms are found significant in assessing the volatility of the stock market indices of South Africa and Japan, an implication is made that the stock market volatility is influenced by its own shocks, meaning by its own ARCH and GARCH factors.

Here, again as in case of the VECM models, the GARCH models run for the developed countries are not appropriate, excluding Japan.

For the last point, it should be noted that in most cases the exogenous dummy variables, assessing the impact of the 2008 financial crisis and the quantitative easing policy adopted by the US on the volatility of the stock market indices, are found not significant.

*Objective 5 - to determine the comparable effectiveness of the VAR/VECM models compared to GARCH models when predicting relevant stock market indices*. As the VECM and GARCH models run for the Brazilian and Indian stock market indices have the highest predictive power, further forecasting tools are applied for the mentioned countries. Both static and dynamic forecasting is applied using the VECM and GARCH models. The predicting power of the forecasts is evaluated based on the Theil Inequality Coefficient, as well as the Bias and Variance Proportions. If the values of the mentioned coefficients are close to zero, it is observed perfect fit to the actual series.

Both the static and the dynamic forecast models run for Brazil and India based on the VECM have close to zero Theil Inequality Coefficients, Bias and Variance Proportions, and, thus show perfect fit to the actual series. If we compare the forecast evaluation indicators for the dynamic and static forecasts, the static forecast model better fits to the actual series because of using the actual lagged values for performing the forecasts.

In case of the GARCH model forecasts, similar forecast evaluation indicators for all the models (dynamic and static), for the Brazilian and Indian stock market indices are observed. Referring to the Brazilian stock market, the variance forecast of the dynamic model illustrates some rapid decreasing trend, stabilising since 2006. And for the static forecast, the variance forecast has fluctuating trend. Going to the Indian stock market, the variance forecast of the dynamic model gradually declines during the whole forecast period, but a rapid decrease is

observed for the static model with fluctuations and slight declining trend. Thus, the dynamic GARCH forecast model shows better fit for both of the countries.

Finally, if we compare the VECM and GARCH forecast models, VECM models outperform the GARCH models, and, thus, have better fit to the actual series.

*Objectives 6 & 7 - to assess and analyse the impact of the 2008 financial crisis and the US quantitative easing monetary policy exercised during the crisis on the relevant stock market index*. The LR test is used for assessing the existence of the structural breaks, i.e. the effect of the financial crisis of 2008 and the quantitative easing policy, included in the model as dummy variables, on the stock market indices of the relevant countries. The LR test results can be used to decide whether the dummy variables need to be included in the VECM or VAR model. The results of the LR test state that the financial crisis and quantitative easing have impact on the stock market indices of the following countries:

## **BRICS** Countries

- Brazil,
- Russia,
- China,
- South Africa.

## **Developed** Countries

- France,
- Japan,
- UK.

Thus, the VECM and VAR models are re-estimated by including the dummy variables. The macroeconomic and dummy variables influencing the stock market indices are stated below for the models that are valid in describing the mentioned relationship:

#### **BRICS** Countries

- Brazil, IBOV GDP, INR, EXR, IFR, CON and HPI, + FCR
- Russia, RTS EXR, IFR, CON, + GDP and FCR
- China, SHCOMP GDP, CON,
- South Africa GDP, CON, HPI,

#### **Developed** Countries

• Japan – IFR.

As we see, the Consumption is not significant for the new models in case of Russia and China, as well as new significant variables are added; FCR for Brazilian and FCR and GDP for Russian markets.

Despite the LR test results indicate that the dummy variables have effect on most of the BRICS stock market indices, except for India, the results of the VECM model, including those dummy variables, illustrated the impact of <u>only</u> one of the selected two dummy variables - the FCR, and <u>only</u> on the stock market indices of Brazil and Russia. And what is worth to mention, the financial crisis has positive impact on the Brazilian stock market, and negative impact on the Russian stock market indices. An implication can be made that Brazilian stock market is somehow an outsourcing destination from the international financial markets.

Regarding the selected developed countries, the LR test results are significant only for French, Japanese and UK stock market indices. The models run for French and UK markets have insignificant F statistic and low R-squared, as it was with models excluding the dummies, and thus, are not appropriate for describing the relationship. Regarding the Japanese stock market, the model has high predictive power, but the dummy variables are found insignificant as opposed to the LR test results.

*Objective 8 - to determine the short and long-run nature of association between and across the relevant stock market indices*. Before analysing the association among the stock market indices, some initial considerations are applied. First, the descriptive statistics of the log values of the stock market indices is studied. The results of the Jarque-Bera test indicate that we reject the null hypothesis of normal distribution for all the index series, except for NIKKEI. As an additional point, the skewness of NIKKEI is very close to zero and the kurtosis is close to 3, as is supposed to be for normally distributed series. Most of the other indices have negative skewness in the interval of (-1,0), except for the S&P500, which demonstrates positive skewness. Referring to the kurtosis, all the indices have a value lower than 3, meaning that the distribution is slightly flat (platykurtic) relative to the normal distribution and implying low probability of the extreme values, as the outlier is less likely to fall within a platykurtic distribution's short tails.

Based on the correlation analysis, high correlation is observed between the stock market indices of the selected developed countries, excluding CAC and S&P500, which demonstrate slightly lower correlation ratio - 0.56. High correlation is also seen between the individual stock market indices of BRICS countries and the German DAX. And finally, the stock market indices of BRICS countries also are found highly correlated, besides the RTS and SHCOMP, which have a correlation ratio of 0.51.

The results of the Johansen-Juselius Trace and Maximun Eigenvalue tests indicate one co-integrated relationship implying that there exists long-term relationship among all the selected stock market indices. Thus, the VECM model is applied and analysed further. The results of the VECM models, assessing the impact of all the other stock market indices to the index of a certain country, have very low R-squared value. Besides, the F-statistic is

insignificant for most of the models, except for the ones, where the dependent variable is **RTS** or **NIKKEI.** 

Referring to the **Russian** stock market, the co-integrated equation, showing the longtern impact, is found statistically significant based on the t-statistics. Concerning the short-term effects, the IBOV is the only statistically significant index, assessing the short-term influence of IBOV on RTS. The R-squared is low - 0.12. What refers to the residual diagnostics, there is observed an issue of heteroscedasticity. Thus, we may conclude that the VECM model fails to describe the association of the stock market indices to RTS.

Regarding the **Japanese** stock market, a significant long-term association is observed, as well as the SHCOMP and CAC, evaluating the short-term impact on NIKKEI, are statistically significant, based on their t-statistics. The R-squared is again low - 0.13. As in case of Russian stock market, here we have an issue of heteroscedasticity among the residuals as well. Thus, this model also fails to predict the relationship among the selected stock market indices and the NIKKEI properly.

Accordingly, a general conclusion can be driven from the aforementioned analysis that the VECM models are not appropriate for assessing the association among the stock market indices for all the countries.

Going further, the causal relationships of the stock market indices are evaluated through applying both the VEC Granger Causality/Block Exogeneity Wald Tests and the Pairwise Granger Causality Tests. In this case again, we accept the existence of the causal relationship in case both the mentioned tests confirm that linkage. Thus, based on the results of the two tests, causal relationship is observed from IBOV to RTS and NIFTY, as well as from CAC to NIKKEI.
The objective is further extended to estimating the association within and across the stock market indices separately per BRICS countries and per selected developed countries.

