

CHARLES UNIVERSITY IN PRAGUE

FACULTY OF SOCIAL SCIENCES

Institute of International Studies

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**The Effect of the 2007-2008 Financial
Crisis on Stock Market Performance:
Evidence from Eastern and Central
European Countries**

Master thesis

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Abstract

The great recession of 2008-2010 has impacted the world's economy, which has begun with the sub-prime crisis in the US subprime mortgage market and subsequently spread to the world economy through the contagion effect. Moreover, the influence of the recession on the other nation's economy has been markedly differentiated, depending on their vulnerability to financial system problems (credit crunch, liquidity inflows). Some countries were hit very hard and experienced a drop in GDP, rising unemployment, etc. However, other countries were affected slightly, or the direct effects on them were not visible. Similarly, Central and Eastern Europe (CEE) countries have experienced a very differentiated course of the crisis. As a result of the recession, economic policymakers have tightened financial supervision and regulatory frameworks.

This study adopts seven Eastern and Central European Countries (Poland, including Czech Republic, Hungary, Romania, Slovakia, Lithuania and Bulgaria) and analyzes the effect of recession on the stock market of the selected countries. The relevant leading stock market indices of individual countries are adopted as an indicator of the development of the financial market. Monthly data for January 2000-May 2021 is used, and this period is further divided into two samples separated by the period of recession related to the financial crisis (December 2007-June 2009).

The results show that the recession has reduced the linear relationship between the CEE and US stock markets. However, the linear relationship has intensified between the markets of the CEE countries. This result is also supported by the fact that trade in goods increased significantly after the 2010 recession. The vector autoregression model (VAR) displays the predictability of the financial market, with European markets predicting each other after the recession and not the US market. The recession has also affected European countries. As a result of the 2008-2009 recession, following trade and investment with the US fell, the integration of European countries with each other improved.

Abstrakt

Hluboká recese z let 2008-2010, začala krizí na americkém subprime hypotéčním trhu a následně se rozšířila do světové ekonomiky. Nicméně, dopady na ostatní ekonomiky byly výrazně diferencované, v závislosti na jejich zranitelnosti vůči problémům finančního systému (credit crunch, výpadky přílivu likvidity). Některé země byly postiženy velmi výrazně a zažily pokles HDP, nárůst nezaměstnanosti atd. Nicméně, jiné země byly zasaženy mírně, případně přímé dopady na ně nebyly viditelné. Podobně i země střední a východní Evropy (SVE) zažily velmi diferencovaný průběh krize. Ve výsledku recese přispěla k tomu, že tvůrci hospodářské politiky zpřísnili finanční dohled a regulační rámce.

Tento text analyzuje sedm evropských zemí (Polsko, ČR, Maďarsko, Rumunsko, Slovensko, Litva a Bulharsko) a analyzuje dopad recese na jejich akciové trhy. Jako ukazatel vývoje finančního trhu jsou použity příslušné hlavní indexy akciových trhů jednotlivých zemí. Použita jsou měsíční data za období leden 2000-květen 2021, přičemž toto období je dále rozděleno do dvou vzorků oddělených obdobími recese související s finanční krizí (prosinec 2007-červen 2009).

Výsledky ukazují, že recese snížila lineární závislost mezi akciovými trhy zemí SVE a USA. Nicméně, lineární vztah se zintenzivnil mezi trhy zemí SVE navzájem. Tento výsledek podporuje i fakt, že se obchod zboží po recesi 2010 výrazně zvýšil. Vektorový autogresní model (VAR) ukazuje predikovatelnost finančního trhu, přičemž evropské trhy se po recesi predikují navzájem a nikoliv trhem USA. Recese ovlivnila i evropské země. Jako důsledek recese 2008-2009 poklesly obchod a investice s USA, zatímco integrace evropských zemí navzájem se zlepšila.

Klíčová slova

Globální recese, finanční trhy, VAR, nákaza

Keywords

Global recession, Financial market, VAR, CONTAGION

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Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.
2. The author hereby declares that all the sources and literature used have been properly cited.
3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague ...27/07/2021

YONGYAN ZHU

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Institute of International Studies

Master thesis proposal

Research question :

The previous research question is the effect and consequences of the financial crisis on the stock market. The reason that I change the research question is I found that the research question is not specific enough, without pointing out a clear study direction. Hence, the new research question need to be narrowed down in period and specific regions.

State of art:

Since the second half of 2008, as the U.S. subprime mortgage crisis has spread to the global financial tsunami and economic crisis, on the one hand, the export products of Central and Eastern European countries are facing a decline in demand; on the other hand, the Western European countries that were the main sources of capital inflows of Central and Eastern European countries but facing the liquidity problem as well. Concentrated with developing countries which highly dependent on exportation, Central and Eastern European countries with exacerbating account deficits and foreign debt is triggered a payment crisis (Xu, 2009). Thus, in this study the effect of the EU on the financial crisis should be considered to a relevant degree. Through a historical institutionalist lens, Amy Verdun (2015) examined the European Union's responses to the euro area financial crisis. Though the result is significant in HI methodology, the EU responses are not efficient and robust for new regulation or policy publish requires tedious procedure inside European parliament. The macroeconomic background for this study should be the influence on Eastern and Central European countries from the financial crisis from the United States and European Union.

Then, it should move to the nation and area-wide, for instance, the market index fluctuation before/under/after the shock. Because stock exchanges play an essential role in providing liquidity and pricing power to the market while fulfilling the function of flowing funds from saving to investment. Fernández de Guevara Radoselovics and Pastor Monsálvez (2013) detected a significant number of exchange merges after the financial crisis in 2008, and they suggest merges is not the problem of releasing liquidity but reshaping the industry structure to reinforce the aggregate international flow of capital. Since there is a lack of sources evaluating the European stock market, this study will focus on two directions. One, the empirical studies with a quantitative method in evaluating the stock market performance. And the other, the relation between stock performance and financial crisis.

Finally, after reviewing post-academic contribution in stock market performance and financial crisis 2008, the quantitative methodology will be established based on the logit theory.

Theory and methodology:

Adopt a more robust research methodology that will include a logit model and t-test for analysis. The test of structural break is developed as Wald and likelihood-ratio test, Robust to heteroskedasticity, and Cumulative sum (CUSUM) test for multiple breaks, as well as the formal t-test for multiple regression model.

The logit model should involve a rigorous testing procedure. Firstly, the ADF unit root test should be run before time-series data analysis. Secondly, the structure break test and cointegration test is introduced to identify whether the market is influenced by the financial crisis 2008 as well as whether Eastern and Central European countries follow the same trend. After that, the multiple linear regression model can also be specified, introducing a dummy variable with essential t-test and f-test. A final approach is to use the ARCH-GARCH framework to analyze the transmission of volatility between markets.

To evaluate the performance of the whole stock market, the best indicator is the market index. It is introducing the CETOP and the MSCI index as a benchmark of market performance evaluator. The Central European Blue-Chip Index (CETOP) is a stock market index that reflects the performance of the companies with the most significant market value and turnover in the Central European region. The MSCI Emerging Markets Eastern Europe Index captures large and mid-cap representation across 4 Emerging Markets countries in Eastern Europe. With 45 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country.

There are several available time frequencies to apply: daily, weekly, monthly, quarterly, and annually. For the macro part of the study, quarterly and annually will be used to consist of economic indicators (i.e. GDP, BOP, Deficit, CPI, Inflation). As for the nation and area-wide, daily, weekly, and monthly will be tested to detect structure break or cointegration.

Proposed structure of dissertation:

The background of this article is the global financial crisis caused by the subprime mortgage crisis in the United States. This paper will then discuss how does the European stock market perform a pre-and post-period financial crisis in 2008. This dissertation will be further arranged into four sections. Section 2 will explore the previous studies done by the relevant scholars in this field and area. Section 3 will describe the data and research methodology that will be adopted in this study to serve the objectives of this paper. Section 4 will show and illustrate the results. Finally, section 5 will cope with discussions and a conclusion

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Chapter I: Introduction

Globalisation has been an unavoidable process that most economies have resorted to by changing trade policies to grow mutually with other nations. It has caused a reduction in trade barriers and developed a conducive environment for international trade and investment with policy change. Technological development further supported it, allowing faster information flow with much accuracy (Mitchell 2015). As a result of globalisation, the global market has been integrated and benefitted the economic development by developing new markets, resources, capital flow and ease of doing business (Zeibote, Volkova and Todorov 2019). As the norms of investment in the financial market have eased, there has been a multi-fold increase in foreign investment in the financial market. An investor from a capital surplus nation could invest in the capital deficit nation. It will benefit the investor with better return and economy as the cheap cost of capital (Drobetz et al. 2018).

1.1 Background of the research

The great recession of 2007 has been a remarkable event that provided many lessons to the policymakers, regulators and government bodies. There have been significant changes in the policy and regulations of financial institutions (Kingsford-Smith and Dixon 2015). The lessons learnt from the recession of 2007, and related regulations that come into force has opened a new chapter for the financial market. There were several changes, including the revival of international policies by the governments. The radical changes in the policies as the learning's of recession have affected the financial market. In the recession, economies with more trade and financial relations with the United States were severely affected (Levichand and Walter 2019). Take Germany as example, which is one of the nations that have the highest trade relations by value among European countries is which strengthens the contagion effect between the two-nation. The pre-recession period and post-recession period has significant changes. There has been tremendous growth in the first period with no or less risk assessment by the regulatory bodies. With the trade and investment of the European nation, the US became the hotspot of their investments. This bubble burst with the bankruptcy of the Lehman brothers. Post-recession has been the period that has witnessed financial growth with growth in the economic fundamentals of the economy (Charles and Shon 2018). The business relations were strengthening between the US and European nations.

US becomes a major business ally with some nations like UK, France, etc. (Buona and Formai 2018).

a. Pre-Recession Period

Globalisation has supported economic growth via the financial market. It is also supported by the exploration of new markets and technological knowledge exchange. Prior to 2007, the international market witnessed a calm market and less fluctuation, termed the Great Moderation. The period of great moderation started during the 1980s and ended with the onset of sub-prime crises. The great moderation ends in recession as the risk was underestimated, and there was over-optimism in the market. The growth was unsustainable due to the ignored fundamentals of the economies. The pre-crisis period has observed a period where there was high financial growth. There was a tremendous boom during the period due to the surge in the external finances like revenue from export, remittances, the flow of capital, etc. The loose monetary policy was conducive to low interest rates and high liquidity in the market. The increase in the flow of capital has resulted in the reduction of the cost of capital. The labour market has significant growth, but then there was a sluggish increase in the real wages in the economy. The difference in the wage share has raised increased inequalities.

However, the opening of the economy and integration of the financial market has made the financial market vulnerable to international events besides domestic events. The deregulation and the lack of supervision by regulatory institutions like the central bank intensified the vulnerability to the economy. The foremost example is the great recession of 2008—the recession started in the United States in 2007. The recession has does not influence the economy and the financial market of the nation. The economic loss and rise in unemployment generated severe side-effects, especially on the health of the citizens of the nation.

b. Recession Period

The period of December 2007 to June 2009 has been a period of recession for the US. However, the starting period of recession was different for the nations considered in the study. The EU nations faced a recession from the second quarter of 2008 to the second quarter of 2009. The recession has started with the subprime crisis. It started after the value of the mortgage assets declined, which resulted in the liquidity crisis of the banks and many financial institutions become bankrupt in many nations. The collapse of the financial institutions has affected the companies.

The collapse of the companies has had a devastating effect on the household economy budget. Eventually, the effect of the subprime crisis has affected the developed and developing economies by the contagion effect (Bell and Blanchflower 2018). The impact of the recession differentiates influence on economies, depending on the credit crunch and liquidity. The worst affected were the European countries, and the most affected were UK and Germany, whose GDP reduced by around 5% in 2009. However, the CEE nations had an average GDP reduction of 2-2.6%, (European Bank Report, 2009). The investors withdrew the capital invested overseas by the investors as the economic gloom sweeps the nation. This period on average, witnessed the shrinking of the economy, increase in unemployment, loss of capital, etc. The situation was challenging for the policymakers (Rothwell and McEwen 2017).

The influence of recession on the nation's economy was not the same but varied from one nation to another. So, as the interventions of the government. European nations' recession ended after the monetary policy revived with the stimulus provided by the government to boost the economy as suggested by the European Commission. One of the most significant emphasis was on the assessment of the risk. Risk assessment becomes an integral part of the financial institution's operations, earlier ignored before the recession.

The US subprime mortgage crisis has spread to the global economies as a financial tsunami and economic crisis since the second half of 2008. On the one hand, the export products of Central and Eastern European countries are facing a decline in demand; conversely, Western European countries were the primary sources of capital inflows to Central and Eastern European countries but faced the liquidity problem because many European banks were overburdened with the non-performing loans and toxic assets. Thus, in this study, the effect of the EU on the financial crisis will be considered the primary focus area. Through a historical institutionalist lens, Amy Verdun (2015) examined the European Union's responses to the euro area financial crisis. The EU responses are not efficient and robust for new regulation or policy publish requires tedious procedure inside European parliament. The macroeconomic background for this study should be the influence on Eastern and Central European countries from the financial crisis from the United States and European Union.

c. Post-Recession Period

The European nation's economy was severely affected by the recession compared to the other nations. As the world was recovering from the recession in 2009, the European economy has taken steps to have financial stability, restrict leverage, and penalise mistakes. The financial stability was made by having regulators bodies look after banks. The revised restrictions have eased lending in the difficult times when the businesses require it in hard times. Leverage which is general terms, means "borrowing to invest" leverage can push the economy into a recession by eroding the capital and losing the value of the investment. Besides, other measures like managing the risk, estimation of risk, and probable solutions by hedging to minimise the risk's impact actually failed during the recession (Sahm,2019).

There have been significant regulations in the financial market. After the recession, the financial market behaviour has been changed with policy change and increased supervision. The trade and investment changed after the recession; the European nation has increased their relationship between themselves by promoting the business and investment with members of the European Union (Figure 1).

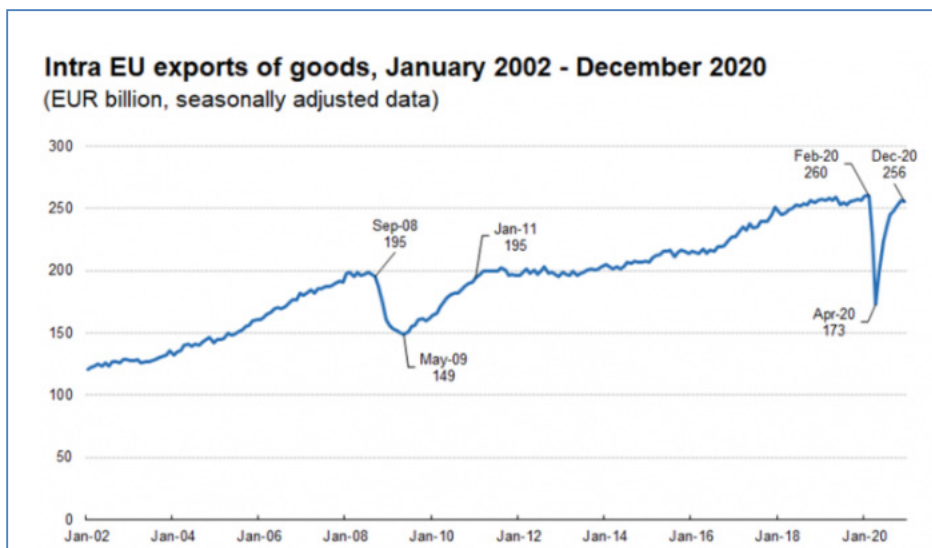


Figure 1: Intra EU trade of goods (reference: Eurostat.com)

1.2 Research Objective

The Efficient Market Hypothesis postulated by Eugene Fama et al. (1969) that "the stock prices reveal all the information". The financial market is driven by news imbibed by the financial market

by a change in the prices. Accompanying the development of Globalization, international news, as well as domestic news, can affect the performance of the financial market. One such is a recession that has forced policymakers to draft strict policies.

The research objective of this thesis is to understand the behaviour of the financial market pre and post-financial crisis of 2008 for the European countries. This research will study the financial market's performance among selected European nations during the two periods, evaluating the performance in terms of returns generated during the two-period by all the countries and the relationship between the financial market. The relationship between the financial market evolves with time as the shocks transfer fast and efficiently, termed as the contagion effect, is the topic of interest. Hence, the contagion effect will be applied, and the change in recession will be quantified to understand the changes that have evolved with the recession.

1.3 Research Question

- a. How does the European stock market perform pre-and post-period financial crisis 2008?
- b. How has the financial market relations has been changed with the great recession of 2008?

1.4 Rationale of the study

The research will study the financial market performance of the US and CEE European nations before and after the recession. The recession, as discussed, has altered the course financial market were working. Regarding this, there have been policy changes with the drafting and deployment of specific regulations. The connection of the financial market or the contagion effect will be analyzed during the two time period, i.e. before and after the recession. The lead-lag approach will contribute to comprehend the variations in the financial market concerning the US and the other European nations. Some European nations were having trade of goods, services and investments relations with the US market, which were affected by the recession. However, smaller European countries not involved in the trade were also affected. The study will provide information regarding the predictability of one financial market with other. The change can be significant in understanding the financial market and its nature.

1.5 Structure of the thesis

The thesis is divided into five chapters. The first chapter of the dissertation is the introduction. Where in this chapter, the background of the research of interest is presented, with the research

objective and the research question. The second chapter of the dissertation is the literature review, where the critical review has been performed on past researches of a similar topic or research context. The findings are analysed to understand the research gap, which forms the basis of the current study. The third chapter is the methodology part where, the variables in the study, sample size and time-period of the data considered in the study are presented. In this chapter, a specific discussion is made about the stepwise data collection and statistical analysis method. The fourth chapter is the result and discussion part. Results obtained through statistical analysis of the data are examined and evaluated against the theory. The statistical analysis outcome was used to test the hypothesis predefined as per the objectives of the study. While, the results obtained in the study were cross-examined against the past literature findings and scholarly claims. The last chapter of the dissertation is the conclusion. A conclusive summary of current study findings is provided with the discussion on the implications of the results obtained, limitations of the study and scope of the future research.

Chapter II – Literature Review

This section presents the overview of previous studies, which attempts to develop a framework for the study. In this section, various approaches adopted by the researchers and results obtained from that is discussed, referring to the previous studies related to stock market performance during economic crises. The literature review was performed for pre-recession, recession and post-recession periods of recession. Apart from this, the effect of recession on the economy and nation has been reviewed for European nations.

2.1 Effect of Financial crisis in the US

The US was the economic superpower at the start of 2000. The dot com bubble occurred during 1995-2000, and that time the investors invested the money in the internet start-ups. This sector was emerging and providing better returns compared to other sectors. To cash in the opportunity, investors ignored the investment metrics and risk assessment. The investment was made conducive to the monetary policy, which made the fund's availability easy for investment (Dhameja 2010). With the IT boom, the financial market has gained much confidence in this economy. It resulted in the confidence of the investors and other nations to have trading relations with the US. The researches of Claessens and Kose (2013) and Ferrerio et al. (2016) shows that there has been a liquidity crunch in the market, increased risk and volatility. The loss is not only in the financial market, but the total macroeconomic and household income has been affected by this.

Baily, Litan and Johnson (2008) the average American household has increased consumption despite the rising prices of consumer goods. The global economic scenario and reduction in productivity increased unemployment and reduced household consumption, even when the household's income was stagnated for a certain period. It also concluded that the consumption at increased prices affects the current account deficit, which raised multiple times. Aassve, Cottini and Vitali (2013), who studied the poverty among the youth who are entering adulthood during the period of recession, observed that the recession has an effect on economic opportunities. It has resulted in an increase in the co-residence with the families. The independent life separately from the parents has declined significantly during the recession.

