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Ph.D. Thesis: Expanding Eurozone or not?

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To the memory of my beloved grand-mother, Despina

(Jan.1926 - Nov.2014)

The Author

Nikolaos Stoupos was born in the island of Chios, Greece on 01 May 1986, where he completed his high-school studies. He holds a Hons B.Sc. (Ptychion) in Accounting and Finance from University of Macedonia (Oct. 2004 - May 2009). In 2010, he successfully completed his postgraduate studies in the United Kingdom. He holds a M.Sc. in Business Economics, Finance and Banking from University of Portsmouth (Sept. 2009- Sept. 2010). His Ph.D. thesis completed in University of Macedonia, Department of International and European Studies, in October 2018, under the supervision of Dr. Apostolos Kiohos (Assistant Professor) (Oct. 2015 – Oct. 2018). He has participated in several international conferences, as a presenter, the previous years in the European continent. Also, he has five publications in international journals (doubled peer review), such as Research in International Business and Finance (2017) (2*), Quarterly Review of Economics and Finance (2019) (2*), International Economic Journal (2018) (1*), International Review of Applied Economics (2018) (1*) and Acta Oeconomica (2017) (1*). His academic interests are related with the European Integration, Monetary Economics, Exchange Rates, Energy Economics, Financial Econometrics and International Financial Markets.

"If I have seen further it is by standing on the shoulders of Giants"

Isaac Newton (1642-1727)

Signature of the author

Nikolaos D. Stoupos

Abstract

The European Project was the most important challenge after the end of World War II in the European continent. However, the European integration has been decelerated especially after the euro-crisis in 2010. Plenty of EU member-states turned to be very sceptical regarding to participation in the European Monetary Union. The principal aim of this doctoral thesis is to examine which EU and EEA countries could join the Euro Area, from a financial viewpoint. In addition, we attempt to explore if the cohesion of the Euro Area is stable. This means that we investigate if the Eurozone countries belong, in effect, to the monetary union. We used a combination of nominal, real and real effective exchange rates in relation to the special characteristic of each country. Our empirical methodology relied on the use of Error Correction model and family GARCH models. The ECM was the mean equation and the GARCH model was the conditional variance equation. Our empirical evidence highly supports that the cohesion of the Euro Area is strong. Germany, France and Italy constitute the "heart" of the monetary union, since they significantly influence the exchange rate of the euro. Moreover, Romania, Poland, Denmark, Norway and Sweden could join the Eurozone since their currencies is bound to the euro, from a financial viewpoint. On the other hand, the Czech Republic, Bulgaria, Hungary, Croatia, Iceland and the United Kingdom could not participate in the EMU, since the euro has negative impact reactions on their currencies. Finally, Switzerland shows historically an exchange rate independence from euro.

Keywords: *European integration, Euro Area, Error Correction Model, GARCH, volatility, forex risk, European Union*

Περίληψη

Το Ευρωπαϊκό Εγχείρημα αποτελεί την πιο σημαντική πρόκληση στην Ευρώπη έπειτα από το τέλος του Β΄ Παγκοσμίου Πολέμου. Η Ευρωπαϊκή ολοκλήρωση επιβραδύνθηκε σε σημαντικό βαθμό από την κρίση χρέους στην Ευρωζώνη το 2010. Αρκετά κράτη-μέλη της ΕΕ έγιναν αρκετά επιφυλακτικά όσον αφορά την συμμετοχή τους στην Οικονομική και Νομισματική Ένωση. Κύριος στόχος της συγκεκριμένης διδακτορικής διατριβής είναι να εξετάσει ποιες χώρες της Ευρωπαϊκής Ένωση, αλλά και του Ευρωπαϊκού Οικονομικού Χώρου, θα μπορούσαν να ενταθούν στην Ευρωζώνη, υπό το πρίσμα των συναλλαγματικών ισοτιμιών και της πραγματικής οικονομίας. Επίσης, προσπαθήσαμε να ερευνήσουμε εάν η συνοχή της ΟΝΕ είναι σταθερή. Ειδικότερα, εξετάσαμε εάν οι χώρες-μέλη της Ευρωζώνης ανήκουν, στην πραγματικότητα, στη νομισματική ένωση. Χρησιμοποιήσαμε ονομαστικές και πραγματικές συναλλαγματικές ισοτιμίες ανάλογα με τα ειδικά χαρακτηριστικά της κάθε χώρας. Η μεθοδολογία που χρησιμοποιήσαμε βασίστηκε στο μοντέλο διόρθωσης σφάλματος (ECM) και στην οικογένεια των γενικευμένων αυτοπαλινδρομούμενων μοντέλων με δεσμευμένη ετεροσκεδαστικότητα (GARCH models). Ειδικότερα, χρησιμοποιήθηκε το υπόδειγμα ECM ως εξίσωση του μέσου και το κάθε υπόδειγμα GARCH ως συνάρτηση της υπό συνθήκης διακύμανσης. Τα αποτελέσματα μας υποστηρίζουν ότι η συνοχή των κρατών-μελών της Ευρωζώνης παραμένει σταθερή. Ο πυρήνας της Ευρωζώνης αποτελείται από τη Γερμανία, τη Γαλλία και την Ιταλία μιας και επηρεάζουν σε μεγαλύτερο βαθμό τη συναλλαγματική ισοτιμία του ευρώ. Επιπλέον, η Ρουμανία, η Πολωνία, η Δανία, η Νορβηγία και η Σουηδία θα μπορούσαν να ενταχθούν στην ΟΝΕ μιας και τα νομίσματά τους επηρεάζονται σε μεγάλο βαθμό από το ευρώ. Από την άλλη, η Τσεχία, η Βουλγαρία, η Ουγγαρία, η Κροατία, η Ισλανδία και το Ηνωμένο Βασίλειο δεν θα ήταν πιθανό να συμμετάσχουν στην Ευρωζώνη αφού το ευρώ έχει αρνητική επίδραση πάνω στα νομίσματα τους. Τέλος, το νόμισμα της Ελβετίας παρουσιάζει μια διαχρονική ανεξαρτησία από το ευρώ, με αποτέλεσμα η σύνδεση των δύο νομισμάτων να είναι ουδέτερη.

Λέξεις Κλειδιά: *Ευρωπαϊκή Ολοκλήρωση, Ευρωζώνη, μοντέλο διόρθωσης σφάλματος, GARCH, μεταβλητότητα, συναλλαγματικός κίνδυνος, Ευρωπαϊκή Ένωση*

Contents

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"*Without your patience and your mental support, I do not know if I would had finished my Ph.D. studies*."

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Author,

N.S.

Chapter 1. The Prologue

The sovereign debt crisis of 2010 in the European Union deaccelerated the integration and shocked the cohesion of the union. The global financial crisis of 2008 revealed the weakness and the inaccuracies of the international finance markets. The banking institutions were not ready to deal with a sudden fall on the economic activity across the globe since they were exposed on high-risk investments. The global financial of 2008 commenced in the United States due to lenders' inability to refinance their loans. The collapse of Lehman Brothers in September 2008 was only the beginning. The international banking system is highly linked since it is not extremely difficult to transfer funds among the countries of the developed world. Undoubtedly, the development of the internet and computer technology was a vital key to the integration of the banking sector across the globe.

The transmission of the financial crisis was quick and the Central Banks and governments were not prepared to pause and isolate this contagious effect. The first victims of this crisis were the American, British and Icelandic banks. In spite of the satisfied reaction of the official authorities, we were witnesses of a sudden reduction of the economic activity in the US, the UK and the EU. The immediate consequences of the global crisis of 2008 were the devaluation of the US dollar and from 2008 to 2010. The American government of that time decided to implement fiscal measures in order to safeguard the US economy. Also, the Federal Reserve decided to reduce the interest rates of the US dollar in order to facilitate the loans payments and enhance the increase of investments. In specific, the US government announced in October 2008 a 250 billion dollars Capital Purchase Program to buy stakes in a wide variety of banks in an effort to restore confidence in the sector. The money came from the 700 billion dollars' bail-out package approved by US lawmakers.

Furthermore, the British government faced the challenge to rescue the banking institutions of the UK. In particular, a bank rescue package of 500 billion pounds was announced in October 2008 by the English government. The plan aimed to restore market confidence and assist stability in the UK banking system and provided for a range of short-term loans and guarantees of interbank lending, as well as up to 50 billion pounds of state investment in the banks themselves. The majority of the UK banks decided to not use the government money. However, the Lloyds TSB and the Royal

Bank of Scotland entered in the governmental program which led to their nationalization.

The European Commission encouraged the member-states of the union to implement austerity measures in order to balance their deficits, harmonize the economic reaction and protect their banking system against the global crisis. However, plenty of EU member states suffered from the side-effects of the global crisis in 2008. The first loss was Hungary which demanded the assistance of IMF in October 2008 by obtaining 25,1 billion dollars' rescue loan package in October 2008. Even the core of the Euro Area (Germany, France, the Netherlands, Finland, Austria, Luxemburg) faced plenty of challenges. However, these countries achieved to successfully manage the economic crisis, basically, due to their stable and strong economies which are able to endure external financial shocks. On the other hand, there were countries of the Euro Area which were not ready to deal with this kind of crisis. In specific, Greece, Ireland, Portugal, Spain and Cyprus were the countries which highly suffer from the transformation of the 2008 global financial crisis 2008 into the 2010 sovereign debt crisis. The debt crisis started as a failure in the banking sector in the majority of these countries. However, each country has its special characteristics which are related with the structure of the economy, the political system and the idiosyncrasy of each nation.

Particularly, Greece was the first country of the Euro Area which was hit by the debt crisis of 2010. The basic reason of the Greek crisis was the inability of the central government to refinance its debt. The Greek authorities decided to demand the assistance of the Eurozone, the European institutions and the IMF in order to confront with this crisis. Greece signed three Memoranda of Understanding with "Troika" (European Commission, European Central Bank and IMF) from May 2010 to August 2018. The Greek crisis begun as a refinance problem of the official sector and it transformed into banking stability problem to PSI (Private Sector Involvement) event in March 2012.

Additionally, Portugal was the second member of the Euro Area which was unable to repay or refinance its government debt without the assistance of third parties. To prevent an insolvency situation in the debt crisis, Portugal applied for bail-out programs and drew a cumulated €79.0 billion (as of November 2014) from the International Monetary Fund (IMF), the European Financial Stabilization Mechanism (EFSM), and the European Financial Stability Facility (EFSF).

Ireland's debt crisis based mainly on the instability of the Irish banking sector. Actually, on 21 November 2010, the Irish Prime Minister confirmed that Ireland had formally requested financial support from the European Union's European Financial Stability Facility (EFSF) and the International Monetary Fund (IMF). On 28 November, the European Union, International Monetary Fund and the Irish state agreed to a €85 billion rescue deal made up of €22.5 billion from the IMF, €22.5 billion from the European Financial Stability Facility (EFSF), €17.5 billion from the Irish Sovereign National Pension Reserve Fund (NPRF) and bilateral loans from the United Kingdom, Denmark and Sweden.

Spain's financial crisis started when the real estate bubble burst in May 2012 and the Spanish government spent large amounts of money on bank bailouts. Nevertheless, in June 2012, Spain became a prime concern for the Eurozone when interest on Spain's 10-year bonds reached the 7% level and it faced difficulty in accessing bond markets. This event led to the Eurogroup on 9 June 2012 to grant Spain a financial support package of up to €100 billion. The funds did not go directly to Spanish banks but be transferred to a government-owned Spanish fund responsible to conduct the needed bank recapitalizations (FROB).

Finally, Cyprus was the last member of the Euro Area which ask the assistance of the European Union. On 25 June 2012, the Cypriot Government requested a bailout from the European Financial Stability Facility or the European Stability Mechanism, citing difficulties in supporting its banking sector from the exposure to the Greek debt haircut (PSI). The Eurozone finance ministers proposed a levy on the Cypriot banks, excluding deposits of less than €100,000 in line with the EU minimum deposit guarantee. The final agreement was settled on 25 March 2013, with the proposal to close the most troubled "Laiki Bank", which helped significantly to reduce the needed loan amount for the overall bailout package, so that €10bn was sufficient without need for imposing a general levy on bank deposits.

The previous economic events in the Eurozone discouraged other EU member-states to join the European Monetary Union. The Treaty of Maastricht (1991), as well as, the Treaty of Lisbon (2007) not specify a particular timetable for joining the euro area but leaves it to Member States to develop their own strategies for meeting the condition for euro adoption. Until 2004, where the 5th Enlargement of the EU took place, twelve out of fifteen members of the EU adopted the euro as their currency. Only the UK, Sweden and Denmark decided to not participated at this step of integration by obtaining special

opt-outs. In addition, seven out of thirteen member-states of the 5th EU enlargement have join the EMU until now (2018). The majority of non-euro members of the EU is very sceptical about the potential benefits of Euro Area participation. The most important reason is the sovereign debt crisis in the Eurozone and the tremendous side effects of peripheral countries, such as Greece, Portugal and Ireland. According to Eurobarometer (2016), the next figure presents the net support for the single currency in non-euro countries from 1990 to 2016.

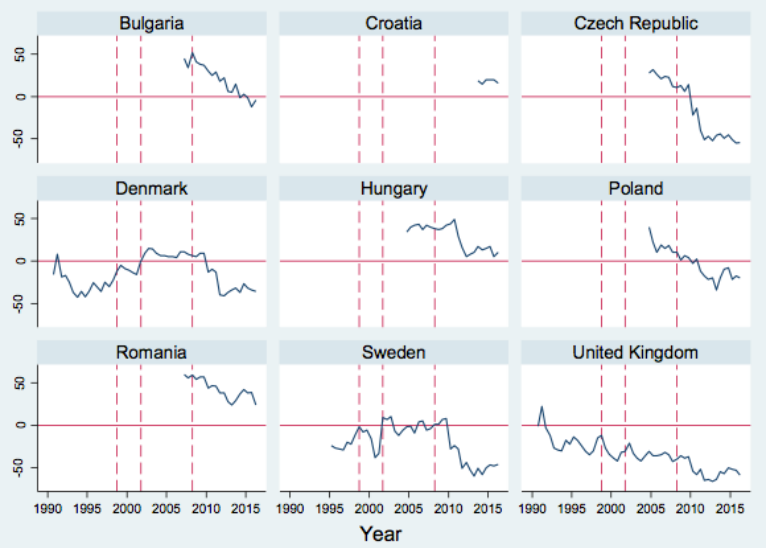
In specific, the figure (below) suggests:

- Outside the Eurozone, net support for the euro has declined in a pronounced manner. Whereas in Bulgaria, the Czech Republic and Poland a majority of citizens supported the euro in the years preceding the crisis, a majority in those countries has turned against the euro after the crisis. The decline in support, ranging from 65 to 30 percentage points, is strong. In contrast, in Romania and Hungary, in spite of a fall of 35 and 28 percentage points, respectively, a majority of euro support still exists.
- In Denmark and Sweden, the majority has turned away from euro support after the crisis. Just before the crisis, there was for brief periods a majority for the euro.
- The UK is an exceptional case. For the 26 years from 1991 to 2016, a majority of citizens was always against the single currency. During the crisis, net support for the euro reached levels as low as -66% (in November 2012). Given the persistent rejection of the euro, the Brexit vote should not come as a surprise but rather as reflecting a long-running critical view towards the European project. Therefore, any knock-on effects of the Brexit vote in the form of a break-up of the Eurozone via potential upcoming referenda in the Eurozone are not likely to emerge.

Undoubtedly, the sovereign debt crisis in 2010 and the BREXIT event shocked and put in danger the entire European Project. The principal aim of the doctoral thesis is to explore which Euro Area countries should be a part of the EMU and which EU and EEA countries should accept the euro as their currency. We used the exchange rates of the EU countries as an empirical instrument and we combined the Error Correction

Model (Engle *et al*, 1987) with the family GARCH models. The ECM was our mean equation and each GARCH type was used as a conditional variance equation.

Figure 1: Net support for the single currency in non-EZ countries, 1990-2016



Source: Eurobarometer (2017)

In particular,

- We used the nominal exchange rates of the UK and Switzerland in order to approve if they follow the economic behaviour of the euro. We combined the Error Correction Model with the Exponential GARCH (EGARCH) model.
- We utilized the nominal exchange rates of new members of the Euro Area in order to investigate if they hopefully entered in the EMU. We combined the ECM with the GJR GARCH model.
- We used the nominal exchange rates of the Post-Communist countries of the EU (Romania, the Czech Republic, Hungary, Croatia and Poland) in order to approve if they follow the economic behaviour of the euro. We combined the Error Correction Model with the Asymmetric Power GARCH (APARCH) model.
- We utilized the real effective exchange rates of the Scandinavian Countries in order to examine if they act according to the real effective exchange of the euro. We combined the Error Correction Model with the Asymmetric Dynamic Conditional Correlation GARCH (ADCC-GARCH) model.
- We used the real exchange rates of the founding Euro Area (EA-12) member states in order to examine if there is a long-term integration among the real

exchange rates and the nominal exchange rates of the euro. We combined a bivariate regression model (Robust Least Squares methodology) with the Asymmetric Component GARCH (AC-GARCH) model.

- Finally, we utilized the real exchange rates of Bulgaria, Estonia and Lithuania in order to find out if these countries follow the real exchange rate of the euro in the long-run. Actually, we checked if the Estonia and Lithuania joined hopefully in the EMU and if Bulgaria is ready to adopt the European single currency. We combined the Error Correction Model with the Threshold GARCH model.

Our empirical findings indicate that the cohesion of the Euro Area is strong. Germany, France and Italy constitute the "heart" of the monetary union, since they significantly influence the exchange rate of the euro. Moreover, Romania, Poland, Denmark, Norway and Sweden could join the Eurozone since their currencies is bound to the euro, from a financial viewpoint. On the other hand, the Czech Republic, Bulgaria, Hungary, Croatia, Iceland and the United Kingdom could not participate in the EMU, since the euro has negative impact reactions on their currencies. Finally, Switzerland shows historically an exchange rate independence from euro.

As regards the benefits of euro area membership, these can be seen from two perspectives: from the perspective of the individual country and from the perspective of the euro area as a whole. The convergence process for euro area entry is aimed at ensuring that participation in the euro area is beneficial for both. Starting with the euro area, Monetary Union represents the completion of the Internal Market in the EU, providing full price and cost transparency to the Single Market for goods, services, labour and capital. The euro has brought exchange rate stability within the area, which supports trade and enables economies of scale, thereby providing the conditions for a more efficient allocation of resources. For the ordinary citizen, the most striking advantage is of course that they no longer need to exchange currencies when travelling in the euro area. In addition, the euro has brought monetary stability, with low inflation and a convergence of long-term interest rates to the low levels prevailing in the countries that had the highest monetary policy credibility before the euro was introduced.

This was not an obvious outcome. In fact, given differences across countries and the complexity of the task at hand, many commentators doubted whether the euro area could ever achieve the high degree of monetary stability and credibility of some of its legacy currencies. Moreover, despite significant economic shocks over the years, due for instance to oil price and financial market developments, inflation and inflation expectations have remained closely anchored to price stability, as defined by the ECB. Price stability, low inflation expectations and low long-term interest rates are key objectives for monetary policy, as they provide the best support for sustainable economic growth and employment.

For the individual countries, however, the story could be somewhat different, given that favourable developments in the euro area could mask a considerable level of diversity among countries. In recent years, there has been much discussion about divergences across countries in the euro area. However, while inflation and growth differentials between euro area countries are not insignificant, they have not been unusually large since the launch of the euro in comparison with other large currency areas, particularly the United States. Moreover, the dispersion of inflation rates is substantially smaller than that experienced in the previous decade, and the dispersion of the growth rates across countries has declined somewhat over the past 20 years.

However, the persistence of inflation and growth differentials across countries, in the sense that it is the same countries which persistently exhibit developments above or below the euro area average, may suggest that the underlying adjustment mechanisms in the euro area economies are functioning only gradually and not as fast as might be desirable. This, in turn, could have adverse implications for activity and employment. Accordingly, appropriate reforms and economic policies are warranted.

The main benefit of the euro for the individual country, especially for small and open economies, relates to its potential to promote trade. By eliminating exchange rate volatility and providing complete price transparency, the euro has greatly enhanced the forces that lead to economic activity to be conducted across borders. It has been shown in a number of studies that trade integration has increased rapidly among countries that have introduced the euro, with a significant increase in intra-euro area trade and foreign direct investment (FDI). Indeed, exports and imports of goods within the euro area rose

from about 27% of GDP in 1999 to around 32% in 2006. This rise in cross-border trade may to a certain extent be due to the introduction of the single currency, the increased price and cost transparency it helped foster and the absence of exchange rate risk. The increasing interdependence of euro area countries is also confirmed by the considerable growth in intra-euro area FDI flows, with the sum of inflows and outflows in 2006 accounting for around 5% of euro area GDP – at par with extra-euro area FDI flows. Intra-euro area FDI stocks have thus grown considerably, doubling from 14% of euro area GDP in 1999 to around 28% in 2006.

At the same time, the increase in trade with the rest of the world has recently been even greater than the increase in intra-euro area trade, with the following figures showing that the euro area is very open. From 1999 to 2006 extra-euro area exports and imports of goods rose to 33% of euro area GDP, from about 24%. The stronger growth of extra-euro area trade has mainly been due to the more sustained growth in world GDP, an increase in global trade integration and the very sizeable increase in trade with China, emerging Asia and the new EU Member States that joined the Union in May 2004.

Finally, a factor which may be particularly important for small, open economies is that adopting the euro may provide stronger protection against international financial disturbances. Such disturbances have often had a disproportional effect on smaller economies, raising the risks of external shocks.

In sum, we would argue that the introduction of the euro has been a great success, showing that clarity of vision, based on sound economic arguments and determined planning and implementation, can yield important results in adapting our economies to the future global challenges.

Nevertheless, there are also challenges related to participation in the euro area which should not be forgotten. As I touched upon earlier, a potential challenge or risk involved in adopting the euro relates to the question of whether the economies that share the euro are relatively similar in terms of business cycles and do not display significant divergences. With monetary policy focusing on the euro area, divergences would place greater demands on domestic fiscal and structural policies as they would need to play a key role in the adjustment process. Divergences may arise from radically different

economic structures or from differences in economic policies, although the latter should be less of a problem given that all EU countries are committed to price stability, sound public finances and the Lisbon Agenda for promoting growth and employment.

Once the euro has been adopted, adjustments to economic problems, external shocks and changes in competitive positions need to be made other than via domestically set short-term interest rates and fluctuations in the exchange rate. Each country consequently needs to assess the likelihood of being exposed to country-specific shocks to which a euro area-wide monetary policy will not be able to react. In particular, it is important to avoid home-made competitiveness problems, for instance through too high wage increases in relation to productivity gains. At present, the business cycles of the euro area and most EU countries are highly correlated, and the correlation can be expected to increase further given the growing trade integration and the pursuit of stability-oriented economic policies.

Some differences between countries will, however, always exist and are a natural feature in all currency areas, reflecting regional adjustments to changes in demand and supply. As long as markets are free to adjust to the changing economic conditions, country differentials should largely be of a transitory nature. This underlines the importance of efficient and flexible labor and product markets which react in a timely manner and thereby moderate the impact of divergent developments on growth and employment. This is also why there is a strong focus in the EU and the euro area on structural reforms, as reflected for instance in the Lisbon process, and on prudent fiscal policies which are sufficiently flexible to provide buffers for bad times. The pressure to reform and improve the working of the domestic economy does not end with the convergence process for euro area entry.

Let us briefly also touch upon the challenges related to the adoption of the euro. As you are aware, the Treaty establishing the European Community specifies a number of nominal convergence criteria which must be fulfilled, including the need to deliver both price and exchange rate stability. This may be complicated in countries which are also undergoing a process of real convergence, which tends to put upward pressure on either inflation or the exchange rate. This suggests that the timing of euro area entry needs to be carefully considered, also in view of the fact that a key challenge relates to the

sustainability of convergence. Only when a country is certain to be able to maintain simultaneously an environment of low inflation and a stable exchange rate can it be confident of functioning smoothly within Monetary Union.

These challenges relate to the country as a whole; the challenge for individual citizens is to adapt to a whole new monetary reference system. While this may take time for older generations, who are used to what is cheap and expensive in the terms of the old currency, it is striking how fast the changeover goes for the younger generations. Unfamiliarity can lead to situations where companies try to take advantage of the euro cash changeover by raising prices. We have had this debate in many countries, and it remains a challenge for public authorities and consumers to scrutinise price-setting behavior closely and act against obvious attempts to take advantage of the situation.

Finally, a key challenge for all countries lies in an open and transparent debate with the general public on the implications of euro area participation and the necessary steps to be taken towards this goal.. Surveys show that there is a small majority of citizens in the new EU Member States (53%; and 52% in Poland) believe that adopting the euro will have positive consequences for their countries. Fewer people feel happy about the prospect of a future changeover (48%; and 46% in Poland). Sometimes, participation in Monetary Union is viewed by sceptics in terms of a loss of sovereignty. However, the room for manoeuvre for independent national policy-making in a highly integrated world economy is debatable in any case. For instance, it is clear that there are limits to the scope for national monetary policy to deliver both price and exchange rate stability in a world with free capital movements.

Before concluding, we would like to point out that our results are aligned with the research of Siskos (2014) where he explored the impact of the exchange rate regime in the EU countries. He suggested that the Euro Area is partially an optimum currency area (OCA). Also, he supports that there are plenty of EU countries which decided to participate in the Euro Area, basically for political and economic reasons. However, the majority of the periphery EU countries paid the price of their quick and unprepared decision. Finally, he proposes that the EU must pause to use the power of the older Euro Area members, against the interest of the new member-states. Actually, a power of balance must be maintained.

In conclusion, we clearly present that our basic research aim was to explore if the Euro Area could expand further in the European continent and beyond. According, to our empirical results we have found out that this research hypothesis could be partially true, since there are European countries where their economic interests are against Eurozone membership. Specifically, we discovered that the European Monetary Union could welcomed five new countries until 2030; Sweden, Denmark, Norway, Poland and Romania.

Lastly, our methodology is explained in details at the following chapters. Also, at this point, we present the structure of this doctoral thesis. Chapter 3 includes important historical events which are related to the establishment of the European Communities, the European Union, the European Economic Area and the Euro Area. Additionally, Chapter 2 shows the most important theories that are related with Optimum Currency Area (OCA) in international finance and economics. Chapter 4 presents the empirical methodology that we followed. Chapter 5 displays the empirical evidence for the UK and Switzerland. Chapter 6 contains the empirical results of the new euro member states. Chapter 7 presents the empirical findings of the Post-Communist countries of the EU. Chapter 8 includes the results of the Scandinavian countries and chapter 9 contains the findings of the founding Euro Area members. Chapter 10 displays the evidence concerning of Bulgaria, Estonia and Lithuania. Lastly, chapter 11 is the epilogue which includes our results, implications and policies and it finalizes this doctoral thesis.

Chapter 2 – Theoretical Background of monetary economics

2.1 The theory of optimum currency areas

It is patently obvious that periodic balance-of-payments crises will remain an integral feature of the international economic system as long as fixed exchange rates and rigid wage and price levels prevent the terms of trade from fulfilling a natural role in the adjustment process. It is, however, far easier to pose the problem and to criticize the alternatives than it is to offer constructive and feasible suggestions for the elimination of what has become an international disequilibrium system.' The present paper, unfortunately, illustrates that proposition by cautioning against the practicability, in certain cases, of the most plausible alternative: a system of national currencies connected by flexible exchange rates (McKinnon, 1963).

A system of flexible exchange rates is usually presented, by its proponents, as a device whereby depreciation can take the place of unemployment when the external balance is in deficit, and appreciation can replace inflation when it is in surplus. But the question then arises whether all existing national currencies should be flexible.

The problem can be posed in a general and more revealing way by defining a currency area as a domain within which exchange rates are fixed and asking:

What is the appropriate domain of a currency area? It might seem at first that the question is purely academic since it hardly appears within the realm of political feasibility that national currencies would ever be abandoned in favour of any other arrangement (McKinnon, 1963). To this, three answers can be given:

(1) Certain parts of the world are undergoing processes of economic integration and disintegration, new experiments are being made, and a conception of what constitutes an optimum currency area can clarify the meaning of these experiments.

(2) Those countries, like Canada, which have experimented with flexible exchange rates are likely to face particular problems which the theory of optimum currency areas can elucidate if the national currency area does not coincide with the optimum currency area.

(3) The idea can be used to illustrate certain functions of currencies which have been inadequately treated in the economic literature and which are sometimes neglected in the consideration of problems of economic policy.

2.2 Optimal currency areas in general-equilibrium models with price rigidities

Bayoumi (1994) presents a formal model of optimal currency areas in which the world is made up of a number of different regions, each specialized in the production of one particular good.

Moreover, wages are downwardly rigid in periods of low demand. The model, however, has no explicit role for financial assets or government policy. Each region can choose to have a separate currency or to join a currency union.

The general-equilibrium model has a closed-form solution and yields a number of interesting results. The size and correlation of disturbances are important factors in choosing a currency union. Labour mobility lowers the costs associated with a currency union both inside and outside the union. The degree of openness is also important as the gains from forming a union depend on the level of demand for the products of the other candidate regions for the union. The most interesting insight is that a currency union, while it can raise the welfare of regions within the union, lowers welfare for regions outside the union. This is because the gains (lower transactions costs) accrue mainly to members, while losses (lower output due to the interaction between the common exchange rate and wage rigidity) affect everybody. Another insight is that the gains from joining a currency union for a region are greater than the benefits to the members of the union of admitting a new member since the reduction in transaction costs depends on the amount of trade that is involved. Consequently, even if a country prefers a free float, it may still have an incentive to join a currency union with other regions if it is going to be formed because the gains are larger once the union is formed.

Ricci (1997b) presents a two-country model that captures both the real and monetary arguments suggested by the traditional OCA literature in a simple trade model with nominal rigidities. The two-country, two-good Ricardian trade model incorporates non-traded goods, random preferences in goods and money, exchange rates, trade costs, and nominal rigidities. Preferences are assumed to differ in the two countries in order to investigate how the degree of openness and of symmetry of shocks affect the desirability of the currency union.

Money supply shocks generated by the authorities reflect national tolerance for inflation. However, the monetary authorities are not allowed to pursue discretionary policies that would enable them to counteract
money demand shocks.

The model is solved for the two cases of mobile and immobile labour. The analysis, however, is static and neglects the existence of capital. The authorities' loss function (in both countries) depends on the unemployment rate, the rate of inflation, and deadweight transaction costs measured in employment terms. The model generates an extreme version of a Phillips curve: flat below full employment and vertical once full employment has been reached. Under a currency union, the two countries adopt the same currency and the transaction costs disappear. The net benefits from participation in a currency union increase with the following:

- the correlation of real shocks between countries;
- the degree of adjustment provided by fiscal policy instruments and by international labour
- mobility, as substitute adjustment mechanisms for the exchange rate;
- the difference between the inflationary bias of the domestic authority from that of the currency union (benefit of tying one's hands);
- the variability of domestic monetary shocks, as part of these shocks are transmitted to other countries within the currency union; and,
- the size of the deadweight and efficiency losses eliminated through the adoption of a single currency.

Other factors, however, will tend to diminish the net benefits of a currency union, including:

- the variability of real shocks, as these shocks generate adjustment costs in the currency
- union;
- the variability of foreign monetary shocks; and,
- the correlation of monetary shocks between countries, as this decreases the probability that the monetary shocks neutralize each other in a currency union.

A unique result of the model is that the effect of openness on the net benefits is ambiguous, in contrast with the usual argument (McKinnon, 1963) that more open

economies are better candidates for a currency union. An increase in openness increases the net benefits of eliminating transactions costs. It also implies that domestic prices can be more flexible in the presence of a foreign shocks, since they include a larger share of imported goods. Consequently, nominal exchange rates changes are less critical to the adjustment of the real exchange rate. However, greater openness also increases the relevance of real trade shocks, which reduces the net benefits of a currency union.

Beine and Docquier (1998) introduce some dynamic considerations. Their model assumes perfect competition, downwardly sluggish wage adjustments, and a traded and non-traded good for each country. Labour is the only factor of production and can migrate between countries in response to changes in relative disposable income. There are no financial markets. Transfers from a federal entity limit the effect of asymmetric shocks on unemployment. Model dynamics come from the sluggish wage adjustments, the gradual migration of the labour force between countries, and growing shock asymmetry caused by increased market and monetary integration. Estimates by Bayoumi and Eichengreen (1992) for Europe are used to calibrate the initial value of demand-and-supply shock asymmetry. The costs and benefits of a monetary union are assessed through its impact on the volatility and level of macroeconomic variables.

Even though the results are broadly consistent with those obtained by Ricci, there are differences worth noting. For instance, the cost of a monetary union can increase over time when it leads to more shock asymmetry. Also, while labour mobility between the two countries tends to reduce the volatility of per capita income, it could also increase average unemployment. This latter result comes partly from the short-run downward wage rigidities in the country affected by inward migration. However, when shocks are permanent, labour mobility clearly reduces average unemployment and facilitates adjustment towards long-run equilibrium. Another difference with Ricci is that the degree of openness of an economy increases unambiguously the desirability of monetary union. As expected, fiscal federalism is shown to reduce unemployment and income volatility in a monetary union. Beine and Docquier conclude that, in the presence of fiscal federalism (where federal spending is funded by a tax rate of 7 per cent), a union becomes desirable when transaction costs exceed 1.2 per cent of GDP. In the absence of fiscal federalism, the threshold is 1.6 percent of GDP.

