FX, Euro, Brexit and Financial Markets in the European Union

Bachar FAKHRY

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Preface

This chapter (I) We celebrate the 20th anniversary of the introduction of the Euro by reviewing one of the key elements: the integration of the Eurozone financial markets. Introducing a multivariate volatility test based on the asymmetrical BEKK (ABEKK) multivariate GARCH model of volatility to analyse the stable market pre-condition hypothesis of the integrated Eurozone equity markets across the euro's timeline. Extending our analysis to the impact of the rise of the populist political movement on the Eurozone financial markets during the last few years. The first and most important contribution is the introduction of a multivariate volatility test based on the ABEKK to analyse the stability of the integration in the Eurozone equity markets. However, another key contribution is the analysis of a period where the whole concept of European integration is coming into question by the rise of the populist political movement. This research could be of importance to the ECB

in stabilising the Eurozone financial markets as well as market participants in portfolio optimization within the Eurozone. Our results point to a difference in financial market integration depending on the definition. The empirical evidence found that market participants tend to react differently according to the affinity of the market participants to the event/news. In essence, market participants are driven by the "time and space" effect. This would point to evidence that the Eurozone equity markets was never truly integrated in the econometrics sense as defined later on. However, our literature review did identify evidence that the Eurozone equity markets was integrated in accordance with the definition of Baele *et al.,* (2004). Hence it really does depend on the definition used. Generally, our policy recommendations are for a committee to be setup to unify the communication and actions of the European Union during crises. A better way of communicating the work and concept of the European Union to the population. Finally, a slower paced policy of integration to overcome the sense of loss national identity which recently many are plying on.

This chapter (II) The recent UK referendum results and subsequent initiation of Article 50 in the 2007 Lisbon Treaty set in motion the UK's withdrawal from the European Union, acknowledge as Brexit. The result and subsequent action were unprecedented and for many unforeseeable. Apart from the political instability and division of the country, the complicated and long process of Brexit have both economic and financial consequences. With this in mind, we analyse the impact of Brexit on four main British financial markets: Equity, Foreign Exchange, Gold and Sovereign Debt; using daily data. We extendthe variance bound test proposed by Fakhry & Richter (2018) underpinned by an asymmetrical C-GARCH-m model of volatility. Unlike many in the past, we placed the emphasis on the stable markets; thus introducing the stable marketpre-

condition hypothesis. We analyse the long and short run effects of Brexit on the stability of the UK's financial market. Our results hint at a certain impact on the UK's financial market in both the long and short runs on the market stability and hence efficiency. This seems to be dictated by the reaction of market participants to uncertainty surrounding the future of the UK

The aim of this chapter (III) We review the EU's actions over the euro's lifetime; since its introduction thru to the populist uprising of the late 2010s. The euro was introduced on a wave of optimism throughout the EU, although based on a compromised monetary agreement. Essentially, underlining the crisis and movement from optimism to pessimism in the EU integration road. Thus, it is hard to analyse the euro without reviewing the theories influencing this road. Furthermore, we analyse the long and short-run market stability of the euro FX market using the variance bound model of (Fakhry & Richter, 2018). However, it is difficult to explain the market analysis without referencing behavioural finance. Thus we use key elements of behavioural finance, such as the opposite scale behaviours of greed and fear, to fully explain the timeline analysis of the euro FX market stability in both the long and short runs. At first glance, the result was unexpected due to the critical factor that the market was significantly volatile in the long run; despite conventional wisdom dictating that in the long-run, the financial markets are generally stable. One possible explanation is that the market participants are fearful of the long-run future of the Euro.

The purpose of this chapter (IV) We review market participants' actions and the EU afterthe introduction of the euro and during the crises period and Brexit process. The crucial factor is the feedback effect in the reactions of the market participants and the EU. The euro was introduced in a compromised monetary union agreement, essentially

underlining the European integrative process issues that were highlighted by the euro crises. Hence, for this reason, it is hard to explain the euro crises without referencing the European integration theories. On the other hand, it is difficult to understate the behavioural factors, including greed and fear, in the full explanation of thecrises. At the heart of this research is the introduction of a new model of testing the stability of the market extending the variance bound test of (Fakhry & Richter, 2015) underpinned by a Markov Switching GARCH model. We analyse the stability of the Euro FX Market from 1st January 1999 to 31st December 2019. We found a mixture of over and under reactions defining the three sub-periods which given the Euro heuristic influencing both the market participants' and EU's views seem to be an acceptable result.

B. Fakhry
3 May, 2021
London

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Introduction

The introduction of the Euro was probably one of the most significant financial events of the last century, not only because of the introduction of a new currency across the Eurozone but also it contains an influencing concept. At its heart lays a strong ideology in order to prevent conflicts between the countries of Europe, like the first and second world wars, there is a need to integrate the economies and financial markets under one currency and monetary policy. Conversely, on 1st January 1999 the euro was first introduced into 11 countries, hence integrating 11 diverse economies and financial markets under one common monetary union. However, the recent further integration is one of the reasons for the fresh increase in the popularity of the populist/nationalist political movements, especially in the aftermath of the crises and

economic downturns, due to the loss of a "national identity" and/or "economic constraints". We introduce a multivariate volatility test using an asymmetrical BEKK MGARCH model first proposed by Engle & Kroner (1995); analysing the stability of the integrated Eurozone financial markets through six different observed periods in the timeline of the euro including the recent rise of populist political movements.

Although, many papers have been written on the impact of the euro on the integration of the financial markets across the Eurozone during the introductory and crises periods. Moreover, there is an extensive library of research on the impact of the euro on the volatility spillover effect and contagious impact of news within the Eurozone. Yet a key issue remains understudied; the stability of the Eurozone markets which was highlighted by the recent financial and sovereign debt crises and extended by the recent rise in the populist political movement, such as the Brexit process or rise of populist political parties, which puts into question the whole concept of European integration.

As argued by Fakhry (2019), since the volatility test indicates that if a market is inefficient then it is deemed to be too volatile to be efficient. Simply put, this means that for a market to be efficient the pre-condition is a measurable stability status. Thus, meaning that essentially the volatility test is a test of the stability pre-condition. In a number of collaborations such as Fakhry & Richter (2016, 2018) using the volatility test, found diverse evidence of market stability in the Eurozone financial markets during the recent global financial and Eurozone sovereign debt crises. While Fakhry (2019) analysing the impact of Brexit on the UK's financial markets found that populism politics could destabilize a market.

Recent studies such as Dotz & Fisher (2011), Metui (2011), Tamakoshi (2011) and Mohl & Sondermann (2013) point to a

changing behaviour in the integrated financial market depending on the general market environment. This was confirmed by Fakhry & Richter (2018) who find that the stability of the financial markets may vary among markets and depend on the general environment. Conversely, as illustrated by Pericoli & Sbracia (2003) the evidence on contagion and spillover effects are strong. Furthermore, as noted by Pericoli & Sbracia (2003), this evidence is not limited to countries within a region but there is also evidence of cross regions volatility transmissions. Louzis (2013) also notes the strong evidence of cross markets spillover effects during the crises highlighting the volatility transmission between the stock and sovereign debt markets during the Eurozone sovereign debt crisis.

Although as Christiansen (2007) demonstrated that it is possible to model volatility spillover effects using an univariate GARCH model. Moreover, the VAR as illustrated by Louzis (2013) could be used to identify spillover effects using Diebold & Yilmaz (2012) methodology. Furthermore, as illustrated by Billio & Pelizzon (2003) and Baele (2005), spillover effects can be detected using a multivariate Markov switching model. However, Multivariate GARCH models are more flexible and thus often used in the study of spillover and contagious effects such as (Missio & Watzka, 2011, Favero & Missale, 2011; Groba *et al.*, 2013; MacDonald *et al.*, 2018; Trabelsi & Hmida, 2018).

To this extent, we use an asymmetrical BEKK-MGARCH (aka ABEKK) model to analyse the impact of volatility spillover effect and contagious impact of news on the Eurozone financial markets since the introduction of the euro. We also introduce a multivariate variant of the volatility test to analyse the stability of the environment in the Eurozone financial market. We restrict our analysis by using the EuroStoxx 50 index as the benchmark market, thus meaning we analyse the transmission of volatility and news

between each observed equity market and the EuroStoxx 50 index. Using the equity markets from the 10 original members of the Eurozone[1] plus Greece[2] observed from 31st December 1997 to 31st December 2018. Furthermore, we use timeline analysis to research the impact of six different periods associated with the pre-euro, introduction of the euro, mid-2000s global asset price bubble, recent crises (i.e. global financial and Eurozone sovereign debt crises) and rise of populist movement in the last few years.

Our key contribution to the literature on financial econometric is the extension of the volatility test of Fakhry & Richter (2016a) to a multivariate volatility test using an ABEKK model. This would allow us to test the stable market precondition hypothesis, as proposed by Fakhry (2019), in the context of a multivariate environment. Therefore, analysing the environment underpinning the transmission of volatility and news from one market to the other within the Eurozone integrated financial market. Although, the ABEKK have been used to analyse the transmission of volatility such as (Wang & Wang, 2005; Li, 2007; Efimova & Serletis, 2014; Emenike, 2014); yet mainly due to the complex nature of such a model and estimation issues, the ABEKK model has been sparingly used in the context of the Eurozone financial markets integration.

Since as hinted by Bekaert *et al*. (2002) and Baele (2005), a fully integrated market displays interdependency and correlated returns amongst its segments; thus it is one where news contagion and volatility spillover from one segment effects all segments. In general, our results suggest that the market participants within the Eurozone subscribe to the "time and space" effect meaning they tend to react

[1] As with other researches in the Eurozone, we don't analyse the Luxemburg financial market.

[2] Although Greece did not join until 1st January 2001, yet we feel that Greece is an important market mainly due to the sovereign debt crisis.

differently to events depending on the time horizon and market. In essence, market participants react differently according to their affinity to the event. Thus suggesting the Eurozone equity markets was never truly fully integrated.

Given our findings and the latest views on further integration, we recommend a slower pace of integration for the foreseeable future to overcome the loss of national identity which gives rise to extreme views. We also advise the European parliament to communicate more with the population in order to raise awareness of the work and concept of the European Union. A key issue raised by the recent crises within the Eurozone and the European Union is miscommunication, we recommend the setup of a committee to oversee the communication and actions during any event.

We follow the convention by firstly reviewing the literature on the Eurozone financial markets integration. Secondly, we review the methodology of the model specifications of the ABEKK MGARCH and our multivariate volatility test. Thirdly, we review our observed data. The fourth section provides our empirical evidence on the stability of the Eurozone integrated equity markets, analysing the volatility spillover effects and impact of contagious news over six periods during the timeline of the euro. Concluding with the conclusions and recommendations.

A literature review of the Eurozone's integrated financial markets

In order to understand the impact of the spillover and contagion effects, we need to research the impact of integration on the Eurozone equity market. Baele *et al.*, (2004) defines an integrated financial market as a market for financial instruments and services where all market participants are governed by three principle characteristics:

1. a single set of rules regarding the purchase or selling of instrument or services.
2. equal access to instruments and services.
3. equal treatment for all market participants engage in a market.

As stated by Baele *et al.,* (2004), economic theory dictate that the integration and development of financial markets are key to economic growth in the Eurozone by removing frictions and barriers and allocating capital more efficiently. However, a key issue is taken a step too far financial integration could be detrimental to market competition as highlighted by Baele *et al.,* (2004). Further, a key argument made by Baele *et al.,* (2004) is that financial integration may affect the structure and hence have implication for the stability of the financial system.

According to Cohen (2003) many economists and academics predicted the Euro will challenge the dollar for global supremacy, for many at the time the question was not if but when. Relatively few, such as Feldstein (1997), questioned the enthusiasm towards the new currency. As quoted by Cohen (2003, p.576), many predicted "*a rosy future*" for the new currency. However, according to Cohen (2003) there were four major obstacles standing in front of the euro challenging the dollar as the global currency at the time: firstly, the persistent inertia behaviour of monetary systems. Secondly, the cost of doing business in euros. Thirdly, the "anti-growth" bias built into EMU and finally the ambiguous governance structure of the EMU. Although as Cohen (2003) states these obstacles could be overcome. Conversely, Papaioannou *et al.,* (2006) found that the influence of the Euro as the reference international reserve currency of the central banking environment was growing and accordingly "*Punching above its weight*".

Ehrmann & Fratzscher (2002) found in the immediate aftermath of the introduction of the euro macroeconomic

news from the US had more impact on the Eurozone financial markets than vice-versa. However, the importance of macroeconomic news, especially the M3 monetary levels and CPI, from the Eurozone grew in the later stages of the Euro's introduction period.

Reviewing the impact of the euro on the financial markets after one year, Danthine *et al.,* (2000) found evidence illustrating the euro did have an immediate impact on the Eurozone financial markets. However, the impact was not mainly due to the elimination of currency risk but a result of indirect feedback mechanisms. These feedback mechanisms include the cross-country transaction costs, liquidity of the Eurozone's financial markets, diversification opportunities available for Eurozone investors and institutional changes effecting the banking sector.

As Trichet (2001) states the euro had a huge impact on the Eurozone's financial markets. Across the board, the Eurozone financial markets grew in the aftermath of the introduction of the euro. A key factor in the equity market was the growth in mergers and acquisitions totalling over $1 trillion during the initial two years of the euro. An important factor in this is the trend towards the merger or cooperation between stock exchanges i.e. the Euronext stock exchange which was created by the merger of the exchanges in Paris, Brussels and Amsterdam. In the aftermath of the introduction of the euro, the total market capitalisation of the Eurozone's equity market stood at €5.5 trillion in 1999 as oppose to €3.6 trillion in 1998. According to Trichet (2001). The contributory factors to this growth are not only the rise in price but also the IPO of private companies. However, as Trichet (2001) states there were still some barriers to further integration of the Eurozone's financial markets; hinting at the Lisbon meeting of the European Council in March 2000 as a landmark in the integration of the European financial markets.

Conversely, in a study of the impact of the euro on the European financial markets after four years, Galati & Tsatsaronis (2003) noted the impact is uneven across the spectrum of the financial market. In many respects the euro have had a positive impact i.e. the redirection of prices in the equity market to reflect industry risk factors as oppose to country risk factors and lower cross border transaction barriers. These positive impacts have enhanced the ability for investors to build pan-European strategies and portfolios. However, Galati & Tsatsaronis (2003) found there were still issues with implications on financial markets integration; like the focus on narrowly defined interests meaning the potential of European Monetary Union to integrate financial markets may not be fully realised. Another issue highlighted is diverged legal and institutional infrastructures and market practices which may impede on further development of the Eurozone financial markets.

According to Fratzscher (2001), European equity markets have become increasingly integrated since 1996. This integration is largely driven by EMU and is at the heart of the Eurozone's equity market overtaking the US equity market within Europe. Furthermore, Baele *et al.*, (2004) found evidence hinting at an increasingly integrated equity market pointing at three key elements of the Eurozone financial markets:

- The advantages of sector diversification have surpassed those of country diversification.
- Equity returns are increasingly determined by common news factors.
- The decrease in home bias within financial institutions' portfolios.

Moreover, the results from Hardouvelis *et al.*, (2006) points at diminishing forwards interest differentials against the German benchmark and inflation differentials have been key to the integration of the equity markets during the 1990s.

Significantly, the exception was the UK's equity market. Conversely, Lane & Walti (2006) found evidence pointing at strong bilateral financial linkages within the Eurozone. However, the results seem to suggest that there are other factors than EMU also driving the financial integration.

Nevertheless, Cappiello *et al.,* (2006) found the integration of Eurozone equity markets was not as strong as the bond markets and was determined by the size of the economy with integration being greater in the large economies. And as Bekaert *et al.,* (2013) found that it is EU membership rather than euro adoption that have increased financial integration. Thus, meaning European equity markets segmentation decreased with EU membership.

An important issue in this paper is the study of the spillover and contagion effects on the Eurozone financial market. Much of the empirical evidence in the past few years have concentrated on the spillover and contagion effect on the Eurozone sovereign debt market during the crises of the late 2000s to mid-2010s. Good examples of recent research in spillover and contagion effects in the Eurozone sovereign debt markets during the crises are Missio & Watzka (2011), Favero & Missale (2011) and Groba *et al.,* (2013). Since this paper is partly researching and analysing the volatility spillover and news contagion of the Eurozone equity market, therefore we will provide empirical evidence on the equity market.

In essence as stated by Groba *et al.,* (2013), a vital factor in the behaviour of volatility in any financial market is the transmission of volatility from one asset or market to another; often referred to as the volatility spillover effect. The introduction of the VEC by Bollerslev *et al.,* (1988) was aimed at the co-movement in the time varying volatility between two or more assets or markets. The BEKK introduced by Engle & Kroner (1995) had the advantage of the conditional covariance matrices being positive definite

by construction as stated by Silvennoinen & Terasvirta (2008). However as hinted by Silvennoinen & Terasvirta (2008) a major problem is due to the number of parameters required in the BEKK; the sheer computing power was prohibiting on most computers. This meant convergence using the BEKK model was and still is difficult.

Using a multivariate regime switching model and world and German indices as benchmarks markets, Billio & Pelizzon (2003) found volatility spillover increased from both benchmarks to most European equity markets since the introduction of the Euro. Furthermore, introducing a regime-dependent shock spillover intensities variant of the Markov switching model, Baele (2005) hints at an increase in intensity in the spillover effects for the European Union throughout the 1980s and 1990s. The key contributory factors are increased trade integration, equity market development and low inflation. Moreover, Baele (2005) found some evidence of contagion during highly volatile periods.

Missio & Watzka (2011) use a DCC multivariate GARCH model to analyse the contagion effect of sovereign debt credit ratings during the Eurozone sovereign debt crisis in seven Eurozone yield spreads. They use the announcements on the Greek credit ratings to analyse the financial contagion between the Greek market and the other observed yield spreads. The results hint at a strong financial contagion from the credit ratings announcement, especially around the first bailout of the Greek economy during the summer of 2010. Furthermore, the results imply contagion only effect economically or politically unstable countries. Similarly, Groba *et al.*, (2013) using the BEKK model on CDS from EU members found a varied transmission of risk from the GIPSI[3] countries to other EU members during the crises period. Like Missio & Watzka (2011), the results hint at a fragmentation

[3] GIPSI are Greece, Italy, Portugal, Spain and Ireland

of the EU between financial distressed members and other members.

Louzis (2013) constructed spillover indices based on Diebold & Yilmaz (2012) framework which uses a generalised decomposition of the forecast-error variance of a VAR model. In general, they found a high level of return and volatility spillover effect over the observed markets. Moreover, the equity market was the largest transmitter of return and volatility spillover, even during the recent sovereign debt crisis.

MacDonald *et al.*, (2018) using a BEKK model found that the direction and intensity of the spillover effect is time dependent. Although the GIPSI nations are occasionally the largest contributors of the spillover effects, however the core Eurozone countries also transmit volatility to the GIPSI. Conversely, the results point to the existence of cluster of countries, hence the spillover effect comes from within the group ((i.e. Core or Periphery). Moreover, Trabelsi & Hmida (2018) using a DCC-MGARCH model and a limited number of Eurozone equity markets showed during the recent financial crisis there was the existence of contagion between all observed markets. However, the results from the sovereign debt crisis points to only Greece and Portugal being impacted by contagion.

Methodology

The importance of a stable environment underpinning the Eurozone financial markets was underlined during the crises period as illustrated by any number of researches during the last few years such as Groba *et al.*, (2013), MacDonald *et al.*, (2018) and Trabelsi & Hmida (2018). The impact of volatility spillover and contagion of news from one market to the other market within the Eurozone is a hot debate that is just as relevant today as it was during the crises and euro introductory periods. Therefore, we extend the volatility test

proposed by Fakhry & Richter (2016a) to a multivariate volatility test using an asymmetrical BEKK-MGARCH model proposed by Engle & Kroner (1995). We use the 5% critical value F-statistics to test the stable market pre-condition hypothesis. As with Fakhry & Richter (2016, 2018), we follow the key pre-requisite step advocated by Shiller (1979, 1981).

As illustrated by Shiller (1981), the key factor underlying any volatility test is the variance calculation. We model the datasets in our test as a time varying lagged variance of the price using equation 1. We used the 5-lagged system as advocated by Fakhry & Richter (2016a)

$$\lim_{t \to T} var\left(Price_{i,t}\right) = \frac{\sum_{q=1}^{Q}\left(Price_{i,q} - \mu_i\right)^2}{Q} \quad (1)$$

However, since we are only concerned with the stability of the transmissions of volatility between the markets and thus the integration of the Eurozone markets; we don't follow step 2 of Shiller (1981) estimating the residuals using an autoregression model.

Model specifications for theABEKK bivariate GARCH

As illustrated by Christiansen (2007) and Ball (2009) among others, a key factor in the behaviour of volatility is the influence of volatility from related external sources. And while the volatility spillover effect could be estimated using a univariate GARCH model as demonstrated by Christiansen (2007) thru the use of a three-step technique. Yet we think that a more elegant method to our observed data would be to use a multivariate GARCH model. There are a number of MGARCH models as surveyed by Bauwens *et al.*, (2006) and Silvennoinen & Terasvirta (2008); chief among these models are the BEKK-MGARCH (Engle &

Kroner, 1995) and DCC-MGARCH (Engle, 2002). We use theABEKK model to model the conditional covariance of our observed equity market indices.

One of the key contributions of our research is the use of a bi-variate ABEKK model. As hinted previously, we differ from previous research into the integration of the Eurozone markets in that we use the EuroStoxx 50 index as the benchmark equity market. Thus, analysing the spillover and contagion effects between the benchmark and observed11 Eurozone members in all six stages of the Euro's timeline.

The reasoning behind our choice of the ABEKK is the restrictions of the other MGARCH models in order to guarantee the positivity of the conditional covariance, thus rendering our results unusable. In order to overcome these restrictions, we chose to use the unrestricted BEKK model. However, the big issue with using any unrestricted BEKK model is the large number of parameters and thus computing power required. In a normal BEKK, each coefficient matrices have a $N \times N$ number of parametersplus a C matrix has $\frac{N(N+1)}{2}$ parameters and lastly there are the N parameters for the mean equation. However, we are using the more complicated ABEKK which adds an asymmetrical matrix, D, with $N \times N$ parameters. With this number of parameters, it is highly likely that one reason why the unrestricted ABEKK have been used sparingly in econometric research is the sheer computing power it requires. Another possible issue with the unrestricted ABEKK is the difficulty to get convergence.

Our single lag ABEKK (1, 1) would be modelled using equations 2 and 3.

Mean Equation

$$\mu = \mu_{Euro} + \mu_i \qquad (2)$$

Covariance Equation

$$H_t = \mathrm{CC}' + Au_{t-1}u_{t-1}'\mathrm{A}' + BH_{t-1}B' + Dv_{t-1}v_{t-1}'D' \quad (3)$$

where

$$v_{t-1} = u_{t-1}{}^{\circ}I_{u<0}u_{t-1},\ u_{t-1} = \left[u_{euro,t-1}u_{i,t-1}\right]' \text{ and } v_{t-1} = \left[v_{euro,t-1}v_{i,t-1}\right]'$$

H_t *and* $H_{t-1}$is the conditional covariance at time t or t-1

$u_{t-1}$is the conditional residuals at time t-1

C is the constant term

A is the coefficient matrix of the conditional residuals or ARCH

B is the coefficient matrix of the conditional covariance or GARCH

D is the coefficient matrix of the asymmetrical effect

Since, we are using a bi-variate system to test the transmission of news and volatility between the euro index and the other Eurozone indices. The generalised matrix system is as in equation 4.

$$C = \begin{vmatrix}\omega_{11} & \omega_{12}\\ 0 & \omega_{22}\end{vmatrix},\ A = \begin{vmatrix}\alpha_{11} & \alpha_{12}\\ \alpha_{21} & \alpha_{22}\end{vmatrix},\ B = \begin{vmatrix}\beta_{11} & \beta_{12}\\ \beta_{21} & \beta_{22}\end{vmatrix},\ D = \begin{vmatrix}\gamma_{11} & \gamma_{12}\\ \gamma_{21} & \gamma_{22}\end{vmatrix} \quad (4)$$

Therefore, when our model is split into its component parts, we can write the components using equations 5-7.

Variance of the Euro equity market benchmark

$$\begin{aligned} h_{1,t} = {} & C(1,1)^2 + A(1,1)^2u_{1,t-1}^2 + 2A(1,1)A(2,1)u_{1,t-1}u_{2,t-1} \\ & + A(2,1)^2u_{2,t-1}^2 \\ & + B(1,1)^2h_{1,t-1} + 2B(1,1)B(2,1)\sigma_{(1,2),t-1} + \\ & B(2,1)^2h_{2,t-1} \\ & + D(1,2)^2v_{1,t-1}^2 + 2D(1,1)D(2,1)v_{1,t-1}v_{2,t-1} + \\ & D(2,1)^2v_{2,t-1}^2 \end{aligned} \quad (5)$$

Variance of the i[th] Eurozone market

$$h_{2,t} = C(2,1)^2 + C(2,2)^2 + A(1,2)^2 u_{1,t-1}^2 + 2A(1,2)A(2,2)u_{1,t-1}u_{2,t-1} + A(2,2)^2 u_{2,t-1}^2 + B(1,2)^2 h_{1,t-1} + 2B(1,2)B(2,2)\sigma_{(1,2),t-1} + B(2,2)^2 h_{t-1} + D(1,2)^2 v_{1,t-1}^2 + 2D(1,2)D(2,2)v_{1,t-1}v_{2,t-1} + D(2,2)^2 v_{2,t-1}^2 \quad (6)$$

Covariance of the Euro and i[th] Eurozone equity markets

$$\sigma_{(1,2),t} = C(1,1)C(2,1) + A(1,1)A(1,2)u_{1,t-1}^2 + \big(A(1,2)A(2,1) + A(1,1)A(2,2)\big)u_{1,t-1}u_{2,t-1} + A(2,1)A(2,2)u_{2,t-1}^2 + B(1,1)B(1,2)h_{1,t-1} + \big(B(1,2)B(2,1) + B(1,1)B(2,2)\big)\sigma_{(1,2),t-1} + B(2,1)B(2,2)h_{1,t-1} + D(1,1)D(1,2)v_{1,t-1}^2 + \big(D(1,2)D(2,1) + D(1,1)D(2,2)\big)v_{1,t-1}v_{2,t-1} + D(2,1)D(2,2)v_{2,t-1}^2 \quad (7)$$

Under our ABEKK specification, the conditional covariance is estimated using equation 3. It is worth noting that the general equation dictates that the conditional covariance at time t depends on the conditional covariance and the product of the residuals multiplied by the inverse residuals at time t-1.However, the key point is the three $N(N+1)$ coefficient matrices and the raw coefficient matrices. These represent the constant, ARCH and GARCH coefficients in the ABEKK.

Of importance is the matrices A, B and D as highlighted in equation 4.Since we are only interested in the transmission between two markets, the key to the interpretation is the off-diagonal coefficients in all three

matrices. As intended by Engle & Kroner (1995), the key to interpreting the ABEKK lays in the three matrices coefficients: A,B and D. Furthermore, as hinted by Engle & Kroner (1995), these coefficients translate into the market shock and volatility transmissions from one market to the next. Put simply, as Kim *et al.* (2015) and MacDonald *et al.*, (2018) states the A matrix coefficient reflects the "*news contagion effect*" and the B matrix coefficient represents the "*volatility spillover effect*". Thus, meaning that a statistically significant value for $A(m,n)$ can be interpreted as the impact of news from market m onmarket n. In the same way, a statistically significant value in the $B(m,n)$ coefficient may be interpreted as the volatility spillover between markets m and n. As intended by Engle & Kroner (1995), the standard ABEKK implies that only the magnitude of the past returns is important in determining the current conditional covariance. Hence, we only need to use the magnitude of the A and B matrices coefficients to interpret the news and volatility spillover effects. Interestingly, the asymmetrical effect, matric D, could be interpreted as the impact of news from market m on the volatility of market n. In other words, a leverage effect is the transmission of bad news from market m to the volatility of market n. Since the leverage effect captures the transmission of bad news, it is logical to say that a positive asymmetrical effect could be interpreted as the transmission of good news from market m to the volatility of market n.

Specification of the multivariate volatility test

The coefficients of the ABEKK model of volatility are also key to our multivariate volatility test. It is essential to note that like Fakhry (2019), we use our volatility test to analyse whether the market is stable or volatile. As mentioned earlier in this section, we derive our stability test by using the f-statistics; for our observed samples, the f-statistics at the 5%

level is 1.96. We calculate our stability test statistics using equations 8 and 9 as the stability status of the transmission. Since as stated earlier, we are only interested in the transmission of volatility from the benchmark euro market to market n and vice-versa, thus we only used the off-diagonal matrices.

$$Stability\ Test_{Euro\rightarrow n} = \frac{(A_{Euro,n} + B_{Euro,n} + D_{Euro,n}) - 1}{sdev(var(Euro)) + sdev(var(n))} \leq Fstatistics \quad (8)$$

$$Stability\ Test_{Euro\leftarrow n} = \frac{(A_{n,Euro} + B_{n,Euro} + D_{n,Euro}) - 1}{sdev(var(Euro)) + sdev(var(n))} \leq Fstatistic \quad (9)$$

Like the univariate volatility test of Fakhry & Richter (2016a), our multivariate volatility test consists of three coefficients: A, B, and D matrices representing the news contagion, volatility spillover and asymmetrical effects. However, since we are analysing a multivariate model of volatility, we use a two-factor denominator representing the standard deviations of the euro benchmark and Eurozone markets.

Data description

Essentially, this paper analyses the stability of the integrated equity markets from the 11 original Eurozone members to establish the impact of key periods in the life of the euro on the Eurozone financial markets against a Eurozone benchmark market. Hence, we use daily prices from the 11 equity markets listed plus the EuroStoxx 50 as the benchmark equity market obtained from investing.com. As with the norm, we chose to use a five-day week filling the missing data with the last known prices. With the exception of the Portuguese PSI 20 index, all the 11 remaining markets were observed between 31st December 1997 and 31st

December 2018 meaning a total of 5,479 observations. However, the Portuguese PSI 20 index was observed from 4th January 1999 making a total of 5,216 observations.

Table 1. *Major Eurozone equity markets Indices*

Market	*Eurozone*	*Austria*	*Belgium*	*Finland*	*France*	*Germany*	*Greece*	*Ireland*	*Italy*	*Holland*	*Portugal*	*Spain*
Index	EuroStoxx 50	ATX	BEL 20	OMX H 25	CAC 50	DAX	ATHEX LC	ISEQ OA	MIB	AEX	PSI 20	IBEX 35

It must be noted that like all indices, the observed equity markets are based on weighted ratios of their component's prices. In common with many researches using the volatility test, such as Fakhry & Richter (2018), we used a modifier of 25 on the prices to overcome an issue with the variance calculations.

Empirical evidence

As hinted earlier, the key variables to our multivariate test of the stability in the Eurozone equity markets lay with the coefficients of the co-variance model and two standard deviation statistics. Essentially, this means the model of volatility is the key, we use a bi-variate ABEKK-MGARCH model. Thus, meaning we analyse the news contagious effect, volatility spillover effect and asymmetrical effect by interpreting the A, B and D matrices respectively. It is worth noting as stated earlier since we are only interested in the transmission effect from one market to the other market, we only report the off-diagonal matrices.

In estimating the models, we used the BFGS estimation method for all estimations. However, with the error distribution, we opted to use a mixture of normal and t-student distribution models to get the best estimation as illustrated by tables2 to 7. For all other options, we used the default settings. Crucially, the system environment may influence the estimation: our system is running Estima

WinRATS Pro (64-bit) 9.20e on a Windows 10 Pro computer with a 10 cores CPU and 32 Gigabytes RAM6F6F[4].

Pre-Euro

During the period immediately before the introduction of the euro, the markets were split between enthusiasm and nervousness about the introduction of the euro. As hinted by Cohen (2003), relatively few questioned the enthusiasm; indeed, many predicted a rosy future. However, the markets were still slightly apprehensive about the introduction of the euro as highlighted by Bates (1999) and as stated by McCauley & White (1997) there were still many uncertainties surrounding EMU. And as Feldstein (1997) hints the fear was that EMU would lead to disagreements among the member states as for the right policies for a given circumstance. The other key issue during this period was the uncertainty bought about by the Russian default and LTCM Crises during the latter half of 1998 see (Dungey *et al.*, 2007; Lowenstein, 2000).

As explained in the methodology, the A matrices pick up the transmission of news. Hence a statistically significant $A_{Euro,i}$ matrix would be interpreted as the impact of news from the EuroStoxx on the Eurozone equity markets and vice-versa. As illustrated by Table 2, with the exception of the ATX and AEX, during the immediate pre-euro period news from the EuroStoxx had a significant impact on all the Eurozone markets giving a ratio of 8:2. However, news from the Eurozone markets did not have a significant impact on the EuroStoxx with the exception of the ATX, CAC and AEX intimating a ratio of 3:7. The B matrices indicate the volatility spillover effect, hence a statistically significant $B_{Euro,i}$ would be interpreted as the transmission of volatility from the

[4] It is possible to have slightly different estimation results in different environments. However, the volatility tests should not be affected.

EuroStoxx to the Eurozone markets. Table 2 seem to be hinting at six Eurozone markets being affected by the transmission of volatility from the EuroStoxx: CAC, DAX, ATHEX, ISEQ, MIB and IBEX hinting at a ratio of 6:4. Conversely, the EuroStoxx was affected by volatility from four Eurozone markets: AIX, OMXH, ISEQ and AEX suggesting a ratio of 4:6. As defined in the methodology, the D matrices is the asymmetrical effect; thus, in short indicates whether the transmitted news is good or bad. The results from the immediate pre-euro period seem to be hinting at a 7:3 transmission of bad news from the EuroStoxx to the Eurozone markets (ATX, BEL, CAC, ATHEX, ISEQ, MIB and IBEX). Furthermore, there is a 2:8 transmission of bad news from the Eurozone markets to the EuroStoxx with only the OMXH and CAC. The stability status of the transmission between the EuroStoxx and Eurozone markets seem to be hinting at a ratio of 6:4 with four markets being volatile: ATX, MIB, AEX and IBEX. Whereas the stability status of the transmission from the Eurozone markets to EuroStoxx is hinting at a ratio of 7:3 with the ATX, OMXH and AEX being volatile.