The effect of unemployment is more prominent in the nation with a low level of social protection. The social protection policies played an important role in supporting the families during the

financial crisis. Fan, Pena and Perloff (2016) studied the effect of the recession on agricultural labour while having a comparative study with and after the recession.

Kilic and Wachter (2018) studied the factors behind the cyclic behaviour of the labour demand in the economy and the unemployment during the different periods of the economy. Another objective of the study is the relationship between the firms that are creating employment and the stock market behaviour. They estimated the time-varying risk with a probability of the economic recession predicted by the behaviour of the labour market. A high probability of the risk in the market poses more significant risk and uncertain future risk. During the period of recession where the risk is high, stock market valuation is low and high unemployment. Hall and Kudlyak (2020) have studied the recovery of the US economy in the past recession, as faced by the US for more than 70 years. The recession faced by the US in history has been due to several reasons, and liquidity crisis was one of them.

Another conclusion by the authors was that the pattern of recovery in all the recessions was the same. Scholars observed that unemployment in the US is reduced by 0.1 log points each year. Mansfield, Mutz and Brackbill (2019) studied the attitude of the Americans towards the trade. It is a general approach since the trade has been badly affected by the recession. The rise in unemployment due to the loss in trade will result in conservatism towards trade. Even after the recession was over, the people employed in the trade were not hostile regarding the trade with other nations. The research points that the neglecting of international trade to safeguard from external shocks will cause more harm to the economy than having international trade.

2.2 Effect of the financial crisis on Central and Eastern European Countries

The financial crisis has affected the financial market in both developed and developing economies. Emerging markets were not able to disassociate from the financial crisis (Eichengreen and Park 2008). New members of the European Union were significantly affected by the crisis.

Financial crisis refers to the economic situation that affects banking, stock market, losses in production, disorganisation of the financial sector, and international markets. That results in the formation of financial bubbles and money crises which caused slow progress of the economy and may lead to the occurrence of recession in the economy. The financial crisis caused during 2007-08 due to the financial burst of the real estate sector in the US has severely affected most parts of

the world. It is said to have a significant effect on the world economy, and the intensity was more severe than the South East Asian Crisis caused during 1997 and more significant than the effects caused due to Great Depression in 1930 (Dhameja 2010).

Hoer (2009) found out the severe decline in car sales in Slovakia, which is the largest producer and exporter of cars. The South Eastern European countries were severely affected by the recession except for Bulgaria, which sustained mainly because of currency and had good credit ratings. The exchange rate is fixed, and the productivity supports competition. (Terazi and Senel 2011). Baltic states were severely affected by the crisis, and Latvia tried hard to get support from IMF. The Lithuanian economy suffered more for almost four years. However, it overcame the challenge and created structural reforms for long-term competitiveness. Romania entered a recession during 2009. The Baltic nation concentrated on social welfare, which makes the basis of the socioeconomic strong by which it overcomes the recession. Zaman and Georgescu (2009) found the decline in GDP for successive quarters.

Romeo (2010) indicated that the countries, including the US and EU27, were unable to face the challenges of the crisis. There was a significant decline in export from 2009 to 2010 in CEEC due to the financial crisis (Bjelica, Jacimovic, and Tasic 2013). Hungary was indeed a bit specific case amongst CEE countries mainly due to the accumulation of previous policy errors and possible high costs of currency depreciation (European Bank report 2009). Dietrich, Knedlik and Lindner (2011) showed the simultaneous occurrence of banking and currency crisis in CEEC during the Great Recession.

Claessens and Kose (2013) the recession of 2007-2008 has the painful reminder considering the multifacet nature of the era. In this recession period, there was a lack of confidence in the banking system. The confidence of the investors in the risk premium has been lost. The European nations have an adverse effect on the European economy.

Ferreiro et al. (2016) studied the influence of the recession on the individual European Union nations. As per the study, the effect of the recession on the individual nation economy is different from another economy. The authors have identified the 17 economic and financial variables and their effect on them. As per their results, the Euro nations were more affected by the recession than the non-Euro nations. They have found that there is a significant difference in the performance of

the financial market. The Euro nation financial market return was most affected, of the euro countries, those nations which have joined after 1999 are mostly affected. The gap in the macroeconomic performance has widened between the Euro and Non-Euro countries.

Macroeconomic variables influence stock market performance (Osamwonyi and Evbayiro-osagie 2012). The influence of the supply of money, price, and output on stock market behaviour can be observed in both developed and developing markets (Bernanke and Gertler,2001). Many researchers examined the dynamic response of stock price to uncertainties using the structural vector autoregression (SVAR) model by many researchers (Hess and Lee,1999; Blanchard and Quah 1989; Campbell and Mankiw 1990). The stock market indicates the real economic activity, and the effect of a financial crisis can be seen through changes in performance indicators of the stock market. The relationship between the macroeconomic shocks and stock market return was analysed by Yang et al. (2018) using the Structural vector autoregression models. The macroeconomic variables like inflation, output growth and stock return were the three variables included in the SVAR model. The macroeconomic effect of the financial crisis on stock market performance is studied by various researchers¹. Osamwonyi and Audu (2020) investigated the long-run relationship stock market and other macroeconomic variables during the 2008 crisis. Claessens et al. (2000) defined the co-movement of stock prices across markets after a shock in a country as a contagion.

Integration of the stock market was examined by Forbes and Rigobon (1999). They developed a model to explain the spread mechanism and proposed an adjustment factor to overcome the bias in the standard method used in examining the cross-market correlation. Financial crisis contagion was studied by Paula et al. (2008) using alternative estimation methods, including DCC-MARCH, and the result indicated six crises during the study period between 1995-2004. Conditional and unconditional measures of volatility, VAR (Vector auto regression), co-integration, and correlation were used by Bianconi et al. (2013) to study the spread of the US financial crisis to other countries. The effect of the news and volatility on associations between stock markets during the financial crisis period was examined by Bianconi et al. (2013) using advanced GARCH and correlation techniques. The co-movement of the stock market was explained by volatility in the majority of the markets, and news has an only insignificant effect (Mun and Brooks,2012). The negative impulse of the financial crisis on stock market performance in CEEC was attributed to

the transmission mechanism and development of internal activities in the countries (Konopczak and Marczewski 2011).

Thalassinos, Pintea, and Iulia (2015) analysed the performance of stock market variables during the crisis period and studied the differential effect of the crisis on matured and emerging economies. The variables selected for the study were market capitalisation, turnover, and share price indices, Beirne et al. (2009) examined the spread of volatility from matured to the emerging stock market and studied the changes in contagion during turbulence in matured markets. CEEC countries such as Czech, Hungarian, Polish, Germany, French, and the UK showed stock market co-movements so many times between 2003 and 2005 (Egert and Kocenda 2007). A strong co-integration among CEE markets was observed (Gilmore et al., 2008). The correlation between the Czech stock market and the STOXX50 index increased during the financial crisis (Gjika and Horvath 2013). The CEE stock market was strongly influenced by developed economies (Hanousek and Kocenda 2009). Barunik and Vacha (2018) used Gallegati's (2012) approach to study contagion. Wavelet correlation was used to decompose correlations.

Dajcman et al. (2012) used the same method to study CEE countries. After the beginning of the financial crisis, there was a contagion between oil and stock prices in the US and Europe (Reboredo and Rivera-castro 2013). There was a contagion between DAX and PX and a lower correlation after the crisis (Barunik and Vacha 2018). Syllignakis and Kouretas (2011) used a dynamic conditional correlation (DCC), multivariate GARCH model given by Engel to study the time-varying conditional correlations for weekly returns of stock market data. The study indicated a statistically significant condition correlation between the US and German stock returns.

2.3 Financial Market Contagion

2.3.1 Definitions of Contagion

Definition of Contagion often remains non-obvious, unresolved and there is no single commonly accepted definition. World Bank (2016) provided three definitions for contagion. There are less than five definitions in literature (Pericoli and Sbracia 2003), and eleven studies are listed by Forbes (2012) with distinct definitions of contagion. Contagion is a cross-country transmission of Shocks/excess co-movement commonly explained by herding behaviour/Situation when cross-country correlation will be more during crisis times relative to tranquil times (World Bank,2016). Knowledge of crisis prevailing somewhere leads to higher chances of occurrence of domestic crisis

during contagion (Eichengreen and Rose 1999; Kaminsky and Reinhart 1999). A remarkable increase in cross-market linkages was followed by a shock to another country or group of countries (Dornbusch, Park and Claessens 2000). The definition given by Forbes and Rigobon (2002) was cited in many studies in which contagion results when there is a significant increase in cross-market linkages after a shock hitting one country or group of the country. This was also defined as shift contagion. A remarkable increase in market co-movement after a shock can be regarded as contagion otherwise continued high level of correlations between the market indicates strong linkages and is regarded as interdependence (Forbes and Rigobon 2002). Literature classified the definitions of contagion into narrow and broad definitions. The broad definition of contagion assumes if two countries are strongly linked through trade and financial linkages, shock in one country requires other countries to adjust to the shock. Government intervention, in this case, is of less effect. In the case of the narrow definition, which is often called shift contagion, two countries will have linkage through trade, finance and other means. A crisis in one country affects other countries for a shorter period. In case of shift contagion, government policies are effective to control contagion and support the country (Classen and Forbes 2004).

2.3.2 Causes of Contagion

Collins and Gavron(2004)analysed the channels of financial market contagion to identify the most significant channel in transmitting crisis between the countries. The authors employed χ^2 contingency table and found the significant association of contagion with the inflation rate and financial liquidity. To compare different channels of transmission series of logit regression was carried out, and the result indicated that the contagion effect was more in the case of an emerging country with a high rate of inflation.

Many literatures indicate that trade links are an important source of contagion (Eichengreen et al. 1997; Glick and Rose 1998; Hernandez and Valdes,2001). Some common trade agreements will also make a country vulnerable to contagion by a member country (Frankel and Schmulker,2000; Kaminsky and Reinhart, 1998). Forbes (2004) employed micro-level data and found out that trade linkages were important means of transmission in the Asian and Russian crises. The typical lender will create interdependence of the country's leading to contagion effect during the crisis period (Kaminsky and Reinhart 1998 and Rijkeghem and Weder 2001)

Though Brazil and Russia have weak economic and financial links, the 1998 Russian crisis affected the Brazilian financial market (Baig and Goldfajn 2001). The potential source of contagion identified was a common set of investors for both the country (Brunnermeier 2001). According to Dornbusch et al. (2000), markets with a lack of complete information and less liquid are inefficient markets and prone to contagion. Contradictory to this, Kaminsky and Reinhart (1998) and Calvo and Mendoza (1998) fewer liquid markets will have less exposure to contagion as they represent a smaller portfolio.

2.3.3 Empirical approaches to study contagion

There are many distinct empirical approaches to study the existence of contagion, which includes conditional probabilities (Eichengreen et al. 1996; Hartmann et al. 2004), correlation analysis (Forbes and Rigobon 2002; Briere et al. 2012; Stove et al. 2014), VAR approach (Climent and Meneu 2003; Rigobon 2003; Gebka and Serwa 2006; Blatt et al. 2015; Samarakoon, 2017) multivariate GARCH models (e.g., Hamao et al., 1990; Gebka and Serwa, 2007; Chiu et al., 2015; Dungey et al., 2015; Mollah et al., 2016), copulas (Philippas and Siriopoulos, 2013)

The single VAR approach was developed by Forbes and Rigobon (2002), which involves estimating the correlation between the residuals of a two-equation VAR system. The dependent variable considered for the model is adjusted daily returns of the markets. Forbes and Rigobon (2002) considered interest rate as an additional independent variable in their VAR system and found out that it has a non-significant effect on their findings. Bae et al. (2003) adopted a new approach for the measurement of contagion in financial markets. This approach captures extreme return shocks across different regions. The study analysed the extent of contagion, its significance, and multinomial logit regression to study the contagion factors. The study period considered was 1990, and the result indicated interest rates prevailing in the region, changes in the exchange rate, and volatility of stock returns are major determinants of contagion.

Syllignakis and Kouretas (2011) used dynamic correlation analysis for estimating contagion in the financial market. Data on weekly stock returns of seven emerging markets of CEEC for the period 1997-2009 were analysed to find out dynamic correlations and to identify contagion effects. The countries selected were the US, Germany, and CEE. The study indicated a statistically significant conditional correlation among these markets during the 2007-09 crisis period. Furthermore, the study indicated the role of economic fundamentals in explaining this condition correlation during

the crisis period. Gallegati (2012) employed the wavelet-based multiscale correlation method to estimate the stock market contagion during the US subprime crisis. The same approach was used by Ranta (2013) to study contagion among the world stock market during the different crisis periods. Contagion between oil prices and the USD exchange rate was studied using a multiscale approach by Reboredo et al. (2014). Da Silva et al. (2016) employed a multiscale approach to study contagion among G7 countries. However, Forbes and Rigobon (2002) identified heteroscedastic bias in these studies as they conditioned on market volatility.

Wang et al. (2017) studied stock market contagion during the global financial crisis using a multiscale approach. The focus of the study is to analyse the stock market contagion from the US to G7 and BRIC countries. The study indicated cross-market correlations are conditioned upon the time scale, and these findings are helpful for international investors while planning global portfolio diversification. Ding et al. (2017) studied the effect of international crude oil price fluctuations on Chinese stock market investor sentiment. To find out the Chinese stock market investor sentiment index, principal component analysis and structural vector autoregression method were used to study the contagion effect. The result indicated that fluctuation of international crude oil price granger causes investor sentiment, and it takes on an average eight months for international crude oil price fluctuation to affect investor sentiment.

Sewraj et al. (2018) identified the financial contagion using a unifying approach. They used the stock market data of 25 major world stock indexes. The result indicated the heterogeneous effect of financial shocks originating from the US on domestic markets. The contagion effect was also less compared to its effect estimated using a commonly used model that assumes interdependencies of the market. Zhou, Liu and Shuxian (2018) analysed international stock market contagion using CEEMDAN (complete ensemble empirical mode decomposition with adaptive noise) wavelet analysis. The procedure involves decomposing stock index return into independent intrinsic mode function and wavelet decomposition functions. Then these functions are divided into three components: a high-frequency component, low-frequency component and long-term trend (Zhou, Liu and Shuxian, 2018). Finally, the accumulated impulse response is estimated, and stock market contagion is analysed under time-varying frequencies. Results indicated that shocks caused by extreme events and irregular events could be transferred to different stock markets.

The shock caused by irregular events can cause sudden and short-term risk contagion, whereas the latter one may cause positive and sustained risk contagion to stock returns. Le and Dieu (2020) studied the contagion effect from the US stock market to the Vietnamese and the Philippine stock markets using DCC-GARCH model. The study employed SandP 500, VN-Index and PSEi index for analysis. The result indicated the absence of contagion effect from the US to Philippine market during global financial crisis whereas Vietnam market was affected by the global financial crisis. Furthermore, the study indicated that both markets were affected by the contagion effect in the COVID-19 pandemic crisis. Osamwonyi and Audu (2021) tried to identify the long-run relationship between stock market behaviour and other macroeconomic variables. The study period selected was 2005 January to 2015 December. The autoregressive Lag modelling technique was employed to study the long-run relationship between stock market behaviour and macroeconomic variables like interest rate, exchange rate, industrial production index, and oil price. The result indicated a significant long-run relationship between stock market price and macroeconomic variables.

2.4 US and world economy post-recession

Pritchett and Summers (2013) there have been structural shifts in the growth of the nation's post-recession. The Chinese economy has experienced major structural shifts associated with the slow but steady growth in the economy. Andolfatto (2015) monetary policy has been an important policy that significantly affects the financial market. During the recession, monetary policy change has a significant effect to overcome the recession. It was observed that during the recession period when there was a liquidity crunch in the market. The monetary policy has no control over inflation, but the fiscal policy has. It was observed that unlike normal period increase in the interest rate on reserves slow down the economic activity.

Corrado et al. (2016) developed a framework to measure intangible investments like technologies, manpower etc., for the US for the pre-recession and post-recession periods. It was observed that in the US, the value of tangible investments had declined significantly during the great recession of 2008. The recovery of the tangible assets has been significantly slow after the recovery of the recession period, unlike European economies. Post-recession growth of the US economy was due to the equal contribution of tangible and intangible assets. Kalleberg and von Wachter (2017) the great recession has a widespread effect on the US labour market. Some of the effects on the labour

market were started before the recession. However, as per the authors' analysis, the impact of the recession on the population is not uniform. The effect is different for the different subgroups of people, which differs for the race, gender and ethnic connectivity. The recession affects marriage, child growth, etc. the recession has also affected the future generation.

(World Bank 2015a). Post-recession, there has been a rebound in the global trade, prices of the oils and commodities. It is due to the fiscal and monetary stimulus provided by the nation to overcome the recession. Most economic indicators, such as the stock market performance level and capital flow, were near the pre-recession period. Post-2011, there has been a sudden decrease in the prices of oil and commodity prices due to weak demand due to trade weakness.

The recession of 2007 -2008 can be the benchmark event that has shattered the economy and provided new lessons to the policymakers and government. However, the effect of the recession is beyond the economy. This has affected the life and health of the people also.

2.5 Central and Eastern European Countries financial market performance post-recession

2.5.1 CEE countries before the recession:

The European nations before the global recession of 2008 were integrated among themselves as being part of the European Union. However, the degrees of integration measured with the ease of business were different. De Guevara, Maudos, and Pérez (2007) adopted the Lerner Index to measure the integration and level of competition between the European countries. The study was done industry wise, it was found that in the banking sector to have inequality among the nation. They found that “the relative margin inequality is due to more differences among countries”. Bartram, Taylor and Wang (2007) studied the impact of single currency on the stock market of the European countries. It was observed that the nation with the developed financial market, the market dependence has increased with the value of Euro while for the nation with less mature financial market co-movement with currency has increased even not adopted Euro.

Tumpel-Gugerell (2007) the development of the central European bank and Eurosystem was the major breakthrough in integrating the European market. this integrated market supposed to be competitive as compared to the individual market. Southhall (2008) the European Union

membership has increased the integration of the financial market. They have studied the co-movement of the financial market with reference to the indices. It was also supported by the findings that the global factors make the financial market more integrated.

2.5.2 CEE countries after the recession

Reinhart and Rogoff (2009) the effect of the recession on the European economy is very hard, taking some time to return to normal. The normal growth is far from reality for the European nations, as their GDP has been reduced by 4% and the industrial growth by 20%. This long-term effect is because the recession that earlier has affected the banking system has affected the real economic scenario.

The recession has a broad effect on society which is much beyond the economic aspect. The advent of recession and overcoming the situation affects the health, marriage, and family, which is beyond the macroeconomics. Most of the studies are concentrated on the financial losses and recovery post-recession. Only a few research has shown the effect of recession on these issues.

Mankiw (2010) the investors are willing to take risks as there is a risk premium associated with it. Therefore, as learning from the recession that the risk management strategy can be failed. Therefore, investors used to avoid investing in high-risk economies even the return is higher. The European nations were replaced by the Asian market, where the risk is moderate compared to the European financial market. The recession has resulted in the GDP loss of 4 % in 2009 for European nations (de Beer, 2012). This loss has diluted the decadal growth rate in the economy by the European nations except for Poland. After 2010 and 2011, there has been a sharp reduction in the financial market of Europe, but that resulted in increased unemployment. The unemployment rate and GDP have not been uniform among the European nations—the growth in unemployment in all the Baltic regions. The countries with an industrial mix had better economic recovery compared to the less industrialised countries. The period after the 2007-2008 recession and the steps undertaken by the European nations to overcome the recession has resulted in European nations' uneven growth (Aizenman, Hutchinson, and Lothian 2013). There were large public debts on some European nations that resulted from recession, which causes a situation worse than the great recession for nations like Portugal, Ireland; the sovereign debt crisis has still prevalent among

the European Union nations. Villarreal (2014) recession has crippled the economy, which has resulted in the loss of jobs. The labour demand has been reduced significantly.