### **BRICS** Countries

Based on the Johansen-Juselius test results no co-integration is observed implying that the stock market indices of BRICS countries do not have long-term association. So as the VAR model is evaluated. The R-squared ratios for all the models, estimating the relationship across and between the stock market indices among the BRICS countries, are close to 30%. The Fstatistic is insignificant for most of the models, excluding the model, where the dependent variable is **IBOV**. No issue regarding the residual diagnostics is observed. Low R-squared with insignificant F-statistic means that the models are not appropriate for describing the association of the BRICS stock market indices.

As the VAR model for the **Brazilian** stock market has significant F-statistic, it may somehow be used for further analysis despite its low R-squared ratio. In this case, the stock market indices significantly effecting the IBOV are the following; DLOGIBOV (-2), DLOGIBOV (-3), DLOGRTS (-8), DLOGNIFTY (-2), DLOGNIFTY (-4), DLOGSHCOMP (-2), DLOGSHCOMP (-3) and DLOGJALSH (-8). This means that all the stock markets within the BRICS countries may have an influence on the Brazilian IBOV.

Here again the VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality tests are applied for assessing the short-term causal relationships between the BRICS stock market indices. The results of the both of the tests imply that IBOV granger cause RTS and NIFTY.

### **Developed** Countries

Here again, the starting point is to evaluate the existence of the co-integrating among the stock market indices of the developed countries. The Trace and Maximum Eigenvalue test

results contradict each other in this case. The Trace Test indicates 3 co-integrated equations, while the Maximum Eigenvalue Test shows no co-integration at 0.05 level. Thus, both the VAR and VECM models are run, and the model selection is done depending on the model and residual diagnostics. So as the VAR model is applied for further analysis. It is worth mentioning that the R-squared ratios of all the models have low values combined with the insignificant F-statistic, as well as slight issue regarding the normal distribution of the residuals is observed. This means that a conclusion can be driven that the VAR model fails to describe the association among the stock market indices of the selected developed countries.

The causal relationships between the stock market indices of the developed countries are estimated again through applying the VAR Granger Causality/Block Exogeneity Wald Tests and Pairwise Granger Causality tests. No causal linkage is concluded as the results of the both of the causality tests fail to comply with each other.

Summarising the Objective 8, it can be concluded that the VECM/VAR models are not appropriate to predict the association among the stock market indices accurately. Moreover, causal relationships are found only from IBOV to RTS and to NIFTY from the BRICS countries, which complies with the results of all the causality tests.

*Objective 9 - to determine any dynamic relationship that exists between the relevant stock market indices and the selected macroeconomic variables*. Thus, the impulse response function and the variance decomposition analysis are applied for this purpose.

The impulse responses of the stock market index and selected macroeconomic variables of a certain country to the corresponding market shock of the relevant country, as well as the dynamic relations among the index and the macroeconomic variables 10 periods ahead are analysed. The Cholesky ordering of the logSMI of a certain country, LOGGDP, LOGINR, LOGEXR, LOGIFR, LOGCON and LOGHPI of the relevant country is applied. The impulse

response functions evaluate the impact of a shock on the stock market index or the macroeconomic variables of a specific country to the stock market index of the relevant country in the VAR/VECM models, whereas the variance decomposition separately estimates the variation in the index of a specific country into the component shocks to the VAR/VECM, showing the relative importance of each random innovation in affecting the stock market indices.

The results of the impulse response and the variance decomposition analyses showed that the stock market indices of the **developed countries** are highly influenced and explained by their **own innovations**, which is estimated 70-80%. Again, an **exception is Japan**, for which only approximately 60% of NIKKEI is explained by its own innovations, and the EXR and IFR among the macroeconomic variables also have high influence.

In case of the **BRICS countries**, it is worth to note that **Chinese** stock market index is highly affected by its **own innovations** compared to the stock markets of the other countries for which, besides of being influenced by their own innovations, the effect of some of the selected macroeconomic variables is more significant. For example, regarding the IBOV, mainly GDP and somehow INR have high influence, for RTS – EXR and IFR, for NIFTY – mainly GDP, somehow EXR and CON, and finally for JALSH – INR.

The resilience is the Chinese market is due to the growing economy in China. Turned towards production and exchange, the Chinese economy has become a world leading economy through its industrialisation. The similarity with the developed country is underlined in the thesis where changes in the Chinese market, as in the developed market, originated from the Chinese economy itself, as the in developed markets, reducing impact from outside the country.

*Objective 10 - to determine any dynamic relationship that exists across the sets of relevant stock market indices*. Similar Impulse Response and Variance Decomposition analyses are implemented for assessing the response of the stock market index of a certain country to one standard deviation shock to its own, as well as to other countries' index innovations. The dynamic linkages across the stock market indices are studied as well. The aforementioned analyses are carried out for all the stock market indices, as well as per BRICS and developed countries markets.

## **BRICS** Countries

The results state that IBOV is mostly affected by its own market. The RTS is affected by its own market – 58%, plus by the Brazilian stock market – 25% 10 periods ahead. NIFTY is influenced 46% by its own, 31% - by the Brazilian, as well as 11% - by the Russian stock markets 10 periods ahead. SHCOMP is highly affected by its own market – 80% 10 periods ahead, and thus, is mostly independent among the BRICS markets. JALSH bears the impact of its own market – 38%, Brazilian market – 33%, as well as Russian – 14% and Indian – 12% markets. Thus, Chinese and Brazilian stock markets are the most independent markets among the BRICS countries. It is worth mentioning here that the independence of the Brazilian stock market may be the result of the Cholesky ordering.

## **Developed** Countries

The results of the analysis of the developed countries state, that the CAC is highly impacted by its own market -86%. NIKKEI is also highly affected by its own market -63%, as well as by the French market 28%. DAX, FTSE100 and S&P500 are more impacted by the French market (50-70%) 10 periods ahead, than by their own markets.

In summary, it must be noted that the Chinese and Brazilian stock markets are the most independent markets, French stock market is also considered as independent from the other

stock markets. It is important to mention here, that when analysing by using the all stock markets, the Brazilian market highly influences all the other stock market except for the Chinese stock market, which can be the effect of the Cholesky ordering of the stock market indices. Taking this point into account, we may conclude the French stock market can be considered independent. With this in mind we may conclude that the Japanese stock market may also be considered as independent, as it does not bear the impact of the French market, when considering all the stock market indices. But for being sure in the conclusions, other analysis are also needed to be implemented. With the same considerations in mind, the independence of the Brazilian stock market may also be the result of Cholesky ordering. Thus, finally, we can be sure only in the existence of the independent nature in the Chinese stock market.

The purpose of the thesis was to find variables that can help predict stock price fluctuation. Therefore, the selected variables have a theoretical linkage with stock price. The thesis has proven that not all variables have influence in stock price in the selected economies. The structure of the economy is then to question on how-why some variable in the BRICS context are valid to influence the stock price and are not appropriate in the developed economies context to do the same. In addition, to the structure of the economies of both selected countries, the other explanation can be that policies applied in both set of countries have various and opposed effects on the macroecono0mic variables of the present thesis. It might be that developed economies policy is oriented towards a better control of factors affecting the stock price while in the BRICS, those factors are still paying a major role as policy may be oriented to different issues and matters.