Table 2. *Stability Test for Pre-Euro Period (07/01/1998 - 31/12/1998)*

Market i	*ATX*	*BEL 20*	*OMX H 25*	*CAC 40*	*DAX*	*ATHEX LC*	*ISEQ Overall*	*MIB*	*AEX*	*IBEX 35*
Distribution	t-Student	Normal	Normal	Normal	Normal	Normal	Normal	Normal	t-Student	Normal
Mean Statistics										
μ_{Euro}	8.2772E-02	7.1454E-02	7.5285E-02	8.4374E-02	8.6885E-02	8.2504E-02	9.1931E-02	5.9678E-02	8.7844E-02	7.9791E-02
	(7.551E-03)	(1.085E-02)	(6.321E-03)	(2.944E-05)	(8.532E-03)	(6.920E-03)	(8.534E-03)	(5.248E-03)	(7.382E-03)	(6.495E-03)
μ_i	9.0271E-03	3.8159E-02	1.7895E-02	1.4127E-01	2.5395E-01	4.2959E+00	1.5790E-01	2.7400E+00	2.1924E-03	1.1026E+00
	(1.235E-03)	(7.121E-03)	(1.365E-03)	(6.961E-03)	(3.660E-02)	(5.211E-01)	(1.711E-02)	(2.487E-01)	(1.656E-04)	(7.339E-02)
Off Diagonal Co-Variance Statistics										
$A_{Euro,\,i}$	7.8386E-03	1.1957E-01	1.0417E-01	3.5509E-01	1.9995E+00	9.8435E+00	3.6564E-01	7.0437E+00	-9.0920E-05	3.6220E+00
	(6.691E-03)	(3.438E-02)	(1.544E-02)	(1.062E-01)	(2.845E-01)	(2.447E+00)	(7.837E-02)	(1.307E+00)	(4.590E-03)	(5.703E-01)
$A_{i,\,Euro}$	4.4204E-01	5.7976E-02	-5.3502E-02	1.2466E-01	-2.1521E-03	2.9895E-04	-2.8240E-02	-1.5726E-04	8.8016E+00	1.1438E-02
	(3.532E-01)	(7.275E-02)	(1.074E-01)	(5.568E-02)	(3.091E-02)	(4.692E-04)	(2.454E-02)	(1.339E-03)	(4.672E+00)	(5.165E-03)
$B_{Euro,\,i}$	7.2789E-03	-1.5334E-02	6.4176E-02	1.0647E-01	-2.4874E+00	-2.1172E+01	-2.1927E-01	2.4303E+00	-3.7133E-03	-3.2495E+00
	(8.114E-03)	(5.060E-02)	(1.415E-02)	(1.880E-01)	(3.171E-01)	(4.358E+00)	(9.152E-02)	(1.975E+00)	(3.403E-03)	(1.039E+00)
$B_{i,\,Euro}$	-1.1902E+00	9.1726E-02	-4.1121E-01	-8.3653E-02	-3.3513E-02	-2.5386E-03	1.2321E-01	-1.8348E-04	-1.0063E+01	-4.1190E-02
	(3.986E-01)	(9.398E-02)	(1.493E-01)	(1.280E-01)	(4.135E-02)	(9.750E-04)	(3.076E-02)	(2.070E-03)	(2.933E+00)	(7.338E-03)
$D_{Euro,\,i}$	-1.0000E-08	-4.4191E-02	3.2120E-01	-3.8847E-01	8.6483E-02	-2.1540E-05	-5.4125E-01	-5.2347E+01	2.8721E-02	-1.5695E+01
	(1.385E-01)	(2.864E-01)	(1.040E-01)	(6.874E-01)	(3.474E+00)	(2.722E+01)	(6.648E-01)	(2.362E+01)	(1.687E-02)	(5.170E+00)
$D_{i,\,Euro}$	7.8000E-07	1.6633E+00	-1.7586E-01	-4.7382E-01	1.0721E-02	3.0000E-08	4.9852E-01	1.5029E-02	5.7256E+01	1.1236E-01
	(1.316E+01)	(9.374E-01)	(3.860E+00)	(1.945E-01)	(4.285E-01)	(6.368E-03)	(2.080E-01)	(1.192E-02)	(4.408E+01)	(2.875E-02)
Model Statistics										
Log-Likelihood	783.8487	387.0287	592.7830	318.7714	53.5277	-840.8711	2,079.6663	-567.2480	1,341.8880	-336.1376
Final Criterion	5.60E-06	6.80E-06	4.10E-06	0.00E+00	9.00E-06	8.90E-06	2.70E-06	9.50E-06	4.80E-06	6.70E-06
Co-integration Volatility Test										
σ^2_{Euro}	0.327011									
σ^2_i	0.045969	0.248090	0.086727	0.448785	1.003011	18.007491	0.709850	8.700593	0.009436	3.918915
Stability Test (Market$_{Euro}$→Market$_i$)										
Statistics $_{(Euro,\,i)}$	2.6406	1.6344	1.2338	1.1948	1.0537	0.6724	1.3453	4.8599	2.8982	3.8442
Status $_{(Euro,\,i)}$	Volatile	Stable	Stable	Stable	Stable	Stable	Stable	Volatile	Volatile	Volatile
Stability Test (Market$_{Euro}$←Market$_i$)										
Statistics $_{(i,\,Euro)}$	4.6871	1.4137	3.9653	1.8469	0.7706	0.0547	0.3921	0.1091	163.4568	0.2161
Status $_{(i,\,Euro)}$	Volatile	Stable	Volatile	Stable	Stable	Stable	Stable	Stable	Volatile	Stable

The introduction of the Euro

As highlighted earlier in the paper, the introduction of the euro bought about a phase of improved environment in the Eurozone financial markets as illustrated by (Danthine *et al.*, 2000; Trichet, 2001). However, as Galati &Tsatsaronis (2003) notes the impact was uneven across the spectrum of the Eurozone financial markets. Nevertheless, EMU did have a huge impact on the integration of the European financial markets, especially within the Eurozone as illustrated by (Fratzscher, 2001; Baele *et al.*, 2004; Lane & Walti, 2006).

On another note, the impact from other events should not be overlooked; especially the war on terror which was initiated by the September 2001 attacks see (Chen & Siems, 2004; Johnston & Nedelescu, 2006) and the accountancy issues of 2002 which led to the bankruptcy of Enron and WorldCom see (Benston & Hartgraves, 2002; Sidak, 2003; Brickey, 2002).

As illustrated by Table 3, the advent of the Euro reduced the impact of news from the EuroStoxx on the Eurozone markets to five markets: DAX, ATHEX, ISEQ, PSI and IBEX. However, the impact of news from the Eurozone markets on the EuroStoxx did increased to five markets: ATX, BEL, OMXH, CAC and AEX. Thus the ratio for both news routes is 5:6.

With the exception of the (ATX, BEL, OMXH AEX and PSI), there was volatility spillover effect between the EuroStoxx and Eurozone market meaning a volatility transmission ratio of 6:5. However, the volatility spillover effect from the Eurozone markets to the EuroStoxx was less significant with only four markets being affected: ATX, CAC, DAX and AEX; giving a ratio of 4:7.

The results seem to be hinting at the EuroStoxx transmitting bad news to six Eurozone markets: BEL, OMXH, CAC, DAX, MIB and AEX; thus indicating a ratio of 6:5. Conversely, the transmission of bad news to EuroStoxx

point to five Eurozone markets: BEL, DAX, ATHEX, AEX and IBEX giving a ratio of 5:6.

The stability status of the transmission between the EuroStoxx and Eurozone markets seem to be hinting at a ratio of 8:3 with three markets being volatile: ATX, CAC and AEX. Whereas the stability status of the transmission from the Eurozone markets to EuroStoxx is hinting at a ratio of 9:2 with only the ATX and AEX being volatile.

Table 3. *Stability Test for Euro Introductory Period (01/01/1999 - 11/03/2003)*

Market	*ATX*	*BEL 20*	*OMX H 25*	*CAC 40*	*DAX*	*ATHEX LC*	*ISEQ Overall*	*MIB*	*AEX*	*PSI 20*	*IBEX 35*
Distribution	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	GED	t-Student	Normal
Mean Statistics											
μ_{Euro}	1.8252E-01	1.4888E-01	1.4110E-01	1.5519E-01	1.5313E-01	1.8019E-01	1.6551E-01	1.3417E-01	1.3906E-01	1.5414E-01	1.5393E-01
	(7.867E-03)	(6.998E-03)	(7.656E-03)	(7.554E-03)	(4.139E-03)	(9.692E-03)	(6.451E-03)	(6.953E-03)	(6.565E-03)	(5.883E-03)	(7.585E-03)
μ_i	4.6904E-03	2.6802E-02	1.3354E-02	2.1369E-01	3.5177E-01	1.1734E+00	1.1992E-01	1.4151E+00	2.2808E-03	2.9903E-01	7.5780E-01
	(2.440E-06)	(2.350E-03)	(1.396E-03)	(1.139E-02)	(6.991E-04)	(7.584E-02)	(9.560E-05)	(9.810E-02)	(1.298E-04)	(1.655E-02)	(3.360E-02)
Off Diagonal Co-Variance Statistics											
$A_{Euro,\,i}$	4.7540E-03	1.8235E-02	-5.3600E-03	-8.5587E-02	4.6463E-01	3.3138E-01	1.8626E-01	8.1012E-02	2.5535E-03	2.2861E-01	1.7249E-01
	(5.859E-04)	(6.076E-03)	(3.339E-03)	(8.764E-02)	(8.680E-02)	(1.975E-01)	(2.020E-02)	(3.579E-01)	(5.108E-04)	(5.895E-02)	(1.279E-01)
$A_{i,\,Euro}$	2.0066E+00	5.2074E-01	3.5355E-01	1.4034E-01	3.0446E-02	4.2181E-04	4.6515E-02	1.8756E-02	6.0038E+00	1.7293E-02	2.9867E-02
	(4.803E-01)	(6.693E-02)	(3.447E-02)	(3.868E-02)	(1.477E-02)	(2.306E-04)	(1.342E-02)	(2.958E-03)	(2.288E+00)	(4.728E-03)	(5.768E-03)
$B_{Euro,\,i}$	-4.6450E-03	-9.2278E-04	1.3913E-02	-9.1728E-01	4.8271E-01	-3.5863E-01	-1.2253E-01	1.8753E+00	1.8722E-03	-9.2672E-03	-1.5536E+00
	(1.178E-03)	(8.106E-03)	(4.359E-03)	(1.292E-01)	(1.078E-01)	(3.531E-01)	(5.028E-02)	(7.457E-01)	(6.672E-04)	(6.524E-02)	(2.651E-01)
$B_{i,\,Euro}$	2.7084E+00	5.0942E-02	-9.3450E-02	2.6438E-01	-1.0712E-01	2.7433E-04	4.7274E-02	-2.3768E-03	-3.6474E+01	8.8741E-03	9.8045E-03
	(7.156E-01)	(7.082E-02)	(3.050E-02)	(5.818E-02)	(3.467E-02)	(2.337E-04)	(2.595E-02)	(4.772E-03)	(2.438E+00)	(6.050E-03)	(8.634E-03)
$D_{Euro,\,i}$	2.6443E-02	-5.8937E-05	-5.0000E-09	-4.7228E-01	-1.1603E+00	1.1339E+01	1.2842E+00	-5.1636E+00	-3.1791E-03	1.9384E+00	6.1840E+00
	(6.750E-03)	(3.144E-01)	(6.113E-02)	(6.798E-01)	(7.285E-01)	(2.628E+00)	(1.628E-01)	(3.550E+00)	(3.604E-03)	(9.347E-01)	(9.942E-01)
$D_{i,\,Euro}$	3.1656E+01	-1.5430E-03	1.2500E-07	1.2236E-01	-2.2348E-02	-7.0240E-02	3.5434E-01	2.4081E-03	-5.1675E+01	3.2060E-01	-6.1823E-02
	(5.756E+00)	(8.231E+00)	(1.534E+00)	(2.386E-01)	(1.455E-01)	(2.399E-02)	(2.623E-01)	(2.070E-02)	(1.432E+01)	(2.116E-01)	(5.292E-02)
Model Statistics											
Log-Likelihood	3,587.0507	1,144.9582	1,202.1530	492.5994	-320.1671	-3,933.0375	-55.2916	-2,299.9445	5,302.0649	-965.6877	-1,485.9866
Final Criterion	0.00E+00	0.00E+00	2.00E-07	2.90E-06	0.00E+00	7.20E-06	0.00E+00	1.80E-06	8.00E-06	1.70E-06	3.10E-06
Co-integration Volatility Test											
σ^2_{Euro}	0.406660										
σ^2_{Market}	0.015024	0.218365	0.340313	0.642757	0.861218	33.759090	0.585550	5.335929	0.007623	2.250696	2.319631
Stability Test (Market$_{Euro}$→Market$_i$)											
Statistics	2.3085	1.5723	1.3273	2.3586	0.9567	0.3018	0.3506	0.7326	2.4108	0.4357	1.3949
Status	Volatile	Stable	Stable	Volatile	Stable	Stable	Stable	Stable	Volatile	Stable	Stable
Stability Test (Market$_{Euro}$←Market$_i$)											
Statistics	83.8807	0.6877	0.9905	0.4507	0.8668	0.0313	0.5562	0.1709	200.6969	0.2458	0.3749
Status	Volatile	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Volatile	Stable	Stable

Note: PSI 20 start 11/01/1999

Mid 2000s Global bull market

In accordance with Pagan & Sossounov (2003), we set a trend to be a financial market period of four or more month. Thus, allowing us to identify the mid-2000s global bull equity market to be between March 2003 and October 2007 using the monthly MCSI World index obtained from investing.com. Furthermore, this observation seems to match the trend in the monthly EuroStoxx 50 index as illustrated by Figure 1.

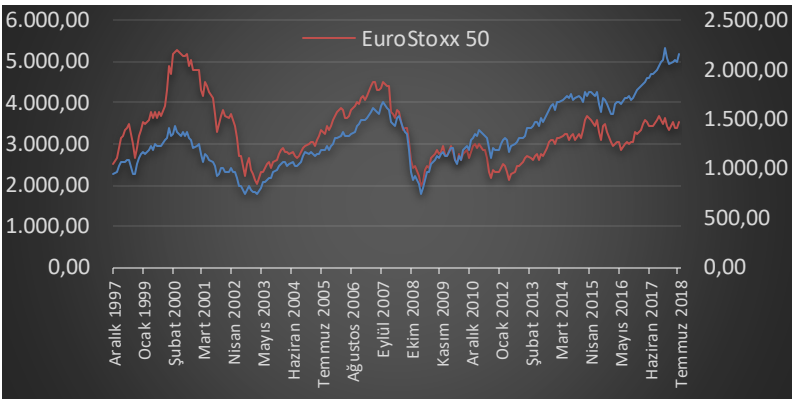

Figure 1. *Trends in Global and Eurozone Equities Markets*

However, another key factor shaping the financial markets in the mid-2000s was the housing bubble primarily in the US which started in 2002 according to Baker (2008). This led to the increase in Mortgage Backed Securities and Collateralized Debt Obligationas hinted by Masood (2009). As hinted by Fender & Kiff (2004), these securities were by their nature complicated to understand and rate. Furthermore, according to Masood (2009), these securities included subprime mortgages which offered a high positive spread with respect to the yields offered by most governments' bonds mainly due to the inherent high risks.

In addition, as highlighted previously, the continuation of "war on terror" was a key issue with the invasion of

Afghanistan and Iraq as illustrated by (Johnston & Nedelescu, 2006; Fernandez, 2008).

During the mid-2000s global bull market, news from the EuroStoxx impacted only three Eurozone markets: CAC, ATHEX and IBEX as noted by Table 4. Furthermore, news from only four Eurozone markets had an impact on the EuroStoxx: ATX, BEL, OMXH and AEX. Therefore giving ratios 3:8 and 4:7 respectively.

With the exception of the (ATX, OMXH AEX and PSI), there was volatility spillover effect between the EuroStoxx and Eurozone markets indicating a ratio of 7:4. However, there was a volatility spillover effect from five Eurozone markets to the EuroStoxx: BEL, OMXH, CAC, ISEQ and AEX. This would hint at a ratio of 5:6.

The results seem to be hinting at the EuroStoxx transmitting bad news to three Eurozone markets: OMXH, AEX and IBEX. Conversely, the transmission of bad news to EuroStoxx point to four Eurozone markets: OMXH, DAX, PSI and IBEX. Moreover hinting at ratios of 3:8 and 4:7 respectively.

The stability status of the transmission between the EuroStoxx and Eurozone markets seem to be hinting at a ratio of 6:5 with five markets being volatile: BEL, OMXH, DAX, AEX and IBEX. Yet, the stability status of the transmission from the Eurozone markets to EuroStoxx is hinting at a ratio of 5:6 with the ATX, OMXH, CAC, DAX, AEX and PSI being volatile.

Table 4. *Stability Test for Mid-2000s Global Bull Market Period (12/03/2003 - 07/06/2007)*

Market	*ATX*	*BEL 20*	*OMX H 25*	*CAC 40*	*DAX*	*ATHEX LC*	*ISEQ Overall*	*MIB*	*AEX*	*PSI 20*	*IBEX 35*
Distribution	Normal	Normal	Normal	t-Student	Normal	Normal	Normal	t-Student	t-Student	Normal	t-Student
Mean Statistics											
μ_{Euro}	2.8179E-02	2.5382E-02	2.5183E-02	2.5341E-02	2.4339E-02	3.1600E-02	3.9000E-02	1.7084E-02	2.3764E-02	3.6367E-02	2.4057E-02
	(1.699E-03)	(1.410E-03)	(1.536E-03)	(1.057E-03)	(1.400E-03)	(1.954E-03)	(1.733E-03)	(8.304E-04)	(9.356E-04)	(1.651E-03)	(1.046E-03)
μ_i	8.7332E-03	1.0806E-02	7.9069E-03	4.4584E-02	6.4174E-02	9.7231E-01	8.1666E-02	1.0390E+00	3.6375E-04	4.5643E-02	1.7456E-01
	(6.749E-04)	(4.482E-05)	(5.228E-04)	(1.823E-03)	(3.484E-03)	(8.125E-02)	(3.580E-03)	(5.560E-02)	(1.396E-05)	(3.409E-03)	(7.162E-03)
Off Diagonal Co-Variance Statistics											
$A_{Euro,i}$	8.4322E-03	7.1397E-02	2.4996E-03	1.3745E-01	8.3948E-02	1.2917E+00	6.2738E-03	-3.7205E-04	2.2310E-03	1.0155E-02	3.8146E-01
	(4.068E-03)	(2.509E-02)	(7.366E-03)	(1.593E-01)	(9.174E-02)	(5.074E-01)	(4.511E-02)	(8.567E-01)	(8.160E-04)	(3.699E-02)	(2.694E-01)
$A_{i,Euro}$	1.6481E-01	3.9793E-01	3.4202E-01	6.5284E-02	6.1610E-02	2.9739E-03	-7.8290E-03	-1.0430E-05	4.7370E+00	2.4023E-02	-1.1681E-03
	(1.417E-02)	(4.434E-02)	(4.564E-02)	(5.524E-02)	(1.463E-02)	(4.129E-04)	(4.685E-03)	(3.940E-06)	(2.512E+00)	(5.122E-03)	(2.718E-03)
$B_{Euro,i}$	4.0547E-03	-2.8218E-01	-6.1637E-02	5.6985E-01	-2.0216E-01	6.5935E-01	-2.4951E-01	-3.7671E-01	-1.5034E-03	2.6707E-02	-5.5080E-01
	(4.930E-03)	(5.596E-02)	(7.153E-03)	(1.688E-01)	(1.428E-01)	(6.011E-01)	(6.414E-02)	(3.408E-01)	(1.391E-03)	(3.377E-02)	(3.018E-01)
$B_{i,Euro}$	5.0791E-02	4.9401E-01	2.3582E-01	-2.2975E-01	-1.4657E-02	-8.4500E-06	1.2306E-01	-6.3000E-07	7.4661E+00	7.1277E-03	8.7852E-03
	(1.209E-02)	(1.209E-01)	(5.493E-02)	(6.086E-02)	(2.810E-02)	(4.258E-04)	(4.675E-03)	(1.680E-06)	(4.293E+00)	(4.590E-03)	(4.031E-03)
$D_{Euro,i}$	7.6479E-01	3.4302E-01	-2.0205E-02	9.4788E-01	1.3840E-06	8.4700E-06	1.6924E+00	9.4636E+01	-6.5039E-03	3.2132E-02	-4.8602E+00
	(1.027E-01)	(2.086E-01)	(1.566E-01)	(1.051E+00)	(9.515E-01)	(1.140E+01)	(3.758E-01)	(6.180E+01)	(1.148E-02)	(4.763E-01)	(5.422E+00)
$D_{i,Euro}$	4.7651E+00	5.2221E-01	-1.5219E+00	2.5993E-01	-2.4000E-08	0.0000E+00	1.9882E-01	1.1085E-02	6.7994E+00	-3.8397E-01	-1.5832E-02
	(9.462E-01)	(8.853E-01)	(1.027E+00)	(3.249E-01)	(1.676E-01)	(8.738E-03)	(8.170E-02)	(1.277E-02)	(3.035E+01)	(2.041E-01)	(4.284E-02)
Model Statistics											
Log-Likelihood	3,430.6909	3,971.7453	4,429.3204	4,379.5326	3,220.4664	-948.3656	1,743.7585	-403.4603	9,147.5749	1,824.7063	1,958.1198
Final Criterion	6.00E-07	9.10E-06	6.40E-06	8.50E-06	2.90E-06	3.20E-06	4.10E-06	3.70E-06	7.00E-07	2.10E-06	1.30E-06
Co-integration Volatility Test											
σ^2_{Euro}	0.125478										
σ^2_{Market}	0.254822	0.129432	0.069595	0.226895	0.295208	6.676128	0.688531	377.490365	0.002580	0.515531	1.147335
Stability Test (Market$_{Euro}$→Market$_i$)											
Statistics	0.5856	3.4042	5.5330	1.8593	2.6581	0.1398	0.5518	0.2470	7.8541	1.4524	4.7372
Status	Stable	Volatile	Volatile	Stable	Volatile	Stable	Stable	Stable	Volatile	Stable	Volatile
Stability Test (Market$_{Euro}$←Market$_i$)											
Statistics	10.4671	1.6247	9.9658	2.5670	2.2655	0.1466	0.8427	0.0026	140.5812	2.1104	0.7921
Status	Volatile	Stable	Volatile	Volatile	Volatile	Stable	Stable	Stable	Volatile	Volatile	Stable

Global financial crises

The global financial crisis started with the subprime mortgages in the US and quickly enveloped the global financial sector. By mid-2007, a number of international banks (e.g. Bear Stearns and BNP Paribas) recorded losses on their off-balance sheet activities associated with the MBS or CDO securities, which resulted in flights to liquidity and quality. This quickly enveloped the global financial sector including many European banks such as Credit Agricole and Deutsche Bank. As the global financial crisis spread, the credit market froze therefore corporations could not find the money required and hence the crisis spread to the equity and corporate bonds market. For further in-depth research and analysis on the crises see (Brunnermeier, 2009; Caballero & Krishnamurthy, 2009; Masood, 2009) amongst others. Conversely, it is important to analyse the equity market during the global financial crisis. A by-product of such a global financial crisis is the inevitable deep recession which for the Eurozone was between 2008 Q1 and 2009 Q2, however some countries in the Eurozone were affected more than others i.e. the GIPS nations.

During the global financial crisis, with the exceptions of three markets (BEL, ISEQ and AEX); news from EuroStoxx impacted the Eurozone markets as Table 5 points. Yet, news from only two Eurozone markets had an impact on the EuroStoxx: BEL and AEX. Hence indicating ratios of 8:3 and 2:9 respectively.

With the exception of the (DAX and AEX), there was volatility spillover effect between the EuroStoxx and Eurozone markets indicating a ratio of 9:2. However, there was a volatility spillover effect from four Eurozone markets to the EuroStoxx: BEL, OMXH, CAC and AEX. Therefore giving a ratio of 4:7.

The results seem to be hinting at the EuroStoxx transmitting bad news to two Eurozone markets: OMXH and

ATHEX meaning a ratio of 2:9. Conversely, the transmission of bad news to EuroStoxx point to four Eurozone markets: BEL, DAX, ISEQ and PSI hinting at a 4:7 ratio.

Table 5. *Stability Test for Global Financial Crises Period (08/06/2007 - 05/11/2009)*

Market	*ATX*	*BEL 20*	*OMX H 25*	*CAC 40*	*DAX*	*ATHEX LC*	*ISEQ Overall*	*MIB*	*AEX*	*PSI 20*	*IBEX 35*
Distribution	Normal	Normal	Normal	Normal	Normal	Normal	Normal	GED	t-Student	Normal	t-Student
					Mean Statistics						
μ_{Euro}	1.0306E-01	9.3310E-02	1.1560E-01	9.2224E-02	9.9391E-02	1.1885E-01	9.1467E-02	7.9555E-02	8.2856E-02	1.1402E-01	8.3285E-02
	(1.051E-02)	(6.749E-03)	(6.117E-03)	(7.933E-03)	(1.209E-04)	(6.056E-03)	(6.809E-03)	(7.591E-03)	(4.614E-03)	(5.490E-03)	(4.383E-03)
μ_i	1.3520E-01	4.5951E-02	8.1944E-02	1.6728E-01	3.8709E-01	4.0273E+00	1.2301E-01	6.3790E+00	9.1593E-04	4.2448E-01	1.1301E+00
	(1.640E-02)	(5.042E-03)	(4.351E-03)	(1.306E-02)	(8.073E-03)	(7.344E-03)	(1.263E-02)	(4.612E-01)	(4.941E-05)	(2.449E-02)	(6.337E-02)
					Off Diagonal Co-Variance Statistics						
$A_{Euro,\,i}$	1.6405E-01	-2.6559E-02	1.2682E-01	1.4315E-01	4.8452E-01	3.5128E+00	6.2091E-02	6.0859E+00	1.0901E-04	1.0367E-01	1.4484E+00
	(6.181E-02)	(3.285E-02)	(2.691E-02)	(1.979E-01)	(6.311E-02)	(1.102E+00)	(9.051E-02)	(5.146E+00)	(9.727E-04)	(2.140E-01)	(7.615E-01)
$A_{i,\,Euro}$	7.6418E-02	2.0537E-01	-3.3607E-02	6.7159E-02	1.1676E-02	2.2338E-03	2.5186E-02	1.9633E-03	9.6908E+00	1.9035E-02	1.0073E-02
	(2.577E-02)	(3.590E-02)	(6.888E-02)	(5.052E-02)	(6.375E-03)	(5.879E-04)	(4.321E-03)	(8.036E-04)	(2.848E+00)	(4.017E-03)	(4.660E-03)
$B_{Euro,\,i}$	1.9014E-01	3.6701E-01	-1.5753E-01	-2.5126E+00	-3.3933E-02	1.4576E+00	2.2907E-01	-2.8125E+01	1.6861E-03	2.2507E+00	-2.2166E+00
	(3.335E-01)	(6.256E-02)	(2.863E-02)	(1.846E-01)	(3.272E-01)	(1.561E+00)	(1.152E-01)	(7.401E+00)	(9.355E-04)	(3.333E-01)	(9.632E-01)
$B_{i,\,Euro}$	-9.9805E-02	-3.3214E-01	2.5727E-01	6.5892E-01	-7.3459E-02	-1.7825E-03	-4.1211E-03	8.0086E-03	-5.4876E-01	-4.0419E-02	1.7872E-02
	(1.200E-01)	(4.762E-02)	(9.630E-02)	(6.167E-02)	(1.806E-02)	(8.737E-04)	(3.599E-03)	(7.816E-04)	(3.406E+00)	(4.894E-03)	(6.184E-03)
$D_{Euro,\,i}$	4.2000E-08	4.3180E-01	-3.4880E-01	6.1678E-01	9.6932E-01	-3.6223E+01	2.2373E+00	2.9644E+01	1.7578E-02	1.6400E-07	1.0852E+01
	(3.133E-01)	(2.684E-01)	(2.116E-01)	(6.747E-01)	(1.293E+00)	(8.189E+00)	(9.615E-01)	(3.359E+01)	(6.357E-03)	(1.115E+00)	(5.358E+00)
$D_{i,\,Euro}$	5.6000E-07	-3.2998E-02	1.4771E+00	1.4696E-01	-3.4274E-01	2.0133E-02	-7.5545E-01	2.9785E-03	2.0524E+01	-1.1000E-08	6.8087E-02
	(2.595E-01)	(5.810E-01)	(2.993E-01)	(2.590E-01)	(7.854E-02)	(6.933E-03)	(2.929E-01)	(4.941E-03)	(7.114E+01)	(1.003E-01)	(2.485E-02)
					Model Statistics						
Log-Likelihood	300.6691	742.1833	931.2756	798.1102	264.2771	-1,865.7951	-377.1802	-1,786.5661	3,652.2827	-591.0954	-621.9875
Final Criterion	4.10E-06	8.90E-06	8.60E-06	2.30E-06	0.00E+00	3.70E-06	2.80E-06	9.00E-06	3.30E-06	3.00E-06	0.00E+00
					Co-integration Volatility Test						
σ^2_{Euro}	0.452223										
σ^2_{Market}	0.630372	0.419485	0.190188	0.744926	1.633878	17.450001	1.692385	29.480684	0.006635	3.083772	6.090440
					Stability Test (Market$_{Euro}$→Market$_i$)						
Statistics	0.5965	0.2613	2.1474	2.2993	0.2013	1.8016	0.7127	0.2207	2.1371	0.3830	1.3884
Status	Stable	Stable	Volatile	Volatile	Stable	Stable	Stable	Stable	Volatile	Stable	Stable
					Stability Test (Market$_{Euro}$←Market$_i$)						
Statistics	0.9453	1.3305	1.0909	0.1061	0.6733	0.0547	0.8087	0.0330	62.4718	0.2889	0.1382
Status	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Volatile	Stable	Stable

The stability status of the transmission between the EuroStoxx and Eurozone markets seem to be hinting at a ratio of 8:3 with three markets being volatile: OMXH, CAC and AEX, Conversely, the stability status of the transmission from the Eurozone markets to EuroStoxx is hinting at a ratio of 10:1 with only the AEX being volatile.

Sovereign debt crisis

The sovereign debt crisis started with the Greek revision of the deficit statistics on 5th November 2009, gradually becoming a wide spread issue of confident in global fiscal policies enveloping a number of Eurozone nations especially the GIPS nations as illustrated by (Schwarcz, 2011; Metiu, 2011; Mohl & Sondermann, 2013). The crisis reached the US with the deficit/debt ceiling crises which closed the US federal government, see (Aye *et al.*, 2016; Nippani & Smith, 2014). The impact from the sovereign debt crisis led to a double dip recession in the Eurozone from 2011 Q3 to 2013 Q1, although for some Eurozone countries this was just a continuation of the recession that followed the global financial crisis.

During the sovereign debt crisis, news from EuroStoxx impacted eight Eurozone markets; with the exception of the BEL, ISEQ and AEX, every Eurozone market was affected as hinted by Table 6. Yet, news from only two Eurozone markets had an impact on the EuroStoxx: BEL and AEX. Surprisingly, the news transmission did not involve the GIPS markets. However, the ratios do tell a varied story with 8:3 and 2:9 respectively.

With the exception of the AEX and PSI, there was volatility spillover effect between the EuroStoxx and Eurozone markets indicating a ratio of 9:2. However, there was a volatility spillover effect from five Eurozone markets to the EuroStoxx: ATX, BEL, OMXH, CAC and AEX. Thus meaning a ratio of 5:6.

The results seem to be hinting at the EuroStoxx transmitting bad news to five Eurozone markets: ATX, OMXH, CAC, ISEQ and PSI. Conversely, there was transmission of bad news to EuroStoxx from the OMXH, CAC, DAX and ATHEX markets. This seem to be indicating ratios of 5:6 and 4:7 respectively.

The stability status of the transmission between the EuroStoxx and Eurozone markets seem to be hinting at a ratio of 3:8 with eight markets being volatile: ATX, BEL, OMXH, CAC, ISEQ, AEX, PSI and IBEX. Conversely, the stability status of the transmission from the Eurozone markets to EuroStoxx is hinting at a ratio of 8:3 with the OMXH, CAC and AEX being volatile.