The assumption that wages are only downwardly rigid has been questioned, however. Some have argued that prices and wages are also rigid on the up side. For

instance, Gordon (1996) rejects the assumption that the U.S. Philips curve is asymmetric. It is also debatable whether shock asymmetry would increase in a monetary union.

Devereux and Engel (1998) focus on pricing mechanisms to determine the choice of an exchange rate regime. They sketch a two-country, infinite-horizon model of optimization under uncertainty. Uncertainty reflects the presence of random monetary shocks at home and abroad.

They assume that imperfectly competitive firms set prices prior to the realization of monetary shocks but that prices are adjusted fully after one period. Two cases are considered. First, prices are set in the producers' own currency and do not respond to exchange rate movements. Second, firms price to market to maintain their competitiveness when the exchange rate fluctuates. The authors conclude that the most appropriate exchange rate regime depends on the currency in which prices are set. When prices are set in the producers' own currency, the results are ambiguous. The variance of domestic consumption is lower under floating exchange rates, but exchange rate volatility reduces the average level of consumption. Exchange rate volatility raises expected marginal costs facing price-setting firms, leading them to set higher average markups, which result in lower average consumption. The greater the degree of risk aversion, the more likely are fixed exchange rates to dominate. By contrast, floating exchange rates will always be preferable under pricing to market since the exchange rate does not influence optimal pricing policies.

Moran (1999) also combines monopolistic competition, pricing to market, and nominal rigidities in a calibrated dynamic general-equilibrium model. The focus of the paper is on the following question: How much is the flexibility implied by a flexible exchange rate worth?

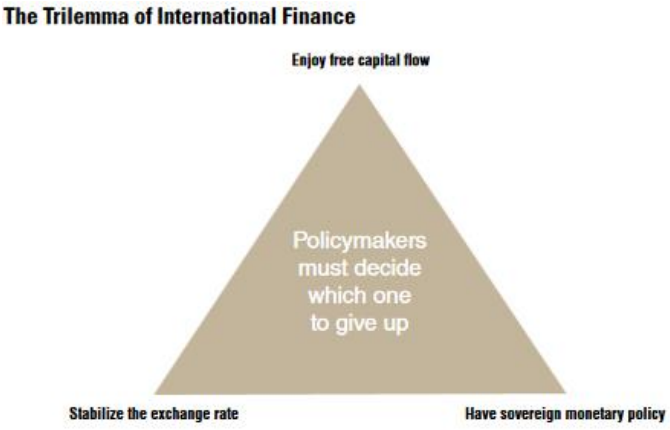
Alternative hypotheses on the rule followed by the monetary authorities are considered. Various degrees of nominal rigidities and shock symmetry between the two (large) countries in his model are also considered. Moran concludes that the welfare benefits of a flexible exchange rate regime, in terms of limiting output fluctuations, are very limited. His results appear to be driven by the type of utility function that he uses and that is in standard use in macroeconomic models (time-separable with low risk aversion).

Today, if the case for flexible exchange rates is a strong one, it is, in logic, a case for flexible exchange rates based on regional currencies, not on national currencies. The optimum currency area is the region.

2.3 Impossible Trinity or the Trilemma in international finance

The most important concept in international macroeconomics may be the trilemma of international finance (also called the impossible trinity). The trilemma states that a country cannot simultaneously have an open capital account, a stable exchange rate and autonomous monetary policy (Figure 2). The trilemma is a constraint on monetary policymaking in any country. The United States has chosen to maintain an independent monetary policy and an open capital account, but as a result, the Federal Reserve must allow the value of the dollar to be market-determined. Countries in the Eurozone have opted to stabilize their exchange rate, and they enjoy the free movement of capital. But as a result, individual nations no longer have an independent monetary policy. Policymakers in China, on the other hand, have chosen to stabilize the exchange rate and maintain an independent monetary policy; but to make this work, they need to impose restrictions on international capital flows.

Figure 2: The Impossible Trilemma



By the logic of the trilemma, if a central bank allows its exchange rate to float, it should have complete monetary autonomy. While this is certainly true in theory, some have begun to question whether it is actually true in practice. In a recent paper, Rey (2013) discusses the "global financial cycle," which is the fact that large swings in capital flows into many emerging-market economies are driven by global factors such as risk and

risk aversion in major developed markets. These swings in capital flows are exogenous from the point of view of the emerging market receiving the capital, the author argues. For many emerging-market economies, swings in the global financial cycle make the trilemma more of a dilemma. Without restrictions on international capital flows, monetary independence is not possible, even for a country with a floating exchange rate.

The fact that a country with open capital markets loses monetary policy autonomy when it adopts a fixed exchange rate is purely mechanical. As discussed in Rey's article, swings in trade and capital flows increase or decrease demand for a currency, and a central bank that tries to maintain a stable exchange rate must adjust currency supply to ensure the exchange rate stays constant as demand fluctuates. Adjusting the supply of the currency means adjusting the size of the central bank's balance sheet and, thus, actions to hold down the value of the currency are indistinguishable from accommodative open-market operations.

The loss of monetary autonomy when a central bank does not try to maintain a fixed exchange rate is less mechanical. Theoretically, without the constraint of trying to stabilize the value of the exchange rate, a central bank with a floating exchange rate can use its balance sheet however it likes. Nonetheless, as shown by Davis and Presno (2014), even when monetary policy is determined optimally to maximize a domestic objective function, optimal policy could still focus on managing volatile capital inflows and outflows. Calvo and Reinhart (2002) discuss a "fear of floating," where even central banks that profess to follow a floating exchange rate policy still actively intervene in foreign-exchange markets to manage the value of their currency.

This is especially true in an environment where a country is subject to large and volatile swings in capital flows. Even though, in theory, the central bank has complete monetary autonomy, in practice, its actions to stabilize the economy in the face of large and volatile swings in capital flows will mean that the optimally chosen monetary policy is nearly indistinguishable from a policy of exchange rate stabilization.

2.4 The original sin in international economics

Original sin was first used in an economic sense in 1999 when economists Barry Eichengreen and Ricardo Hausmann described the developing world's inability to borrow abroad in their local currency the "original sin" of emerging markets.

Original sin is a pernicious phenomenon. Borrowing in foreign currencies can both trigger and exacerbate financial and economic crises. When a country's debts are denominated in foreign currencies, it often forces policy makers to keep exchange rates pegged or heavily managed.
If the rate buckles, the authorities have to burn through valuable reserves and raise interest rates to protect the value of the local currency – even in the midst of a recession if necessary. If the peg breaks and the local currency tumbles, the foreign currency-denominated debt burden becomes much greater and can result in defaults.

The original sin hypothesis has undergone a series of changes since its introduction.
The original sin hypothesis was first defined as a situation "in which the domestic currency cannot be used to borrow abroad or to borrow long term even domestically" by Barry Eichengreen and Ricardo Hausmann in 1999. Based on their measure of original sin (shares of home currency-denominated bank loans and international bond debt), they showed that original sin was present in most of the developing economies and independent from histories of high inflation and currency depreciation. However, this early study left the causes of original sin as an open question.

In the second version of the original sin hypothesis, Barry Eichengreen, Ricardo Hausmann and Ugo Panizza in 2002 discarded the domestic element of original sin and redefined (international) original sin as a situation in which most countries cannot borrow abroad in their own currency. They showed that almost all of the countries (except US, Euro area, Japan, UK, and Switzerland) suffered from (international) original sin over time. Eichengreen, *et al.* (2003). concluded that weaknesses of national macroeconomic policies and institutions are not statistically related with original sin and found that the only statistically robust determinant of original sin was country size. Moreover, they claimed that international transaction costs, network externalities, and global capital market imperfections were the main reasons (which are beyond the control of an individual country) of the original sin. Hence, as a solution for the original sin problem, they proposed an international initiative and recommended development of a basket index of emerging-market currencies so that international financial institutions could issue debt denominated in this index until a liquid-market in this index had developed. Burger and Warnock (2003) suggested inclusion of information on domestic bond markets to account for the possibility that foreign investors were holding

local-currency emerging market bonds to analyse the determinants of original sin. Using this expanded measure, they showed that emerging markets economies could develop local bond markets (in which they can borrow in domestic currency) and attract global investors with stronger institutions and credible domestic policies. Reinhart, Rogoff and Savastano (2003) criticized the suggested international solution for the original sin problem by claiming that the main problem of emerging market economies is to learn how to borrow less (debt intolerance) rather than learn how to borrow more in their domestic currency.

In these two earlier versions of original sin hypothesis, Eichengreen, Hausmann and Panizza argued that in the presence of high levels of original sin, domestic investments will have a currency mismatch (projects that generate domestic currency will be financed with a foreign currency) so that macroeconomic and financial instability will be unavoidable. Hence, original sin and currency mismatch are used interchangeable in these early studies. Goldstein and Turner (2003) criticized this by showing that large output losses due to the currency mismatches during financial crises could not be attributed to original sin. Hence, they claimed that the original sin is not a sufficient condition for a currency mismatch.

In their last version of their original sin hypothesis, Eichengreen, Hausmann and Panizza (2007) defined domestic component of original sin as the "inability to borrow domestically long-term at fixed rates in local currency" while keeping the definition of (international) original sin same. They reported that no country (having an original sin ratio higher than 0.75) with high domestic original sin had low international original sin suggesting that if a country could not persuade its own citizens to lend in local currency at long maturities, it could not convince foreigners to do the same. On the other hand, they reported that seven countries, among the 21 emerging countries included in their sample, had low domestic original sin but relatively high international original sin, suggesting that dominant use of local currency in domestic markets is not a sufficient condition for dominant use internationally.

Empirical studies mainly focus on a few parameters as being the determinants of the original sin: (i) the level of development, (ii) monetary credibility, (iii) level of debt burden, (iv) the exchange rate regime, (v) slope of the yield curve, and (vi) size of the investor base.

The first determinant is level of development; measured generally with GDP per capita. Empirical studies indicate that GDP per capita is significantly correlated with original sin. However, this result is not robust to inclusion of other regressors (Hausmann and Panizza, 2003).

The second determinant of the original sin is monetary credibility. This is important for both domestic and international original sin. The monetary credibility is proxied usually by inflation. Generally, the ratio of domestic debt to total public debt is higher in countries with lower and less volatile inflation indicating that inflation can change the composition of public debt and make it riskier. Hausmann and Panizza (2003) find that monetary credibility, as measured by lower inflation and the imposition of capital controls, are associated with lower domestic original sin in emerging economies. On the international side, their study shows that if the monetary and fiscal authorities are inflation prone, foreign investors will lend only in foreign currency, which is protected against inflation risk, or at short maturities, so that the interest rates can be adjusted quickly to any acceleration of inflation.

The third determinant is the level of debt burden. High public indebtedness gives rise to an inability to service debt. Consequently, governments attempt to reduce debt service costs through inflation, unexpected changes in interest rates, explicit taxation, or outright default. Such situations reduce their credibility. Therefore, governments will tend to have a shorter maturity debt composition to enhance credibility when the debt burden is high. Most commonly, the ability to service debt is proxied with an array of macroeconomic indicators including the ratios of the fiscal balance to GDP, primary balance to GDP, government debt to exports and government debt to GDP (Hausman *et al*.,2003 and Mehl *et al*.,2005).

The fourth determinant is the exchange rate regime. As indicated by Hausmann and Panizza (2003), countries with fixed exchange rate regime experience large volatility in their domestic-currency interest rate, while countries that have a floating exchange rate regime experience larger exchange rate volatility. This creates differences in the structures of borrowing. Empirical studies show that fixed exchange rate regime is the main reason of liability dollarization. Despite these common weaknesses, emerging and developing economies have been able to attract capital because they have often operated under fixed or pegged exchange rate regimes until the early 2000s.

The fifth attempt is the slope of the yield curve. In theory, and given the existence of term premiums, issuing short-term debt is cheaper than issuing long-term debt. However, refinancing risk is higher for short-term debt and frequent refinancing implies a larger risk of financing with higher interest rates. Therefore, governments face a trade-off between cheaper funding costs, which tilts the duration towards short-term maturities and refinancing risk, which tilts the duration towards longer-term maturities. Generally, an upward-sloping yield curve is associated with higher long-term borrowing to meet investor demand and, hence, lower original sin.

Moreover, size of the investor base is another determinant of the domestic original sin. This concept actually indicates the level of financial development which is measured most of the time by a ratio of total domestic credits to GDP. Finally, a special care to the level of openness which is generally measured by total foreign trade, should be taken into account.

2.5 Special Exchange Rate Regimes

An exchange rate regime is the system that a country's monetary authority, -generally the central bank-, adopts to establish the exchange rate of its own currency against other currencies. Each country is free to adopt the exchange-rate regime that it considers optimal, and will do so using mostly monetary and sometimes even fiscal policies (Godley and Lavoie, 2012).

The distinction amongst these exchange rates regimes is generally just made between fixed and flexible exchange rate regimes, but we find there are many other different regimes, some of which are in between these extreme cases:

A) Monetary Union

A monetary union (also known as currency union) is an exchange rate regime where two or more countries use the same currency. However, in some special cases there may also be a monetary union even if there is more than a single currency, if the currencies have a fixed exchange rate with each other. In that case, total and irreversible convertibility of the currencies of those countries is required. Their parity relationships are fixed irrevocably, without admitting fluctuation of exchange rates. This process is progressively implemented, until reaching full monetary integration (Bain and Howells, 2009).

As explained by the impossible trilemma, in a monetary union there is exchange rate stability and a full financial integration enjoyed among the countries in it, at the cost of monetary independence. A common central bank should exist in order to coordinate the adequate monetary policy to assure a correct functioning of the monetary union, independently from national central banks, which lose many of its competencies. Economist Robert Mundell made a great contribution to the analysis on monetary unions in his paper "A Theory of Optimum Currency Areas", 1961. The theory of optimum currency areas determines the characteristics that are necessary so that monetary unions can be optimal, and therefore sustainable and economically efficient in the long run (Bain and Howells, 2009).

When analysing the impact of monetary unions on the members' economic performance, there are positive and negative effects. Negative effects of the establishment of a monetary union are, among others: the loss of monetary policy independence, the emergence of problems due to the initial establishment of parities or the difficulties in establishing full capital mobility. Positive effects include: the disappearance of the uncertainty in the fluctuation of exchange rates, lower transaction costs between countries, higher monetary stability and inflation controlling by the supranational central bank.

B) No Separate Legal Tender

Under a no separate legal tender regime, a country uses another one's currency and thus gives away its capacity of using monetary policies. As stated by the IMF, under an exchange arrangement with no separate legal tender, "the currency of another country circulates as the sole legal tender, or the member belongs to a monetary or currency union in which the same legal tender is shared by the members of the union". Following this definition, we could include every country in the Eurozone. However, since in that case a new central governing entity, the European Central Bank, was created, it is considered as a pure monetary union.

The most widely used example of an exchange arrangement with no separate legal tender is a formal dollarization. In this case, the country adopts the dollar as its currency. The most common examples are the cases of Ecuador, Panama and El Salvador. El Salvador is a rare case since dollars coexist with the former domestic currency, the colón. However, the printing of new colones is prohibited, so they will coexist with dollars until all colón notes wear out physically (Bain and Howells, 2009).

The main implication for a country to adopt an exchange arrangement with no separate legal tender is that it completely surrenders its control over monetary policy. Therefore, usually this regime is adopted by governments that are considered as non-reliable, substituting their currency in favour of a currency of another country considered to be stable and with an effective monetary policy.

C) Currency Board

A currency board is an exchange rate regime based on the full convertibility of a local currency into a reserve one, by a fixed exchange rate and 100 percent coverage of the monetary supply backed up with foreign currency reserves. Therefore, in the currency board system there can be no fiduciary issuing of money. As defined by the IMF, a currency board agreement is "a monetary regime based on an explicit legislative commitment to exchange domestic currency for a specific foreign currency at a fixed exchange rate, combined with restrictions on the issuing authority". For currency boards to work properly, there has to be a long-term commitment to the system and automatic currency convertibility. This includes, but is not limited to, a limitation on printing new money, since this would affect the exchange rate (Bain and Howells, 2009).

The first currency boards appeared during the nineteenth century in Britain and France's colonies. Since for locals of those colonies using the metropolitan currency was risky (loss or destruction of notes and coins, resources being permanently locked into the currency), the implementation of currency boards in the colonies made sense. The principle of the currency board was thus created in 1844 by the British Bank Charter Act.

The advantages of using a currency board includes low inflation, economic credibility, and lower interest rates. However, there is practically no monetary independence as monetary policies will focus in maintaining the coverage of the reserve's monetary supply in detriment of other domestic considerations. The central bank will no longer act as a lender-of-last-resort, and monetary policy will be strictly limited to that allowed by the banking rules of the currency board arrangement.

Examples include the Bulgarian lev against the Euro, or the Hong Kong dollar against the U.S. dollar.

D) Target Zone Arrangement

A target zone arrangement is an agreed exchange rate system in which certain countries pledge to maintain their currency exchange rate within a specific fluctuation margin or band. This margins can be set vis-à-vis another currency, a cooperative arrangement (such as the ERMII), or a basket of currencies. The spread of this margin can however vary, giving way to two different versions:

Strong version: also known as conventional fixed peg arrangements. The exchange rate, fluctuates within margins of ±1% or less, and is revised quite infrequently. The monetary authority can maintain the exchange rate within margins through direct intervention (for instance, purchasing and selling domestic and foreign currency in the market) or through indirect intervention (for instance influencing on interest rates). The flexibility of monetary policy is larger than for exchange arrangements with no separate legal tender (Bain and Howells, 2009).

Weak version: also known as pegged exchange rates within horizontal bands. In this case, the exchange rate fluctuates more than ±1% around the fixed central rate. Here, there is a limited degree of monetary policy discretion (Bain and Howells, 2009).

Target zone arrangements can be seen as being half way between fixed and flexible exchange rates. This kind of exchange rate system therefore allows for relatively stable trading conditions to prevail between countries, and at the same time allows some fluctuation in foreign exchange rates depending on relative economic conditions and trade flows.

E) Crawling Peg

A crawling peg is an exchange rate system mainly defined by two characteristics: a fixed par value of the currency which is frequently revised and adjusted due to market factors such as inflation; and a band of rates within which it is allowed to fluctuate (Handa, 2008).

As the IMF puts it, in crawling pegs "the currency is adjusted periodically in small amounts at a fixed rate or in response to changes in selective quantitative indicators, such as past inflation differentials vis-à-vis major trading partners, differentials between inflation target and expected inflation in major trading partners". The crawling rate can be set in a backward-looking manner (adjusting depending on inflation or other indicators), or in a forward-looking manner (adjusting depending on preannounced fixed rate and/or the projected inflation). It must be noted that maintaining a crawling

peg limits monetary policymaking, to a similar degree than for target zone arrangements.

These characteristics allow for progressive devaluation of the currency which has a less traumatic effect in the country's economy. Furthermore, this technique helps prevent, or at least soften, speculation over the currency. For these reasons, this type of exchange rate system is most commonly used with "weak" currencies. Latin American countries are known for being prone to use the crawling peg exchange system against the United States dollar, where in some cases devaluation can be seen occurring on a daily basis (Handa, 2008).

F) Managed (dirty) float

A managed or dirty float is a flexible exchange rate system in which the government or the country's central bank may occasionally intervene in order to direct the country's currency value into a certain direction. This is generally done in order to act as a buffer against economic shocks and hence soften its effect in the economy.

A managed float is halfway between a fixed exchange rate and a flexible one as a country can obtain the benefits of a free floating system but still has the option to intervene and minimize the risks associated with a free floating currency. For example, if a currency's value increases or decreases too rapidly, the central bank may decide to intervene in order to minimize any harmful effects that might result from the otherwise radical fluctuation. This is especially the case when international trade might be affected: central banks might act to counter a large appreciation of their currency, in order to maintain net exports. For instance, in 1994 the American government decided to buy large amounts of Mexican pesos with the objective of stopping the rapid loss in value of the peso, so to keep the trade status quo (Godley and Lavoie, 2012).

Even though most developed countries use a flexible exchange rate regime, in truth, they all use it to a limit. In fact, since most countries intervene in foreign exchange markets to some extent from time to time, these can be considered managed floating systems. The International Monetary System, which oversees the correct functioning of the international monetary system and monitors its members' financial and economic policies, "allows" for exchange rate intervention when there are clear signs of risk to any of its member's economy (Godley and Lavoie, 2012).

G) Free (clean) float

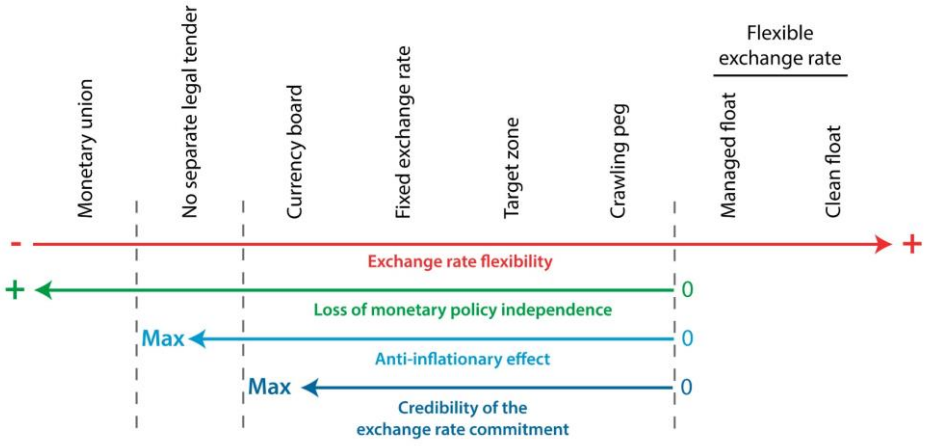
A free floating exchange rate, sometimes referred to as clean or pure float, is a flexible exchange rate system solely determined by market forces of demand and supply of foreign and domestic currency, and where government intervention is totally inexistent. Clean floats are a result of laissez-faire or free market economics (Handa, 2008).

Clean float is, theoretically, the best way to go. It allows countries to retain their monetary independence, which basically means they can focus on the internal aspects of their economy, and control inflation and unemployment without worrying about external aspects. However, we must take into consideration external shocks, such as oil price rises or capital flights, which can make it impossible to maintain a purely clean floating exchange rate system.

In reality, almost none of the currencies of developed countries have a clean float, as they all have some degree of support from their corresponding central bank, and so have a managed float. In fact, since most countries intervene in foreign exchange markets to some extent from time to time, these can be considered managed floating systems. The International Monetary System, which oversees the correct functioning of the international monetary system and monitors its members' financial and economic policies, "allows" for exchange rate intervention when there are clear signs of risk to any of its member's economy (Handa, 2008).

In conclusion, every exchange rate regime obviously has its particularities, virtues and flaws. To determine the most appropriate exchange-rate regime for a certain country is not a simple task as much will be at stake. A country's economy is hugely affected by this decision.

Graph 1: Special Exchange Rate Regimes



The previous graph shows the different regimes according to four different variables: exchange rate flexibility, loss of monetary policy independence, anti-inflation effect and credibility of the exchange rate commitment:

2.6 Is Euro Area an Optimum Currency Area?

Adopting Krugman and Obstfeld's (2009) case study on Europe as an OCA, we will raise the question if the Eurozone really fulfils the criteria of an optimum currency area. For this Krugman and Obstfeld's four OCA criteria will be enlisted, examined and interpreted in the perspective of the Euro and will then be evaluated as reasons for the foundation of the Eurozone.

According to Krugman and Obstfeld a fixed exchange rate area will serve the economic interests of each of its members best if the degree of output and factor trade among the included economies is high. They define OCAs as “groups of regions with economies closely linked by trade in goods and services and by factor mobility”. When they examine Europe's suitability for being an OCA the authors discuss the extent of intra-European trade, mobility of Europe's labour force, similarity of economic structure and the amount of fiscal federalism within the EU.

The extend of intra-regional trade is the first OCA criteria to illuminate. A country is more likely to benefit from joining a currency union if the union's economy is closely linked to its own. Economic integration can be valuated looking at both, the integration of product and factor markets – so looking at the extend of trade between the currency area and the potential new member, as well as at the easiness of movement of labour and capital be- tween the joining-country and the currency area. In 1999 EU intern trade amounted among 10 and 20% of the EU member states' total trade. This is a fairly high number, but still smaller than the amount of trade be- tween regions of the United States.

Summing up, the volume of intra-EU commerce has not been high enough to have a clear argument for forming the European Monetary Union (EMU) in 1999.

Labour mobility is the next OCA criteria to discuss. Since the formation of the EU's Single Market with freedom of movement of goods, capital, services, and people in 1993, national border controls have not been a major barrier to labour mobility any-more. Still labour is by far not moving as freely as in the United States, however. Differences in languages, cultures, social security systems, etc. are discouraging EU

residents in their labour movement. Even within European countries labour mobility appears limited and this partly be- cause of governmental regulations.

Due to the limited labour mobility, there is a risk of high unemployment rates in the case of product market disturbances; since there is no way of balancing economic shocks via labour migration within the Union. For this rea- son labour mobility is no indicator in favour of the foundation of the EMU either.

Similarity of Economic Structure is a further OCA criterion to evaluate. Extensive trade with the rest of the Eurozone makes it easier for a member state to adjust to output market disturbances that effects itself and its currency partners differently. A key element in minimizing such disturbances is similarity in economic structure, and here especially similarity in the types of produced products. Members of the EMU are not entirely distinct in their industrial and manufacturing structure; in fact, they have a high volume of intra- industry trade – which is trade with the same product variants. There are vital differences in economic structure, however. Looking at production structure, labour force qualification and capital stock, there are considerable differences between northern and southern Europe. While the north is in general highly equipped with skilled labour, capital and a high-quality production structure, the south disposes from a less innovative and specialized manufacturing structure, from less capitalization, as well as from a smaller number of qualified labour.

Owing to the varying intensity of technology in the production process, due to the differing levels of education and because of the discrepancy in labour markets between northern and southern Europe there is little reasoning for the formation of the EMU in the geographical extent we are experiencing nowadays. The high intra-industry trade is a pro-argument of course, but it seems to be outweighed by the number of contra-arguments proving dissimilarities in economic structure.

The last OCA criterion to mind is fiscal federalism. Fiscal federalism is the “European Un- ion's ability to transfer economic resources from members with healthy economies to those suffering economic setbacks”8. When an U.S. federal state is having economic problems in contrast to the rest of the nation, it automatically receives support from public authorities in Washington like welfare bene- fits or other federal transfer payments which are financed through tax payments. Financial federalism can help to balance a loss of economic stability due to fixed exchange rates.

The European Union has limited fiscal powers, however. It has only very small taxation capabilities – the EU only has 1% of the member states' GDP at its disposal. For this

reason, there is no EU budget to carry out fiscal federalism or to rescue a member state in economic difficulties.

Looking at the analysis of the European economic structure we can conclude that the EU economies are open to trade and that capital is highly mobile. Likewise, however, we must agree that labour is largely immobile for linguistic and cultural reasons, as well as for personal and social costs of migration. There is evidence that national financial markets have become better integrated with each other as a result of the Euro, and that the Euro has promoted intra-EU trade. As we have seen the volume of intra-European trade is fairly high, but still away from American quantities. In the United States labour force is significantly more footloose – in the case of economic shocks workers are willing to mi- grate to other federal states to avoid unemployment. On the other hand, in Europe, the low labour mobility between and within the EU countries implies a high risk of economic stability loss from Eurozone membership. Additionally, the European Union is because of its limited fiscal powers not able to support a European country in economic difficulties. The Union has no budgetary capabilities to transfer support payments from tax-earnings to the single member state.

Taking those influencing factors on the functionality of an Optimal Currency Areas one may have to conclude, that looking at the economic and structural factors there were no clear and steadfast arguments for the EMU at its founding moment in 1999. We should not forget though, that there are never only economic, but also political reasons to mind. Discussing the complex political rea- sons for the EMU foundation would go be- yond the scope of this paper, their crucial influencing power is not to neglect however.

What is more, one should not forget the positive cohesiveness effect of the EMU itself. By forming a monetary union, although it may not have been an OCA at its founding moment, the member states might have triggered a momentum for becoming one in the course of time. Andrew K. Rose (2008) surveyed 26 studies on the effects of the EMU on European trade and comes to the conclusion, that depending on the conservativeness of interpretation, the EMU has raised trade inside the Eurozone by at least 8% and up to 23%. He also identifies effect of trade on the synchronization of business cycles, which suggests in total according to him that the EMU has created a virtuous circle: by increasing trade and the synchronization of business cycles the EMU is reducing the need for national monetary policy and therefore is creating a momentum in favour of being an OCA.

Even though the EMU may not have been created as an Optimum Currency Area, it might be argued that it is moving in that direction ever since. One of the few unquestioned effects of the EMU is its trade- promoting effect. Also minding the from Rose postulated trade-synchronization effect and the therefore sinking need for national monetary policy, one may not be able to speak of the Eurozone as being an OCA ex ante, but maybe of becoming one ex post.

Chapter 3. From the European Communities to the European Union

3.1 Introduction

The World War II was extremely devastating for the entire European continent. Over 60 million people were killed, which was about 3% of the 1940 world population (est. 2.3 billion). The final battles of the European Theatre of World War II as well as the German surrender to the Allies took place in late April and early May 1945. After the termination of the World War II, the European governments made great efforts in order to establish and maintain a long-term peace and prosperity in Europe. The first step of this goal was the Treaty of Brussels. The Treaty of Brussels was signed on 17 March 1948 between Belgium, France, Luxembourg, the Netherlands and the United Kingdom, as an expansion to the preceding year's defence pledge, the Dunkirk Treaty signed between Britain and France. As the Treaty of Brussels contained a mutual defence clause (Article IV), it established the Western Union Defence Organization (WUDO). It also provided a basis upon which the 1954 Paris Conference established the Western European Union (WEU), after which the modified text was referred to as the Modified Brussels Treaty (MBT). The treaty was intended to provide Western Europe with a bulwark against the communist threat and to bring greater collective security. There were cultural and social clauses and concepts for the setting up of a 'Consultative Council'. Co-operation between Western nations was believed to help stop the spread of Communism.

The next step of the European Project was the forge of the European Communities. The European Communities (EC), sometimes referred to as the European Community, were three international organizations that were governed by the same set of institutions. These were the European Coal and Steel Community (ECSC), the European Atomic Energy Community (EAEC or Euratom), and the European Economic Community (EEC); the last of which was renamed the European Community (EC) in 1993 by the Maastricht Treaty, which formed the European Union.

When the Communities were incorporated into the European Union in 1993, they became its first pillar. The European Coal and Steel Community ceased to exist in 2002 when its founding treaty expired. The European Economic Community was dissolved into the European Union by the Treaty of Lisbon in 2009; with the EU becoming the

legal successor to the Community. Euratom remained an entity distinct from the EU but is governed by the same institutions.

3.2 The European Communities

As we have already described above, the European Communities (EC) were three international organizations that were governed by the same set of institutions. These were the European Coal and Steel Community (ECSC), the European Atomic Energy Community (EAEC or Euratom), and the European Economic Community (EEC). The ECSC was created first. Following its proposal in 1950 in the Schuman Declaration, Belgium, France, Italy, Luxembourg, the Netherlands, and West Germany came together to sign the Treaty of Paris in 1951 which established the Community. The success of this Community led to the desire to create more but attempts at creating a European Defence Community and a European Political Community failed leading to a return to economic matters. In 1957, the EAEC and EEC were created by the Treaties of Rome. They were to share some of the institutions of the ECSC but have separate executive structures.

The ECSC's aim was to combine the coal and steel industries of its members to create a single market in those resources. It was intended that this would increase prosperity and decrease the risk of these countries going to war through the process of European integration. The EAEC was working on nuclear energy co-operation between the members. The EEC was to create a customs union and general economic co-operation. It later led to the creation of a European single market.

The EEC became the European Community pillar of the EU, with the ECSC and EAEC continuing in a similar subordinate position, existing separately in a legal sense but governed by the institutions of the EU as if they were its own. The ECSC's treaty had a 50-year limit and thus expired in 2002, all its activities are now absorbed into the European Community. The EAEC had no such limit and thus continues to exist. Due to the sensitive nature of nuclear power with the European electorate, the treaty has gone without amendment since its signing and was not even to be changed with the European Constitution intended to repeal all other treaties (the Constitution's replacement, the Treaty of Lisbon, likewise makes no attempt at amendment).

As the EAEC has a low profile, and the profile of the European Community is dwarfed by that of the EU, the term "European Communities" sees little usage. However, when

the EU was established the institutions that dealt solely or mainly with the European Community (as opposed to all three pillars) retained their original names, for example the formal name of the European Court of Justice was the "Court of Justice of the European Communities" until 2009.

In 1967, the Merger Treaty combined these separate executives. The Commission and Council of the EEC were to take over the responsibilities of its counterparts in the other organizations. From then on, they became known collectively as the "European Communities", for example the Commission was known as the "Commission of the European Communities", although the communities themselves remained separate in legal terms.