# 7.3 Policy Contribution and Implications

The main implications derived from the analysis of this research are the following:

## **Objective 1 - Implication:**

The OLS models run for most of the BRICS countries, excluding China, are valid to be considered in describing influence of the macroeconomic and/or dummy variables on the stock market indices of the relevant countries. The OLS models run for the developed countries fail to describe the relationship between the selected variables. Thus, an implication can be made that the stock market indices of the developed countries bear the impact of other factors not covered in this research, and China, the largest and most independent economy among the BRICS countries, stands close to the developed countries. It is also worth to mention that the Exchange Rate is found significant in describing the stock market indices of most of the BRICS countries; Brazil, Russia, India and South Africa.

# Contribution

Once analysing the relationship between the stock market and macroeconomic variables in the developed countries, the investors and government officers should consider the Mosteller / Wallace regression, because it will ensure that the indicated macroeconomic variables or other factors, which affect the stock market indices are identified. Regarding the BRICS economies, the Mosteller / Wallace regression should be considered by policy makers for the Chinese stock market, as the OLS is not appropriate in this context to analyse factors that affect the aforementioned market index. Based on the results, the research suggests that the other BRICS economies and the interaction with the stock markets could be spotted by using a simple regression model.

Policy makers and investors should consider the exchange rate when deciding for economic and financial anticipation, as the decrease of the exchange rate or the

devaluation of the currency of the relevant BRICS country (excluding China) relative to USD, will result in an increase of the stock market index of the corresponding country, therefore econometric models regarding those countries should include the exchange rate.

The development of any model – linear or nonlinear - brings with it the need to evaluatively assess each term within the model. Are all terms of the same importance? Does each term contribute equally to the overall explanatory power of the model? Or, are some terms more important than others in this context? If this is the case, then which terms are more important and what is their relative contribution to the model? The **Mosteller-Wallace (1963)** test was developed by Frederick Mosteller and David Wallace to address precisely such questions within many statistical models. In other words, their test provides answers to the percentage contribution of each explanatory or independent variable within a model towards its overall explanatory power for the model.

The research has developed several models (multiple regressions, VAR/VECM and GARCH) and, as appropriate, each of the terms within these models could be potentially evaluated using the Mosteller-Wallace regression statistical test. Such usage would provide helpful insights into not only the models themselves but also the individual explanatory power of the independent terms as well.

• Objective 2 - Implication

Long-run cointegrated relationship is observed among the set of the macroeconomic variables and the stock market indices of the relevant countries for all the BRICS countries, as well as France and Japan. The VECM models run for the BRICS countries and Japan are generally estimated to be valid for predicting the association among the

variables. The Wald test results also confirmed the existence of the significant longterm effects for the BRICS countries and Japan.

### Contribution:

The existence of the cointegration between the BRICS, along with the Japanese stock market indices and the selected macroeconomic variables suggest the policy makers and the government to consider the trends of the macroeconomic variables when deciding for long-term investments or strategies. For the detailed list of the significant macroeconomic variables per selected countries refer to **Appendix 9 (Volume 2, p. 62)**.

## • *Objective 3 – Implication*

Regarding the short-term implications of the VECM models, the short-term effects of the selected macroeconomic variables are found positive for one country, but negative for another, meaning that theoretical justifications are not always supported by the statistics. The VAR/VECM models run for the other developed countries, excluding Japan, failed to address the proper association among the macroeconomic variables and the stock market indices. This implies that theory is not supported by the reality, and other factors exist that influence the markets of the developed countries.

It is also worth to mention that the only causal relationship that is identified from a macroeconomic variable to the stock market index is from IFR to NIFTY.

## **Contribution**

The investors and policy makers should not take into account the short-term trends of the selected macroeconomic variables, when considering investment strategies in the developed countries, excluding Japan. However, in case of BRICS countries, along with Japan, they should consider the trend of the selected macroeconomic variables, when

deciding for investment strategies. In addition, investments strategies should be the reflection of the fact that the chosen macroeconomic variables do not enjoy similar relationship across those countries. And finally, Indian investors should consider the inflation rate in case of short-term planning.

## • *Objective 4 – Implication*

The GARCH model results identified that GARCH effect is statistically significant for the stock markets of all the BRICS countries, plus the ARCH effect is significant for the JALSH of South Africa. Both ARCH and GARCH effects are found significant for the NIKKEI of Japan, as well. Like in case of VECM models, the GARCH models are not appropriate to be used for the other developed countries. Finally, the dummy variables, included in the GARCH models as exogenous variables, are found not significant for most cases.

# Contribution

For the investment strategies, the policy makers and the government should consider the volatility effect of the macroeconomic variable on the long-term basis. While for the short-term implications the previous day's stock market index information should be considered as it influences the stock market index volatility for the South African and Japanese markets. If the policy makers and investors want to consider the shortterm volatility effect of the macroeconomic variables on the stock market index, they should discard the selected macroeconomic variables of the research and should also consider advanced GARCH model, such as M-GARCH or E-GARCH

## • *Objective* 5 – *Implication*

Based on the forecast analysis, using the models of Brazil and India, the VECM models showed comparable effectiveness against the GARCH models, and thus, have better fit to the actual data series.

### **Contribution**

The results of the research state that the VECM models have comparative effectiveness compared to the GARCH models for the Brazilian and Indian markets.

### • *Objective 6 & 7 – Implication*

The LR tests analysis revealed importance of the dummy variables, the financial crisis of 2008 and the quantitative easing policy, on the stock market indices of the following countries; Brazil, Russia, China, South Africa, as well as France, Japan and UK. However, the results of the VECM model, including those dummy variables, illustrated the impact of only one of the two dummy variables - the FCR, and only on the stock market indices of Brazil and Russia, with positive impact on the Brazilian stock market, and negative impact on the Russian stock market indices. For the developed countries, only the model run for Japan is valid for describing the association, but the dummy variables are found insignificant as opposed to the LR test results.

## **Contribution**

During the financial crisis the investors, policy makers and government should not consider the monetary policy in other countries, such as the quantitative easing, which impact only the country of its origin. However, cointegrated or not, policy makers should consider the effect of the potential financial crisis of the selected countries, mainly the developed ones, when forecasting the future economic trends. Moreover, it

could be inferred from the results that Brazilian stock market is somehow an outsourcing destination from the international financial markets.

### • *Objective* 8 – *Implication*

The VECM models run for estimating the association between and across the selected stock market variables for the BRICS and for the developed countries, as well as for all the selected countries, fail to properly describe the relationship. Causal relationships are observed only from IBOV to RTS and to NIFTY, which complies with the results of all the causality tests estimated both in case of analysing the BRICS countries, as well as all the selected countries.

## **Contribution**

Refer to Objective 10.

### • Objective 9 – Implication

Based on the impulse response function and variance decomposition analysis assessing the dynamic relationship existing between the selected macroeconomic variables and the relevant stock market indices the following implications are made: the stock market indices of the **developed countries** are highly influenced and explained by their **own innovations**. Here, again an exception is the Japanese NIKKEI, which, in spite of being highly explained by its own innovations, also is essentially explained by the Exchange Rate and Inflation from the selected macroeconomic variables. Regarding the BRICS countries, SHCOMP of China is also highly influenced by its own innovations. The other BRICS countries bear the impact of the own innovations, as well as are also highly explained by the following macroeconomic variables; IBOV - mainly GDP and somehow INR, RTS – EXR and IFR, NIFTY – mainly GDP, somehow EXR and CON, and finally JALSH – INR.