Table 6. *Stability Test for Eurozone Sovereign Debt Crises Period (06/11/2009 - 23/05/2014)*

Market	*ATX*	*BEL 20*	*OMX H 25*	*CAC 40*	*DAX*	*ATHEX LC*	*ISEQ Overal.*	*MIB*	*AEX*	*PSI 20*	*IBEX 35*
Distribution	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Mean Statistics											
μ_{Euro}	4.2214E-02	4.3411E-02	4.4181E-02	4.0793E-02	3.7419E-02	4.5479E-02	4.6584E-02	3.8975E-02	3.8686E-02	4.4333E-02	4.4682E-02
	(7.597E-05)	(1.916E-03)	(2.037E-03)	(1.758E-03)	(1.746E-03)	(2.039E-03)	(2.130E-03)	(1.764E-03)	(1.848E-03)	(2.000E-03)	(1.820E-03)
μ_i	4.1706E-02	2.6321E-02	3.8216E-02	7.5143E-02	2.3663E-01	3.4170E-01	5.7336E-02	2.5418E+00	4.1851E-04	1.6396E-01	6.3992E-01
	(1.538E-03)	(1.307E-03)	(1.789E-03)	(3.302E-03)	(1.213E-02)	(1.689E-02)	(2.833E-03)	(1.091E-01)	(2.246E-05)	(1.215E-02)	(2.675E-02)
Off Diagonal Co-Variance Statistics											
$A_{Euro,\,i}$	1.0900E-01	3.6479E-02	1.0474E-01	2.0161E-01	5.2311E-01	7.8490E-01	7.2979E-02	1.3068E+00	1.1437E-03	6.7880E-01	-9.5931E-01
	(2.443E-02)	(2.921E-02)	(2.035E-02)	(1.406E-01)	(1.469E-01)	(1.349E-01)	(2.385E-02)	(2.028E+00)	(3.746E-04)	(1.158E-01)	(5.145E-01)
$A_{i,\,Euro}$	9.8249E-02	1.8070E-01	7.9670E-02	9.1798E-02	1.0966E-03	2.2790E-03	4.8118E-02	3.1065E-03	7.7313E+00	2.7663E-02	1.2245E-02
	(2.704E-02)	(5.300E-02)	(2.756E-02)	(4.066E-02)	(4.932E-03)	(6.294E-04)	(1.413E-02)	(4.503E-04)	(3.281E+00)	(2.945E-03)	(1.613E-03)
$B_{Euro,\,i}$	-2.7845E-01	-2.3045E-01	-2.5995E-01	-5.7131E-01	-1.5299E-01	-8.0178E-01	-2.2053E-01	-1.6886E+01	-3.1681E-04	5.0368E-02	1.1253E+01
	(4.339E-02)	(6.853E-02)	(2.800E-02)	(2.026E-01)	(1.541E-01)	(1.934E-01)	(3.398E-02)	(5.171E+00)	(6.616E-04)	(1.721E-01)	(8.378E-01)
$B_{i,\,Euro}$	2.0417E-01	4.8208E-01	-1.3146E-01	-1.5341E-01	9.0305E-03	1.5469E-03	2.0764E-02	2.2508E-03	1.3918E+01	7.4351E-03	-2.4606E-02
	(4.275E-02)	(1.589E-01)	(0.000E+00	(6.510E-02)	(4.775E-03)	(6.042E-04)	(2.060E-02)	(1.467E-03)	(4.377E+00)	(3.696E-03)	(2.920E-03)
$D_{Euro,\,i}$	-2.8138E-01	7.3576E-02	-1.6930E-0(	-5.1480E-06	2.1350E-06	2.1350E-06	-1.7266E-01	2.5327E+01	0.0000E+00	-3.9973E+00	3.9239E-01
	(2.450E-01)	(1.813E-01)	(1.607E-01)	(7.397E-01)	(1.151E+00)	(1.151E+00)	(2.825E-01)	(1.449E+01)	(2.811E-03)	(1.175E+00)	(1.983E+01)
$D_{i,\,Euro}$	1.0298E+00	5.0410E-01	-2.9590E-0(	-3.4610E-05	-1.1000E-07	-1.1000E-07	5.0595E-01	1.5599E-02	2.9000E-07	1.1728E-02	1.5643E-03
	(1.603E-01)	(6.086E-01)	(2.612E-01)	(3.537E-01)	(3.188E-02)	(3.188E-02)	(1.979E-01)	(3.061E-03)	(2.944E+01)	(6.312E-02)	(8.010E-02)
Model Statistics											
Log-Likelihood	3,260.4049	4,034.0831	3,431.8634	3,571.6650	1,365.2570	-349.4377	2,686.5624	-1,375.5705	8,904.9819	764.7998	109.0727
Final Criterion	1.60E-06	1.70E-06	2.00E-06	0.00E+00	9.00E-07	5.10E-06	6.70E-06	4.60E-06	1.20E-06	7.20E-06	6.90E-06
Co-integration Volatility Test											
σ^2_{Euro}	0.162061										
σ^2_{Market}	0.173969	0.111005	0.120255	0.296825	1.044217	4.723441	0.203134	10.875993	0.001786	1.179788	3.082813
Stability Test (Market$_{Euro}$→Market$_i$)											
Statistics	4.3176	4.1030	4.0919	2.9848	0.5222	0.2081	3.6151	0.7926	6.0982	3.1808	2.9849
Status	Volatile	Volatile	Volatile	Volatile	Stable	Stable	Volatile	Stable	Volatile	Volatile	Volatile
Stability Test (Market$_{Euro}$←Market$_i$)											
Statistics	0.9885	0.6112	3.7256	2.3135	0.8206	0.2039	1.1642	0.0887	126.0313	0.7103	0.3115
Status	Stable	Stable	Volatile	Volatile	Stable	Stable	Stable	Stable	Volatile	Stable	Stable

Rise of populist movement

A key issue facing any further integration of the Eurozone is the rise of the populist right-wing movement. As hinted by Weyland (2001), traditionally populism has been defined as a cumulative concept, characterized by the simultaneous presence of political, economic, social, and discursive attributes. However, as hinted by a number of articles including (Mudde, 2004; Mudde & Kaltwasser, 2013; Jansen, 2011) populism is difficult to define. Indeed, as with any ism word it is hard to conceptualised as stated by Jansen (2011) leading to Mudde (2004, p.542) to state the following" *Defining the Undefinable*". Many authors have used different definition depending on their writings. Mudde (2004) defines populism as

> "an ideology that considers society to be ultimately separated into two homogeneous and antagonistic groups, 'the pure people' versus 'the corrupt elite', and which argues that politics should be an expression of the volonté générale (general will) of the people."

Whichever definition you used, the rise of the populist movement is seen as a threat to the further integration of the EU and Eurozone economies and financial markets as hinted by Polyakova & Fligstein (2016), Fligstein *et al.*, (2012), Guiso *et al.*, (2018) and Luo (2017). The underlying influences of the Brexit results and prospective Italexit have been attributed to the populist movement in both the UK and Italy caused by deep issues as illustrated by (Inglehart & Norris, 2016; Hobolt, 2016; Codogno & Galli, 2017). In particular as the Franco-German axis is the driving force behind European integration, the rise in popularity and strength of National Rally (an anti-Integration party) in France would be seen as a weakness in the future push to further integration. And as put by Luo (2017, p.407) "*The growth of Eurosceptism in major EU members thus has resulted in political instability to European*

integration." Moreover, as implied by Luo (2017), the European Parliament elections in May 2014 was a watershed event for this rise. Although, many like Mudde[5] and Mudde (2016), disagree with the significant of the 2014 European Parliament elections. Yet we use the day after the 2014 European Parliament elections, 26 May 2014, as the start date of our observation.

Furthermore, the continued impact of the Brexit vote on the Eurozone equity markets as the UK and EU struggle to get a workable agreement that would suit both sides and more importantly get approval from both parliaments. According to Hobolt (2016), in the wake of the 23 June 2016 Brexit vote global equity markets loss over two trillion dollars. The reaction on 24th June 2016 of the Eurozone equity markets illustrated the shock wave to the Brexit vote as shown by Figure 2. With the exception of Finland, the losses were greater than 5% meaning an average of 8.17% across all 12 observed Eurozone equity markets. With the current draft agreement[6] in the balance, the continued disfunction at the heart of the British government look likely to negatively impact on the global and hence the Eurozone equity markets in the short run.

Moreover, an additional impact on the integration of the Eurozone came on 1st October 2017 when Catalonia held a referendum on independence from Spain as highlighted by Cetra & Lineira (2018). According to Cetra & Lineira (2018), the turnout was only 43% resulting in a 90.2% vote for independence against 7.8%. The Spanish government declared the referendum illegal. However, as stated by Cetra & Lineira (2018), this was not the only bid for independence

[5] In an article to the Washington Post on 30/05/2014 titled "The far right in the 2014 European Elections: of earthquakes, cartels and designer fascists."

[6] The draft agreement document number TF50 (2018) 55 agreed on 14 November 2018. the agreement could be accessed on [Retrieved from].

within the European Union, in 2014 the UK government agreed a referendum on Scottish independence. The turnout was 99.91% resulting in a 55.3% win for the unionists. However, as argued by Cetra & Lineira (2018), with the Brexit results many in Scotland feel there is a need to hold a new referendum. Furthermore, according to Cetra & Lineira (2018), there are other regions within the EU and in particular the Eurozone who are calling for independence.

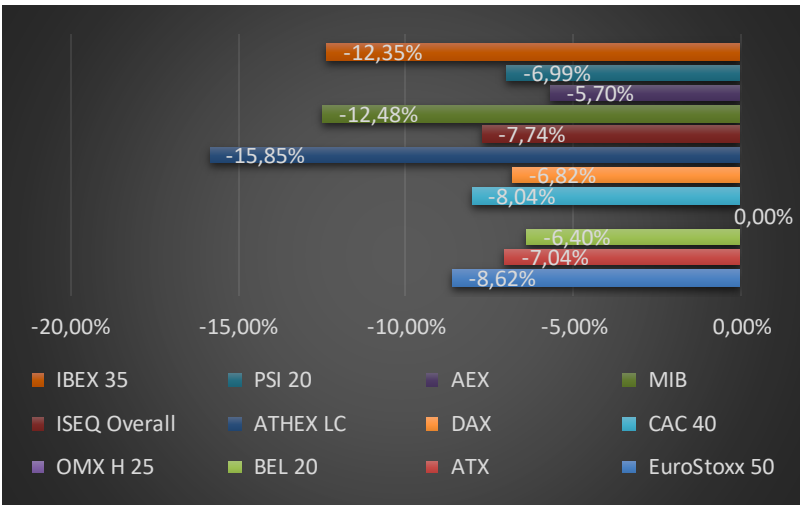

Figure 2. *Impact of Brexit Vote on the Eurozone Equity Markets on 24 June 2016*

Table 7 seem to be hinting at news from the EuroStoxx effecting seven markets during this period with the exception of the ATX, BEL, ATHEX and AEX, all the markets were effected. However, the news from only two markets, BEL and AEX, did have an impact on the EuroStoxx. Thus resulting in ratios of 7:4 and 2:9 respectively.

With the exception of four markets: ATX, BEL, OMXH and AEX; there was a volatility spillover effect between the EuroStoxx and Eurozone markets hinting at a ratio of 7:4. However, the transmission of volatility between the

Eurozone markets and EuroStoxx impacted five markets: BEL, OMXH, CAC, ATHEX and AEX. Hence, the ratio was 5:6.

The statistics indicate a ratio of 7:4 effected by negative news from the EuroStoxx with the exceptions being the ATX, OMXH, ATHEX and PSI. With the exception of three Eurozone markets: OMXH, MIB and AEX; the EuroStoxx was effected by the transmission of negative news which gives a ratio of 8:3.

The stability status of the transmission between the EuroStoxx and Eurozone markets seem to be hinting at a ratio of 7:4 with seven markets being volatile: ATX, BEL, OMXH, CAC, DAX, MIB and AEX. Conversely, the stability status of the transmission from the Eurozone markets to EuroStoxx is hinting at a ratio of 6:5 with the ATX, BEL, OMXH, CAC, ATHEX and AEX being volatile.

Table 7. *Stability Test for the Rise of Populist Movement Period (26/05/2014-31/12/2018)*

Market	*ATX*	*BEL 20*	*OMX H 25*	*CAC 40*	*DAX*	*ATHEX LCISEQ Overall*	*MIB*	*AEX*	*PSI 20*	*IBEX 35*
Distribution	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Mean Statistics										
μ_{Euro}	4.1771E-02	3.3660E-02	4.2091E-02	2.4358E-02	3.4035E-02	3.8468E-02	4.2687E-02	4.4956E-02	3.2119E-02	4.1652E-02	4.2365E-02
	(2.336E-03)	(2.115E-03)	(2.471E-03)	(2.513E-03)	(2.669E-03)	(2.549E-03)	(2.965E-03)	(1.970E-03)	(2.252E-03)	(2.425E-03)	(2.239E-03)
μ_i	2.5922E-02	2.6019E-02	4.8286E-02	4.6757E-02	4.4106E-01	2.9950E-03	1.4756E-01	2.6007E+00	4.7916E-04	6.3112E-02	4.4258E-01
	(1.303E-03)	(1.539E-03)	(2.492E-03)	(4.438E-03)	(2.811E-02)	(1.485E-04)	(6.979E-03)	(9.871E-02)	(3.508E-05)	(2.745E-04)	(2.167E-02)
Off Diagonal Co-Variance Statistics										
$A_{Euro,\,i}$	6.5956E-02	7.4354E-02	2.5277E-01	4.6829E-01	-1.3120E-01	1.4008E-02	2.4249E-01	3.7100E+00	6.3213E-04	1.3655E-01	2.2454E+00
	(1.296E-02)	(2.989E-02)	(2.878E-02)	(1.339E-01)	(5.078E-01)	(2.074E-02)	(6.206E-02)	(1.605E+00)	(7.406E-04)	(4.740E-02)	(3.840E-01)
$A_{i,\,Euro}$	7.0825E-02	2.2526E-01	-7.6780E-04	5.5285E-02	1.7186E-02	3.0693E-02	3.4760E-02	1.3161E-03	8.5865E+00	2.2882E-02	3.2391E-03
	(2.831E-02)	(4.011E-02)	(2.234E-02)	(2.971E-02)	(4.306E-03)	(8.795E-03)	(8.269E-03)	(4.971E-04)	(2.663E+00)	(4.679E-03)	(3.452E-03)
$B_{Euro,\,i}$	-9.8366E-02	9.6478E-02	-1.5693E-02	1.8777E+00	-6.7737E+00	-5.8065E-01	2.8419E-01	1.5017E+01	6.5862E-03	-3.1323E-01	-2.1523E+00
	(1.447E-02)	(5.499E-02)	(5.529E-02)	(2.663E-01)	(5.657E-01)	(3.171E-02)	(7.833E-02)	(3.471E+00)	(1.026E-03)	(6.020E-02)	(5.787E-01)
$B_{i,\,Euro}$	-6.3768E-02	-2.2701E-01	-2.7863E-01	-3.9242E-01	3.6006E-02	2.0875E-01	-9.7483E-03	-3.8105E-03	-1.8047E+01	2.3561E-02	2.4226E-03
	(3.200E-02)	(8.698E-02)	(4.425E-02)	(6.335E-02)	(4.649E-03)	(1.331E-02)	(1.236E-02)	(1.085E-03)	(3.638E+00)	(6.853E-03)	(4.240E-03)
$D_{Euro,\,i}$	2.0374E-	1.8480E-06	-2.9151E-05	-1.2676E-04	3.5310E-02	-6.2155E-02	-9.4102E+01	-9.0000E-08	1.0238E+00	-4.0354E-05	
	(1.724E-01)	(2.238E-01)	(2.996E-01)	(8.773E-01)	(4.723E+00)	(1.635E-01)	(6.667E-01)	(1.271E+01)	(4.641E-03)	(5.597E-01)	(2.363E+00)
$D_{i,\,Euro}$	-8.8674E-01	-2.2260E-06	2.2700E-07	-1.0818E-05	-1.1050E-06	-3.9788E+00	-2.5844E-01	3.6774E-02	1.5700E-06	-4.8491E-02	-5.5900E-07
	(5.766E-01)	(4.216E-01)	(1.862E-01)	(2.247E-01)	(3.752E-02)	(6.380E+00)	(7.726E-02)	(4.498E-03)	(2.084E+01)	(1.372E-01)	(3.029E-02)
Model Statistics										
Log-Likelihood	3,268.6108	3,351.5086	2,640.4200	3,063.0282	503.8979	1,736.1457	1,282.4553	-1,796.3557	8,207.2039	1,236.5167	304.3198
Final Criterion	7.50E-06	0.00E+00	5.20E-06	7.30E-06	5.00E-07	8.80E-06	2.70E-06	3.70E-06	0.00E+00	3.90E-06	7.10E-06
Co-integration Volatility Test										
σ^2_{Euro}	0.208121									
σ^2_{Market}	0.118393	0.197020	0.184744	0.401641	1.976284	0.684980	1.194872	11.891184	0.003519	0.751496	2.286339
Stability Test ($Market_{Euro} \rightarrow Market_i$)										
Statistics	2.9548	2.3091	2.1999	2.3877	3.6968	1.8079	0.3946	6.3365	5.9958	0.1674	0.3704
Status	Volatile	Volatile	Volatile	Volatile	Volatile	Stable	Stable	Volatile	Volatile	Stable	Stable
Stability Test ($Market_{Euro} \leftarrow Market_i$)										
Statistics	6.7023	2.7898	3.6891	2.3721	0.4428	5.5952	0.9090	0.0801	63.1730	1.0969	0.4061
Status	Volatile	Volatile	Volatile	Volatile	Stable	Volatile	Stable	Stable	Volatile	Stable	Stable

Summary of the results

It is worth noting that theoretically in econometrics a fully integrated market news affecting one segment would affect all segments and hence the magnitude of the volatility spillover effect would be similar thru all segmentsas hinted by Baele (2005) and Bekaert *et al.*, (2002). In reality the markets do react differently to news depending on the affinity of the market's participants to the event. In a market, such as the Eurozone, where there is a number of diverse factors influencing the behaviour of market participants in each segment; the reaction to news and thus magnitude of the volatility spillover effect is likely to differ between segments and thru time. The truth is that the impact of any event is connected to "time and space" and hence the gravitational pull of the reaction is determined by the close affiliation of the market participants to the event at any given time.

In analysing the complete picture, you get the impression the interaction between Eurozone equity markets is governed by the underlining context as illustrated by Table 2. Simply put, this means that the market environment is key to financial integration, hence market participants reaction to general market environmental factors determine the level and stability of the financial market integration. Furthermore, these environmental factors are influenced by the "time and space" effect. In essence, this means that market participants react differently to any news or event at any time given the market.

Table 2. *Statistical Ratios of Results*

Period	*Direction*	*Pre-Euro*	*Euro Introductory*	*Bull Market*	*Financial Crisis*	*Sovereign Debt Crisis*	*Populist Movement*
News Contagion	Euro → Market	8:2	5:6	3:8	8:3	8:3	7:4
	Euro ← Market	3:7	5:6	4:7	2:9	2:9	2:9
Volatility Spillover	Euro → Market	6:4	6:5	7:4	9:2	9:2	7:4
	Euro ← Market	4:6	4:7	5:6	4:7	5:6	5:6
Negative News Effect	Euro → Market	7:3	6:5	3:8	2:9	5:6	7:4
	Euro ← Market	2:8	5:6	4:7	4:7	4:7	8:3
SMPCH	Euro → Market	6:4	8:3	6:5	8:3	3:8	7:4
	Euro ← Market	7:3	9:2	5:6	10:1	8:3	6:5

As illustrated by Table 2, the behaviour of market participants varies depending on the market and event in time. Hence the general differences and similarities in reacting to varying events which is illustrated by the period of high uncertainties during the later part of the observation. There are several similarities and yet several differences in the reactions to the events during the financial and sovereign debt crises and populist movements period.

The funny thing is thateven though the Eurozone financial markets may react differently; yet in the overall scheme of things the evidence from the literature is that of integration, especially during the euro introductory and bull market periods. In truth the Eurozone equity markets were never truly integrated as dictated by the econometrics theories earlier in this section and illustrated by Table 2. However, this does not mean that the markets were never integrated in accordance to the definition of Baele *et al.*, (2004).

Conclusion

In this paper, we extended the volatility test to analyse the stability status of the integration of the Eurozone equity markets in the aftermath of the Euro by introducing a multivariate volatility test. The underlining model was a bivariate asymmetrical BEKK GARCH, allowing us to analyse the volatility spillover, news contagion effect and stability of the market environment during six different periods with differing impacts.

Surprisingly, our findings seem to be hinting at generally news and volatility seem to travel from the Eurozone to the sovereign equity market. Conversely, the results of our stable market pre-condition hypothesis seem to suggest generally with the exception of two observed periods, the underlining market environment is stable. Unsurprisingly the two exceptions occur when the markets either massively underreact as in the case of the bull market period or massively overreact as in the sovereign debt crisis within the Eurozone.

Our empirical results point to differences in the reaction of market participants which hints at the "time and space" effect. This seem to be suggesting that the Eurozone equity markets were never truly integrated in the sense of the econometrics definition. However, this does not mean that the Eurozone equity markets were not integrated in accordance with the definition of Baele *et al.* (2004). What is without doubt is the reactions of market participants depends on two factors: the time and market of the eventas illustrated earlier, hence the "time and space" effect. This is what drives the Eurozone equity market's integration, especially during highly volatile and uncertain times.

A relevant factor raised by our empirical evidence regarding the stability of some markets during highly volatile periods is they seem to be defying conventional wisdom by being stable, in particular the Greek market

during the sovereign debt crisis. As hinted by Fakhry (2016b), a possible explanation could be found in the underreaction / overreaction hypothesis which suggests that market participants' reaction leads to overvaluation or undervaluation during any period. Hence, a highly volatile period with instances of both under reaction and overreaction could give the impression of a stable market. This is what seems to have happened during these periods as market participants reacted to the information and news.

We also reviewed the literature on the integration of the Eurozone equity markets in the aftermath of the introduction of the Euro. We found most of the past empirical and literature pointed to an acceleration of the integration in the aftermath of the euro's introduction and during the bull market. However, this was slowed down in the aftermath of both crises; although, the literature does point to the sovereign debt crisis having a bigger impact than the financial crisis. Nevertheless, the real danger is in the rise of the populist and nationalist movements across Europe which depending on the views could result in the disintegration of the EU and thus the Eurozone. The case of Brexit and the resulting deal will no doubt be watched carefully with the potential of others to follow suit, there are already signs that the Italians want out.

A relevant factor to emerge from the Brexit and 2014 European Union parliamentary elections is that many people don't fully understand the workings and fundamental concept of the European Union. Hence, many on the opposing view are able to significantly highlight the weaknesses of the European Union. This points to a lack of communication by the European Union parliament. We therefore advise the European Union parliament to communicate more with the population in order to raise the awareness of the work and concept of the European Union. Another issue raised was the loss of a sense of national

identity, therefore pushing a significant number to extreme nationalist. Although, I am a supporter of European integration; however, a policy of slower paced integration would be of benefit to most considering the rise in nationalist views within the European Union and Eurozone. A key issue raised by the recent crises is the miscommunication and disjointed actions by key politicians which resulted in the financial markets being highly volatile and over reactive. We recommend the setup of a committee to oversee the communication and actions, especially during any future crisis, which would help to stabilize the Eurozone financial markets and therefore lead to a more integrated financial market.

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2 Did Brexit change the behaviour of the UK's financial markets?

Introduction

In an unprecedented move, on 23 June 2016, the UK voted to leave the European Union by a margin of 51.89% to 48.11%. The result signalled the start of the so-called Brexit process whereby the negotiations over the withdrawal of the UK from the European Union could start. This was initiated by the UK's government on 29 March 2017 when they invoked Article 500F0F[i] of the 2007 Lisbon Treaty1F1F[ii] which set out the guidelines and conditions of a member state withdrawal from the European Union.

Conversely, according to Hobolt (2016), in the wake of the Brexit vote the financial markets reacted quickly with the pound plunging to a 31-year low against the dollar and the global stock markets losing over two trillion dollars. This would hint at the overreaction hypothesis being in play in the financial market in the aftermath of the Brexit vote.

However, in recent years the global political and economic environment have changed, mainly due to the global financial crisis and ensuing economic downturn. The resulting Brexit vote was partly the product of this changed in the environment. In essence, this may have had an impact on the market participants making them highly reactive to any news that brings added uncertainty.

According to a number of articles including Dorling (2016), Hobolt (2016) and Inglehart & Norris (2016); the signs were there from the start. Inglehart & Norris (2016) state that two theories come into play as for the rise of populist policies: the economic insecurity perspective and culture backlash thesis. At the heart of both these theories are common grievances such as immigration, integration and globalisation, as hinted by Hobolt (2016) and Dorling (2016). A reflection of the Brexit vote would illustrate this, Dorling (2016) argues that the 59% of the middle classes voted to leave the EU as opposed to 24% from the poorer classes.

As stated by Hobolt (2016), in truth the Brexit vote highlight a divide not just among the British but across Europe which resulted in the results of recent general elections in Europe such as the French and German. It is worth remembering that financial markets react to political instability which goes to the heart of the increasingly reactive nature of the UK's financial markets in the aftermath of Brexit. The results of the Brexit vote highlighted major political issues and divisions in the UK, this instability was confounded by the following general election which produced a hang parliament at a time when the UK needs a strong government. As highlighted by Taylor (2009) and Carmassi & Micossi (2009), often financial markets tend to react to uncertainty and miscommunication by governments. In the run-up to the referendum and, to a certain extent, aftermath of the Brexit vote; the conflicting statements and confusions not only by members of the British government

but also by members of the EU, as hinted by Hobolt (2016), led to a highly reactive financial market.

Was the Brexit result a shock to the market, in a way it should not have been as Hobolt (2016), Dorling (2016) and Inglehart & Norris (2016) identified, the indicators were there. However, even the politicians advocating Brexit were not sure of the results, as stated by Hobolt (2016), and many in the financial market as did many political commentators thought that the threat to economic stability and certainty would defer enough from voting for Brexit.

With this change in the environment across different aspects in mind, we analyse the UK's financial markets to determine the change in the market's environment in the aftermath of the Brexit vote in the long and short runs. We use the daily prices on four indices representing the Equity. FX, commodity and sovereign debt markets. Using an asymmetrical C-GARCH-m variance bound test based on the test used by Fakhry & Richter (2018) to analyse the feedback effect in addition.

A major contributory factor to this paper is as hinted in Fakhry (2016), since the variance bound test indicates that if a market is inefficient then it is deemed to be too volatile to be efficient. Simply put, this means that for a market to be efficient the pre-condition is a measurable stability status. Hence in short, the variance bound test is a test of this stability pre-condition. Therefore, we differ from many in the past by using the variance bound test to analyse the stablemarketpre-condition hypothesis and hence the efficiency of the market, whereas most have used the variance bound test to analyse the efficiency of the market, examples are Fakhry & Richter (2015, 2016a, 2016b, 2018) and Fakhry *et al.*, (2016, 2017). Thus the key to our analysis is using the variance bound test to analyse the stability of the markets which is of greater importance than the efficiency. However, the stability status of any market during any

observational period would naturally indicate the efficiency of the market.

There are a number of further contributions, we make to the literature on financial econometrics and the Brexit debate. The first and most important of which is that this paper is unique in that it is the only, thus far, to analyse the impact from Brexit on the reaction of the market participants in the UK's financial markets. For this extent, we extend the variance bound test first proposed by Fakhry & Richter (2018) to also analyse the feedback effect, thus using an asymmetrical C-GARCH-m model to analyse the different behaviour of price volatility and the impact of Brexit on the stability of the market. Furthermore, the paper also contributes in using four major UK markets to determine the true extent of the impact from Brexit on the UK's financial market, following from Fakhry & Richter (2018). Finally, the paper is thus far the only paper to carry out a timeline analysis on the impact of Brexit on the UK's financial market.

We found evidence suggesting that there were some changes in the general behaviour of the financial markets in the aftermath of the Brexit vote, especially in the short run. However, as we suspected, the evidence did point to a limited change in the behavioural factors of the price volatility which suggests that the markets have not fully recovered from the recent financial crises including the sovereign debt crises. Yet our analysis seems to hint at a hike in volatility across all four financial markets in the immediate aftermath of the Brexit vote.

We conclude while the Brexit vote did impact the UK's financial market in the short run and slightly in the long run. However, a big question is whether this was a continuation of the market participants reaction to uncertainty during the recent financial crises or a new period of uncertainty bought about by Brexit. Certainly, there is some evidence pointing to the existence of the continuation factor. The issues of

miscommunication and confusion from the government illustrate that policy makers have not learnt the lessons of the recent financial crises. Based on our findings, we advise the policy makers to make clear and decisive statements. We also recommend an agreement among all the policy makers to put forward a unified voice and plan. It is essential not to repeat the same mistakes made during the financial crises and early parts of the Brexit process.

The rest of this paper is divided into six sections; the first two sections are reviews into the impact of Brexit on the economy and financial markets. The third section is the methodology which precedes the data description. We then provide our empirical evidence of the impact of Brexit on the financial market. Concluding the paper with the conclusion.

A literature review of the impact of Brexit on the UK's economy

Although this paper is essentially about the behaviour of financial markets during the uncertainty of Brexit. It is important to observe that the real impact of Brexit on the UK's financial markets comes not from the UK leaving the EU but from the effect of Brexit on the UK's economy. As we will see, the UK's economy is predicted to contract by anything up to 5% in the aftermath of Brexit in accordance with reliable sources. Of course, these predicted statistics are based on a number of scenarios made before the UK's government decision on which policy to pursue, we now know that the UK is heading to an EU/UK free trade Agreement or failing that a hard Brexit on the 31st March 2019. So, the economy is likely to be the major source of price volatility and uncertainty in the short run, this is confirmed by the UK's Economic Policy Uncertainty[iii]I as illustrated by Figure 3, especially in the aftermath of the actual Brexit. Additionally, much of the uncertainty in the financial market comes from the confusions and miscommunication about the

economy. Hence a review of the literature on the economy is vital in understanding this main source of uncertainty and volatility in the aftermath of the referendum.

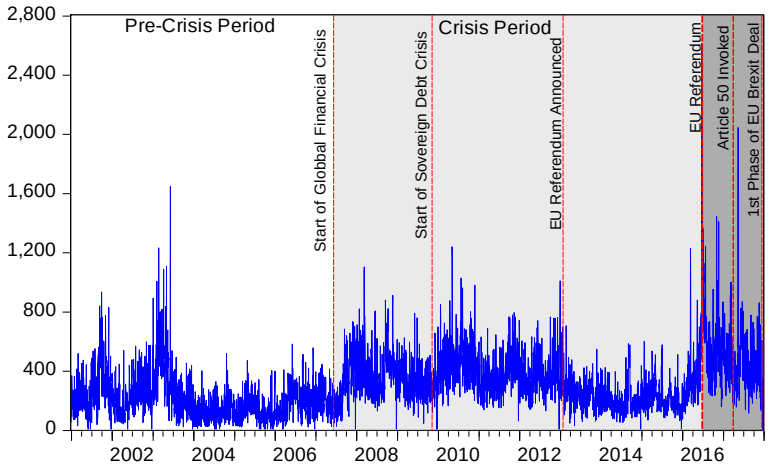

Figure 3. *UK Economic Policy Uncertainty Index*

A review of the options would suggest that there were only three realistic options available for the UK and EU. As highlighted by a number of articles such as Erken *et al.*, (2017) and Sampson (2017), the options included: Soft Brexit, Hard Brexit and an EU/UK free trade agreement. As hinted by Brakman *et al.*, (2017), the problem is that negotiations between the UK and EU on a new trade deal are likely to be confrontational and difficult, mainly due to politics on both sides. And as stated by Niederjohn *et al.* (2017, p.86), a key issue is that members of the EU:

> "seem determined to make an example of Britain for fear that if the UK negotiates too good a deal, other nations will vote to leave too"

This was illustrated on 6th December 2016 by a speech from the EU's chief negotiator, Michel Barnier, in a press conference on Brexit in which he said:

> "Cherry picking is not an option"

According to Erken (2017), the soft Brexit option would mean that the UK retains its membership in the single market under the European Economic Area or EEA agreement but leave the Custom Union. As Sampson (2017) states, this would mean the UK would continue to get free market access for goods, services and capital across the EU. However as illustrated by Sampson (2017), this would also mean having to sign to a free movement of labour, which was one of the main reason for the Brexit vote according to Hobolt (2016) and Dorling (2016) and contributing to the EU budget. Conversely, the EEA also entails the adoption of all EU legislation regarding the single market as hinted by Sampson (2017). And the UK has already signalled that it will not pursue this avenue as confirmed by the secretary for the Department of Exiting the EU, David Davis MP in a speech to the House of Commons on 7th September 2017:

> "The UK will no longer participate in the EEA agreement once it leaves the European Union"

Adopting the hard Brexit option would mean a complete and total divorce between the EU and UK without any trade agreement, as hinted by Erken *et al.*, (2017). According to Sampson (2017) and Erken *et al.*, (2017), this would result in a World Trade Organisation's trade agreement between the EU and UK, along the lines of the agreement which both the US and China have withthe EU. Under the agreement goods would be subject to most favoured-nation tariffs. As indicated by Sampson (2017), the average EU tariff as of 2015 was 4.4%. However, as hinted by Sampson (2017), there has not been a similar agreement for the trade in servicesincluding the financial sector. Conversely, as hinted by Chang (2017), the WTO trade agreement forms the basis of the argument that the UK could do better outside the EU put forwards by the EFT3F3F[iv].

The third option is to negotiate a new trade agreement with the EU as hinted by Erken *et al.*, (2017) and Sampson

(2017). As illustrated by Sampson (2017), the agreement could take a number of shapes. However, as illustrated by Sampson (2017), in order to maintain the advantage of being part of the single market; most EU trade deals, such as the EU-Canada agreement, do much less to harmonize economic regulations and do not include free or reduced tariff access for service providers. Consequently, any free trade agreement would come with a higher trade cost to the UK. And as Sampson (2017) and Kierzenkowski *et al.,* (2016) hint negotiations for a free trade agreement are unlikely to be concluded before March 2019, the EU/Canada negotiations took 8 years. This point is also alluded to by Busch & Matthes (2016) who states that any negotiation on a new trade deal with the EU or any other country could take a long period of time. Conversely, in an interview with Belgian newspaper, De Tijd on 24th October 2017, Michel Barnier warned that a trade deal between the EU and U.K. would take three years to negotiate and may unravel, stating:

> "Three years if we start talking in December. It comes with risks too, because all parliaments have to give approval [to a new deal]."

However, the negotiations for a new trade agreement between the EU and UK could follow existing templates with other countries. As illustrated by Sampson (2017), the UK could follow the Turkish template and join the custom union, this would alone would not solve the key issues of inner-border barriers and services trade. It would also have the disadvantage of preventing the UK from negotiating with non- EU nations. Another option would be to follow the Swiss template with tighter integration, effectively meaning that Switzerland is in a single market in terms of goods. However, this again means that the UK will have to adopt EU economic legislations, freelabour movement and contribute to the EU budget. Despite these concessions,

EU/Switzerlandagreement didn't include services; in essence putting a block on the Swiss banking industry within the EU.

The importance of this last statement is underlined by analysing the dependency of the UK's economy on the financial services industry. According to Armour (2017), the financial services sector generates between 7 to 12 percent of GDP, it also accounts for 11% of total tax receipt and employs 7-12 percent of the total workforce. Additionally, the financial service sector is responsible for the biggest trade surplus of any sector as highlighted by Armour (2017). The issue, as illustrated by Armour (2017), isthat about 24% of the total revenue is dependent on intra-EU operations. Hence a free trade agreement without including services or at the very least financial services would be detrimental to the UK's economy. However, in a speech by Michel Barnier in a press conference on Brexit negotiations dated 18th December 2017, he said:

> "There is no place (for financial services). There is not a single trade agreement that is open to financial services"

Nevertheless, it is dangerous to understate the importance of the UK's financial services to the EU as illustrated by Armour (2017). Furthermore, a disagreement on whether to include financial services in the final deal has the potential to cause high levels of uncertainty and volatility in the EU's economy as Belke *et al*., (2016) hints, hitting the GIPS countries the most.