The Maastricht Treaty built upon the Single European Act and the Solemn Declaration on European Union in the creation of the European Union. The treaty was signed on 7 February 1992 and came into force on 1 November 1993. The Union superseded and absorbed the European Communities as one of its three pillars. The first Commission President following the creation of the EU was Jacques Delors, who briefly continued his previous EEC tenure before handing over to Jacques Santer in 1994.

Only the first pillar followed the principles of supranationalism. The pillar structure of the EU allowed the areas of European co-operation to be increased without leaders handing a large amount of power to supranational institutions. The pillar system segregated the EU. What were formerly the competencies of the EEC fell within the European Community pillar. Justice and Home Affairs was introduced as a new pillar while European Political Cooperation became the second pillar (the Common Foreign and Security Policy).

The Community institutions became the institutions of the EU but the roles of the institutions between the pillars are different. The Commission, Parliament and Court of Justice are largely cut out of activities in the second and third pillars, with the Council dominating proceedings. This is reflected in the names of the institutions; the Council is formally the "Council of the European Union" while the Commission is formally the "Commission of the European Communities". This allowed the new areas to be based on intergovernmentalism (unanimous agreement between governments) rather than majority voting and independent institutions according to supranational democracy.

However, after the Treaty of Maastricht, Parliament gained a much bigger role. Maastricht brought in the co-decision procedure, which gave it equal legislative power with the Council on Community matters. Hence, with the greater powers of the

supranational institutions and the operation of Qualified Majority Voting in the Council, the Community pillar could be described as a far more federal method of decision making.

The Amsterdam Treaty transferred rule making powers for border controls, immigration, asylum and cooperation in civil and commercial law from the Justice and Home Affairs (JHA) pillar to the European Community (JHA was renamed Police and Judicial Co-operation in Criminal Matters (PJCC) as a result). Both Amsterdam and the Treaty of Nice also extended codecision procedure to nearly all policy areas, giving Parliament equal power to the Council in the Community.

In 2002, the Treaty of Paris which established the European Coal and Steel Community (one of the three communities which comprised the European Communities) expired, having reached its 50-year limit (as the first treaty, it was the only one with a limit). No attempt was made to renew its mandate; instead, the Treaty of Nice transferred certain of its elements to the Treaty of Rome and hence its work continued as part of the EEC area of the Community's remit.

The Treaty of Lisbon merged the three pillars and abolished the European Community; with the European Union becoming the Community's legal successor. Only one of the three European Communities still exists and the phrase "European Communities" no longer appears in the treaties. The abolition of the pillar structure was first proposed under the European Constitution but that treaty was not ratified.

The three Communities shared the same membership, the six states that signed the Treaty of Paris and subsequent treaties were known as the "Inner Six" (the "outer seven" were those countries who formed the European Free Trade Association). The six founding countries were France, West Germany, Italy and the three Benelux countries: Belgium, the Netherlands and Luxembourg. The first enlargement was in 1973, with the accession of Denmark, Ireland and the United Kingdom. Greece, Spain and Portugal joined in the 1980s. Following the creation of the EU in November 1993, it has enlarged to include a further sixteen countries by July 2013.

3.3 The European Union

The European Union (EU) is a political and economic union of 28-member states that are located primarily in Europe. It has an estimated population of over 510 million. The EU has developed an internal single market through a standardized system of laws that

apply in all member states. EU policies aim to ensure the free movement of people, goods, services, and capital within the internal market, enact legislation in justice and home affairs, and maintain common policies on trade, agriculture, fisheries, and regional development. Within the Schengen Area, passport controls have been abolished. A monetary union was established in 1999 and came into full force in 2002 and is composed of 19 EU member states which use the euro currency.

The EU traces its origins from the European Coal and Steel Community (ECSC) and the European Economic Community (EEC), established, respectively, by the 1951 Treaty of Paris and 1957 Treaty of Rome. The original members of what came to be known as the European Communities, were the Inner Six; Belgium, France, Italy, Luxembourg, the Netherlands and West Germany. The Communities and its successors have grown in size by the accession of new member states and in power by the addition of policy areas to its remit. While no member state has left the EU or its antecedent organizations, the United Kingdom enacted the result of a membership referendum in June 2016 and is currently negotiating its withdrawal. The Maastricht Treaty established the European Union in 1993 and introduced European citizenship. The latest major amendment to the constitutional basis of the EU, the Treaty of Lisbon, came into force in 2009.

The European Union was formally established when the Maastricht Treaty—whose main architects were Helmut Kohl and François Mitterrand—came into force on 1 November 1993. The treaty also gave the name European Community to the EEC, even if it was referred as such before the treaty. In 1995, Austria, Finland, and Sweden joined the EU.

In 2002, euro banknotes and coins replaced national currencies in 12 of the member states. Since then, the Eurozone has increased to encompass 19 countries. The euro currency became the second largest reserve currency in the world. In 2004, the EU saw its biggest enlargement to date when Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia joined the Union.

In 2007, Bulgaria and Romania became EU members. The same year, Slovenia adopted the euro, followed in 2008 by Cyprus and Malta, by Slovakia in 2009, by Estonia in 2011, by Latvia in 2014 and by Lithuania in 2015.

On 1 December 2009, the Lisbon Treaty entered into force and reformed many aspects of the EU. In particular, it changed the legal structure of the European Union, merging the EU three pillars system into a single legal entity provisioned with a legal

personality, created a permanent President of the European Council, the first of which was Herman Van Rompuy, and strengthened the position of the High Representative of the Union for Foreign Affairs and Security Policy.

In 2012, the EU received the Nobel Peace Prize for having "contributed to the advancement of peace and reconciliation, democracy, and human rights in Europe." In 2013, Croatia became the 28th EU member.

From the beginning of the 2010s, the cohesion of the European Union has been tested by several issues, including a debt crisis in some of the Eurozone countries, increasing migration from the Middle East and the United Kingdom's withdrawal from the EU. A referendum in the UK on its membership of the European Union was held on 23 June 2016, with 51.9% of participants voting to leave. This is referred to in common parlance throughout Europe as Brexit, a portmanteau of "Britain" and "exit". The UK formally notified the European Council of its decision to leave on 29 March 2017 initiating the formal withdrawal procedure for leaving the EU, committing the UK to leave the EU on 29 March 2019.

3.4 The Euro Area

The Eurozone officially called the Euro Area, is a monetary union of 19 of the 28 European Union (EU) member states which have adopted the euro (€) as their common currency and sole legal tender. The monetary authority of the Eurozone is the Eurosystem. The other nine members of the European Union continue to use their own national currencies, although most of them are obliged to adopt the euro in the future.

The Eurozone consists of Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain. Other EU states (except for Denmark and the United Kingdom) are obliged to join once they meet the criteria to do so. No state has left, and there are no provisions to do so or to be expelled. Andorra, Monaco, San Marino, and Vatican City have formal agreements with the EU to use the euro as their official currency and issue their own coins. Kosovo and Montenegro have adopted the euro unilaterally, but these countries do not officially form part of the Eurozone and do not have representation in the European Central Bank (ECB) or in the Eurogroup.

The ECB, which is governed by a president and a board of the heads of national central banks, sets the monetary policy of the zone. The principal task of the ECB is to keep inflation under control. Though there is no common representation, governance or fiscal policy for the currency union, some co-operation does take place through the Eurogroup, which makes political decisions regarding the Eurozone and the euro. The Eurogroup is composed of the finance ministers of Eurozone states, but in emergencies, national leaders also form the Eurogroup.

Since the financial crisis of 2007–08, the Eurozone has established and used provisions for granting emergency loans to member states in return for the enactment of economic reforms. The Eurozone has also enacted some limited fiscal integration, for example in peer review of each other's national budgets. The issue is political and in a state of flux in terms of what further provisions will be agreed for Eurozone change.

In 1998 eleven-member states of the European Union had met the euro convergence criteria, and the Eurozone came into existence with the official launch of the euro (alongside national currencies) on 1 January 1999. Particularly, the Eurozone was born with its first 11-member states on 1 January 1999. The first enlargement of the Eurozone, to Greece, where the country qualified in 2000 and was admitted on 1 January 2001 before physical notes and coins were introduced on 1 January 2002 replacing all national currencies.

The next enlargements were to states which joined the EU in 2004, and then joined the Eurozone on 1 January in the year noted: Slovenia (2007), Cyprus (2008), Malta (2008), Slovakia (2009), Estonia (2011), Latvia (2014), and Lithuania (2015).

All new EU members joining the bloc after the signing of the Maastricht treaty in 1992 are obliged to adopt the euro under the terms of their accession treaties. However, the last of the five economic convergence criteria which need first to be complied with in order to qualify for euro adoption, is the exchange rate stability criterion, which requires having been an ERM-member for a minimum of two years without the presence of "severe tensions" for the currency exchange rate.

Nine countries (Bulgaria, Croatia, Czech Republic, Denmark, Hungary, Poland, Romania, Sweden, and the United Kingdom) are EU members but do not use the euro. Before joining the Eurozone, a state must spend two years in the European Exchange Rate Mechanism (ERM II). As of January 2017, only the National Central Bank (NCB) of Denmark participates in ERM II.

Denmark and the United Kingdom obtained special opt-outs in the original Maastricht Treaty. Both countries are legally exempt from joining the Eurozone unless their governments decide otherwise, either by parliamentary vote or referendum.

The other seven countries are obliged to adopt the euro in future, although the EU has so far not tried to enforce any time plan. They should join as soon as they fulfil the convergence criteria, which include being part of ERM II for two years. Sweden, which joined the EU in 1995 after the Maastricht Treaty was signed, is required to join the Eurozone. However, the Swedish people turned down euro adoption in a 2003 referendum and since then the country has intentionally avoided fulfilling the adoption requirements by not joining ERM II, which is voluntary.

Interest in joining the Eurozone increased in Denmark, and initially in Poland, as a result of the 2008 financial crisis. However, by 2010 the debt crisis in the Eurozone caused interest from Poland, as well as the Czech Republic, to cool. Latvia adopted the Euro in 2014, followed by Lithuania in 2015.

Although the Eurozone is open to all EU member states to join once they meet the criteria, the treaty is silent on the matter of states leaving the Eurozone, neither prohibiting nor permitting it. Likewise, there is no provision for a state to be expelled from the euro. Some, however, including the Dutch government, favour such a provision being created in the event that a heavily indebted state in the Eurozone refuses to comply with an EU economic reform policy. EU law contains an implicit right for member states to leave the Eurozone if they no longer meet the criteria that they had to meet in order to join the Eurozone.

The outcome of leaving the euro would vary depending on the situation. If the country's own replacement currency was expected to devalue against the euro, the state might experience a large-scale exodus of money, whereas if the currency were expected to appreciate then more money would flow into the economy. A rapidly appreciating currency would be detrimental to the country's exports.

In 2015 Greece's case, one additional problem is that if Greece were to replace the euro with a new currency, this cannot be achieved very quickly. Banknotes must be printed for example, which takes up to six months. The changeover would likely require bank deposits be converted from euros to the new devalued currency. The prospect of this could lead to currency leaving the country and people withdrawing cash, causing a bank run and necessitating capital controls.

3.5 The European Economic Area

The European Economic Area (EEA) is the area in which the Agreement on the EEA provides for the free movement of persons, goods, services and capital within the European Single Market, including the freedom to choose residence in any country within this area. The EEA was established on 1 January 1994 upon entry into force of the EEA Agreement.

The EEA Agreement specifies that membership is open to member states of either the European Union (EU) or European Free Trade Association (EFTA). EFTA states which are party to the EEA Agreement participate in the EU's internal market without being members of the EU. They adopt most EU legislation concerning the single market, however with notable exclusions including laws regarding agriculture and fisheries. The EEA's "decision-shaping" processes enable EEA EFTA member states to influence and contribute to new EEA policy and legislation from an early stage. Third country goods are excluded for these states on rules of origin.

When entering into force in 1994, the EEA parties were 17 states and two European Communities: the European Community, which was later absorbed into the EU's wider framework, and the now defunct European Coal and Steel Community. Membership has grown to 31 states as of 2016: 28 EU member states, as well as three of the four-member states of the EFTA (Iceland, Liechtenstein and Norway). One EFTA member, Switzerland, has not joined the EEA, but has a series of bilateral agreements with the EU which allow it also to participate in the internal market.

The EEA Agreement was signed in Porto on 2 May 1992 by the then seven states of the European Free Trade Association (EFTA), the European Community (EC) and its then 12-member states. On 6 December 1992, Switzerland's voters rejected the ratification of the agreement in a constitutionally mandated referendum, effectively freezing the application for EC membership submitted earlier in the year. Switzerland is instead linked to the EU by a series of bilateral agreements. On 1 January 1995, three erstwhile members of the EFTA—Austria, Finland and Sweden—acceded to the European Union, which had superseded the European Community upon the entry into force of the Maastricht Treaty on 1 November 1993. Liechtenstein's participation in the EEA was delayed until 1 May 1995.

A 2016 UK referendum voted to withdraw from the European Union. Staying in the EEA, possibly eventually as an EFTA member, is one of the suggested options. A 2013

paper presented to the Parliament of the United Kingdom proposed a number of alternatives to EU membership which would continue to allow it access to the EU's internal market, including continuing EEA membership as an EFTA member state, or the Swiss model of a number of bilateral treaties covering the provisions of the single market. The United Kingdom was a co-founder of EFTA in 1960 but ceased to be a member upon joining the European Union. In the first meeting since the Brexit vote, EFTA reacted by saying both that they were open to a UK return and that Britain has many issues to work through although the Norwegian Government later expressed reservations. In January 2017, Theresa May, the British Prime Minister, announced a 12-point plan of negotiating objectives and confirmed that the UK government would not seek continued permanent membership in the single market. The UK could be allowed by other member states to join the EEA or EFTA but existing EEA members such as Norway would have concerns about taking the risk of opening a difficult negotiation with the EU that could lead them to lose their current advantages. The Scottish Government has looked into membership of EFTA to retain access to the EEA. However, other EFTA states have stated that only sovereign states are eligible for membership, so it could only join if it became independent from the UK.

Finally, The EEA relies on the same "four freedoms" underpinning the European Single Market as does the European Union: the free movement of goods, persons, services, and capital among the EEA countries. Thus, the EEA countries that are not part of the EU enjoy free trade with the European Union. Also, the free movement of persons is one of the core rights guaranteed in the European Economic Area (EEA). It is perhaps the most important right for individuals, as it gives citizens of the 31 EEA countries the opportunity to live, work, establish business and study in any of these countries'.

As a counterpart, these countries have to adopt part of the Law of the European Union. However, they also contribute to and influence the formation of new EEA relevant policies and legislation at an early stage as part of a formal decision-shaping process.

Agriculture and fisheries are not covered by the EEA. Not being bound by the Common Fisheries Policy is perceived as very important by Norway and Iceland, and a major reason not to join the EU. The Common Fisheries Policy would mean giving away fishing quotas in their waters.

The EEA countries that are not part of the EU do not contribute financially to Union objectives to the same extent as do its members, although they contribute to the EEA Grants scheme to “reduce social and economic disparities in the EEA”. Additionally,

some choose to take part in EU programs such as Trans-European Networks and the European Regional Development Fund. Norway also has its own Norway Grants scheme.

Chapter 4. Methodology

4.1 Augmented Dickey-Fuller unit root test

In statistics and econometrics, an augmented Dickey–Fuller test (ADF) tests the null hypothesis that a unit root is present in a time series sample. The alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models (Fuller, 1976).

The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence.

The testing procedure for the ADF test is the same as for the Dickey–Fuller test but it is applied to the model

$$\Delta y_t = a + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad (1)$$

where α is a constant, β is the coefficient on a time trend and p is the lag order of the autoregressive process. Imposing the constraints $\alpha = 0$ and $\beta = 0$ corresponds to modelling a random walk and using the constraint $\beta = 0$ corresponds to modelling a random walk with a drift. Consequently, there are three main versions of the test, analogous to the ones discussed on Dickey–Fuller test.

By including lags of the order p the ADF formulation allows for higher-order autoregressive processes. This means that the lag length p has to be determined when applying the test. One possible approach is to test down from high orders and examine the t-values on coefficients. An alternative approach is to examine information criteria such as the Akaike information criterion, Bayesian information criterion or the Hannan–Quinn information criterion.

The unit root test is then carried out under the null hypothesis $\gamma = 0$ against the alternative hypothesis of $\gamma < 0$. Once a value for the test statistic

$$DF_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})} \ (2)$$

is computed it can be compared to the relevant critical value for the Dickey–Fuller Test. If the test statistic is less (this test is non symmetrical so we do not consider an absolute value) than the (larger negative) critical value, then the null hypothesis of $\gamma = 0$ is rejected and no unit root is present (Fuller, 1976).

4.2 Lee and Strazicich two structural breakpoints unit root test

Lee and Strazicich (2001) further claimed that endogenous break tests can lead researchers to conclude that a time series is trend-break stationary when, in fact, the series is non-stationary with break(s)in testing unit root.

In order to solve this problem, they proposed a two break minimum Lagrange Multiplier (LM) unit root test in which the alternative hypothesis clearly implies the series is trend stationary.

The break minimum LM unit root can be described as follows. According to the LM principle, a unit root test statistic can be obtained from the following regression:

$$\Delta r_{it} = \delta' \Delta Z_t + \varphi \bar{S}_{t-1} + \mu_t \ (3)$$

Here, Δ is the first difference operator;

$\bar{S}_t = r_t - \hat{\Psi}_\chi - Z_t\hat{\delta}_t, t = 2, \dots T$; $\hat{\delta}$ are coefficients in the regression of Δr_t on ΔZ_t; $\hat{\Psi}_\chi$ is given by $r_t - Z_t\delta$. If times series has a unit root then $\varphi t=0$, which is the null hypothesis tested using the t-test against the alternative hypothesis that $\varphi t<0$. The panel LM test statistic is obtained by averaging the optimal univariate LM unit root t-test statistic. This is denoted as LM_i^τ,

$$\overline{LM}_{NT} = \frac{1}{N}\sum_{i=1}^{N} LM_i^\tau \ (4)$$

Im *et al.* (2005) constructed a standardized panel LM unit root test statistic by letting $E(L_T)$ and $V(L_T)$ denote the expected value and variance of LM_i^{τ} respectively under the null hypothesis. Im *et al.* (2005) computed the following expression:

$$\boldsymbol{\Psi_{LM}} = \frac{\sqrt{\boldsymbol{N}}\,[\overline{\boldsymbol{LM}}_{\boldsymbol{NT}} - \boldsymbol{E(L_T)}]}{\sqrt{\boldsymbol{V(L_T)}}} \quad \textbf{(5)}$$

The asymptotic distribution is unaffected by the presence of structural breaks and is standard normal.

4.3 Silvestre, Kim and Perron multiple structural breakpoints unit root test

According to Silvestre *et al.* (2009), in order to allow endogenously multiple structural breaks, the following model could be considered:

$$\boldsymbol{y_t} = \boldsymbol{d_t} + \boldsymbol{u_t} \ \textbf{(6)}$$
$$\boldsymbol{u_t} = \boldsymbol{au_t} + \boldsymbol{v_t t} = \boldsymbol{0}, \dots, \boldsymbol{T} \ \textbf{(7)}$$

Where y_t is a vector and $\{u_t\}$ is an unobserved mean-zero process. u_0 is assumed to be equal to 0. The disturbance v_t is defined by $v_t = \sum_{i=0}^{\infty} \gamma_i \eta_{t-i}$ with $\sum_{i=0}^{\infty} i|\gamma_i| < \infty$ and $\{\eta_i\}$ a martingale difference sequence adapted to the filtration $F_i = \sigma - field\{\eta_{t-i}; i \geq 0\}$. The long- and short-term variances are defined as $\sigma^2 = \sigma_\eta^2 \gamma(1)^2$ and $\sigma_\eta^2 = \lim_{T\to\infty} T^{-1} \sum_{t=1}^{T} E(\eta_t^2)$, respectively.

The deterministic component in equation (1) is given by,

$$\boldsymbol{d_t} = \boldsymbol{z_t'(T_0)\psi_0} + \boldsymbol{z_t'(T_1)\psi_1} + \cdots + \boldsymbol{z_t'(T_m)\psi_m} \equiv \boldsymbol{z_t'(\lambda)\psi} \ \textbf{(8)}$$

Where,

$$\boldsymbol{z_t'(\lambda)} = \left[\boldsymbol{z_t'(T_j)}, \boldsymbol{z_t'(T_1)}, \dots, \boldsymbol{z_t'(T_m)}\right] \boldsymbol{and}\ \boldsymbol{\psi} = (\boldsymbol{\psi_0'}, \boldsymbol{\psi_1'}, \dots, \boldsymbol{\psi_m'})' \ \textbf{(9)}$$

To estimate the break dates, Silvestre et al. (2009) use the global minimization of the sum of squared residuals (SSR) of the GLS-detrended model,

$$\hat{\lambda} = \arg\min_{\lambda \in \Lambda(\varepsilon)} S(\bar{\bar{a}}, \lambda) \quad (10)$$

Where $S(\bar{\bar{a}}, \lambda)$ is the minimum of an objective function. $\bar{a} = 1 + \bar{c}/T$ is a non-centrality parameter; $\wedge_{\varepsilon}\{\lambda: |\lambda_{i+1} - \lambda_i| \geq \varepsilon, \lambda_1 > \varepsilon, \lambda_k > 1 - \varepsilon\}$, and ε is a small arbitrary number, where in practice the common value of ε is equal to 0.15.

The proposed tests are defined by:

$$MZ_a^{GLS}(\lambda) = \left(T^{-1}\tilde{y}_T{}^2 - s(\lambda)^2\right)\left(2T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1} \quad (11)$$

$$MSB^{GLS}(\lambda) = \left(s(\lambda)^2 T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{1/2} \quad (12)$$

$$MZ_t^{GLS}(\lambda) = \left(T^{-1}\tilde{y}_T{}^2 - s(\lambda)^2\right)\left(4s(\lambda)^2 T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2\right)^{-1/2} \quad (13)$$

$$MP_T^{GLS}(\lambda) = \left(\bar{c}^2 T^{-2}\sum_{t=1}^{T}\tilde{y}_{t-1}^2 + (1-\bar{c})T^{-1}\tilde{y}_T^2\right)/s(\lambda)^2 \quad (14)$$

Where $\tilde{y}_t = y_t - \hat{\psi}' z_t'(\lambda)$ and $\hat{\psi}'$ are the estimated values of ψ,s $(\lambda)^2$ which is an estimate of the spectral density at frequency zero of ν_t.

4.4 Johansen's Co-integration test

The Johansen's Co-integration Test is the simplest methodology in order to discover possible long-term linkage among a group of variables. The methodology developed in Johansen (1991, 1995) performed using a Group object or an estimated VAR object.

Consider a VAR of order p:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t \quad (15)$$

Where y_t is a nx1 vector of variables that are integrated of order one-commonly denoted I(1) - and ε_t is an nx1 vector of innovations. This VAR can be re-written as:

$$\boldsymbol{\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t} \ \mathbf{(16)}$$

Where

$$\boldsymbol{\Pi = \sum_{i=1}^{p} A_i - I \ and \ \Gamma_i = -\sum_{j=i+1}^{p} A_j} \ \mathbf{(17)}$$

If the coefficient matrix Π has reduced rank r<n, then there exist nxr matrices α and β each with rank r such that Π=αβ′and $\beta' y_t$ is stationary. R is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of βis a cointegrating vector. It can be shown that for a given r, the maximum likelihood estimator of β defines the combination of y_{t-1} that yields the r largest canonical correlations of Δy_t with y_{t-1} after correcting for lagged differences and deterministic variables when present.

4.5 Johansen's Co-integration test with structural breaks

The Johansen's Co-integration Test with structural breaks is based on a model which allows for any pre-specified number of sample periods (q) of length $T_j - T_{j-1}$ *for* $j = 1,\ldots,q$ *and* $0=T_0 < T_1 < T_2 < \ldots < T_q = T$. It follows that the last observation in the *j*th sample is T_j while T_{j+1} is the first observation in sample period number (j+1). A vector autoregressive model of order k is considered. In analogy with the usual models without structural breaks, the model is formulated conditionally on the first k observations of each sub-sample, $XT_{j-1}+1, \ldots, XT_{j-1}+k$, and it is given by the equations

$$\boldsymbol{\Delta X_t = (\Pi, \Pi_j)\begin{pmatrix} X_{t-1} \\ t \end{pmatrix} + \mu_j + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-1} + \varepsilon_t} \ \mathbf{(18)}$$

for $j = 1,\ldots,q$ and $T_{j-1} + k < t \leq T_j$. The innovations are assumed to be independently, identically normally distributed with mean zero and variance Ω. The parameters vary freely, so Π, Γ_i, Ω which relate to the stochastic component of the time series are the

same in all sub-samples and of dimension (p x p) with Ω being symmetric and positive definite, while the p-vectors Π_j, μ_j relate to the deterministic component and could be different in different sample periods (Johansen *et al*. 2000).

4.6 The Error Correction Model (ECM)

The general mathematic formula of the Error Correction Model, according to Engle and Granger (1987) is the following one:

$$\Delta Y_t = \omega + \varphi EC_{t-1} + \sum_{i=1}^{p} \psi_i \Delta Y_{t-i} + \sum_{j=0}^{q} \theta_j \Delta X_{t-j} + \varepsilon_t \quad (19)$$

where, φ presents the adjustment speed back to equilibrium, ψ expresses the short-term dynamics coefficient and θ displays the long-term dynamics coefficient (Brooks, 2014). According to Engle and Granger (1987), the value of EC term should be strictly negative and statistically significant in order to have a successful long-term equilibrium between the two variables. Otherwise, a disequilibrium takes places.

An alternative expression of the ECM model is the following one, according to Brooks (2014):

$$\Delta Y_t = a + \sum \beta_1 \Delta X_{it} + \beta_2 \left(Y_{t-1} - \sum \beta_3 (X_{t-1}) \right) + u_t \quad (20)$$

where,

β_1 shows the short term dynamics
β_2 displays the adjustment speed back to equilibrium
β_3 expresses the long term equilibrium relationship

The use of Error Correction Model is most suitable when we wish to explore simultaneously a dynamic short-term or long-term linkage among a group of variables. On the contrary, we decided not use the Vector Error Correction Model (VECM) because this statistic procedure is used when there is not co-integration condition

among the examined series. VECM is most suitable to explore short-term relationships only (Brooks, 2014).

4.7 The Asymmetric Power ARCH model (APARCH)

The Asymmetric Power ARCH model (APARCH) is developed by Ding *et al.* (1993). APARCH model includes volatility asymmetry, leverage effect and volatility persistence. The conditional variance of an APARCH model is specified as follows:

$$\boldsymbol{\sigma_t^{\delta} = \omega + \sum_{i=1}^{p} \alpha(|\varepsilon_{t-i}| - \gamma_i \varepsilon_{t-i})^{\delta} + \sum_{j=1}^{q} \beta_j \sigma_{t-i}^{\delta}} \quad \mathbf{(21)}$$

where, α parameter represents volatility asymmetry, β parameter displays the volatility persistence, γ parameter shows the leverage effect and δ parameter is the power of the APARCH model. The restrictions for the positivity of σ_t^{δ} are given by Ding *et al.* (1993) as follows:

$$\boldsymbol{\omega > 0, \delta \geq 0, -1 < \gamma < 1, \alpha \geq 0 \; and \; \beta \geq 0} \quad \mathbf{(22)}$$

δ parameter is very important because it nests plenty of other volatility models.
In specific, we obtain an/a:
ARCH model if δ=2, γ=0, β=0 and α≠0 (Engle, 1983)
GARCH model if δ=2, γ=0, β≠0 and α≠0 (Bollerslev, 1986)
GJR-GARCH model if δ=2, γ≠0, β≠0 and α≠0 (Glosten *et al.* 1993)
TGARCH model if δ=1, γ≠0, β≠0 and α≠0 (Zakoian, 1991)
NARCH model if δ=1, γ=0, β=0 and α≠0 (Bera and Higgins, 1992)

4.8 The Exponential GARCH model (EGARCH)

Furthermore, we used the exponential GARCH model (EGARCH) in order to discover the volatility persistence and volatility asymmetry of each currency against the impact of the euro. Volatility persistence is commonly known as the response to shocks. Volatility asymmetry is a phenomenon which refers to the fact that there are higher volatility levels in downturns than in upturns of a time series (Brooks, 2014).

We have selected the EGARCH model because it attempts to address volatility clustering in an innovative process. Volatility clustering occurs when an innovation process does not exhibit significant autocorrelation, but the variance of the process changes with time. By modelling the logarithm, positivity constraints on the model parameters are relaxed. However, forecasts of conditional variances from an EGARCH model are biased, because by Jensen's inequality,

$$\boldsymbol{E(\sigma_t^2) \geq \exp\{E(log(\sigma_t^2))\}} \quad (23)$$

EGARCH models are appropriate when positive and negative shocks of equal magnitude might not contribute equally to volatility (Tsay, 2010).
According to Nelson and Cao (1992) the general mathematic expression of an EGARCH(P,Q) model is:

$$\log(\sigma_t^2) = \omega + \sum_{j=1}^{Q} \delta_j \left(\frac{\varepsilon_{t-j}}{\sigma_{t-j}}\right) + \sum_{i=1}^{P} \varphi_i \, log(\sigma_{t-i}^2) + \sum_{j=1}^{Q} \alpha_j \left[\frac{|\varepsilon_{t-j}|}{\sigma_{t-j}} - E\left\{\frac{|\varepsilon_{t-j}|}{\sigma_{t-j}}\right\}\right] \quad (24)$$

where, ω is the conditional variance model constant, δ shows the sign effect (volatility asymmetry), φ expresses the volatility persistence (GARCH component coefficients) and α presents the size effect (ARCH component coefficients) (Engle and Ng, 1993).
If z_t is Gaussian, then

$$E\left\{\frac{|\varepsilon_{t-j}|}{\sigma_t - j}\right\} = E\{|z_{t-j}|\} = \sqrt{\frac{2}{\pi}} \quad (25)$$

If z_t is t distributed with ν>2 degrees of freedom, then

$$E\left\{\frac{|\varepsilon_{t-j}|}{\sigma_t - j}\right\} = E\{|z_{t-j}|\} = \sqrt{\frac{\nu-2}{\pi}} \frac{\Gamma\left(\frac{\nu-1}{2}\right)}{\Gamma\left(\frac{\nu}{2}\right)} \quad (26)$$

4.9 The Threshold GARCH model (TGARCH)

The TGARCH (Zakoïan, 1994) model is similar to GJR-GARCH model (Glosten, Jaganathan, and Runkle, 1993). In TGARCH model the good and the bad news have different impacts on the conditional variance. The mathematic formula of the conditional variance of a TGARCH model is the following:

$$\sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \gamma \varepsilon_{t-1}^2 d_{t-1} + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \quad (27)$$

where dt=1 if εt< 0 (bad news) and dt = 0 if εt> 0 (good news). Particularly, when εt> 0 then the good news has an impact of αparameter. Also, then εt< 0 then the bad news has an impact on α+γ. If γ parameter is positive and statistically significant, then the leverage effect resides and the bad news raises volatility. Additionally, if the γ parameter is not zero, then the news effect is asymmetric (So et al. 2002).

4.10 The Asymmetric Component GARCH model (AC-GARCH)

Engle and Lee (1999) suggested the asymmetric component GARCH (AC-GARCH) model in order to explore the long-term and short-term volatility and the existence of leverage effect. The asymmetric component GARCH model permits mean reversion to a time-varying level qt and allows shocks to affect the volatility components asymmetrically. An AC-GARCH model is defined as:

$$\sigma_t^2 = q_t + \alpha\left(\varepsilon_{t-1}^2 - q_{t-1}\right) + \gamma\left(d(\varepsilon_{t-1} < 0)\varepsilon_{t-1}^2 - 0.5 q_{t-1}\right) + \beta\left(\sigma_{t-1}^2 - q_{t-1}\right) \quad (28)$$

$$q_t = \omega + q_{t-1} + \rho\left(d(\varepsilon_{t-1} < 0)\varepsilon_{t-1}^2 - 0.5\sigma_{t-1}^2\right) + \varphi\left(\varepsilon_{t-1}^2 - \sigma_{t-1}^2\right) \quad (29)$$

Where, *d(.)* denotes the indicator function (i.e. $d(\varepsilon_{t-i} < 0) = 1$ if $\varepsilon_{t-i} < 0$ and $d(\varepsilon_{t-i} < 0) = 0$ otherwise). α parameter presents the volatility clustering, γ parameter shows the volatility asymmetry, β displays the short-term component of conditional variance or

transitory effect, ρ is the long-term component of conditional variance and φ parameter is related with the difference of ARCH and GARCH effect.

4.11 Asymmetric Dynamic Conditional Correlation GARCH model (ADCC-GARCH)

Engle and Sheppard (2001) proposed the Dynamic Conditional Correlation GARCH (DCC-GARCH) which allows two stage estimation of the conditional variance matrix. In fact, the DCC-GARCH is a multivariate GARCH model which has been built on the idea of modelling the conditional variances and correlations instead of straightforward modelling the conditional covariance matrix. The covariance matrix, Ht, can be decomposed into conditional standard deviations, Dt, and a correlation matrix, Rt. Also, the most interesting part of the DCC-GARCH model is that both Dt and Rt are designed to be time-varying.