## **Contribution**

For the developed countries the selected macroeconomic variables, again, do not explain the stock market index of the relevant country, again excluding Japan, for which the exchange rate and inflation can also be considered by the investors and government officers. Regarding the BRICS market, Chinese index is mainly explained by its own innovations, but for the rest of the countries, the following variables are needed to be addressed by the policy makers and investors: the real GDP for Brazil and India, exchange rate and inflation for Russia and interest rate for South Africa.

## • Objective 10 – Implication

The assessment of the impulse response function and variance decomposition analysis, implemented for the selected stock market indices revealed that the Chinese stock market is the most independent among all the markets studied in this research. The stock markets of Germany, UK and US are influenced more by the French stock market than are explained by their own innovations. The Brazilian stock market is also found independent, and impacts all the markets of other selected countries, except for China. But it is worth mentioning here that the final argument may be the result of Cholesky ordering. As a last point, if we combine the findings that the financial crisis has a positive impact on IBOV, we may surely conclude that Brazilian market is independent from international financial markets.

# Contribution

As the stock market indices of the developed countries are not cointegrated, investors and policy makers should consider separately each country when developing investment policies or forecasting future economic trends. Regarding the BRICS markets investors and government officers should consider the fact that the emerging

market is non-cointegrated as whole when investment strategy is developed. Further, investment portfolio should not combine developed markets and emerging markets for profitability maximisation, as the risks they share are not the same. As for the last point, the Chinese and Brazilian stock markets are the most independent among the selected countries, and, thus, may offer diversification benefits.

Thus, summarising the aforementioned implications, derived from the research analysis, a general conclusion can be done that the selected macroeconomic variables are not found significant in describing the stock market indices of the developed countries. An exception is the Japanese NIKKEI, which can be attributed to the fact that Japan may be not as much developed as the other selected developed countries ranking below the selected developed countries by its GDP (PPP) per capita. Another reason may be that Japan is not as active in the international political relations as the other developed countries studied. For example, Japan is not included as a permanent member in the UN Security Council, etc. Second, the Chinese and Brazilian stock markets are found to be independent from the other stock markets. And finally, China acts more like a developed country than an emerging one.

Clearly in a thesis of the present sort, there is much potential for suggestions relating to public policy, particularly of the distributive type. And, issues of public policy are of much importance. Within virtually all shades of "capitalist" and/or "mixed" economies, they place together for concurrent considerations, matters that relate to profits, people and planet (the Triple Bottom Line) and issues that embrace global governance (**Cable, 1999**). In a sense, these embrace Corporate Social Responsibility (**Margolis and Walsh, 2001**) and transnational corporations (**Bailey et al, 1994**).

In Chapter 7, the research presents, on an objective per objective basis, several contributions and policy implications that derive from its findings/results. These policies

should be of help to investors and policy makers in the private sectors of several economies. However, the results and findings of the thesis are not limited to only the interests of private policy makers. There is also potential for "public policy" to be derived from them. **Cochrane and Malone (2014)** describe "public policy" as "the overall framework within which government actions are undertaken to achieve public goals, decisions and actions designed to deal with a matter of public concern".

**Cochrane and Malone (2014)** go on to identify three major types of public policy: **regulatory policy**, **distributive policy**, and **redistributive policy**. Each type has its own special focus and purpose. One can define **regulatory policy** as the attempt by governments and policy makers to protect society against any wrongdoing. This is more in relation with human interaction and personal life within the society. Thus, a major goal of regulatory policy is to maintain order and prohibit behaviours that endanger society. **Distributive policy** is mostly linked to economic activities and the promotion of economic activities. The intent behind a distributive policy is to encourage and enable a more equitable distribution of resources. Finally, the end goal of the **redistributive policy** is to promote equality i.e. the redistribution of resources and/or benefits or the enabling equal access to (inter alia) health care.

Given the nature of **regulatory policies** and that of the present research, which is grounded in the spirit of "free market capitalism" and relatively inimical to the spirit of "regulation", there is limited potential for such policy to emerge from the results/findings of the thesis and the fulfilment of its objectives. However, one must not overlook the fact that the stock market of all the 10 relevant countries have regulations that hold on their individual stock markets. Additionally, one could well advise public policy makers to be mindful of the power of the researched macroeconomic variables and their potential for economic change.

Equally, given the nature of **re-distributive policies** when considered against the objectives of the research, one could conclude that there is limited potential to further promote equality and the re-distribution of resources and/or benefits (such as health care). Nevertheless, one must recognise that when overall public wealth increases, there is increased potential for governments to outlay that increased wealth towards particular recipients of the public and across particular strands of the public sector.

In so far as the wealth of a nation is very much the wealth of the public of that nation, it soon becomes evident that policies relating to the investment, holding or disposal of its wealth, must necessarily bring under consideration matters of public policy. In terms of the present research this is particularly so. As the independent variables considered are all macro (not micro) economic variables, against that background, the use and issuance of **distributive** (**public**) **policies** assume much relevance. And, in terms of the objectives of the research, that relevance is discussed in the following paragraphs.

**Objective 1** set out "to determine sets of macroeconomic variables that are statistically significant when predicting relevant stock market indices". The second objective was an attempt "to identify any statistically significant long run relationship and - or linkage between selected sets of macroeconomic variables and their relevant stock market indices". Equally, the third objective set out "to identify the directional and potentially causal relationship between sets of selected macroeconomic variables and their relevant stock market indices" and the fourth objective sought "to determine intensities of the volatility of selected macroeconomic variables on their relevant stock market indices". What all the above objectives share in common is their attempt to link market indices with particular sets of macroeconomic variables

(or characteristics of them). Accordingly, in this contest, it is appropriate to consider all these four objectives in conjunction with each other.

Awareness of macroeconomic policy is important, as this supports business in planning and operating in the sectors in which they invest. In the BRICS context, the empirical results demonstrate the importance of particular macroeconomic variables. Macroeconomic policy is a critical tool used by governments to manage and influence economic performance. Five objectives are to be considered when putting in place a macroeconomic policy - these are price stability, employment, economic growth, balance of payment stability and adequate distribution of wealth and resources. Macroeconomic policies are well established in most of the advanced economies which may be a reason why, in the present thesis, they are found not to be of consistently significant impact on the selected stock market of those countries except Japan. However, for most of the BRICS countries and Japan, rigorous macroeconomic policies will likely have impact. In the BRICS context – except China, the government will likely wish to monitor and boost its economy through exchange rate/monetary policy, as there is good evidence to suggest that those economies with tight monetary policies reap economic benefits. Such a macro-economic government policy should be beneficial in controlling level of demand and supply. Exchange rate policies should, in most of the BRICS economies, help in controlling inflation - particularly in country a like India which has an important dependence on consumption consequent to its vast population.