Della Porta and Parks (2015) have investigated the trust in the European Union. The group of nations with a single currency and free trade among the member nations. During the recession, the contagion effect influenced some nations directly and other nations indirectly. Nations with better trade relations with the US were badly affected by the recession. These nations have affected the other EU nation which was having trade and investment with other European nations. The people's confidence in the financial institutions supported by the EU since they failed to save the EU from the recession was blamed for the sufferings arising from the recession. The concept of one Europe or integrated Europe was affected by the recession.

Vassallo and Ding (2016) The recession of 2008 has increased the mistrust of the European Union among the citizens they have surveyed the citizens from 2006 to 2012. It was observed that the protest against the European Union has increased among the citizens. The economic indicators which were not favouring EU after the recovery of the recession by the other nation. The recession has been prolonged in the EU, the benefit of integrated Europe has failed to deliver. Therefore, IEU was protested on the weak economic variables.

Corrado et al. (2016) In the European nation the tangible investors were the main drivers of the economic recovery. The framework drafted by the authors shows that tangible investments were the main drivers of the economic recovery. Capital deepening has supported the economy moved out of the recession. National account intangibles were responsible for 80% of the national growth while 20% due to national account intangible assets. The slowdown in the labour productivity rate during the recession period was due to the minimum role of the tangible and intangible assets.

Brůha and Kucharčuková (2017) have analysed the macroeconomic development in the European Union countries. As per the authors, the quality of the financial institution is remarkable in containing the effect of the shocks arising from the other nations. The nations that have quickly recovered from the recession's effects had some common characteristics: political stability, quality of regulation, and fiscal regulations prior to the recession.

Bown (2018) have studied the cross border supply chain for the intermediate goods and the final goods. In post-recession economy has witnessed a slow growth rate, which is also affected by the

political relations between the US and UK. The policy of trade barriers by the nation to safeguard the domestic economy has a repercussive effect. The trade barriers will affect the relationship between the two nations. China has been affected by the trade barriers by the nation for the final goods only.

Arpino and Obydenkova (2019) investigated the great recession of 2008 effect on the democracy and political relationship in the national and international institutions. As per their findings, the political trust has been decreased since the recession of 2008. These findings were for both the regional as well as the international institutions.

Tezcan (2019) studied the effect of the global crisis and the effect of the policy on the economy for India and Argentina. Both the nations were not much affected by the integration with the US economy but was affected through the international trade and capital flows. Both the nations adopted a fiscal and monetary policy to overcome the recession. The cut in the tax system has resulted in a decreased growth rate in the economy, which resulted that the effect on the economy has been lesser compared to Argentina, which has witnessed negative growth after the recession was over.

In Poland and Bulgaria, the recession crisis was not due to the direct channel with the US by the mortgage crises but via the European nation like Italy and Germany, which has directly affected the mortgage crisis. This is because of less dependency on the exports. These nations have better import-export relations with the other central and eastern nations of Europe. However, the Bulgarian economy was least affected, but the effect was due to the trading partners and FDI in Bulgaria. The effect was not so much as the financial market was immature compared to the other financial market of Europe.

Kose and Ohnsorge (2019) studied the emerging country's economics. As per the authors, the emerging nations have countered the recession better than the developed economies like the US or European nations. Economists now believe that the risk has been reduced for these nations. However, the potential of these nations to grow has been restricted. The smaller economies must have a scope of policy changes. To have sustained growth, the policy must be strengthened with the scope of further improvement. These nations must have policies that are resilient to the shocks arising from the outside economies. Lago, Lago-Peñas and Martinez-Vazquez (2020) have studied

the relationship between the government and sub government in European countries. The great recession of 2008 has affected the political consensus in the European Union countries. They have concluded in the study that the nation with the centralised government has tackled the recession better than the decentralised government. The fiscal stability in the centralised government is more as the autonomy and authority are better than the decentralised government.

Flachenecker, Kornejew and Janiri (2021) have studied the firms of the sixteen-member European nations for the duration of nine years, i.e. 2005 to 2014. The analysis of firm characteristics shows that the recession has affected the growth of the firm irrespective of the size and industry of firm. That majorly, primarily due to the decrease in consumption. The recovery of the firm's post-recession was disproportionate as the large firms were recovered fast than the smaller firms. The firms with the high growth were of all classes, i.e. small, mid-size or large. Peritz et al. (2021) investigated the integration of the nations in the European Union, which has caused the economic specialisation region wise. It is generally argued that the nations of the European Union are more susceptible to the recession as financial integration will cause a contagion effect. The use of common currency supports this; however, the study supports that the specialised region, which has commonalities were found to withstand the recession and its impact. Their performance was better than the other non-specialised regions. The results were different for the nations which were outside the European nation. Societal equality and stability have been different for the European nations. The nation, which has stabilisers to control the recession with the fiscal stimulus, was able to absorb the recession shocks. The market level inequality persists depending on the measures taken by the host nation. The shocks that automatically stabilise the economy has a varying effect that varies from one nation to another. The automatic stabilisers income shocks of 38% in European Union while up to 20% in the US.

Like the US, the effect of the recession was also beyond the economic or financial loss. This has affected the lifestyle and health of the people of Europe.

2.6 Research Gap

The critical literature review of financial market situation in the pre-and post-recession period provided critical insights. The literature review shows that recession come as unexpected by the economies as the financial market was smooth. The subprime crisis has affected most of the economy, with the liquidity crisis affecting financial institutions. The contagion effect of the

recession affected the other nation's economies as well. This was potentially due to globalisation and financial integration. The world first experienced this recession with contagion effect.

The research gap that arises here is with the methodological issue and the objective of the past studies. There was a study of the fiscal and monetary steps taken by the government. The other studies were carried to identify the contagion effect and financial integration between the US and the other nations. The studies of the contagion have been to the Asian and the developed European nations. The Central and Eastern European Countries have not been studied broadly for the effect of the recession on the financial market performance.

The research reviewed has used a range of econometric methods. There have been sophisticated econometric method has been adopted by the researchers. However, stepwise use of the econometric method has been the issue that is observed based on the conditions fulfilling the statistic criteria.

Most of the studies were related to study the contagion effect. This study is focused on the exploring the linkage in recessionary effect on the performance of the stock market. The financial market in the study is the Central and Eastern European Countries. These countries financial market has not been studied widely for the effect of the recession. There have been significant changes in the financial market as the effect of recession. The financial market has come with new regulations as investors have changed their behaviour. The investors have become more risk-averse as stable financial institutions were also affected, affecting investors beliefs and preferences (Guiso 2012). The study will be a comparative analysis of the performance of the financial market pre and post-recession. It will quantify the financial market performance as the effect of recession. The study's findings will be useful to the investors in decision making interested in investment in the European nations.

Chapter III- Data and Methodology

It is the third chapter of the dissertation; in this chapter, the data used in the study methodology that will be adopted further in the study and test the hypothesis is presented and discussed.

The main focus of the research is to find out the effect of the 2007-09 financial crisis on stock market performance. The impact of the financial crisis was analysed by various literature in terms of contagion effect, interdependence, and spill-over effects. The present study aims at testing the effect of the financial crisis of the US on CEE markets, and the study is limited only to find out the contagion effect of the crisis on CEE markets. The crisis period relationship between the US and CEE markets is explored through various methodologies, as discussed in this chapter. There are a total of 7 CEE countries, and one major stock index for each country is selected (Table 1). Each stock index is compared with the benchmark stock index SandP 500 index, a stock market index that measures the market performance of 500 companies listed in US stock exchanges. The US market is selected as a benchmark because it is the place of origin of the crisis.

3.1 Identification of crisis period

2007-09 crisis was different from other crises in terms of identifying contagion events. In other crises, identification of contagion, the event was easy since they were short-lived. The CBOE VIX tool was used to identify the contagion event window, which helps to identify which period produced the most significant shock to investors. This Cboe volatility index is the real-time index representing the market expectations for the relative strength of near-term price changes of the SandP 500 index. It is popularly called the fear index or fear gauge. The index measures the SandP market volatility expectation for the future 30 days. The index has been used by previous researchers (Ciarlone and Piselli,2009; DuanandYeh,2008).

The financial crisis was started in the US, and to identify which event has given rise to greater shock, VIX is used. The index has shown an upward trend during 2007. Also, there was a sudden increase in VIX during the last quarter of 2008, with a drastic increase in volatility during September 2008(figure1). VIX remained high till 2009, and market volatility diminished around October 2009, and this can be considered as the end period.

The time period considered in the study is monthly data of the indices considered in the study. The period of the data is from January 2000 to May 2021; the period is divided into two time periods with the benchmark of recession. The period which started from December 2007 to June 2009 is the recession period during which the economy has been badly affected. The period prior to December 2007 is termed as the pre-recession period, and the period after June 2009 is the post-recession period.



Figure 2: VIX volatility time series plot

3.2 Data

The data to represent the financial market performance of the nation considered in the study are the main indices of the nation. The main index of the nation considered in the study is presented in the table. The monthly adjusted closing price of the stocks of all the stock markets is considered for the study. The data of SandP 500 is collected from Yahoo finance, and the first of every month is the reporting date. Other stock market data are obtained from Bloomberg, where monthly stock market data are reported on the last day of the month. So to match SandP 500 prices with other stock markets, the opening price of SandP, as reported at the start of every month, is considered the previous month's stock price. The main limitation of this study has been not opting for daily data. Because the researcher has taken multiple countries for study while there were time zone difference and market holiday's difference. For example, national holidays differ country to country, so impact of any incident on same day and after 2 days of holiday is sometimes very different. It resulted in a series of non-corresponding data in all over raw data. It would consume considerable time in data cleaning in each data set and deleting non –corresponding dates manually. The use of monthly data has been inspired from the articles Thalassinos et al (2015) and Peter (2015).

3.3 Data Cleaning

Still in some cases, due to the prevalence of market holidays, there will be a chance that the US market will open other country markets to be closed. One can see date mismatch or the presence

of non-corresponding dates between markets in raw data. So, deleting non-corresponding dates between markets will be done manually. Since adjusted closing prices of the stocks are considered, variation in time zone will not be an issue for data analysis.

Table 1: country and their index considered in the study

Countries	Name of the stock market	Stock index Used	Founded
United States	New York Stock Exchange	Standard and Poor 500	1926
Bulgaria	Bulgarian stock exchange ¹	SOFIX Index	1991
Czech Republic	Prague stock exchange ²	Prague Stock Exchange Index	1994
Hungary	Budapest stock exchange	Budapest Stock Exchange Index Budape	1999
Lithuania	Vilnius stock exchange	OMX Vilnius Index	
Poland	Warsaw stock exchange ³	Warsaw Stock Exchange WIG Tota	1991
Romania	Bucharest stock exchange ⁴	Bucharest Stock Exchange Trade	1997
Slovakia	Bratislava stock exchange	Slovak Share Index	1998

¹The original successor, the Sofia Stok Exchange

²Founded in1871.After 50-year of suspension due to World War II and the communist regime, it was reopened in 1993

³Founded in 1817.1991(Current form)

⁴Fouded during 1882, closed in 1945 by the communist government, reopened on April 21 1995.

i. SandP 500: Standard and Poor 500 (SandP 500) is one of the main indices of the United States, which has started in the year 1926. This index comprises the 500 companies that are cumulatively valued at more than \$4.6 trillion at present, which is more than the GDP of many economies. This index is a weighted capitalisation index where the top ten companies by capitalisation form about 26.4% of the index's market capitalisation. The inclusion of the company in the SandP 500 index is very strong like it is for US Origin Company with the minimum capitalisation of \$11.8 billion. Apart from these two rules, there are other requirements for inclusion. This index has been considered in the study, which represents the financial market performance of the US.

ii. Prague Stock Exchange Index: this index is the main index of the Czech, which is traded at the Prague stock exchange, which started in 1994. This index is also a free-floating price index which is comprised of most liquid stock traded at the Prague stock exchange. The market capitalisation of the Prague index is 26313 million USD. The requirement to be part of the Prague stock exchange index is the market capitalisation of the participating company must be more than 5 billion CZK. The company stocks must be highly liquid with high trading volume. This index has been considered in the study, representing the Czech republic's financial market performance.

iii. Budapest Stock Exchange Budapest: Budapest stock exchange is the second-largest stock exchange in central Europe. The main index of this exchange is the Budapest Stock exchange index which lists the blue-chip companies where the companies with the highest market capitalisation are included. This index has initially started the free-floating capitalisation weighing in 1999. The business turnover of the company and the free float capitalisation of the company are considered when a new company is considered to be included in the Budapest stock exchange index. This index has been considered in the study, which represents the financial market performance of Budapest.

iv. Bucharest Stock Exchange Trading Index: Bucharest stock exchange trading index is the index that comprises the 15 most liquid stocks. This index started in 1997 with a base value of 1000. This index is also free-floated capitalisation. The companies to be part of this index must have strong corporate governance, transparency and quality reporting. This index has been considered in the study, which represents the financial market performance of Bucharest.

v. Slovak Share Index: Slovak share index is the main index of Slovakia. This index started in 1998 with free-floated capitalisation. This index has been considered in the study, which represents the financial market performance of Slovakia.

vi. OMX Vilnius Index: The OMX Vilnius index is Lithuania's main stock index listed at the Baltic stock exchange. To be listed at this index, it is not required to have minimum capitalisation, geographical boundary, liquidity etc. This index has been considered in the study, which represents the financial market performance of Lithuania.

vii. SOFIX Index: Sofix index is the main index traded at the Bulgarian stock exchange. The index was started in the year 1991. The index is the constituent of the 15 companies. It changes its constituents half-yearly, and it has initially started the free-floating capitalisation weighing. The business turnover of the company and the free float capitalisation of the company are considered when a new company is considered to be included in the Budapest stock exchange index. This index has been considered in the study, which represents the financial market performance of Bulgaria.

viii. Warsaw Stock Exchange WIG Total: This is the oldest index at the Warsaw stock exchange, which started in 1991. This index comprises 318 companies with a market capitalisation of 232 million Euros. This index is also the free float index where the blue-chip companies of Poland are listed. This index has been considered in the study, which represents the financial market performance of Poland.

3.4 Calculation of the return of the financial market

The return of the index is considered for the market to estimate the performance of the financial market. The return is estimated by using the formula

$$= \frac{\quad}{\quad}$$

3.5 Graphical analysis of the index

The first step to study the financial market's performance is by studying the behaviour of the stock market selected for the study. The graphical analysis of the index performance shows the presence

of the components of the time-series data (Tsay and Chen 2018). The components of the time series data which will be looked at in the time series plot of the index are

a. Trend: The trend in the data is a long-time upward or downward pattern present in long-term data. The presence of trends in the time series data provides the time series plot with a wave-like pattern in either direction.

b. Cyclicity: Cyclicity in the data is present when the data is of more than two years. The repeated cyclicity in the time-series graph across the trend is the cyclicity in the data.

c. Seasonality: Seasonality in the data represents the common behaviour of the data during a certain period of time in a year. The time-series graph shows the presence of fluctuations or depression at a common period (month, quarter, week etc.) in a year.

The analysis of time series data requires that the data be free from time-series data components. If there is any of the components of the time series data, then the results obtained are biased ones that cannot be used for decision making. The forecasting of the data will be biased (Box et al., 2015). However, the analysis of the data is using the return series for further analysis in the dissertation

3.6 Descriptive statistics of data

Descriptive analysis or summary statistics will be used to measure the central tendency, which is the single number that can represent the complete set of data and the distribution of data. Central tendency provides rough information about the dataset. The measures of central tendency which is used are mean, median and quartiles, which provides some information about the average value, the middle value and the concentration of the data (Black 2019). The second part of the descriptive statistics is the distribution which is measured by the standard deviation. The standard deviation shows the distribution of the data around its mean. Another is the range, which is the difference between the maximum and the minimum value of the data set (Anderson et al. 2020). The percentiles provide information about the percentage of the data above and below the point of interest. Descriptive statistics provide some rough information about the data set. This study does not provide inferential information about the population from the data.

3.7 Stationarity of data

Some of the statistical techniques requires that the data must be stationary in nature. It is the prerequisite of the time series data analysis. Time-series data is said to be stationary if the variance and the mean are time-invariant, i.e. mean is zero and the variance is constant. The properties of the data remain the same with time for stationary time series data. The joint distribution of the data

$$x_{t1}, x_{t2}, x_{t3}, \dots, x_{tn} \text{ and } x_{k+1}, x_{k+2}, x_{k+3}, \dots, x_{k+tn}$$

is identical for n data points (Bowerman, O'Connell and Orris 2015).

The stationarity of the data is tested with the application of the Augmented Dickey-Fuller (ADF) test. The null hypothesis of the ADF test is that the data has the presence of the unit root, i.e. the data is non-stationary, and the alternate hypothesis is that the data does not have a unit root, i.e. the data is stationary. The presence of stationarity of data, or the differentiation at which the data becomes stationary, guides to adopt the relevant econometric technique. If the data stationarity is not being fulfilled, then the data is differentiated to first order and tested for stationarity (Bowerman, O'Connell and Orris 2015). Suppose the data is not made stationary before the analysis of the data. In that case, the results obtained from the time series analysis will be spurious, and the decision making will not be informative.

3.8 Correlation analysis

The correlational analysis will be used to understand the linear relationship between the return of the two financial markets. The correlation coefficient varies from +1 to -1, including zero. The correlation coefficient of +1 means very strong, and -1 is the very strong negative correlation (Holmes, Illowsky and Dean 2017). The strength of correlation shows how two data are related. If there are unit changes in one data, it shows the expected change in the other data based on the correlation strength. The correlation analysis will be done between the financial market before and after the recession. The change in the strength of the correlation coefficient shows the effect of the recession on the financial market's performance for the monthly return.

Contagion tests

Different methods of testing contagion were identified by Forbes and Rigobon(2002). They classified these methodologies into four main groups (Table 3). The present study focuses on correlation coefficient analysis and cointegration techniques.

Table 2: Methodologies of cointegration

Methodology	Literature
Correlation Coefficient Analysis	King And Wadhvani (1990); Lee and Kim (1993); Forbes and Rigobon (2002) and Caporale, Cipollini and Spagnolo (2005)
DCC-ARCH/GARCH	Engle (2002); Chiang, Jeon, and Li (2007);
Cointegration Technique	Longin and Solnik (1995); Kanas (1998)
Transmission Mechanism Approach	Eichengreen, Rose, and Wyplosz (1996); Forbes (2004)

Source: Forbes and Rigobon (2002), Cheung, Tam and Szeto (2009), and Bello (2015)

Cointegration of the data: The cointegration of the data will depend on the stationarity and the difference at which the data becomes stationary. It has been observed that the contagion effect is due to the cointegration of the financial market. The cointegration test will proceed if the return series of the two financial markets are integrated at the same level. If the data is stationary at level, then Vector Auto Regression will be adopted, which will show the lead-lag relationship between the financial market. When there is a presence of cointegration, then the two financial markets move together in the long run. Suppose there is movement from the stable relationship (Shi, Worden and Cross 2019). The arbitrage opportunity arises, which is eliminated with the buying selling approach. The stable relationship is again established, and the financial markets are cointegrated (Gil-Alana, Yaya and Awe 2017)

3.9 Vector Autoregression

If the financial market is not cointegrated, the relationship between the two financial markets can be studied with the Vector Auto Regression model. VAR is applied when the data is stationary. The financial market can be related to each other by the lead-lag effect. This statistical analysis is the multivariate time series analysis which is the extended version of the univariate autoregression model (Siggiridou and Kugiumtzis, 2015). This statistical analysis shows the dynamic behaviour of the data. In the VAR model, each variable is a linear function of the other values and their lag values. The VAR model can be represented as

$$\begin{aligned}
 &= + \quad + \quad + \\
 &\quad - \quad - \\
 &= + \quad + \quad + \\
 &\quad - \quad -
 \end{aligned}$$

Where R_1 is the return of market one

and R_2 return for the market two

There will be eight regression equations will be formed with each index return as the dependent variable and the other index return as the independent variable.