If we assume that there are at returns from n variables with expected value equal to zero (0) and covariance matrix Ht, then the DCC-GARCH model is defined as:

$$\boldsymbol{r_t = \mu_t + a_t} \ \mathbf{(30)}$$

$$\boldsymbol{a_t = H_t^{0,5} z_t} \ \mathbf{(31)}$$

$$\boldsymbol{H_t = D_t R_t D_t} \ \mathbf{(32)}$$

where,

r_t: n x 1 vector of log returns of n variables at time t

a_t: n x 1 vector of mean-corrected returns of n variables at time t, i.e. $E[a_t] = 0$ and $Cov[a_t] = H_t$.

μ_t: n x 1 vector of the expected value of the conditional r_t

H_t: n x n matrix of conditional variance of a_t at time t

D_t: n x n, diagonal matrix of conditional standard deviations of a_t at time t.

R_t: n x n conditional correlation matrix of a_t at time t

z_t: n x 1 of iid errors such that $E[z_t] = 0$ and $E[z_t z_t^T] = I$

In addition, the mathematical formula of the correlation structure can be extended to the general form DCC(m,n) – GARCH model:

In addition, the mathematical formula of the correlation structure can be extended to the general form DCC(m,n) – GARCH model:

$$\boldsymbol{Q_t} = \left(\mathbf{1} - \sum_{\boldsymbol{m=1}}^{\boldsymbol{M}} \boldsymbol{\lambda_{1_m}} - \sum_{\boldsymbol{n=1}}^{\boldsymbol{N}} \boldsymbol{\lambda_{2_n}}\right) \overline{\boldsymbol{Q_t}} + \sum_{\boldsymbol{m-1}}^{\boldsymbol{M}} \boldsymbol{\lambda_{1_m}}\ \boldsymbol{a_{t-1}a_{t-1}^T} + \sum_{\boldsymbol{n-1}}^{\boldsymbol{N}} \boldsymbol{\lambda_{2_n}Q_{t-1}}\ \mathbf{(33)}$$

where,

$\bar{Q}$: the unconditional covariance matrix of the standardized errors ε_t

λ_1,λ_2: are scalars parameters

There are imposed some conditions on the parameters λ_1 and λ_2 to guarantee $\boldsymbol{H_t}$ to be positive definite. Also, the conditions for the univariate GARCH model to ensure positive unconditional variances, the scalars λ_1 and λ_2 must satisfy the following restrictions:

$$\boldsymbol{\lambda_1 \geq 0, \lambda_2 \geq 0\ and\ \lambda_1 + \lambda_2 \leq 1}\ \mathbf{(34)}$$

During the first stage, univariate volatility models are fit for each variable, and estimates of h_{it} are taken. In fact, the first stage R_t is replaced with the identity matrix I_n, which results in the quasi-likelihood function:

$$\mathbf{ln}\big(\boldsymbol{L_1(\varphi)}\big) = \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \left(-\mathbf{0,5} \sum_{\boldsymbol{\tau=1}}^{\boldsymbol{T}} [\mathbf{ln}(\boldsymbol{h_{it}}) + \frac{\boldsymbol{a_{it}^2}}{\boldsymbol{h_{it}}} + \boldsymbol{c}\right)\ \mathbf{(35)}$$

From the first step, the parameter set $\varphi = \varphi_1, \ldots, \varphi_n$ is estimated. When φ is estimated, also the conditional variance h_{it} is estimated for each variable i = 1, …, n. When, the first step is ended, only the parameters λ_1 and λ_2 are unknown. These parameters are calculated in the second step.

During the second stage, variable returns, transformed by their estimated standard deviations, are used to produce the constant parameters of the conditional correlation. In fact, $\psi = (\lambda_1, \lambda_2)$ is estimated using the correctly specified log-likelihood. The second stage quasi-likelihood function is then:

$$\ln\left(L_2(\psi)\right) = -0,5 \sum_{t=1}^{T} (nln(2\pi) + 2\ln(|D_t|) + \ln(|R_t|) + \varepsilon_t^T R_t^{-1} \varepsilon_t \quad (36)$$

Since D_t is constant when conditioning on the parameters from first step, we can exclude the constant terms and maximize:

$$\ln\left(L_2^*(\psi)\right) = -0,5 \sum_{t=1}^{T} \ln(|R_t|) + \varepsilon_t^T R_t^{-1} \varepsilon_t \quad (37)$$

It can be shown under certain conditions that the pseudo-maximum-likelihood method yields consistent and asymptotically normal estimators.

Cappielo et al. (2006) clearly support that the DCC-GARCH model of Engle and Sheppard (2001) has a limitation. Particularly, the dynamics of the conditional correlation do not account for asymmetric impacts. This means that the model includes the magnitude of past shocks' impacts on potential conditional volatility and correlation, however it presents no differences between the negative and positive volatility responses. Cappielo *et al.* (2006) proposed the Asymmetric DCC-GARCH model in order to account for these future asymmetries in the conditional correlation between the times series. Therefore, the following equation (11) can be extended:

$$Q_{ij,t} = (1 - \lambda_1 - \lambda_2)\overline{Q_t} - \gamma\overline{\Psi_t} + \lambda_1\left(\varepsilon_{i,t-1}\, \varepsilon'_{j,t-1}\right) + \lambda_2\left(Q_{ij,t-1}\right) + \theta\left(\xi_{i,t-1}\, \xi'_{j,t-1}\right) \quad (38)$$

where, $\overline{\Psi_t} = E\left[\overline{\xi_{it}\, \xi_{Jt}'}\right]$ and $\overline{\xi_{it}} = (I[\overline{\varepsilon_{it}} < 0], o\ \overline{\varepsilon_{it}}\ ]$, the latter being the element by element Hadamard product of the residuals if sector shocks are negative, and $\overline{\xi_t} = 0$ otherwise. Therefore, the asymmetric factor, γ, captures periods where both markets experience bad news (negative shocks), making $\left[\overline{\xi_{it}\, \xi_{Jt}'}\right] = I_t$.

4.12 Glosten-Jagannathan-Runkle GARCH model (GJR- GARCH)

Glosten *et al.* (1993) suggest the GJR-GARCH model as an alternative method to the EGARCH model. Like the EGARCH model, the GJR-GARCH model has also achieved a good empirical record in the literature. The variance of this model can be written as:

$$\sigma_t^2 = w + \sum_{i=1}^{q} a_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \delta S_{t-i}^{-} \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \quad (39)$$

Where,

S^{-}_{t-i} is a dummy variable which takes the value 1 if ε_{t-i} is negative and 0 otherwise. The formula expresses the impact of ε^2_{t-i} on conditional variance σ^2_t. The above model also confirms that bad news ($\varepsilon_t < 0$) and good news ($\varepsilon_t > 0$) might have different conditional variance. If the leverage effect exists, δ is expected to be positive. The leverage effect is observed as the impulse ($\alpha+\delta$) of negative shocks, which is larger than the impulse (α) of positive shocks. In this model, good news and bad news have different effects on the conditional variance: good news has an impact of α, while bad news has an impact of ($\alpha+\delta$). For $\delta>0$, the leverage effect exists.

4.13 Rolling Regression methodology

Rolling approaches (also known as rolling regression, recursive regression or reverse recursive regression) are often used in time series analysis to assess the stability of the model parameters with respect to time (Banerjee et al. 1992). A common assumption of time series analysis is that the model parameters are time-invariant. However, as the economic environment often changes, it may be reasonable to examine whether the model parameters are also constant over time. One technique to assess the constancy of the model parameters is to compute the parameter estimates over a rolling window with a fixed sample size through the entire sample. If the parameters are truly constant over the entire sample, then the rolling estimates over the rolling windows will not change much. If the parameters change at some point in the sample, then the rolling estimates will show how the estimates have changed over time (Banerjee et al. 1992).

Lastly, the empirical results have been calculated by using the most updated versions of advanced statistical programs, such as E-views 10 and STATA 15, and MS Office Excel 2017. Also, R-programming language was utilized as an auxiliary tool in order to doubled check our empirical results. We used the official database of Bloomberg, European Central Bank (ECB), Federal Reserve System (FED), Bank of International Settlements (BIS) and Eurostat in order to gather our data.

Chapter 5. United Kingdom and Switzerland

5.1 Introduction

Generations of economists and researchers have occupied themselves with the impact of the exchange rates on various economic matters. However, only a few have attempted exchange rates as an instrument to examine the degree of unification in the EU. The Treaty of Maastricht was the first step for the European integration. The European politicians attempted to create a common European space without borders or variety of currencies. However, there are countries, such as the United Kingdom and Sweden which have obtained an official opt-out from adopting the euro (European Commission, 1993). The main question is if the currencies of non-euro member states follow the economic behaviour of the euro.

Ausloos et al. (2002) and Matsushita et al. (2007) presented strong evidence that the euro and the pound have been locked together in the long-run despite any daily fluctuations. Inagaki (2007) discovered that the euro volatility has one-sided effect on the volatility of British pound. Similar empirical findings have been presented by Chortareas et al. (2011) using a random walk approach. Pesaran et al. (2007) attempted to predict if the UK's and Sweden's economy would have been beneficial, in the case that the two countries had joined the Euro area (EA) in 1999. Their results highly support that the UK would have had higher economic growth, but lower prices if it was a member of the euro area. On the contrary, Pesaran et al. (2007) discovered that Sweden would have had higher GDP and higher prices if the country had joined the euro in 1999. Reade and Volz (2009) support the previous findings by claiming that Sweden would benefit more by entering the Euro area.

On the other hand, there are researchers and academics who support an opposite direction. For instance, McMillan and Speight (2010) discovered that the realized volatility spillovers are negative between the euro and the sterling. According to Tsay (2010), a spillover effect, in economics, is an economic event in one context that occurs because of something else in a seemingly unrelated context. Hence, realized volatility spillover is an event when there is an impact because of volatility between two variables using realized GARCH methodology.

Moreover, Minford (2008) highly claim that the UK should not join the Euro Area or the European Exchange Rate Mechanism (ERM II). He supports his opinion by using

a theoretical approach based on the transaction costs, the exchange risk, the cost of capital and the limitation of shocks absorbance without an independent currency. Lopes (2010) supports that Sweden and the UK should not join Eurozone because the in-put losses are greater than the out-put benefits.

Volatility is a tool which supports to discover the impact of one financial variable on another. The volatility measurement is important in financial markets because the investors and the financial/banking sector are able to evaluate the market risk. In our case, the measurement of volatility on the exchange rates is valuable in order to manage the exchange rate risk. GARCH models are the most appropriate for measuring dynamic characteristics of volatility. Kitamura (2010) supports that volatility spillovers between dissimilar economic or financial variables have been tested in a wide range. Spillover refers to the causality in return of variance.

Our empirical research attempts to investigate if the UK and Switzerland should join the Eurozone, as they have strong economic interrelationships with the other partners of the EU. The UK citizens voted for the country's withdrawal from the EU (BREXIT) on 23rd June 2016. However, the UK is still a member of the union, despite the fact that the British Government "triggered" article 50 of the Lisbon Treaty on the EU at 29th March 2017. Thus, we decided to include the UK in our research because the condition about Brexit is extremely volatile. Towards the end, we used the nominal exchange rate of each currency, in order to identify the short and long-term impact of the euro on each national currency. Furthermore, we empirically calculated the euro volatility spillovers on the volatility of each currency. It is important to support that we used the formula of the Error Correction Model (ECM) as the mean equation and the formula of EGARCH as the conditional variance equation. In fact, the combination of these two methods create an ECM-EGARCH model. Particularly, we used the errors of the ECM at the conditional variance equation of EGARCH.

Finally, we describe the motivation of this study. We used a novel approach in order to discover whether the EU economic and political unification should take place. We used the nominal exchange rates because we believe that this parameter reflects to the pragmatic condition of an economy. For instance, the value of the pound had collapsed against the major global currencies (euro, yen, US dollar) during the economic recession of 2008-2010 in the UK. Moreover, the nominal exchange rate is traded continuously over time instead of other economic parameters, such as GDP or inflation where the official measurements are not frequent. Each exchange rate is calculated per

US dollar (USD). We selected to use the nominal exchange rate of each examined currency against the US dollar as the USD is the world's official reserve currency (JP Morgan, 2009).

This study expresses interesting findings for politicians, EU policy makers, investors, risk managers and international institutions (IMF, World Bank and BIS) because a potential join of these leading European countries in the Euro Area would create new balances in the modern financial world. The economic magnitude of the UK and Switzerland is high and therefore, the euro would possibly be overvalued against the other leading currencies, such as the US dollar and the Japanese Yen. A potential enlargement of the Eurozone would influence the investors and the speculators. The investments will be paid back at a different currency. Moreover, the speculation profits and hedging activities over the fluctuation of the exchange rates will diminish because the currencies will not exist any longer. Lastly, the depositors will see their savings being converted into a different currency. Hence, the results of the current study are very important for individuals, multinational companies (MNCs) and global institutions in order to reprogram their financial schedule if an expansion of the Eurozone will take place. We should mention that the current research presents interesting findings for the UK politicians and policy makers. Particularly, they will be eligible to evaluate if the result of the current UK referendum is in the correct direction, under the financial aspect of view. The financial analysts and investors of Switzerland should evaluate the possible benefits of participating actively into the economic and political integration of the EU. Switzerland is a member state of the European Economic Area. This means that the country has access to the European Single Market, but no right to interfere with the political decision of the union. Hence, the results of the current study may intrigue the Swiss politicians to re-evaluate the neutral position of the country. Zurich is a significant centre for banking, asset management including provision of alternative investment products, and insurance. Swiss bankers and investors should assess the possible advantages and disadvantages by joining the Euro Area.

5.2 Dataset Analysis and Methodology

The current research uses the nominal exchange rates of three leading currencies in the European Union and the European Economic Area. Particularly, we examine any possible linkages among the euro, the British pound and the Swiss franc. The sample

includes daily observations covering a period of thirty years. The examination period is from 01 January 1986 to 31 December 2015. The data were collected from the official database of Bloomberg®. Each exchange rate is calculated per US dollar (USD). The dataset was divided into four periods of examinations in order to explore the characteristics of each period. The cut points of the dataset occurred by taking into account significant historical (political and economic) events. Also, we examined the features of the total period by covering an era of 30-years. We decided to investigate the features of total period, as well as, the four sub-periods in order to check if there is an overall tendency.

Table 1 displays the nature (acronym, measure and source) of each variable that we used in this research.

Table 1: Data Presentation (Source: Bloomberg®)		
Variables	**Acronym**	**Measure**
Euro	EUR	€/$
British Pound	GBP	£/$
Swiss Franc	CHF	SFr/$

The four sub-periods are presented below:

a) 01 January 1986 to 31 October 1993

This examined period is characterized as the pre-European Union era. The European Union is formally established on 01 November 1993 when the Maastricht Treaty came into force by replacing the name of European Economic Community.

b) 01 November 1993 to 31 December 2001

The present period is named as the pre-Eurozone era. During this period, the leaders of the member-states of the EU attempted to integrate economically and financially the nature of the union. The output of this effort was the creation of the Euro Area which took its physical form with the circulation of the euro on 01 January 2002.

c) 01 January 2002 to 14 September 2008

This era covers completely the thriving period of modern human history for advanced economies. The circulation of the euro, the development of the technology and the excessive connection of the international banking system created an economic development of six continuous years. However, the global economic development was ended with the collapse of the American investment bank Lehman Brothers' on 15 September 2008.

d) 15 September 2008 to 31 December 2015

This period is characterized as the presence of the global financial crisis of 2008 and the Eurozone debt crisis of 2010. However, we decided to include both crises because our independent variable is the euro. The Eurozone is economically and structurally instable during this era. According to Eigner and Umlauft (2014), the global financial crisis of 2007-2008 is considered for plenty of economists as the worst financial crisis of modern history. Plenty of international banking and financial institutions have been threatened to collapse by creating a contagious or domino effect in the international financial system. Secondly, the Eurozone faced a severe sovereign debt crisis where four member-states (Cyprus, Greece, Ireland and Portugal) signed Memoranda of Understanding with the European Commission (EC), the European Central Bank (ECB) and the International Monetary Fund (IMF).

We used the Error Correction Model because it is the most appropriate to interpret the change of one variable that is related to the change of another variable, as well as the gap between the variables in the previous period. The ECM is used when the dynamic impacts are visible on the time series as stationary data. On the other hand, we decided to not use the Vector Error Correction Model (VECM). It occurs because in VECM, the independent time series tend to be chaotic and non-stationary. Thus, we should normalize the data by using ordinary least squares (OLS) in order to predict the dependent variable. In summary, the ECM is more dependable. The VECM presents limitations (Brooks, 2014). In this study, the formula of the ECM is:

$$\boldsymbol{\Delta CUR_t = \beta_1 * \Delta EUR_t + \beta_2 * (CUR_{t-1} - \gamma * EUR_{t-1}) + e_t} \quad \mathbf{(40)}$$

where, the dependent variable CURt represents the nominal exchange rate of British pound (GBP), or Swiss franc (CHF) against the US dollar (USD). The independent variable is the nominal exchange rate of euro (EUR) against the dollar (USD).

5.3 Empirical Results

Table 2 shows the results of Augmented Dickey-Fuller test in order to discover if the series have a unit root. The test was executed by using level and 1st difference approach with intercept in test equation. We selected ADF test because it performs better in finite samples than the Phillips-Perron test (Davidson et al, 2004).

The empirical results of ADF tests highly supports that the series are not stationary at levels. However, we found out that the series are stationary at the first differences. Thus, we are eligible to execute the Johansen Co-integration test in order to examine if the series are co-integrated.

Table 2: Estimation Results of Augmented Dickey Fuller Test (ADF)

Series	**t-statistic(levels)**	**t-statistic(1st difference)**
Euro	-2.472	-86.906*
British Pound	-3.150	-88.641*
Swiss Franc	-2,788	-91.050*

Note: (*) denotes statistically significant at 0.01 level

Table 3 presents the empirical findings of Johansen Co-integration test. We decided to imply the present test in EUR, GBP and CHF series, according to Bansal et al. (2009). We selected the deterministic trend assumption of test that there is trend and intercept in co-integrating equations (CE) and no intercept in VAR with one lag only. VAR selects a system of equations with 1 lag for each variable. The estimation outcomes are the following.

The empirical results indicate that there is at most 1 co-integrated vector at a=0.05. Thus, we failed to reject the null hypothesis for co-integration among the examined variables. We are able to claim that the series (EUR, GBP, CHF) have a long-term steady equilibrium relationship.

Table 3: Johansen's Co-integration Test in series EUR, GBP,CHF				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value (a=0.05)**	**Probability**
None	0.005053	64.77	63.88	0.0419*
At most 1	0.001858	25.14	42.92	0.7826
At most 2	0.000837	10.59	25.87	0.8973

Note: (*) denotes statistically significant at 0.05 level

Table 4 expresses the estimation results of the Error Correction Model. The dependent variable was selected as the nominal exchange rate of Great Britain Pound against the US dollar and the independent variable is the nominal exchange rate of the euro against the US dollar. The t-statistic values are in the parenthesis. Note that all the diagnostic tests show that there is no autocorrelation.

According to the results, we observe that there is not a speed adjustment back to equilibrium for every period. It is clear that the nominal value of the euro influences positively the nominal value of the British Pound in the short-run. The short-term impact seems to be higher during the first period. This result occurs the first examined era is linked to European Economic Community. Therefore, the economic linkages among the member-states were more bound. However, when the Maastricht Treaty came into force, the balances changed because a few countries decided to reject the adoption of the euro as their currency, such as the UK. The UK preserved a special condition afterwards (opt-out right). This is the reason where the short-term impact of the euro on Sterling pound declined at the next periods.

On the other hand, it is observed that the long-term impact of the euro on the British Pound is negative for every period. This finding means that the nominal exchange rate of the British Pound would be overvalued, if the euro have been decreasing. This shows an opposite direction between the euro and the pound. Moreover, the long-term impact of the euro on the pound is higher during the pre-Maastricht Treaty and during the financial crisis of 2008 and the debt crisis of 2010. After the financial crisis of 2008, the British economy faced the most severe recession of the last years. The British pound lost a significant portion of its nominal value during this crisis. On the other hand, the euro strengthened its nominal value. Consequently, the long-term impact of the euro on the pound seems to be higher during the financial crisis.

Table 4: Estimation Results of Error Correction Model - GBPvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
β_1	0.365 (45.58)*	0.549 (55.91)*	0.237 (23.57)*	0.393 (34.78)*	0.310 (23.38)*
β_2	-0.001 (-1.93)	-0.001 (-3.89)*	0.001 (-1.07)	0.001 (-0.54)	0.001 (1.38)
γ	0.66 (12.73)*	0.739 (58.08)*	0.644 (7.11)*	0.675 (9.73)*	0.753 (8.29)*

Note: (*) denotes statistically significant at 0.01 level

Table 5 presents the empirical evidence of the ECM by using the nominal exchange rate of the Swiss Franc as the dependent variable and the nominal exchange rate of the euro as the control variable. Note that all the diagnostic tests show that there is no autocorrelation. The empirical evidence highly supports that there is a declined, but still positive short-term effect between the euro and the Swiss Franc. This means that the short-term impact of euro on the Swiss franc is getting weaker through the years. On the other hand, we observe a strong and negative long-term impact between the euro and the Swiss Franc. The above sentence indicates that the Swiss franc will be overvalued when the euro falls against the dollar in the long-run.

Table 5: Estimation Results of Error Correction Model CHFvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
β_1	0.737 (37.34)*	1.051 (26.68)*	0.894 (28.58)*	0.784 (22.94)*	0.641 (40.61)*
β_2	-0.001 (-2.75)*	-0.027 (-6.35)*	-0.02 (-5.82)*	-0.01 (-3.14)*	-0.001 (-0.74)
γ	1.482 (18.60)*	1.851 (185.41)*	1.591 (154.04*)	1.547 (75.33)*	0.319 (0.24)

Note: (*) denotes statistically significant at 0.01 level

However, it is important to mention that the long-term effect during the 4th period is not statistically significant. There is not a long-term impact between the two currencies. This event may occur because the Swiss National Bank (SNB) and the European

Central Bank (ECB) agreed a fixed exchange rate between the euro and the Swiss franc at approximately 1,22 CHF per EUR (average value). Specifically, the nominal exchange rate between the CHF and the EUR was allowed to be traded between 1,20 CHF/EUR (lower bound) and 1,25 CHF/EUR (upper bound). This exchange rate regime came into force from 07 September 2011 to 14 January 2015. On 15th January 2015, the Governor of SNB decided to unpeg the franc. In fact, Switzerland and the Eurozone agreed a monetary union for a small period of time. The current policy implemented by the two Central Banks (SNB and ECB) in order to maintain a reasonable nominal exchange rate between the euro and the Swiss franc. That was a strategy to minimize the depositors cash flows from Eurozone to Switzerland.

The EGARCH methodology was used in order to investigate the volatility asymmetry of each currency when the volatility shocks of euro take place. We used the formula of Error Correction model as the mean equation and the typical EGARCH model mathematical expression as the variance equation (Floros et al. 2009). Particularly, we re-estimated ECM with EGARCH errors in order to capture leptokurtosis, skewness and volatility clustering (ECM-EGARCH(1,1)).

Table 6 indicates the estimation results of the EGARCH (1,1) with 1 asymmetric order by using in mean equation the nominal exchange rate of the British Pound as the dependent variable and the nominal exchange rate of the euro as the independent variable. The empirical results express that δ parameter is positive during each period. Thus, the devaluation of the euro influences higher the sterling instead of the overvaluation of euro. Specifically, the bad news of the euro (devaluation against dollar) show a 12,1% greater impact than the good news of the euro (overvaluation against the dollar) on the pound during the first period. The current volatility asymmetry seems to be stable for the next two periods. Especially, the bad news influence higher the nominal exchange rate of British Pound by 15,7% during 2nd period and 13,5% during the 3rd period. However, the sign effect gets lower during the 4th period. The devaluation of the euro against the US dollar has 2,9% greater impact on the nominal exchange rate of the British Pound instead of a similar overvaluation of the euro. Additionally, the φ coefficient is positive and close to unity for each period. This means that the volatility persistence of the pound against the euro is high.

Table 6: Estimation Results of Exponential GARCH - GBPvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
ω	-0.191 (-5.22)*	-0.407 (-8.11)*	-1.078 (-5.37)*	-0.527 (-4.42)*	-0.065 (-4.13)*
δ	0.103 (7.43)*	0.121 (7.92)*	0.157 (10.74)*	0.135 (6.30)*	0.029 (2.85)*
φ	0.990 (391.43)*	0.972 (243.34)*	0.917 (54.88)*	0.965 (103.66)*	0.996 (849.90)*
α	0.024 (3.49)*	0.065 (6.31)*	0.009 (0.77)	0.002 (0.11)	0.069 (11.21)*

Note: (*) denotes statistically significant at 0.01 level

The coefficient of volatility persistence is lower (0,917) during 2nd period than the other period. Essentially, the duration effect of the euro on the pound lasts more time in the 2nd period. Moreover, the α coefficient presents the size effect and it is positive at each period. In case that the volatility is sensitive to large shocks, one expects α to be positive and significant. Thus, large shocks of both signs will increase volatility. The sign and size effect is statistically significant for 1st and 4th period. This implies that once the asymmetric impact of innovations is accounted for, the absolute size of the innovation is also important. On the other hand, it is clear that the sign effect is statistically significant, but the size effect is not statistically significant during the 2nd and 3rd period. This implies that once the asymmetric impact of innovations is accounted for, the absolute size of the innovation is not important. Moreover, large positive shocks actually decrease volatility. Finally, the sum of δ, φ and α coefficients is above unity which indicates an integrated EGARCH model.

Table 7 displays the empirical results of the ECM-EGARCH (1,1) with 1 asymmetric order by using in the mean equation, the nominal exchange rate of the Swiss Franc as the dependent variable, and the nominal exchange rate of the euro as the control variable. The empirical evidence indicates that the sign effect is positive during the periods, but its value declines until the 3rd period. In fact, the bad news of the euro (devaluation of the euro) have a greater impact on the Swiss franc than the good news (overvaluation of the euro). Particularly, the bad news of the euro (devaluation) show a

15,1% greater impact than the good news of the euro (overvaluation) on Swiss franc during the first period.

Table 7: Estimation Results of Exponential GARCH - CHFvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
ω	-0.116 (-5.37)*	-0.428 (-5.07)*	-0.232 (-5.86)*	-0.172 (-4.07)*	-6.795 (-38.82)*
δ	0.091 (8.16)*	0.151 (8.40)*	0.093 (6.99)*	0.076 (4.71)*	1.001 (35.09)*
φ	0.995 (638.22)*	0.957 (114.98)*	0.983 (255.96)*	0.989 (278.35)*	0.381 (20.81)*
α	0.009 (1.35)	0.015 (1.31)	-0.32 (-4.55)*	-0.014 (-1.083)	0.225 (6.90)*

Note: (*) denotes statistically significant at 0.01 level

In addition, the bad news influence more the nominal exchange rate of Swiss Franc by 9,3% during 2nd period and 7,6% during the 3rd period. However, the sign effect becomes extremely high during the 4th period. The devaluation of the euro against the dollar has 100,1% greater impact on the nominal exchange rate of the Swiss Franc instead of the overvaluation of the euro. The φ coefficient is positive and close to unity for the 1st, 2nd and 3rd period. Consequently, the volatility persistence of the Swiss franc against the euro is higher. During the 4th period the coefficient of volatility persistence is extremely low (0,381). This implies that the duration effect of the euro on the Swiss franc lasts more time in the 4th period. This phenomenon could be combined with the fixed exchange rates regime between the Swiss franc and the euro which took place from 07 September 2011 to 14 January 2015. The constant nominal exchange rate between the two currencies influenced the Swiss franc endurances against the volatilities of the euro during the financial crisis era. The size effect is statistically significant during the 2nd (negative) and the 4th period (positive). This implies that once the asymmetric impact of innovations is accounted for, the absolute size of the innovation is also important. On the other hand, the size effect is not statistically significant during the 1st and the 3rd period. This shows that once the asymmetric impact of innovations is accounted for, the absolute size of the innovation is not important. Moreover, large positive shocks actually decrease volatility. The sum

of δ, φ and α coefficients is above unity for 1st, 3rd and 4th period indicating integration existence.

5.4 Conclusions

The current research attempted to answer the question whether the Eurozone should be further extended. We utilized the nominal exchange rates of three leading European countries, the UK and Switzerland, which have not adopted the euro. Our empirical findings are based on three pillars, volatility shocks persistence, volatility asymmetries and short-term/long-term impacts. The results of the ECM show that the euro influences positively the Sterling pound and the Swiss franc in the short-run. However, the impact of euro seems to be negative in the long-run for the Sterling pound and the Swiss franc. Furthermore, it is clear that the euro's bad news has a greater impact on the volatility of each examined currency, according to the ECM-EGARCH (1,1). The volatility persistence is high for each examined period. The effect is constant among the examined currencies. However, the Swiss franc presents lower endurance on the volatility of euro during the financial crisis. In summary, we support the idea that there is not any evidence that the UK should adopt the euro. The present findings are in favour of the results of the current UK referendum. Recently, the citizens of the UK decided to withdraw from the EU by selecting the Brexit choice. Hence, we should take into account that the 30-year results of the present research agree with the decision of the British people. In fact, not only does the UK not to be a member of the EU, but also not even participate in the economic and political integration of the union. Moreover, our results are in favour with the findings of McMillan (2010) and Minford (2008) and against the researches of Matsushita et al. (2007) and Ausloos et al. (2000).

Finally, there are strong indications for Switzerland, that the Swiss franc follows the fluctuations of the euro after the occurring financial crisis of 2008 and the debt crisis in the Euro Area. The economic and financial benefits are good motivations for joining the Eurozone. Therefore, the countries will be persuaded to abandon their own currency when they understand that the linkages of their currency are positive with the euro. Obviously, the parameter of politics is really important, but this is out of the aims of the current research.

Chapter 6. New members-states of the Euro Area

6.1 Introduction

The sovereign debt crisis of 2010 in Eurozone raised plenty of discussions about the sustainability of the monetary union. Before this crisis, the Euro Area did not have a safety net in order to manage and confront possible anomalies in the financial/banking sector of the monetary union in Europe. In fact, the European Union attempted to establish a single currency area in order to facilitate the trade and the financial transactions among the member states without constructing barriers which will be able to absorb external financial shocks. The structure of the euro was doomed intrinsically to fail because the Eurozone does not fulfil the requirements of an optimal currency region (McKinnon, 1963). Mundell (1961) supported that the optimum currency region is related to the theory of optimum currency area, where there is a geographical area in which it would maximize the economic effectiveness to have the entire region share a single common currency. According to Mundell (1961), McKinnon (1963) and Kenen (1969) an optimum currency area could effectively operate and adsorb external shocks when the following criteria were accomplished:

a) Labour mobility across the region.
b) Openness with capital mobility and price and wage flexibility across the region.
c) A risk sharing system such as an automatic fiscal transfer mechanism to redistribute money to areas/sectors which have been adversely affected by the first two characteristics.
d) Participant countries have similar business cycles.

However, there are plenty of supporters who claim that the Eurozone does not fulfil the appropriate criteria in order to be an optimal currency area (Ricci, 2008). This occurs because, not only the Eurozone fulfil all the criteria, but also because there is not efficient political integration in the union. The enactment of a pan-European Ministry of Finance would assist the finance of countries in economic crisis. However, there is not the political will to this direction. On the other hand, Kouparitsas (2001) discovered that the United States meet the prerequisites of the optimal currency area. This happens

because the United States has only one government which is able to manage the risk sharing system in the monetary union.

This study attempts to discover if the member-states of the Eurozone, which joined the monetary union after the EU enlargement of 2004, should be a part on the monetary union. The motivation of this research is the defective structure of the Eurozone. We decided not to use the methodologies of Mundell (1961) or McKinnon (1963). On the contrary, we followed a different procedure by using the nominal exchange rates of the euro and the nominal exchange rate of each member-state before joining the Euro Area. Particularly, we utilized an innovative approach by using the nominal exchange rates of new member-states of the Eurozone. The financial behaviour of the nominal exchange rate reflects the pragmatic condition of the economy, the political stability and the expectation of the financial markets for the future. In fact, we should discover if there are possible short-term or long-term linkages between the euro and each examined currency. The goal of this research is to explore if the currencies of the countries, which are under examination, have followed the economic behaviour of the euro. After the EU enlargement of 2004, the EU welcomed Malta, Cyprus, Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovenia, Slovakia and Hungary. Therefore, the aim of this research is to explore if the new member states of the EU, in 2004, were favoured by the EU membership to be a part of the EMU in the future. In more detail, we have chosen to investigate Cyprus, Malta, Latvia, Slovenia and Slovakia because these countries have adopted the euro as their official currency. Estonia and Lithuania are Euro Area members, but they had an official agreement that time, with the European Central Bank (ECB) to present a fixed exchange rate against the euro in the past. According to this event, we are not able to use the currencies of these countries for the purpose of this research. On the other hand, Poland, the Czech Republic and Hungary maintained their own currencies, but they are obliged to adopt the euro in the near future when they fulfil the criteria of Maastricht Treaty (1991).