Accordingly, the second policy that should be highly considered within the BRICS – including China is a robust monetary policy. This should help in terms of managing the level of interest rate particularly in Russia and China, and inflation in India. Finally, Japan may wish to consider putting in place more aggressive macroeconomic policies so as to help ensure

consistent growth in the national GDP. This could be triggered by implementing a soft taxation policy or taking monetary pressure off the local investors.

In terms of **Objective 5** which set out "to determine the comparable effectiveness of the VAR or VECM models as compared to GARCH models when predicting relevant stock market indices" and distributive public policy, some thoughts are of consequence. The results of this objective showed that VAR/VECM was more effective than the GARCH models in terms of the BRICS group of economies but less so in terms of the developed economies. Accordingly, any public policy suggestion must distinguish between those two sets of econometric techniques and economies. And so, it would be reasonable to suggest the BRICS economies pay significant attention to the VAR/VECM and for the developed economies to use advanced forms of these models in order to capture linkage between the identified macroeconomic variables and stock market indices.

**Objective 6** was an attempt to "to determine any significant reactive effect of the 2008 financial crisis on relevant stock market indices". Thus, any policy suggestion grounded in the results of this objective must give guidance in terms of any future financial crisis. However, given that financial crises may have a variety of origins, such policy must always be issued with significant provisos. Nevertheless, with such provisos, the related public authorities in BRICS countries would be well advised to put in place specific crisis policies for the BRICS economies and particular ones in relation to the developed economies. The reason behind this is that a crisis originating in any BRICS economy will likely be of some consequence to any other country of that group. Equally, any financial crisis originating from one of the selected developed economies may not necessarily have an impact upon the BRICS economies. Nevertheless, in terms of the developed countries, the results do not strongly suggest a change

or shift in policy direction. Rather, they tend to suggest a reinforcement of extant financial crisis policy – recognising, however, that an economic crisis originating in one developed country, may well have consequences in another.

The empirical results also support the fact that BRICS, except China were affected by the 2008 financial crisis. Thus, it will be extremely important that BRICS countries put in place policy preparedness against future financial crises. Preferably, it is of importance for the relevant government to detect crisis *before* they impact upon the entire economy. So the financial crisis policy would comprise the prevention, action and the management of the crisis and pre-crisis.

The intent behind **Objective 7** was "to determine the impact of the (US) quantitative easing monetary policy during the 2008 financial crisis on the relevant stock market indices" the empirical results of this objective "supported that the quantitative easing appears to have impact on the BRICS economies, except India and the developed economies except Germany and the US itself". Thus, public policy suggestion that would follow from these results could likely flow from the fact that the results for this objective show that QE does have macroeconomic consequence – when undertaken by developed countries primarily within and across developed countries. However, there is also evidence to suggest secondary impact within BRICS economies also. Accordingly, appropriate policies emanating from these results would suggest in terms of the developed economies that they should continue to carefully monitor and evaluate extant policies in terms of QE.

In terms of the BRICS economies, the results suggest that they be alert to QE policies emanating without and be prepared with and anticipate responses to such policy application.

**Objective 8** sought "to determine the nature of association (if any) between and across the relevant stock market indices". The results for this objective indicated that the present thesis evidenced that VECM/VAR macroeconomic models are not extremely helpful when predicting stock market indices accurately. Moreover, causal relationships are found only from IBOV to RTS and to NIFTY from the BRICS countries. These relationships appear to comply with the results of all the causality tests. Given those results, possible public policy suggestions arise from them. In terms of BRICS economies, they would be well advised not to overly consider the VECM/VAR when analysing and relying on the BRICS stock market indices perhaps except for Brazil and China. And, in terms of developed economies, they would be equally well advised to take little regard the VAR/VECM, as these models cannot very usefully help predict/interpret macroeconomics relationships among the advanced economies in terms of stock market indices.

**Objectives 9** and **10** both sought to identify and reveal dynamic relationships. In terms of Objective 9, it sought to do that in terms of "relevant stock market indices and the selected macroeconomic variables". In terms of **Objective 10**, it sought to do the same "between and across sets of relevant stock market indices". Here, in terms of **Objective 9**, the results showed that the stock market indices of the developed countries are highly influenced and explained by their own innovations (changes), which is estimated at 70-80%. An exception is Japan, for which only approximately 60% of NIKKEI is explained by its own innovations (changes), while EXR and IFR are two of the macroeconomic variables that also appear to have high influence.

In the case of the BRICS countries, it is worth noting that the Chinese stock market index is highly affected by its own innovations (changes). Compared to the stock markets of

the other countries which, besides being influenced by their own innovations, are also affected by some of the selected macroeconomic variables. For example, in terms of the IBOV, mainly GDP and curiously INR have much influence, for RTS – EXR and IFR, for NIFTY – mainly GDP, EXR and CON, and finally for JALSH – INR. In terms of **Objective 10**, the results showed that the Chinese and Brazilian stock markets are the most independent markets among the BRICS countries. And, the results of the analysis of the developed countries state, that the CAC is highly impacted by its own market – 86%. NIKKEI is also highly affected by its own market – 63%, as well as by the French market 28%. DAX, FTSE100 and S&P500 are more impacted by the French market (50-70%) 10 periods ahead, than by their own markets.

All the immediately preceding results and discussions in terms of Objectives 9 and 10, suggest, public policies that could respectively be of benefit to both BRICS and developed economies. Overall, one must support the view that public policy and future planning should be based on the performance of their own local economies (except for Japan, where government should carefully consider the exchange rate when making decisions).

In the BRICS context, rigorous macroeconomics policies should be developed and implemented as described for Objectives 1, 2, 3 and 4. In terms of objective 10, public policy makers should bear in mind that the Brazilian and Chinese economies for future investments strategies, while in terms of the developed economies, policy makers should carefully consider the interaction between the French economy and most of the other selected developed economies when deciding future economic and financial actions.

Using the Keran Theory as its main rationalising source, the research deductively employs it to empirically assess its applicability to the two sets of (BRICS and developed) economies. In doing so, the research employs some rationally selected macroeconomic

variables from the Keran Theory. But the empirical results accord with the theory relatively weakly. Accordingly, this provokes a search for other indicators that could also have been selected for the purposes of analysis. Consideration of several indicators suggest that these could include Monetary Policy, Fiscal Policy (Income Tax, Value-Added Tax), Import and Export Tax Policies, External Credit Ratings, Development Level of Country, Internal Politics, War & Terrorism and Natural Disasters. All these features (or variables) are likely to provide some additional explanatory value for institutional investors and the scientific world. Accordingly, in turn, some discussion as to their relevance and empirical evidence relating to a few of these, essentially macroeconomic variables, is provided in the following paragraphs.

## **Monetary Policy:**

In its most basic form, the impact of monetary policy on stock market indices is directed through the level and direction of interest rates. Indirectly, this is true through expectations regarding inflation. **Suhaibua et al (2017, Page 1372)**, within an African context, empirically confirm that "there are complicated and significant relationships between monetary policy and stock market performance and that the relationship is bidirectional".