To have the correct VAR model, it must have the correct lag length for the VAR model. The correct lag length criteria can be estimated with the correct AIC, BIC values. Therefore, prior to estimating the VAR model, the requirement of the optimum lag length criteria will be assessed (Adenomon, Michael and Evans,2015).

3.10 Granger Causality test

The implication of the VAR model is to forecast the variable of interest by the lag and group of other variables and their lags. When a variable is statistically significant, the lag of other variables is then it is said that the variable of interest is granger caused by other variables. The Granger causality test used to test the non zero correlation between the error process for the cause and effect model (Maziarz 2015).

3.11 DCC Garch model

The conditional GARCH model estimates the varying variance as the function of the past volatility and the variance of the residuals. The multivariate GARCH model is the extension of the univariate GARCH model. These models are used to estimate the impact of the volatility of one variable on the other variable. DCC model is one of multivariate GARCH model which is used to model the variance and its flexibility. This model estimates the time-varying conditional correlation between two or more time-series data (Chittedi 2015).

This model is applicable when there is a presence of Heteroscedasticity in the data. The presence of Heteroscedasticity in the model is tested with the ARCH LM test for Heteroscedasticity. The null hypothesis of the ARCH LM test is that there is no presence of the Heteroscedasticity or the ARCH effect at the lag 1.

Chapter IV: Result and Discussion

4.1 Graphical Analysis of Data

4.1.1 Time series plot

The time series plot of the performance of the financial market is presented in figure I to figure viii,

i. SandP 500: The performance of the US financial market is represented by the SandP 500 index, whose time series plot is presented in figure 1. the index shows that there is a trend in the behaviour but is not continuous. The downward trend is observed from 2000 to 2003, after that, it is an upward trend which is the period of dot com growth which was very optimistic period. This upward trend ceased after 2008 when the global financial crisis started causing a sudden downfall in financial performance. After that from 2009, there is an upward trend which is continued even after the end of 2019, as there is a sudden fall due to the corona pandemic (Mogaji 2020)

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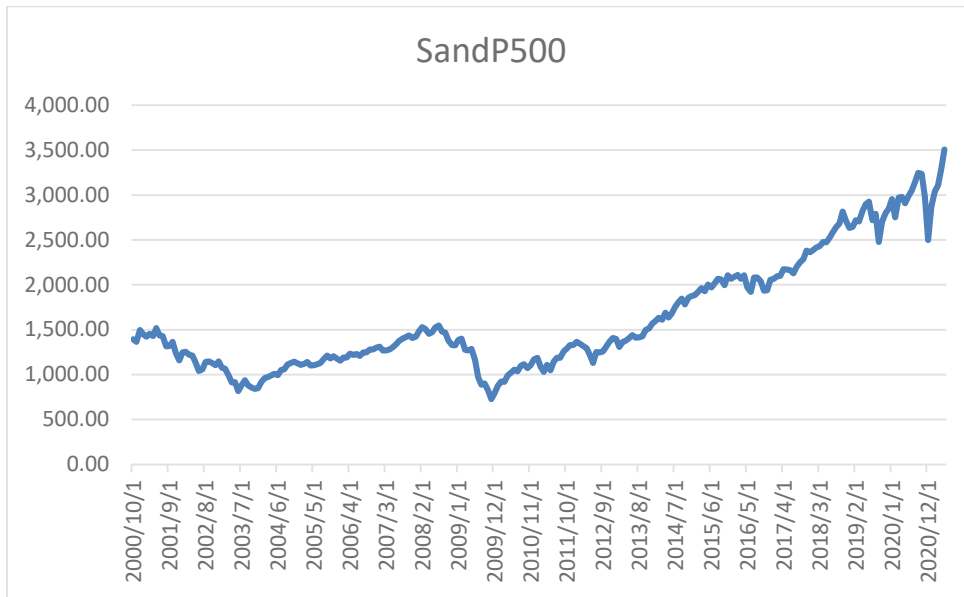


Figure 3: Time Series plot of SandP 500

ii. Hungary Financial Market: The Budapest index is presented in figure 2; here, some components of the time series are observed, which is not continuous. There is an upward trend from 2000 to 2007; then there is a sudden fall in the index after that, this is again supported after

the end of 2009. There is a flat period when the index value moves within certain limits. After that, there is an upward trend in which the index value is increasing until the end of 2019, where there is a sudden fall in the value in the index value due to the corona pandemic.

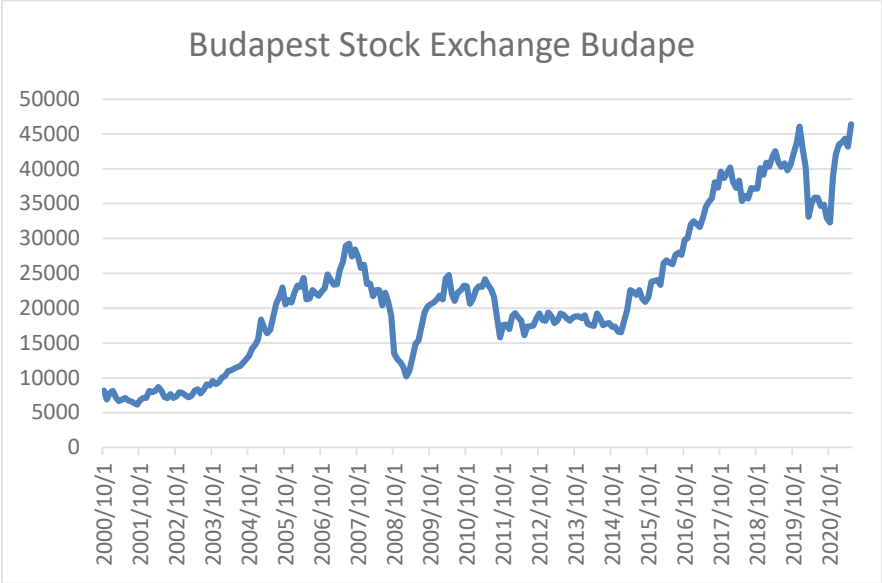


Figure 4: Time Series plot of Budapest index

iii. Czech Republic financial market: The Pragueindex is presented in figure 3; here, some components of time series are observed, which is not continuous. Like previous one there is an upward trend from 2000 to 2007, after that there is a sudden fall in the index. The behaviour of the Prague financial market is similar to the Hungary financial market, but there is a steep decrease in the index value compared to it.

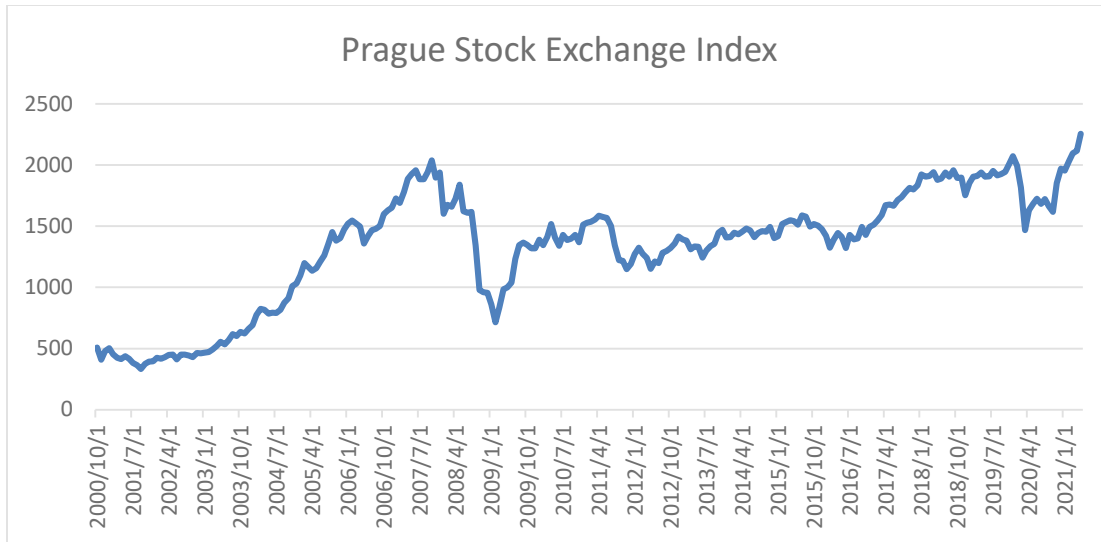


Figure 5: Time series plot of Prague index

iv. Slovak financial market: The Bratislava index is presented in figure 4; here, some components of time series are observed, which is not continuous. Like another financial market, this has also benefitted from the pre-recession boom. Here it is observed that there is a steep increase in the performance of the Slovak financial market. After that, there is mix trend, followed by a steep decrease in the index value as the recession hits the market at the end of 2007. After 2009 there is some improvement, but the significant improvement in the index value comes after 2012 when the upward trend is observed There is a decrease in the value of the index at the end of 2019, but the decrease is not like another financial market.

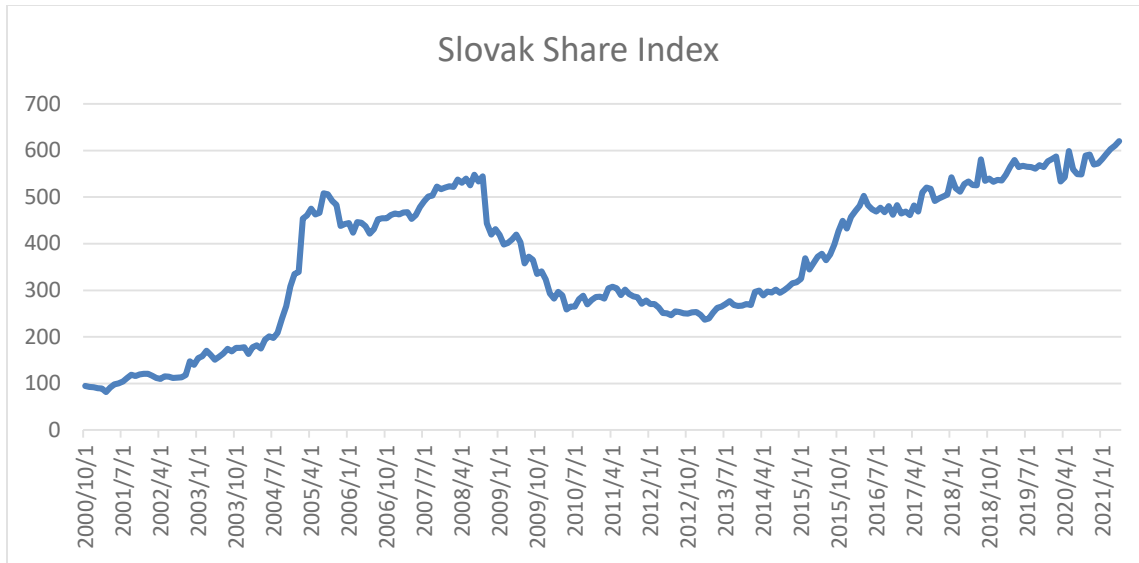


Figure 6: Time series plot of Slovak financial market

v. Lithuania financial market: The Lithuania index is presented in figure 5; here, some components of the time series are observed, which is not continuous. There is a component of time series data as per the figure. It is observed that the financial market has an upward trend from 2000 to 2005. After that, it reduces and again balances till 2007. Since then financial index decreases steeply due to the start of the recession of 2008. The financial market stabilised after the mid of 2008, after which the value of the index starts increasing. There is a slight rise and fall in the value of the index.

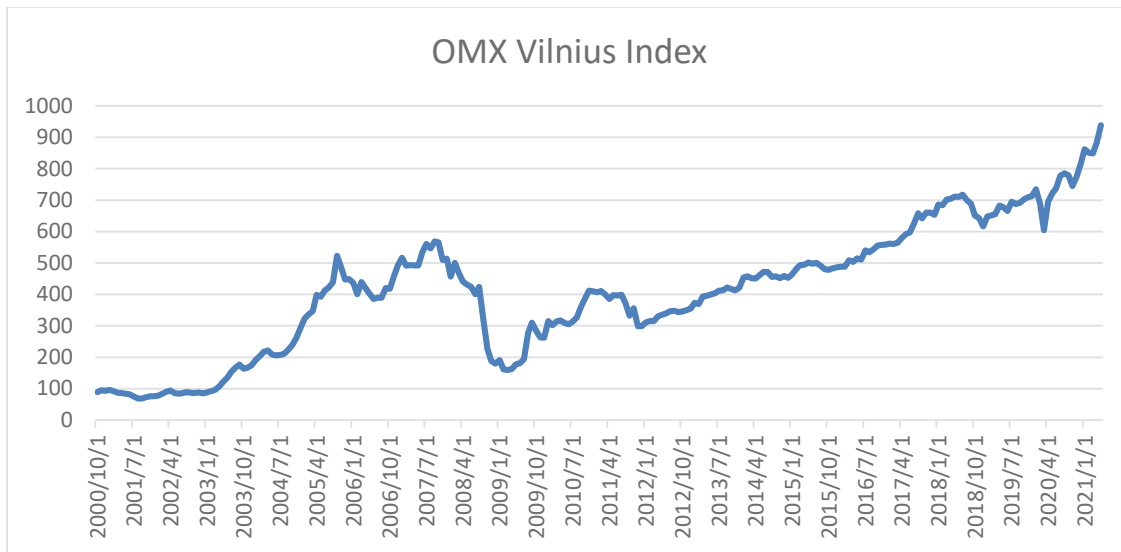


Figure 5: Time series plot of Lithuania financial market

vi. Bulgaria financial market: The Bulgaria index is presented in figure 6, some components of the time series are observed, which is not continuous. Like the previous one there is an upward trend from 2000 to 2007 after that there is a sudden fall in the index. The behaviour of the Bulgaria financial market is similar to the Lithuania financial market, but there is a steep decrease in the index value compared to it. There is a sudden decrease in the value of the index due to the Covid 19 pandemic at the start of 2020.

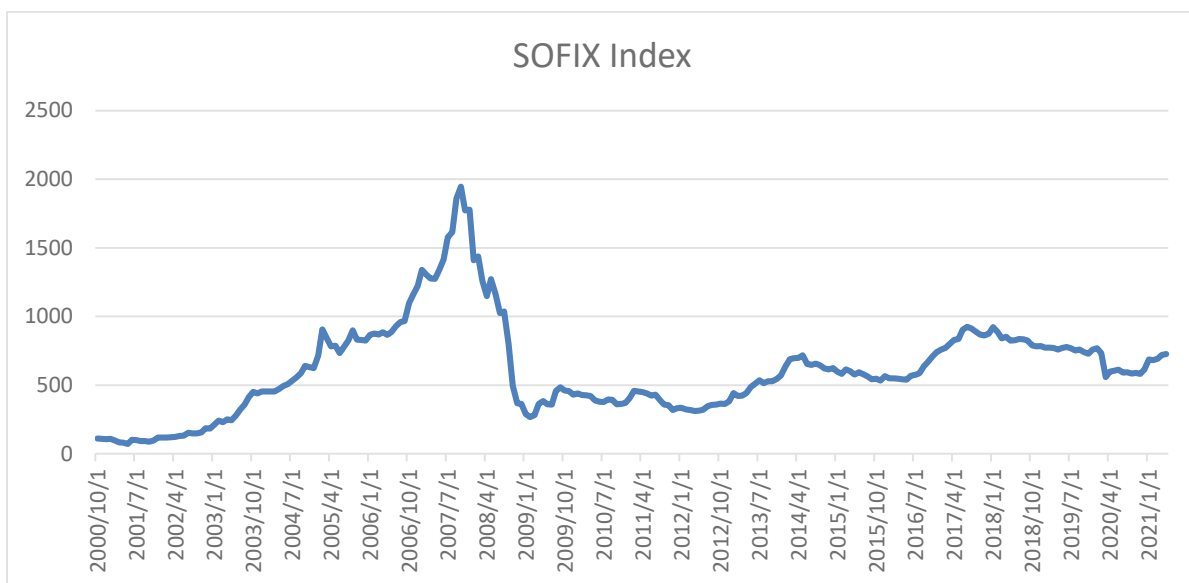


Figure 6: Time series plot of Bulgaria financial market

vii. Romania financial market: The time series plot of the Romania financial market is presented in figure vii. As per the figure, the performance is similar to the other with an upward trend till 2007 after that there is a sudden decrease in the index values due to the onset of the recession. After the recession is over and the economy is stabilising, the index value again increases. However, in mid of 2018 and 2020 end, there is a decrease in the index values.

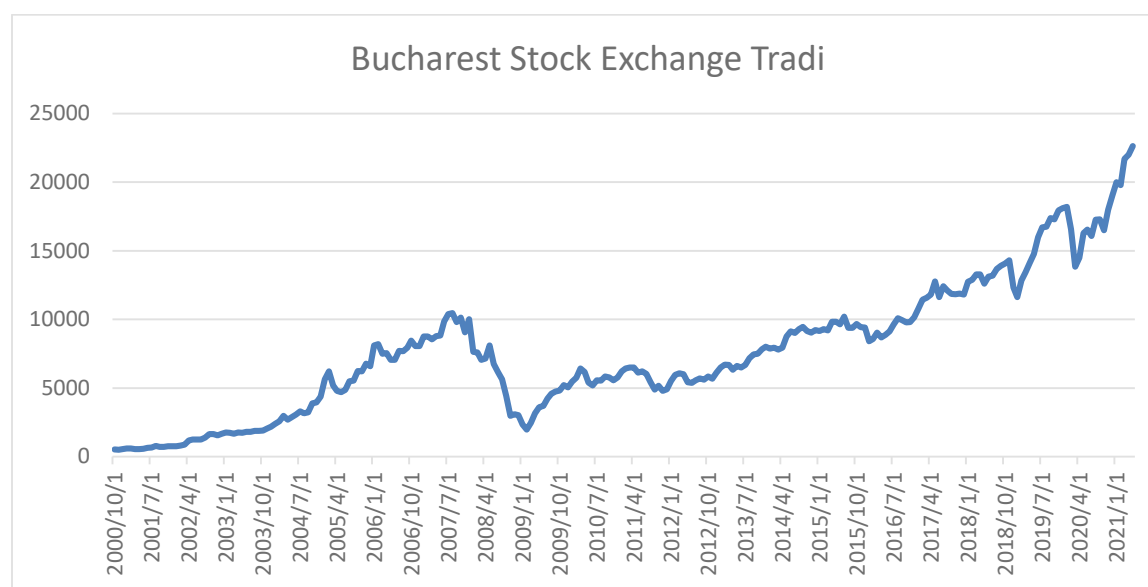
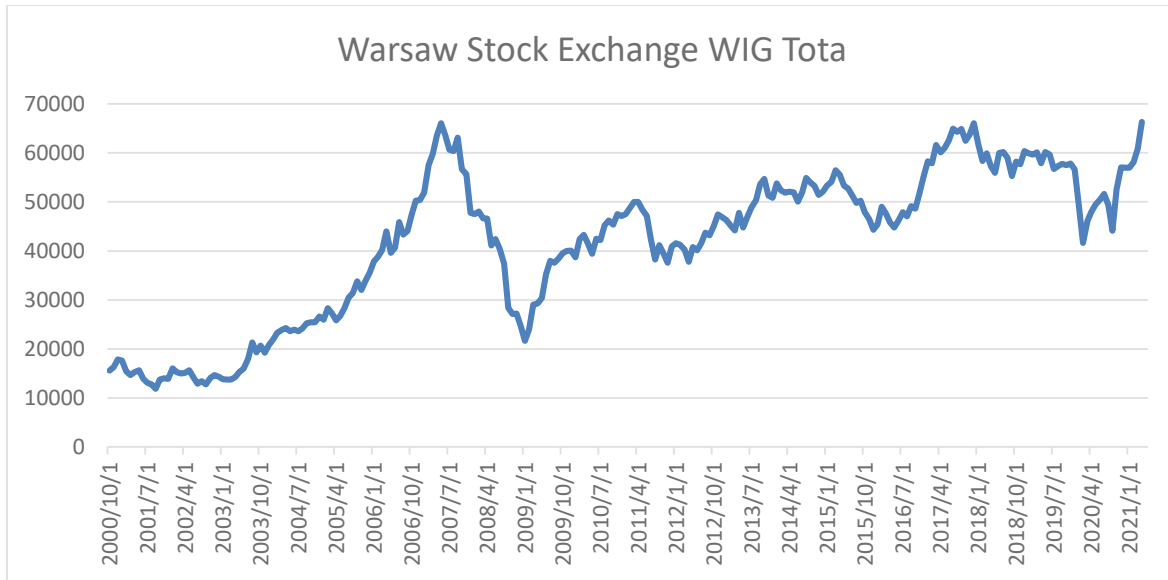


Figure 7: Time series plot of

Viii Poland financial market: The time series plot of the Poland financial market is presented in figure viii. As per the figure, the performance is similar to the other with an upward trend till 2007. After that, there is a sudden decrease in the index values due to the onset of the recession. After the recession is over and the economy is stabilising, the index value again increases. Again, there is a sudden increase and decrease in the value, but the trend is not continuous, which decreases and increases periodically (Hanck 2019).