The literature on the estimated impact of Brexit on the economy of the UK varies with each option and depends on the initial view point of the author, a point illustrated by Busch & Matthes (2016) and Chang (2017). As Busch & Matthes (2016) argue a large amount of research have been done on the economic impact of Brexit on the UK, the results range from significant benefits to marked losses. With the more reliable researches predicting a loss of between 1 and 5

percent of GDP. Brakman *et al.*, (2017) also alludes to this variety of results,the rebalancing of trade will more likely reduce trade and economic welfare, estimates range from 1.5% to 7.0% of GDP depending on the type of Brexit. Chang (2017) states there are a number of estimates of the impact of Brexit on long-term economic growth, ranging from pessimistic to optimistic:

- the LSE and HM Treasury predict a decrease in growth of 7%
- OCED with a negative growth rate of 5%
- CBI/PwC, NIESR and Oxford Economics hint at a 3% decrease.
- The only optimistic view was from the EFT with an increase in growth rate of 4%. It must be stated that this optimistic view relies on the full uniliteral adoption of the WTO free trade agreement which many critics have slated as "*far removed from reality*", Chang (2017, p. 13).

Dhingra *et al.*, (2016) states that depending on the type of Brexit, the short run loses would be between 1.3% and 2.6% on economic growth. If the UK decides to unilaterally adopt the FTA, economic growth would be reduced by 1% to 2.3%. In the long run the cumulative effect on economic growth from Brexit could be around -6.3% to -9.5%.

Erken *et al.*, (2017) show that in all three options the UK will experience a recession immediately after Brexit. The different is that in the long run the decrease would vary in size with a free trade agreement the reduction would be 2.5%, soft Brexit would produce a fall of 10% and hard Brexit would decrease the growth by 18%.

As put by Chang (2017), the reality of the situation is unless the UK can somehow maintain full access to the EU market without a high price, Brexit could have a sustained negative impact on the economy. However, as suggested by Gudgin *et al.*, (2017) while the losses in the UK economic growth are inevitable, the size of these losses could be offset

by three factors: a lower sterling FX rate, fiscal stimulus policies and monetary expansionary policies.

A further consequence of Brexit, as Emerson *et al.,* (2017) hints, is that many companies, especially those in the services industry, are considering redirecting their investment from the UK to the EU to benefit from being inside the EU. Hence, Emerson *et al.,* (2017) points to studies by HM Treasury and the OCED hinting that when accounting for Foreign Direct Investment, the economic growth loss could be even greater at 7.5% in the long run that is an average of 0.75% annually.

A Literature review on the reactions of market participants to Brexit

The financial markets are highly reactive to any event inducing uncertainty. The key here is the interpretation of events during the Brexit negotiations and the economic statistics. As elegantly put by Bernard Baruch (Lee *et al.,* 2002, p.2277),

> "What is important in market fluctuations are not the events themselves but the human reaction to those events."

On 20 February 2016, the UK's prime minister announced the date of the EU referendum, the following Monday the pound fell by approximately 2% and 1.5% against the dollar and euro respectively. As Haan *et al.,* (2016) points some have suggested that the hike in volatility and decrease in the pound value were to be expected in the financial market during the period of the EU referendum and that the financial markets would get increasingly volatile as the date get closer and thereafter. Others put the run on the British pound as just an overreaction and pointed out that financial markets are by their nature volatile. In this part of the literature review, we will review the theoretical and practical literature on the reaction of the market participants during

the early stages of the Brexit process including the EU referendum and the aftermath. We will also review the limited empirical evidence of the reaction. Finally, we will review the academics views of Brexit.

As stated by Carmassi & Micossi (2010), it is not uncommon for financial market to grossly overreact; an example is the Eurozone sovereign debt crisis which started with Greece. The funny thing is Greece's public debt is a tiny proportion of the Eurozone total debt and banks' capital, yet the crisis grew into a full blown Eurozone sovereign debt crisis. As hinted by Collignon *et al.,* (2013), conflicting views on the solution to the sovereign debt crisis between key members and an initial lack of will to take action sent contradicting signals to market participants. This was further enhanced by each member state putting its own interest ahead of the EU's. And as stated by Carmassi & Micossi (2010), at the heart of the Eurozone's sovereign debt crisis was the big issue of political miscommunication and confusions. In fact, as highlighted by Collignon *et al.,* (2013), the issue of political miscommunication and confusion was the leading reason for market participants lack of willingness to hold the Greek sovereign debt and more importantly price the asset accordingly, this led to a hike in the required interest rates or yields. Mainly due to the perceived risk of default. In essence it was this political miscommunication and confusion which was at the heart of the contagion effect and the duration of the crisis.

Given as illustrated previously by the comments of those involved in the Brexit process, be it during the referendum or the negotiations, once again political miscommunications and confusions seem to be at the heart of the uncertainty within the financial markets. As highlighted by Gade *et al.,* (2013), political miscommunication does tend to have a negative asymmetrical effect on financial markets, thus meaning that negative communication has an increased

impact on financial markets than positive communication. And as hinted by Gade *et al.*, (2013) the impact of the political communication on the financial markets is highly susceptible to the attributed person/organisation, this means the financial markets would react more heavily with the levels of importance of the originating person/organisation is to the event. In short, there seem to be a positive correlation between the importance of the originating person/organisation and the impact on the markets. Certainly, the evident seem to suggest there is a link between the political communication and the volatility of the financial markets during Brexit.

A further complication of the financial market reaction to the Brexit process is the area of policy uncertainty as suggested by Belke *et al.*, (2016). As stated by Smales (2017), a key factor found in previous studies of the impact of political uncertainty on financial markets is a change in the political orientation or a sudden policy change can dramatically increase financial market uncertainty. And as illustrated by Smales (2017), past empirical evidence has found that national elections have a positive relationship with uncertainty in the financial market. This relationship has an increasingly positive correlation as the election approaches. The magnitude of the impact on the financial market is determined partly by the margin of victory andchanges in the political orientation. Furthermore, financial markets are increasingly volatile when the result is uncertain. In addition, the financial markets' reaction is dependent on whether the current status quo is continued. Conversely, the evidence seems to suggest the industries dependant on trade are especially sensitive to political events.

Smales (2017) finds that during the EU referendum there was a significantly positive relationship between market and political uncertainty. Put simply, as political uncertainty

rises or fall an equivalence rise or fall in uncertainty is registered in the financial markets. the magnitude of this relationship was heightened in the aftermath of the announcement of the referendum. As suggested earlier, they found that the influence of political uncertainty from the EU referendum increase as the polling day approaches. Moreover, the result seems to be consistent with past findings that market uncertainty significantly increases with political uncertainty when opinion polls indicate a very close outcome.

Belke *et al.,* (2016) also argue that a key affect during the Brexit campaign was the impact of the poll updates on the financial markets. Gropp (2016) states evidence from the polls before the Brexit referendum seem to suggest a negative impact on the banks stocks and FX markets of the EU and UK. when the polls suggest a Brexit. This is further highlighted by Danielsson *et al.,* (2016), who states that the markets are reacting to a substantial shock indicating weaknesses for sterling and global asset markets, especially banks. Thus, hinting at a negative impact on banks stocks and FX markets in the event of a Brexit vote. However, as pointed by Gropp (2016), a key factor is the differentiation of the UK leaving the EU and the impact on the Euro in the FX markets. A key factor, as Belke *et al.,* (2016) hints, is that policy uncertainty typically tends to lead to option value effect, a "*wait and see attitude*" by market participants.

Using a VAR variance decomposition-based model proposed by Diebold & Yilmaz (2009) with the daily UK's economic policy uncertainty index and CBOEVIX index observed from 01/01/2001 to 23/09/2015. Belke *et al.,* (2016) results seem to confirm that policy uncertainty about Brexit did have an adverse effect on the price volatility of the UK's financial markets.

As stated by Danielsson *et al.,* (2016), it is tempting to say that the initial reactions are nothing but the markets normal

reaction to news, however the probability of a consequent increase in systemic crisis, however remote, is certainly not zero. There are some who think that systemic risk will increase due to the large disruptions in the financial markets bought about by Brexit. The main issues seem to be based around two key legal factors: "legal plumbing" and equivalence.

According to Danielsson *et al.,* (2017), the issue of legal plumbing arises when a function such as a settlement or rehypothecation has its legal status questioned. Good examples are the bankruptcy of Lehman Brothers and AIG which intensified the recent financial crisis. Unfortunately, legal timescales operate on a completely different horizon to market participants. Hence should a legal issue arise, the UK and EU government must underwrite the affected activity until a legal solution can be found.

As stated by Danielsson *et al.,* (2017), the issue of legal equivalence arises when any financial organisations operate under the assumption that there is a permanent equivalence agreement that both the UK and EU rules are compliance with each other. Under the UK's membership of the EU, no problems had arisen with regard to interpretation of the rules because the UK's rules were regarded as EU rule and vice-versa. However, when the UK leaves the EU, the assumption is that a permanent equivalence agreement will be agreed. Unfortunately, by their very nature. such agreements are transient; meaning in principle they could be revoked with just a few months' notice.

However, as Danielsson *et al.,* (2017) points, there are others who believe that systemic risk will likely decrease mainly due to the behaviour of market participants under uncertainty and fear and the increase of fragmentation in the financial market. Certainly, as Danielsson *et al.,* (2016) hints, if the UK loses some of its financial sector to the EU be it at a substantial economic cost, the potential benefits are the

reduction of the importance of the financial sector on the economy and hence systemic risks. A counter argument, put by Danielsson *et al.,* (2016), is although theoretically both the UK and EU could benefit, however the more likely outcome could be an increase in inefficiency, protectionism and systemic risk and a fall in the quality of financial regulation.

As both Busch & Matthes (2016) and Chang (2017) alludes a key issue is the addition of large levels of uncertainty on the UK's economy which could hinder the confidence of investors and consumers. There is already a danger of financial markets pricing the uncertainties and risks posed by Brexit causing a certain degree of financial turmoil as highlighted by Busch & Matthes (2016). Furthermore, as Busch & Matthes (2016) alludes the rating agencies have hinted of a possible downgrade depending on the negotiations and final agreement. And as Kierzenkowski *et al.,* (2016) hints a hike in economic uncertainty could reduce confident and hence increase risk premiums and cost of finance. According to a survey commissioned by the Centre for Macroeconomics, published on 25 February 2016, amongst its members a significant majority thought there was going to be a hike in volatility as illustrated by Haan *et al.,* (2016). The reasons behind the expectation of a hike in volatility was uncertainty regarding the result of the referendum and implication of Brexit. However, some members disagreed as illustrated by Haan *et al.,* (2016).

Methodology

As stated by Pastor & Stambaugh (2012), conventional wisdom dictates there is a different between the long and short run. Generally, markets are less volatile in the long run due to being less perceptive to shocks; hence they are increasingly stable. As Engle & Lee (1999) states volatility is greater in the short horizon than in the long horizon. This indicates a more rapid short run volatility mean reversion

than in the long run as hinted by Engle & Lee (1999). Per Colacito *et al.,* (2011), another important principle often made in economics is the existence of different long and short run sources affecting volatility. Additionally, as de Bondt (2000) hints the price reverts to the fundamental value in the long run. Effectively what de Bondt (2000), Pastor & Stambaugh (2012) and many others like Engle & Lee (1999) are hinting is the reaction of markets participants tend to deviate with time. Another factor, suggested by Engle & Lee (1999), is the different impact from the leverage effect and market risk premium on the market in the short and long run. In a paper written as part of a book in honour of Clive Granger, Engle & Lee (1999) extended the GARCH model to account for the permanent (long run) and transitory (short run) components of volatility deriving the component GARCH model (aka C-GARCH).

It must be remembered that as hinted by Black (1976), a key observation often made in the equity market is the negative correlation between returns and volatility, acknowledged as a leverage effect. Additionally, as indicated by Engle *et al.,* (1987), theory dictate that market participants require increasingly high premium on returns for investing and/or holding increasingly risky assets which is often referred to as the feedback effect.

As previously stated the main aim of this paper is to analyse the impact of Brexit on the stability of the markets in the long and short runs. We extend the variance bound test proposed by Fakhry & Richter (2018) using an asymmetrical C-GARCH-m model, proposed by Engle & Lee (1999). We use the 5% critical value F-statistics to test thestable marketpre-condition hypothesis and hence the efficient market hypothesis. As withFakhry & Richter (2015, 2016a, 2016b, 2018) and Fakhry *et al.,* (2016, 2017), we follow the pre-requisite steps advocated by Shiller (1979, 1981).

1. As illustrated by Shiller (1981), the key factor underlying any variance bound test is the variance calculation. We model the datasets in our test as a time varying lagged variance of the price using equation 1. We used the 5-lagged system, as oppose to the 20-lagged system advocated by Fakhry & Richter (2015).

$$\lim_{t \to T} var(Price_t) = \frac{\sum_{q=1}^{Q} (Price - \mu)^2}{Q} \quad (1)$$

2. As with previous works, Fakhry & Richter (2015, 2016a, 2016b, 2018) and Fakhry *et al.*, (2016, 2017), we estimate the residuals by using a first order autoregressive model as illustrated by equation 2.

$$var(Price_t) = a + b_1 var(Price_{t-1}) + \mu_t \quad (2)$$
$$\mu_t = \tau \mu_{t-1} + \varepsilon_t$$

In a previous paper, Fakhry & Richter (2018) used a first order autoregression model as the underlining equation to the mean section of the GARCH model as illustrated in equation 3.

$$var(Price_t) = a + b_1 var(Price_{t-1}) + \mu_t \quad (3)$$

However, in this paper we are analysing the feedback effect, hence as defined by Engle *et al.*, (1987), we use equation 4.

$$var(Price_t) = \lambda h_{t-1} + a + b_1 var(Price_{t-1}) + \mu_t \quad (4)$$

The key to interpreting the feedback effect is the λ coefficient in equation 4. Thus, a significantly positive λ coefficient hints at a positive feedback effect and suggests that as risk increases the return should increase as well.

However, in contrast a significantly negative λ coefficient suggests as risks increases, the returns should decrease. We estimate a first order asymmetrical C-GARCH (1, 1) model to obtain the long run and short run volatility coefficients. It is worth remembering that the GARCH (p, q) model as proposed by Bollerslev (1986) is written as equation 5 where $h_t = \sigma_t^2$ and $k_t = \varepsilon_t^2$

$$h_t = \omega + \alpha_p k_{t-1} + \beta_q h_{t-1} \quad (5)$$

As suggested by Engle & Lee (1999), equation 5 can be slightly transformed into equation 6 where the dynamics of the structure of conditional variance can be illustrated.

$$h_t = \sigma^2 + \left(\alpha_p k_{t-1} - \sigma^2\right) + \left(\beta_q h_{t-1} - \sigma^2\right) \quad (6)$$

The issue is that σ^2 represents the unconditional long run variance. However as argued by Engle & Lee (1999), at the heart of this equation is the question of whether the long run volatility is truly constant over time. Surely, a more flexible specification where the long run volatility is allowed to evolve slowly in an autoregressive manner is a more appropriate model of volatility, given the empirical evidence on time varying and mean reverting volatility as stated by Engle & Lee (1999). A more flexible model would be equations 7 and 8 where by σ^2 is represented by m_t,a time varying long run model of volatility.

$$m_t = \omega + \rho m_{t-1} + \varphi(k_{t-1} - h_{t-1}) \quad (7)$$
$$(h_t - m_t) = \sigma^2 + \left(\alpha_p k_{t-1} - m_{t-1}\right) + \left(\beta_q h_{t-1} - m_{t-1}\right) \quad (8)$$

Hence, equation 7 is s stochastic representatives of the long run volatility otherwise known as the trend in volatility and equation 8 is the different between the conditional

volatility and trend, i.e. the long run volatility. Essentially equation 8 is the short run or transitory volatility.

In essence, this means the dynamics of the volatility components can be interpretedin three steps. Firstly, the short run volatility component is mean reverting to zero at a geometric rate of $(\alpha + \beta)$ under the condition of $0 < (\alpha + \beta) < 1$. Secondly, as highlighted previously the long run volatility component evolves over time in an AR process; conversely if $0 < \rho < 1$ then it will converge to a constant level of $\frac{\omega}{1-\rho}$. The third step is based on the assumption that the long run volatility component has a slow rate of mean reversion than the short run volatility component; simply put, the long run volatility component is the more persistent of the two components meaning $0 < (\alpha + \beta) < \rho < 1$.

We opt to use a single asymmetrical order one lagged C-GARCH model in our tests. Remember the short run volatility component is given by equation 8. The TARCH model as defined by Zakoian (1994) is given by equation 9. Taking equation 9, we could transform it to a single order asymmetrical C-GARCH model by subtracting the long run volatility from each term in the equation to give equation 10. Notice how if the asymmetrical effect is zero the basic model collapses to a C-GARCH model as illustrated by equation 8. A key factor is that the asymmetrical effect is only added to the short run component of the C-GARCH model, see equation 10. This is mainly due to the short life of the asymmetrical effect.

$$h_t = \alpha k_{t-1} + \beta h_{t-1} + \gamma k_{t-1} I \quad (9)$$

$$(h_t - m_t) = \sigma^2 + (\alpha_p k_{t-1} - m_{t-1}) + (\beta_q h_{t-1} - m_{t-1}) + \gamma(k_{t-1} - m_{t-1})I \quad (10)$$

$$\text{Where } I = \begin{cases} 0, & \varepsilon_t \geq 0 \\ 1, & \varepsilon_t < 0 \end{cases}$$

Unlike Fakhry & Richter (2015, 2016a, 2016b, 2018), we also illustrate the impact of the asymmetrical effect on the stability of the market. The key is the γ coefficient in equation 10 where $\gamma \neq 0$ then there is an asymmetrical effect; if $\gamma > 0$ then there is a leverage effect meaning negative shocks have greater impact than positive shocks. As noted by Engle & Patton (2001), there is a story within any member of the GARCH family of volatility models influenced by the coefficients in thevariance equations. Since as illustrated by Engle & Patton (2001), the market shocks and persistent are indicated by the coefficients α and β, respectively. Therefore, we can deduce that ϕ and ϱ indicate the long run market shocks and persistent, respectively.

The coefficients of the Component-GARCH model of volatility are also key to our variance bound test. As mentioned earlier in this section, we derive our stability test by using the f-statistics; for our observed samples, the f-statistics at the 5% level is 1.96. We calculate our test statistics using equation 11 and 12 as the short run and long run tests of stability respectively.

$$Stability\ Test_{SR} = \frac{(\alpha+\beta+\gamma)-1}{standarddeviation(var(x))} \leq Fstatistics \qquad (11)$$

$$Stability\ Test_{LR} = \frac{(\rho+\Phi)-1}{standarddeviation(var(x))} \leq Fstatistics \qquad (12)$$

In previous work by Fakhry & Richter (2015, 2016a, 2016b, 2018) and Fakhry *et al.*, (2016, 2017), the definition was the market is efficient when the conditions as set in equations 11 and 12 are true. Theoretically, the market is only truly efficient when the StabilityTest statistics is equal to the f-statistic. Hence, we reject the null hypothesis for the EMH if the condition in equations 11 and 12 are true but accept the null hypothesis of the market being too volatile to be efficient for anything else. However, since in this paper the main emphasis is on the stability of the market, therefore we

use this test to analyse whether the market is stable or to what extent the market is volatile. The condition given by equations 11 and 12 also state that the market is stable and the variable Stability Test in both equations gives the volatile levels for the long and short runs.

Data description

As stated previously, this paper analyses the stability and thusefficiency of the four major UK financial marketsto establish whether Brexit affected the financial markets. With this in mind, we test the stability and hence efficiency of the equity, FX, gold and sovereign debt markets. As illustrated in table 1, we opt to use the price on the major indices to reflect the British financial market. As with the norm, we choose to use a five-day week filling in the missing data with the last known price.

Table 1. *Major British financial markets indices*

Market	Equity	Gold	Foreign Exchange	Sovereign Debt 1	Sovereign Debt 2
Index	FTSE 100		Effective Exchange Rate index, £	UK Gilt Index	
Source	investing.com	World Gold Council	Bank of England	Barclays Capital	S&P4F4F[v]
Modifier	250	25	1	2.5	
Period	08/06/2007–29/12.2017			08/06/2007-23/06/2016	24/06/2016-29/12/2017
Observations	3356			2360	396

It must be noted that like all indices, the four indices are based on weighted ratios of the components prices. The FTSE100 consist of 100 of the largest listed companies on the British equity market each weighted by a given ratio. The Sterling Currency Index 5F5F[vi] is calculated daily by the Bank of England using the five major currencies with a weighted ratio: US Dollar, Euro, Japanese Yen, Swiss Franc and Swedish Krona. As hinted by the name, the UK

GiltIndex consists of all the government bonds maturities weighted by a ratio. The gold market index is the price of gold weighted by the 3-year GDP in US $.

For reasons noted in footnote v and as illustrated in table 1, we used two indices to analyse the sovereign debt market over both observational periods. Apart from the sovereign debt market, a key issue with our variance bound test was the standard deviation of the FTSE 100, gold and UK gilt indices variances which caused a problem with the stabilitytest statistics. We tried several methods to resolve the issue, the best solution was to divide the daily index price by the modifier as illustrated by table1 before calculating the five-day variance.

Empirical evidence

As hinted earlier, the keys to the stability and henceEMH test statistics are the coefficients to the variance equation of the volatility model and standard deviation of the observed dataset. Hence in essence the model of volatility estimated determines the statistics. In Fakhry & Richter (2015) and Fakhry *et al.*, (2016, 2017), the estimated model was the GARCH. In Fakhry & Richter (2016a, 2016b), the model used was the GJR-GARCH. The GJR-GARCH had the influential factor of allowing for the analysis of the asymmetrical effect on the EMH. In Fakhry & Richter (2018), the model totest the efficiency in the long and short runs was an asymmetrical variant of the C-GARCH model. We continue to use the asymmetrical effect in this paper; however, in order to extend the analysis of the behavioural factors to include the feedback effect, we use an asymmetrical C-GARCH-m model.

In estimating the models, we used the Marquandt estimation method for all estimations. However, with the error distribution, we used a different distribution model to get the best estimation as illustrated by table 2. For all other

options, we used the default settings. Crucially, the system environment may influence the estimation: our system is running EViews 9.5 on a Windows 10 Procomputer with a 10 cores CPU and 32 Gigabytes RAM6F6F[vii].

Crisis Period (8th June 2007 - 23rd June 2016)

This period was influenced by a combination of three factors leading to a period of sustained uncertainty and highly volatile global financial markets. The financial crisis started with the subprime mortgages in the US and quickly enveloped the global financial sector, for further in-depth research and analysis on the crises see (Brunnermeier, 2009; Caballero & Krishnamurthy, 2009; Masood, 2009) amongst others. The sovereign debt crisis started with the Greek revision of the deficit statistics, gradually becoming a wide spread issue of confident in global fiscal policies enveloping the GIPS nations as illustrated by (Schwarcz, 2011; Metiu, 2011; Mohl & Sondermann, 2013). The crisis reached the US with the deficit/debt ceiling crises which closed the US federal government. The third factor is the causal effect resulting from a deep and costly financial crisis which developed into a deep recession, see (Taylor, 2008; Feldstein, 2009) amongst others for details of the recent economic downturns. An added issue within this period was the confusion and miscommunication by the policy makers which heightened uncertainty during the financial and sovereign debt crisis.

Table 2 seem to be hinting at a significantnegative feedback effect across all markets during the crisis. This seem to be highlighting a change in the risk premium required by the market participants. However, the key to understanding the main impact of the crises in the UK can be obtained from the equity market. The λ coefficient of the equity market is hinting at a significantly large negative feedback effect in relation to the other markets. It must be

noted that the equity market was the main source of uncertainty and risk in the UK's financial market throughout the crises period, especially the banking sector.

Table 1. *Statistics for Variance Bound Test using Asymmetrical C-GARCH model7*[8]

Observation period	*Crises: 08/06/2007 – 23/06/2016*				*Brexit: 24/06/2016 – 29/12/2017*			
Market	Equity	Forex	Gold	SD	Equity	Forex	Gold	SD
Distribution	Student's	GED	Normal	Normal	Student's	Student's	Student's	GED
Method	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt
Total Observations	2360				396			
Mean Equation								
λ	-14.61138*	-2.506798*	-7.540547*	-5.204332*	-18.22398*	-0.393644***	-1.734168*	-6.966527*
	(0.833948)	(0.157923)	(0.372064)	(0.088347)	(3.694410)	(0.216195)	(0.335234)	(0.118301)
a	0.012499*	0.029464*	0.007504*	0.045705*	0.006789*	0.038081*	0.008478*	0.044532*
	(0.000113)	(0.000182)	(7.57E-05)	(0.000419)	(0.053051)	(0.001939)	(0.000245)	(0.000968)
b	0.882882*	0.887579*	0.911270*	0.842696*	0.858644*	0.982891*	0.952141*	0.874123*
	(0.001855)	(0.001980)	(0.000793)	(0.000983)	(0.002771)	(0.007903)	(0.007075)	(0.002382)
μ	1.006296*	0.999861*	1.046510*	1.035662*	1.028093*	1.075765*	0.974598*	1.030880*
	(0.002710)	(0.002130)	(0.000468)	(0.001382)	(0.005240)	(0.011609)	(0.010333)	(0.004209)
Volatility Equation								
ω	0.000153***	0.029676	0.000149*	0.001287*	1.88E-05*	0.000948*	-0.000911	0.001205*
	(8.39E-05)	(0.031871)	(1.89E-05)	(0.000134)	(2.98E-06)	(0.000148)	(0.014018)	(0.000191)
Long-run Volatility								
ρ	0.987871*	0.999807*	0.993478*	0.991699*	0.696449*	0.713193*	0.999489*	0.733613*
	(0.005963)	(0.000218)	(0.000698)	(0.000878)	(0.053051)	(0.043864)	(0.004620)	(0.023861)
φ	0.22698*	0.127902*	0.140644*	0.086387	0.422920*	0.146804**	0.386175	0.129337*
	(0.032056)	(0.016950)	(0.012887)	(0.002735)	(0.130071)	(0.062024)	(0.413189)	(0.010586)
Short-run Volatility								
α	0.274436*	0.382169*	0.486538*	0.42283*	0.235360***	0.137976	0.340276	0.457846*
	(0.023626)	(0.033525)	(0.007261)	(0.013742)	(0.133692)	(0.092175)	(0.413304)	(0.019318)
γ	-0.257393*	-0.117114*	-0.177517*	-0.318547*	-0.417178*	-0.105734**	0.006011	-0.516112*
	(0.022442)	(0.029772)	(0.005991)	(0.014115)	(0.067039)	(0.048677)	(0.008475)	(0.010576)
β	0.70506*	0.500877*	0.483129*	0.533635*	0.515414*	0.766262*	0.647343	0.093503*
	(0.025432)	(0.045433)	(0.008781)	(0.016916)	(0.131232)	(0.133142)	(0.408035)	(0.030059)

Notes: The numbers in brackets are standard errors, *** indicated 10% p-value significance level, ** is 5% and * is 1%.

Table 2. *Statistics for Variance Bound Test using Asymmetrical C-GARCH model7 (Cont.)*

Observation period	*Crises: 08/06/2007 – 23/06/2016*				*Brexit: 24/06/2016 – 29/12/2017*			
Market	Equity	Forex	Gold	SD	Equity	Forex	Gold	SD
Distribution	Student's	GED	Normal	Normal	Student's	Student's	Student's	GED
Method	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt	Marquandt
Total Observations	2360				396			
Model Statistics								
Log Likelihood	8125.126	5727.662	8495.525	5029.003	1543.342	772.0003	1442.913	847.2657
R^2	0.981631	0.970930	0.975552	0.977924	0.976612	0.955086	0.955215	0.972766
DW-Statistics	1.669845	1.463619	1.549033	1.630397	1.808503	1.264399	1.048389	1.964433
ARCH Effects	0.702242	0.778608	4.718990	1.276436	0.299449	0.721682	0.261395	0.003581
Jarque-Bera	14918.69	41686.10	10565.50	4148.194	1603.041	599.8994	287.6948	7333.443
σ^2	0.105889	0.316246	0.094745	0.289699	0.075373	1.195377	0.22601	0.351247
Stability Tests								
Long Run Stability								
Stability Statistics	2.02902	0.40383	1.41561	0.26954	1.58371	0.11712	1.70640	0.39018
Stability Status	Volatile	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Short Run Stability								
Stability Statistics	2.62442	0.74015	2.19378	1.24986	8.84142	0.16856	0.02818	2.74668
Stability Status	Volatile	Stable	Volatile	Stable	Volatile	Stable	Stable	Volatile

Notes: The numbers in brackets are standard errors, *** indicated 10% p-value significance level, ** is 5% and * is 1%.

The volatility has a uniformed long run persistent across all observed markets as highlighted by the ϱ coefficient. This means that the crisis did impactthe long run persistent of volatility in the UK's financial market. The spotlight falls on the significant of the φ coefficient in the equity market, this confirms the earlier observation that the main effect of the crisis was on the equity market. The other observed markets all recorded a lesser significantreaction. Part of the reason why is that the remaining three markets were seen as safe haven from the high risks and uncertainties during the crises.

In the short run, the level of the reaction is significant throughout all four observed UK financial markets as illustrated by the α coefficient. However, rather surprisingly the level of reaction to a shock to the market in the gold market issignificant, thus hinting at a highly reactive market environment. Since, the gold market is seen as a solid safe haven commodity market, hence the highly reactive market could be the result offlights from other markets. The β coefficient is hinting at a mixed market with the equitymarket hinting at high level of persistent in the aftermath of a shock to the market in comparison with the other markets. It must be said thatthe equity market was at the centre of the crisis in the UK. The second factor is the Brexit referendum which came towards the end of this observed period, thus hinting at an increasingly significant persistent in the FX market. With respect to the asymmetrical effect, all markets exhibit a negative γ coefficient meaning a leverage effect. However, there is a different in the level of leverage effect with the sovereign debt market showing a significantly high γ coefficient. As noted earlier the leverage effect hint at market participants reacting to negative shocks to the market with greater magnitude than positive shocks. Although globally the observe period was highly reactive with negative market shocks, yet it must be remembered that

apart from the financial sector the financial market was not significantly affected by negative shocks during the crises. However, the sovereign debt market was affected by the hike in government debt and deficit plus the drop in key economic indicators, more importantly the downgrading of several sovereign debts during the sovereign debt crisis. In addition, the claims and counter claims regarding the impact of Brexit on the economy during the EU referendum.

Analysing the stability statistics and status from Table 1, it is worth noting that the impact from the crises only affected theequity market in the long run as previously hinted. Conversely, closer inspection of the stability statistic for the equity market hints at a small different between stability and volatile status with a level of approximately 2.03, it is worth remembering that the optimal stability statistic is set to a f-statistics of 1.96. The other observed markets all accept the conventional wisdom of markets being stable in the long run as argued by Engle & Lee (1990) and De Bondt (2000). The stability test points to a mixed result in the short run with both the FX and sovereign debt markets defying the conventional wisdom that markets tend to be more volatile in the short run as hinted by Engle & Lee (1990) and De Bondt (2000). Thus, the statistics are pointing to the FX and sovereign debt markets being stableand hence accepting the EMH. The remaining two markets hint at the accepted convention of markets being volatile in the short run with levels of approximately 2.6 and 2.2.

Brexit Period (24th June 2016 – 29th December 2017)

As with any big change in any country's direction, the aftermath of the Brexit vote was highlighted by uncertainty and a highly volatile period. Politically, the UK became increasingly unstable especially after a snap general election which was meant to strengthen the hand of the government in the Brexit negotiations resulted in a hang parliament.

Economically, as illustrated in the second section, there are huge questions and uncertainties surrounding the economic prospects of the UK during the next few years. Added to these issues, the referendum and Brexit result left a deeply divided country. In the midst of this volatile and uncertain environment, the UK's financial markets must function. The big issue inall thisis the miscommunication, indecision and arguments at the heart of the EU and UK policy making concerning Brexit. Theoretically, this have all the makings of a highly volatile financial market.

Table 1 seem to be hinting at a mixed negative feedback effect from the observed markets during the Brexit period as illustrated by the λ coefficient, with the equity and sovereign debt markets showing signs of an increasing impact. However, the gold and FX markets seem to be hinting at a decreasing impact. Surprisingly, the FX markets is more likely hinting at an indifferent feedback effect than a negative effect. However, upon close inspections of the environment, there a number of pointers to the indifferent. The first is that there is a weakness induced by uncertainty in all the major currencies. Secondly, the mixed communication from the EU and British policy makers contradicting each other. The third point is that the British economy seem to be performing much better than expected in the aftermath of the referendum result. However, the most vital point is the uncertainty surrounding a weak British government within a hang parliament.

Other than the gold market, the observed markets are hinting at a reduction in the long-run persistency factor with the ϱ coefficient pointing at relatively large decrease. Although significant on its own when combined with the increase in the φcoefficient across all markets hinting at an increase in the reaction to market shocks, this becomes increasingly significant. It must be noted that a weak persistent and strong reaction points to a highly reactive

market, hinting at a random walk model behaviour, generally, consistent with a stable market.

Although reduced in significant from the crisis period in all markets except the sovereign debt, the α coefficients still hint at a significant level of market shock reaction in the short run. The persistent in the aftermath of a shock in the short run, as given by β, seem to be hinting at mixed results with the equity and sovereign debt markets hinting at a decrease. The issue is that the sovereign debt is approaching an indifferent persistent during the Brexit period, thus meaning a highly reactive market. In a reversal of the short run persistent analysis, the leverage effect seems to be intensifying in the equity and sovereign debt markets. While the FX and especially gold markets are pointing towards a reversal of the asymmetrical effect. The gold market seems to be hinting at an indifferent asymmetrical effect with the γ coefficient pointing to an insufficient positive asymmetrical effect.

As illustrated by Table 1, during the Brexit period all the observed markets were stable and hence efficient in the long run. This seem to be highlighting that the market participants were pricing the long run impact of Brexit on the financial market and economy. However, the picture is rather splitwith respect to the short run, with the gold and FX markets seemingly stable and efficient. As noted earlier, there is a weakness in the global FX market induced by uncertainty in the economy and political stability. Hence, this may have played a major role in stabilizing the British FX market in the short run. In contrast the equity and sovereign debt markets were volatile and hence inefficient over the short run with levels of 8.84 and 2.75 approximately. As previously hinted, Brexit is likely to have an impact on the economy and trades, hence these two factors have a strong bearing on the equity and sovereign debt markets. The uncertainty and confusions surrounding

the economy and any trade deals is being highlighted by the volatile conditions in the two markets with the most significant propensity with these two factors. In reality these two volatile markets are reacting to the market participants evaluation of thenegotiation status and the likely impact on the economy and trade. At the heart of this is the miscommunication by the policy makers on both sides of the Channel. In effect this explains why the gold market isn't volatile because of its global status as a safe haven commodity which means that to a certain extent it isn't affected by Brexit.