This study contributes to the academic community by shedding new light on the debate regarding the European Monetary and Political Integration. In fact, a succeeded monetary integration shall create stability and economic prosperity to the member-states of the monetary union. However, it would only occur if the candidate member-countries are ready to be a part of the union, under the condition that they meet all the convergence criteria. The adoption of the euro was beneficial for the weak European economies. Especially, the Eastern European countries (Baltic Countries, Slovenia, and

Slovakia) and Southern European countries (Greece, Portugal, and Spain) increased their consumption power by replacing their old currency. The adoption of a strong currency is extremely beneficial during the times of the economic development. However, it is extremely difficult to manage a strong currency during an economic recession. This happens because the central governments are not able to refinance their debt by exploiting the monetary policy tools. The fall of the economic growth leads to austerity measures and internal devaluation of the general prices (currency devaluation is impossible in monetary unions). During an economic recession, the economic and trade activity rapidly falls. People prefer to save their money rather investing or consuming. Also, countries which have strong foundation of their economy are able to manage the shocks of the economic downturn. However, it is not possible for countries which have more volatile economic activity. The management becomes more difficult, when the structure of the economy is vulnerable to external financial shocks. The openness and the competitiveness of an economy plays important role in order to fortify the endurance of an economy against the external financial, political or economic shocks. A response to this call is the reforms settlement, the government's budgetary management and the competitiveness of the economy through the decrease of domestic prices. This fact is extremely important when a monetary union has been established. Particularly, the member-countries of the Euro Area should follow the economic adjustments of the monetary union in order to maintain the sustainability of the euro and their position in the union.

The EU membership undoubtedly accelerated the political, economic and trade partnership among the member-states. This happens because of the cancellations and limitations of quotas, taxes and custom fees. Therefore, it is reasonable to observe that the economic impact of the euro on the currencies of these countries is significant. The main idea behind this study is to explore if the local currencies of the examined countries followed similarly the economic tendency of the euro after their participation in the EU. In fact, we should examine if the national currencies were more bound to the euro after the EU membership. Traditionally, Malta and Cyprus have strong political and financial bonds with the United Kingdom, as being post-colonies of the British Empire. Also,

On the other hand, Latvia, Slovenia and Slovakia are Post-Communist countries. In fact, the Russian Federation still influence these countries as a descendant of the Soviet Union. Therefore, it is academically interesting to discover if the EU membership

changed this tradition. Also, we should explore if the euro, as a currency, is eligible to manipulate the economic behaviour and reactions of the ex-national currencies of these EU countries.

In this research, we used the Error Correction Model to find out possible short-term and long-term linkages between the euro and the old currencies of the new member-states. The empirical findings highly indicate that the euro has a greater positive impact on the old currency of Cyprus, Latvia, Slovenia and Slovakia when the countries became a part of the EU. On the other hand, there are indications which show that the entrance of Malta in the EU was against the interest of the country. Particularly, the impact of the euro on the Maltese Lira was slightly more negative after the EU membership. Furthermore, we used the GJR GARCH model to discover the leverage effect and the impact of the bad and the good news (responses) of the euro on the volatility of each member-state's currency. The empirical results highly support that the bad news of the euro influences more the volatility of the Cypriot Pound after the EU membership of Cyprus. Similar findings have been discovered for Latvia. On the other hand, we found out that there is not a significant leverage effect for Malta, Slovenia and Slovakia. Particularly, the bad and the good news of the euro has no impact on the volatility of their old currency after the EU membership of these countries.

In conclusion, we provide important evidence on the level of monetary integration in the EU. The history of the European Union and the former European Communities is very narrow. The Treaty of Rome was signed in March 1957 and the EU is only 60 years old. The transformation of the European Communities to the EU lasted approximately 34 years (1957-1991). This means that there was enough time for the appropriate establishment of the institutions, acts, laws and orders. On the other hand, the monetary and economic integration of the EU lasted merely 8 years (1991-1999). The EU policy makers did not take into account any political, social and macroeconomic factors which were totally different among the member-states of the EU (asymmetries in the economy). This means that the monetary integration of Europe was not well-organized and completely vulnerable to international economic or financial shocks. The leaders of the EU were forced by the debt crisis of 2010 to take action. Particularly, they decided to establish the European Stability Mechanism (ESM) and a banking union in order to reinforce the coherence of the Euro Area. Therefore, the empirical results of this study provide important information for the EU and EEA governments, EU executives and policy makers about the sustainability of the Euro

Area. This means that the cohesion of the Euro Area is very important for the economic stability of Europe. Therefore, the countries were not ready to enter in the Euro Area should follow structural economic and legal reforms in order to maintain their stability, especially during the present (2018) economic-political condition in the EU. Undoubtedly, the present results are for the interests, not only the politicians, but the investment funds, individual investors and European citizens. A strong and sustainable euro is on the interest of the private sector. The European Monetary Union has specific operational rules. An exit from the euro would raise instability in the economy and in the banking sector. Therefore, the private sector should be kept informed if these examined countries were eligible to join the Euro Area.

In fact, there is not a legal way for a Eurozone country to abandon the Euro Area and simultaneously maintain the membership of the EU. Thus, an exit from the Eurozone means also the withdrawal from the EU (Article 50 of Treaty on the EU). However, the modern economic world is changing continuously and some unfortunate events may be true. A characteristic paradigm is the recent unofficial UK withdrawal (Br-exit) from the EU (23rd June 2016). This means that the governments of the EU member countries may reconsider their membership at the union, if a participation in the monetary union is against the interests of their people. Hence, the results of this research may arise more conversations or researches in the near future.

6.2 Literature Review for New Euro Area member-states

Koukouritakis and Michelis (2006) claim that the currencies of 10-member states of 2004 EU enlargement behave independently from the real exchange rate of France and Germany. This means that there is not integration between the economies of new member states and the economies of France and Germany before 2004. Alexandrou et al. (2011) attempted to explore if the adoption of the euro had a positive impact on the integration of banking industry in the Eurozone member-countries. They found out significant evidence of negative volatility spillovers among the bank stock returns for different groups of countries that have been involved in various recent stages of the European economic and political integration. In addition, Doyle and Fidrmuc (2006) discovered that the EU membership was in favour of new member-states by using multiple microeconomic and macroeconomic factors. Allam and Goerres (2008) investigated the adoption of the euro in Post-Communist Countries which became

members of the EU in 2004. They discovered similar evidence which get aligned with the results of Doyle and Fidrmuc (2006). Mika and Zymek (2018) examined the impact of the euro on the trade of the old and the new member-states of the Euro Area. Their findings suggest that the euro accession countries should not expect a significant boost to their trade from joining EMU. In addition, Weyerstrass (2008) attempted to discover the impact of the euro on the Slovenian economy due its participation in EMU on 01 January 2007. His results suggest that the labour market performance in Slovenia can be significantly improved by cutting non-wage labour costs due to Euro Area membership. Kliber and Pluciennik (2017) examined the benefits of a Euro Area membership by comparing the Czech Republic (not Eurozone member) with Slovakia (Eurozone member). Their findings indicate that the euro behaves as a shield against the global financial shocks for Slovakia. The Euro adoption did not make Slovakia more vulnerable to the pan-European problems (debt crisis 2010). Slovakia is still identified by investors as an emerging Central-European region, rather than a country of the Eurozone. Also, Dean et al. (2013) found out that Slovakia has kept unit costs competitive, fostered a sound banking system, and managed its monetary and fiscal policy responsibly after the adoption of the euro in 2007. Balcilar et al. (2017) attempted to discover the integration of the Cypriot economy with the Greek economy, as its motherland. Their evidence supports that the integration of Cypriot and Greek economy has significantly boosted after the participation of the Republic of Cyprus (Hellenic part) to the EMU. Moreover, Pattichis et al. (2007) investigated whether the real effective exchange rate of the Cyprus pound is misaligned by generating measures of the equilibrium rate. Their findings suggest that the EU membership of Cyprus offered support against the exchange rate misalignment of Cypriot Pound. Pace (2007) attempted to reveal the vulnerabilities of small states, such as Malta, to be members of the EU. The author outlines how the EU may 'enlarge' such states in both economic, security and political terms. Ivanova (2015) attempted to determine differences in population income within the European Union, and especially in the Euro Area. Her results indicate very varied competitiveness of nations that can sufficiently determine the social and economic development of the EU member states, including Latvia. Cavallo et al. (2014) discovered that the price dispersion between Latvia and euro zone countries collapsed swiftly following entry to the euro. These results suggest that membership in a currency union has significant implications for a country's real exchange rate. Moreover, Syrichas (2008) examined the fixed exchange rate policy

followed in Cyprus for more than 40 years helped to deliver price stability amid high growth rates and low unemployment and contributed to the successful adoption of the euro. Finally, Stoupos and Kiohos (2017a) examined the monetary integration of the EU by using ECM-EGARCH model for Switzerland, the UK and Sweden. Additionally, the same researchers explored the monetary and financial integration of the Post-Communist countries of the EU with the Euro Area (Stoupos and Kiohos, 2017b).

6.3 Dataset Analysis and Methodology

The present research uses the nominal exchange rates of five member-states currencies in the Eurozone. These countries joined the monetary union at different dates, but they have been participating in the EU since 01 May 2004. Particularly, we explore any possible relationships among the Euro, the Cypriot Pound, the Latvian Lats, the Maltese Lira, the Slovenian Tolar and the Slovakian Koruna. The examination period is different among the currencies (Table 8).

Table 8: Data Presentation (Source: European Central Bank)

Countries	Period	Acronym	Measure
Euro Area	01/01/99 – 31/12/08	EUR	€/$
Cyprus	01/01/99 – 31/12/07	CYP	£/$
Latvia*	01/01/99 - 31/12/08	LVL	Ls/$
Malta	01/01/99 – 31/12/07	MLT	₤/$
Slovenia	01/01/99 – 31/12/06	SIT	Tl/$
Slovakia	01/01/99 – 31/12/08	SKK	Sk/$

Note: (*) denotes fixed exchange rate against euro from 01/01/09 to 31/12/2013

This happens because each country had adopted the euro, as its own currency, at different dates when they fulfilled the euro convergence criteria. Essentially, our dataset covers a period of 11 years in daily basis. The data was gathered from the official database of the European Central Bank (ECB). The nominal exchange rate of each currency is calculated per US dollar (USD). We decided to use the US dollar because it is historically the most tradable currency across the globe. The international markets

still use more frequent the US dollar as their currency in order to receive and give payments. The dataset was divided into two periods in order to investigate the special features of each era. The cut point is the date of 01 May 2004 when the 5th Enlargement of the EU officially took place. Also, we explore the total period for each country in order to discover the overall trend. The use of the nominal exchange rate includes all the market reactions to external shocks. For instance, the nominal exchange rate includes the information of an economic downturn, money supply increase, the political risk etc. Therefore, we have considered that the nominal exchange rate is close enough to economic reality.

The two periods are the following:

a) 01 January 1999 to 30 April 2004

During this period the examined countries were not member-states of the European Union. Therefore, they had limited trade and economic relationships with the 15 countries of the EU. This happens because Slovenia, Slovakia and Latvia are Post-Communist countries, historically they had strong political, economic and trade relationships with Russia. Also, the UK played an important influential role over Malta and Cyprus. Finally, these countries had limited access to European Single Market as not participating in the union. Thus, no free trade flows were able to take place (quotas, taxes and custom fees).

b) 01 May 2004 to 31 December 2008

The present period is related with the adoption of the euro for the examined countries. However, each examined country had adopted the euro at different dates. The aim of this era is to investigate the impact of the EU membership on the economy of each country. The performance of each economy is measured by using the impact of the nominal exchange rate of the euro on the old currency of each country.

The use of Error Correction Model is most suitable when we wish to explore simultaneously a dynamic short-term or long-term linkage among a group of variables. On the contrary, we decided not use the Vector Error Correction Model (VECM) because this statistic procedure is used when there is not co-integration condition

among the examined series. VECM is most suitable to explore short-term relationships only (Brooks, 2014). In the present research, the mathematic expression of the Error Correction Model is the following:

$$\boldsymbol{\Delta CUR_t = a + \beta_1 \Delta EUR_{it} + \beta_2 (CUR_{t-1} - \beta_3 (EUR_{t-1}) + u_t)} \quad \textbf{(41)}$$

where, the dependent variable CURt represents the nominal exchange rate of Cypriot Pound (CYP), or Latvian Lats (LVL), or Maltese Lira (MTL), or Slovenian Tolar (SIT), or the Slovakian Koruna (SKK) against the US dollar (USD). The independent variable is the nominal exchange rate of the euro (EUR) against the dollar (USD).

The examination of a unit root is particularly important in time series analysis. This test is executed both in levels and 1st difference. The empirical results (table 9) reveal that each series is stationary in 1st difference. Therefore, we are able to use Johansen Co-integration test in order to examine if the series are co-integrated in the long run. We used a trend and an intercept in the equation of the Augmented Dickey-Fuller test.

Table 9: Estimation Results of Augmented Dickey Fuller Test (ADF)

Series	t-statistic(levels)	t-statistic (1st difference)
Euro	-3.065	-51.249*
Cypriot Pound	-2.967	-49.279*
Latvian Lats	-1.569	-40.698*
Maltese Lira	-2.713	-52.803*
Slovenian Tolar	-2.657	-47.543*
Slovakian Koruna	-3.423	-49.961*

Note: (*) denotes statistically significant at 0.01 level

Table 10 shows the empirical findings of the co-integration analysis. The co-integration test was executed by using the linear deterministic trend. We selected the deterministic trend assumption of test that there is trend and intercept in co-integrating equations (CE) and no intercept in VAR with one lag only. VAR selects a system of equations with 1 lag for each variable. The empirical findings of table 3 highly supports that there is at most one co-integrated vector at a level of significance equal to 0.05 (a=0.05).

Therefore, we cannot reject the null hypothesis of co-integration test. This means that each examined series (EUR, CYP, LVL, MTL, SIT and SKK) have a dynamic long-term equilibrium relationship (Johansen, 1991).

Table 10: Johansen's Co-integration Test in series EUR, CYP, LTL, MTL, SIT, SKK

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (a=0.05)	Probability
None	0.027852	97.51090	95.75366	0.0376*
At most 1	0.017456	57.08984	69.81889	0.3354
At most 2	0.012903	31.88997	47.85613	0.6182
At most 3	0.004554	13.30601	29.79707	0.8771
At most 4	0.003694	6.774495	15.49471	0.6040
At most 5	0.001032	1.478132	3.841466	0.2241

Note: (*) denotes statistically significant at 0.05 level

6.6 Empirical Results

Table 11 presents the estimation results of Error Correction Model for the Cypriot Pound. The dependent variable is the nominal exchange rate of the Cypriot Pound (CYP) against the US dollar (USD) and the control variable is the nominal exchange rate of the Euro (EUR) against the US dollar (USD). The coefficient of each parameter is statistically significant, except the constant and the coefficient of the error correction model (ECT) for the 1st period. The coefficients of ECT, ΔEUR and ΔEUR(t-1) influence the dependent variable. The nominal value of the euro influences positively the nominal value of the Cypriot Pound in the short-run during the total period. The impact is still positive during the two periods. This means that the nominal value of the euro has a positive effect on the nominal value of the Cypriot Pound. This impact is not related with the EU membership of Cyprus. However, the impact of the nominal exchange rate of the euro seems to have negative effect on the nominal exchange rate of the Cypriot Pound during the first period. This indicates that the euro had a negative influence on the Cypriot Pound when Cyprus was not a member of the EU. On the other hand, we discovered that the EU membership was in favour to Cyprus because the nominal value of the euro influences positively the nominal value of the Cypriot Pound

during the 2nd period. Also, the coefficient of error correction term (ECT) expresses that an upwards adjustment during the following period is expected. The adjustment speed is extremely low. The adjustment speed back to equilibrium is approximately zero and then the 0% of a deviation from the error correction mechanism is corrected within 1 day between Cypriot Pound and the euro. This may happen because the Cypriot government made a great effort to be a member of the EU and enter in the Euro Area. Cyprus evaluated the EMU participation as a shield against the Turkey threat and a pressure to the EU in order to solve the Cypriot problem (dichotomy of the island). Therefore, the Central Bank of Cyprus aligned its monetary policy with the European Central Bank (2004-2008). In specific, the interest rate of the Cypriot Pound followed the behaviour of euro's interest rate, especially, after the EU participation. Also, this policy has been boosted by Cyprus' trade relationships with their principal partners (Greece, Italy and Germany).

Table 11: Estimation Results of Error Correction Model - CYPvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ΔEUR	0.576 (2265.58)*	0.570 (692.20)*	0.578 (1061.82)*
ΔEUR_{t-1}	0.029 (2.35)*	0.109 (6.19)*	-0.182 (-7.79)*
Constant	0.0007 (5.08)*	0.0006 (1.19)	0.0008 (3.58)*
ECT	0.0002 (4.51)*	0.0001 (0.99)	0.0002 (3.31)*

Note: (*) denotes statistically significant at 0.05 level

Table 12 displays the empirical results of the ECM for Latvian Lats. We observe that the coefficients ΔEUR, ΔEUR(t-1) and ECT is statistically significant for each period, except the 1st period where the coefficients ΔEUR and ΔEUR(t-1) are not significant. Particularly, the exchange rate of the euro has a positive short-term effect on the exchange rate of the Latvian Lats for the entire period. However, the impact is zero during the first period where Latvia was not a member of the EU. On the other hand, the short-term impact of the euro on the Latvian Lats is positive when Latvia joined the

EU in May 2004. In addition, we observe that the long-term effect of the euro on the Latvian Lats is positive when Latvia became a member of the EU. This means that the euro influences positively the past currency of Latvia. This may occur because the Also, the coefficient of error correction term (ECT) expresses that an upwards adjustment during the 2nd period is expected. In contrary, a downwards adjustment during the first period is expected. The adjustment speed is extremely low (close to zero). The adjustment speed back to equilibrium is approximately zero and then the 0% of a deviation from the error correction mechanism is corrected within 1 day between Latvian Lats and the euro. This phenomenon may be occurred due to the Latvian governmental policy. For instance, Latvia made great attempts to join in the EU by adopting the euro as its currency. The Bank of Latvia followed the same monetary policy with the ECB from 2004 to 2013 in order to join the Euro Area. Also, a fixed exchange rate against the euro was decided from 2009 to 2013. This means that the aim of the country was to be a member of the Eurozone be harmonizing its monetary, financial and macroeconomics factors in order to fulfil the Maastricht criteria.

Table 12: Estimation Results of Error Correction Model - LVLvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ΔEUR	3.452 (318.80)*	0.011 (1.40)	3.449 (551.06)*
ΔEUR_{t-1}	0.161 (1.62)	0.001 (0.19)	-0.591 (3.97)*
Constant	-0.0004 (-31.78)*	-0.023 (-17.85)*	0.0094 (30.23)*
ECT	-0.0002 (31.77)*	0.008 (18.09)*	-0.0049 (-30.22)*

Note: (*) denotes statistically significant at 0.05 level

In addition, Estonia and Lithuania shared the same goal to enter the Euro Area. This means that Latvia would have a common currency with their neighbours which are its main trade partners. Finally, there were several studies which supported that the EMU membership would be beneficial. For instance, Bitans and Kauzens (2004) indicated that the economic structure of Latvia displays closer similarity to that of the euro area

countries. Therefore, even though upon the introduction of the euro in Latvia the possibility for asymmetric shocks to emerge may be stronger than in the core EMU countries (e.g. Germany), it may actually be weaker if compared with its own currency. Table 13 indicates the findings of the ECM for Malta. The results of Error Correction Model highly support that the exchange rate of the euro influences positively the exchange rate of the Maltese Lira in the short-run. The impact seems to be higher at the second period than the first period. Therefore, we can claim that the EU membership of Malta had strengthened the influence of the euro on the ex-Maltese currency. However, the empirical results support that the long-term impact differs within the examined periods. The effect of the exchange rate of the euro influences slightly positive the exchange rate of the Maltese Lira during the 1st period when Malta was not a part of the EU. However, the entrance of Malta in the EU created a slightly negative long-term effect on the Maltese Lira. Particularly, the euro seems to influence negatively the Maltese Lira after Malta's membership as an EU country.

Table 13: Estimation Results of Error Correction Model - MTLvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ΔEUR	0.429 (847.15)*	0.273 (173.78)*	0.429 (762.11)*
ΔEUR_{-1}	-0.106 (7.516)*	-0.079 (10.06)*	0.100 (-6.98)*
Constant	-0.0002 (-35.72)*	-0.0009 (-0.90)	0.0005 (0.59)
ECT	-0.0005 (-35.88)*	-0.0001 (-0.84)	0.0001 (0.63)

Note: (*) denotes statistically significant at 0.05 level

The coefficient of error correction term (ECT) expresses that an upwards adjustment during the 2nd period is expected. Nevertheless, an approximately zero adjustment during the two periods is expected. The adjustment speed back to equilibrium is approximately zero and then the 0% of a deviation from the error correction mechanism is corrected within 1 day between Maltese Lira and the euro. This phenomenon may have occurred because the structure of the Maltese economy is not flexible for a

common currency. According to Scerri (2001), positive developments with respect to others, leaving a neutral effect on factor employment. When a country relies upon a small number of exports, equilibrium will be very sensitive to changes in the prices and demands for those goods. The less diversified economies may need flexibility in exchange rates, the more diversified will not. In this respect, Malta is characterized by a huge dependency on two sectors for most of its foreign-currency earnings. In the manufacturing industry, one firm manufacturing electronic components accounts for roughly 50% of the country's total exports. The excessive dependence on these two industries renders Malta vulnerable to changes in their fortunes. Unfavourable circumstances in these areas of economic concentration would lead to significant decreases in foreign exchange earnings, GDP and employment. On this measure, Malta's economic structure is not consonant with a fixed arrangement. It has been observed that while diversified economies should find it least costly to peg, many highly specialized nations actually peg their ex- change rates (Eichengreen, 1994). This practice reflects the fact that, as in Malta's case, highly specialized economies tend to be very open.

Table 14 presents the results of Error Correction Model for Slovenia. We observe that the short-term impact of the euro on the Slovenian Tolar is similar during the examined periods. Particularly, the euro influences positively the Slovenian Tolar. The impact is quite higher when the country entered in the EU in May 2004. Additionally, the exchange rate of the euro has a positive effect on the Slovenian Tolar in the long-run. The impact is positive within the two periods. However, the results support that the EU membership of Slovenia influenced more the relationship between the euro and the Slovenian Tolar.

Specifically, the impact of the euro on the Slovenian Tolar had doubled after the join of Slovenia in the EU. Also, the coefficient of error correction term (ECT) expresses that an upwards adjustment during the following period is expected. The adjustment speed is extremely low and close to zero. The adjustment speed back to equilibrium is approximately zero and then the 0% of a deviation from the error correction mechanism is corrected within 1 day between Slovenian Tolar and the euro. According to Mikek (2003) this tendency may be happened because the goal of the Bank of Slovenia (BOS) was to regulate the restrictivity of the monetary policy by squeezing the home consumption and through this the final goal of lowering the growth of prices for non-

tradables, by targeting real interest rates. Also, an additional aim of the BOS was to implement a policy of gradual depreciation of the Slovenian Tolar against the euro.

Table 14: Estimation Results of Error Correction Model - SITvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ΔEUR	239.19 (1566.13)*	228.18 (456.28)*	239.57 (1497.52)*
ΔEUR_{-1}	-45.50 (10.47)*	-44.88 (8.56)*	-71.39 (7.95)*
Constant	-0.060 (-3.82)*	-0.067 (-1.74)	-0.022 (-1.22)
ECT	0.0003 (3.82)*	0.0004 (2.51)*	0.0001 (1.21)

Note: (*) denotes statistically significant at 0.05 level

Mencinger and Mrak (2003) point out that: "Managed floating should therefore remain the pillar of monetary policy until a credible commitment to peg enables fast passage from the ERM2 to the EMU, which has shortened the period of uncertainty.
Additionally, the central bank informs that at the time of entering the ERM2 "given approximately equal levels of nominal interest rates, the monetary policy was directed towards keeping the interest parities within magnitudes that do not encourage speculative flows of hot capital and therefore do not cause major fluctuations of the exchange rate" (BoS, 2003).

Table 15 displays the results of the ECM for Slovakia. We observe that the empirical findings are totally different instead of the other examined countries. Specifically, the short-term effect of the euro is positive on the Slovakian Koruna. The impact remains unchanged within the periods. However, the magnitude of the euro on the past falls significantly during the second period when Slovakia became a member of the EU. Additionally, the long-term impact of the exchange rate of the euro is negative on the exchange rate of the Slovakian Koruna. The effect remains negative within the two periods, but it is clear that the magnitude's effect diminished.

Table 15: Estimation Results of Error Correction Model - SKKvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ΔEUR	39.55 (153.82)*	41.25 (107.60)*	34.18 (101.31)*
ΔEUR_{-1}	3.03 (-3.27)*	5.15 (-3.94)*	1.49 (-1.11)
Constant	-0.011 (-1.49)	-0.0005 (0.02)	-0.0056 (-0.41)
ECT	0.0002 (0.96)	0.0006 (-0.12)	-0.0003 (-0.06)

Note: (*) denotes statistically significant at 0.05 level

Particularly, the entrance of Slovakia in the EU influenced positively the dynamic relationship between the euro and the Slovakian Koruna. However, the effect of the euro on the Slovakian Koruna is not clear during the second period because the coefficient of the long-term dynamics is not statistically significant. The adjustment speed back to equilibrium is approximately zero and then the 0% of a deviation from the error correction mechanism is corrected within 1 day between Slovakian koruna and the euro. This finding may have occurred because the monetary policy of the National Bank of Slovakia (NBS) on the inflation was accentuated by the amendment to the NBS Act of 2001, as the main objective of maintaining monetary stability was replaced with the aim of maintaining price stability. NBS continued in the changing of the monetary instruments setting and it decided to lower the reserve requirement from 6.5 % to 5 % (together with gradual annual decrease of 1 p.p. up to 2 % in 2004, i.e. to 4 % in 2002 and to 3 % in 2003 (NBS, 2004). Since January 2002, the NBS eliminated the use of administrative instruments in favour of standardized (Lombard loans provision and promissory notes transactions were cancelled) and set the discount rate equal to the NBS announced limit rate for two-week REPO tenders. Also, in July 2003, the Slovak government discussed the common material of Ministry of finance and the NBS “Euro adoption strategy" and endorsed the Joint declaration of the Government of Slovakia and the NBS concerning the procedure for joining the euro area" and committed itself to the successful implementation of reforms and the introduction of the euro in Slovakia in the beginning of 2009 (NBS, 2004).

We decided to combine two econometric procedures in order to create an ECM-GJR-GARCH model. Particularly, the Error Correction Model (ECM) was used as a mean equation and the typical mathematical expression of GJR-GARCH model as the variance equation. Also, we used the errors of the ECM in order to run a GJR-GARCH (1,1) with 1 threshold. GJR-GARCH is the most suitable in order to explore leverage effect as well as the impact of the bad and the good news on the volatility (Smith, 2009; Floros, 2009).

Table 16 presents the empirical results of a GJR-GARCH model by using in mean equation the nominal exchange rate of the Cypriot Pound as the dependent variable and the nominal exchange rate of the euro as the control variable. The sum of ARCH and GARCH coefficients is very close to unity, expressing that the Cypriot Pound's volatility shocks are quite persistent.

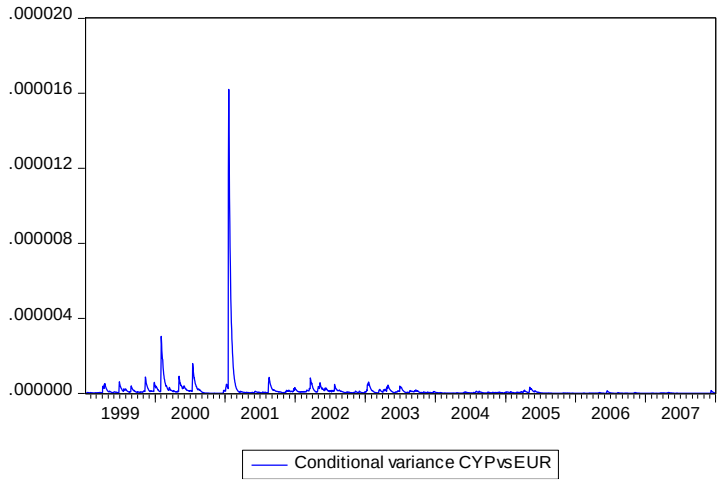
Table 16: Estimation Results of GJR GARCH - CYPvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0022 (21.93)*	0.0002 (-8.73)*	0.0002 (11.03)*
ARCH	0.143 (15.17)*	0.207 (6.99)*	0.257 (6.52)*
δ	-0.081 (-5.42)*	-0.192 (-4.46)*	0.351 (5.10)*
GARCH	0.856 (155.15)*	0.783 (52.17)*	0.548 (19.42)*

Note: (*) denotes statistically significant at 0.01 level

Also, the coefficient of the lagged squared is positive and statistically significant. Thus, we are able to support that strong GARCH effect is apparent. The coefficient of lagged conditional variance is statistically significant, but its value is lower than the unity. This supports that the impact of the "old" news on volatility is significant. Also, the magnitude of the GARCH coefficient is high. This means that there is a long memory in the variance. The δ parameter (leverage effect) is negative during the 1st period indicating that bad news of the euro has lower impact on the volatility of the Cypriot Pound. On the contrary, the δ parameter is positive during the 2nd period expressing

that news impact is asymmetric and the bad news of the euro has larger effect on the volatility of the Cypriot Pound.

Figure 3: Conditional Variance for Cypriot Pound



The conditional variance of the Cypriot Pound remains quite steady concerning of the shocks of the euro. However, the conditional variance seems to be volatile from January 2001 to March 2001. This may occur because on 1 January 2001, together with the abolition of the long–standing and statutory interest rate ceiling, wider bands of ±15% were introduced in order to enable the Central Bank of Cyprus to absorb any shocks from possible destabilizing capital movements and to deter speculative capital flows resulting from capital account liberalization (Kyriacou and Papageorghiou, 2010).

Table 17 presents the empirical results of GJR-GARCH methodology by using only one threshold in the equation. We utilized the errors of the Error Correction Model (mean equation) in order to execute a GJR-GARCH(1,1) (variance equation). The dependent variable in the ECM equation was the exchange rate of the Latvian Lats and the independent variable was the exchange rate of the euro. The sum of ARCH and GARCH effect is very close to one indicating that Latvian Lats volatility shocks are quite persistent. The coefficient of the lagged squared is positive and statistically significant. Thus, we are able to support that strong GARCH effect is clear. Moreover, the size of the GARCH coefficient is high for overall and 1st period. This indicates that a long memory in the variance exists during these periods.

Table 17: Estimation Results of GJR GARCH - LVLvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0032 (0.21)	0.0044 (3.10)*	0.0025 (2.13)*
ARCH	0.198 (14.45)*	0.064 (5.52)*	0.641 (3.93)*
δ	0.092 (3.09)*	0.229 (9.97)*	0.136 (0.583)
GARCH	0.783 (126.77)*	0.874 (99.86)*	0.337 (-4.63)*

Note: (*) denotes statistically significant at 0.05 level

However, the GARCH coefficient is low in the 2nd period. Hence, we could support that a short memory in the variance takes place. The δ parameter represents the leverage effect on the conditional variance. The leverage effect is positive within the two periods, expressing that bad news of the euro has lower effect on the volatility of the Latvian Lats. The impact of the bad news is greater during the 1st period when Latvia was not a member of the EU.

Figure 4: Conditional Variance for Latvian Lats

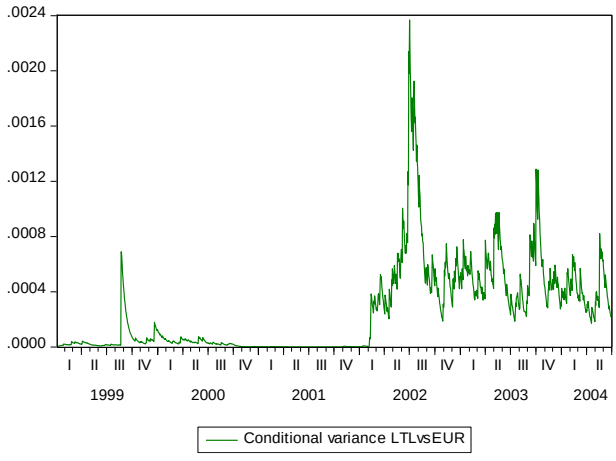


Figure 4 displays the timeline of the conditional variance of GJR-GARCH(1,1) for the Latvian Lats. The conditional variance of Latvian Lats is quite constant from January 1999 to December 2001 concerning of the responses of the euro. However, the

conditional variance became more volatile after the official circulation of the euro. This means that the euro influenced more the volatility of the Latvian Lats after 2002.

Table 18 presents the finding of a GJR-GARCH for the Maltese Lira. We followed the same procedure as before by using the errors of the ECM equation at the variance equation of a GJR-GARCH(1,1). The sum of ARCH and GARCH coefficients is close to unity within the two periods, indicating that Maltese Liras' volatility shocks are quite persistent. The GARCH effect is positive and statistically significant within the two periods.