# **Fiscal policy:**

Changes in the tax rates on imported and exported products will result in more or less competitive advantages for local companies to compete in both local and international trade. The final impact will be an increase or decrease of stock prices as a consequence of the change in the real earnings of the companies (being adversely or favourably affected). Empirically, in the context of three national stock markets (Germany, Japan and USA), **Arin et al (2009, Page 33)** determine "that indirect taxes have a larger effect on market returns than do labour taxes. Further, corporate tax innovations do not have any statistically significant effect on stock

returns". They consider this finding "to be a result of a firm's ability to switch between equity financing and bond financing". Equally, an increase of the income tax rate should result in a decrease in the purchasing power of consumers, causing consequent changes in total consumption. A similar effect is likely to be observed when there is an increase in the Value-Added Tax (VAT) rate". Relevant research from **Ardagna (2004)** and Alonso and **Sousa (2011)** further reinforce empirical evidence for a strong link between fiscal policy and stock market valuations and indices.

### **External Ratings:**

The big three rating agencies — Moody's Investor Services, Standard & Poor and Fitch Ratings — often provide new information to the markets in addition to what is already publicly available. When such ratings are provided, it could be reasonably assumed that investors react more strongly to rating downgrades than to rating upgrades. Thus, rating changes may also impact stock market indices. **Pacheco (2011, Page 1)**, in the context of the Portuguese stock market, finds "a significant response of share prices to changes in ratings, with that response anticipating the announcement". He suggests that "this could be explained by previous sovereign rating changes or to the contagion effects of a bearish market".

In an Italian context **Linciano (2004, Page 1)** determines that "significant average excess returns are recorded only for negative watches and for actual downgrades. Abnormal returns however seem to be driven mainly by the release of relevant information around the announcement of the rating action". The study provides evidence for a specific European country,-i.e. Italy and "is a useful sensitivity check to earlier empirical research, mainly focused on the U.S."

### The economic development level of the country

The level of economic development within an economy will also likely have an impact on the stock market index of the relevant country, as the external rating of the relevant country will moderate the external ratings of its companies. Another argument is that the companies from developed countries are seen to face fewer obstacles when entering into international markets. This gives such companies a competitive advantage. In the context of 5 European (Belgium, France, Portugal, Netherlands and the United Kingdom) (Euronext) countries, **Boukari and Jin (2010, Page 14)** determine that their research suggests "a positive link between the stock market and economic growth for some countries – especially those where the stock market is liquid and highly active". However, the same authors reject "a causality relationship for countries in which the stock market is small and less liquid".

## **Internal Politics & Stability:**

A rapidly changing internal political environment will likely have an adverse impact on the stock market index of the relevant country, when compared to countries that have a stable political environment. Within the context of Pakistan and using a range of provocations (strikes, assassinations, riots, etc) for instability, **Irshad (2017, Page 70)** finds a "negative relationship between stock prices and political instability". Moreover, his results suggest that "instable political systems ultimately lead to a significant decline in stock prices".

# War & Terrorism:

Fear can change investment habits. For instance, after the 9/11, investors withdrew their money from the US and the values of stock market indices plummeted. Some empirical evidence for this phenomenon follows.

Drawing primarily on two war episodes (The 1999 Gulf and the 2003 Iraq Wars) and additionally on sets of terrorist events (including 9/11, 2004 Madrid bombings and the 2008 Mumbai bombings), **Kollias et al (2013, Page 743)** determine (in relation to the US S&P500, the European DAX and the FTSE 100) that the "covariance between stock and oil returns is affected by war. This may be as a result of the two wars examined provoking "some predispositions" of investors and market agents for more profound and longer lasting effects in terms of global markets". On the other hand, these authors determine that "when terrorist incidents are one-off unanticipated security shocks, only the co-movement between CAC40, DAX and oil returns is affected and no significant impact is observed in the relationship between the relevant markets indices (S&P500, FTSE100 and Oil Returns)". They interpret this to be an indication of the fact that "the latter are more efficient in absorbing the impact of terrorist attacks".

Taking regard only for terror attack within five western European countries (UK, Belgium, France, Germany and Spain, **Schepers (2016, Page 3)** finds "a significant effect on the bond market of those countries. For the stock market there is no significant effect". He also finds that "larger attacks have a significant positive effect on stock and bond market. However, if the attack happened in the tested country, there is no significant effect on either the stock or bond market".

# **Natural Disasters:**

"In today's increasingly interconnected economy, the economic fallout from a natural disaster is rarely relegated to the geographic area it hits. In fact, even natural disasters that take place thousands of miles away can shake up one's domestic portfolio. Besides loss of life, infrastructure destruction is by far the most obvious type of natural disaster damage. But the

economic consequences are rarely considered beyond what the cost will be to rebuild." Mary Hall (2018), following Hurricane Katrina in the US, found evidence to suggest that "the markets actually improved and continued to improve in the following months". By contrast, Hurricane Sandy literally damaged the markets, initially forcing Wall Street to close, but later witnessing growth.

Rebuilding efforts after floods, earthquakes, hurricanes and so on certainly actually boost the economy. Accordingly, employing an event study methodology in terms of the 122 most serious natural disasters between 1980 and 2014, **Seetharam (2017)** finds that "exposed companies are associated with stock market valuations that are 0.3 to 0.7 percentage points lower relative to the returns of non-exposed companies. The estimated impact translates into US\$9 million to US\$22 million lost in the market valuation of exposed firms, with the larger losses occurring further away from the day of the disaster. Firms operating a large number of subsidiaries are able to mitigate these impacts to some extent, but labour market frictions play no role in explaining these negative impacts". All the above macroeconomic variables (and indeed several others not highlighted presently) almost certainly impact on the prices of securities and so Stock Market Indices. While the preceding paragraphs are not presented with a view to identifying and selecting precise variables for addition to a modified Keran Diagram-Theory, they are all presented (together with some related empirical evidence) to show that (clearly to varying degrees), they have potential to be added to the same, so resulting in a more robust theory.

The implications of the VECM/VAR models summarised through the Keran diagram are visually depicted in **Figure 7.1** 



The relationship between a country's economy and its stock market is both fascinating and complex. Do stock market indices influence economic statistics (such as GDP or unemployment) or do economic statistics influence stock market indices? This is an issue addressed in Duca's (2007) paper entitled "The relationship between the stock market and the economy". In his paper, Duca (2007) argues that "theoretically, there should be a strong relationship between stock price and the state of the economy on the basis that the standard discounted-cash-flow model implies that stock prices lead real economic activity if investors' expectations about firms' future pay-outs are correct on average". In this context, Duca (2007) suggests that there are three theoretical propositions. And these are as follows:

- 1. **Tobin (1969),** puts forth Tobin's Q which measures the impact of share prices (and so the stock market) on the cost of the capital. It is the co-efficient ratio of the market value of current capital to the cost of replacement capital. "When share prices are high, the value of the firm relative to the replacement cost of its stock of capital (Tobin's Q) is also high. Consequently, this leads to increased investment expenditure and thus to higher aggregate economic output as firms find it easier to finance investment expenditures. This occurs because investment would be easier as it would require a lower share offering in a situation of a high share price" (Duca, 2007, Page 3). The higher the Tobin's Q the stronger the relationship between the stock market and the economy within a country.
- 2. Another theoretical explanation of the linkage between stock market and the economy of a country is suggested by **Modigliani (1971)** who contends that an increase in personal wealth will result in more investments which should positively influence the economy of a country. "His proposition operated through the impact that wealth

variable has on consumption. A permanent increase in security prices results in an increase in the individual's wealth holdings, and therefore in higher permanent income. Through the permanent income hypothesis, Modigliani postulated that intertemporally, consumers smoothen consumption in order to maximise their utility. An increase in permanent income will therefore enable consumers to re-adjust upwards their consumption level each period" (Duca, 2007, Page 3)

3. Equally, the linkage between stock price and economy can be explained through the concept of the financial accelerator<sup>3</sup>. (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). This rationalisation focuses on the impact of stock prices on companies' balance sheets. "Due to the presence of asymmetric information in credit markets, the ability of firms to borrow depends substantially on the collateral they can pledge. The collateral value firms can offer increases in scenarios where their stock price value increases. As the collateral, they can offer increases, higher credit can be raised, which in turn can be used for investment purposes and thereby triggers an expansion in economic activity" (Duca, 2007, Page 4). In the same article, Duca (2007) provides several empirical instances to support each of these three possible explanations. These include Schwert (1989), Campbell (1998), Stock and Watson (2001), Humper and Macmillan (2005).