Conclusion

In this paper, we introduced the stable market pre-condition hypothesis and used an asymmetrical C-GARCH-m variant of the variance bound test proposed by Fakhry & Richter (2018) to distinguish between the long and short run effect of Brexit on the stability and hence efficiency of the British financial markets. We also analysed the asymmetrical and feedback effect on the financial markets. The results suggest a limited impact on the general financial market going from the global crisis of the late 2000s-mid 2010s to the Brexit process. During the Brexit process, we found that the markets in general were stable in the long run. However, in the short run, we found the results were mixed with two markets hinting at stability.

There is some evidence from the literature and our empirical evidence pointing at a highly volatile impact from the Brexit process, although it does seem to be short lived. Therefore, backing one of the key arguments in the behavioural finance theory, as hinted by De Bondt (2000); market participants sometimes overreact heavily at the initial stages of an event, thus leading to correction in the long run. Like any game changing event, in the immediate time horizon market participants tend to act on little and

often conflicting information leading to asymmetrical information and/or a failure in the information system which is reflected in unstable markets in the short run.

Certainly, the evidence from the literature and news is that there is a hint of miscommunication and confusions brought about by the policy makers. This is at the heart ofthe reaction from the market participants. One of the key lessons of the recent global financial and sovereign debt crises is that a percentage of the underlying uncertainty and volatility is linked to political miscommunication, confusion and disjointed action. These three vital factors of volatile markets have seemingly continued during the referendum debate and to a high extent the Brexit process. Based on our findings, we advise all policy makers to make clear and decisive statements and not to engage in tit-for-tat arguments. We also recommend an agreement by all policy makers on both sides to put forward a unified voice and plan. It is essential not to repeat the same mistakes made during the recent crisesand early stages of the Brexit process. Also, we advise the UK policy makers to put forward a decisive and unified plan for the economyin the aftermath of Brexit and effectively communicate it. As illustrated previously by the literature, the economy is and will be the main source of uncertainty in the financial markets at present and for the foreseeable future.

In concluding, it would seem that market participants have already priced the impact of the EU Referendum into the markets in the long run. However, with market participants being humans and hence reactive, any unexpected event in the Brexit process or sign of weakness in the economy during the Brexit process could result in a highly volatile and uncertain financial market. The key in any event and not just Brexit is the information that filters in the aftermath of the event, be it statements or statistics;

needs to be collated and more importantly not conflicting, if market are to remain stable.

Notes

[i] See [Retrieved from] for details of Article 50 of the 2007 Lisbon Treaty

[ii] See [Retrieved from] for details of the 2007 Lisbon Treaty.

[iii] See [Retrieved from] for details on the EPU

[iv] Economists for Free Trade formerly known as Economists for Brexit

[v] Due to our inability to get the full observation of the Gilt market, we used the Barclays Index to cover the pre-crises and crises periods and S&P Index to cover the Brexit observational periods.

[vi] For a description of the index and how it is calculated see the following Bank of England website: [Retrieved from].

[vii] We tested on a different environment and got slightly different estimation results. However, the variance bound tests were not affected.

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3 From optimism to pessimism: The stability of the Euro FX market in the short and long run

Introduction

As argued by (Schmitter, 2005), at the heart of the further and deeper integration of Europe lays a strong ideology which is to prevent conflicts between the major European countries, there is a need for a deep integration. The introduction of the euro and EMU in 1999 was regarded as a necessary step on this road, integrating the economies and financial markets under one currency and monetary policy. Conversely, on 1st January 1999, the euro was first introduced into 11 countries, and as we will see in the next section, it was greeted with extreme optimism by many economists and academics. However, recent developments have caused a rise in the popularity of populist nationalism political movements, especially in the aftermath of the crises and economic downturns. Mainly due to the loss of a "*national identity*" and"*economic constraints*".

So, the key questions are: how did we go from optimism to pessimism in two decades? Additionally, what is the impact on the stability of the Euro FX market?

In this paper, we analyse the stability of the Euro FX Market in the short and long run to capture the impact of this movement from optimism to pessimism. We use the variance bound test of (Fakhry & Richter, 2018) to analyse the long and short-run stability of the Euro FX market from its introduction till 31st December 2019. We subdivide the observations according to three different periods of impact: the introductory, crises and populist movement.

Our essential contribution to the literature on European integration is in our research and analysis of the long and short-run stability of the Euro FX market over three sub-periods. The sub-periods correspond to different episodes in the Euro timescale as the mood changes from optimism to pessimism. We follow (Fakhry & Richter, 2018) in using the C-GARCH model of (Engle & Lee, 1999) to model our variance bound test and analyse the volatility pattern. Furthermore, we combine behavioural and EU theories in explaining the movement from optimism to pessimism.

Our findings seem to be hinting at a critical requirement of two fundamental theories to explain the timeframe of the euro: behavioural finance and EU integration. It is only by combining these two theories that one begins to capture the impact of the three main episodes in the timeframe of the euro on the FX market, and hence the market participants. Damningly, our analysis hint at long-run concerns based on underlying policy issues in the European integration. Moreover, the problems were known, since the interception of the EMU. Conversely, our test of the stability of the Euro FX market in the short and long runs illustrates that as the market moves from one episode to the next, the market become increasingly volatile in the long run. This movement seems to be correlating with the trends from optimism

towards pessimism on the EMU and EU integration. A possible explanation is that market participants are increasingly fearful of the long term life of the euro.

The structure of the paper follows the usual format in that the next section is the literature review. The following chapter is the methodology and data description. The last two parts are the empirical evidence and conclusion.

Literature review

A critical factor in the European integration process, as highlighted previously, is the elimination of the threat of war. As argued by (Rosamond, 2005), both (Haas, 1958) and (Hoffmann, 1966) extended the ideology of David Mitranythat international cooperation is the best way of preventing conflicts amongst different nation-states. It was this fear of another war and the underlying thinking of David Mitrany that were the driving forces behind what would eventually become the European Union. Furthermore, as stated by (Bekaert *et al.*, 2013), from its inception in 1957, the EU has promoted the free movements of goods, services, capital and people.

Furthermore, the goal of the EU has always been complete economics and financial integration among its members. Conversely, as outlined by (Genschel & Jachtenfuchs, 2018), since the mid-1950s, EU policy has been market integration, which does not require political function integration. However, with the increasing market integration activities in the 1990s; there was added functional spillover pressures into monetary/fiscalpolicies. Moreover, as suggested by (Genschel & Jachtenfuchs, 2018), the member states refused to have these fundamental core state powers integrated under the European Union. Hence the European Union opted to regulation integration and horizontal differentiation. Furthermore, as argued by (Gali & Perotti, 2003), fiscal integration was regarded by many as an

unnecessary and harmful "straitjacket" on national fiscal policies. Conversely, the EMUpolicies of monetary integrationcame into EU regulations with the Maastricht Treaty of 1992.

The Maastricht Treaty did not come into effect until 1999 when the introduction of the euro and EMUcame into being. Both were launched to much fanfare by many academics and policymakers as highlighted by (Cohen, 2003), many predicted a rosy future for the new currency and some predicted the euro would eventually challenge the US dollar for global supremacy. (Gros & Thygesen, 1998, p.373) states that the euro will be a second global currency. Furthermore, (Mundell, 2000, p.57) was in no doubt that the euro would eventually challenge the US dollar. Moreover, according to (Bergsten, 1997) and (Alogoskoufis & Portes, 1997), the strength of the Eurozone's economy and hence economic fundamentals means that the euro challenge was likely to be sooner.

However, according to (Cohen, 2003), few, such as McCauley, (1997) and (Wyplosz, 1999) disagreed with the pace, not the trajectory of the euro's challenge and optimism. Moreover, fewer still questioned the enthusiasms towards the euro at the time, such as Feldstein, (1997) and Calomiris, (1999). Feldstein, (1997) warns of the increased likelihood of conflicts between EU member states due to disagreements among the Eurozone memberstates with regards to the goals and methods of monetary policy. Thus, leading to economic disputes on several issues and hence distrust amongst some member states.

Moreover, as Calomiris, (1999) argues there are two significant issues at the heart of the EMU agreement that could prevent the euro from challenging the US dollar. The first is the ability of any member state to exits the Eurozone, thus leading to the possibility of the threat of withdrawal being used to influence monetary policy. The second issue is

a lack of credible plans to guard the euro against fiscal shocks in member states. Furthermore, according to (Cohen, 2003), significant obstacles were standing in the way of the euro:

- The persistent inertia behaviour of monetary systems
- The high costs of business
- The "*anti-growth*" bias built into EMU
- Ambiguous governance structure of EMU

Although as hinted by (Cohen, 2003), there is no reason why the EU may not overcome these obstacles.

Nevertheless, during the early partsof the euro, there were many positives concerning the financial markets. According to (Danthine, Giavazzi & Von Thadden, 2000) and (Trichet, 2001), the euro had an immediate impact on the Eurozone financial markets. Furthermore, according to (Fratzscher, 2002) and (Baele *et al.*, 2004), the EMU is the main driving force for the increased integration in the Eurozone equity markets since 1996. As (Baele *et al.*, 2004) states, there are three critical elements of the Eurozone financial market integration:

- The advantages of sector diversification have surpassed those of country diversification.
- Common news factors increasingly determine equity returns.
- The decrease of home bias leading to an increasing diversification in financial portfolios.

However, (Ehrmann & Fratzscher, 2002) found that US macroeconomics news continued to have a more considerable impact on Eurozone financial markets. Moreover, the effect of the euro was diverse across theEurozone financial markets spectrum, as (Galati & Tsatsaronis, 2003) notes. Indeed (Cappiello *et al.*, 2006) found that in comparison with the bond market, the integration of the equity market was partial. Furthermore, according to

(Bekaert *et al.*, 2013), the increased financial integration was mainly due to EU Membership and not euro adoption.

According to (Banducci, Karp & Loedel, 2009), the euro enjoyed majority support across the EU despite the significant inflationary pressures during the first ten years. The reasoning is a combination of positive effects on the EU and the strength of the new currency. Nevertheless, (Tsoukalis, 2011) hints at a shift during the second decade in the prospects of the euro. After a period of economic recession and financial crisis, many were questioning the monetary unionand EU. According to (Genschel & Jachtenfuchs, 2018) and (Jones, Kelemen & Meunier, 2016), the crises and economic recessions have highlighted the fundamental flaws in the original structure of the monetary union agreement. However, as European Commission president, Romano Prodi, prophesied in the Financial Times in December 2001:

> "I am sure the euro will oblige us to introduce a new set of economic policy instruments. It is politically impossible to propose that now. But some day there will be a crisis and new instruments will be created."

As illustrated by the comment, the EU knew these flaws since the interception of the EMU project. As argued by (Jones, Kelemen & Meunier, 2016), the EMU project had three crucial factors for the success of the euro in the long term missing:

- Fiscal Union
- Macroeconomics adjustment policies
- A unified banking regulation

According to (Jones, Kelemen & Meunier, 2016) then, the seeds to the crises were planted in the inadequate policies underpinning the EMU on its interception. Moreover, at the heart of this inadequacy was the lowest common denominator factor facilitated by the intergovernmental

bargaining process as dictated by liberal intergovernmentalism.

As hinted by (Genschel & Jachtenfuchs, 2018), at the heart of the neofunctionalism and liberal intergovernmentalism theories is a simple truth that integration is the efficient collective response to a common European problem. The problem is that the EMU was not genuinely efficient and collective as proved by the crises. In essence, the EMU project created as many problems as it solved. As listed by (Genschel & Jachtenfuchs, 2018), the EU has come up with some possible scenarios for the future path of integration:

- "carry on", this implies an ad-hoc problem-solving unreformed EU. Nevertheless, as recent events have proven, this is a risk riddled scenario.
- Unwind back to the Single market integration policy, thus dropping all attempts at core-power integration and abandoning the EMU and Schengen projects. This scenario was unpredictable and had many unknown issues. Therefore it was deemedtoo costly, even for crisis-hit members such as Greece.
- Increased horizontal differentiational integration whereby unwilling or unable member states opt or forced to opt-out of further integration of state core powers. This scenario contains no understanding of the solutions to existing problems. Moreover, it would need an increased willingness by the "*able*" to show a multilateral solidarity.
- "doing less more efficiently", this implies the EU focusing on a few essential functions and more importantly getting involved in the regulation of these functions.
- Increase full integration for all member states. The fear is that this scenario may lead to a federal interpretation of theEU integration.

Furthermore, As argued by (Jones, Kelemen & Meunier, 2016), the incomplete piecemeal approach to the crisis

presented two intertwined puzzles. The first is that at the start of the Euro crises, the leaders acknowledged that such an approach would be inadequate. The second is the tendency for every step in this piecemeal approach to lead to further EU integration rather than disintegrate. As a result, "failing forward" by the constant policy of responding to failures of incremental reform of EU with new piecemeal reform for deeper integration. Providing answers to this intertwined puzzle means analysing both the intergovernmentalism and neofunctionalism approaches. The key argument here is that each school addresses a specific issue within this puzzle; intergovernmentalism captures the dynamism within the critical junctures, whereas neofunctionalism defines the mechanism underpinning links between one critical juncture and the next. The fusion of these two schools would present acomplete picture of the EU's response to the Eurozone crisis, thus explaining the fail forward pattern in EU integration.

As defined by (Schimmelfennig, 2017), a crisis in European integration is a situation whereby the decision-making process couldmanifest into a threat leading to a significant probability of disintegration. A disintegration is the reduction of the current level, scope and membership of integration. Simply put, an integration crisis is one which could threaten the extent of pooling and delegation, EU policy competences or member states exiting. This definition was at the heart of the crises within the EU during the last few years. Furthermore, crises are open-ended events that may disintegrate the EU, the reassertion of the status quo or further integration. Thus, capturing the essence of a decision-based crisis cycle: spill-back, encapsulation and spillover leading to positive, negative or stable changes in the integration process.

According to (Schimmelfennig, 2017), in its most general conceptualisation an explanation of a crisis in the EU

integration process generates a deviated response from all three prevailing theories of EU integration. As illustrated by Table 3, there are varied differences in all categories of an integrated crisis which highlights the underlining assumptions of each theory. These differences range from the explanation of the crisis to the eventual outcome. Depending on the theory, the result could be disintegration or further integration. In summarising, the three theories do agree with the importance of the crises to the catalyst of theoretical and observational changes in European integration. However, they disagree with the source, processes and effects of the crises on the integration process.

Table 3. *Integration Theories General Explanation of Crises*

	Intergovernmentalism	*Neofunctionalism*	*Postfunctionalism*
Crisis origin	Exogenous: International Challenges Domestic changes	Endogenous & International: Spillover	Endogenous & domestic: euro-scepticism
Crisis mechanism	Bargaining	Path-dependency	Politicisation
Condition of crisis outcome	Intergovernmental preferences Power constellation	Interdependence, supranational autonomy and capacity	Insulation
Crisis Outcome	N/A	Positive feedback: resilience, integration	Negative feedback: stagnation, disintegration

Source: Schimmelfennig, (2017).

Thus, highlighting the three separations in the explanation of the EU integration process during the crises. Firstly, the intergovernmentalism account for the euro crises. As suggested by (Hooghe & Marks, 2019), the euro crises had several features which could be explained by intergovernmentalism. The threat to the existence of the Eurozone was significant and immediate.

Moreover, the EU did not have the financial resources and legality to intervene as the lender of last resort. Hence the solution was in the intergovernmental bargaining between the member states. Thus, resulting in a "*chicken game*" characterised by hard intergovernmental bargaining and brinksmanship between the northern rich nations and southern crisis-ridden nations. The threat of the crisis to the existent of the Eurozone ensured a lengthy and iterated intergovernmental negotiation characterised by substantial interdependence and sharp asymmetries. The resulting series of lowest-common-denominator deals constrained by the diverged preferences on the distribution of costs did just enough to avert the dissolution of the Eurozone. Conversely, minimising the immediate expense to the northern states in the dominant bargaining position.

As hinted by (Hooghe & Marks, 2019), the long-term perspective was explained by the neofunctionalism approach. The severity of the euro crises was mainly due to the "*half baked*" functionality of economic and monetary integration introduced by the Maastricht Treaty. Neofunctionalism dictates that when the euro crises hit, path dependency meant that member states were primarily concerned with saving the Euro generating intense pressures to fixing the flaws. Initially, the agreements were to introduce several institutions under the direct influence of member states; subsequence agreements nudged these institutions towards control by the EU. The ECB also obtained more powers to act as like any central bank to supply money and buy assets thru QE and outright monetary transactions policies. Hence, the crisis was the result of an unintended spillover and concluded with enhanced supranationalism.

And finally, the postfunctionalism account. According to (Hooghe & Marks, 2019) in contrast, postfunctionalism perceived the response by the EU to the euro crises as a

result of domestic politics and, particularly, the rise of nationalist opposed to European integration. Thisissue was central to the lack of a quick, cohesive and strategic response; therefore resulting in the spiral of the crisis. Moreover, the domestic politics during the crisis meant a resistance to supranational solutions. Furthermore, northern governments were reluctant to heed advice to ditch their "*me first*" policies of economic growth fearing public opinion. This combination of fear and greedundermined the response of the EU nearly led to the collapse of the Eurozone. A further complication, according to postfunctionalism, was the politicisation of the crisis. Thus, leading to a narrowing of reform options in the wake of the crisis. This procrastination meant that instead of the urgently required reform of the Eurozone, a cocktail of monetary policy, bailouts and tightening regulations was the result. Moreover, the price paid by all sides was high.

However, the impact on the euro was small, to explain the limited impact, we need to understand the psychology of the market participants. A fundamentalexplanationof the lack of any effect on the euro is the euro heuristic, as derived by (Szyszka, 2013). The euro heuristics is the tendency of market participants to put all Eurozone states under the same label. Another factor is the belief by many that the euro was safe because both sides were not willing to abandon it. As stated by (Moravcsik & Schimmelfennig, 2012), the risk of catastrophe would unite all parties of the EU to avoid the immediate costs of default. For the southern countries at risk from high debt, there were high external and internal macroeconomic risks associated with leaving the euro. For the more prosperous countries of the north, the breakup of the euro would have meant currency appreciation and thus loss of trade.

Nevertheless, the popular resistance to further EU integration, as highlighted by severalrecent events, has the

potential to impact on the Euro. As highlighted by (Schimmelfennig, 2018), according to postfunctionalism differentiated integration and disintegration are attributed to a politicisation process. This process points to a shift in European integration issues from interest groups to the masses where political identity plays a more significant role. Here are several factors driving the politicisation process:

- the depth of integration
- exclusive national identity
- Euroscepticism
- referendums

According to (Schimmelfennig, 2018), the demand for disintegration centre around the three hypotheses based on the last three factors:

- The spillover of integration into identity-relevant areas.
- A big issue is the increaseinEurosceptic political parties within the member states.
- The increase availability or use of EU integration referendums.

The European Parliament election of 2014 and Brexit werethe catalyst for the demands for a partial or full disintegration. Underpinned by nationalist populism tendencies which are deviated towards euro scepticism as hinted by (Fligstein, Polyakova & Sandholtz, 2012),(Guiso *et al.*, 2019),(Luo, 2017), (Polyakova & Fligstein, 2016) and (Tsarouhas, 2019). The increasing popularity of political parties such as National Rally in France is a threat to further EU and Eurozone integration. Furthermore, as hinted by (Fakhry, 2019b) since the Franco-German axis is the driving force behind European integration, the substantial rise of National Rally could present some difficulties to further Eurozone and EU integrations. However, many like (Mudde, 2016) disagree with the significance of both the 2014 European Parliament election and Brexit. Moreover, the

problematic and long winding Brexit negotiations should act as a repellent against any thoughts of disintegration, especially for the eurozone members.

Methodology

Since as stated by (Pastor & Stambaugh, 2012), conventional wisdom dictates that there is a difference between long and short runs in economicsand, more specifically, the financial markets. Moreover, (Engle & Lee, 1999) hints that volatility has a more rapid mean reversion in the short run than in the long run. Also, (De Bondt, 2000) indicates that the price reverts to the fundamental price in the long run. Effectively what (De Bondt, 2000), (Engle & Lee, 1999) and (Pastor & Stambaugh, 2012) are indicating is market participants' reactions tend to deviate overtime. Thus, meaning that markets are generally less volatile and reactive in the long run due mainly to being less perspective to shocks and hence are more stable.

In analysing the stability of the Eurozone financial markets in the long and short run in the aftermath of the introduction of the Euro, we used the methodology of (Fakhry & Richter, 2018). Like (Fakhry, 2019a), we use the asymmetrical C-GARCH-m model of (Engle & Lee, 1999) as the model of volatility underpinning our stability test in the long and short run. As with (Fakhry & Richter, 2018) and (Fakhry, 2019a), we adhere to the two pre-requisite steps advocated by (Shiller, 1979) and (Shiller, 1981): calculate the 5-day variance and estimate the residuals as in Equation 1 and Equation 2.

$$\lim_{t \to T} var(Price_t) = \frac{\sum_{q=1}^{Q} (Price_t - u)^2}{Q} \quad (1)$$

$$var(Price_t) = a + b.var(Price_{t-1}) + \mu_t, \mu_t = \mathrm{T}\mu_{t-1} + \varepsilon_t \quad (2)$$

Since we follow the methodology of (Fakhry, 2019a) by including the feedback effect, we are thus using the GARCH-m model of (Engle, Lilien & Robins, 1987) as the mean equation illustrated in Equation 3. The key to interpreting the feedback effect is the λ coefficient in equation Equation 3. Thus, a significantly positive λ coefficient hints at a positive feedback effect and suggests that as risk increases, the return should increase as well. However, in contrast, a significantly negative λ coefficient means as risks increases, the returns should decrease.

$$var(Price_t) = \lambda h_{t-1} + a + b.var(Price_{t-1}) + \mu_t \quad (3)$$

We estimate a first-order asymmetrical C-GARCH-m (1, 1) model to obtain the long and short-run volatility using Equation 3. As derived by (Engle & Lee, 1999), the asymmetrical C-GARCH model is as illustrated in Equation 4 and Equation 5. Equation 4 is the long-run volatility, and Equation 5 is the short-run volatility. The critical interpretation of the volatility model and the calculation of the stability status is in the coefficients of Equation 4 and Equation 5. Since as illustrated by (Engle & Patton, 2001), in the short-run, the α and β coefficients represent the market shocks (or news) and persistent respectively in Equation 5; thus in the long-run, we can deduce that φ and ρ represent the market shock (or news) and persistent respectively. γ is the asymmetrical effect whereby if γ is >0, then there is a leverage effect meaning that negative shocks have a more significant impact than positive shocks.

$$m_t = \omega + \rho m_{t-1} + \varphi(k_{t-1} - h_{t-1}) \quad (4)$$

$$(h_t - m_t) = \sigma^2 + (\alpha k_{t-1} - m_{t-1}) + (\beta h_{t-1} - m_{t-1}) + \gamma(k_{t-1} - m_{t-1})I \quad (5)$$

where $I = \begin{cases} 0, \varepsilon \geq 0 \\ 1, \varepsilon < 0 \end{cases}$

As stated by (Fakhry, 2019a), the coefficients of both equations are required to calculate the stability statistics in our variance bound test. We derive our stability test by using the f-statistics, which for our observed data samples at the 5% level is 1.96, which means that our short and long-run stability statuses are Equation 6 and Equation 7 as derived by (Fakhry, 2019a). As in (Fakhry, 2019a), the conditions in Equation 6 and Equation 7 mean that the markets are stable and therefore have the potential to be efficient. Otherwise, they are volatile and inefficient.

$$SS_{SR} = \frac{(\alpha+\beta+\gamma)-1}{sdev(var(Price))} \leq FStat \quad (6)$$

$$SS_{LR} = \frac{(\varphi+\rho)-1}{sdev(var(Price))} \leq FStat \quad (7)$$

Data description

As stated earlier, this paper analyses the stability of the eurozone financial markets during three different periods (Euro introductory and enthusiastic period, crises period, and the rise of nationalistic tendencies period). Hence, we observe the Euro FX market to determines the stability of the market. We use the nominal broad effective exchange rate obtained from the Bank for International Settlement as our observed Euro FX index dataset. Our data consist of daily market observations on a 5-day week basis between 1st January 1999 and 31st December 2019, filling the missing data with the last previously known data. Thus, giving us a total of 5,478 observations.

Empirical evidence

This research is essentially an analysis of the long/short-run behaviour of the FX market over the three critical periods in the lifetime of the euro. Hence, in this section, we

will analyse the stability and reaction of the Euro FX Index during three observed periods:

- The Introductory period observed from 1st January 1999 to 7th June 2007
- The Crises period observed from 8th June 2007 to 23rd May 2014
- Populist era observed from 24th May 2014 to 31st December 2019

In estimating the models, we used the Marquandt estimation method and normal distribution for all except the last period where used GED distribution. Crucially, the system environment may influence the estimation: our system is running EViews 11 on a Windows 10 Procomputer with a ten cores CPU and 32 Gigabytes RAM.

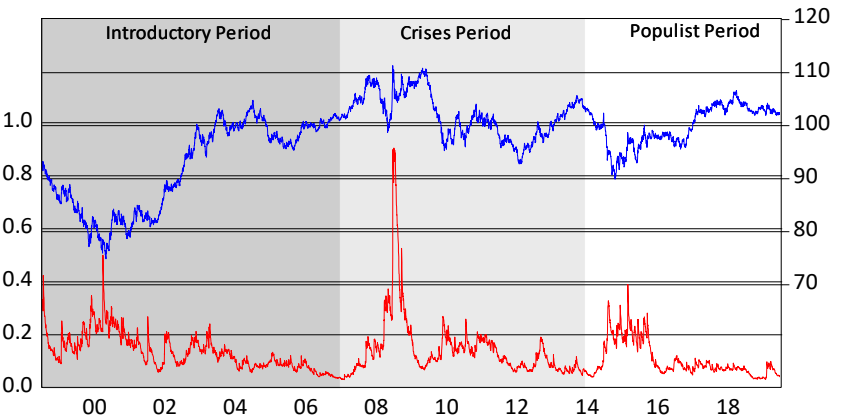

Figure 1. *Euro FX Index Price/Volatility*
Introductory period (1st January 1999 – 7th June 2007)

As illustrated by Table 2, the stability statistic during the introductory period point to a stable Euro FX market in the long run; nevertheless, in the short-run, the statistic point to a volatile market. This market status is to be expected, since as stated by (Pastor & Stambaugh, 2012), conventional wisdom dictates there is a difference between the short and

long runs. Generally, markets are more volatile in the short run than the long run due to being more perceptive to shocks. In other words, the Euro FX market was acting according to the standard model of stability. For an explanation, we should look no further than the impact on the behaviour of market participants due to the high esteem held on the euro.

Table 2. *Stability Statistics*

Period	Introductory	Crisis	Populism
	Mean Equation		
λ	-48.16507	-1.159715	-20.06817
	(1.47052)	(0.013797)	(2.280472)
a	0.006503	0.008379	0.004446
	(0.0000637)	(0.0000711)	(0.000057)
b	0.850834	0.8869	0.895971
	(0.000977)	(0.000534)	(0.001304)
μ	1.041197	0.996237	1.065394
	(0.001745)	(0.000383)	(0.001581)
	Variance Equation		
ω	5.51E-05	1.37E-05	3.95E-04
	(0.0000689)	(0.000000424	(0.000213)
	Long-run Volatility		
ρ	0.999717	0.688325	0.99896
	(0.000499)	(0.015007)	(0.000599)
ϕ	0.062181	0.136586	0.306595
	(0.004522)	(0.003271)	(0.012149)
	Short-run Volatility		
α	0.509198	0.334797	0.264035
	(0.012595)	(0.001347)	(0.013898)
γ	-0.284205	-0.254329	-0.094332
	(0.008399)	(0.000971)	(0.011982)
β	0.410574	0.62349	0.732849
	(0.014589)	(0.001354)	(0.01454)
	Model Statistics		
R2	0.976249	0.989023	0.974515
Log Likelihood	9002.11	7559.88	6309.92
DW-Statistics	1.757622	1.719615	1.709137
ARCH effect	0.607483	1.861465	0.00193
Jarque-Bera	1.31E+03	2.22E+03	1.45E+03
σ2	0.036304	0.06877	0.041619
	Stability Test		
	Long-run Stability		
Stability Statistic	1.704991	2.546008	7.341719
Stability Status	**Stable**	**Volatile**	**Volatile**
	Short-run Stability		
Stability Statistic	10.038370	4.304813	2.341431
Stability Status	**Volatile**	**Volatile**	**Volatile**

The euro came into being on the back of some over-enthusiasm reaction. Thus as illustrated by Figure 1; during the initial stage of the introduction, the euro was highly volatile. This over-enthusiasm led to the euro being initially over-priced, which meant there were some intense downward pressures on the price. However, by early 2001, the euro was beginning to establish itself as a primary global currency and stabilising force in the European integrative process. The European Union economies, more specifically the Eurozone, were on an upwards trends which reflected on the euro. It seems the criticisms directed at the underlining EMU policy were not an issue. However, on closer inspection, the economic situation underpinning the strength of the euro was somehow weaker than first sight would suggest as illustrated by the collection of economic graphs in Figure 4. Remember the Stability & Growth Pact underpinning the European Monetary Union set the limit at 60% and 3% for the debt and deficit to GDP ratios. Although, neither the ECB nor the EU seems to have GDP growth and unemployment rate targets, yet the majority of the 12 original Eurozone members had a higher unemployment than the US target of 5.5%. What is astonishing is the Greek statistics, yet the banks continued to buy the Greek debt.

A long bull market and economic upturn in the global economy was at the forefront of this period. At the heart of this long period of economic boom was the housing market bubble induced by low interestrates and high leverage. Although the headline housing market bubble was mainly in the US; however, there was evidence across the Eurozone of a housing market bubble. The bubble was subsidised by the securitisation of mortgages in highly complex mortgage-backed securities and collateralised debt obligations offering high rates of returns. These securitised financial assets offered high yields on investments; however, they were highly risky and complicated financial assets as argued by

(Barberis, 2013), (Brunnermeier, 2009) and (Masood, 2009) amongst others. Although, most people would agree that the US securitisation market was instrumental in the bubble; yet, European securitisation markets were also partly responsible for the housing market bubbles in certain countries.

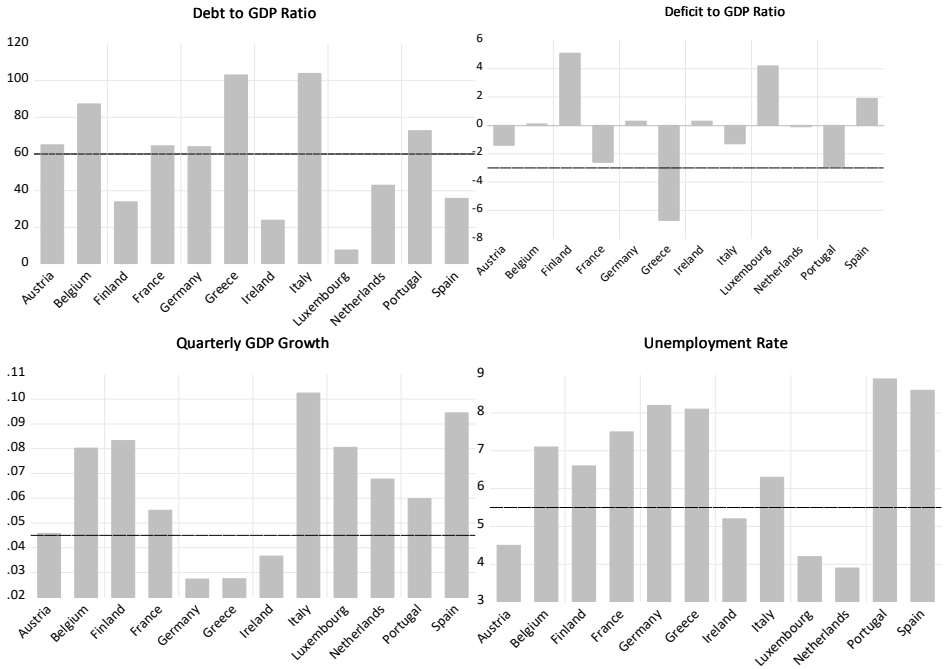

Figure 4. *Key Economic Statistical Data in 2007 (source Eurostat)*

One possible explanation for the market participants' reaction is found in the "Euro Heuristic" as derived by (Szyszka, 2013), which dictated that market participants tended to simplify by putting all the Eurozone financial assets in the same boat marked euro. This scenario included the adoption of sovereign debt from the GIIPS group of nations as safe-haven assets required by the Basel II regulation; in addition to risky financial assets from the

periphery Eurozone member states, such as the securitised MBS or CDO from the GIIPS nations.

According to (Barberis, 2013) and (Szyszka, 2013), an underlying issue was that market participants were extrapolating into the future with both sovereign debt and securitised assets markets. In the case of the securitised assets, they were extrapolating the rise of house prices too far into the future as identified by (Barberis, 2013). However, with the sovereign debts; they were extrapolating the continuation of the economic upturn as signified by (Szyszka, 2013). The markets were enjoying the honeymoon period of the Euro and EMU, failing to see the strategic consequences of the EMU and hence associated risks. This false sense of confidence in the economy and financial markets created by the integrative process of EMU and euro created a bubbled and overleveraged economy.

As portrayed by (Szyszka, 2010), at the heart of this period of economic boom and bubbled financial market was the fear/hope (greed) conundrum[1]. As explained by (Lopes, 1987) and (Shefrin & Statman, 2000), there are two emotions dictating risk management, namely fear and hope(greed). While fear is determined by the overweighing of the worst-case scenario probabilities, greed is determined by the overweighing of the best-case scenario probabilities. Simply put, greed makes market participants unduly optimistic on investment opportunities; while fear makesmarket participants increasingly pessimistic. In short, market participants were showing signs of greed due to their excessive optimism towards the euro.