4.1.2 Test for structural breaks: The time series plot of the financial market (indices) shows a sudden change in the value due to unexpected negative news in the market. The test of the structural breaks in data that shows a sudden change in the value of indices is done with the Swald test. This test shows whether the structural break is statistically significant (Deb, Norton and Manning 2017). The result of the Swald test for the complete data (2000-2021) is presented in table 1. The null hypothesis of the Swald test is that the null hypothesis is "no structural break in the data" (Das 2019). As per the results, the null hypothesis is rejected by the US, Romanian, Slovakian, Bulgarian financial markets. In contrast, there is a structural break in the statistically significant data at a 5% significance level (Woolridge 2010). However, the Czech market, Hungarian Lithuania, and the Polish financial market have structural breaks in the data, but they are not statistically significant (Das 2019). The test was conducted with unknown dates.

Table 3: Result of the structural break in the data (2000-2021) complete data

	statistics	SWald statistics	Null hypothesis	Structural break month
US_ret	9.121	0.0394	Rejected	2009m12

Cz_ret	3.8594	0.396	accepted	2007m11
Hun_ret	2.1658	0.7447	accepted	2007m8
Rom_ret	11.102	0.015	Rejected	2005m3
Slo_ret	14.900	0.002	Rejected	2005m8
Lit_ret	7.950	0.067	accepted	2005m10
Bul_ret	14.055	0.003	Rejected	2007m11
Pol_ret	4.968	0.250	accepted	2007m6

Table 4: Descriptive statistics of the return of the financial market pre-recession and post-recession (indices)

	US_ret		Cz_ret		Hun_ret		Rom_ret		Slo_ret		Lit_ret		Bul_ret		Pol_ret	
	Pre	post	Pre	post	Pre	post	Pre	post	Pre	post	Pre	post	Pre	post	Pre	post
Mean	0.01	0.77	1.55	0.54	1.35	0.77	3.34	1.27	2.00	0.30	2.05	1.15	3.27	0.49	1.50	0.44
Median	0.59	1.50	1.97	0.98	2.21	0.64	2.66	1.62	0.79	0.72	2.72	0.69	2.27	0.28	2.52	0.18
Standard Deviation	4.10	4.81	5.76	4.73	6.38	5.66	7.83	5.35	6.04	4.05	6.00	5.14	8.12	5.20	6.28	4.85
Kurtosis	0.55	2.83	2.21	3.54	0.27	1.82	1.63	1.32	5.06	1.13	-0.36	16.34	2.19	7.83	-0.15	1.61
Skewness	-0.42	-1.06	-0.84	-0.45	-0.45	-0.25	0.53	-0.76	1.57	-0.16	0.00	2.02	0.80	-0.17	-0.14	-0.20
Range	20.89	32.23	36.95	38.38	33.64	37.76	48.13	31.13	38.91	24.66	27.94	53.39	50.63	51.48	29.89	34.58
Minimum	-11.66	- 18.38	- 21.48	-21.27	-16.92	-19.40	-18.37	-17.90	-9.83	- 12.03	- 10.35	- 17.31	- 15.59	- 27.17	-12.91	-16.88
Maximum	9.23	13.85	15.47	17.11	16.72	18.35	29.77	13.23	29.08	12.63	17.59	36.08	35.04	24.31	16.98	17.71

4.2 Descriptive statistics of return of the financial market pre-recession and post-recession

4.2.1 United States Financial Market

The descriptive statistics of the financial performance of the US, Czech, Hungary, Slovakia, Lithuania, Bulgaria and Poland are presented in table 2. As observed in the table, for the US market, the average mean monthly return is 0.01%, while post-recession is 0.77%, with a standard deviation of 4.10% and 4.81%, respectively, during the period. The coefficient of variation of the return in the pre-recession period is 410, while post-recession is 6.24. There is a huge difference in the coefficient of variation pre-recession (Canchola 2017). The return in the pre-recession period is highly dispersed compared to the post-recession period. During the pre-recession period, the maximum monthly return obtained was 9.23%, while the minimum return was the loss of 11.66% in a month. Therefore, the range is 20.89%. Post-recession, the maximum monthly return obtained was 13.85 %, while the minimum return was the loss of 18.38% in a month; the range is therefore 32.23%.

During the pre-recession period, the return distribution has a kurtosis of 0.55 and skewness of -0.42. The distribution of the return in the pre-recession period is platykurtic, with distribution having a flat peak and more dispersed values in the tails (Levin 2011). The skewness is negative, i.e. the left tail of the data distribution is long compared to its right side of the mean. After the recession, the kurtosis has observed to be 2.83, which is near to 3 (normal distribution), but the data becomes more skewed towards the left (Woolridge 2010).

4.2.2 Czech financial market

In the Czech financial market, the average mean monthly return is 1.55%, while post-recession is 0.54%, with a standard deviation of 5.76% and 4.73%, respectively, during the period. The coefficient of variation of the return in the pre-recession period is 0.26, while post-recession is 0.11. There is not much difference in the coefficient of variation (Canchola 2017). During the pre-recession period, the maximum monthly return obtained was 15.47%, while the minimum return was the loss of 21.48% in a month. Therefore, the range is 36.95%. Post-recession, the maximum monthly return obtained was 17.11 %, while the minimum return was the loss of 21.27% in a month; the range is therefore 38.38%.

During the pre-recession, the distribution of the return in the Czech market has a kurtosis of 2.21 and 3.54 post-recession. The distribution peakedness increases after the recession, with the distribution being mesokurtik with peakedness close to normal distribution. The skewness of return distribution in both the period is observed to be negatively skewed however the skewness decreases post-recession (Deb et al. 2017).

4.2.3 Hungary financial market

The Hungary financial market has provided an average monthly return of 1.35% per month and 0.77% per month with a standard deviation of 6.38 and 5.66 respectively in the pre-recession and post-recession period. Therefore the coefficient of variation is 0.211 and 0.13; the coefficient of variation is lower in post-recession. The data is concentrated towards its mean in the post-recession period in Hungary. During the pre-recession period, the maximum monthly return obtained was 16.72%, while the minimum return was the loss of 16.92 % in a month. Therefore, the range is 33.64 %. Post-recession, the maximum monthly return obtained was 18.35 %, while the minimum return was the loss of 219.14% in a month; the range is therefore 37.76%.

During the pre-recession period, The distribution of the return has a kurtosis of 0.27 and skewness of -0.45. The distribution of the return in the pre-recession period is platykurtic, with distribution having a flat peak and more dispersed values in the tails. The skewness is negative, i.e. the left tail of the distribution of data is long compared to its right side of the mean (Deb et al. 2017). After the recession, the kurtosis has observed to be 1.82, but the data becomes less skewed towards the left (skewness =-0.25).

4.2.4 Romania Financial Market

The Romanian financial market has provided an average monthly return of 3.34 % per month and 1.27 % per month with a standard deviation of 7.83 and 5.35 respectively in the pre-recession and post-recession periods. Therefore the coefficient of variation is 0.42 and 0.237; the coefficient of variation is lower in post-recession. The data is concentrated towards its mean in the post-recession period in Romania. During the pre-recession period, the maximum monthly return obtained was 29.77 %, while the minimum return was the loss of 18.37 % in a month. Therefore, the range is 48.13 %. Post-recession, the maximum monthly return obtained was 13.23 %, while the minimum return was the loss of 17.90% in a month; the range is therefore 31.13%.

During the pre-recession period, the distribution of the return has a kurtosis of 1.63 and skewness of 0.53. The distribution of the return in the pre-recession period is platykurtic, with distribution having a flat peak and more dispersed values in the tails. The skewness is positive, i.e. the right tail of the distribution of data is long compared to its left side of the mean (Deb et al. 2017). After the recession, the kurtosis has observed to be 1.32, but the data becomes skewed towards the left (skewness =-0.76).

4.2.5 Slovakia financial market

The Slovakia financial market has provided an average monthly return of 2 % per month and 0.30 % per month with a standard deviation of 6.04 and 4.05, respectively, in the pre-recession and post-recession periods. Therefore the coefficient of variation is 0.33 and 0.07; the coefficient of variation is lower in post-recession. The data is concentrated towards its mean in the post-recession period in Slovakia. During the pre-recession period, the maximum monthly return obtained was 29.08 %, while the minimum return was the loss of 9.83 % in a month. Therefore, the range is 38.91 %. Post-recession, the maximum monthly return obtained was 12.63 %, while the minimum return was the loss of 12.03% in a month; the range is therefore 24.66%.

During the pre-recession period, the distribution of the return has a kurtosis of 5.06 and skewness of 1.57. The distribution of the return in the pre-recession period is leptokurtic, with distribution having peaked and more dispersed values in the tails. The skewness is positive, i.e. the right tail of the distribution of data is long compared to its left side of the mean (Deb et al. 2017). After the recession, the kurtosis has been observed to be 1.13. The head becomes flat, but the data becomes skewed towards the left (skewness =-0.16).

4.2.6 Lithuania Financial Market

The Lithuanian financial market has provided an average monthly return of 2.05 % per month and 1.15% per month with a standard deviation of 6.00 and 5.14 respectively in the pre-recession and post-recession period. Therefore the coefficient of variation is 0.34 and 0.22; the coefficient of variation is lower in post-recession. The data is concentrated towards its mean in the post-recession period in lit. During the pre-recession period, the maximum monthly return obtained was 17.59 %, while the minimum return was the loss of 10.53 % in a month. Therefore, the range is 27.94 %. Post-recession, the maximum monthly return obtained was 36.08 %, while the minimum return was the loss of 17.31 % in a month; the range is therefore 53.39%.

During the pre-recession period, the distribution of the return has a kurtosis of -0.36 and skewness of 0. The distribution of data is flat with thin tails. The skewness is positive, i.e. the right tail of the distribution of data is long compared to its left side of the mean (Deb et al. 2017). After the recession, the kurtosis has been observed to be 16.34. The head becomes peaked, but the data becomes skewed towards the right (skewness =2.02).

4.2.7 Bulgarian Financial Market

The Bulgarian financial market has provided an average monthly return of 3.27 % per month and 0.49% per month with a standard deviation of 8.12 and 5.20 respectively in the pre-recession and post-recession periods. Therefore the coefficient of variation is 0.402 and 0.094; the coefficient of variation is lower in post-recession. The data is concentrated towards its mean in the post-recession period in Bul. during the pre-recession period, the maximum monthly return obtained was 35.04 %, while the minimum return was the loss of 15.59 % in a month. Therefore, the range is 50.63 %. Post-recession, the maximum monthly return obtained was 24.31 %, while the minimum return was the loss of 12.91 % in a month; the range is therefore 51.48 %.

During the pre-recession period, the distribution of the return has a kurtosis of 2.19 and skewness of 0.80. The distribution of data is platykurtic. The skewness is positive, i.e. the right tail of the distribution of data is long compared to its left side of the mean (Deb et al. 2017). After the recession, the kurtosis has been observed to be 7.84 the head becomes peaked, but the data becomes skewed towards the left (skewness =-0.17).

4.2.8 Poland financial market

The polish financial market has provided an average monthly return of 1.50 % per month and 0.44% per annum with a standard deviation of 6.28 and 4.85 respectively in the pre-recession and post-recession period. Therefore the coefficient of variation is 0.23 and 0.09; the coefficient of variation is lower in post-recession. The data is concentrated towards its mean in the post-recession period in Bul. during the pre-recession period, the maximum monthly return obtained was 16.98 %, while the minimum return was the loss of 12.91 % in a month. Therefore, the range is 29.89 %. Post-recession, the maximum monthly return obtained was 17.71 %, while the minimum return was the loss of 16.88 % in a month; the range is therefore 34.58 %.

During the pre-recession period, The distribution of the return has a kurtosis of -0.15 and skewness of -0.14. The distribution of data is a flat top. The skewness is negative, i.e. the left tail of the distribution of data is long compared to its right side of the mean (Deb et al. 2017). After the recession, the kurtosis has been observed to be 1.61. The head becomes peaked, but the data becomes skewed towards the left (skewness =-0.20).

4.3. Correlation Analysis

Table 5: Correlation coefficient between the financial market performance – pre and post-recession

		<i>US_ret</i>	<i>Cz_ret</i>	<i>Hun_ret</i>	<i>Rom_ret</i>	<i>Slo_ret</i>	<i>Lit_ret</i>	<i>Bul_ret</i>	<i>Pol_ret</i>
US_ret	Pre	1.000							
	post	1.000							
Cz_ret	Pre	0.368	1.000						
	post	-0.165	1.000						
Hun_ret	Pre	0.400	0.758	1.000					
	post	-0.201	0.707	1.000					
Rom_ret	Pre	0.012	0.298	0.343	1.000				
	post	-0.150	0.597	0.586	1.000				
Slo_ret	Pre	-0.066	0.172	0.237	0.046	1.000			
	post	0.090	0.076	0.131	0.070	1.000			
Lit_ret	Pre	0.102	0.350	0.307	0.106	0.098	1.000		
	post	-0.082	0.489	0.418	0.396	0.095	1.000		
Bul_ret	Pre	-0.183	0.219	0.213	0.242	0.311	0.232	1.000	
	post	-0.128	0.385	0.409	0.392	0.276	0.554	1.000	
Pol_ret	Pre	0.327	0.530	0.640	0.083	0.093	0.214	0.045	1.000
	post	0.015	0.040	0.024	0.028	-0.073	-0.036	0.083	1.000

The correlation coefficient of different financial markets return data pre and post-recession is presented in table 3; as observed, the correlation between the US market and the Czech market prior to the recession was 0.368, which is moderately positive. Therefore, if the US market moves

in positive, then the Czech market will also be expected to move slightly in the same manner. However, post-recession, the correlation changes from weakly positive to very weak negative correlation, i.e. -0.165. The linear relation changes between the two markets with recession.

The correlation between the US and Hun financial market is 0.4, which is again a weakly positive relationship between the two that changes to -0.201 post-recession. Similar changes have been observed between the Romanian financial and US market. The correlation earlier was 0.012 (positive very weak) to -0.15 (negative very weak). Similar was observed by Lit and US where the correlation coefficient changes from weakly positive (0.102) to weakly negative (-0.082). The reduction in correlation strength is observed in the Polish and the US financial market, where the correlation is reduced from 0.327 to 0.015 with the advent of recession.

The correlation between the Slovakian financial market and the US market was having a weakly negative relationship (-0.066) which changes to 0.09, which is positive weakly. The correlation between Bulgaria and the US financial market has changed from -0.183 to -0.128 due to the recession. However, the correlation between the European nations has strengthened to the positive side, which supports that business, trade and investments are increasing among members of the EU (Lobo and Lewis 2021).

4.4 Stationarity test

The data of the study is time-series in nature which requires the data to be tested for stationarity. The presence or absence of stationarity in the data decides the flow of the time series analysis. A data is said to be stationary when the mean and variance are constant. The stationarity of the data is tested with the Augmented Dickey-Fuller (ADF) test without trend and drift; the null hypothesis of the test is that there is a presence of unit root in the data (Woolridge 2010). The presence of unit root in the data shows that the data is non-stationary. The alternate hypothesis of the ADF test is that there is the absence of the unit root in the data, and the data is stationary with constant mean and variance. The result of the ADF test for stationarity shows that the p-value for all the financial markets is less than 5% (without drift and trend).

$$= + - +$$

Where,

t is time index

γ is the coefficient presenting process root

p is the lag order

e_t is residual term

Therefore, the null hypothesis of "presence of unit root in data", i.e. non-stationarity, is rejected, and the data is stationary for all the financial markets in the pre-recession and post-recession periods (Pole, West and Harrison 2018). The return data were tested for the differences which were found stationary also.

Table 6: Result of the ADF test for stationarity (pre-recession period) of returns

	<i>US_ret</i>	<i>Cz_ret</i>	<i>Hun_ret</i>	<i>Rom_ret</i>	<i>Slo_ret</i>	<i>Lit_ret</i>	<i>Bul_ret</i>	<i>Pol_ret</i>
t test	-9.029	-10.415	-9.819	-8.27	-8.524	-6.193	-8.94	-9.16
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table 7: Result of the ADF test for stationarity (post-recession period) of returns

	<i>US_ret</i>	<i>Cz_ret</i>	<i>Hun_ret</i>	<i>Rom_ret</i>	<i>Slo_ret</i>	<i>Lit_ret</i>	<i>Bul_ret</i>	<i>Pol_ret</i>
t test	-12.367	-11.760	-10.783	-10.601	-13.886	-10.535	-9.859	-
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	11.608 (0.00)

4.5 Vector Auto correlation between the financial market before and after recession

Vector Autoregression is adopted as the monthly return data of the indices are stationary. Since, the returns are stationary multivariate model of VAR is suitable. The objective to identify the Effect of the 2007-2008 Financial Crisis on Stock Market Performance: Evidence from Eastern and Central European Countries. The change in the lead-lag relationship between the US and the

CEE financial market and CEE market with other CEE markets and US will be studied with VAR. As in this statistical technique, all the variables (return of indices) are endogenous.

The result of the ADF test for the presence of stationarity in the data shows that all data are stationary at level. Therefore the "integration at the same level" is not found in the data (Hanck et al. 2019). So, vector autoregression is applied in the data to identify the lead-lag relationship between the financial markets. The VAR was done in two periods, i.e. the first period being the pre-recession period, and the second period is the post-recession period.

4.5.1 Pre Recession period

a. Lag length selection Criteria: The result of the lag length selection criteria is presented in figure 16. The AIC and FPE selection criteria support that the appropriate lag length is 0, but the minimum is 1, so one is considered.