Table 18: Estimation Results of GJR GARCH - MTLvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0045 (-0.65)	0.0033 (5.40)*	0.0003 (14.82)*
ARCH	0.199 (11.72)*	0.068 (6.27)*	0.188 (15.54)*
δ	0.031 (1.17)	0.134 (7.52)*	0.011 (0.59)
GARCH	0.796 (111.50)*	0.874 (170.79)*	0.665 (63.75)*

Note: (*) denotes statistically significant at 0.05 level

The memory in the variance is longer during the 1st period than the 2nd period. The δ parameter is positive within the two periods, but the coefficient is statistically significant only in the 1st period. Therefore, we may claim that the bad news of the euro has lower impact on the volatility of the Maltese Lira. On the other hand, there are no evidences which support the presence of a leverage effect during the 2nd period, when Malta became a member of the European Union.

Figure 4 shows the timeline of the conditional variance of GJR-GARCH(1,1) for the Maltese Lira. We observe that the volatility of the Maltese Lira, in response of the euro, is higher when Malta was not a member of the EU. The volatility of Maltese Lira

significantly decreased after the participation of Malta in the EU. This means that the shock responses of the euro had lower impact on the volatility of the Maltese Lira.

Figure 5: Conditional Variance for Maltese Lira

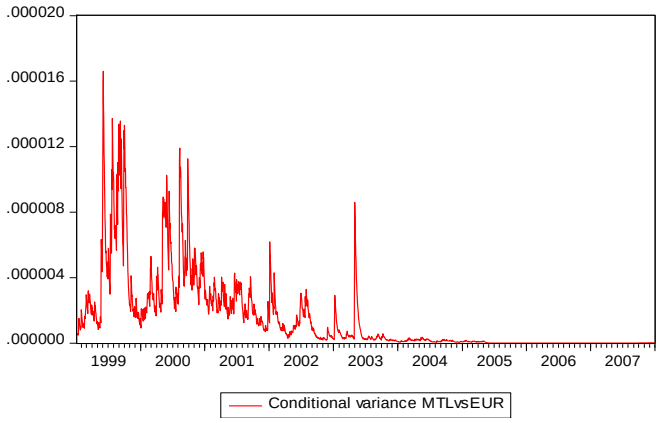


Table 19 shows the empirical evidences of GJR-GARCH methodology for Slovenia. We used in mean equation the exchange rate of the Slovenian Tolar as the dependent variable and the exchange rate of the euro as the independent variable. In addition, we utilized the errors of the ECM in order to execute a GJR-GARCH(1,1) with 1 threshold. The sum of ARCH and GARCH coefficients is very close to unity, expressing that Slovenian Tolar's volatility shocks are quite persistent. Also, the coefficient of the lagged squared is positive and statistically significant. Thus, we are able to support that strong GARCH effect is apparent. The coefficient of lagged conditional variance is statistically significant, but its price is lower than the one. This means that the effect of the "old" news on volatility is significant. The size of the GARCH coefficient is high. This indicates that there is a long memory in the variance within the two periods. The present effect seems to be stable during the two periods. The δ parameter is positive during the 1st period indicating that the news' impact is asymmetric and the bad news of the euro has larger effect on the volatility of the Slovenian Tolar.

On the contrary, there are no evidences which claim the presence of a leverage effect during the 2nd period, when Slovenia became a member of the European Union. Therefore, the bad or the good news of the euro has no effect on the volatility of the Slovenian Tolar. Essentially, the join of Slovenia in the EU did not influence the financial attitude of the euro on the Slovenian Tolar.

Table 19: Estimation Results of GJR GARCH - SITvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0045 (5.02)*	0.0006 (6.54)*	0.0001 (4.51)*
ARCH	0.102 (12.06)*	0.113 (10.53)*	0.107 (4.65)*
δ	0.066 (5.21)*	0.140 (6.37)*	-0.013 (-0.55)
GARCH	0.888 (237.27)*	0.843 (131.30)*	0.865 (46.34)*

Note: (*) denotes statistically significant at 0.05 level

Figure 6 presents the historically evolution of the conditional variance of GJR-GARCH(1,1) for the Slovenian Tolar. The euro's shocks responses are higher in 1999. Afterwards, the conditional variance is fluctuated but it shows a declined tendency. There is a sub-period where there is excessive volatility (from January 2002 to March 2002). This event may be related with the circulation of the euro and the euro adjustment period. Finally, we observe that the volatility of the Slovenian Tolar is close to zero after the EU membership of Slovenia in May 2004.

Figure 6: Conditional Variance for Slovenian Tolar

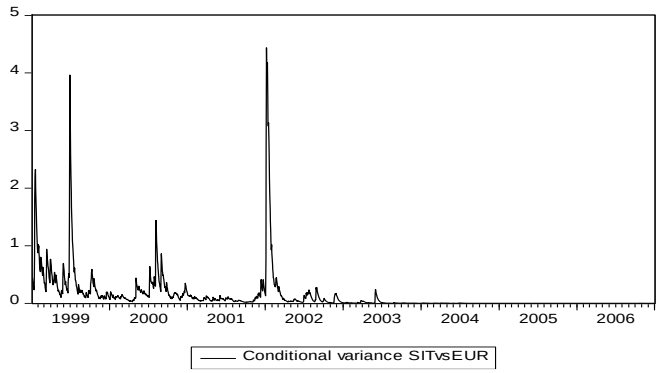


Table 20 presents the empirical findings of GJR-GARCH methodology by using only one threshold in the equation. We used the errors of the Error Correction Model (mean equation) in order to execute a GJR-GARCH(1,1) (variance equation). The dependent variable in the ECM equation was the exchange rate of the Slovakian Koruna and the

control variable was the exchange rate of the euro. We observe that the sum of ARCH and GARCH coefficients is very close to unity, expressing that the Slovakian Koruna's volatility shocks are quite persistent. Furthermore, the magnitude of the GARCH coefficient is high and stable within the two periods. Therefore, we may support that a long memory in the variance exists during these periods.

Table 20: Estimation Results of GJR GARCH - SKKvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0003 (12.85)*	0.0004 (7.50)*	0.0002 (6.71)*
ARCH	0.092 (12.70)*	0.087 (8.69)*	0.120 (8.35)*
δ	-0.014 (-1.61)	-0.016 (-1.28)	0.024 (1.52)
GARCH	0.892 (149.63)*	0.897 (109.28)*	0.862 (82.79)*

Note: (*) denotes statistically significant at 0.05 level

The δ parameter, which represents the leverage effect on the conditional variance, is not statistically significant. This means that the bad or the good news of the euro has no impact on the volatility of the Slovakian Koruna within the two periods. We observe that the EU membership did not influence the behaviour of the euro on the Slovakian Koruna.

Figure 7: Conditional Variance for Slovakian Koruna

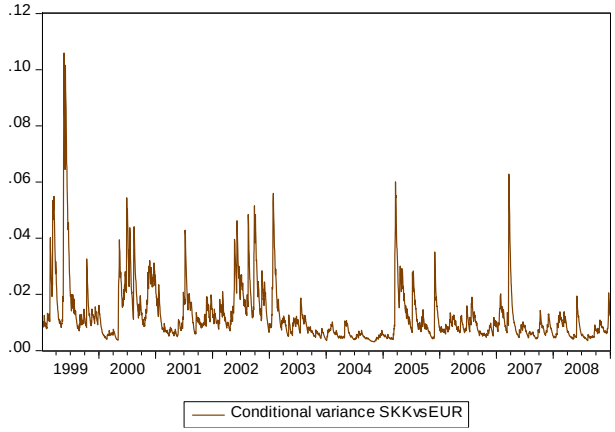


Figure 7 presents the conditional variance of GJR-GARCH(1,1) for the Slovakian Koruna from 1999 to 2008. The volatility of the Slovakian Koruna, because of the shock responses of the euro, is extremely high during the entire period. The impact seems to be homeomorphous. However, the volatility effect is lower from January 2003 to December 2004. Finally, we could estimate that the shock responses of the euro on the Slovakian Koruna remained unchanged. Particularly, the volatility of the exchange rate of the Slovakian Koruna was not influenced by the EU membership of Slovakia.

6.7 Conclusions

The aim of the present research is to re-explore the enlargement of the Eurozone. Particularly, we wanted to discover if the new member-states favoured by the EU membership and if they were ready to enter in the Euro Area. We used the nominal exchange rates of five new member-states of the Eurozone, Cyprus, Latvia, Malta, Slovenia and Slovenia, which have adopted the euro recently. Our empirical findings are relied on three pillars, volatility shocks persistence, leverage effects and short-term/long-term linkages. The results of the Error Correction Model support that there is a greater short-term impact of the euro on the old currencies of the member-states after the entrance in the EU. Moreover, we observed a greater positive and long-term impact of the euro on the Cypriot Pound, the Latvian Lats, the Slovenian Tolar and the Slovakian Koruna after the EU membership of these countries. On the other hand, we discovered that the join of Malta in the EU had a negative and a long-term impact in the relationship between the euro and the Maltese currency. As a matter of fact, the CYP, the LVL, the SIT and the SKK and the EUR seem to be a same currency in response to US dollar. Therefore, we support that Cyprus, Latvia, Slovenia and Slovakia had a fixed exchange rate with the euro, despite the fact that its exchange rate was varying against the euro. However, Malta did not show such a behaviour. Moreover, the ECM-GJR-GARCH(1,1) results highly support that the volatility shocks are quite persistent for each country. The leverage effect is positive for Latvia, Malta and Slovenia before their EU membership. Thus, the bad news of the euro had larger effect on the volatility of their old currency. Also, the leverage effect is negative for Cyprus, indicating that bad news of the euro has lower impact on the volatility of the Cypriot Pound. No leverage effect exists between the euro and the Slovakian Koruna. In addition, we discovered that the leverage effect is positive only for Cyprus after its

join in the EU. On the other hand, it is clear that there is no leverage effect between the euro and the Maltese Lira, Latvian Lats, Slovenian Tolar and Slovakian Koruna during the second period.

In conclusion, our results express that the adoption of the euro was completely in favour for Cyprus since the Cypriot Pound followed the fluctuation of the euro. Also, similar findings exist for Latvia, Slovenia and Slovakia but it is clear that the bad or the good news of the euro has no impact on the volatility of old currency of these countries. Malta's participation in the Euro Area was not beneficial for the country, under the financial aspect of view. Therefore, our empirical results indicate that its entrance in the Eurozone was not in favour of the Maltese economy. This is reasonable because Malta is a country which has no direct borders with the other countries of the EU and also its economy is basically based on the manufacturing and tourism sector. Our results are against the empirical evidence of Scerri (2001), who proposed a totally different direction for the country. Finally, we should mention that our results are against the findings of Koukouritakis and Michelis (2006). On the contrary, we totally agree with the results of Alexandou et al (2011) and Doyle and Fidrmuc (2006). In addition, our findings are aligned with the empirical evidence of Allam and Goerres (2008). In summary, our estimation is the adoption of the euro significantly aided the economies of Post-Communist countries, such as Latvia, Slovenia and Slovakia. Additionally, the circulation of the euro in Cyprus (Southern part only) favoured the Cypriot economy regardless its historical linkages with the UK. Finally, there are indications that the adoption of the euro from Malta was against the interests of its economy because the long-term linkages between the two currencies are not positive. Thus, we propose that the circulation of the euro in Malta should have been avoided. Nevertheless, the Euro Area participation cannot be cancelled, without the loss of the EU membership (50 Article of the Treaty on the EU). Essentially, if Maltese Government decides to leave from the Eurozone, then Malta should drop its EU participation. However, the euro debt crisis of 2010 revealed that Malta did not face any collateral damages. Maltese economy endured the external economic shocks and also it achieved approximately 4,5% real GDP growth rate from 2010 to 2016 (Eurostat, 2016). At the end, our empirical results highly propose that the EU membership of Cyprus and Malta increased the influence of the euro on their currency. We are able to support that these countries partially abandon their bonds with the United Kingdom. In addition, a similar phenomenon takes place in the Post-Communist Countries (Latvia, Slovenia and Slovakia). The euro

adoption increased their bonds with the EU and weakened the traditional relationships with the Russian Federation as an heir to the heritage of the Soviet Union.

Chapter 7. Post-Communist Countries of the EU

7.1. Introduction

The decay of Communism started in November 1989 when the Berlin Wall was collapsed and a revolution took place in Poland with the creation of the Solidarity movement. This wave of change continued to Hungary, East Germany, Bulgaria, Czechoslovakia, and Romania. Until the end of 1991, Soviet Union had completely collapsed. Plenty of Post-Communist Countries attempted to find a niche at the modern capitalistic world. The rise of the European Union in 1991 was a good opportunity by participating in a group where the principles were completely opposite instead of the Communist way. The leaders of the EU decided to expand the borders of the union on 16 April 2003 in Athens (Treaty of Accession). The EU welcomed in May 2004 eight Post-Communist countries (the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia). Part of the same wave of enlargement was the accession of Bulgaria and Romania in 2007, which were unable to join in 2004, but, according to the European Commission, constitute part of the fifth enlargement (May 2004). Croatia is the last Post-Communist country which entered in the EU on 1st July 2013. The next step of the EU integration is the adoption of the euro from each member state. Only five Post-Communist countries (Estonia, Latvia, Lithuania, Slovakia and Slovenia) joined the Eurozone, with Lithuania being the last one (01 January 2015). However, the Czech Republic, Bulgaria, Croatia, Hungary, Poland and Romania are obliged to join the Eurozone (Treaty of Lisbon), when the countries fulfil the criteria of Maastricht Treaty (European Commission, 1993).

Basora (2013) claims that the EU membership boosted the Freedom Democratic scores in the Post-Communist countries. However, there are not any traditionally political linkages with the Western Europe countries. This event does not help the economic relationships among the historical members of the EU. Chang and Tzeng (2011) found out that there is a long-term integration of the Purchasing Power Parity (PPP) among the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Russia. The Post-Communist countries seem to have close linkages with Russia, even being members of the EU. Economidou and Kool (2009) discovered that the EU membership of the Post-Communist countries was in favour of their economies. Particularly, their join in the EU appear to strengthen the economic and trade relationship with the older

members of the union. Koukouritakis et al. (2015) indicate that the nominal exchange rate of the euro against the US dollar, influence similarly the macroeconomic factors in the Post-Communist countries of the EU. In contrary, Podkaminer (2016) claimed that the economic disintegration of the European Union is not unavoidable but probable. In fact, he supported that the negative consequences implicit in the existence of the common currency could be neutralized. Finally, Petrevski et al. (2015) propose that the euro and the expansion of the Eurozone to Slovenia and Slovakia influenced positively (transmission effect) the macroeconomic indicators of other Post-Communist countries of the EU such as Croatia and Bulgaria.

Nowadays (2017), a country or a coalition of states are eligible to choose among a variety of exchange rate regimes in order to maintain the economic prosperity to their people. The modern economic theory (Tavlas *et al.* 2008) supports the establishment of three most important exchange rate regimes by using the nominal exchange rate of a currency:

a. *Flexible regime*
b. *Fixed exchange rate regime*
c. *Monetary union*

The recent years, several central banks have unexpectedly intervened in the foreign exchange market, reacting to changes in the world economic environment (low oil prices and a slowdown of world growth) and to announcements by the Federal Reserve and the European Central Bank (ECB).

In fact, most central banks have as their mandate keeping inflation low and stable while avoiding large fluctuations in the real economy (such as in unemployment and the output gap). To achieve their objective, they use an instrument, mainly the short-term nominal interest rate, which they increase when the economy is booming (typically when inflation is above its target and the output gap is positive and large) and decrease when the economy is in a recession (typically when inflation is below its target and the output gap is negative). This has been the case for the Fed, the ECB and the Bank of England, among others (Santacreu, 2015).

In very open economies, such as Australia, Canada and New Zealand—monetary authorities also care about avoiding large fluctuations in their respective nominal exchange rates, which affect inflation through imports. They change their nominal

interest rates when there are fluctuations of inflation and the output gap, as well as the nominal exchange rate (Santacreu, 2015).

Due to the global financial crisis of 2008 and the debt crisis of 2010 in the Euro Area, the majority of countries desires a flexible exchange rate regime in order to have alternative choices when the economy is in downturn. The cases of Argentina and Greece were representative in order to avoid fixed exchange regime and early entrance to monetary unions. Even, the Swiss National Bank unexpectedly abandoned their minimum exchange rate of 1.20 Swiss francs per euro in January 2015. Switzerland has been keeping a minimum exchange rate with the Euro since September of 2011 (Swiss National Bank, 2015).

Additionally, Denmark has reduced its interest rates four times in the past several weeks to defend its peg to the euro. Several commentators have argued that if speculators bet that Denmark's currency peg to the euro will break, this policy could become unsustainable. The Danish krone is part of the ERM-II mechanism, so its exchange rate is tied to within 2.25% of the euro (the Danish central bank targets a rate of 7.46038 kroner per euro inside a 2.25 percent band) (Jolly, 2015).

The previous events highly support that the modern economies wish to have a flexible exchange rate regime, by having the control of the monetary policy and confront the economic volatility of nowadays (2017). In our research, we use the flexible exchange regime of a currency in order to approve its potential transformation into a monetary union for some or all the examined Post-Communist countries of the EU.

However, we act against the tendency of our times by assuming that the economic and political integration of the Euro Area must go further. This means that the entrance of new countries in the European Monetary Union will be beneficial for them. Theoretically, the Eurozone membership offers a strong shield against to the external financial or economic shocks when the countries have implemented the necessary adjustments in the economy.

More specifically, the aim of the current research is to explore if the Eurozone is able to welcome new member-states of the EU. The expansion of the Euro Area is an important matter to European political integration. However, the first step was the economic and monetary integration. Historically, the Post-Communist countries have still economic, political and social relationship with the Russian Republic. Therefore, we propose that it is interesting to examine if the Post-Communist countries of the EU are ready to be a part of the economic and monetary integration. The join of these

countries to the political integration of the union is extremely difficult without the participation of the economic and monetary integration. Eurozone includes already five Post-Communist countries (Estonia, Latvia, Lithuania, Slovakia and Slovenia). However, there are six remaining countries (Bulgaria, the Czech Republic, Croatia, Hungary, Poland and Romania) which are still not members of the Euro Area. We decided to use the nominal exchange rate of the euro against the US dollar, in order to discover if there are possible dynamic linkages with the nominal exchange rate of each currency against the US dollar. We decided to use the nominal exchange rate as an empirical tool because the currencies reflect the real condition of an economy. The condition of an economy can be influenced by political (political instability) and economic matters (economic recession). Hence, we utilized the nominal exchange rates as an empirical instrument, by following the methodology of Wilfling (2009). He had implemented the nominal exchange rates in order to examine the volatility regime-switching in European exchange rates prior to monetary unification of 1999. Particularly, his data consist of daily spot exchange rates of sixteen currencies vis-a-vis to the German mark (DEM) (01/01/1996 to 31/12/1998) or to the euro (01/01/1999 to 31/12/2006). Also, he used the univariate Markov-switching GARCH dispersion model in order to calculate the volatility term. His findings suggest that for future EMU accession countries volatility regime-switching models provide a useful tool for a broad range of financial applications (Wilfling, 2009).

In addition, Huang and Yang (2015) used the nominal exchange rates in order to examine the nominal exchange regime and the real exchange rates for eleven Eurozone countries. Their main empirical tool was the use of the Error Correction Model. They have found out that the real exchange rates are much weaker in the post-1998, euro period than in the pre-euro period. Also, the Norwegian, Swedish, Swiss, and British real exchange rates are strong in both the pre- and post-euro (post-1998) periods. At the end, they discovered that the flexibility of nominal exchange rates is crucial for the adjustment of real exchange rates to PPP.

Recently, Stoupos and Kiohos (2017) used the nominal exchange rates of three leading currencies of Europe in order to explore the monetary integration of the EU in the UK, Switzerland and Sweden. They combined the Error Correction Model with the EGARCH, ECM-EGARCH. Their results show that, from a financial viewpoint, the UK should not join the euro. Switzerland shows historically an exchange rate independence from euro but there are recent indications which support the opposite

direction. Additionally, the results suggest that Sweden should join the Eurozone as there is a strong historical linkage between the euro and the Swedish Koruna.

Consequently, we have chosen to handle with the currencies of the Czech Republic, Croatia, Hungary, Poland and Romania because they present unpeg exchange rates with the euro. These countries are the only countries which include three features; Soviet history, EU members and their own free trade currency against the euro. In addition, Croatia, Hungary, Poland and Romania are emerging economies according to IMF report (2015). Only the Czech Republic is an advanced economy. This is interesting to study if there is a difference between the two groups.

On the other hand, Bulgaria has had a fixed exchange rate regime bounded to the euro (1,955 BGN/EUR) since 1999. Thus, there is no academic interest to explore if there is currency integration in the long run. If we prove that these currencies follow the economic behaviour of the euro and react similarly against the shocks of the euro, it means that these countries have, in fact, a pegged exchange rate against the euro. Consequently, it seems as if they have already adopted the European common currency. A question can be posed for the reason why these countries should not replace their currencies with the euro; once they meet the Maastricht euro criteria. Exchange rate policy changes are not only a function of economic conditions, but they are also fundamentally related to political processes. According to this, governments' decisions have always impact on the value of currencies. A characteristic paradigm is the Brexit, where the British Pound has collapsed by 15% against the US dollar after the official result of the UK referendum (23th June 2016). The British government had declared to respect the voting outcome by "triggering" the Article 50 of the Lisbon Treaty of the European Union in 29th March 2017.

The introduction of a fixed or flexible exchange-rate regime would influence specific factors of the economy, such as the inflation, the imports and the twin-deficits; anomaly in current account balance and government budget balance. Essentially, Central Banks and Governments are able to follow a flexible exchange-rate regime, a fixed exchange-rate regime or a common currency. However, the third choice is hardly irreversible. The Treaty of Lisbon (European Commission, 2007), commonly known as the Treaty on the Functioning of the European Union, requires unconditionally that each member of the EU should adopt the euro as its currency in the future. Only the UK and Denmark have had an opt-out of the monetary integration of the EU. Therefore, the non-euro member states of the EU should participate in a particular exchange-rate regime.

However, the Eurozone debt crisis of 2010 indicated that the euro is extremely "painful" for countries which are not economically primed. A characteristic paradigm is the case of Greece where the return of Greek Drachma (GRD) is extremely costly for the society and the businesses. This is truly interesting to explore, from the financial aspect of view, if the Czech Republic, Croatia, Hungary, Poland and Romania are eligible to be part of the Euro Area in the near or distant future. The economies of these countries are not so strong, such the German economy in order to endure large financial crisis shocks.

The present research uses an innovative econometric approach by combining the Error Correction Model (Engle et al., 1987) with the Asymmetric Power ARCH (Ding et al. 1993). Particularly, we used the Error Correction Model as the mean equation of the ARCH model and the APARCH model as the variance equation. In fact, the errors of the ECM model will help us in order to examine volatility persistency, volatility asymmetry and leverage effect. Finally, the use of the rolling regression took place as an auxiliary methodology to the ECM.

The Error Correction Model is an advanced econometric model which provides short- and long-term dynamics among a group of variables. The most important component for our research is the long-term coefficient. If it will be positive, it means that the reaction of the nominal exchange rate of the euro has a positive impact on each examined Post-Communist currency. The first research hypothesis is related with the ECM. Therefore, we test the following null and alternative hypothesis.

H_{01}: the long-term impact of the euro would be positive on each Post-Communist currency.

H_{11}: the long-term impact of the euro would be not positive on each Post-Communist currency.

Moreover, the APARCH model is suitable in order to examine volatility asymmetry, volatility persistence and leverage effect. In fact, the use of the APARCH model is very useful in order to find out the resistance (volatility asymmetry and persistence) of each examined variable against the financial or economic shocks of the euro. Additionally, the leverage effect is related with the impact of good news (overvaluation of the euro) and bad news (devaluation of the euro) on the economic behaviour of the examined

currencies. Consequently, we would discover if the examined currencies are vulnerable against the shocks of the euro's market reaction. Hence, the second and third research hypotheses are linked with the APARCH model. We assume test the following null and alternative hypotheses.

H_{02}: The examined currencies would be vulnerable against the economic/financial shocks of the euro.

H_{12}: The examined currencies would be not vulnerable against the economic/financial shocks of the euro.

and

H_{03}: The overvaluation of the euro would influence more the nominal exchange rate of each currency than the devaluation of the euro.

H_{13}: The overvaluation of the euro would not influence more the nominal exchange rate of each currency than the devaluation of the euro.

Actually, the three research hypotheses, that we described previously, present the main purposes of the current empirical study. At the end of this study, we describe if they are true, according to our empirical evidence.

At the end, if we discover that the three hypotheses are true simultaneously, then we would eligible to claim that the economic behaviour of the examined currency follows the economic reactions of the European common currency. Therefore, we may ask; "Why these countries do not enter in the EMU, since they have already unofficially adopted the euro, from the financial aspect of view?".

7.2. Dataset Analysis and Methodology

The present research uses the nominal exchange rates of five EU member-states which have not adopted yet the euro as their official currency. Specifically, we attempt to investigate if there are possible linkages among the euro, the Czech Koruna, the

Croatian Kuna, the Hungarian Forint, the Polish Zloty and the Romanian Leu. The data sample was collected from the official database of the European Central Bank (ECB). The nominal exchange rate of each currency is expressed in US dollars (USD). This happens because the US dollar is historically the most traded currency across the globe (JP Morgan, 2009). We, also, decided to use the nominal exchange rate instead of the real exchange rate because we wanted to include the actual reaction of the global financial markets. We used daily observations from 01 January 1999 to 31 December 2016, by covering a range of 18 continuous years. We divided the dataset into three periods. The cut points were designed by using the unit root testing of Lee and Strazicich (2003). The main characteristic of this test is that it reveals the structural breaks endogenously from the data and indicates if the breaks exist only in the intercept or both in the intercept and the trend of the series. The results of this test are presented at the following section.

Table 21 shows the features of each variable by presenting the nature, the acronym and the measure of each currency.

Table 21: Data Presentation		
Variables	**Acronym**	**Measure**
Euro	EUR	€/$
Czech Koruna	CZK	Kč/$
Croatian Kuna	HRK	Kn/$
Hungarian Forint	HUF	Ft/$
Polish Zloty	PLN	Zl/$
Romanian Leu	RON	L/$

Source: **European Central Bank (ECB)**

The three sub-periods are the following:

a) *01 January 1999 to 28 February 2002*

The main characteristic of this period is that none of these countries was a member of the EU. They had submitted an official application to the European Commission in order to obtain the EU membership. However, the European Council had not taken any

political decision in order to expand the borders of the EU at that time. Also, during this era, the Euro Area executives were occupied with the creation and the regular operation of the European Monetary Union (EMU), which took its physical form on 01 January 2002. The ex-currencies of the 12-initial founding member of the Euro Area had completely stopped to circulate on 28 February 2002.

b) 01 March 2002 to 30 April 2010

During this period, the Czech Republic, Hungary, Poland and Romania joined in the EU. This period is characterized by a financial prosperity in Europe until 2008 when the global financial crisis took place. However, the actual European crisis occurred in May 2010 when the Eurozone debt crisis emerged. In 2010, after months of frantic diplomatic negotiations, the International Monetary Fund (IMF), the European Commission (EC) and the European Central Bank (ECB) hammer out a three-year package to rescue Greece on 1st May 2010. Greece was the first member of the Euro Area which demanded the financial assistance and solidarity of the other participants in the Eurozone.

c) 01 May 2010 to 31 December 2016

This period is historically known as the debt crisis in the Euro Area. The Eurozone and the EU was under structural reform for the establishment of the European Banking Union, the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM). In addition, Greece was signed three Memoranda of Understanding (MoU). Portugal, Ireland and Cyprus were signed only one Memorandum of Understanding. Essentially, Greece call for aid was the beginning of the sovereign debt crisis in the Euro Area. During this period, it is observed that the non-euro countries of the EU have plenty of second thoughts about Euro Area participation. Finally, we displayed a summary of the exchange rates regime that have been adopted by the Czech Republic, Croatia, Hungary, Poland and Romania after the fall of the Soviet Union.
Table 22 shows the nature of each regime. We observe that the governments of these countries decided to follow a friendly Western and European policy concerning of their currencies.

Table 22: Exchange-rate Regimes in the Post-Communist countries of the EU	
Countries	**Regime**
Croatia	Currency pegged with DEM (subsequently EUR) from 1998, (Managed float)
Czech Republic	Fixed peg against basket 65% DEM, 35% USD from March 1997
	Managed float against EUR from March 1997
Hungary	Peg to basket 50% ECU, 50% USD, Basket changed to 50% DEM, 50% USD from August 1993, Basket changed to 70% ECU, 30% USD from May 1994, Crawling peg/band to basket from March 1995, Basket changed to 70% EUR, 30% USD from January 1999, Basket changed to 100% EUR from January 2000
Poland	Fixed to USD from January 1990, Fixed to basket (45% USD, 55% DEM + GBP + FF + CHF) from May 1991, Crawling peg to (same) basket, Basket changed to 55% EUR, 45% USD from January 1999, Free float (but Central Bank reserves extraordinary right to intervene) from April 2000
Romania	Managed float, various degrees of tightness from August 1992

Source: **International Monetary Fund (2015), Maican and Sweeny (2013)**

In specific, we used the following multivariate model in our research in order to explore short-term and long-term dynamics among the examined variables.

$$\boldsymbol{\Delta\big(ln(CUR_t)\big) = \omega + \varphi EC_{t-1} + \psi\big(\Delta ln(CUR_{t-1})\big) + \theta\big(\Delta(ln(EUR_{t-1})\big) + \varepsilon_t (42)}$$

where, the dependent variable lnCURt represents the natural logarithmic value of the nominal exchange rate of the Czech Koruna (CZK), or Croatian Kuna (HRK), or Hungarian Forint (HUF), or Polish Zloty (PLN), or Romanian Leu (RON) against the US dollar (USD). The independent variable (lnEURt) is the natural logarithmic value of the nominal exchange rate of euro (EUR) against the US dollar (USD).

We used the logarithmic expression because its small changes in the log of a variable are directly interpretable as percentage changes, to a very close approximation, in econometrics. This means that the prediction accuracy of the impulse responses would be higher and more qualitative.

7.3. Empirical Results

The exploration of a random walk (unit root) is very important in time series analysis. A stationarity test is perquisite before executing a co-integration test. We ran a Lee and Strazicich (2003) two breakpoints stationarity test. We included an intercept and a trend in test equation.

Table 23: Estimation Results of Lee and Strazicich unit root test

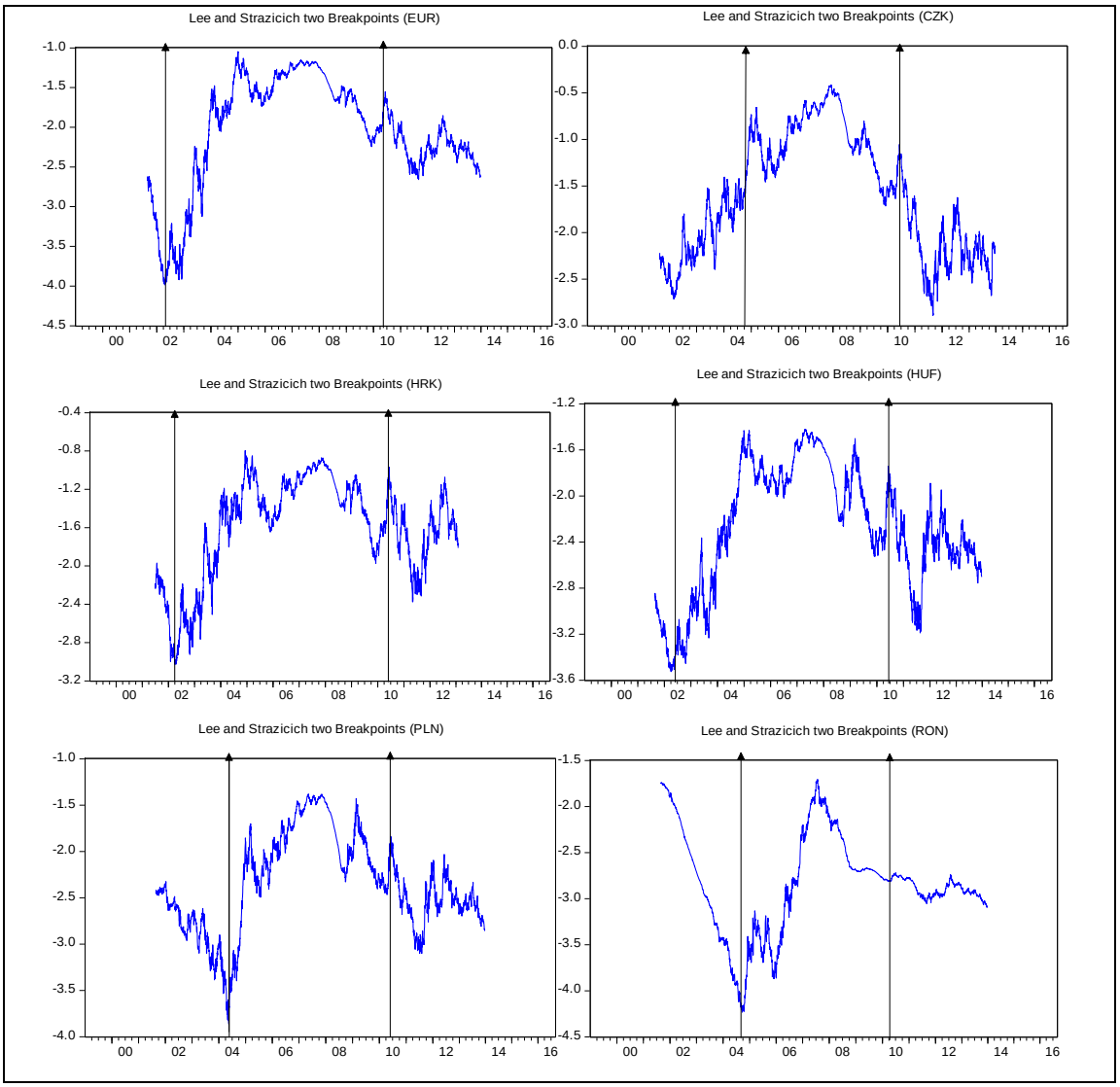
Series – ln values	**t-statistic**	**Probability**
Euro	-3.03*	0.036*
Czech Koruna	-2.89*	0.021*
Croatian Kuna	-3.03*	0.036*
Hungarian Forint	-3.53*	0.047*
Polish Zloty	-3.87*	0.001*
Romanian Leu	-4.23*	0.001*

Note: (*) denotes statistically significant at 0.05 level

The Lee and Strazicich test was executed by using the natural logarithmic value of the nominal exchange rates of each currency. Table 23 presents the results of Lee and Strazicich test. We discovered that time series are stationary according to t-statistic and probability value criteria. Specifically, figure 8 shows the two breakpoints of each time series that we used. The main characteristic of each time series is that the first break

point is the same (around 01/05/2010). Also, the majority of the time series present a second break point at around 01/03/2002.