This greed gave rise to a housing market and securitisation assets bubble in some eurozone member states, particularly Spain. The influencing factor behind this bubble

[1](Szyszka, 2010) refers to greed and fear but (Shefrin & Statman, 2000) and (Lopes, 1987) refer to it as hope and fear.

is the ever-increasing rate of returns required by market participants during a period of long-lasting boom in the global financial market. Furthermore, the low cost of finance meant market participants were able to leverage at high levels just to increase the returns on investment. Policymakers underestimationof the significance of the developing bubble and the euro heuristic certainly helped inflame these two factors, as hinted by (Szyszka, 2010). The high rates of returns and low costs of finance during a booming economy meant that market participants became increasingly greedy and demanding,

There is a further explanation of there was a need for European market participants to invest in these financial assets, due to the enormous earnings made by their US counterparts. Thus inducing peer group pressure and leading to envy as highlighted by (Hodgson, 2013). Moreover, as noted by (Alchian, 1950) and (Friedman, 1953), the sole existence of a publicly listed company is to maximise the shareholders' wealth. Hence, many European financial institutions were under pressure to increase earnings and thus maximise the shareholderswealth.

In essence, as noted by (Barberis, 2013), thru the use of the belief manipulation hypothesis; market participants were able to delude themselves into thinking that their model was in the best interest of the organisation and thus the shareholders' wealth. The belief manipulation hypothesis dictates that market participants affected by cognitive dissonance will attempt to manipulate their mindsets into thinking they are acting for the good of all involved. A key behavioural component in the belief manipulation hypothesis is the representative heuristic dictating that since the pricesof the underlining assets; in this case, the houses, were likely to continue rising; hence these securitised assets were expected to continue to be low risk. Another representative heuristic is that the economy of the Eurozone

was expected to continue getting more robust based on the strength of the euro. Therefore investing in the sovereign debt of many periphery member states was risk-free and hence could be regarded as tier 1 capital under the Basel II regulations.

The Eurozone Crises (8th June 2007 – 23rd May 2014)

Table 2 is pointing at a volatile Euro FX market during the crisis period, and the critical factor is that it is not limited to the short-run. The long-run is also volatile, thus going against the conventional wisdom as dictated by (Pastor & Stambaugh, 2012). Therefore, highlighting the depth and extreme uncertainty of the crises. In essence, this period was the combination of three critical factors into a perfect storm; which left many people questioning the European integrative process and the EMU. However, as (Dabrowski, 2010) illustrates the continuation of the euro optimism; when added to the initial rebuttal of the financial crises as merely an American issue, meant that market participants continued to believe in the euro. Furthermore, the European response when it finally did arrive was late and uncoordinated. To understand the impact of this EU and euro FX market uncertainty on the market participants, we need to understand the reactions of the market participants towards the volatile financial markets and confusion at the heart of the EU.

By the end of 2005/early 2006, the housing market bubble burst, and subprime defaults rose. Nevertheless, as subprime defaults rose, the securitisation of the subprime loans was continuing; eventually leading to the global financial crisis. As noted by (Barberis, 2013), a surprising feature of the crisis was the dramatic decline of many risky assets of various types. Given the relatively small size of the subprime loan, the widespread and dramatic nature of the falls in prices of risky assets did, to say the least, take most people by

surprise. Moreover, the speed at which the crisis spread globally suddenly bought into context the integrative nature of the financial market.

A key statistic in explaining this issue is the total write-down, which as of April 2009 stood at $1.109 trillion in European banks[2] as reported by the IMF[3]. Thecriticalpoint is that nobody knew the full extent of the total number of subprime-related assets; hence the shareholders were extrapolating across the banking sector and therefore making them fearful of the global banking sector.

As (Szyszka, 2010) suggests and hinted earlier, fear and hope (greed) have opposite attractions on the behaviour of market participants and generally on the trends in the markets. Hence, it comes as no surprise that when the global financial crisis hit; market participants' fear levels rose quickly. Furthermore, an ever-increasing level of fear inevitably leads to panic, which intensifies the depreciation of assets. Thus, increasing the inflow of investments in safe-haven markets such as particular sovereign debt and commodities markets, more specifically the high graded sovereign bonds and gold markets. During the global financial crises, as market participants grew ever anxious concerning the securitised subprime loans market; as highlighted earlier, they became increasingly worried about the extent of the global financial sector's holding of these "*bad*" assets. Hence fear increased and spread to the global financial sector as observed by panic runs on the global banking sector terminating in the bankruptcy of Lehman Brothers, an investment bank at the heart of the securitised subprime loans, among other major global financial institutions. There are two further conceptualisations of fear that could exuberate a crisis:

[2] Excluding the UK banks

[3] IMF Global Financial Stability Report, April 2009.

- The policy effect dictates the action or inaction of policymakers has the potential of hiking fear among market participants. This issue is key to the lengthening of the crisis, the indecision or incorrect actions by the central banks and government had a negative impact. In the aftermath of the Lehman Brothers bankruptcy, central banks and governments across the globe were forced into action by events.
- The spillover effect or liquidity spiral see Figure 5, which dictates that if a financial institution has troubles selling a "*bad*" asset, then it may try to sell a "*good*" asset. Hence, overflooding the market; thus, decreasing the price and turning the "good" asset into a "bad" asset. This situation occurred during the global financial crisis.

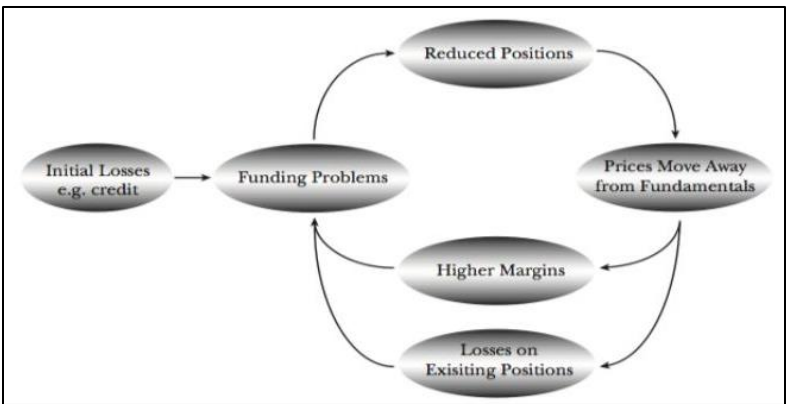

Figure 5. *The Liquidity Spiral, source: (Brunnermeier, 2009).*

As (Barberis, 2013) hints, a possible explanation is the amplification mechanism. During the crisis, the amplification mechanism dictated that any market participant facing a loss in the value of subprime backed securities tended to sell other risky assets. Thus, pushing down the prices of the other risky assets forcing them to sell their other less risky assets, thereby ensuring a loss or margin spiral. This behaviour is fundamental to the

explanation of the global spread of the crisis, particularly in our case to Europe.

However, as noted by (Barberis, 2013), the loss aversion and ambiguity aversion related amplification mechanisms may also have played a vital role in the global financial crisis. Ambiguity aversion dictates that in situations where participants are unable to assign probabilities to future trends, they become increasingly averse. An extension to the ambiguity aversion is the competence hypothesis as presented by (Heath & Tversky, 1991). The competence hypothesis dictates that the level of competence at analysing the situation determines whether the person is ambiguity averse or seeking. This hypothesis partly explains the global financial crisis; the explanation maintains that the initial loss on the subprime backed securities made investors less competent in analysing risky assets. They were thereby increasing ambiguity aversion, leading to a reduction in their holding of risky assets, therefore further reducing the price of these assets.

According to (Barberis, 2013), the second fundamental explanation is the loss aversion theory of (Kahneman & Tversky, 1979). This obverse that losses are more sensitive to market participants than profits of similar magnitudes. The less obvious observation is that the degree of aversion may vary with time, depending on the trend of losses or gains. Put simply this means any recent loss increases loss version making them less willing to take risks that they would have taken otherwise. In terms of the global financial crisis, the initial decline in the price of subprime securities made market participants loss averse; thus, selling the risky assets on their books, further reducing the prices and hence increasing loss aversion. Both the ambiguity and loss aversions played a big part in the amplification mechanism during the global financial crisis and arguably in turning the crisis from a local to a global event.

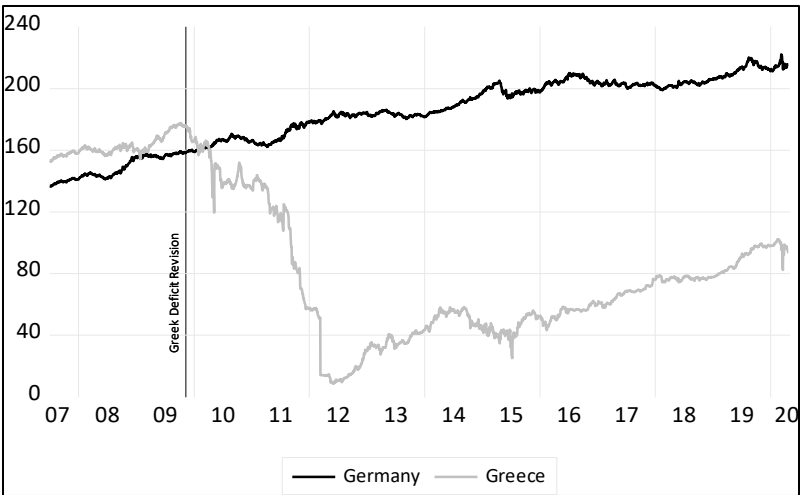

Figure 6. *Greek vs German Sovereign Debt Index Prices*
Source: S&P Dow Jones Indices

A vital element of the global financial crisis was the continuation of the euro heuristic and horizontal extrapolation, which meant that market participants ignored the weak macroeconomics indicators of the periphery Eurozone member states. This ignorance led to continued high credit rating and investment in the sovereign debt of the GIPS nations as safe havens throughout the global financial crisis.

As stated by (Szyszka, 2013), a puzzling factor in the euro crises is the somewhat belated action of the European banks in reassessing the Greek sovereign debts on their balance sheet. As illustrated by Figure 6, as late as 5th April 2010, the Greek sovereign debt was priced higher than the German. The Greek crisis started with the announcement of the upwards amendment of the fiscal deficit in 5th November 2009; the banks did not react by amending their financial statements until late 2010-early 2011. Why did it take that long to reassess the risk on their balance sheet? In truth, bad news travels slowly, simply put it is hard to accept bad

news. Theoretically, market participants tend to deploy over-optimism or wishful thinking in the belief that positive results can still be possible. Hence, as stated by (Barberis & Thaler, 2003), cognitive conservatism underweights any new information contradicting an earlier positive view. Moreover, since market participants are by nature loss avert, therefore mentally, they are discouraged from admitting failure. Furthermore, as suggested by (Kahneman & Tversky, 1979), market participants may take higher risks to avoid or postpone loss.

As identified by (Szyszka, 2013), the influence of external players, such as hedge funds and rating agencies, during the euro crises, cannot be underestimated. Among the strategies hedge funds use are short-selling and hedging by buying derivatives such as CDS. Simply put short selling is a strategy whereby the hedge fund bets on the price of an asset falling, as illustrated by Figure 7. Another strategy often used by hedge funds is hedging against a country or organisation by buying a derivative, often Credit Default Swap, against the possibility of a default. EU and national politicians blamed these two strategies during the euro crises for intensifying the crisis. A key behavioural factor underpinning these hedge funds strategies is herding, essentially herding is where market participants react to information or event in a similar way. The hedge funds often used this strategy during the euro crises whereby they would bet on a fall in euro against the dollar and Greek default.

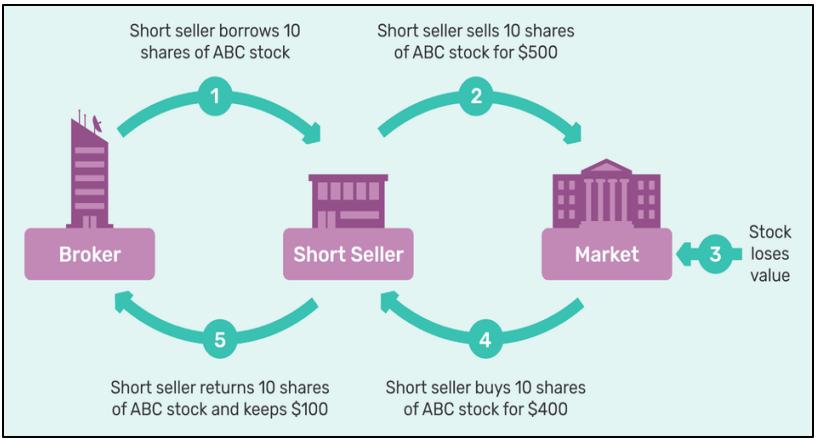

Figure 7. *Short-selling strategy*

As indicated by (Szyszka, 2013), the second relevant players during the euro crises were the rating agencies who were implicated for the global financial crisis as highlighted by (Barberis, 2013). During the euro crises, it was a case of belated action followed by a quick reaction. The failure to recognise the risk disparity among the EU members gave rise to countries with weak macroeconomics factors being given the same triple-A rating as Germany, essentially Spain and Ireland. Furthermore, the continuation of Greek sovereign debt ratings as investment grade even though macroeconomic factors pointed towards a downgrading was instrumental in the continued investment by market participants. Additionally, the credit rating agencies only acted long after the markets classed the Greek yields as junk. Nevertheless, the rating agencies overreacted in the downgrading of the Portuguese and Irish sovereign debts, even though both countries have agreed to undertake IMF restructuring programs and their economies were in better health than the Greek.

The Rise of Populism and Nationalism (24th May 2014 – 31st December 2019)

The stability statistics in

Table **2.** illustrate the volatile euro FX market during this period of rising populism and nationalism policies among the EU member states. The surprising factor is the long-run stability statistic given, as highlighted previously, conventional wisdom dictates that in the long-run, the market is generally more stable than the short-run. Thus, a stability statistic for the long-run that is significantly greater than in the short-run indicates the highly volatile events during this period. A point worthy of mentioning is that several voices within the Eurozone and EU nation-states were calling for the disbandment of the Eurozone and EMU policy. There were two events which highlighted the uncertainty existing within the Eurozone during this period: the 2014 European parliament elections and 2016 Brexit referendum.

At the heart of the surge in support for the populist and nationalist policies was the dissatisfaction in the economic reality and loss of national identity. However, the problem was that there no previous precedent for an unwinding of a monetary union. As pointed by (Ellsberg, 1961), any situation where the quality and confidence levels of the information is unknown leads to market participants becoming increasingly averse to ambiguity. Hence, the results of the 2014 European parliament and 2016 Brexit referendum were a shock to the EU system, which many did not foresee. A related issue was the availability bias; due to lack of information to relate, market participants linked these events to the euro crisis.

At the heart of the market participants' fear of these events lays a simple truth that humans fear any social signals as hinted by (Zweig, 2010). Thus, meaning any media communication affecting the financial market in any way

leads to a reaction from the market participants. Since, there was mix news and political communication about these events and the process, market participants' perceptions were negative. Another critical factor is that the whole these events were emotionally charged, which triggered a snowball effect into the financial market, causing a loss of confidence as suggested by (Zweig, 2010).

Moreover, as observed previously, market participants tend to extrapolate events into the future. During this period, notably the Brexit process, there was an element of vertical extrapolation in the analysis of the economic consequences of the Eurozone collapse. This trait was due in no small part to the ambiguity by the politicians at the heart of these events. Also, during the Brexit process, there was a horizontal extrapolation in play based on the fear that the UK could signal the partial or full collapse of the Eurozone. This fear led to uncertainty in the integrated financial market of the EU, and in particular the Eurozone as many member nations were growing disincentivised with the whole EU integrative process (e.g. Italy, France and Holland). The prolonged and complicated process of Brexit is partly down to the fact that the EU does not want togive too many concessions to the UK, in the process illustrating that life outside the EU could be worth considering.

Conclusion

In summarising, this research used the theory of European integration to review how the European Union reacted to three different episodes in the lifetime of the euro. Furthermore, to give depth to the empirical section, we used behavioural finance theories in explaining the reaction of the market participants in the euro FX market. We analysed the reactions in the market over the short and long runs using the variance bound test of (Fakhry & Richter, 2018).

We found that the market was volatile in the short-run, this is to ve expected; since as indicated by (Pastor & Stambaugh, 2012), conventional wisdom dictates that the short run is volatile. However, we also found that the long run was highly volatile during both the euro crises and populist movements episodes which do not conform to the conventional wisdom. On closer analysis, the behaviour of the market participants does suggest a feedback effect between the market participants and the EU. Moreover, since these two episodes were reflecting questionsabout the very existence of the euro, especiallythe populist movement episode; hence, they were mirroring the genuine fear in the FX market.

In concluding, it is hard to overestimate the feedback effect on the reactions of both the market participants and the EU during the euro crises and populist movements episodes. The lack of a uniformed plan and miscommunication from the EU and member states did impact the market in the long run. However, as put elegantly by John Maynard Keynes:

"The long run is a misleading guide to current affairs. In the long run, weare all dead."

What we mean is that the EU concentrated too much over the long-run; it partially neglected the problems in the short run. Issues like the loss of a national identity and economic issues, which the populist political parties managed to turn into mass politics. However, another crucial factor is the weaknesses in the EMU at the time of conceptualisation as hinted by Romano Prodi:

"I am sure the euro will oblige us to introduce a new set of economic policy instruments. It is politically impossible to propose

that now. But someday there will be a crisis and new instruments will be created."

This factor hint at the long-run issues of the EMU and hence the euro.

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4 Towards an explanation of the Euro FX market reaction in the EU: A review of European integration during the EU crises

Introduction

The euro's introduction was probably one of the most significant financial events of the last 50 years. Moreover, at its heart lays an influencing concept underpinning the EU integrative process. As stated by Schmitter, (2005), the main objective of scholars such as Ernst Haas and Stanley Hoffmann was how to conceive a process of European integration to eliminate the horrors of the two world wars. The two grand theories of EU integration, neofunctionalism and intergovernmentalism derived by Haas, (1958) and Hoffmann, (1966) respectively, were aimed at European unity in the aftermath of the war. Indeed, in its early manifestations, neofunctionalism was an attempt at theorizing the foundation of post-war European unity as noted by Rosamond, (2000). On the other hand, postfunctionalism was introduced by Hooghe & Marks,

(2009) to explain the disruptive nature of a clash between functional pressures and national identity in the European integration process in recent years.

The global financial and Eurozone sovereign debt crises highlighted the issues at the heart of European integration, emphasising the incomplete and compromised European monetary union (aka EMU). Hence in this paper, we evaluate the three grand theories of European integration to the crises and Brexit. Since Brexit is seen as a crossroad in the European integration process with others, such as Italy, waiting on the Brexit deal. Brexit could prove to be the catalyst to a fully integrative EU or the disintegration of the EU. However, since our research is about the Eurozone and the Euro FX market; it is not enough to evaluate the European integration process during the observed periods. Since, in essence, the investors/EU actions feedback is the key to explaining the crises and Brexit. Hence, we use the behavioural finance theory influenced by the seminal articles Tversky & Kahneman, (1974) and Kahneman & Tversky, (1979) to evaluate the actions of the market participants during the crises and Brexit process.

Thus, one crucial contribution is using European integration theories and behavioural finance to evaluate the crises in the Eurozone and Brexit process. We believe there are no papers written with a comprehensive evaluation of the EU's actions and market participants during the Eurozone crises and Brexit process in the Eurozone financial market. Another essential contribution is the introduction of a stability model with an emphasis on market participants' reaction. The model derived from the variance bound test of Fakhry & Richter, (2015) uses a Markov Switching GARCH model, which illustrates the differing reactions of market participants in the Euro FX market since the introduction of the euro until 31st December 2019.

Our findings suggest only by combining the explanatory powers of the EU integration theories with behavioural finance that a full picture of the crises and Brexit impact on the financial market could emerge. Damningly, the evaluation signalled too often the EU's actions were the results of reacting to the market participants and did not adequately address the issues at the heart of the crises. These issues included the lack of an available macroeconomic adjustment and fiscal policy to deal with the crisis and the incomplete and compromised monetary union at the heart of the Euro. Also, the market participants' reaction bore the whole mark of the opposite scale behaviours: greed and fear. Moreover, at the heart of explaining the Eurozone crises lay the fundamental truth that market participants were taken by the Euro heuristic factor as identified by Szyszka, (2013). Additionally, our stability model results illustrated the changing behaviour of the Euro FX market during the crises and, in particular, Brexit. The results seem to confirm the Euro FX Market trend, given the euro's strong impression during the observed periods.

However, further research is needed to confirm the validity of our model. One possible study is to analyse for different markets. Another possible route is to use other Markov Switching Garchmodels like the Markov switching EGARCH model Henry, (2009) to include the asymmetrical effect.

The rest of this paper consists offour sections: literature review, methodology, empirical evidence, and conclusion. The literature review contains the evaluations of European integration and behavioural finance theories during the crises and Brexit.

Literature review

It is essential to note that the European monetary union and euro's introduction underlinedthe relevancy of financial

markets to the EU integration process. Thus, EU integration's critical advanceshave not been political or fiscal integrations, but market integration over the last few decades. Conversely, as stated by Bekaert *et al*., (2013), the EU's goal has always been full economic and, more importantly, to this research, financial integration. Furthermore, as hinted by Genschel & Jachtenfuchs, (2018), financialintegration was thought to be more acceptable and politically less sensitiveto member states than core political powers such as fiscal policies. Since, according to Gali & Perotti, (2003) fiscal integration was regarded as unnecessary and a harmful "straitjacket" on national fiscal policies. The fear is that fiscal integration would create a vacuum where the need to react to a national recession would lead a clash with the limits imposed by the Stability and Growth Pact. Thus, leading to a procyclical fiscal policy and amplifying the economic fluctuation among Eurozone countries. Moreover, financial integration is a market rather than a supranational induced process, especially in the equity markets and banking sector with the merger of many organisations across borders. Even though this was the result of a spillover effect from the euro and EMU integration process.

A critical factor in any integrative process is the stability in the economy and financial markets. Crucially, the much-criticised Stability and Growth Pact was to prove a stable environment to the monetary union and consequently to the financial market and economy. However, as highlighted by Fakhry, (2019a) and Fakhry, (2019b), the global financial crisis and ensuing euro crises and to a lesser extent Brexit process underlined the issues of the Stability and Growth Pact. Additionally, these events highlighted the fragile stability of the financial market. Conversely as stated by Bernard Baruch and Bertrand Russell:

> "What is important in market fluctuations are not the events themselves but the human reactions to those events."
>
> "Neither a man nor a crowd nor a nation can be trusted to act humanly or think sanely under the influence of fear".

These two statements were relevant during the crises period; hinting at the need for behavioural finance to explain the market participants' psychological mindset in response to the crises and the EU reactions. However, a crucial factor in understanding the EU reaction is the integrative process; this means analysing the three primary schools of EU integration during the crises:

- Neofunctionalism as derived by Haas, (1958)
- Intergovernmentalism as originally derived by Hoffmann, (1966); subsequently extended to liberal intergovernmentalism by Moravcsik, (1993)
- Postfunctionalism identified by Marks & Hooghe over several seminal papers including Hooghe & Marks, (2009)

This literature review will be sub-categorised into two sections; the first section will review the EU's actions via the three integration schools. The second section will review the behavioural explanation of the crisis on the EU financial markets.

A review of European integration during the crises

Schimmelfennig, (2017) defines a crisis in European integration as a situation where the decision-making process could and often manifests into a threat leading to a significant disintegration probability. Whereby disintegration is the reduction of the current level, scope and membership of integration. Simply put, an integration crisis is one which could threaten the extent of pooling and delegation, EU policy competences or member states exiting.

This definition was at the heart of thecrises within the EU during the last few years. Furthermore, crises are open-ended events that may result in disintegration, the status quo's reassertion, or further integration. In essence, capturing the essence of a decision-based crisis cycle: spill-back, encapsulation and spillover leading to positive, negative or stable changes in the integration process.

Table 4. *Integration Theories General Explanation of Crises*

	Intergovernmentalism	Neofunctionalism	Postfunctionalism
Crisis origin	Exogenous: International Challenges Domestic changes	Endogenous & International: Spillover	Endogenous & domestic: euro-scepticism
Crisis mechanism	Bargaining	Path-dependency	Politicisation
Condition of crisis outcome	Intergovernmental preferences Power constellation	Interdependence, supranational autonomy and capacity	Insulation
Crisis Outcome	N/A	Positive feedback: resilience, Integration	Negative feedback: stagnation, disintegration

Source: Schimmelfennig (2017).

According to Schimmelfennig, (2017), in its most general conceptualisation, an explanation of a crisis generates a deviated response from all three prevailingintegration theories. As illustrated by Table 3, there are varied differences in all categories of an integrated crisis, highlighting each theory's underlining assumptions. These differences range from the explanation of the crisis to the eventual outcome. Depending on the theory; the outcome could be disintegration or further integration. In summarising, the three theories agree with the importance of crises to the catalyst of theoretical and observational European integration changes. However, they disagree with

the source, processes and effects of the crises on the integration process.

The Euro crisis

It is worth remembering that the euro crises resulted from a perfect storm starting with the subprime crisis in the US and developing into a global financial crisis enveloping the global financial and banking sectors. This episode had the devastating impact of spilling over into a debt crisis involving several Eurozone member states. Conversely, impacting the Euro and EMU policies' stability putting into question the membership of some states and the whole European integration process. Moreover, according to Genschel & Jachtenfuchs, (2018); the crisesraised several unsolved issues regarding the integration process:

- Why was there a high level of domestic politicisation?
- Whywas there an intractable distributive implication to the crisis?
- Why was there not an increase in differentiated integration?
- Why did the EU rely on extensive external actors?

As illustrated by Genschel & Jachtenfuchs, (2018), the principal explanation of these issues lies in distinguishing between market and core state power integrations. At the heart of this distinction are three similar assumptions made by the two fundamental theories of EU integration, neofunctionalism and liberal intergovernmentalism:

1. Interdependence increases integration: in essence, both externalities and spillover effects are mostly triggered by interdependent in sector-specific elements. Thus, implying a collective benefit in integrating these elements under a supranational policy coordination to EU members states. Therefore, this integration process is the institutional

definition of collective power-solving within the complex conditions of interdependence.

2. The harmonisation of national rules and regulations is key to the supply route of the integration process. Conversely, the delegation process to supranational bodies is limited to supporting regulatory integration via centralised monitoring, enforcement and adjudication. It is essential to note that the EU is not a positive state but a regulatory state.

3. Political supply is not automotive; this is due to distributive conflicts between member states' governments impeding the agreement of common European rules. Nevertheless, both neofunctionalism and liberal intergovernmentalism stipulate that member states resolve differences efficiently and within EU regulations' bounds. Neofunctionalism dictates that an upgrade of common interests can manage conflicts while liberal intergovernmentalism emphasises the resolution of disputes via distributive bargaining.

Central to the crisis is the supply differentiation between market integration and political (i.e. the core state power functions) integration. As observed by Genschel & Jachtenfuchs, (2018), both neofunctionalism and liberal intergovernmentalism were derived to explain market integration. Since market integration is the liberalisation of trade and incorporation of regulation across the EU, it may benefit all member states. Moreover, any disagreement between member states over regulations may be overcome based onthe most significant common multiple. Thus, resolving conflicts by upgrading common interests and power-based distributive bargaining.

As hinted by Genschel & Jachtenfuchs, (2018), political integration is an entirely different type of beast. Moreover, the functional optimism of both theories become increasingly marginalised. Since political integration involved the turnover of core state powers (such as defence,

fiscal, monetary, policing) to the EU, this suddenly becomes an invasion of national state affairs. Thus, leading to a misconception aboutoverall governance and resentment from the nation-states leading to nationalist or Eurosceptics taking advantage. However, central to the political integration issue are two key factors: unlike markets, core state powers have limited resources, and hence the distributive conflicts involved tend to be more pronounced. Thus, leaving little room for conflict resolution by upgraded common interest or power-based distributive bargaining.

Moreover, regulation is less effective in integrating core state power due to compliance cost falling only on the member states. Thus, meaning compliance is a matter of ability rather than willingness. Conversely, political integration could magnify the exogenous shocks or amplify the asymmetric interdependencies leading to endogenous shocks. Therefore, the integration of core state powers needs to be backed by burden-sharing at the European level to reduce excessive risk on member states. Of noteworthy is just because there are difficulties in the supply of political integration does not mean there is no demand for it. However, this demand was met by inadequate supply before and during the crises.

As outlined by Genschel & Jachtenfuchs, (2018), since the mid-1950s, EU policy haspreferred market function integration due to not requiring political functions integration. However, with the increasing market integration activities in the 1990s; there was increasing functional spillover pressures into monetary and fiscal policies. Furthermore, as suggested by Genschel & Jachtenfuchs, (2018), the member states refused to have these fundamental core state powers integrated under the European Union. Hence the European Union opted to regulation integration and horizontal differentiation. Conversely, monetaryintegrationcame into EU regulations with the

European Monetary Union's introduction in the Maastricht Treaty of 1992.

The EMUwas a compromise of the power-based distributive bargaining and upgrading of common interest methods. The creation of the ECB to take over monetary policies; however, as argued by Genschel & Jachtenfuchs, (2018), due to member states objections, there were restrictions on EMU policies and ECB actions; in effect, these restrictions denied the ECB the power to act as a lender of last resort to governments:

- Article 123 of the Treaty on the Functioning of the European Union (TFEU) prohibits monetary financing of public debts.
- Article 125 of the TFEU prohibits fiscal debt sharing with member states or the EU institutions; this means no bailouts.
- Article 127 of the TFEU restricts the ECB mandates in the maintenance of price stability.

As hinted by Genschel & Jachtenfuchs, (2018), EMUwas achieved thru horizontal differentiation, mainly due to countries not willing or able to participate in such policies. A prime example is the UK opting out of the EMU policies because the national actors did not have the political or mass support. Another reason is the inability to participatebecausethe entry standards wereprohibitingor the member state felt it was unable to do so for reasons other than political or support from national actors. Moreover, the focus on regulations integration instead of core functionalintegration did help to overcome the issue of domestic politicisation.

As pointed by Genschel & Jachtenfuchs, (2018), a major contributory factor to the Eurozone crises was low compliance with the regulations as evidenced in the excessive deficit or debt of a large proportion of the Eurozone member states in diffidence of the Stability and

Growth Pact. Moreover, according to Genschel & Jachtenfuchs, (2018), there are three possible explanation as to the low compliance:

- the cost of full compliance fell solely on each member state
- many regulatory gaps in the Stability and Growth Pact
- insufficient burden and risk-sharing

As hinted by Genschel & Jachtenfuchs, (2018), at the heart of the neofunctionalism and liberal intergovernmentalism theories is a simple truth that integration is the efficient collective responseto a common European problem. The problem is that the EMU was notgenuinely efficient and collective as proved by the crises. In essence, the EMU project created as many problems as it solved. As listed by Genschel & Jachtenfuchs, (2018), the EU has come up with several possible scenarios for the future path of integration:

- "carry on", this implies an ad-hoc problem-solving unreformed EU. However, as recent events have proven this is a risk riddled scenario
- unwind back to the Single market integration policy, thus dropping all attempts at core-power integration and abandoning the EMU and Schengen projects. This option would contain some unforeseen and unknown issues; hence it is deemed to be too costly even for crisis-hit members such as Greece
- increased horizontal differentiational integration whereby unwilling or unable member states opt or forced to opt-out of further integration of state core powers. This option contains no understanding of the solutions to existing problems. Moreover, it would need an increased willingness by the "*able*" to show a multilateral solidarity.
- "doing less more efficiently" implies the EU focusing on a few essential functions and, more importantly, getting involved in regulating these functions.

- Increase full integration for all member states. The fear is that this may leadto an anticipation of a type of federal integration.

As noted by Genschel & Jachtenfuchs, (2018), a lesson from historical federation buildings is that the integration of central functions key to the survival of the EU, in the long run, is a challenging, long and conflictual process.

As argued by Jones, Kelemen & Meunier, (2016), the incomplete piecemeal approach to the crisis presented two intertwined puzzles. The first is that at the start of the Euro crises, the leaders acknowledged that such an approach would be inadequate. The second is the tendency for every step in this piecemeal approach to integrate the EU further rather than disintegrate. As a result, "failing forward" by the constant policy of responding to failures of incremental reform of EU with new piecemeal reform for deeper integration. Providing answers to this intertwined puzzle means analysing both the intergovernmentalism and neofunctionalism approaches. The key argument here is that each school addresses a specific issue within this puzzle; intergovernmentalism captures the dynamism within the critical junctures, whereas neofunctionalism defines the mechanism underpinning links between one critical juncture and the next. The fusion of these two schools would present a complete picture of the EU's response to the Eurozone crisis, thus explaining the fail forward pattern in EU integration.

As argued by Jones, Kelemen & Meunier, (2016), initially the governance structure of the Eurozone had three crucial factors missing to succeed over the long term:

- Fiscal policy
- Macroeconomic adjustment policies
- Banking regulations

Many leading policymakers and academics recognised the issues of limited governance within the Eurozone.

Essentially, as the European Commission president Romano Prodi prophesied in the Financial Times in December 2001:

> "I am sure the euro will oblige us to introduce a new set of economic policy instruments. It is politically impossible to propose that now. But someday there will be a crisis and new instruments will be created."

According to Jones, Kelemen & Meunier, (2016), the inadequate policies underpinning EMU planted the euro crises' seeds. Moreover, at the heart of this inadequacy was the lowest common denominator policy facilitated by the intergovernmental bargaining process. For domestic politicalreasons, the national leaders could not agree to a fully integrated monetary/fiscal union under an EU supranational actor. Thus, providing emphasis to the neofunctionalism spillover approach due to the incompleteness of EMU. Furthermore, as statedabove in Romano Prodi's quote, many of the supranational actors knew that EMU was incomplete; therefore, as neofunctionalism argues the societal actors inevitably would create pressures for a deepening of integration.

As explained by Jones, Kelemen & Meunier, (2016), the euro crises' responses bore the hallmark of failing forward to integration. The key to understanding the EU's reactionsduring the euro crises is inliberal intergovernmentalism, over the short term, and neofunctionalism, over the long term. In the short term, the leaders' response to each stage of the crisis was dictated by the liberal intergovernmentalism bargaining approach which only resulted in the lowest common denominator solutions meaning a piecemeal fix to the EMU issues. In the long term, as argued by neofunctionalism, this led to a further spillover to other policy areas to fixissues neglected by the previous fix. Therefore, giving rise to additional pressures by the societal actors towards the deepening of EU integration.

With each response to an event during the crisis, the EU members were ever so slowly failing towards integration.