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1985.09				3.3e+11*	49.212*	49.3069*	49.4485*
1	-1944.15	81.883	64	0.065	5.8e+11	49.7814	50.6353	51.9098
2	-1893.85	100.6	64	0.002	8.5e+11	50.1197	51.7327	54.14
3	-1834.7	118.29	64	0.000	1.1e+12	50.2395	52.6116	56.1518
4	-1775.64	118.13*	64	0.000	1.5e+12	50.3614	53.4925	58.1655

Endogenous: US_ret Cz_ret Hun_ret Rom_ret Slo_ret Lit_ret Bul_ret Pol_ret

Figure 7: Lag length selection

b. Vector Autoregression: Vector autoregression was carried out with lag 1; the result of the VAR with lag one is presented in figure 17.

Sample: 2000m2 - 2009m1	Number of obs	=	64		
Time series used	AR	=	49.79295		
RFE	HQIC	=	50.63052		
Det (sigma_m)	SRIC	=	51.87651		
Equation	Parma	RMSE	R-sq	chi2	Pch12
US_ret	0	3.95971	0.1641	16.49495	0.0358
CA_ret	0	5.10006	0.1324	12.91132	0.1189
Hun_ret	0	6.13885	0.0670	6.027423	0.6442
Rom_ret	0	7.73384	0.1038	9.724008	0.2842
Slo_ret	0	6.13227	0.0761	6.919195	0.5454
Lit_ret	0	3.45923	0.2184	2.139875	0.0331
Bul_ret	0	2.20083	0.0806	2.344445	0.4774
Pol_ret	0	6.26955	0.1078	10.14569	0.2549

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
US_ret					
US_ret	-.1617479	.1167271	1.39	0.166	[-.067033, .3905288]
CA_ret	-.3161224	.1129539	-2.80	0.005	[-.537508, -.0947367]
Hun_ret	-.0285836	.1177855	0.24	0.808	[-.2022718, .259439]
Rom_ret	-.0154056	.0588994	-0.26	0.794	[-.1308462, .1000351]
Slo_ret	.0667226	.0732841	0.91	0.363	[-.0769117, .2103569]
Lit_ret	.0998932	.0750156	1.33	0.183	[-.0471347, .246921]
Bul_ret	.1327403	.0578118	2.30	0.022	[-.0194311, .2460494]
Pol_ret	.056043	.0872819	0.64	0.521	[-.1150264, .2271123]
_cons	-.3292129	.5055117	-0.65	0.515	[-1.319998, .6612719]
CA_ret					
US_ret	-.0065334	.1503433	-0.04	0.965	[-.3012009, .2881342]
CA_ret	-.1899571	.1454835	-1.37	0.169	[-.4850996, .0851854]
Hun_ret	-.0257424	.1517066	-0.17	0.865	[-.3230818, .2715971]
Rom_ret	-.0358022	.0758618	-0.47	0.637	[-.1844886, .1128842]
Slo_ret	-.0518284	.0943892	-0.55	0.583	[-.2368279, .1331711]
Lit_ret	.2796454	.0966193	2.89	0.004	[-.090275, .4690158]
Bul_ret	.0243291	.0744611	0.33	0.744	[-.1216119, .1702702]
Pol_ret	.1694975	.1124192	1.50	0.134	[-.0533992, .3888331]
_cons	1.467393	.651094	2.25	0.024	[-.1912724, 2.743514]
Hun_ret					
US_ret	-.1110904	.1824276	-0.61	0.543	[-.4686418, .246441]
CA_ret	.0246783	.1765307	0.14	0.889	[-.3213154, .3706721]
Hun_ret	-.0917072	.1840817	-0.50	0.618	[-.4525007, .2690864]
Rom_ret	-.0878417	.0920512	-0.95	0.340	[-.2682587, .0925753]
Slo_ret	-.0426297	.1145325	-0.37	0.710	[-.2671093, .1818499]
Lit_ret	.2196276	.1172385	1.87	0.061	[-.0101557, .4494108]
Bul_ret	.0120756	.0903515	0.13	0.894	[-.1650102, .1891614]
Pol_ret	.0774986	.1364059	0.57	0.570	[-.1898581, .3448552]
_cons	1.438333	.7900416	1.80	0.073	[-.1301205, 2.966786]
Rom_ret					
US_ret	.1227126	.2297523	0.53	0.593	[-.3275937, .5730188]
CA_ret	.178401	.2223256	0.80	0.422	[-.2573492, .6141513]
Hun_ret	.0185972	.2318356	0.08	0.936	[-.4357922, .4729866]
Rom_ret	.0759555	.1159308	0.66	0.512	[-.1512647, .3031757]
Slo_ret	-.0581751	.1442441	-0.40	0.687	[-.3408884, .2245383]
Lit_ret	.2523472	.1476521	1.71	0.087	[-.0370456, .5417401]
Bul_ret	-.2045533	.1137902	-1.80	0.072	[-.427578, .0184715]
Pol_ret	-.1128716	.1717957	-0.66	0.511	[-.449585, .2238418]
_cons	3.276578	.9949915	3.29	0.001	[-.1326431, 5.226726]
Slo_ret					
US_ret	.2404917	.1807715	1.33	0.183	[-.1138139, .5947973]
CA_ret	-.195678	.1749281	-1.12	0.263	[-.5385308, .1471748]
Hun_ret	.1101615	.1824107	0.60	0.546	[-.2473568, .4676799]
Rom_ret	.1421211	.0912156	1.56	0.119	[-.0366582, .3208003]
Slo_ret	.0370789	.1134928	0.33	0.744	[-.1853619, .2595217]
Lit_ret	.0270666	.1161742	0.23	0.816	[-.2006307, .254764]
Bul_ret	.0797114	.0895313	0.89	0.373	[-.0957668, .2551896]
Pol_ret	-.0181432	.1351706	-0.13	0.893	[-.2830728, .2467864]
_cons	1.320453	.7828697	1.69	0.092	[-.2139439, 2.854849]
Lit_ret					
US_ret	-.0429917	.1653522	-0.26	0.795	[-.367076, .2810926]
CA_ret	.2363164	.1600072	1.48	0.140	[-.077292, .5499249]
Hun_ret	.0171798	.1668515	0.10	0.918	[-.3098432, .3442027]
Rom_ret	-.1692252	.0834351	-2.03	0.043	[-.332755, -.0056953]
Slo_ret	.0355967	.1038122	0.34	0.732	[-.1678714, .2390648]
Lit_ret	.2625115	.1062649	2.47	0.013	[-.0542362, .4707869]
Bul_ret	-.0502458	.0818946	-0.61	0.540	[-.2107562, .1102646]
Pol_ret	.1074869	.123641	0.87	0.385	[-.1348449, .3498187]
_cons	1.539924	.716093	2.15	0.032	[-.1364078, 2.943441]
Bul_ret					
US_ret	-.1755856	.2426343	-0.72	0.469	[-.6511401, .299969]
CA_ret	.1648652	.2347913	0.70	0.483	[-.2953173, .6250476]
Hun_ret	-.138	.2448344	-0.56	0.573	[-.6178666, .3418667]
Rom_ret	.1359314	.122431	1.11	0.267	[-.1040289, .3758917]
Slo_ret	-.0211392	.1523316	-0.14	0.890	[-.3197041, .2774256]
Lit_ret	.2257334	.1559309	1.45	0.148	[-.0798855, .5313523]
Bul_ret	-.0916029	.1201704	-0.68	0.497	[-.3171325, .1539267]
Pol_ret	.2148039	.1814282	1.18	0.236	[-.1407887, .5703966]
_cons	2.264198	1.05078	2.15	0.031	[-.2047076, 4.323689]
Pol_ret					
US_ret	-.0146158	.1848184	-0.08	0.937	[-.3768531, .3476215]
CA_ret	.0394683	.1788442	0.22	0.825	[-.3110598, .3899965]
Hun_ret	-.2372026	.1864942	-1.27	0.203	[-.6027245, .1283194]
Rom_ret	-.0284538	.0932576	-0.31	0.760	[-.2112352, .1543277]
Slo_ret	-.1654159	.1160335	-1.43	0.154	[-.3928374, .0620056]
Lit_ret	.2660603	.1180775	2.24	0.025	[-.0326656, .498855]
Bul_ret	.0528529	.0915356	0.58	0.564	[-.1265536, .2322595]
Pol_ret	.0884168	.1381967	0.64	0.522	[-.1824437, .3592773]
_cons	1.275646	.8003955	1.59	0.111	[-.2930999, 2.844393]

Figure 8: Result of the VAR test (Pre-recession)

Equation	Excluded	chi2	df	Prob > chi2
US_ret	Cz_ret	7.8326	1	0.005
US_ret	Hun_ret	.05889	1	0.808
US_ret	Rom_ret	.06841	1	0.794
US_ret	Slo_ret	.82895	1	0.363
US_ret	Lit_ret	1.7732	1	0.183
US_ret	Bul_ret	5.272	1	0.022
US_ret	Pol_ret	.41228	1	0.521
US_ret	ALL	16.494	7	0.021
Cz_ret	US_ret	.00189	1	0.965
Cz_ret	Hun_ret	.02879	1	0.865
Cz_ret	Rom_ret	.22273	1	0.637
Cz_ret	Slo_ret	.3015	1	0.583
Cz_ret	Lit_ret	8.377	1	0.004
Cz_ret	Bul_ret	.10676	1	0.744
Cz_ret	Pol_ret	2.2465	1	0.134
Cz_ret	ALL	12.556	7	0.084
Hun_ret	US_ret	.37083	1	0.543
Hun_ret	Cz_ret	.01954	1	0.889
Hun_ret	Rom_ret	.91063	1	0.340
Hun_ret	Slo_ret	.13854	1	0.710
Hun_ret	Lit_ret	3.5094	1	0.061
Hun_ret	Bul_ret	.01786	1	0.894
Hun_ret	Pol_ret	.32278	1	0.570
Hun_ret	ALL	5.8922	7	0.552
Rom_ret	US_ret	.28527	1	0.593
Rom_ret	Cz_ret	.6439	1	0.422
Rom_ret	Hun_ret	.00643	1	0.936
Rom_ret	Slo_ret	.16266	1	0.687
Rom_ret	Lit_ret	2.9209	1	0.087
Rom_ret	Bul_ret	3.2315	1	0.072
Rom_ret	Pol_ret	.43166	1	0.511
Rom_ret	ALL	9.2142	7	0.238
Slo_ret	US_ret	1.7699	1	0.183
Slo_ret	Cz_ret	1.2513	1	0.263
Slo_ret	Hun_ret	.36472	1	0.546
Slo_ret	Rom_ret	2.4276	1	0.119
Slo_ret	Lit_ret	.05428	1	0.816
Slo_ret	Bul_ret	.79267	1	0.373
Slo_ret	Pol_ret	.01802	1	0.893
Slo_ret	ALL	6.5755	7	0.474
Lit_ret	US_ret	.0676	1	0.795
Lit_ret	Cz_ret	2.1813	1	0.140
Lit_ret	Hun_ret	.0106	1	0.918
Lit_ret	Rom_ret	4.1137	1	0.043
Lit_ret	Slo_ret	.11758	1	0.732
Lit_ret	Bul_ret	.37643	1	0.540
Lit_ret	Pol_ret	.75576	1	0.385
Lit_ret	ALL	11.456	7	0.120
Bul_ret	US_ret	.52369	1	0.469
Bul_ret	Cz_ret	.49305	1	0.483
Bul_ret	Hun_ret	.3177	1	0.573
Bul_ret	Rom_ret	1.2327	1	0.267
Bul_ret	Slo_ret	.01926	1	0.890
Bul_ret	Lit_ret	2.0957	1	0.148
Bul_ret	Pol_ret	1.4018	1	0.236
Bul_ret	ALL	7.3667	7	0.392
Pol_ret	US_ret	.00625	1	0.937
Pol_ret	Cz_ret	.0487	1	0.825
Pol_ret	Hun_ret	1.6177	1	0.203
Pol_ret	Rom_ret	.09309	1	0.760
Pol_ret	Slo_ret	2.0323	1	0.154
Pol_ret	Lit_ret	5.0178	1	0.025
Pol_ret	Bul_ret	.33339	1	0.564
Pol_ret	ALL	10.132	7	0.181

Figure 9: Granger Causality test (pre-recession)

c. Granger Causality test: The result of the Granger causality test (pre-recession period) is presented in figure 18. As per the results prior to the recession, lagged value of the Bulgaria

financial market help predict the financial market performance of the US financial market ($p=0.022$). there is huge investment of the US companies in Bulgaria in energy, banking and financial institutions. Similar results were found, where the lagged Lithuania helps predict the Czech financial market ($p=0.004$), lag Romania financial market performance helps predict Lithuania financial market (Beckett 2013).

The residuals of the VAR must not have autocorrelation which is the requisite condition of the VAR model.

4.5.2 Post Recession

a. Lag length selection Criteria: The result of the lag length selection criteria is presented in figure 19. The AIC and FPE selection criteria support that the appropriate lag length is 1.

Selection-order criteria									
Sample: 2009m11 - 2021m5						Number of obs		=	139
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC	
0	-3151.03				7.6e+09	45.4537	45.5223*	45.6226*	
1	-3053.61	194.85	64	0.000	4.7e+09*	44.9728*	45.5904	46.4928	
2	-3015.31	76.599	64	0.134	6.9e+09	45.3425	46.5093	48.2137	
3	-2969.06	92.49*	64	0.011	9.1e+09	45.598	47.3138	49.8203	
4	-2934.11	69.902	64	0.286	1.4e+10	46.016	48.2809	51.5894	

Endogenous: US_ret Cz_ret Hun_ret Rom_ret Slo_ret Lit_ret Bul_ret Pol_ret

Figure 10: Lag length selection

b. Vector Auto Regression: The VAR was carried out with lag selection 1; the result of the VAR post-recession is presented in figure 20.

Equation	Parms	RMSR	R-sq	ch12	Pch12	
US_ret	9	4.572223	0.404663	5	0.899558	0.524775
CS_ret	9	3.000822	0.388623	5	0.911809	0.000000
Hup_ret	9	4.135518	0.000000	133	0.000000	0.000000
Rom_ret	9	4.318559	0.388623	5	0.911809	0.000000
Sic_ret	9	3.930052	0.000000	133	0.000000	0.000000
Lit_ret	9	4.738975	0.217031	5	0.885484	0.000000
Bul_ret	9	4.875664	0.033733	5	0.907034	0.000000
Pol_ret	9	4.875664	0.033733	5	0.907034	0.000000
_____	_____	_____	_____	_____	_____	_____
	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
US_ret						
US_ret	-.0165487	.0804066	-0.21	0.837	-.1741415	.1410441
CS_ret	.0063195	.1216766	0.05	0.959	-.2321622	.2448012
Hup_ret	-.057865	.0992228	-0.58	0.560	-.2523483	.1366183
Rom_ret	-.0056297	.0920888	-0.06	0.951	-.1861205	.1748811
Sic_ret	.1197663	.0973507	1.23	0.219	-.0710375	.3105701
Lit_ret	.083357	.0942206	0.88	0.376	-.101312	.2680261
Bul_ret	-.0992238	.0935316	-1.06	0.289	-.2825424	.0840947
Pol_ret	-.1316151	.0778673	-1.69	0.091	-.2842321	.021002
_____	_____	_____	_____	_____	_____	_____
CS_ret						
US_ret	.0393168	.0527717	0.75	0.456	-.0641138	.1427473
CS_ret	-.0369925	.0798582	-0.46	0.643	-.1925116	.1195267
Hup_ret	.009588	.0651248	0.15	0.883	-.1180543	.1372303
Rom_ret	.0592531	.0604393	0.98	0.327	-.0592058	.177712
Sic_ret	.0782787	.0638927	1.23	0.221	-.0469487	.2035061
Lit_ret	.0416499	.0618384	0.67	0.501	-.0795511	.162851
Bul_ret	-.0356808	.0613862	-0.58	0.561	-.1559956	.0846339
Pol_ret	.71428	.0511055	13.98	0.000	.6141151	.8144449
_____	_____	_____	_____	_____	_____	_____
Hup_ret						
US_ret	-.060767	.0727905	-0.83	0.404	-.2034337	.0818997
CS_ret	.0487843	.1101522	0.44	0.658	-.1671101	.2646786
Hup_ret	.0334715	.0898298	0.37	0.709	-.1425916	.2095347
Rom_ret	.0382462	.0833668	0.46	0.646	-.1251497	.2016422
Sic_ret	.1102629	.0881303	1.25	0.211	-.0624693	.2829951
Lit_ret	-.0645109	.0825967	-0.78	0.449	-.2316894	.1026675
Bul_ret	.0129174	.0846729	0.15	0.879	-.1530385	.1788733
Pol_ret	.7839486	.0704922	11.12	0.000	.6457864	.9221108
_____	_____	_____	_____	_____	_____	_____
Rom_ret						
US_ret	.0816825	.0759632	1.08	0.282	-.0672025	.2305676
CS_ret	.3451833	.1149534	3.00	0.003	.1198789	.5704877
Hup_ret	-.1575975	.0937452	-1.68	0.093	-.3433347	.0261396
Rom_ret	.0380638	.0870005	0.44	0.662	-.132454	.2085816
Sic_ret	.006506	.0919716	0.07	0.944	-.1737549	.186767
Lit_ret	-.0248389	.0890145	-0.28	0.780	-.1993041	.1496263
Bul_ret	.0276879	.0883635	0.31	0.754	-.1455014	.2008772
Pol_ret	.5855955	.0735647	7.96	0.000	.4434113	.7297797
_____	_____	_____	_____	_____	_____	_____
Sic_ret						
US_ret	-.0376135	.069122	-0.54	0.586	-.1730902	.0978632
CS_ret	.0797718	.1046008	0.76	0.446	-.1252959	.2847318
Hup_ret	-.073726	.0853026	-0.86	0.387	-.240916	.093464
Rom_ret	-.0070871	.0791654	-0.09	0.929	-.1622483	.1480742
Sic_ret	-.1228376	.0836888	-1.47	0.142	-.2868646	.0431893
Lit_ret	-.0392044	.0809998	-0.48	0.628	-.1979574	.1195487
Bul_ret	.0686793	.0804056	0.85	0.393	-.0889128	.2262715
Pol_ret	.1276113	.0666936	1.91	0.057	-.0035879	.2588105
_____	_____	_____	_____	_____	_____	_____
Lit_ret						
US_ret	-.1815245	.0794062	-2.29	0.022	-.3371578	-.0258913
CS_ret	.1818637	.1201626	1.51	0.130	-.0538526	.4173801
Hup_ret	-.0446201	.0979942	-0.46	0.649	-.2366851	.147445
Rom_ret	.0088061	.0909438	0.10	0.923	-.1694404	.1870527
Sic_ret	-.1001228	.0961402	-1.04	0.298	-.2885541	.0883085
Lit_ret	.1484842	.0930491	1.60	0.111	-.0338886	.330857
Bul_ret	-.1561073	.0923686	-1.69	0.091	-.3371464	.0249318
Pol_ret	.4568424	.0768991	5.94	0.000	.3061231	.6075618
_____	_____	_____	_____	_____	_____	_____
Bul_ret						
US_ret	-.0463938	.0835103	-0.56	0.579	-.210071	.1172833
CS_ret	.3156279	.1263743	2.50	0.013	.0679389	.5633169
Hup_ret	-.0446507	.103059	-0.43	0.665	-.2466427	.1573412
Rom_ret	-.0072499	.0956442	-0.08	0.940	-.1947091	.1802094
Sic_ret	-.0655366	.1011092	-0.65	0.510	-.264707	.1316338
Lit_ret	-.0428379	.0978583	-0.44	0.662	-.2346366	.1489609
Bul_ret	.0961597	.0971427	0.99	0.322	-.0942364	.2865559
Pol_ret	.3749556	.0808736	4.64	0.000	.2164463	.5334649
_____	_____	_____	_____	_____	_____	_____
Pol_ret						
US_ret	-.0651604	.0858812	-0.76	0.448	-.2333488	.103028
CS_ret	-.1418531	.1298573	-1.09	0.275	-.3963688	.1126626
Hup_ret	-.0267335	.1058995	-0.25	0.801	-.2342926	.1808256
Rom_ret	-.0532319	.0982803	-0.54	0.588	-.2458578	.139394
Sic_ret	-.0733048	.1038959	-0.71	0.480	-.276937	.1303275
Lit_ret	.0844513	.1005554	0.84	0.401	-.1126337	.2815363
Bul_ret	.0035991	.0998201	0.04	0.971	-.1920446	.1992429
Pol_ret	.0338881	.0831026	0.41	0.683	-.128899	.1967661
_____	_____	_____	_____	_____	_____	_____