Figure 8: Lee and Strazicich Breakpoints Unit Root Test



Therefore, we have selected these dates as the two breakpoints in order to create the three sub periods that we have already described previously. The previous figure (7) presents the breakpoints of each time series according to the Lee and Strazicich (2003) unit root test. The breakpoints are presented with the use of arrows.

Table 24 displays the empirical results of the co-integration test. We used the natural logarithmic value of each currency in order to discover if the series are co-integrated in the long-run. We selected the deterministic trend assumption of test that there is a trend

and an intercept in co-integrating equations (CE) and no intercept in VAR with three lags according to Schwarz criterion. The results of Johansen Co-integration testing with structural breaks for the Czech Republic are presented at Table 24.

Table 24: Johansen's Co-integration Structural Breaks Test in ln series CZK and EUR				
Hypothesized No. of CE(s)	**Total Period**	**1st Period**	**2nd Period**	**3rd Period**
None	0.0921**	0.0005*	0.0117*	0.0097*
At most 1	0.1131	0.0877**	0.2058	0.0246*

Note: (*) denotes statistically significant at 0.05 level, (**) denotes statistically significant at 0.1 level (probabilities)

The results of Johansen's Co-integration test with structural breaks show that there is a long-term tendency between the euro and the Czech Koruna. This trend takes place among the examined sub-periods, as well the total period.

Table 25: Johansen's Co-integration Structural Breaks Test in ln series HRK and EUR				
Hypothesized No. of CE(s)	**Total Period**	**1st Period**	**2nd Period**	**3rd Period**
None	0.0181*	0.0209*	0.0470*	0.0418*
At most 1	0.0846	0.2581	0.1157	0.0833

Note: (*) denotes statistically significant at 0.05 level (probabilities)

Moreover, we found out that a similar behaviour exists between the Croatian Kuna and the euro. These two currencies are co-integrated among the examined periods.

Table 26: Johansen's Co-integration Structural Breaks Test in ln series HUF and EUR				
Hypothesized No. of CE(s)	**Total Period**	**1st Period**	**2nd Period**	**3rd Period**
None	0.0871**	0.0979**	0.0102*	0.0498*
At most 1	0.9376	0.5634	0.0716	0.3800

Note: (*) denotes statistically significant at 0.05 level, (**) denotes statistically significant at 0.1 level (probabilities)

A co-integration takes place between the euro and the Hungarian Forint during the total period and the 1st sub-period (a=0.1). A similar trend exists during the 2nd and 3rd sub-period (a=0.05).

Table 27: Johansen's Co-integration Structural Breaks Test in ln series PLN and EUR				
Hypothesized No. of CE(s)	**Total Period**	**1st Period**	**2nd Period**	**3rd Period**
None	0.0789**	0.0079*	0.0465*	0.0412*
At most 1	0.3505	0.0813	0.1911	0.2256

Note: (*) denotes statistically significant at 0.05 level, (**) denotes statistically significant at 0.1 level (probabilities)

The findings of Johansen's Co-integration test with structural breaks express that there is a long-term tendency between the euro and the Polish Zloty. This trend takes place among the examined sub-periods, as well the total period.

Table 28: Johansen's Co-integration Structural Breaks Test in ln series RON and EUR				
Hypothesized No. of CE(s)	**Total Period**	**1st Period**	**2nd Period**	**3rd Period**
None	0.0000*	0.0050*	0.0365*	0.0204*
At most 1	0.1711	0.2175	0.1265	0.1930

Note: (*) denotes statistically significant at 0.05 level (probabilities)

At the end, it is obvious that a long-term tendency takes place between the euro and the Romanian Leu. Therefore, the series are co-integrated during the total period and the sub-periods.

The Error Correction Model shows short-term and long-term dynamics among the natural logarithmic values of the nominal exchange rates. Table 29 presents the empirical results of the ECM for each period. The dependent variable is the natural logarithmic value of the CZK/USD. The independent variable is the natural logarithmic value of the nominal exchange rate of the euro against the US dollar. The t-statistic values are in the parenthesis. Note that all the diagnostic tests show that there is no autocorrelation. The majority of coefficients are statistically significant. Particularly, the euro influences slightly positive the nominal exchange rate of the CZK/USD in the short-run. We observe that the EU membership increased the short-term impact of the

euro on the Czech Koruna, especially during the second and the third period. It may have happened because the Czech National Bank/Ceska Narodni Banka (CNB) follows the same monetary policy with the European Central Bank (ECB) from 2004 to 2016. Also, the euro seems to have no impact on the Czech Koruna when the Czech Republic was not a member in the EU (during the first period). The long-term impact of the euro is slightly negative during the total period. During the 1st and the 3rd period, there is no impact of the euro on the Czech Koruna.

Table 29: Estimation Results of Error Correction Model - CZKvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	-0.001 (-0.35)*	-0.001 (-0.60)	-0.001 (1.63)	0.001 (2.02)*
ψ	0.070 (2.34)*	-0.20 (-2.76)*	0.164 (4.12)*	0.109 (1.98)*
φ	0.002 (1.38)	0.007 (2.64)*	0.001 (0.18)	0.007 (1.94)*
θ	-0.071 (-2.02)*	0.115 (1.54)	-0.169 (-3.46)*	0.093 (-1.25)

Note: (*) denotes statistically significant at 0.05 level

The long-term impact changes to negative during the 2nd period. It may occur because the CNB had kept a lid on the crown since 2013 and intervened with increased regularity over the last year to hold the exchange rate on the weak side of 27 per euro as the country's economy has thrived. In addition, the Czech Central Bank introduced a temporary exchange rate targeting policy in 2015. Since then the Czech Koruna is on a completely different path from that of the euro. But one plausible interpretation is that the CNB had an additional tool to fight zero lower bound that was not available for the ECB. Also, the CNB's ex-governor expected to remove the cap around the middle of 2018, but after a change of guard at the Czech Central Bank and with increasing wage pressure expected to fire up inflation, traders are looking more closely at the timing of the move. The new CNB's governor has announced that the weak crown policy could end around the middle of 2017 even if inflation is still slightly below the bank's 2% target but is heading higher (Muller and Hovet, 2017). Finally, the Czech National Bank

has removed its upper limit on the koruna after three-and-a-half years in an extraordinary meeting, highlighting how the rise in inflation across the region is prompting change in long-standing central bank policies (Martin, 2017). In April 2015, the Czech coalition government announced that it had agreed to not set a euro adoption target and not to enter ERM II before the next legislative election scheduled for October 2017, making it unlikely that the Czech Republic will adopt the euro before 2020 (Harper, 2017). Finally, the EC term is positive or statistically insignificant which means that a disequilibrium takes place between the Czech Koruna and the euro.

Figure 9: Rolling Regression Results of ECM (Czech Republic)

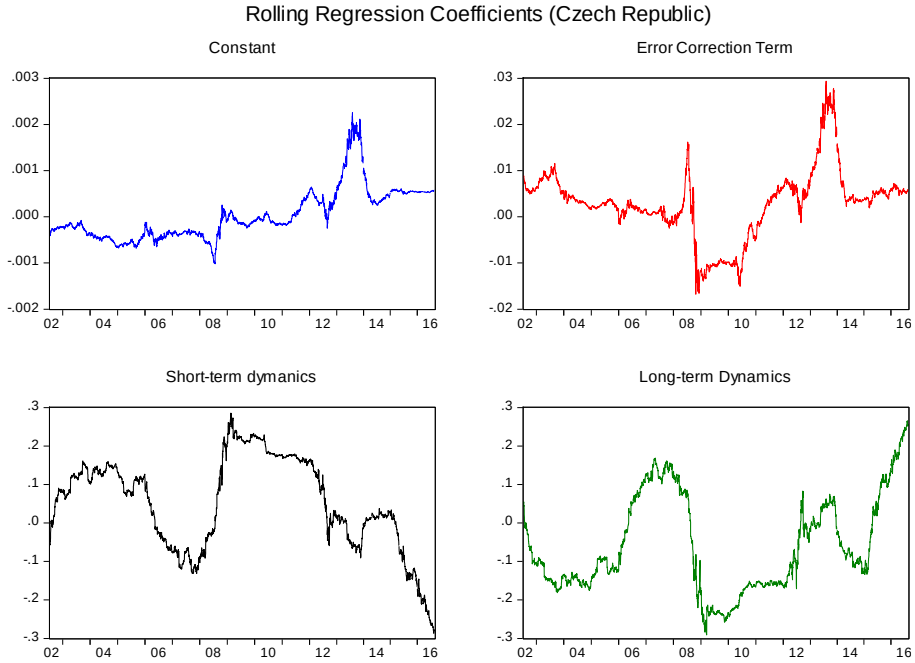


Figure 9 presents the results of rolling regression for the Czech Republic. The rolling regression shows that the short-term dynamics coefficient is positive during the examined period. However, it changed to negative from 2006 to 2008 and from 2015 to 2016. The tendency is strictly negative during the last period. On the other hand, the long-term dynamics coefficient follows a different behaviour. Its value is negative during the largest part of the examined period. However, we observe that the long-term tendency between the euro and the CZK seems to be positive from 2015 to 2016. Consequently, we could support there are strong indications that the Czech Republic is not ready to adopt the euro. Regarding the similar interest rate policy, that the both central banks have followed, the null relationship between these two currencies means

that the Czech Koruna does not follow, in fact, the long-term economic behaviour of the euro.

Table 30 presents the results of the ECM for Croatia. The dependent variable is the natural logarithmic value of the nominal exchange rate of the Croatian Kuna against the US dollar. Also, the control variable is the natural logarithmic value of the exchange rate of the euro against the US dollar. The constant is not statistically significant for each period. The short-term effect of the euro on the Croatian Kuna is positive among the periods, but its tendency decreases through time. On the other hand, the long-term impact of the euro on the Croatian Kuna is negative during each period which weakens thought time. The above is obvious because Croatia became a member of the EU on 1st July 2013.

Table 30: Estimation Results of Error Correction Model - HRKvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	-0.001 (-0.30)	0.001 (0.78)	-0.001 (1.93)	-0.001 (-0.06)
ψ	0.092 (2.52)*	0.228 (2.61)*	0.193 (2.42)*	0.102 (2.72)*
φ	0.004 (0.95)	0.012 (0.74)	-0.014 (-1.42)	-0.01 (-1.20)
θ	-0.12 (-2.01)*	-0.34 (-2.32)*	-0.19 (2.31)*	-0.10 (-2.72)*

Note: (*) denotes statistically significant at 0.05 level

During the 2nd period, the long-term impact is negative. This may occur due to the decision of the governor of Croatian National Bank to reject a euro-peg. He decided to implement the official agreement of that time which permitted the Kuna to float against the euro within a 15 per cent "price corridor" could not be preserved unless market forces were restrained (Jansson, 2005). Especially, the Croatian National Bank (Hrvatska Narodna Banka) commenced to follow a similar monetary policy to the European Central Bank, after its official application in September 2012. Furthermore, the governor of Croatian National Bank recently (March 2016) stated that the Croatia is going to be the 20th member of the Euro Area as soon as possible (Mus, 2017).

However, the country is obliged to be a member of the ERM II for at least two continuous years and fulfil each criterion of Maastricht Treaty. The report of ECB in 2016 stated that Croatia fulfils only 4 out of 7 Maastricht criteria and therefore the country is not ready to participate in the Eurozone (ECB, 2016). However, the CNB estimates that the Croatia will be a member of the EMU by 2020. We observe that Croatia increases continuously the economic and financial interactions with the Euro Area after its EU membership in 2013. Therefore, it is logical that the tendency of the negative long-term relationship between the two currencies decreases over time. Finally, the EC term is positive or statistically insignificant which means that a disequilibrium takes place between the Croatian Kuna and the euro.

Figure 10: Rolling Regression Results of ECM (Croatia)

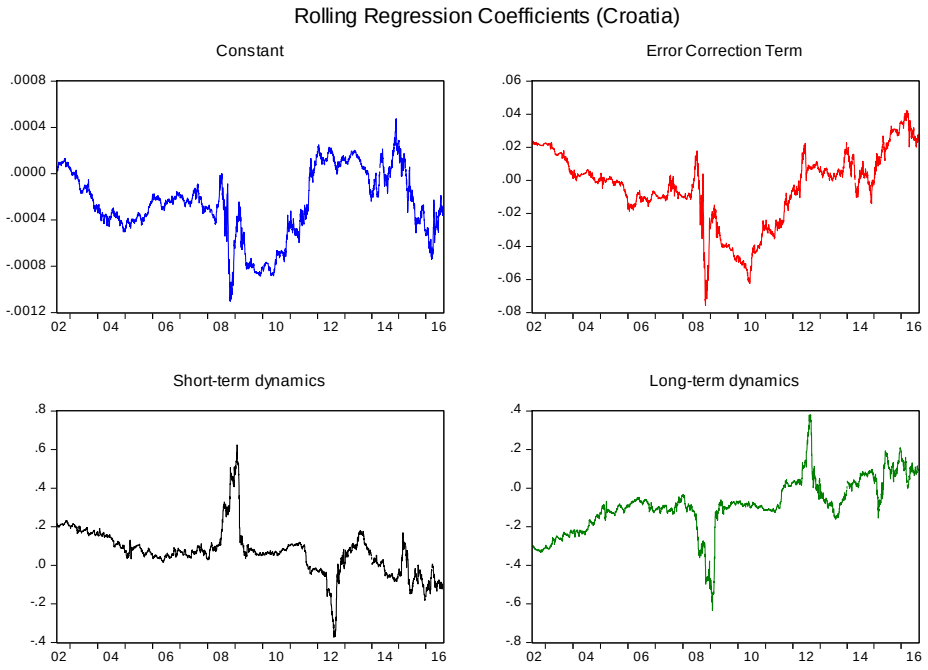


Figure 10 shows the empirical findings of the rolling regression estimation. We observe that the coefficient of short-term dynamics is positive but it has a declining tendency. On the other hand, the coefficient of long-term dynamics expresses an increasing tendency. Especially, the long-term coefficient becomes positive after participation of Croatia in the EU. The present results are aligned with the findings of the Error Correction Model which have been displayed previously.

Table 31 shows the empirical results of the ECM for Hungary. Hungary became a member-state of the EU in May 2004. We observe that the short-term dynamics of the

euro on the Hungarian Forint increased after the join of Hungary in the EU (2nd period). However, we observe that there is no short-term euro's impact on the Hungarian currency during the debt crisis in the Euro Area. The error correction term is statistically significant only during the 2nd period. Thus, there is an adjustment speed back to equilibrium. We observe that the long-term effect of the euro on the Hungarian Forint is negative through the total period. Nevertheless, the long-term impact of the euro on the Hungarian currency is zero during the first period, negative during the second period and deeper negative during the third period. This may occur because Hungary was not a part of the EU during the 1st period. This means that there were limited trade and economic relationships between Hungary and the EU.

Table 31: Estimation Results of Error Correction Model - HUFvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (0.43)	0.001 (0.27)	-0.001 (-2.49)*	-0.001 (1.35)
ψ	0.050 (2.02)*	-0.155 (-2.06)*	0.112 (3.23)*	-0.004 (-1.10)
φ	-0.001 (-0.89)	-0.011 (-1.32)	-0.011 (-2.56)*	-0.004 (-0.93)
θ	-0.081 (-2.32)*	0.067 (0.89)	-0.161 (-3.10)*	-0.316 (2.23)*

Note: (*) denotes statistically significant at 0.05 level

Also, there is a negative long-term impact of the euro on the Hungarian Forint during the 2nd period. This may have happened due to the following reasons. The Hungarian governments have planned the participation of Hungary in the Euro Area on 01 January 2012. However, that date was abandoned because of an excessively high budget deficit, inflation, and public debt (Matolcsy, 2010). Specifically, the Hungarian government introduced austerity measures in late 2006 and an economic slowdown took place in 2007 and 2008. Also, in 2007, the deficit had been reduced to less than 5% (from 9.2%) and approached the 3% threshold in 2008. In the same year, analysts claimed that Hungary could join ERM II in 2010 or 2011 and so might adopt the euro in 2013, but more feasibly in 2014, or later, depending on Eurozone crisis developments. In 2008,

Hungary received financial aid (loan agreement) from the International Monetary Fund, the European Union and the World Bank in order to confront the financial crisis of that time (Impey, 2011). Therefore, the imbalances of the Hungarian economy forced the central government to abandon its plans for Euro Area participation. During the third period, a new government was elected in Hungary. The first goal of this Hungarian government was to implement more austerity measures in order to manage the macroeconomic factors. In 2011, the Hungarian government announced that the country was not yet ready to adopt the European common currency and they would not discuss the possibility until the public debt reached a 50% threshold (Matolcsy, 2011). When the countries of the Eurozone adopted the Euro Plus Pact on 25 March 2011, Hungary decided to go along with the United Kingdom, Sweden and the Czech Republic and chose not to join the pact. In April 2013, the Hungarian government proclaimed euro adoption would not happen until the Hungarian purchasing power parity weighted GDP per capita had reached 90% of the Eurozone average. However, it is estimated that will take place after 2050, according to the present available economic data (Jones, 2016). Thus, it is logical due to the previous matters that the impact of the euro on the Hungarian Forint is more negative during the third period. Finally, the Hungarian National Bank (Magyar Nemzeti Bank) has followed a similar monetary policy to the ECB since 2004 (Kiss, 2005). However, we do not observe the same economic responses between the two currencies. In fact, the Hungarian Forint does not financially peg with the euro. According to our results, Hungary could not join the Euro Area in the near future. Finally, the EC term is statistically insignificant during the 1st and 3rd period which means that a disequilibrium takes place between the Hungarian Forint and the euro. However, the EC parameter is negative and statistically significant during the 2nd period. This implies that the model identified the sizable speed of adjustment by 1,1% of disequilibrium correction daily for reaching long run equilibrium.

Figure 11 (below) presents the historical evolution of the ECM components though time. The main characteristic of the rolling regression's results is that the short-term impact of the euro on the Hungarian Forint is approximately zero, but there is a sense of slight positivity during the total period. On the other hand, we observe that the long-term impact of the euro on the Hungarian Forint is approximately zero. The empirical findings of the rolling regression methodology support the evidence of the ECM.

Figure 11: Rolling Regression Results of ECM (Hungary)

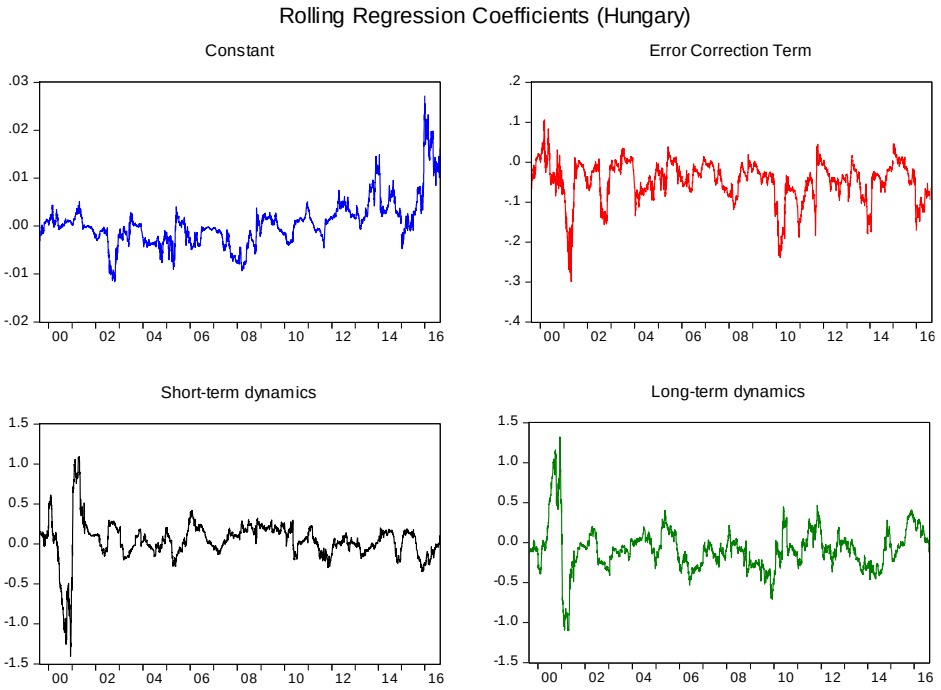


Table 32 presents the empirical findings of the ECM for Poland. The dependent variable was the natural logarithmic value of the nominal value of the Polish Zloty against the US dollar and the independent variable was the natural logarithmic value of the nominal value of the euro against the US dollar. Our evidence highly supports that there is a statistically significant positive relationship in the long-run during the first period. This happens because Poland's exchange rate policy has incorporated the parity against the euro as one of its main components, until the April's 2000 decision to float the currency, the zloty central parity was based on a partial peg to the euro (Morales, 2000). A more accelerated convergence of interest rate and inflation to euro levels should in itself favour a stronger correlation between the currencies and the euro in the period prior to their formal incorporation to the EU.

Moreover, the euro market has become even more important for exports from Poland in the aftermath of the Russian crisis of 1998 (Morales, 2000). During the second period, we observe that there is a positive impact of the euro on the Polish Zloty in the short-run. Also, there is a neutral long-term relationship between these two currencies. This condition may take place due to the monetary policy of the Polish National Bank (Narodowy Bank Polski).

Table 32: Estimation Results of Error Correction Model - PLNvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (0.25)	0.001 (0.684)	-0.001 (-1.10)	0.001 (1.31)
ψ	-0.027 (-1.33)	-0.029 (-0.761)	0.052 (2.67)*	-0.078 (1.98)*
φ	-0.004 (-2.14)*	-0.004 (-0.82)	-0.005 (-1.99)*	-0.001 (-1.16)
θ	0.152 (2.61)*	0.311 (2.03)*	-0.185 (-1.27)	0.343 (2.52)*

Note: (*) denotes statistically significant at 0.05 level

If a country keeps its interest rates at a relatively high level, it usually attracts large short-term capital flows and the currency of this country appreciates. In 2002-2003, the difference between interest rate levels decreased, and the zloty depreciated. In subsequent years, there has been no longer such a clear relationship (Bojanowska and MacDonald, 2009). In 2007-2008, the zloty exchange rate fluctuated in accordance with the interest rate parity condition, but towards the end of 2008 the trend of the EUR/PLN exchange rate was reversed. It was a consequence of the global financial crisis and increase in foreign investors' aversion to invest in emerging markets (Bojanowska and MacDonald, 2009). In 2010, the zloty was appreciating, which could not be justified by changes in interest rates. Also, an important factor was the participation of Poland in the EU in May 2004 (Arratibel and Michaelis, 2014). During the third period, it is clear that there is a negative effect of the euro on the Polish Zloty. This may happen because the policy of Polish government and the governor of Polish National Bank (PNB) is to delay the participation in the Euro Area. The main reason to this decision is the debt crisis in the Eurozone after 2010 (Arratibel and Michaelis, 2014). Therefore, the euro membership might be positive for the Polish economy, according to Polish government. In addition, the governor of PNB raised plenty of concerns about the speculations over the Polish Zloty when the currency would enter in the ERM II of the European Central Bank. Polish government does not intend to participate in the EMU before 2020. On the other hand, there is a positive long-term linkage between the euro and the Polish Zloty during the third period. This occurs due to the similar monetary

policy (interest rates) which has been implemented by ECB and PNB after 2010 (Arratibel and Michaelis, 2014). An important factor is the increase of trade relationship between Poland and the Euro Area. Especially, the trade and economic linkages of Poland are greater with Germany and Slovakia and Lithuania due to common borders. However, Germany is the most important trade partner of Poland with 50 billions of euros in exports (World Bank, 2016). Furthermore, the coefficient of error correction term expresses that a downturn adjustment back to equilibrium during the 2nd period is expected. Essentially, we have discovered important evidence which supports that there is a positive long-term tendency between the euro and the Polish Zloty in the distant future. Consequently, Poland is ready to join the Eurozone, from the financial aspect of view. Also, the public opinion of Poland is in favour of euro adoption and the country has already fulfilled the Maastricht criteria, except the ERM II participation. In fact, the Euro Area membership is a political choice of the Polish government.

Finally, the EC term is statistically insignificant during the 1st and 3rd period which means that a disequilibrium takes place between the Polish Zloty and the euro. However, the EC parameter is negative and statistically significant during the second period. This implies that the model identified the sizable speed of adjustment by 0,5% of disequilibrium correction daily for reaching long run equilibrium steady state position. A similar effect exists for the whole examined period, indicating a sizable speed of adjustment by 0,4% of disequilibrium correction in daily basis.

Figure 11: Rolling Regression Results of ECM (Poland)

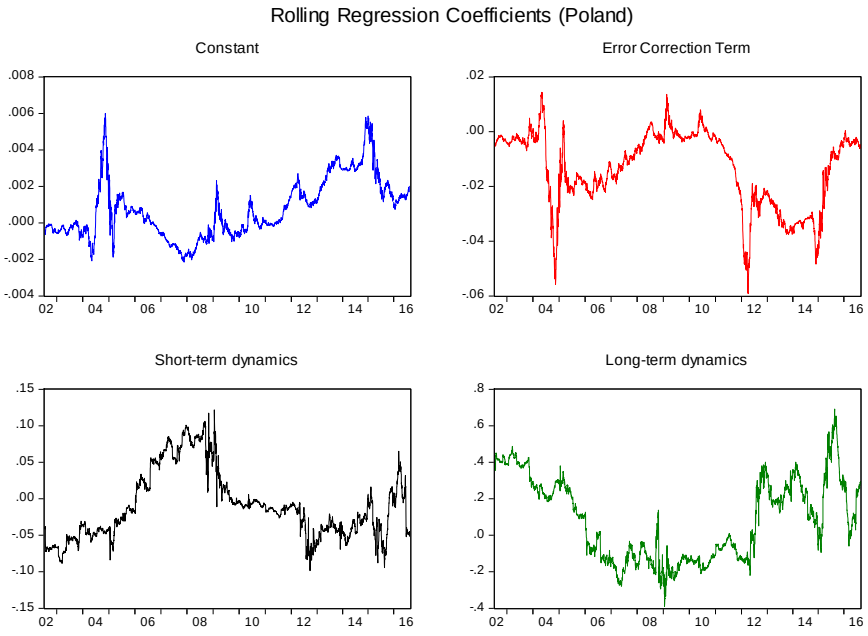


Figure 12 (above) presents the empirical findings of the rolling regression estimation. We observe that the coefficient of short-term dynamics is positive until 2008. After the global financial crisis of 2008, there is a declining tendency. On the other hand, the coefficient of long-term dynamics expresses an increasing positive tendency after 2010. Especially, the long-term coefficient becomes positive after the presence of the debt crisis in the Euro Area. The present results are aligned with the findings of the Error Correction Model which have been displayed previously.

Table 33 expresses the empirical evidence of Romania. Romania became a member of the EU on 1st January 2007 (full membership). Historically, Romania is a Post-Communist country and it has strong relationships (political and economic) with Russian Federation. The short-term dynamics between the euro and the Romanian Leu were strictly negative when Romania was not a member of the EU. During the first period, Romania had limited trade relationships with the EU. The EU of that time had not been expanded to the Balkan Peninsula, except Greece. Also, Romania kept economic and trade linkages with Russia due to Communist regime in country until 1989. During the second period, the short-term impact of the euro on the Romanian Leu is less negative that the first period. In addition, the long-term effect is neutral.

Table 33: Estimation Results of Error Correction Model - RONvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (2.90)*	0.001 (2.85)*	0.001 (-0.19)	0.001 (1.54)
ψ	-0.116 (-5.93)*	-0.236 (-6.95)*	-0.107 (-3.32)*	-0.086 (-1.30)
φ	-0.002 (-4.94)*	-0.003 (-3.33)*	-0.002 (-1.34)	-0.001 (-1.22)
θ	0.085 (3.83)*	0.013 (0.41)	0.069 (1.94)	0.112 (2.01)*

Note: (*) denotes statistically significant at 0.05 level

This is reasonable because Romania became a member of the EU at the end of this period. There were not strong economic linkages between Romania and the EU

(Angeloni et al. 2003). Specifically, after the EU participation, the Romanian National Bank (Banca Nationala a Romaniei) started to follow similar interest rate policy, such as the ECB. Moreover, the short-term impact of the euro on the Romanian Leu became neutral during the third period. The debt crisis of 2010 in the Eurozone does not influence the relationship between the two currencies.

The coefficient of error correction term (φ) expresses that a downturn adjustment during the following period is expected. The adjustment speed is extremely low and close to zero. The long-term impact of the euro on the Romanian currency seems to be positive during the third period. We observe that the trend is an upturn. Essentially, the positive relationship between these two currencies means that the Romanian Leu follows the long-term economic behaviour of the euro. This indicates that the EU membership of Romania influenced positively the relationship between its currency and the euro. During the third period, we observe that the National Bank of Romania follows literally the monetary policy of the ECB, especially the regime of interest rates (Popescu, 2013). Also, the trade relationship of Romania with the EU has been strengthened. For instance, the three top import partners of Romania are Germany (19,1%), Italy (10,8%) and Hungary (7,8%) and the three top export partners of Romania are Germany (21.5%), Italy (11,4%) and France (7,2%) in 2016 (World Bank, 2016). Finally, there is a strong political intention of the Romanian government to join the Euro Area in the near future. However, there are plenty of concerns about the long-term condition of the Romanian economy in the euro. For instance, the participation of Greece in the EMU approved as an incorrect decision. The Greek economy is very vulnerable to external financial shocks without having any successful safeguards. In addition, the Romanian banking sector is linked with the Greek banking industry because of the presences of the Greek banking institution in the country. Therefore, the participation of Romania in the EMU would strengthen the relationship between these countries, but also, we may observe an increase of the transitory effect due to the common currency. The most recent (June 2016) ECB report declares that Romania fulfils each convergence criterion of Maastricht Treaty. Therefore, Romania need only the two-year participation in the ERM II before adopting the euro (ECB, 2016).

Finally, the EC term is statistically insignificant during the 2nd and 3rd period which means that a disequilibrium takes place between the Romanian Leu and the euro. However, the EC parameter is negative and statistically significant during the first period. This indicates that the model identified the sizable speed of adjustment by 0,3%

of disequilibrium correction daily for reaching long run equilibrium steady state position. A similar effect exists for the whole examined period, indicating a sizable speed of adjustment by 0,2% of disequilibrium correction in daily basis.