However, there can also be a disconnect (or disaccord) between the economy of a country and the stock market. And for this, there could be (at least) four possible explanations.

<sup>&</sup>lt;sup>3</sup> The concept of the financial accelerator is based on the relationship between the economy and the financial markets, which defines the process by which negative shocks to the economy are subject to amplification following a deterioration in the financial markets. More specifically, the financial and macroeconomic slowdown is mainly due to poor conditions in the real economy and financial markets.

- 1. Economic interventions or stimuli: In certain situations, and in some countries, governments may seek to intervene in the natural order and flow of the capital markets. While such interventions (or stimuli) are primarily monetary and/or fiscal, they can (and do) take a variety of forms. For example, one such monetary stimulus has been the Quantitative Easing (QE) that was undertaken by some governments at the time of the 2008 financial crisis. Expectedly, such stimuli will have an impact on both the economy and the stock market but not necessarily to the same degree and/or the same time. In such instances, monetary stimulus may well create a country economy/stock market dissonance.
- 2. Nature of economic stimuli: Additionally, stock market indices (which tend to reflect the health of only the corporate economy and corporate life) may be buoyant and optimistic for precisely the very reasons why parts of the general economy are depressed. For example, when unemployment is high, labour rates tend to be contained. In turn, this may well lead to lower than expected labour costs and, in time, higher returns. Consequently, these higher returns may well stimulate market activity leading to higher market indices at a time when the relevant economy reflects higher unemployment. Such phenomena is sometimes referred to as the "perversity" of the market. And it illustrates a dissonance between one indicator of the economy and its associated stock market.
- 3. **Response time of economic stimuli**: While it is easy to appreciate that (economic) stimuli must have some impact or response upon both economy and stock market, it is also relevant to appreciate that these responses may not necessarily be at the same point in time. Thus, for example, a particular fiscal policy may provoke a spike in employment (good for the economy). However, it is possible that the "disposable

income" feature attached to such high employment will not be manifest for some further period of time. In other words, in this instance, the stock market would be a "lagging indicator" of the employment market. In brief, response times lags, on occasions may also bring about, such disaccord or dissonance.

4. Stage of country's economic development: Countries (like persons) develop and mature at individual rates and have their own individual starting points. As such, it is reasonable to expect that not all countries are at the same level of economic development. There is some agreement that countries such as some lesser-developed but developing countries are at a primary (mainly agricultural) stage of economic development, while countries such as China and India are at a secondary (mainly agricultural and part-industrial) stage of economic development. Further, countries such as UK and US are at the tertiary (mainly industrial and technological services) stage of economic development. Thus, it would be reasonable to expect that the same stimulus (nature and intensity) applied to individual countries reflecting different stages of development may well have differing impacts and responses – both in terms of timing and intensity. Taking regard for the above, it would be reasonable to expect that the economic health of individual countries is not necessarily always reflected (fully or in part) in the stock market of that country.

This research has provided some interesting insights into the economies of the selected countries and their related stock market indices. But what would be of more interest and importance is some discussion as to why only the relevant identified variables tend to have linkage with their stock market indices and how might this be so. On a country-by-country basis, the following paragraphs address these issues.

In terms of **Brazil**, the research determined that domestic interest rates and house prices appear to be of consequence. To address the question as to why these two macroeconomic variables are of significance when predicting the Brazilian Bovespa, one must recognise that in terms of the Brazilian economy, a significant quantum of its output -primarily dairy and agricultural - is exported. Thus, the Exchange Rate for the Brazilian Real, to some degree will influence agricultural output demand and (possibly to a lesser degree) supply. Accordingly, given this linkage into the Brazilian economy, one could well conclude that when the Exchange Rate encourages inflows and they are high, the potential for housing purchase are also high and vice-versa.

When analysing the data regarding the **Russian** economy, the results indicate that while Interest rate and Exchange rate are possible important drivers of the Russian stock market index – consumption is not. Why?

To fully appreciate the Russian economy, one must recognise the fact that, in general, it is not overly stable. In good measure, that instability stems from its deep reliance on the value of its Ruble on foreign exchange markets. In turn, this is dependent on the demand for oil and gas. Thus, while the Exchange Rate itself cannot be independently controlled by the Russian Central Bank – it can partly do so by leveraging deposit Interest rates. Increasing interest rates attracts "hot money" and with it the demand for the Ruble – so increasing the Ruble exchange rates.

Russia is known for its critical dependence on its exports from oil production sector and its support from its banking sector. The Central Bank of Russia often directly intervenes to prevent the Ruble from depreciating severely. At the same time, extreme exposure to oil production and considerable volatility of its interest rate within the Russian economy undermine national consumption. Equally, the Russian economy, is extremely vulnerable

in terms of international exchange rates. A relatively non-controlled banking sector (despite some recapitalisation of Russian Banking) important sectors such as construction, which can trigger consumption, are traditionally weak.

In most economies, it would be the case that "disposable income" will likely influence the relevant stock market index. For, when disposable income increases, the potential for stock/equity investment increases and vice-versa. However, one quickly recognises that "disposable income" itself is a function of consumption. For, the more consumption that occurs, the less there is of disposable income. And the less consumption occurring, the more there is the potential for savings and consequent investments. But the Russian economy is also somewhat unique. That economy is significantly enriched by its sale of extracted oil and gas. So, it would not be unreasonable to assume that that increased wealth from the sale of these national resources would not substantially flow into the hands of domestic units and so become available for private investments. What is more likely to be the case is that most of that increased wealth would flow into the national coffers and not necessarily seek investment on the Russian stock market and/or Russian economic opportunities. They are, possibly, transferred overseas, for investment onto other stock exchanges - possibly influencing non-Russian stock market indices. Meanwhile, Russian consumption may very well continue, more or less, unadjusted. Such possibilities may likely explain the results whereby Russian consumption appears not to causally influence the Russian stock market index.

In terms of the **Indian** Nifty Index, the research determined that in terms of the Indian economy, this was much influenced by the Rupee's exchange rate and domestic consumption. To appreciate why these two features are of likely consequence when predicting the Indian NIFTY, one must take regard for particular aspects of its economy.