Figure 11: Result of VAR (Post-recession)

Equation	Excluded	chi2	df	Prob > chi2
US_ret	Cz_ret	.0027	1	0.959
US_ret	Hun_ret	.34007	1	0.560
US_ret	Rom_ret	.00374	1	0.951
US_ret	Slo_ret	1.5135	1	0.219
US_ret	Lit_ret	.7827	1	0.376
US_ret	Bul_ret	1.1254	1	0.289
US_ret	Pol_ret	2.8569	1	0.091
US_ret	ALL	6.8814	7	0.441
Cz_ret	US_ret	.55508	1	0.456
Cz_ret	Hun_ret	.02168	1	0.883
Cz_ret	Rom_ret	.96113	1	0.327
Cz_ret	Slo_ret	1.501	1	0.221
Cz_ret	Lit_ret	.45364	1	0.501
Cz_ret	Bul_ret	.33785	1	0.561
Cz_ret	Pol_ret	195.34	1	0.000
Cz_ret	ALL	200.38	7	0.000
Hun_ret	US_ret	.69693	1	0.404
Hun_ret	Cz_ret	.19614	1	0.658
Hun_ret	Rom_ret	.21047	1	0.646
Hun_ret	Slo_ret	1.5653	1	0.211
Hun_ret	Lit_ret	.57201	1	0.449
Hun_ret	Bul_ret	.02327	1	0.879
Hun_ret	Pol_ret	123.68	1	0.000
Hun_ret	ALL	130.12	7	0.000
Rom_ret	US_ret	1.1563	1	0.282
Rom_ret	Cz_ret	9.0169	1	0.003
Rom_ret	Hun_ret	2.8262	1	0.093
Rom_ret	Slo_ret	.005	1	0.944
Rom_ret	Lit_ret	.07787	1	0.780
Rom_ret	Bul_ret	.09818	1	0.754
Rom_ret	Pol_ret	63.366	1	0.000
Rom_ret	ALL	78.439	7	0.000
Slo_ret	US_ret	.29611	1	0.586
Slo_ret	Cz_ret	.58082	1	0.446
Slo_ret	Hun_ret	.74699	1	0.387
Slo_ret	Rom_ret	.00801	1	0.929
Slo_ret	Lit_ret	.23427	1	0.628
Slo_ret	Bul_ret	.72959	1	0.393
Slo_ret	Pol_ret	3.6342	1	0.057
Slo_ret	ALL	6.0872	7	0.530
Lit_ret	US_ret	5.2259	1	0.022
Lit_ret	Cz_ret	2.2906	1	0.130
Lit_ret	Hun_ret	.20733	1	0.649
Lit_ret	Rom_ret	.00938	1	0.923
Lit_ret	Slo_ret	1.0846	1	0.298
Lit_ret	Bul_ret	2.8563	1	0.091
Lit_ret	Pol_ret	35.293	1	0.000
Lit_ret	ALL	49.877	7	0.000
Bul_ret	US_ret	.30863	1	0.579
Bul_ret	Cz_ret	6.2378	1	0.013
Bul_ret	Hun_ret	.18771	1	0.665
Bul_ret	Rom_ret	.00575	1	0.940
Bul_ret	Slo_ret	.43305	1	0.510
Bul_ret	Lit_ret	.19163	1	0.662
Bul_ret	Pol_ret	21.495	1	0.000
Bul_ret	ALL	33.932	7	0.000
Pol_ret	US_ret	.5766	1	0.448
Pol_ret	Cz_ret	1.1933	1	0.275
Pol_ret	Hun_ret	.06373	1	0.801
Pol_ret	Rom_ret	.29337	1	0.588
Pol_ret	Slo_ret	.49781	1	0.480
Pol_ret	Lit_ret	.70535	1	0.401
Pol_ret	Bul_ret	.0013	1	0.971
Pol_ret	ALL	5.396	7	0.612

Figure 12: Result of Granger causality test (post-recession)

c. Granger Causality test:

The result of the Granger causality test shows that post-recession lagged performance of Polish financial market helps predict Czech financial market ($p = 0.00$), similarly lagged performance of Polish financial market helps predict Hungarian financial market ($p = 0.00$). Lagged value of the Romanian financial market helps predict the performance of the Czech financial market ($p = 0.003$) and Polish financial market ($p = 0.00$). Lagged value of the Lithuanian financial market helps predict the Polish financial market ($p = 0.00$). Lagged value of the Bulgaria financial market helps predict the Polish financial market ($p = 0.00$) (Woolridge 2010).

4.6 Dynamic Conditional Correlation – GARCH

Dynamic Conditional Correlation GARCH model is the recent model which provides information with a conditional correlation that changes over time. This requires the presence of Heteroscedasticity in the data. The Heteroscedasticity is checked with the ARCH Lm test.

4.6.1 ARCH test

The ARCH LM test was carried out to test the presence of Heteroscedasticity in the data. Heteroscedasticity in the data is the varying variance which makes the estimation of the volatility by the ARCH GARCH method (Wang and Yang 2018). This method estimates the volatility as the function of past volatility (GARCH) with the variance of the time series. The ARCH effect is found to be observed in the post-recession period in the US financial market, Czech financial market, Hungary financial market and Polish financial market. The p-value of these nations is less than 5%; therefore, the null hypothesis of the presence of no conditional heteroscedasticity is rejected against the alternate hypothesis of the presence of conditional Heteroscedasticity (Chitkasame and Tansuchat 2019). However, it is observed that the conditional volatility being absent in all the financial markets before the recession of 2007-2009.

Table 8: Result of the ARCH LM test of the presence of Heteroscedasticity

	duration	Chi-square	Lag	p-value	Null Hypothesis
US_ret	Pre-recession	2.616	1	0.105	Accepted
	Post-recession	27.749	1	0.00	Rejected
Cz_ret	Pre-recession	19.015	1	0.00	Rejected
	Post-recession	12.107	1	0.0005	Rejected
Hun_ret	Pre-recession	0.339	1	0.560	Accepted
	Post-recession	4.343	1	0.037	Rejected
Rom_ret	Pre-recession	0.207	1	0.649	Accepted
	Post-recession	1.376	1	0.240	Accepted
Slo_ret	Pre-recession	0.079	1	0.778	Accepted
	Post-recession	0.324	1	0.569	Accepted
Lit_ret	Pre-recession	1.350	1	0.245	Accepted
	Post-recession	1.428	1	0.2321	Accepted
Bul_ret	Pre-recession	3.04	1	0.081	Accepted
	Post-recession	0.031	1	0.859	Accepted
Pol_ret	Pre-recession	1.546	1	0.213	Accepted
	Post-recession	31.303	1	0.000	Rejected

4.6.2 Estimation of Condition volatility

a. US_ret: The US financial market shows the presence of the Heteroscedasticity in the data post-recession. The result of the GARCH (1,1) model is presented in figure 5. It can be observed that

both ARCH and GARCH terms are statistically significant at a 5% significance level (Wang and Yang 2018). The time series plot of the US_ret post-recession is presented in figure 6. From the figure, it can be inferred that the conditional volatility is high during the period after the recession is over and the economy is reviving. There is volatility clustering in the model where the high volatility is followed by high volatility, and low volatility is followed by low volatility (Woolridge 2010).

		OPG				
US_ret	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Sample: 2009m7 - 2021m5 Number of obs = 143						
Distribution: Gaussian Wald chi2(.) = .						
Log likelihood = -409.7894 Prob > chi2 = .						
US_ret						
_cons	.8753761	.392443	2.23	0.026	.1062018	1.64455
ARCH						
arch						
L1.	.4036436	.1229156	3.28	0.001	.1627335	.6445537
garch						
L1.	.4422457	.1764114	2.51	0.012	.0964856	.7880058
_cons	4.03194	2.025574	1.99	0.047	.0618872	8.001992

Figure 13: Result of GARCH (1,1)

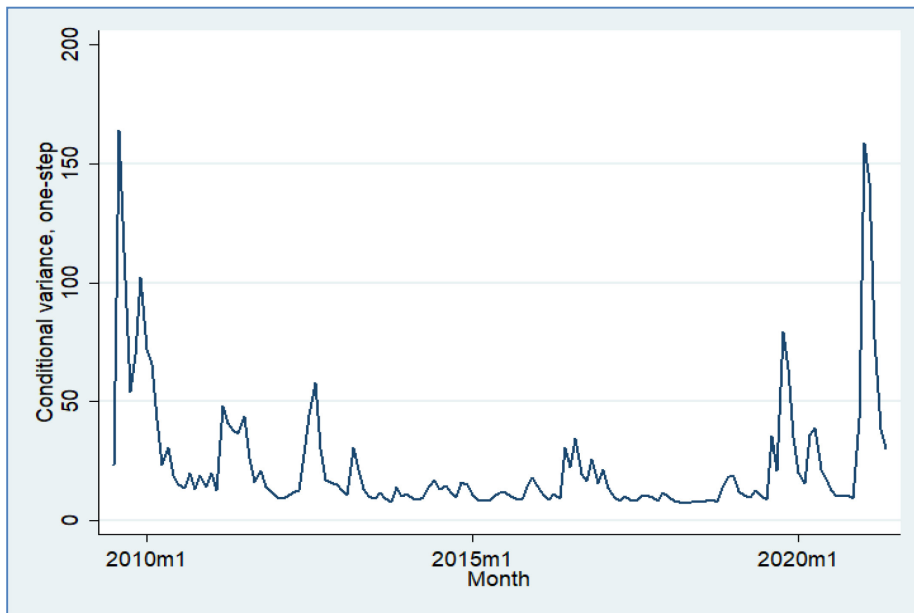


Figure 14: Conditional volatility of US_ret

b. Czech_ret:

i. Pre-recession: Czech financial market have Heteroscedasticity in both the period before and after the recession. The result of the ARCH (1) model is presented in figure 7. It can be observed that both ARCH terms are statistically significant at a 5% significance level. The time series plot of the Czech financial market pre-recession is presented in figure 6. From the figure, it can be inferred that the conditional volatility is high during the start of 2000 when the IT boom increases the financial market. There is volatility clustering in the model where the high volatility is followed by high volatility, and low volatility is followed by low volatility (Woolridge 2010).

Sample: 2000m1 - 2007m11		Number of obs =		85		
Distribution: Gaussian		Wald chi2(.) =		.		
Log likelihood = -265.8109		Prob > chi2 =		.		
Cz_ret	Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]	
Cz_ret _cons	1.614958	.6756579	2.39	0.017	.2906926	2.939223
ARCH						
arch						
l1.	.4723407	.2358254	2.00	0.045	.0101314	.93455
_cons	20.21531	6.080734	3.32	0.001	8.297295	32.13333

Figure 15: ARCH 1 model of Cz_ret

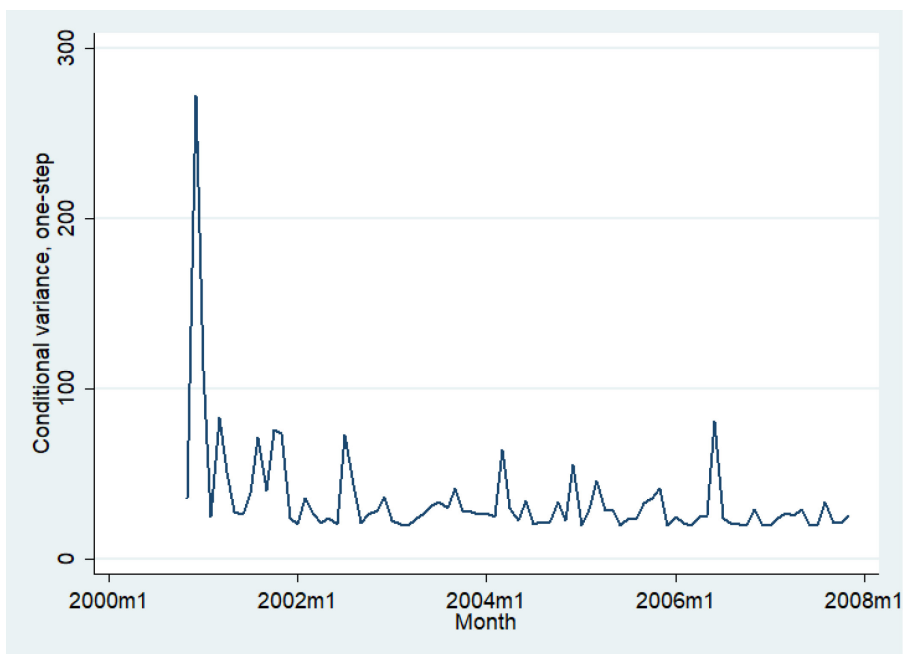


Figure 16

ii. Post-recession

The result of the ARCH (1) model for post-recession is presented in figure 9. It can be observed that the ARCH terms are statistically significant at a 5% significance level. The time series plot of the conditional volatility of the Czech financial market post-recession is presented in figure 10. From the figure, it can be inferred that the conditional volatility is high during the start recovery of recession in the financial market. There is volatility clustering in the model where the high volatility is followed by high volatility, and low volatility is followed by low volatility.

Cz_ret		Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]	
Cz_ret	_cons	.8882328	.3354784	2.65	0.008	.2307073	1.545758
ARCH	arch						
	l1.	.599704	.1591393	3.77	0.000	.2877968	.9116112
	_cons	11.19377	2.034109	5.50	0.000	7.206989	15.18055

Figure 17: ARCH 1 model (pre-recession)

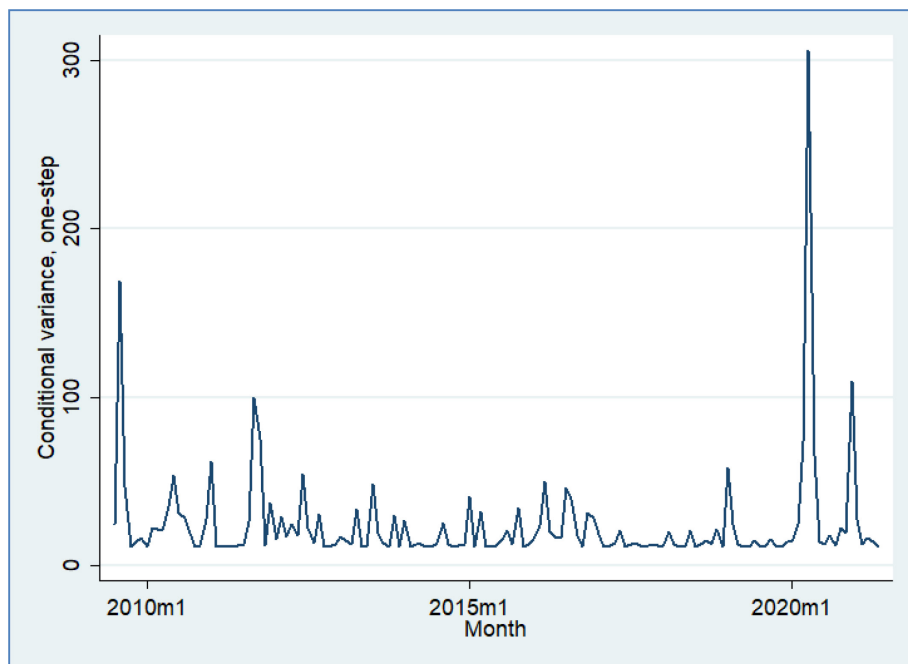


Figure 18: Conditional volatility Checz post-recession

b. Hungary _ret:

The result of the ARCH (1) model for the Hungary financial market post-post-recession is presented in figure 11. It can be observed that the ARCH term are statistically significant at a 5% significance level. The time series plot of the conditional volatility of the Czech financial market post-recession is presented in figure 10. From the figure, it can be inferred that the conditional volatility is high throughout the period compared to other financial markets.

		Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]
Sample: 2009m7 - 2021m5				Number of obs =	143	
Distribution: Gaussian				Wald chi2(.) =	.	
Log likelihood = -447.2006				Prob > chi2 =	.	
Hun_ret	_cons	1.025849	.4565578	2.25	0.025	.1310117 1.920685
ARCH	arch					
	L1.	.2308592	.1183344	1.95	0.051	-.0010719 .4627903
	_cons	24.90575	3.507214	7.10	0.000	18.03174 31.77977

Figure 19: ARCH 1 model of Hun_ret

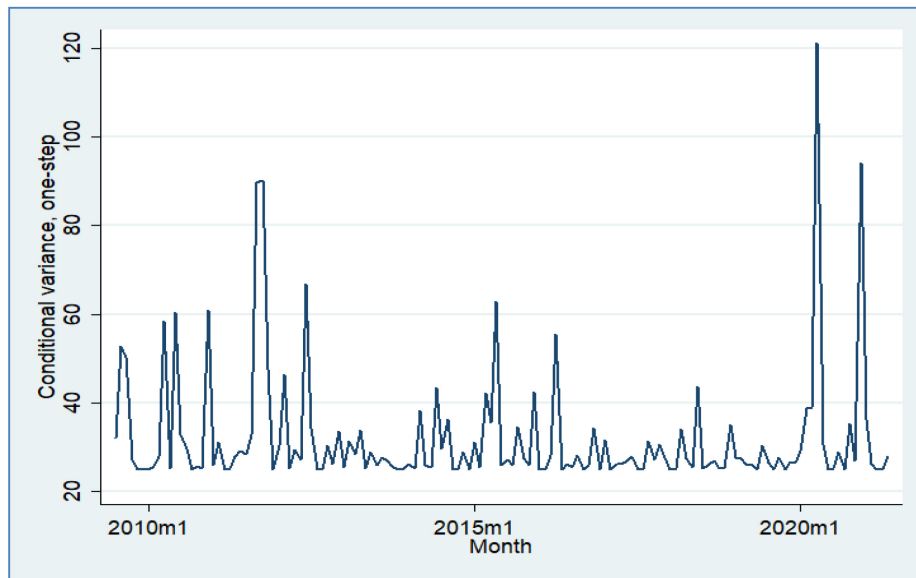


Figure 20: conditional volatility of Hungary

c. Poland_ret

The result of the ARCH (1) model for the Polish financial market post-post-recession is presented in figure 13. It can be observed that the ARCH term are statistically significant at a 5% significance level. The time series plot of the conditional volatility of the Polish financial market post-recession is presented in figure 14. From the figure, it can be inferred that the conditional volatility is high throughout the period compared to other financial markets. There is evidence of volatility clustering.