In truth, the euro crises had its origins in the global financial crisis, which started in mid-2007 with the sub-prime crisis in the US[1]. Conversely, as pointed by Hooghe & Marks, (2019), all three integration schools had different explanations for the euro crises. Hence, the crisis was: a case of iterated intergovernmental bargaining, a crisis that extended integration and the constraining effects of politicisation.

The liberal Intergovernmentalism explanation

Firstly, the intergovernmentalism account for the euro crises. As suggested by Hooghe & Marks, (2019), the euro crises had several features which could be explained by intergovernmentalism. The threat to the existence of the Eurozone was vast and immediate. Moreover, the EU did not have the financial resources and legality to intervene as the lender of last resort. Hence the solution was in the intergovernmental bargaining between the member states. The threat of the crisis to the Eurozone's existent throughout the late 2000s to mid-2010s ensured a lengthy and iterated intergovernmental negotiation characterized by substantial interdependence and sharp asymmetries. The resulting series of lowest common denominator deals constrained by the diverged preferences on the distribution of costs did just enough to avert the Eurozone's dissolution. Conversely, minimizing the immediate cost to the northern states in the dominant bargaining position.

As Moravcsik & Schimmelfennig, (2012) states that liberal intergovernmentalism predicts that the risk of catastrophe would unite all sides of the EU to avoid the immediate costs

[1] see Brunnermeier, (2009); Caballero & Krishnamurthy, (2009); Masood, (2009).

of default. There were high external and internal macroeconomic risks associated with leaving the euro for the southern countries at risk from the high debt. For the more prosperousnorthern countries, the euro's breakup would have meant currency appreciation and thus loss of trade. Moreover, liberal intergovernmentalism predicts that the varying motives dictate the major intergovernmental coalitions in the bargaining process. Hence, the less prosperous south pushed for a Europeanised solution, while the richer north demanded the crises countries push through macroeconomic austerity policies.

Furthermore, as stated by Moravcsik & Schimmelfennig, (2012), this led to a "*chicken game*"characterised by hard intergovernmental bargaining and brinksmanship with the north having the upper hand. Intergovernmental bargaining led to further integrative regulations and supranational powers like the SGP, banking union, EFSF and ESM. Therefore, the northern countries push the crisis-hit countries to the brink of sovereign default; while the southern countries tried to convince the solvent countries that a rescue was requiredto save the euro. Conversely, thisbrinksmanship was at the heart of this"*chicken game*". The result was that the solvent northern countries could push through the strict regulations and fiscal adjustments in return for giving the indebted southern countries the required funds. In short, the northern countries led by Germany were able to push thru their agenda on integration during the crisis.

Moreover, according to Moravcsik & Schimmelfennig, (2012), the new phase of integration in response to the crisis thru institutions and regulations was deliberately limited in scope and power; mainly due to the preferences of the solvent northern countries who had the clout in the intergovernmental bargaining process. However, the imposition of strict fiscal rules and macroeconomic

adjustments cannot be forced upon the indebted countries by the EU or the solvent countries; hence the system remains unstable for the foreseeable future.

As highlighted by Schimmelfennig, (2017), from an intergovernmentalism perspective on the crisis, the euro crises was a typical predicament involving intergovernmental bargaining between converging and diverging member states' interests to rescue/strengthen the euro and EMU. The crisis highlighted a clash of interests between common interdependencies and different preferences on the nature of integration.

Additionally, as noted by Schimmelfennig, (2017), in line with intergovernmentalism, the dominant actors were the member states' governments as evidenced in the intergovernmental institutions which coordinated and implemented the rescue programmes and macroeconomics policies as opposed to the classical Community methods. Furthermore, increased integration does not necessarily mean further delegation of core state powers to supranational actors.

The neofunctionalism explanation

As hinted by Hooghe & Marks, (2019), neofunctionalism explained the long-term perspective. The euro crises' severity was mainly due to the "*half baked*" functionality of economic and monetary integration introduced by the Maastricht Treaty. Neofunctionalism dictates that path dependency meant that member states were primarily concerned with saving the Euro generating intense pressures to fixing the flaws when the euro crises hit. Initially, the agreements introducedseveral institutions under the direct influence of member states; subsequence agreements nudged these institutions towards control by the EU. The ECB also obtained more power to act like any central bank to supply money and buy assets through QE and outright monetary

transactions policies. Hence, the crisis was the result of an unintended spillover and concluded with enhanced supranationalism.

Neofunctionalism focuses on the endogenous nature of the euro crises; as highlighted by Schimmelfennig, (2017), neofunctionalists attribute the crisis to the functioning of the integrated process. This perspective hints at the true underlining nature of the integration process; it is a very unpredictable, highly complexed and dynamic process. Meaning that while state actors havethe power to shape the initial integration agreement, they cannot control the consequences, moreover, this is the supranational actors' domain. Conversely, the intensity and process of change come thru spillover, where an integration process spills over to another function. The spillover process does not necessarily trigger a crisis; however, a possible explanation for any crisis in the EU isthe existence of a massive spillover.

Further, as argued by Schimmelfennig, (2017), there were several aspects of the euro crises, which could be explained by neofunctionalism:

1. Endogenous causes of the crisis

   The euro crises may have started with an exogenous event in the form of the global financial crisis; however, the onslaught of the integration issues at the heart of the euro crises was mainly due to the inherent economic tensions and institutional flaws of EMU. Put simply; the euro crisis resultedfrom the exogenous shock exposure of endogenous tensions and dependencies highlighted by the lack of a credible fiscal policy to deal with such events. A common argument against the EMU is that monetary union without fiscal union does not work; the result of an intergovernmental bargaining issue, at its heart lays a conflict of interests between the two powerhouses of European integration: France and

Germany.Essentially, the same underlining conflict that emerge during the euro crises. As already alluded to previously, Germany had the superior bargaining powers; hence it was able to shape monetary union powerfully according to its preferences: inflation targeting, independent central bank and only fiscal supervision. Furthermore, the rules governing membership of the EMU were relaxed and weakly enforced

2. Path-dependent on the intergovernmental bargaining before the Maastricht Treaty

The strong backing for the euro and EMU by the Eurozone countries during the euro crises is, possibly, due to the initial endogenous decision on monetary union. Hence, as quoted by Schimmelfennig, (2017), the euro crises resulted from a "*heavily discounted or unintended effect*". However, Eurozone and member interdependencies' sunk costs prohibited any orderly exit strategy by Eurozone member states during the euro crises. Thus, the member states somewhat reluctantly agreed upon a set of further integrative steps they had initially dismissed during the Maastricht treaty's intergovernmental negotiations. This decision for further integration is path-dependent on the decisions taken during the intergovernmental bargaining for the Maastricht treaty.

3. Trans/supranational actors drove the negotiation and resulting decisions of the states

As already stated previously, a "*chicken game*" between the creditors and debtors ensued after the initial shock. The resulting reaction of the transnational financial markets endangering the debtors' ability and putting downwards pressures on the sovereign debts' prices forced the EU members into actions. Thus, meaning that the creditor member states were now

heavily exposed to the debtorsthru the transnational banks. Therefore, forcing all member states to agree on further incremental integrative actions. However, the national actors might have been unable to prevent further contagious effects and eventual disintegration of the Eurozone, if it was not to the supranational interventions by the ECB. Against intergovernmentalism assumptions, the ECB was the main factor in stabilising the Eurozone through monetary instruments that were at the limit of the Maastricht agreement on monetary union. The ECB was able to act against many internal and external policymakers' wishes because the Maastricht treaty granted it the required independence.

As perfectly summarised by Schimmelfennig, (2017), the euro crises hints at the intergovernmental bargaining process becoming embedded into neofunctionalism's strategic path-dependent development of integration. Moreover, the crisis outcomes generally typify the lowest common denominator solutions that are likely to spillover into further integration. This process is the *"failing forward"* argument of Jones, Kelemen and Meunier, (2016) stated previously.

The postfunctionalism explanation

According to Hooghe & Marks, (2019) in contrast, postfunctionalism perceived the response by the EU to the euro crises as a result of domestic politics and, particularly, the rise of nationalist opposed to European integration. This issue was critical to the EU's inadequate and inconsistent response throughout the crises leading to the spiral of the crisis. Moreover, the domestic politics during the crisis meant a resistance to supranational solutions. Furthermore, northern governments were reluctant to heed advice to ditch

their "*me first*" economic growth policies fearing public opinion. Thus, the combination of fear and greedundermined the EU response nearly led to the collapse of the Eurozone. A further complication, according to postfunctionalism, was the politicization of the crisis.

Conversely, this led to a narrowing of reform options in the wake of the crisis. This procrastination meant that instead of the urgently required reform of the Eurozone; a cocktail of monetary policy, bailouts and tightening regulations resulted. Moreover, the price paid by all sides was high.

As hinted by Schimmelfennig, (2017), the euro crises represented a perfect picture for postfunctionalism, a crisis with all the components of the postfunctionalist perspective on European integration. However, in reality, it was a significant puzzle because it had all the components:

- The anti-EU politicisation
- An increasingly eurosceptic public opinion
- An increase in the popularity of populist and eurosceptic national political parties in member states

Nevertheless, the resulting integration process was not as predicted by the postfunctionalism school. Postfunctionalism predicts that these components should reflect a strong disincentive for national governments in furthering the integration process. In reality, due mainly to addressing weaknesses in the monetary union and banking regulations, the integration process was able to gather pace during the early stages of the euro crises. As stated by Schimmelfennig, (2017), the reasons were simple:

- Formation of strong coalitions of EU friendly national governments, for the most part, the members' national government were from the political mainstream parties which were centre-right or left. Before 2015, most of the snap elections presented an EU friendly national government.

Hence further integration was able to proceed without any significant issues.

- Avoidance of constraining referendums, this was done by designing treaty revisions or new treaties in such a way as to avoid the necessity of a referendum. It is essential to note that generally, Eurozone governments have been reluctant to embark onsignificant integration treaties during the euro crises.
- Fear of economic doom if the euro was to collapse or partial disintegration of the EU or Eurozone.
- As stated previously, the critical integration processes during the euro crises were done by the supranational bodies, such as the ECB, out of necessity to contain the crisis did not need the member governments' rectification.

However, according to Schimmelfennig, (2017), in January 2015 Greece elected the left-wing populist Syriza party which formed a coalition with eurosceptic right-wing parties. Thus, enabling the Greek government to hold a successful anti-austerity EU Bailout referendum. However, the negotiations' outcome was an even harsher austerity programme, reflectingthe Greek government low bargaining power in the "*chicken game*" throughout the euro crises.

As summarised by Schimmelfennig, (2017), even though theoretically postfunctionalism was correct to highlight the rise of mass level euro-scepticism politicisation effects on EU integration and to a certain extent it did make intergovernmental negotiations harder. Nevertheless, the adverse effects predicted by postfunctionalism did not materialize. However, the extensive further integration indicated by neofunctionalism resulting from a "*good crisis*" did not materialise either. Conversely, all three theories are required to gain a deeper understanding of the euro crises and response of the EU. Additionally, as noted by Hooghe & Marks, (2019), the three theories complement each other in explaining the euro crises; while neofunctionalism clarified

the issues of supranational reforms in the face of the euro crises. Intergovernmentalism rationalised the diverse national preferences and intergovernmental bargaining, which resulted in partial solutions to the euro crises. Moreover, postfunctionalism explains that domestic politics and the politicisation of the issues underpinning the euro crises led to a war of ideologies between proponents and opponents of European integration.

The Brexit process

As highlighted by Hooghe & Marks, (2019), in explaining the issues and effects involving the EU referendum and Brexit, postfunctionalism certainly has greater leverage. However, this does not mean that we should discount the contributions of neofunctionalism and intergovernmentalism. They both stress the argument of strong economic interdependence as a case against hard Brexit. Nevertheless, in contrast with neofunctionalism and postfunctionalism, liberal intergovernmentalism does further states that Brexit is epiphenomenal.

Conversely, as hinted by Schimmelfennig, (2018a) and Schimmelfennig, (2018b), the key to explaining the Brexit crises lays in a combination of postfunctionalism and liberal intergovernmentalism. The central axis is the activation of article 50 of the Lisbon Treaty, which shifted the emphasis from integration to disintegration. There is a difference between demanding an opt-out from an integrative function and exiting the EU by invoking article 50. As highlighted by Schimmelfennig, (2018a), postfunctionalism seems to explain the UK government's reasonings and actions for the Brexit route. However, according to Schimmelfennig, (2018b), the intergovernmental negotiations after the invoking of article 50 seem to be best explained by liberal intergovernmentalism. Moreover, liberal

intergovernmentalism partly explains the preferences of the EU and member states.

The postfunctionalism explanation

As hinted by Schimmelfennig, (2018a) and Hooghe & Marks, (2019), the rise of UKIP and an increasing number of eurosceptic within the Conservative party forced UK prime minister David Cameron to promise a referendum on the negotiated EU agreement. He was gambling on the hope of appeasing his backbenchers while deflecting the UKIP challenge. An in/out referendum was passed into law the support of 81 Conservatives MPs going against the wishes of the government. As predicted by postfunctionalism the referendum campaign was fought on national identity versus economic consequences. The leave campaign focussed on the identity and self-determination issues promising to limit immigration and to take back control of the key factors of national concerns. The remain campaign focussed on the inevitable negative economic consequences of leaving the EU with many researches from international and national organisations as well as economic academics highlighting the economic downturn in the short to long term. The two sides sidestepped each-others arguments. The referendum resulted in a close defeat to the remain campaign 51.89% to 48.11%.

Moreover, as argued by Hooghe & Marks, (2019), postfunctionalism analysis of the role of national identity in mass settings, such as the referendum, was proved correct. Further, evidence since the referendum has illustrated the hardening polarisation of the two sides. Few events have demonstrated the impact of politicisation more than the EU referendum. Far from reducing tensions, political infighting and divisions in the UK; the EU referendum exacerbated them on every level. A key argument against the EU referendum is that it consisted of a simple choice to a

complicated argument consisting of many compromises and trade-offs.

As stated by Schimmelfennig, (2018a), according to postfunctionalism differentiated integration and disintegration are attributed to a politicisation process, pointing to a shift in European integration issues from interest groups to the masses where political identity plays a more significant role. Here several factors are driving the politicisation process:

- the depth of integration
- exclusive national identity
- Euroscepticism
- referendums

According to Schimmelfennig, (2018a), the demand for disintegration centre around the three hypotheses based on the last three factors:

1. the spillover of integration into identity-relevant areas
2. the rise of Eurosceptic political parties
3. the increase availability or use of EU integration referendums

Conversely, with Brexit, all three hypotheses were central for the increase in the demand for disintegration. As argued by Schimmelfennig, (2018a), the spillover of the EU's enlargement to Eastern Europe gave rise to an unanticipated and undesired increase in immigration to the UK. However, the UK has always supported the enlargement and was one of four states to open its labour market to the new member states in 2004. Nevertheless, despite abandoning their liberal immigration policy and pledging to control the flow of immigration, the UK continued to be the focus of intra-EU immigration due to the EU policies on freedom of movement for any EU citizen. A survey in 2015 highlighted the extent of the UK's population fears with 63% ticking immigration as the number one cause for concern.

According to Schimmelfennig, (2018a), the issue of immigration gave rise to the Eurosceptic UKIP political party with its dual anti-EU and anti-immigration messages. As with all populist political parties, UKIP's success was in politicising and communicating these two issues to the masses. Moreover, UKIP was able to infuse EU membership issues with the immigration issue and frustration with governmental performance. Thus, leading UKIP to electoral success, especially in the 2014 European elections and emphasizing EU membership.

Although, the government did not state the nature of the exit from the EU before or during the referendum. However, the government under pressure from its backbenchers and UKIP decided to go with a "hard" Brexit when the UK invoked article 50, signalling the beginning of negotiations to reach an agreement within two years. As stated previously, postfunctionalism does not have a credible explanation to the negotiations and bargaining in the aftermath of Article 50.

The liberal intergovernmentalism explanation

As highlighted by Hooghe & Marks, (2019), the causes of Brexit were not just British but also European. In essence, an explanation Brexit is giving thru the use of two critical principles of intergovernmentalism. The course of European integration is dependent on cooperation facilitated by intergovernmental bargaining, and ironically, intergovernmental bargaining depends on economic interests and NOT on a referendum result. Conversely, both the UK and EU's economic interestis in maintaining the UK's membership of the single market. However, that the negotiations turned out the way they turned out was a lesson in asymmetry. It is one thing to negotiate an opt-out from a function or reform; it is quite another to opt-out from Article 50, the rules governing exit from the EU. Moreover,

the UK was in a weak bargaining position in comparison to the EU.

According to Schimmelfennig, (2018b), the negotiations in the aftermath of the invocation of Article 50 supports the superior explanation of asymmetrical interdependence and bargain power of liberal intergovernmentalism. Since liberal intergovernmentalism, as in any other negotiation theory, revolves around the two negotiation sides' initial preference constellations. Thus, the initial preferences of the UK and EU are critical to the Brexit negotiations. Initially, the UK's position was to stem the flow of EU based immigration, however, in the aftermath of the referendum the UK's government decided that a soft Brexit would imply remaining under the EU's influence[2] without having a say in the future direction of the EU. The basis of the UK's preferences is to leave the EU but still have services and goods access to the EU free market. This scenario prompted Michel Barnier comment: "*Cherry picking is not an option*" on 6th December 2016. In contrast, the EU's preferences were to protect the EU and euro's integrity and signal that leaving the EU is very difficult and economically costly. With two polar axis preferences, the negotiations were going to be difficult.

As stated by Schimmelfennig, (2018b), in intergovernmental bargaining between the EU and UK, the EU had both material and institutional superior bargaining power. A major bargaining advantage is the UK exports 44% to the EU, while the EU only exports 6-7% to the UK. Institutionally, the EU had superior power due to four circumstances:

[2] The acceptance of EU legislations, Court of Justice jurisdiction, freedom of movement for labour and "*large contributions*" to the EU budget

1. The European Commission negotiated on behalf of all the EU member states. Thus, giving it unity and hence superior bargaining power
2. The withdrawal agreement requires the consent of the European Parliament meaning any member state not happy with the agreement could theoretically block it
3. Article 50 imposes two years to complete the process; however, a country could extend the period, if the European Parliament votes in favour of a request to extend by the exiting nation
4. A requirement of ratification by each member state for a "mixedagreement" that is an agreement beyond a basic free trade deal

According to Schimmelfennig, (2018b), in line with liberal intergovernmentalism, the EU bargaining powers was reflected in the first step agreement. The terms of the agreement were:

1. Negotiations on further agreements only start once there was sufficient progress on the withdrawal terms
2. All parties honour financial obligations under the current financial framework ending in 2020
3. Avoidance of a hard border andcontinuation of internal market and customs union in Ireland
4. Guarantee the rights of EU citizens residing in the UK after the withdrawal

The neofunctionalism explanation

As Hooghe & Marks, (2019) and Cavlak, (2019) states central to the neofunctionalism explanation of the effects of Brexit on the UK is the concept of spillover, which states thatan agreement to integrate a function into the EU spills over to another function. This concept works asymmetrically, meaning that EU integration had spilt over several national public organisations' and governmental departments' workings. The big issue is to unwind the long

duration of the spillover effect of EU integration is going to be both complicated and time-consuming. Furthermore, there are the knowneconomic issues; in addition to thesocial, cultural and political issues currently in play. These issueshas resulted in a 21 months transitional period after the completion of the Brexit negotiations.

Conversely, the big question is whether spill back is successful in the disintegration of the regulations and functions inthe aftermath of Brexit. Whether or not spill back is successful, the EU hopes that the difficulties experience by the UK in the negotiations and inevitable unwinding of integration processeswillillustrate how difficult and costly it is, and thus discouraging others. Moreover as argued by Hooghe & Marks, (2019), another critical factor in neofunctionalist reading into Brexit is centred around the fact that the health of the UK's economy is to a certain extent heavily dependent on the EU as illustrated earlier and by Fakhry, (2019a). Therefore, the threat of economic disruptions would serve as a disincentive to a hard Brexit.

As argued by Schimmelfennig, (2018b), the differences in the three integration theories explanation of Brexit highlight the strengths of the theories:

- Postfunctionalism explains how Brexit came into being
- Neofunctionalism explains the effect the UK from Brexit
- Liberal intergovernmentalism explains the factors behind the Brexit negotiations, including the reasoning for the UK weak position in the intergovernmental bargaining process

A review of behavioural finance during the crises

As observed by Barberis, (2013), central to the global financial crisis is the concept of a bubble in real estate during

the late 1990s – early 2000s, particularly in the USA[3]; meaningthat prices reached levels which were unsustainable due to irrational thinking or friction in the housing market. There are two concepts behind the realisation of a bubble:

- investor beliefs.

  One theory of beliefs is the bullish vs bearish friction in the market, which leads to bearish investors omitting the market altogether. The prices reflect the bullish investors' views; hence the market becomes overvalued.

  A second belief theory argues that investors extrapolate historical outcomes too far into the future. The argument based on the representativeness heuristicstates that many people base their expectation on "*over-extrapolating*" small samples of the overall observations. Thus, prices rise and hence bubbles form.

  Lastly is the theory of overconfidence in the analysis and information. This theory dictates that investors could become overconfidence in the information or analysis leading to increases in the prices and hence a bubble formulation.

- investor preferences

  The first theory is that investors often become less risk-averse and increasingly profit maximisers once they profit on an asset. Thus, keep investing in the asset, rising the price and therefore triggering a bubble.

  Another theory is the overvaluation of a new idea due to investors relating these to lotteries. The basis of this theory is that investors may think that the new concept could be a high lottery-payoff, hence investing in the asset in the hope of obtaining a significant payoff on a small investment and thus increasing the price and creating a bubble.

[3] Although not limited to the USA, there was evidence of real estate bubbles in the UK and across Europe (particularly in Spain)

According to Barberis, (2013), the most likely explanation of the housing price bubble is a multi-level deviation of the past extrapolation theory:

1. The homebuyers
2. The mortgage lenders
3. The securitisation firms
4. The rating agencies
5. The investors

Ofcourse, in some countries, securitisation did not apply; hence, the over-extrapolation hypothesis suggests mortgage lenders were basing the hypothesis on past low mortgage default rates. In summary, the commonality between most of the recent bubbles is a tendency for market participants at different levels to over extrapolates past performance too far into the future.

As highlighted by Barberis, (2013), the accumulation of subprime-linked mortgages and securities requirescognitive behaviour analysis. The puzzle was why, despite the enormity of the risk, did banks take on the exposure?" There are three possible explanations:

- the bad incentives view dictates incentiviseparticipants only care about their compensations and bonuses in the short term and not about the risk to their organisation in the long term
- the bad model view implies faulty reasoning on behave of participants who were genuinely unaware of the risks posed to their organisations. This explanation may have been due to the belief and/or model usedthat tended to extrapolate past growth too far in too the future without taking account of risk
- the bad luck view hypothesises that rational participants could not have foreseen the subsequent bad performance, hence the risk to the organisation was due to bad luck. This explanation can be ruled out due to any careful and exhaustive analysis of these assets,

especially during the years immediately precedingthe crisis, by rational participants, would have highlighted the riskiness of these assets.

However, as argued by Barberis, (2013), both the bad incentives and models' views are incomplete views of the pre-crisis period. On the one hand, these organisations employedhighly skilled and intelligent employees, which begs the question about the plausibility of the bad model view. On the other hand, the fact that a high number of participants knowingly and repeatedly exposed their organisations to high risks just for the stake of a bonus does not sit well with the human mind.

As suggested by Barberis, (2013), an alternative hypothesis dictates that participants were vaguely aware of the high risks. However, by belief manipulation, they deluded themselves into thinking that their model/belief was not risky and was positive for their organisation's wellbeing. Psychologically speaking, an explanation of this mindset is thru the concept ofcognitive dissonance; in simple terms, the discomfort that exists when an action conflicts with the typically positive self-image. Conversely, to remove this discomfort, many resorts to the manipulation of their mindset. Hence, by manipulating their beliefsinto thinking their model was not endangering the organisation or livelihood of many people, they could maintain their positive self-image and remove any uncomfortable cognitive dissonance. An example would be for the market participant not to analyse the subprime loan or security carefully.

Moreover, as noted by Barberis, (2013), a similar explanation could be used for the credit rating agencies. The agents' dilemma was a trade-off between personal dissonance by giving the required ratings and competition by not giving the required ratings. As in the market participants' cases, the agent overcomes this dissonance by manipulating their beliefs via merely convincing themselves

that the asset prices, in this case, houses, will continue to rise and thus subprime defaults will remain low. Since, according to the representativeness heuristic, people naturally tend to believe past trends will continue.

Furthermore, as stated by Barberis, (2013), twoadditional factors in the manipulation of beliefs occurred in the case of the subprime securitisation:

1. they were overly complicated assets to understand, and hence it was complicated to prove they were highly risky assets. Therefore, making it easier for many participants to delude themselves about the risks posed
2. the representative heuristics which dictated that since the prices of the underlining asset, in this case, houses, were likely to continue rising, hence these subprime securities were likely to continue to have low risks

Moreover, as argued by Barberis, (2013), the belief manipulation hypothesis is a valid alternative to the bad belief, bad model and bad luck views explaining what happened before the global financial crisis.

By the end of 2005/early 2006, the housing market bubble burst, and subprime defaults rose. Nevertheless, as subprime defaults rose, the subprime loans' securitisation was continuing; eventually leading to the global financial crisis. As noted by Barberis, (2013), a surprising feature of the crisis was the dramatic decline of many risky assets of various types. Given the relatively small size of the subprime loan, the widespread and dramatic nature of the falls in prices of risky assets did, to say the least, take most people by surprise. Moreover, the speed at which the crisis spread globally suddenly bought into context the financial market's integrative nature.

As Barberis, (2013) hints, a possible explanation is the amplification mechanism. During s crisis, the amplification mechanism dictated that any market participant facing a loss in the value of subprime backed securities tend to sell other

risky assets. Thus, pushing down the other risky assets' prices, forcing them to sell their other less risky assets, thereby ensuring a loss or margin spiral. This behaviour is fundamental to explaining the global spread of the crisis, particularly to Europe.

However, as noted by Barberis, (2013), the loss aversion and ambiguity aversion related amplification mechanisms may also have played a vital role in the global financial crisis. Ambiguity aversiondictatesthat in situations where participants cannot assign probabilities to future trends, they become increasingly averse. An extension to the ambiguity aversion is the competence hypothesis presented by Heath & Tversky, (1991). The competence hypothesis dictates thatthe level of competence at analysingthe situation determines whether the person is ambiguity averse or seeking. This hypothesis partly explains the global financial crisis; the explanation maintains that the initial loss on the subprime backed securities made investors less competent in analysing risky assets. Hence, increasing ambiguity aversion leading to a reduction in their holding of risky assets, therefore further reducing these assets' price.

According to Barberis, (2013), the second fundamental explanation isthe loss aversion theory of Kahneman & Tversky, (1979). This obverse that losses are more sensitive to market participants than profits of similar magnitudes. The less obvious observation is that the degree of aversion may vary with time, depending on the trend of losses or gains. Thus, any recent loss increases loss aversion making them less willing to take risks that they would have taken otherwise. In terms of the global financial crisis, the initial decline in the price of subprime securities made market participants loss averse; thus, selling the risky assets on their books, further reducing the price and increasing loss aversion. Both the ambiguity and loss aversions played a big part in the amplification mechanism during the global

financial crisis and arguably in turning the crisis from a local to a global event since the subprime crisis began in the US housing market.

Another explanation of the global financial crisis as provided by Szyszka, (2010) is thru the fear/hope conundrum[4]. As explained by Lopes, (1987) and Shefrin & Statman, (2000), the two emotions dictating risk management are fear and hope. While fear is determined by an overweighing of the worst-case scenario probabilities relative to the best-case scenario, hope or greed is the opposite effect. Simply put, hope (greed) make market participants unduly optimistic on investment opportunities, while fear makes them increasingly unoptimistic on investment opportunities.

The global financial crisis is a lesson in both hope and fear. In general, hope rises during a booming economy and asset pricing bubble; however, fear increases during a recession and/or financial crisis. According to Szyszka, (2010), macroeconomic factors shaped the background to the pre/post-financial crisis. Hence, the pre-crisis asset price bubble in the housing market and securitised loans was, to a certain extent, the result of over-exuberated hope created by an overheating global economy, particularly in the US. Also, taxes and the cost of finance were low, which gave rise to optimism in the financial market. Essentially, during times of a booming economy, risk-free assets generally offer low rates of returns relative to the optimism in the financial market.

As hinted by Szyszka, (2010), market participants began to exhibit increasing hope given this background of long-lasting economic prosperity. The feeling of hope was demonstrated by the substitution ofmoney and safe-haven assets with loans and ever increasingly risky assets to get a

[4]Szyszka, (2010) refers to greed and fear but Shefrin & Statman, (2000) and Lopes, (1987) refer to it as hope and fear

growing return on investment. However, there is a thin line between hope and greed. As some market participants became increasingly hopeful of maximising asset returns, they took ever-increasing risks, in essence, investing in high yielding securitised subprime loans. Furthermore, the unconscious development of greed as the market participants increased their hopes meant that some turned to massive financial leverage to increase their returns. This unconscious feeling of greed meant that often many market participants were indebtedmore than ten times their worth on the expectation ofmaximising their returnson the high-risk assets in the belief of the continuation of the booming economy and housing market bubble. Market participants exhibited increasing greed in the later stages of the securitised subprime loans price bubble due to the underlining housing market bubble's collapse in late-2005 to mid-2006. The continuation of investment in these high yielding/high-risk assets even after the collapse of the underlining assets' market is a sign of greed being the overwhelming psychological emotion in some market participants' mindset. Conversely, afundamental explanation is that greed blinds market participants on the risks of such assets. Thus, making them overconfident and unable to analyse market and risk trends, hence underestimating and underpricingrisk.

As Szyszka, (2010), suggests, fear and hope have opposite attractions on the behaviour of market participants and generally on the trends in the markets. Hence, it comes as no surprise that when the global financial crisis hit; market participants' fear levelsrose quickly. Furthermore, an ever-increasing level of fear inevitably leads to panic, which intensifies the depreciation of assets. Thus, increasing the inflow of investments in safe-haven markets such as particular sovereign debt and commodities markets, more specifically the high graded sovereign bonds and gold

markets. During the global financial crises, as market participants grow ever anxious concerning the securitised subprime loans market, they became increasingly worried about the extent of the global financial sector's holding of these *"bad"* assets. Hence fear increased and spread to the global financial sector as observed by panic runs on the global banking sector terminating in the bankruptcy of Lehman Brothers, an investment bank at the heart of the securitised subprime loans, among other major global financial institutions. There are two further conceptualisations of fear that could exuberate a crisis:

- The policy effect dictates the action or inaction of policymakers has the potential of hiking fear among market participants. This issue is key to the lengthening of the crisis, the indecision or incorrect actions bythe central banks and government had a negative impact. In the aftermath of the Lehman Brothers bankruptcy, central banks and governments across the globe were forced into action by events.
- The spillover effects dictate that if a financial institution has trouble selling a "bad" asset, it may try to sell a "*good*" asset. Hence, turning the good asset into a bad asset because the market is overflooded and therefore, the price drops. This situation occurred during the global financial crisis.

As stated previously, the roots of the euro crises had its origins in the issues at the heart of European monetary union. Put simply; EMU was an incomplete and compromisedintegrative process with many issues that were exposed by theeuro crises as hinted by Genschel & Jachtenfuchs, (2018) and Jones, Kelemen & Meunier, (2016). Nevertheless, as indicated by (Cohen, 2003), in the aftermath of the euro's introduction, many were optimistic about the new currency's prospects, some even predicting the euro will challenge the US dollar for global supremacy. Relatively few,

such as Feldstein, (1997), questioned theenthusiasmtowards the new currency. Many pieces of research into the integrative nature of the EMU and the euro in the early yearsfound that the euro and EMU had a hugely beneficial impact on the integration process in the economy and financial markets as argued by Danthine, Giavazzi & Von Thadden, (2000) and Trichet, (2001) amongst others.

This optimism added to the initial rebuttal of the global financial crisis as merely temporary contagious effect from the US, as stated by Dabrowski, (2010) meant that the European response was late and uncoordinated. Furthermore, as Galati & Tsatsaronis, (2003) and Baele *et al.*, (2004) pointed out the impact of the euro and EMU wasnot uniform across the Eurozonemeaning that a two-tire Eurozone was developing, namely the core member states and the periphery member states (primarily the GIIPS[5] nations). Even before the euro criseserupted, there were signs of macroeconomics weaknesses amongst the Eurozone member states. As highlighted by Dabrowski, (2010) and Szyszka, (2013) amongst others, someperiphery member states had weak macroeconomics fundamentals before the introduction of the euro. Moreover, the global financial crisis highlighted the inadequatefinancial regulations and economic policies at the heart of the integrative process as hinted by Dabrowski, (2010), Szyszka, (2013), Jones, Kelemen & Meunier, (2016) and Genschel & Jachtenfuchs, (2018). A key point reflected in thedisoriented and confusing miscommunication by the EU and member states as hinted by Carmassi & Micossi, (2010) and Fakhry, (2019b).

Initially, the euro crises were an extension of the global financial crisis to the European scene. It was a case of how to

[5] GIIPS or PIIGS nations are Greece, Ireland, Italy, Portugal and Spain. However many prefer to omit Ireland, therefore referencing the GIPS or PIGS.

implement an economic recovery plan sand save the European banking system; which was the case throughout the global economy. It was not until the Greek government fiscal deficit revision announcement on 5th November 2009, as stated by Fakhry, (2019b) that the euro crises increasingly became Europeanised as illustrated by Metiu, (2011), Mohl & Sondermann, (2013) and Szyszka, (2013). Once again, the spotlight fell on the inadequate and disintegrated financial regulations and economic policies at the heart of the integrative process highlighted by Szyszka, (2013), Jones, Kelemen & Meunier, (2016) and Genschel & Jachtenfuchs, (2018). Moreover, the lack of a coordinated response and often confusing communication by the member states and EU continued to hint at the intergovernmental bargaining and disagreement. The vital macroeconomic issues at the heart of the euro crises, as hinted at previously in this paper, amongst others were:

- A monetary union of difference economies
- Inflexibility of monetary policies
- Lack of fiscal watchdog and rising sovereign debt

According to Szyszka, (2013), several behavioural traitsthat were, to a certain extent, implicit in prolonging and intensifying the euro crises. The first is thehuman/macroeconomic time horizon conflict. According to Kahneman & Tversky, (1979), humans tend to make decisions in short time horizons and focus on the fear of immediate losses while discounting remote outcomes. As hinted by Szyszka, (2013), this differs with the work and type of the person. Typically, investors evaluate their investment decision on a yearly basis while politicians like to think in terms of an electorate term. Moreover, consumers usually evaluate their consumption in accordance to their monthly salary. However, theories dictate that the laws of macroeconomics tend to be on a longer time horizon spectrum. Thus, there is a danger thatthe laws of

macroeconomics are often overlooked by this short-sightedness by market participants and policymakers in the decision-making process.