Firstly, India's Foreign Exchange reserves have traditionally been challenged and under attack. Its continuing and intense need for overseas energy and the (agricultural/food) vagaries of its monsoon, can both place excessive strain on these reserves, not to mention "dips" in its remittances from Indian overseas residents. Such strains undoubtedly test the stability of the Exchange Rate of the Indian Rupee, and with it, the purchasing power attached to it. Such power also undoubtedly influences consumption and so one obtains insights as to why both these identified variables might well be of consequence within the Indian context and the NIFTY

In the case of **China** and the Shanghai Composite Index, the research determined that both interest rates and house prices are of consequence when considering that index. In an attempt to appreciate why the Interest Rate and House Prices are of consequence in terms of China, one must recognise that the captains of the Chinese economy have long been aware of the power behind interest rates. These rates influence both production within the country and the potential to export its goods and produce outside the country. For, when interest rates rise, overall costs rise and this disincentivises domestic purchases and overseas sales. Over time, this would tend to result in significantly weaker domestic consumption (purchases) and overseas sales - in turn influencing demand for (and the strength of) the Chinese Yuan/Remimbi. In the opposite case, when economic activity is high, confidence in the economy is high and willingness to invest in tangibles – such as houses – also increases. In time, such willingness and increased demand would very likely lead to an increase in the prices of houses. Equally, in times of economic hardship and difficulty, the very opposite would hold true. Against the preceding, one starts to appreciate why in terms of the Chinese economy, their interest rates and house price purchase index appears to influence the Chinese Shanghai Composite Index.

The only macroeconomic variable that appears to be of consequence, per the results of this research, in terms of predicting the JALSH index in **South Africa** is the Exchange Rate for the South African Rand. Why might this be so? To consider this question, one must recognise that the South African economy is very much focused towards exports – significantly minerals and agricultural produce. Thus, much of the South African economy responds to (even relatively minor) changes to the value of the South African Rand. Ironically, while a weak rand is good for exporters, it is not so welcome for importers and consumers of imported produce. The reverse holds true in terms of a strong Rand. In any event, one starts to appreciate the intense role that imports/exports play within the South African Rand. This appreciation throws light on the phenomenon as to why Exchange Rates variable seems to be of much consequence when predicting the Johannesburg (JALSH) index.

On a country-by-country basis, the preceding paragraphs discussed, in terms of the BRICS set of economies, why the research – identified macroeconomic variables would likely have linkage with the relevant stock market index. But what prevails, in a comparable context, for the selected set of developed economies? In terms of the developed economies, the research determined that, with one exception, overall, there was no real clear and consistent linkage between the macroeconomic variables analysed and their related stock market indices. Some pertinent discussion relating to the possible causes for this phenomenon is provided in response to point 5 of those listed by the external examiner (See pages 9-12 of this set of responses).

In terms of the developed economies, the single exception (referred to previously) is Japan. In terms of Japan, the research identified inflation rate to be of some reasonable influence when predicting the NIKKEI index. Why might this be so? While inflation has been a

matter of continuing concern in Japan for the last two decades – that concern should not be overly exaggerated. With virtually no exception, the range of CPI inflation over the period has been within  $\pm 2.00\%$  to  $\pm 2.00\%$ . When positive, the rate has been generally within the targets set by the Bank of Japan (Japan's Central Bank). One possible reason for inflation when positive might well be provoked by Japan significant reliance on imported energy (oil and gas), the price of which would be determined outside Japan. But, energy permeates and impacts upon virtually all sectors of the economy. Thus, increased energy costs filter through to many aspects of the economy – and, in time, is reflected in inflation. In due course, such increased costs are very likely to be recognised within stock prices and ultimately within the stock market index. This could possibly be theoretical explanation for the identified linkage, in the case of Japan, between its stock market index and its inflation rate, one of the researched macroeconomic variables considered within the thesis.

# 7.4 Further Research

Other types of GARCH models may set a wide horizon for further studies, particularly:

- EGARCH (Exponential GARCH) model, which explicitly allows for asymmetries in the relationship between return and volatility.
- IGARCH (Integrated GARCH). The GARCH process is weakly stationary since the mean, variance, and autocovariance are finite and constant over time. It is worth mentioning that the IGARCH model can be strongly stationary even though unconditional variance for the IGARCH model does not exist.
- MGARCH (Multivariate GARCH), which allows for modelling the co-movements of the asset returns. Multivariate GARCH models also enable to investigate spillover effects of contagion, which can better assess the effects of the dummy variables selected for this current research.

• PGARCH (Periodic GARCH), which enables to account for periodic dependencies in the conditional variance by allowing the parameters of the model to vary over the cycle, etc.

# 7.5 Overall Conclusions

The previous chapter thoroughly discusses the results derived from the models used in this research for researching the relationship between selected macroeconomic variables (GDP, IFR, INR, CON, EXR and HPI) and the set of BRICS (Brazil, Russia, India, China and South Africa) and developed countries (France, Germany, Japan, UK and US). The current chapter summarises the obtained results, their implications and makes final conclusions on their economic value added leading to theoretical contributions.

The main implications from the carried research analysis can be summarised that the selected macroeconomic variables are not estimated significant in describing the stock market indices of the developed countries, with an exception of the Japanese NIKKEI, and the investors and policy makers are directed to consider the Mosteller / Wallace regression. Another implication is that the Chinese and Brazilian stock markets are assessed independent from the other stock markets and, thus, may offer diversification benefits. Moreover, China acts more like a developed country than an emerging one.

Thus, in general the stock market indices of the developed countries are not assessed to bear the influence of the macroeconomic variables derived from the **Keran (1970)** diagram. The research then suggests other factors that may supplement and/or replace the macroeconomic indicators suggested by Keran theory for predicting the value of the stock market index subject for further analysis as follows: monetary policy, fiscal policy – i.e. the income tax and value-added tax rate, as well as import and export tax rates, external ratings, the development level of the country, internal politics, participation in the international political
relationships, war and terrorism, and finally natural disasters. The aforementioned factors set a huge scope of the further research and analysis with important implications for investors and scientific world, as well as the different GARCH models can be applied for further research purposes leading to valuable findings.

The research could have been done differently by putting more personal view in the thesis. It will have definitely changed the nature of this research giving particular importance to the people who work in the industry. For instance, the variable selection could have been subject to people experience through questionnaire, based on their real-life experience. People perception of the crisis would have then been captured. Additionally, this thesis could have been done by comparing region to encompass spill-over from one region to another. It would have been possible to compare the BRICS against the EU or ASEAN for instance. Methodologically, the use of more advanced methods as suggested in the present thesis would have benefited the researchers in the field. The results are surprising for Japan because, the researcher was expecting to observe same behaviour in all the developed country. However, Japan display set of results which might be an indication that this country is driven by certain macroeconomic variables not similar to the other developed economies.it is important to note that Japan as not FULLY recovered from the financial crisis even recovery was observed last year. Stressed in the thesis is the Chinese market results is surprising as this economy stands as a developed country with main changes originated from Chinese environment. This might be due to the fact that; China has become a leading economy in term of production worldwide. The other surprising results will be the fact that the other developed economies are not influenced by the selected variables. Meaning that, the developed world economy is driven by variables that are not included in the research. Other reason maybe that those countries have a

well-controlled economy which allows them to appear robust compared to the BRICS economies in the thesis.

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(3:174) So they returned with a mighty favour and a great bounty from Allah having suffered no harm. They followed the good pleasure of Allah, and Allah is the Lord of great bounty.