Sample: 2009m7 - 2021m5		Number of obs =		143		
Distribution: Gaussian		Wald chi2(.) =		.		
Log likelihood = -417.662		Prob > chi2 =		.		
Pol_ret	Coef.	OPG Std. Err.	z	P> z	[95% Conf. Interval]	
Pol_ret _cons	.7299066	.3867053	1.89	0.059	-.0280219	1.487835
ARCH						
arch L1.	.3590929	.1733196	2.07	0.038	.0193928	.698793
_cons	14.12848	2.58531	5.46	0.000	9.061363	19.19559

Figure 21: ARCH 1 model for Hungary financial market

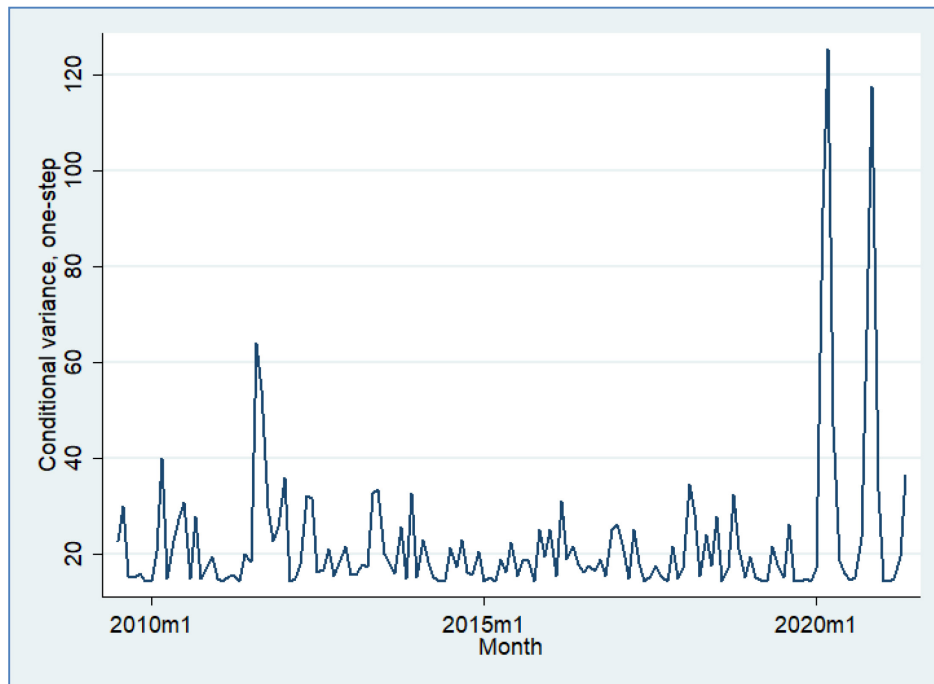


Figure 22: Conditional volatility of Hungary financial market

4.6. 2 DCC Garch model estimation

DCC garch model was used to estimate the dynamic conditional correlation where there is an ARCH effect. The ARCH effect is present in the US (post-recession), Czech post-recession, Hungary post-recession and Poland post-recession. Therefore the Dynamic Conditional correlation is estimated between

i. DCC garch model (US Post-recession and Czech post-recession)

The result of the DCC garch model is presented in figure 15. It can be observed that the conditional volatility is non-significant at a 5% significant level.

Dynamic conditional correlation MGARCH model						
Sample: 2009m7 - 2021m5		Number of obs =		143		
Distribution: Gaussian		Wald chi2(.) =		.		
Log likelihood = -821.566		Prob > chi2 =		.		
		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
US_ret	_cons	.8640675	.2933835	2.95	0.003	.2890465 1.439089
ARCH_US_ret	arch					
	L1.	.388894	.1467104	2.65	0.008	.1013469 .6764411
	garch					
	L1.	.463574	.1514645	3.06	0.002	.1667091 .7604389
	_cons	3.814493	1.942287	1.96	0.050	.0076805 7.621305
Cz_ret	_cons	.7036856	.3770479	1.87	0.062	-.0353147 1.442686
ARCH_Cz_ret	arch					
	L1.	.4476759	.1289415	3.47	0.001	.1949552 .7003965
	garch					
	L1.	-.247154	.0613631	-4.03	0.000	-.3674234 -.1268845
	_cons	18.26769	2.998987	6.09	0.000	12.38979 24.1456
corr(US_ret,Cz_ret)		-.0363988	.1103897	-0.33	0.742	-.2527586 .179961
Adjustment	lambda1	.0033671	.0120409	0.28	0.780	-.0202326 .0269668
	lambda2	.8847405	.2477511	3.57	0.000	.3991572 1.370324

Figure 23Result of the DCC garch model

ii. US Post-recession and Poland post-recession

The result of the DCC garch model between US post-recession and Poland post-recession is presented in figure 16. It can be observed that the conditional volatility is non-significant at a 5% significant level.

Dynamic conditional correlation MGARCH model						
Sample: 2009m7 - 2021m5		Number of obs =		143		
Distribution: Gaussian		Wald chi2(.) =		.		
Log likelihood = -826.6868		Prob > chi2 =		.		
		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
US_ret	_cons	.8858837	.2974208	2.98	0.003	.3029497 1.468818
ARCH_US_ret	arch					
	L1.	.4049626	.1548639	2.61	0.009	.1014349 .7084902
	garch					
	L1.	.4388607	.1556695	2.82	0.005	.133754 .7439673
	_cons	4.09171	2.046417	2.00	0.046	.0808063 8.102615
Pol_ret	_cons	.5492141	.4890163	1.12	0.261	-.4092402 1.507668
ARCH_Pol_ret	arch					
	L1.	.3450437	.109395	3.15	0.002	.1306335 .5594539
	garch					
	L1.	-.4355921	.0987792	-4.41	0.000	-.6291957 -.2419885
	_cons	24.15998	4.641957	5.20	0.000	15.06191 33.25805
corr(US_ret,Pol_ret)		.0779041	.1205475	0.65	0.518	-.1583647 .314173
Adjustment	lambda1	.001594	.0071453	0.22	0.823	-.0124106 .0155986
	lambda2	.9433966	.1466813	6.43	0.000	.6559064 1.230887

Figure 24: Result of the DCC garch model (the US and Poland post-recession)

4.7 Discussion

Globalisation and integration have economy has increased the cross border trade and investment. To promote internal business, the trade barriers have been reduced, and the monetary policies are made conducive that promotes cross border trade. This has integrated the economies and developed into market. The capital deficit nation is able to get capital to develop business activities at a low cost, and the inventors get a better return on their investment which makes a win-win situation for both nations (receiving and giving). However, the development of such relations has demerits as each economy becomes vulnerable to the developments in other nations (Müllner 2017). This is what is experienced in the recession of 2008, which has started as the subprime crisis in the US after there was a loss in the value of the mortgage assets causing a liquidity crisis (Grusky, Western and Wimern 2011). This all started in the US but affected the other economies as well. The recession does not affect the nation which was having trade relations with it. In Europe, the bigger economies like UK and Germany were the nation with better business

relationships with the US. However, the nations with a relatively new or young financial market like Bulgaria, which does not have such trade or investment relationships, were affected as they have a business relationship with the UK and Germany. Another factor that affected these nations as they were having the same currency, i.e. Euro. The currency rates were highly volatile, and changes affected these economies. The contagion effect was passed to these nations by the currency value fluctuations during the period. The financial crisis has caused a considerable slowdown in the economic activities affecting the nation's financial market and economic atmosphere. However, the effect of the recession varies from one economy to another. Some nations economies, like the US, Italy, Spain etc., were badly affected, while Asian nations China and India were mildly affected by the recession (Gulati, Nohria and Wohlgezogen 2010).

The recession has affected the financial market of the nations throughout the world except for the isolated economies. The US was considered the most developed financial market, which provides a better return on capital in the 2000s. Most of the economies do investment in the US market as well as in the domestic market. It is observed that there is a sudden decrease in the financial market capitalisation in all the economies considered in the study. However, a statistically significant fall was in the economies of Romania, Slovenia, Lithuania, and Bulgaria but the intensity has been different in each country. These follow the same trend of downward, but some countries recovered soon while the impact of crisis on United States had been severe.

During and aftermath of the recession, the regulatory, monetary and fiscal policymakers were all working to understand, restrict and repair the economic loss that arises due to the recession. Prior to the recession, it was expected that the loss could be hedged by financial engineering (Tufanno, 1996) The experience has changed the financial market work. This has changed the financial integration and international business relationship with other nations (Webber 2018). To avoid the loss economies have experienced during 2007 -2009.

As study by Syllignakis, and Kouretas (2011) investigated increase in correlation of contagion effects among the United States, Russia, German stock markets and the CEE stock markets. This study has also found that some countries are correlated with US economy such as Czech but after post recession this relation changed to negative and same trends were found in Romania, lit and Hun. While some countries were negatively correlated. This study's result is in line with findings of Terazi and Şenel (2011) that stated that financial crisis mostly affected United States then

European like Romania, Czech Republic, and Central union nations. It was also found that relation did not went negative all the time, but its impact reduced on other countries such as Polish. In case of Bulgaria, it was negative firstly but changed to positive.

The event of recession has reduced the linear relationship between the Eastern and Central European nations with US. After the recession, it was the developing nations that were the hotspots of the capital investments like India, China etc. which safeguarded their economy from the recession (Quaglia 2014). Therefore the financial linkages from the US have reduced, and United States developed business relations to these emerging nations. These economies were providing between return on investment. Also, the financial integration has improved with the Eastern and Central European nations. As observed from the correlation figure, most of the European nation has improved their financial ties with the other European nation. After the recession, the international financial relation of the US was affected and since these countries were being a member of European Union the financial relationship further improved (Ward, Davidson and Lukens 2020).

Prior to the recession, the US was one of nations where countries were more interested to invest as financial market was roaring due to the IT boom. The foreign investment in the country under study were high, mostly from the European nations and the US.

It is observed that the financial markets did not have conditional volatility prior to the recession (except the Checzech market). The results show that after the recession, there was a presence of conditional volatility developed post-recession in the US financial market, Hungarian and Polish financial market. Conditional volatility means the volatility of random variable provided with some additional information This shows that risk in the financial market has increased post-recession, but there was difference in time in market volatility which is significant in the financial market. The risk is not constant but is varying; therefore, the decision making in these financial markets post-recession becomes more difficult (Banerjee 2017). The risk high risk is expected to get followed by high risk and low risk being followed by low risk, i.e. volatility clustering. The risk in the financial market where there is no presence of conditional volatility like in all the financial markets except check.

Since the stock market is driven by the news, with positive news improves the financial market, negative news triggers the capital flight. The impact of negative news is much more than positive news (Soon, 2010) Also, the improvement in the technology by which the capital transfer can be made promptly has made the economic system vulnerable to other nation's events. Any news can trigger capital transfer which can induce volatility in the financial market, which is observed in Hungarian and Polish markets (Henryk Gurgul and Tomasz Wójtowicz, 2014; Büttner, Hayo, and Neuenkirch, F., 2015) The nations where conditional volatility has been found have developed time-varying risks. The time-varying conditional correlation was found to be non-significant with the US financial market. This supports the argument that the US has no longer a business hotspot (Torsekar 2019). The result of the VAR and the Granger Causality test shows the predictability of the US market from the financial market is from one country, i.e. Czech, while Lithuania and Romania are predicted by the Lithuania financial market prior to the recession. The recession has changed the predictability of the financial market where the European market is being predicted by each other and not the US market.

The recession has affected the economies of the world and has reshaped financial integration with the nations. The integration of the economies has increased trade and investment but also has made vulnerable to international events. The recession has had an effect on the European nation like any other nation. The recession has affected the European countries as well; as a result of the recession of 2008-2009, the trade and investment with the US market have declined, and the integration of the European countries with each other has improved. This has been the result of the learnings of the recession (Koh and Su 2021). Since European Union countries are homogenous as compared to the US or other nations. However, risk has been increased in some of the European nations under study post-recession. The financial market within the European nation has become more integrated compared to US European countries.

Chapter V: Conclusion

This chapter highlights the conclusive findings of the study with its implication. Also it highlights the limitations of current study and future research direction.

5.1 Conclusion

Recession has been a significant event in the history of the financial market, which has changed the behaviour of the financial market. Since globalization has integrated the economies, the effect of one financial market has a significant effect on the other financial market. The contagion of the recession, which affected the other nations, was due to the integration of the financial market. This contagion affects all the economies of the world except the few (Gabbi, Kalbaska and Vercelli 2015). It was observed that the countries which have better trade relations with the US like the European nations. The recession has resulted in the nation re-examining the economic policies and have pressurized for better regulation of the financial market. After the recession was over, the performance of the financial market has been changed. The recessions have a multifold effect on the citizens as they were unable to follow the system.. After the recession, the US was not the favourite by the investors, and developing nations like China and India emerged as the investors' investment heaven. The recession has resulted in the European nation having financial integration within themselves compared with the US (Hoffmann, Kremer and Zaharia 2020).

The study was conducted to study the effect of the recession on the seven European financial countries. The financial market was represented by their main index being traded. The index comprises the main companies with the highest market capitalization, high liquidity and better performance in the stock market. One thing that is common among all the financial markets was that there was an upward trend and after the recession till the impact of covid -19. There is a dip in the index performance post-2007. The results show the significant impact on the US financial market due to the start of the recession of 2007, where the structural break is significant. The effect of the recession, which resulted in the sudden dip in the index performance Czech market, Hungarian Lithuania and Polish financial market, is not statistically significant but is present. The distribution of the financial market has changed post-recession each financial market has different changes, but the coefficient of variation of the return of the index is more. The average return during the pre-recession period is more than the post-recession period for the European nation, while for the US market, the average return during the pre-recession period is less than the post-

recession period. There is a stark difference between the performance of the financial market in the European and US nations. Since the recession, the US has taken robust steps to promote economic development. These steps by the US policymakers to move the economy out of recession has worked. As observed, the average return provided by the US financial market is more in the post-recession than the post-recession period. The steps adopted by the policymakers to recover the policy and stringent rules for a financial institution like BASEL norms has supported the economy. This has made the environment conducive for US financial market to perform better. There is a huge difference in the coefficient of variation pre-recession. The return in the pre-recession period is highly dispersed compared to the post-recession period. T

The correlational analysis shows that there is a reduction in the linear relationship between the financial market performance. It can be said that the financial market is least correlated with the US market for all the European nations considered in the study. This is due to the learnings of the recession by which the influence of the US financial market or the contagion effect was reduced. However, the relationship among the European nations has increased.

The stationary test shows that all the data are stationary at level. There was no hint of the presence of cointegration; therefore, Vector autoregression was carried out. That is the multivariate analysis where the equation consists of the lag of its own and other variables. It can provide information about the lead-lag relationship between the variables. The VAR analysis was done for both the pre-recession and post-recession periods to understand the causal effect of the recession. In the pre-recession period where the lagged Lithuania helps predict Czech financial market lag, Romania financial market performance helps predict Lithuania financial market. However, after the recession, the prediction of the financial by the other financial market has changed. Post-recession lagged performance of Polish financial market helps predict Czech financial market.

Similarly, the past performance of the Polish financial market helps predict the Hungarian financial market. Past value of the Romanian financial market helps predict the performance of the Czech financial market and Polish financial market. Past value of Lithuanian financial market helps predict Polish financial market. Past value of Bulgaria financial market helps predict Polish financial market. It is observed that the prediction value increases more for the European nations and not with the US market. The VAR approach also shows that the financial market in Europe tends to get more integrated with the fellow European nations compared to the US market.

Dynamic condition correlation (DCC) GARCH was adopted to estimate and study the time-varying correlation between the financial market. The application of these techniques requires that there must be the presence of heteroscedasticity. The statistical test shows that the ARCH effect is observed in the post-recession period in the US financial market, Czech financial market, Hungary financial market and Polish financial market, while in the pre-recession period, the heteroscedasticity is found in the Czech financial market. The estimation of the conditional heteroscedasticity was supported by the GARCH(1,1) model for the pre-recession period for the Czech market. The estimation shows that there is a presence of conditional volatility clustering where the high volatility is followed by high volatility, and low volatility is followed by low volatility, post-recession the conditional volatility of the changes to ARCH (1) model for the Czech financial market. A similar model was for the Hungary and Polish financial markets. One thing that is common in volatility is volatility clustering. The presence of conditional heteroscedasticity, which has developed in the two financial markets post-recession, shows that the risk in this financial market has increased. The risk is the inherent property of the stock market. The recession has made the investors aware of the risk as sometimes risk management is not optimal to avoid or minimize the risk since post-recession conditional volatility is developed in these financial markets. The unpredictability of the financial market increases. It is expected that large swings in the financial market (Altunbas, Manganeli and Marques-Ibanez 2017).

The DCC garch estimated between the US financial market and the Czech financial market, US Post-recession and Poland post-recession. The DCC garch results that the conditional volatility to statistically non-significant for both the financial market situation.

The recession is a regular event that regularly comes in the financial history at an irregular interval. The reason for the recession has been different, but the effect on the stock market has been different. The 2007 recession has been due to the liquidity crunch and the subprime crises that has bankrupted various financial institutions (Christiano, Eichenbaum and Trabandt 2015). This recession which has started, affected the other economy as well. Since financial institutions are linked with each other, the bankruptcy of one of the financial institutions affects the financial institution of the other economy. The lack in risk mitigation and its measurement has added fuel to the fire; the fact catalyzed this recession as the measures to contain the recession was not there due to confidence in hedging as the risk management tool to reduce the risk. The recession has

increased risk as in the few nations there is the development of conditional volatility. The investors in these financial markets are likely to observe a swing in the financial market.

5.2 Limitations of the study

1. The study is carried on with considering the main index performance as the financial market's performance. These indices comprise the companies with the highest market capitalization. However, the other indices of the financial market may have different behaviour which is left out in the study. There is no way by which the exact financial behaviour of the financial market can be identified.

2. The data used in the study is the monthly data of the index. The daily data can provide a much better picture of the financial market as the data is high frequency in nature. The study tried to use complex statistical techniques, which are more suited as the presence of the ARCH effect is more prominent in the daily data than the monthly data.

3. This study has considered seven European nations and the US financial markets. The study considering the other developed European nation like the UK can provide better information about the effect of recession on the performance of the European market.

5.3 Scope of future research

1. The study can be extended by the researchers using the daily return, which is the high-frequency data. The use of daily data can provide a more detailed change in the financial market's performance with the recession of 2007.

2. The study can be extended in future to study the recession caused due to the Covid-19 pandemic. The covid 19 pandemics have resulted in a loss in the financial market. A covid-19 pandemic is also a significant event that affects the behaviour of the financial market. The study can be the base to understand the financial market pre and post covid pandemic for the different waves of the corona.

3. Sectoral contagion has not been studied; sector-based contagion can provide better information about the strength of the contagion. Sectoral analyses like Banking and financial sector cointegration can have different integration than the general cointegration, which is studied with the index in this study.

5.4 Implications of the study

1. Recession affects all the economies, which has resulted in a change in the way the financial market behaves. The policymakers can use the result of the study, researchers to understand the level of change in the integration between the two economies considered in the study.
2. The investors can decide on the investment as the relationship between the financial market has changed. The international investor can use this information to take a justified decision regarding the international portfolio. An international investor can make the portfolio of its investment in those nations which have a negative correlation. This will reduce the risk of the international investor.
3. The recession has an effect on the financial market is presented in the study. The recession is a cyclic and periodic event that is due to different reasons. The European nations have witnessed the recession within their own boundary, which has not been considered as like the European debt crisis of 2010-2012. The study can be provided as a base to study the effect of the recession that occurred in the European market.
4. volatility Spillover effect between the two financial markets is an emerging study that has not been conducted. It shows the transmission of financial shock from one country to another. The presence of the ARCH effect is the requirement for the analysis. Studying the daily data with the spillover effect provide information about how one market is affected by the volatility of another financial market.

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