As highlighted by Szyszka, (2013), the importance of this issue is that some of the peripheral member states (i.e. Greece, Ireland and Spain) were blinded by the previous economic upturn extrapolation errors and short-termism on all three levels: governmental, consumer and market participants. The advanced of EMU and the Euro created a false sense of stability andprolong economic growth that was extrapolated into the future, failing to see the strategic consequences of EMU and hence associatedrisks. This false sense created a level of confidence in the economy and financial markets created by the integrative process of EMU and the Euro, which led to an overspend in all three levels across some Eurozone countries. Thus, creating a bubble and an overleveraged economy based on high consumptions and limited savings.

According to Szyszka, (2013), the next behavioural trait is the underestimation/underpricingof risk. At the heart of this trait lays greed which blinded consumers, market participants and governments into pursuing avenues which led to increasingly higher consumptions, profits and popularities respectively. Other behavioural factors were influencing thistrait of which overconfidence is the critical aspect:

- above-average effect
- calibration effect
- illusion of control bias
- ungrounded optimism

Thus, resulting in the underpricing of risk. A key contributory factor to overconfidence is wishful thinking, as observed in many politicians and market participants as reasoned by (Szyszka, 2013). Other vital contributory factors are:

- the self-attribution bias which states people tend to attribute successes to one-selves while ascribing failures to external factors such as bad luck or other people mistakes
- the confirmation bias suggests people often seek to analyse their performance by selecting information consistent with their opinions while excluding information that conflicts with their views. Hence, thru this selective approach, they may have an illusion of validity as described by Einhorn & Hogarth, (1978).

As argued by Szyszka, (2013), these factors influenced the underpricing of risk by all three levels contributing to a seemingly never-ending bull market. Thus, misjudging or missing of certain warning signs that would have prevented this overconfidence. Moreover, market participants thought they could beat the market on their skills rather than the markets' general trend. Furthermore, people's tendency to overplay certainty and downplay uncertainty created an environment where theunderpricing of risk could foster. According to Kahneman & Tversky, (1979), the prospect theory dictates the decision-making process is affected by the S-shaped value and weighing functions of the utility of a total assessment. Furthermore, the weighing function is set to 0 when the probability is very low and set to 1 when the probability is high. Thus, pointing at the tendency for market participants to account for only highly likely events in their decision-making process.

The third behavioural trait during the euro crises was the euro heuristic; as derived by Szyszka, (2013), the term indicatesmarket participants willing to put all EMU member states under the same euro label. The theoretical argument is there is an overload of daily news for any human to process, hence the requirement to simplify arises, this simplification is often called a heuristic. The heuristic may be a useful procedure in dealing with the information overload;

however, there is a danger that using heuristic techniques to base decision-making processes on could lead to misjudgements as argued by Tversky & Kahneman, (1974). The euro heuristic led to market participants underpricing some EMU member states' risk when the macroeconomics factors were telling a different story. As stated by Szyszka, (2013), an example is the annual spread in the10-year government yields of Germany and Greece, which was a mere 0.27 percentage points in 2007. There are two possible psychological explanations for the euro heuristic. The first explanation is the halo effect, meaning humans' tendency to form an impression in one area influenced by an opinion in another area.

Moreover, as argued by Nisbett & Wilson, (1977), humans sometimes concentrate on the most visible characteristic of a piece of information and attached significance to it in forming an opinion on a different matter discounting any other information. Another explanation could be the availability bias as derived by Tversky & Kahneman, (1974) is the tendency to rely heavily on events/information from memory. Since not all memory is available at any given time, thus leading to short-termism or salient event heavily distorting beliefs.

As stated previously, there was too much optimism surrounding the euro and EMU at the time of their launch, which carried until the early parts of the global financial crisis. Thus, providing emphasis to the halo effect and availability bias which converted into the optimism in the financial markets. Hence meaning market participants disregarded relevant macroeconomics factors which highlighted the risks and valuations of the periphery member states, primarilythe GIPS states, sovereign debt.

As stated by Szyszka, (2013), a puzzling factor in the euro crises is the European banks' somewhat belated action in reassessing the Greek sovereign debts on their balance sheet.

The Greek crisis started with the announcement of the upwards amendment of the fiscal deficit in 5th November 2009; the banks did not react by amending their financial statements until late 2010-early 2011. Why did it take that long to reassess the risk on their balance sheet? In truth, bad news travels slowly, simply put it is hard to accept bad news. Theoretically, market participants tend to deploy over-optimism or wishful thinking inthe belief that positive results can still be possible. Hence, as stated by Barberis & Thaler, (2003), cognitive conservatism underweights any new information contradicting an earlier positive view. Moreover, since market participants are bynature loss avert, therefore mentally, they are discouraged from admitting failure. Furthermore, as suggested by Kahneman & Tversky, (1979), market participants may take higher risks to avoid or postpone loss.

As identified by Szyszka, (2013), the influence of external players, such as hedge funds and rating agencies, during the euro crises, cannot be underestimated. Among the strategies hedge funds use are short-selling and hedging by buying derivatives such as CDS. Simply put short selling is a strategy whereby the hedge fund bets on the price of an asset falling, hence the strategy illustrated by Figure 7. Another strategy often used by hedge funds is hedging against a country or organisation by buying a derivative, often Credit Default Swap, against the possibility of a default.

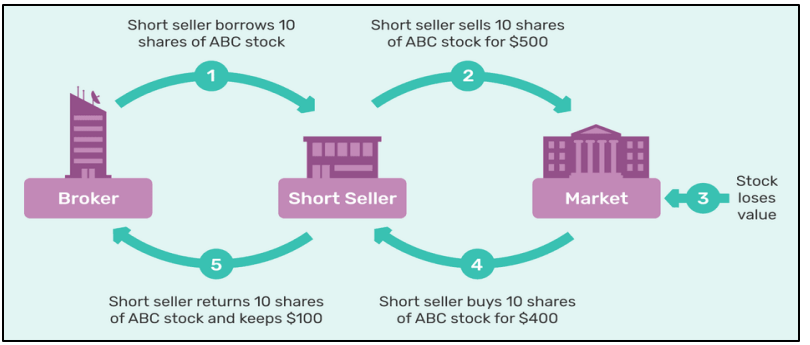

Figure 8. *Short-selling strategy*

EU and national politicians blamed these two strategies during the euro crises for intensifying the crisis. A key behavioural factor underpinning these hedge funds strategies is herding, essentially herding is where market participants reactto information or event in a similar way. Thehedge funds often used this strategyto bet on a fall in the euro against the dollar and Greek default during the euro crises.

As indicated by Szyszka, (2013), the second relevant players during the euro crises were the rating agencies who were partly to blame for the global financial crisis as highlighted previously. During the euro crises, it was a case of belated action followed by a quick reaction. The failure to recognise the risk disparity among the EU members gave rise to countries with weak macroeconomics factors being given the same triple-A rating as Germany, essentially Spain and Ireland. Furthermore, Greek sovereign debt ratings as investment grade even though macroeconomic factors pointed towards a downgrading were instrumental in market participants' continued investment. Additionally, the credit rating agencies only acted long after the markets classed the Greek yields as junk. Nevertheless, the rating agencies overreacted in the Portuguese and Irish sovereign debts downgrading, even though both countries have agreed

to undertake IMF restructuring programs and their economies were in better health than the Greek.

On 23rd June 2016, the UK voted in the referendum to leave the European Union by 51.89% to 48.11%. The results signalled the start of the so-called Brexit process whereby negotiations over the UK's withdrawal from the EU could start. This process was initiated by the UK's government on 29th March 2017 when they invoked Article 50 of the 2007 Lisbon Treaty which sets out the guidelines and conditions of a member state withdrawal from the EU. In terms of the financial markets, Brexit was a lesson in market participants' reaction to news and miscommunication by politicians. As highlighted by Fakhry, (2019b), except for Finland, on 24th June 2016 the losses on the Eurozone stock markets were higher than 5% averaging 8.17%. In the UK, the FTSE 100 loss 5.62% of its value.

There were some behavioural traits at play during the Brexit process. As observed previously, market participants tend to extrapolate events into the future. During the referendum and Brexit processes, there was a sense that market participants were not only extrapolating vertically but also horizontally. Indeed, there was an element of vertical extrapolation analysis of the economic consequences of Brexit in the UK. This analysis was bought about because market participants did not have any comparable eventto base their perception, which led to a highly volatile and uncertain market. A possible explanation is that market participants exhibited ambiguity aversion. As pointed by Ellsberg, (1961), market participants become increasingly ambiguity averse during any situation where the information's quality or confidence levels are unknown. Another explanation is the availability bias; market participants did not have any comparable situations; this caused them to link Brexit to the recent euro crises. At the heart of the market participants' fear of Brexit lays a

fundamental truth in that humans fear any social signals as hinted by Zweig, (2010). Thus, meaning any media communication affecting the financial market in any way leads to a reaction from the market participants. Since mixed news and political communications about Brexitwas plentiful, market participants' perception was negative. Another critical factor is that Brexit was an emotionally charged event which triggered a snowball effect on the financial market, causing a loss of confidence as suggested by Zweig, (2010).

The basis for horizontal extrapolation wasthe fear that the UK would signal others to follow suit and exit the EU and particularly the Eurozone. This situation would have had a ripple effecton the integration process, as highlighted previously and led to uncertainty in the integrated financial market of the EU. Particularly the Eurozone, as many member nations were growing disincentivised with the whole EU integrative process (e.g. Italy, France and Holland). The prolonged and complicated process of Brexit is partly down to the fact that the EU does not want to give too many concessions to the UK, in the process illustrating that a life outside the EU could be worth considering.

Methodology

The crises have highlighted the importance of a stable financial market underpinning the EU integration process. Several pieces of research had been conducted over the past few years emphasising this issue Groba, Lafuente & Serrano, (2013), MacDonald, Sogiakas & Tsopanakis, (2018), Trabelsi & Hmida, (2018) and Fakhry, (2019b) to name but a few. In analysing the efficiency of a number of the most affected Eurozone financial markets during the recent crises, Fakhry & Richter, (2016) and Fakhry, Masood & Bellalah, (2017) found that in general, the financial markets were unstable. As hinted by Fakhry, (2019b), there is a strong linkage

between financial markets integration and stability. Indeed, the thinking behind the Stability and Growth Pact and mandate of the ECB were partly to keep market stability.

Theoretically, if a market is unstable, it is regarded as reactive, as indicated by behavioural finance. Moreover, as put by Bernard Baruch Lee, Jiang & Indro, (2002:2277):

> "What is important in market fluctuations are not the events themselves but the human reactions to those events."

As hinted by Barberis, (2013), Szyszka, (2010), Szyszka, (2013) and Masood *et al.*, (2017) among many, the reaction of market participants tend to deviate between overreaction and underreaction. Indeed, during the crises, there was a hint of both reactive trends in the Eurozone financial markets as alluded previously.

A critical factor in our research is the shifts in volatility regimes, this phenomenon has been the subject of many pieces of research, mainly in the FX markets, over the years: Haas, Mittnik & Paolella, (2004), Kanas, (2005), Brunetti *et al.*, (2008), Chakrabart & Sen, (2011), Beg & Anwar, (2012) and Chortareas, & Jiang, (2017). The EMU effect on regime shifting has only been the subject of a relatively few number of researches: Frommel, (2004), Frommel, (2006), Wilfling, (2001) and Wilfling, (2009) to name a few. We use a Markov Switching GARCH model to analyse the shift in reactive behaviour in the Euro FX markets since as suggested by Fakhry, (2018), it is possible to model the shift between overreaction and underreaction regimes by using the Markov Switching GARCH model.

The market stability hypothesis model specification

As alluded by Fakhry, (2018), the simple statement underpinning our hypothesis is that any financial market's stability depends on the market participants' reaction during any period. This point crucially underpins every factor in the

global financial markets and decisions by monetary policymakers. Moreover, here is the critical factor during any period there is a mixture of highly volatile sub-periods hinting at overreaction and highly stable sub-periods hinting at underreaction. However, for any observed period, the market should stabilize if the reactions balanced out. Essentially, this means that the overreaction and underreaction cancel out; hence the sub-periods of high and low volatility deviates towards zero. This ideology is the essence of our hypothesis; the model suggests that the markets stabilize as the reaction approaches zero.

$$\boldsymbol{RS_T = SS_{O,T} - SS_{U,T} \rightarrow 0}$$

Condition 1: $\boldsymbol{RS_T \gg 0}$, an overreaction

Condition 2: $RS_T \ll 0$, an underreaction (1)

However, if the null hypothesis is correct, the market participants react to the news or event in ways that do not agree with our market stability hypothesis. Primarily the market participants exhibit either overreaction or underreaction towards the news or event; this is where our model differs from any previous model. Since, Equation 1 states that reaction at time T, RS_T, is the difference between the overreaction at T, $SS_{O,T}$, and the underreaction, $SS_{U,T}$, during any observed period. Hence, in a null hypothesis, Condition 1 and Condition 2 should illustrate market participants' overall reaction status during the observed period.

$$SS_{\{O,T}_{U,T\}} = \frac{\left(\sum coeffiocients_{\{H}_{L\}}\right)-1}{SD(var(Price))} \leq FStat \quad (2)$$

Primarily, our model's simple top-level equation is the variance bound test introduced by Fakhry & Richter, (2015). We derived both our independent variables $SS_{O,T}$ and $SS_{U,T}$

from the variance bound test in Equation 1 and Equation 2 is a hypothesis suggesting the null hypothesis of each stable status, where $SS_{O,T} > FStat$ and $SS_{U,T} > FStat$, essentially means the market is volatile and hence inefficient. However, at the heart of the equation is the summation $\left(\sum coeffiocients_{\{L}^{H}\right)$ whereby the coefficients the high or low volatility are summed. As with Fakhry & Richter, (2015), we follow the first pre-requisite step advocated by Shiller, (1981).

$$\lim_{t \to T} var(Price) = \frac{\sum_{q=1}^{Q} (Price_q - \mu)^2}{Q} \quad (3)$$

However, since we are only concerned with the market's stability and reaction to news and events; we do not follow the second step as described by Fakhry & Richter, (2015) and advocated by Shiller, (1981). This change was partly due to the estimation of the model underpinning the coefficients, but mainly because we deemed it unnecessary Fakhry, (2019b).

$$y_t = \mu_{S_t} + b\left(y_{t-1} - \mu_{S_{t-1}}\right) + \varepsilon_t \quad \text{where} \quad S_t = \begin{cases} 0 \; is \; one \; regime \\ 1 \; is \; another \; regime \end{cases} \quad (4)$$

$$P(S_t = s_t | S_{t-1} = s_{t-1}) = \begin{bmatrix} p00 & p10 \\ p01 & p11 \end{bmatrix} \quad (5)$$

The model underpinning our coefficients is any variant of the Markov switching GARCH model. In essence, the Markov switching GARCH model is an extension of the Markov switching model introduced by Hamilton, (1989) and Hamilton, (1990). As illustrated by Hamilton, (1989), severalresearchers have pointed to a weakness in analysing economic data and business cycles in a stationary linear data

set. This issue pointed to a changing environment in the underlining economic trend which a non-stationary regime-switching model using a discrete-state Markov process could pick up. As stated in Equation 4, the model specifies that the dependent variable y_t is regime dependence on the mean with probabilities of Equation 5 of a transition between regime 1 and 2.

$$h_t = \omega + \alpha_p \varepsilon_{t-1}^2 \tag{6}$$

$$h_t = \omega + \alpha_p \varepsilon_{t-1}^2 + \xi d_{t-1} \varepsilon_{t-1}^2 \text{ where } d_{t-1} = \begin{cases} 0, \varepsilon_{t-1}^2 > 0 \\ 1, \varepsilon_{t-1}^2 \leq 0 \end{cases} \tag{7}$$

$$h_t = \omega_{S_t} + \alpha_p \varepsilon_{t-1}^2 \tag{8}$$

However, as stated by Hamilton & Susmel, (1994) and Cai, (1994) amongst others, financial markets often interchanged between periods of low and high volatility. Furthermore, as argued by Hamilton & Susmel, (1994), the importance of this is two folds, on the one hand, the risk determines the price of any financial asset or index; on the other hand, the conditional mean of econometric models depend on the correct conditional variance. Conversely, due to issues regarding path dependence in Markov Switching GARCH arising from the literal translation of Bollerslev, (1986) GARCH model. Thus meaning the models of Hamilton & Susmel, (1994) and Cai, (1994) were base on the ARCH model of volatility of Engle, (1982) given by Equation 6. In essence, both Hamilton & Susmel, (1994) and Cai, (1994) were variant of the SWARCH model illustrated by Equation 7 and Equation 8, respectively.

$$h_t = \omega + \alpha k_{t-1} + \beta h_{t-1} \text{ where } k = \varepsilon^2 \text{ and } h = \sigma^2 \tag{9}$$

$$h_t = \omega_{S_t} + \alpha_{S_t} k_{t-1} + \beta_{S_t} h_{t-1} h_t = \omega_{S_t} + \alpha_{S_t} k_{t-1} + \beta_{S_t} \overline{h}_{t-1} : \overline{h}_{t-1} = \hat{\xi}_{t-1|t-2} h_{t-1} \tag{10}$$

where $h_t = \left(\omega_0 + \alpha_0 k_{t-1} + \beta_0 \overline{h}_{t-1}, \ldots, \omega_{S-1} + \alpha_{S-1} k_{t-1} + \beta_{S-1} \overline{h}_{t-1}\right)$ (11)

As noted by Haas, Mittnik & Paolella, (2004), GARCH models provide a better description of volatility than ARCH models. Further, ARCH models contain only part of the information on volatility, the impact of news or new information on the volatility captured by α. In reality, the persistence of volatility is the other vital information captured by β in the GARCH model illustrated by Equation 9. Conversely, a direct substitution would seem to be the answer; however consider Equation 10, h_t would depend on the entire regime history, which would render direct estimation virtually impossible. A possible method of implementing an MS-GARCH model was introduced by Gray, (1996) as illustrated by Equation 11. Klaassen, (2002) argued it would be more convenient to use $\overline{h}_{t-1} = \hat{\xi}_{t-1|t-1} h_{t-1}$ instead of $\overline{h}_{t-1} = \hat{\xi}_{t-1|t-2} h_{t-1}$ as used in Gray, (1996).

$$\boldsymbol{y_t = \mu_{S_t} + \varepsilon_t}$$
$$\boldsymbol{\varepsilon_t = h_{t,S_t}^{\frac{1}{2}} \epsilon_t, \epsilon_t \sim N(0,1)}$$
$$\boldsymbol{h_{t,S_t} = \omega_{S_t} + \alpha_{S_t} k_{t-1} + \beta_{S_t} h_{t-1,S_t}} \quad (12)$$
where $k = \varepsilon_t^2$ and $S_t = 1, \ldots, S-1$

We use a much more efficient and powerful MS-GARCH model derived by Haas, Mittnik & Paolella, (2004) as illustrated in Equation 12. Conversely, this means that each GARCH regime can be recursively updated; moreover, the GARCH regime only depends on the previous period's volatility and residual information. Additionally, the GARCH structure may be evaluated before the Markov-Switching filter.

Data description

This paper analyses the Euro FX market's stability and reactionfrom its introduction on 1st January 1999 to 31st December 2019. We obtain the dataset from the Bank for International Settlements (aka BIS) using the Nominal Broad Effective Exchange Rate (aka NBEER) index. The NBEER is an index of weighted averaged bilateral exchange rates from 27 economies. We observed the market on a 5-day week basis and filled any missing data with the previously known data, therefore using a total observation of 5,478 daily data.

Empirical evidence

The keys to the stability statistics and hencethe reaction of the markets in our test lay in the MS-GARCH model's coefficients and standard deviation of the observed datasets As suggested earlier; we use the Haas, Mittnik & Paolella, (2004) variant of the MS-GARCH model. In estimating the model, we used OxMetrics 8.0 with the standard defaults' options. The system was a Windows 10 on a ten core CPU with 32Gbytes of RAM computer.

We observed three critical periods in the European integration process: theEuro's introduction, the crises period, which started with the global financial crises and ended with the Eurozone sovereign debt crises, and finally Brexit. All three are critical periods on the road of European integration for different reasons. The introduction of the Euro, although a compromised concept with some glaring omissionfactors; yet the euphoria and optimism surrounding the introduction led to a strong belief in the integration process. The crises started with a denial that the global financial crises would impact the financial system in the EU and continued with a near-collapse of the Eurozone with the sovereign debt crises. However, it ended with possible further integration of the Eurozone. In a way, the real impact of Brexit is still on-going, but Brexit illustrated the potential for a partial disintegration

of the EU led by forces of populist and nationalist uprising. The outcome was eagerly watched by other potential member states and political parties wishing to break out of the EU integration process; like Italy, the Netherland and France.

The introduction and aftermath of the Euro

As illustrated by Cohen, (2003), the euro was born to a much euphoria environment. Indeed many in the market and academic predicted the euro would challenge the US dollar for global FX supremacy; relatively few questioned the enthusiasm towards the euro such as Feldstein, (1997). Conversely, Papaioannou, Portes & Siourounis, (2006) found that the euro's influence as the reference international reserve currency in the central banking environment was growing and accordingly *"punching above its weight"*. However, as highlighted earlier, the EMU was a compromised integrative policy with glaring omissions.

Moreover, as hinted by Trichet, (2001) and Galati & Tsatsaronis, (2003), there were still some issues regarding the EMU that meant the full potential for financial market integration mightremain unrealised. Nevertheless, this did not prevent the Eurozone from enjoying a prolonged period of economic and financial upturn. Furthermore, the financial markets, such as the equity and to a lesser extent bond markets, were being integrated. According to Trichet, (2001), generally, the Eurozone financial markets grew in the aftermath of the introduction of the euro.

As illustrated previously and by Szyszka, (2013), this general upturn in the Eurozone economies gave rise to a blinded greed in some member states on all three macroeconomic levels: governments, market participants and consumers. Thus, highlighting extrapolating errors and short-termism behavioural traits, It seems that the advanced of the EMU and Euro created a false sense of stability and

economic growth that all three levels of macroeconomics extrapolated further into the future. This falsified sense inevitably led to the underpricing of risk and overconfident, thus missing or misjudging certain warning signs.

As described in Table 5, the estimated model has a significant news coefficient, α, for both high and low volatility regimes signifying the impact of news or information during this period. However, the high volatility regime's coefficient is substantially high, indicating that news or information had a massive effect on the high volatility regime. Not surprisingly then that the persistent coefficient, β, is insignificant on both regimes. Indeed, the statistics is hinting at a zero-volatility persistent on the high volatility regime. The probability statistics, P{0,0} and P{1,1}, of the regime not changing are significant. Moreover, the low volatility regime's probability is high, which seems to point at the high likelihood of a low volatility regime.

Table 5. *Statistics for Stability Test using MS-GARCH of (Haas, Mittnik and Paolella, 2004)*

Event	Euro	Crises	Brexit
Observed Period	01/01/1999 - 07/06/2007	08/07/2007 - 23/06/2016	24/06/2020 - 31/12/2019
		Mean Statistics	
a	0.598865 (1.626E-2)	0.595143 (1.558E-2)	0.600688 (2.660E-2)
$\mathbf{b_{(r=0)}}$	0.100822 (7.213E-3)	0.150256 (1.338E-2)	0.0648588 (9.682E-3)
$\mathbf{b_{(r=1)}}$	0.0135454 (1.009E-3)	0.0145214 (1.006E-3)	0.00838425 (8.867E-4)
		MS-GARCH Statistics	
$\mathbf{\varsigma_{(r=0)}}$	0.0907291 (1.329E-2)	0.078508 (1.192E-2)	0.0474232 (1.883E-2)
$\mathbf{\varsigma_{(r=1)}}$	0.0114705 (8.616E-4)	0.0149895 (8.684E-4)	0.00676886 (7.929E-4)
$\mathbf{\alpha_{(r=0)}}$	0.777673 (1.380E-1)	0.160935 (7.228E-2)	0.0489391 (2.004E-1)
$\mathbf{\alpha_{(r=1)}}$	0.183682 (2.713E-2)	0.452751 (4.365E-2)	0.211467 (5.997E-2)
$\mathbf{\beta_{(r=0)}}$	0 (1.816E-1)	0.640363 (8.376E-2)	0.214238 (5.200E-1)
$\mathbf{\beta_{(r=1)}}$	0.413854 (3.793E-2)	0.248812 (2.801E-2)	0.42438 (6.100E-2)
P{0|0}	0.656355 (3.417E-2)	0.578598 (4.423E-2)	0.533096 (8.809E-2)
P{1|1}	0.851016 (1.305E-2)	0.897037 (1.011E-2)	0.870392 (2.325E-2)
		Description Statistics	
log-likelihood	3.218E+03	3.244E+03	2.026E+03
AIC	-2.915E+00	-2.739E+00	-4.385E+00
Linearity	2.183E+03	4.318E+03	7.953E+02
Normality	4.775E+02	6.615E+02	2.068E+01
ARCH	7.595E-01	3.943E-02	1.036E+00
Autocorrelation	2.443E+02	2.669E+02	8.091E+01
Mean	0.123247	0.14575	0.0557982
Std Dev	0.145216	0.269079	0.0618362
		Stability Statistics	
$\mathbf{S\text{-}stat_{(r-0)}}$	3.6136314	1.7036038	-2.5277055
$\mathbf{S\text{-}stat_{(r-1)}}$	3.167849961	2.28033217	8.296238449
$\mathbf{Stabilty_{(r-0)}}$	Volatle	Stable	Volatle
$\mathbf{Stabilty_{(r=1)}}$	Volatile	Volatile	Volatile
R-stat	0.4457815	-0.5767284	-5.7685330
Reaction	Overreaction	Underreactioon	Underreactioon

Both stable statistics point to a highly volatile Euro FX market during this period as illustrated by the S-stats. Nevertheless, the evidence from the R-stat is that the market is only slightly overreactive. Thus, pointing to the reaction to information or news generally being within the bounds of rationality in the Euro FX market during this period.

The global financial and Eurozone crises

In essence, as illustrated earlier and by Schimmelfennig, (2017), Genschel & Jachtenfuchs, (2018) and Hooghe & Marks, (2019); both crises had their roots in the incomplete and compromised integration process of the EMU and Euro. As hinted by Jones, Kelemen & Meunier, (2016), the lack of a genuinely integrative Eurozone broad regulation for an increasing European banking system and financial market played a significant part in the global financial crisis in the Eurozone. Moreover, as pointed by Jones, Kelemen & Meunier, (2016), another issue was the lack of an integrated fiscal and macroeconomic adjustment policies to deal with a Eurozone macroeconomic recession and crisis. Further, as highlighted by Genschel & Jachtenfuchs, (2018), the lack of tools and restricted mandate for the ECB to act in the crises. These issues meant added to the fact that many in the European Union were in denial about the global financial crisis and thought that it was an American problem meant the actions of the EU were often too late and in the words of Moravcsik & Schimmelfennig, (2012) characterised by the "chicken game".

As illustrated previously and by Szyszka, (2013), there are several behavioural traits in explaining the crises. The first is the human/macroeconomic time-horizon conflict Kahneman & Tversky, (1979). Humans act on short time-horizons focusing on the immediate fear of losses; while macroeconomics works on longer time horizons. The second is the underpricing/underestimation of risk, which hints at

greed by governments and market participants. The third trait is the Euro heuristics as explained earlier and derived by Szyszka, (2013), this is the tendency to group all EMU member states under the same label. A key factor influencing the euro crises was the rather belated actions of market participants, particularly the European banks, in reassessing their portfolios and balance sheets. The explanation is that it is hard to accept bad news, and hence bad news travels slowly. As Kahneman & Tversky, (1979) argue that market participants tend to avoid or postpone losses.

Table 5 is hinting at a significant news coefficient on both regimes during the crises period. Conversely, the low volatility regime's news coefficient was the higher of the two regimes during the crises hinting at approximately three times the impact. Although both persistent coefficients are insignificant, yet the high volatility regime is persistent, it is the highest of the three sub-periods. The probability statistics illustrate the regimes' differences with the low volatility regime being more significant than the high volatility regime.

There is a difference in the Euro FX market's stability status with the high volatility regime hinting a stable market while the low volatility regime isindicatinga volatile market. Moreover, the crises period highlighted a slight underreaction as implied by the R-stat, meaning that the reaction to news or information during the crises was within the bounds of rationality. Remember that the Euro did not suffer any significant impact or runs on it during the crises, unlike the other markets within the Eurozone.

The Brexit impact

As stated by Schimmelfennig, (2018a) and Schimmelfennig, (2018b), the issues at the heart of Brexit were politicisation and bargaining. The politicisation of Brexit helped shift the emphasis froma few interest groups to

the mass population where political identity plays a more significant role. Given the increasing eurosceptic population due to the loss of national identity and depth of integration, politicisation was an influencing factor. As illustrated by Schimmelfennig, (2018b), the critical factor in the intergovernmental bargaining with the two sides' initial position. The EU wanted to protect the integrity of the EU and euro while discouraging any further disintegration. The UK wanted to leave the EU while protecting their services and goods trades with the EU. Eventually, the UK and EU agreed to a withdrawal agreement on 22nd October 2019 approximately 40 months after the UK voted to withdraw from the EU. The EU and UK still have to agree on the nature of a trade relationship which as things stand, if a deal is not reached by 31st December 2020 then the UK could still leave in 2021 without a trade deal. Remember as highlighted by Fakhry, (2019a), the economic impact of Brexit is likely to be more significant on the UK than the EU and Eurozone. However, just how much of an impact is open to debate and depends on the economic deal, if any, within 2021.

The critical factor to remember during Brexit is the impact of information or lack thereof; two behavioural traits can influence this. The first is, as pointed by Ellsberg, (1961), the ambiguity bias which states that market participants tend to exhibit increasing ambiguity aversion when the quality or confidence levels of the information is unknown. The second is the availability bias which dictates that market participants tend to react differently to the lack of information or comparable event. The lack of information about Brexit may have triggered an association with the euro crises, as explained previously. Furthermore, as hinted by Zweig, (2010), humans fear any social signal; thus meaning market participants perception of any political communication or news regarding Brexit or the process was negative. There is another factor as suggested by Zweig,

(2010), since Brexit was emotionally charged on all sides, thus triggering a snowball effect into the financial market. The final factor is horizontal extrapolation by market participants based on the fear that the UK could signal other countries to exit the EU and particularly the Eurozone with noises from Italy, France and Holland. Therefore, causing a domino effect ending with the euro being abandoned.

Table 5 seems to be hinting at a split in the impact of news or information during the Brexit period. The high volatility regime is hinting at a near-zero impact on the Euro FX market, while the low volatility regime points at a significant impact. Thus, mainly due to the impact of news and information from Brexit falling mostly on the UK Sterling FX market. Both persistent volatility coefficients are insignificant, even though the low volatility regime is nearly double the high volatility regime's persistence. The probabilities are slightly lower than the crises period range, hinting at the low volatility regime being more highly likely.

The stability stats of both regimes are indicating a highly volatile market during the Brexit negotiation period. However, the low volatility regime seems to be more highly volatile. Moreover, the R-stats seem to be indicating a significant high underreaction in the Euro FX market. The crucial clue is the euro, remember as stated previously, the significant impact of Brexit fell on the UK Sterling FX market.

Conclusion

In summarising, this research combines the three European integration theories with behavioural finance to give a full picture of the Eurozone crises and Brexit. In order to understand the whole picture influencing any event and not just the EUcrises, it is necessary to include the action of both the governing organisation, in this case, the EU, and the market participants. Only when taking account of this factor,

a full grasp of the feedback effect between the actions or inaction of both the EU and market participants can be appreciated. The issues were two folds:

- the EU was too reactive and sensitive to the markets, and thus their actions did not resolve the problems at the heart of the crises
- the techniques used by market participants bore the wholemark of the opposite scale behaviours: greed and fear

Further, market participants extrapolated information vertically thru time horizons and horizontally thru markets orEU member states which led to false information resulting in bad investments decisions. At the heart of the issues with both the EU and market participants was the euro heuristic which, as identified by Szyszka, (2013), is the willingness by market participants to put all Eurozone members states in the same boat marked euro. Likewise, the euro heuristic influenced the EU actions, where a misconception grew with the euro regarding the stability and strength of the Eurozone economy. This factor led to the EU underreacting on the global financial and Eurozone sovereign debt crises

We also introduced a newmodel of testing any market's stability using the variance bound test of Fakhry & Richter, (2015) underpinned by a Markov Switching GARCH. We used the MS-GARCH model of Haas, Mittnik & Paolella, (2004); however, any MS-GARCH model would work with our new market stability test. The test modelled the critical behavioural factors influencing the reaction of market participants: underreactions and overreactions. The results seem to point to a slight overreaction in the Euro FX market to the introduction of the euro. However, during the crises period and, particularly the Brexit period, the result suggests an underreaction.

Furthermore, whereas with the crises period, there was a slight underreaction, the Brexit period seem to hint at a significant underreaction. Given the impression of the euro

within these different observational periods, the results seem to be a full reflection of the times. However, further research is required on other markets to test whether our model does truly convey market participants' reaction during uncertain events such as the recent crises or Brexit. A possible second route for further research is the MS-EGARCH model derived by Henry, (2009) to analyse the asymmetrical effect on the stability and reaction.

In concluding, it is hard to overestimate the feedback effect in the reactions of the market participant and EU during the recent crises and to a lesser extent Brexit. The lack of a uniformed plan and miscommunication from the EU during the crises or the British government during Brexit gave rise to unstable markets. Since market participants are homo sapiens and not homo economicus or Econ, hence as elegantly put by Bernard Baruch and Bertrand Russell:

> *"What is important in market fluctuations are not the events themselves but the humans' reactions to those events."*
>
> *"Neither man nor a crowd nor a nation can be trusted to act humanly or think slowly under the influence of fear."*

The second quote can be extended to explain the EU's reactions during the crises and, to a certain extent, Brexit.

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