Figure 13: Rolling Regression Results of ECM (Romania)

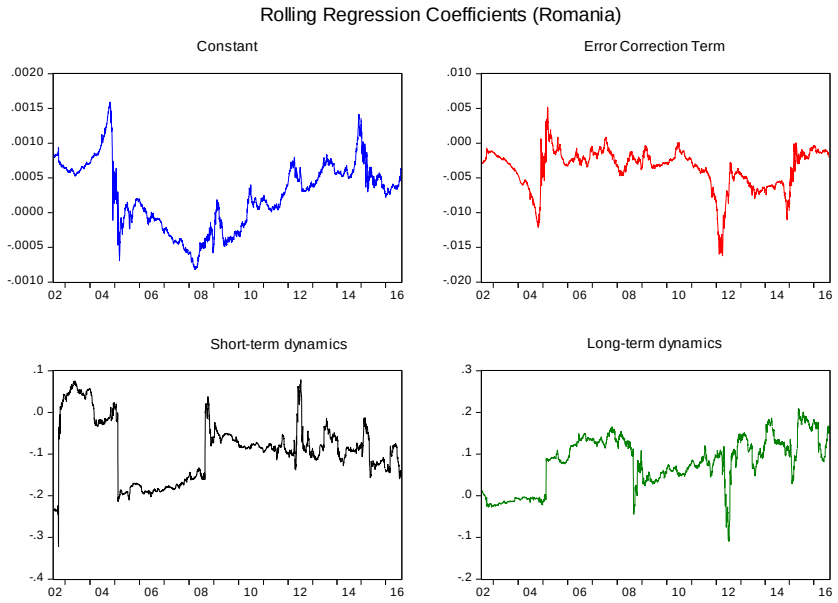


Figure 13 (above) presents the results of rolling regression for Romania. The rolling regression shows that the short-term dynamics coefficient is negative, especially after the EU membership. This tendency does not change during the third period. On the other hand, the long-term dynamics coefficient follows a different behaviour. The value of the long-term coefficient is positive after the unofficially (an Acceding Country) EU membership (May 2004) of Romania. Moreover, we observe that the long-term tendency between the euro and the Romanian Leu seems to be positive from 2004 to 2016. The trend is more and more augmentative through time. The empirical evidence of rolling regression is totally aligned with the findings of the ECM.

The present research combined two econometric processes in order to produce the empirical results. Specifically, we utilized the errors of the Error Correction Model (mean equation) and an APARCH model (variance equation). APARCH model is suitable in order to examine volatility asymmetry, volatility persistence and leverage effect (Karanasos and Kim, 2006).

The asymmetric volatility phenomenon (sometimes known as AVP) is a market dynamic that shows that there are higher market volatility levels in market downswings than in market upswings (Xekalaki and Degiannakis, 2010).

Persistence in volatility of variable returns is one of the common 'stylized facts' when it comes to analysing time series. In fact, the volatility should have a long memory. This mean that the information flow is slow and therefore news coming into the markets are not absorbed immediately but with some latency, leading to 'long-term-adjustments' (Xekalaki and Degiannakis, 2010).

The "leverage effect" refers to the well-established relationship between variables returns and both implied and volatility: volatility increases when a security price falls. A standard explanation ties the phenomenon to the effect of a change in market valuation of a security, with an increase in leverage producing an increase in variable volatility (Xekalaki and Degiannakis, 2010).

By taking into account the previous terms, the use of the APARCH model will offer important evidence about the dynamic volatility responses of the euro on the each examined currency. Actually, the use of the present ARCH model offer assistance in order to examine the resistance (volatility asymmetry and persistence) of each examined variable against the financial or economic shocks of the euro. In addition, the leverage effect is occupied with the impact of good news (overvaluation of the euro) and bad news (devaluation of the euro) on the economic behaviour of the examined currencies. Consequently, we would discover if the examined currencies are vulnerable against the shocks of the euro's market reaction.

In our empirical analysis, we used an APARCH(1,1) model with 1 asymmetric order and random power effect (δ parameter). In addition, the use of the APARCH captures the exchange rate risk of each currency through the volatility parameters (Xekalaki and Degiannakis, 2010).

Table 34 presents the empirical results of an APARCH(1,1) model by using in the mean equation the natural logarithmic value of the nominal exchange rate of the CZK/USD as the dependent variable and the natural logarithmic value of the nominal exchange rate of the EUR/USD as the control variable. The δ parameter represents the power of the APARCH model. We observe that its value is close to 2 for each period. This means that the APARCH model behaves such as a GARCH model. The sum of α parameter (ARCH effect) and β parameter (GARCH effect) is close to unity, indicating that the

Czech Koruna's volatility shocks are quite persistent. The coefficient of GARCH effect is lower than the one expressing that the past news on volatility is significant. The magnitude of lagged conditional variance is high. This means that long memory exists in variance.

Table 34: Estimation Results of Asymmetric Power ARCH – CZKvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (1.20)	0.001 (0.87)	0.001 (0.56)	0.001 (0.70)
α	0.034 (11.11)*	0.023 (0.96)	0.031 (4.01)*	0.296 (4.57)*
γ	-0.028 (-0.69)	-0.251 (-1.05)	0.092 (0.99)	-0.183 (-1.21)
β	0.966 (289.19)*	0.900 (8.50)*	0.961 (173.20)*	0.967 (150.58)*
δ	1.66 (7.62)*	1.74 (1.99)*	2.21 (6.87)*	1.55 (2.20)*

Note: (*) denotes statistically significant at 0.05 level

The γ parameter shows the leverage effect, which is zero during each period. This indicates that there is not an asymmetry at the news impact and the bad news of the euro influences more the volatility of the Czech Koruna. The bad news of the euro shows the same impact such as the good news. In fact, the news responses of the euro seem to be symmetric on the Czech Koruna during the entire examined period. This means that the impact of the overvaluation and devaluation of the euro is the same on the Czech Koruna.

Table 35 presents the empirical findings of an APARCH(1,1) model by using the errors of the ECM for Croatia. The δ parameter is close to one, approximately for each period, expressing that the APARCH model mutates to TGARCH model. Also, a GARCH model takes place during the 2nd period. The α coefficient presents the size effect and it is positive at each period. In case that the volatility is sensitive to large shocks, one expects α to be positive and significant. Thus, large shocks of both signs will increase

volatility. The sum of ARCH and GARCH effect is close to unity for each period, indicating that Croatian Kuna's volatility shocks are quite persistent. We discovered that an increasing long memory effect exists. The leverage effect does not take place during the 2nd period. This means that the news of the euro has no effect on the conditional variance of the Croatian Kuna. In fact, the news responses of the euro seem to be symmetric on the Croatian Kuna during this sub-period.

Table 35: Estimation Results of Asymmetric Power ARCH – HRKvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (0.89)	0.001 (1.01)	0.001 (0.82)	0.001 (0.77)
α	0.033 (9.80)*	0.053 (1.02)	0.035 (5.24)*	0.032 (5.64)*
γ	-0.133 (-2.87)*	0.999 (27.13)*	0.069 (1.17)	-0.221 (2.55)*
β	0.967 (255.06)*	0.222 (0.597)	0.964 (180.35)*	0.967 (131.88)*
δ	1.33 (6.75)*	0.44 (0.67)	1.81 (5.46)*	0.89 (2.49)*

Note: (*) denotes statistically significant at 0.05 level

The bad news of the euro shows the same impact such as the good news. This means that the impact of the overvaluation and devaluation of the euro is the same on the Croatian Kuna. This is quite logical because Croatia became a member of the EU in 2013. Additionally, the γ parameter is positive during the 1st period. Particularly, the bad news of the euro has larger impact on the volatility of the Croatian Kuna than the good news. This means that the impact of the devaluation of the euro is greater than the overvaluation of the euro on the Croatian Kuna. A different effect takes place during the 3rd period, where the good news of the euro seems to have greater effect on the volatility of the Croatian Kuna. In fact, the news responses of the euro are asymmetric during this sub-period. This means that the impact of the overvaluation of the euro is greater than the devaluation of the euro on the Croatian Kuna.

Table 36 shows the results of an APARCH (1,1) model of Hungary by using the errors of the Error Correction Model. The δ parameter expresses that a TGARCH model exist during the 1st and the 3rd period. However, a GJR-GARCH takes places during the 2nd period because δ coefficient is close to two. The GJR-GARCH model is similar to TGARCH model (Glosten et al. 1993) and QGARCH (Sentana, 1995). The ARCH effect is positive during the periods, but its magnitude decreases through time.

Table 36: Estimation Results of Asymmetric Power ARCH – HUFvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (1.15)	0.001 (0.39)	0.001 (0.62)	0.001 (0.64)
α	0.039 (9.97)*	0.013 (3.91)*	0.048 (5.16)*	0.036 (5.73)*
γ	-0.291 (-4.28)*	-0.999 (-5.43)*	-0.199 (-2.12)*	0.191 (-1.22)
β	0.963 (241.70)*	0.986 (93.75)*	0.946 (126.86)*	0.964 (159.50)*
δ	1.24 (19.98)*	0.813 (1.98)*	1.53 (4.57)*	0.954 (2.71)*

Note: (*) denotes statistically significant at 0.05 level

This means that the volatility of the Hungarian Forint is less sensitive to large shocks of the euro after the join of the country in the EU. The coefficient of β parameter has an upturn trend during the periods. The persistency of the conditional variance of the Hungarian Forint against the euro's shocks seems to increase continuously. The leverage effect (γ parameter) is negative, but it has a decreasing tendency. This effect becomes stronger through time, expressing that the euro influences less the Hungarian currency in the long run. Actually, the news responses of the euro are asymmetric. We observe that the impact of the overvaluation of the euro is greater than the devaluation of the euro on the Hungarian Forint with a decreasing tendency.

Table 37 presents the empirical evidence of APARCH model for Poland. The δ parameter is close to one during each period expressing that there is a TGARCH model. The size effect (α) is positive during the examined periods but the tendency is

downward. Therefore, the Polish Zloty is less sensitive to large shocks of the euro. Also, GARCH effect indicates long memory in the variance. The magnitude is higher after the join of Poland in the EU. The volatility persistence of the Polish Zloty against the euro shocks is high. The γ parameter is negative during the examined periods but the effect declines over time. Particularly, the good news of the euro has greater impact on the conditional variance instead of the bad news.

Table 37: Estimation Results of Asymmetric Power ARCH – PLNvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (2.57)*	0.001 (1.04)	0.001 (1.19)	0.002 (1.34)
α	0.010 (18.12)*	0.159 (5.30)*	0.074 (8.95)*	0.045 (5.24)*
γ	-0.271 (-7.24)*	-0.589 (-4.41)*	-0.221 (-4.01)*	-0.456 (-3.77)*
β	0.903 (157.12)*	0.759 (17.35)*	0.928 (128.71)*	0.955 (132.38)*
δ	1.02 (9.49)*	0.93 (3.70)*	1.27 (5.69)*	0.29 (2.64)*

Note: (*) denotes statistically significant at 0.05 level

The leverage effect is greater during the first period when Poland was not a member of the EU, but the effect sign remains almost stable. Actually, the bad news responses of the euro influence more the economic reaction of the Polish Zloty during the entire period. We discovered that the impact of the overvaluation of the euro is larger than the devaluation of the euro on the Polish Zloty with an increasing tendency.

Table 38 shows the findings of an APARCH model for Romania. We used the errors of the Romania ECM model (mean equation) at the variance equation of the APARCH model. The δ parameter expresses that there is a TGARCH model during each period. The sum of ARCH and GARCH coefficients is close to unity for each period, expressing that the Romanian Leu volatility is quite persistent to the shocks of the euro. The size of the GARCH coefficient raised between the 1st and the 2nd period.

Therefore, an increase of the long memory in the variance took place. This event maybe is related with the EU membership of Romania in 2007. The γ parameter represents the leverage effect on the conditional variance. The leverage effect is negative only at the 3nd period, expressing that the good news of the euro has higher effect on the volatility of the Romanian Leu. Also, the leverage effect is positive only at the 2nd period, expressing that the bad news of the euro has higher effect on the volatility of the Romanian Leu.

Table 38: Estimation Results of Asymmetric Power ARCH – RONvsEUR				
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**
ω	0.001 (3.29)*	0.001 (1.85)	0.001 (1.599)	0.001 (0.77)
α	0.111 (29.97)*	0.562 (18.52)*	0.076 (8.72)*	0.036 (6.19)*
γ	-0.019 (-0.71)	0.027 (0.70)	0.138 (2.64)*	-0.325 (-2.89)*
β	0.906 (268.80)*	0.491 (24.76)*	0.931 (137.98)*	0.964 (164.01)*
δ	0.836 (16.66)*	0.91 (10.17)*	1.29 (11.77)*	0.674 (2.60)*

Note: (*) denotes statistically significant at 0.05 level

Finally, there is no leverage effect during the 1st period. This means that the news of the euro does not influence the conditional variance of the Romanian Leu. Actually, we observe that the impact of the overvaluation of the euro is getting greater than the devaluation of the euro through time on the Romanian Leu with an uprising trend.

7.4. Conclusions

The purpose of the current research is to investigate if the Post-Communist countries of the EU (four emerging economies and one advanced) are eligible to participate in the European monetary union. Essentially, we based on the methodology of Wilfling (2009) by using the nominal exchange rates as an empirical instrument in order to answer our research aims. The idea of Stoupos and Kiohos (2017) was used as an

auxiliary empirical method in order to produce our evidence. In fact, we explored if Croatia, the Czech Republic, Hungary, Poland and Romania could be members of the Euro Area. Our empirical findings are relied on three parameters; volatility shocks persistence, leverage effects and short-term/long-term dynamic relationships.

The Error Correction Model highly supports that there is a positive dynamic linkage between the euro and the Czech Koruna, Hungarian Forint and Croatian Kuna, especially after the participation of these countries in the EU in the short-run. Also, we studied that the debt crisis of 2010 in the Eurozone had no impact on the short-term relationship between the euro and the Polish Zloty and the Romanian Leu. The long-term impact of the euro on the Czech Koruna, the Croatian Kuna and the Hungarian Forint is strictly negative. However, a significant improvement (positive tendency) takes place through time for each country (the Czech Republic and Croatia), except Hungary. Therefore, there is strong evidence which supports that these Post-Communist countries are not ready for Eurozone participation, from the financial aspect of view. However, there are only indications that it may occur in the distant future. On the other hand, we observed that there is an increasing positive linkage between the euro and the Polish Zloty, as well as the Romanian Leu in the long-run. Finally, the results of the rolling regression test are totally aligned with the evidence of the ECM. Also, the empirical results of the ECM highly claim that the first research hypothesis (H01) is rejected for the Czech Republic, Hungary and Croatia. On the other hand, the H01 is failed to reject for Romania and Poland.

Furthermore, the results of ECM-APARCH(1,1) propose that there is high volatility persistence of each currency against the volatility shocks' of the euro. The leverage effect was zero for the Czech Republic during the entire examined period. There are symmetric effects between the bad and the good news of the euro on the Czech Koruna. On the other hand, the γ parameter is positive during the 1st period for Croatia. Particularly, the bad news of the euro has larger impact on the volatility of the Croatian Kuna than the good news. A different effect takes place during the 3rd period when the country became a member of the EU. The leverage effect for Hungary is negative and it has a falling tendency. This indicates that the good news of the euro has larger impact on the volatility of the Hungarian Forint. Thus, the euro influences less the Hungarian Forint through time. In addition, a similar effect occurs between the Polish Zloty and the euro. Finally, we discovered that there is no leverage effect between the 1st period

for Romania. The leverage effect is negative during the 3nd period when it became member of the European Union.

The results of the APARCH model shows that the resistance of Czech, Croatian and Hungarian currency against the financial/economic shocks of the euro, is higher than the endurance of Polish and Romanian currency. Hence, the second research (H02) hypothesis is true for Poland and Romania.

Concerning of the third research hypothesis (H03), it is true for the Hungary, Croatia and Poland. The leverage effect is negative and therefore the overvaluation of the euro has a greater impact that the devaluation of the euro. On the other hand, the H3 is rejected for the Czech Republic and Romania because the leverage effect is equal to zero. This means that there is a symmetric effect on the Czech and Romanian currency due to the economic behaviour (overvaluation or devaluation) of the European common currency.

Consequently, there are only two Post-Communist countries which meet simultaneously our research criteria (hypotheses). This implies that only Romania and Poland are eligible to enter in the EMU, from the financial aspect of view.

In conclusion, our empirical findings support that there are two Post-Communist countries of the EU which are able to participate in the European monetary union in the near future. Especially, Polish and Romanian currencies are more influenced by the euro and hence, these two Post-Communist countries are eligible to adopt the European common currency in the close future. On the other hand, the Czech Republic, Croatia and Hungary are not ready to be members of the Euro Area, from the financial aspect of view. Nevertheless, there are strong indications that it might occur in the distant future, when the countries would have strengthened their economies and especially, clear political intensions to Eurozone membership would have taken place.

Moreover, we propose that the EU partnership of the examined countries changed the global political and economic relations of the Post-Communist Countries. Particularly, we indicate that these countries have started to abandon their Communism past and they made significant efforts in order to create western type economies (capitalistic economies). The central governments of these countries should proceed to reforms by increasing economy competiveness, labour movement flexibility and trade openness. However, it seems too soon, since the majority of these countries entered in the EU between 2004 and 2007. Even if these states proceed to previous reforms and fulfil the euro convergence criteria (Article 140 of the Maastricht Treaty), their currencies should

join the European Rate Mechanism (ERM II) of the ECB, at least, for two years in order to stabilize their nominal exchange rate against the euro.

On the other hand, the dynamic linkages among the exchange rates is not the only indicator which is able to strictly propose that a member-state of the EU is eligible to become a part of the Euro Area. The short and long-term economic relationships of the euro against the currencies of the Post-Communist countries is only the one side of the coin. This means that we should explore in the future the economic behaviour of other parameters, such as the trade flows, the real exchange rate, the consumer price index and even the political and economic stability at each country. If a meticulous examination of each economic parameter takes place, then we could definitely propose if these countries can adopt euro as their currency. However, the empirical investigation of these parameters is outside the aims of this research.

Finally, our findings are in favour with the results of Economidou and Kool (2009) research. We, also, agree with the evidence of Koukouritakis et al. (2015). On the other hand, we discovered that our results are against the findings of Chang and Tzeng (2011) as well as Podkaminer's (2016) claims because we highly support the idea that the European monetary integration should be inevitably continued in the future. Our opinion is that the Post-Communist countries should continue to improve the economic and political relations with the other members of the union in order to adopt this exchange rate regime (euro adoption) when they are financially apt. The participation of two new member-states of the EU in the Euro Area in the future would be a clear and positive sign for the economic and political integration of the EU, which has been decelerated after the debt crisis of 2010 in the Eurozone.

At the end, Romania and Poland should focus more to this direction if they wish to participate in the EMU without any collateral losses. Otherwise, they would face the fortune of Greece because the euro is a really strong currency and it is not suitable for weak and vulnerable economies of Europe which have no sufficient adjustments.

Chapter 8. The Scandinavian Countries

8.1. Introduction

The European Union has been forged upon the ashes of the World War II in order to maintain the social security and the economic stability in the European continent. In March 2017, the remaining 27 members of the EU celebrated the 60 years' anniversary from the establishment of the EU (formerly, European Economic Community, Treaty of Rome, 1957). However, the UK has decided, on 23rd June 2016, to withdraw its participation in the EU when the 52% of British people voted in favour of BREXIT. It is true that the EU has entered into an introversion phase after the outbreak of the debt crisis of 2010 in the Euro Area. During the previous seven years, the EU has been occupied with the cohesion of the Eurozone and the partial reformation of the EU. Particularly, the creation of the European Stability Mechanism (ESM) was a first step for the security of the Euro Area. The European banking union was, in fact, the transfer of banking policy responsibility, from the national to the EU level, in several countries of the European Union and it was initiated in 2012 as a response to the Eurozone crisis. In May 2017, the President of France and the German Minister of Finance have announced some thoughts in order to establish a common Ministry of Finance among the members of the Euro Area in the future.

Nowadays (2018), the EU contains officially 28 members-states. Nineteen countries have already participated in the European Monetary Union (EMU), one member has granted an opt-out of the EMU (Denmark) but it is a member of ERM II, one state has officially made an application to withdraw from the EU (UK) and seven countries[1] are obliged to adopt the euro in the future when they meet the convergence criteria of the Maastricht Treaty (1991). Additionally, the EU has an official political agreement with Norway, Iceland, Lichtenstein and Switzerland. These countries have created the European Economic Area (EEA). The Agreement on the EEA provides for the free movement of persons, goods, services and capital within the European Single Market, including the freedom to choose residence in any country within this area. In fact, these countries have accepted the principals and the acts of the EU. They annually participate in the budget of the EU, but they have no right to vote for the decisions in the EU. Also,

[1]According to the Maastricht Treaty (1991), Bulgaria, Croatia, the Czech Republic, Hungary, Romania, Poland and Sweden must adopt the euro when they fulfill the convergence criteria.

they have no obligation to adopt the euro or to enter in the ERM II of the European Central Bank (ECB).

The main purpose of this research is to examine whether two members of the EU (Denmark and Sweden) and two members of the EEA (Norway and Iceland) have highly bound economies to the Euro Area, which consequently means that they could be possible members of the EMU or the EU, respectively. Actually, a possible EMU membership of a Nordic country (except Finland) will change the economic environment in Scandinavia. This will happen because the European common currency will facilitate the trade and the financial transaction among the companies, banks and public sector. In addition, the impact of the exchange risk on the corporate financial statements and daily transactions would diminish due to the use of the common currency.

Additionally, one of the most important argument against the Swedish and Danish participation in the EMU was the loss of the monetary policy independence. Read and Volz (2009) suggest that Riksbank (Swedish Central Bank), despite staying outside of the Eurosystem, is de facto not master in its own house. Rather, they argue that Sweden is lulled by some kind of monetary independence delusion. By joining the euro, Sweden would give up monetary sovereignty, but the cost in terms of a loss of monetary policy autonomy would be negligible. The argument made by the Calmfors Commission (which was mandated by the Swedish government to assess the consequences of Swedish EMU membership) and others that through EMU membership Sweden would "no longer have the opportunity to pursue an independent monetary policy" (Calmfors *et al.,* 1997) and, hence, face serious consequences for stabilisation policy, is therefore flawed. The cost of ceding monetary sovereignty would arguably be outweighed by Sweden gaining a seat in the ECB's governing council, where the governor of the Riksbank would have a say in formulating the common European monetary policy stance. Instead of being a passive bystander to the ECB's interest rate decisions, the Riksbank could play an integral part in European monetary policy making.

Furthermore, there are more political rather economic reasons that Denmark has not yet participated in the EMU. In fact, Danmarks Nationalbank (Danish Central Bank) has an official agreement with the European Central Bank to follow a fixed exchange rate regime. A euro is equal to 7,46 DKK within a range of 2,25% (upper bound 7,62 DKK/euro and 7,29 DKK/euro) since 1999. This means that the Danish Central Bank

does not have the power to handle the nominal exchange rate of krone against the euro. Also, the independence of the Danish monetary policy is an illusion, since Denmark historically follows the monetary policy of the ECB. The expected practical advantages of euro adoption are a decrease of transaction costs with the Eurozone, a better transparency of foreign markets for Danish consumers, and more importantly a decrease of the interest rates which has a positive effect on growth. However, when joining the euro, Denmark would abandon the possibility to adopt a different monetary policy from the ECB. If ever an economic crisis were to strike specifically the country it would have to rely only on fiscal policy and labour market reforms (Sorensen, 2014). Being a member of the EU, Iceland could be more confident that the benefits of the access to the single market would be in place in the long-run. The membership would also ensure regular consultations and participation in the EU decision making instead of continuing instructions from the European Commission. Regular consultations could help a small country with limited institutional capacity to increase professionalism. Moreover, EU membership could possibly shield Iceland during times of crisis, economically and in terms of security. There is a greater need for external support given the weaker ties with the US during the post-cold war era. Closer cooperation with EU member states and support from EU institutions could contribute to stability, as Iceland has a history of economic boom and bust (Hilmarsson, 2017).

According to Cambos (2015), there are substantial benefits from EU membership for Norway. Actually, if Norway had joined the EU in 1995, productivity levels (GDP per hour worked) in the average Norwegian region between 1995 and 2000 would have been 6% higher. Only one of the seven NUTS2 (Nomenclature of territorial units for statistics) regions of Norway (except Oslo) would have had negative economic benefits, due to EU participation. Unsurprisingly, if Norway had joined the EU in 1995, productivity levels (GDP per hour worked) in the average Norwegian region between 1995 and 2000 would have been 9% higher instead. Also, the researchers suggest that these politically-driven payoffs are significant and substantial, and distinctively favour deep (economic and political) over shallow (only economic) integration.

The common characteristic of these countries is that they geographically belong to Scandinavia. According to Oxford Dictionaries (2017), Scandinavia is a cultural region consisting of the countries of Norway, Sweden, and Denmark and sometimes also of Iceland, Finland, and the Faroe Islands. By considering the previous term, we are

eligible to study only Norway, Sweden, Denmark and Iceland[2]. Finland is already a member of the Euro Area and the Faroe Islands belong administratively to Denmark.
In this research, we used the real effective exchange rates (REER), as an empirical instrument, in order to show if these countries are highly linked with the Eurozone economy. The REER is derived by taking a country's nominal effective exchange rate (NEER) and adjusting it to include price indices and other trends. The REER is essentially a country's NEER after removing price inflation or labour cost inflation. The REER represents the value that an individual consumer pays for an imported good at the consumer level. This rate includes any tariffs and transaction costs associated with importing the good (Fender, 2012).

The scope of the real effective exchange rate is based on the Purchasing Power Parity (PPP). In addition, the REER serves two main functions: a) REER can be useful for making comparisons between countries because they stay fairly constant from day to day or week to week and only change modestly, if at all, from year to year, b) over a period of years, nominal exchange rates do tend to move in the general direction of the REER and there is some value to knowing in which direction the nominal exchange rate is more likely to shift over the long run (Schmitz *et al.* 2012).

Moreover, a country's REER is an important measure when assessing its trade capabilities and current import/export situation. The REER can be used to measure the equilibrium value of a country's currency, identify the underlying factors of a country's trade flow, look at any changes in international price or cost competition, and allocate incentives between tradable and non-tradable sectors (Masson and Ruge-Murcia, 2005).
In fact, it is obvious that the real effective exchange rate is an instrument which is able to reflect the pragmatic condition of an open modern economy. This occurs because the real effective rate harmonizes the corrosive effect of the inflation. Also, the REER is a better empirical tool than the real exchange rate against a specific currency. This happens because the REER is based on a basket of currencies. This is very important because the modern world is characterized with the presence of an open and free international trade across the countries.

[2] These Nordic countries have three common features: a) similar cultural background, b) no participation in the EMU, c) strong economic and trade relationships with the EU.

The current paper innovatively combines the Error Correction Model (ECM) (Engle *et al*, 1987) with the Asymmetric Dynamic Conditional Correlation GARCH (ADCC-GARCH) (Cappielo *et al*, 2006). We use the ECM as a mean equation and the ADCC-GARCH as the conditional variance equation. The errors of the ECM are used at the ADCC-GARCH equation in order to produce our empirical results. The combination of these two models creates the new ECM-ADCC-GARCH model. We are inspired by the study of Kiohos and Stoupos (2018) who combined the ECM model with the Threshold GARCH model.

This model provides the opportunity to isolate (capture) only the long-term volatility which is the most important interest of our research. Long-term volatility is able to express the reaction and the impact of the control variable on the dependent variable in the long-run. The use of errors in the mean equation provides information about the causality of leverage effect in the long-run (asymmetries). Therefore, our results express higher validity on the estimation of volatility and the effect of bad and good news (leverage effect) than the use of the two models (ECM and ADCC-GARCH) separately.

The results of the ECM, for the whole period, show that there is a continuous and constant positive relationship between the REER of euro and the REER of Danish krone. Also, we observe that there is a similar economic behaviour for Swedish krona and Norwegian krone. On the other hand, the linkage between the REER of Icelandic krona and the REER of euro seems to be quite different. We observed that the relationship is strictly negative until 2017 with an upturn tendency. This means that historically the real effective exchange rates of Denmark, Norway and Sweden are bound to the real effective exchange rate of euro.

Additionally, the empirical evidence of the ADCC-GARCH model support, for the total era, that the overvaluation of the euro has a greater impact on Icelandic krona instead of its devaluation. A similar effect takes place for Swedish krona and Norwegian krone. However, the magnitude of this effect is larger on the Swedish currency. According to ADCC-GARCH model results, the euro has no asymmetric impact on the volatility of the Danish krone. In addition, the outcome of our findings highly support that the Danish krone is more vulnerable to the market shocks of euro. On the other hand, Icelandic krona is less vulnerable to the market shocks of euro, indicating high

persistence. Also, the Norwegian krone and the Swedish krona show similar resistance against the economic shocks of euro. The magnitude of their endurance is in the middle compare to the other two currencies (Danish krone and Icelandic krona).

The outcomes of the present paper provide important evidence to academia, EU policy makers, international institutions (IMF, World Bank, BIS), investors, risk managers and individual people across the globe. A potential entry of Scandinavian countries in the Euro Area would definitely change the balances in the international markets and in the modern world. We provide a long analysis of our results at the conclusions section.

8.2 Literature Review for Scandinavian Countries

Huang and Yang (2015) used the real effective exchange rates of 11 Eurozone countries in order to provide evidence if the introduction of the euro changed the competiveness of these countries. They chose to use the Error Correction model with the common correlated effects (CCE) estimators a la Pesaran (2006). Their empirical results support that a co-integration status among the REER of the Euro Area countries took place after the adoption of the euro. Also, they exhibited similar results for non-euro countries such as Norway, Sweden and Switzerland. Additionally, Clark and Jones (2012) have supported that Iceland should continue the negotiations of the EU in order to join the union, especially after the Icelandic financial crisis of 2008. Pesaran *et al.* (2007) discovered that Sweden would have had higher GDP and higher prices, if the country had joined the euro in 1999. Reade and Volz (2009) support the previous findings by claiming that Sweden would benefit more by entering the Euro area. Micco *et al.* (2003) explored the impact of the euro on the trade among the non-Euro area members in EU. They discovered that the European common currency boosted the trade linkages between the non-Eurozone states and the Euro area.

According to Miller (2000), in 1992 Denmark obtained a special arrangement allowing the country not to proceed to the third stage of Economic and Monetary Union (EMU or the single currency) unless or until this had been approved in a national referendum. Also, he highly supported that the Danish referendum outcome to reject the euro adoption will lead to the establishment of two European Unions in the EU. Moreover, Idruchova (2013) claims that, although the result of the Danish referendum was “No” to the euro with a majority of 53%, the close link to the euro in the framework of ERM II and its monetary and exchange rate policy makes Denmark a de facto member of the

euro area. Marcussen (2005) claims that despite the fact that Denmark is a euro-outsider, it is performing quite well economically and politically. Thus, Denmark may be an 'out' country but it is definitely not 'over' and done with in regards to the European monetary integration. Actually, the present situation is not historically unprecedented since Danish monetary authorities have traditionally not been used to having monetary sovereignty to any significant extent. This implies that Danish policymakers have found a number of indirect means to influence monetary policy-making in the euro-area.

On the contrary, Cohen (2007) highly supports that a potential enlargement of the Euro Area will diminish the value of the euro, as well as, its attractiveness as an international currency. However, he does not consider a possible EMU expansion to the Nordic countries, but only that the EU member states have different economic and political interests (especially Post-Communist countries of the EU). Similar concerns are expressed by Rehman (2007). Keppel and Prettner (2015) attempted to examine the interrelationship among the Euro Area and five Central and Eastern European economies by using interest rates and exchanges rates. Their findings strongly suggest inter-regional spillovers of output shocks with the magnitude being similarly strong in both areas.

Recently, Stoupos and Kiohos (2017[a]) used the nominal exchange rates of three leading currencies of Europe in order to explore the EU monetary integration in the UK, Switzerland and Sweden, as well as, in the Post-Communist countries of the EU (Stoupos and Kiohos, 2017[b]). Jonung (2004) indicates that the Euro Area membership of a country lies upon people's opinion in spite of any encouragements of the governments and European policy maker institutions. Bergvall (2004) used the real exchange rates dynamics of Nordic countries in order to explore the impact of the trade and the labour productivity. The researcher figures out that the trade between the Nordic countries and the EU has positively influenced their real exchange rates. Hoffmann and Holtemöller (2010) display similar findings regarding the interrelationship between nominal exchange rates and trade in Scandinavia. Finally, Larsson (2004) provided evidence on the behaviour of the Swedish real exchange rate relative to Germany, under different currency regimes. In specific, the results suggest that the real exchange rate is co-integrated with Swedish and German productivity.

8.3. Dataset Analysis and Methodology

The present study uses the real effective exchange rates (REER) of four Scandinavian countries (Denmark, Iceland, Norway and Sweden). Specifically, we attempt to provide evidence if there are any possible linkages among euro, Danish krone, Icelandic krona, Norwegian krone and Swedish krona. We used daily observations by covering a period of approximately 32 continuous years, from 01 January 1986 to 30 September 2017. The data was extracted from the official database of the Federal Reserve System ® in the United States. We divided our dataset into four sub-periods. Each period contains specific features. We generated the three breakpoints by using the following historical events in the European Union and in Scandinavia:

a) The end of banking crisis in Scandinavia and the participation of the new Nordic counties in the EU or EEA.
b) The physical circulation of the euro in 2002
c) The pick of the financial crisis 2008 in Europe

The selection of these breakpoints is justified by the empirical results of the Silvestre, Kim and Perron unit root test, which are presented at the next section. We decided to explore the characteristics of total period, as well as the four sub-periods in order to estimate whether there is an overall tendency.
Table 39 presents the features of each variable by indicating the nature, the acronym and the official symbol at the international markets.

Table 39: Data Presentation

Variables	***Acronym***	***Symbol***
Euro	EUR	€
Danish krone	DKK	kr
Icelandic krona	ISK	Íkr
Norwegian krone	NOK	kr
Swedish krona	SEK	kr

Source: Federal Reserve System (FED)

The four sub-periods are displayed below:

a) ***01 January 1986 to 31 December 1994 or 1996****:* The main characteristic of this era is that only Denmark is a member of the European Union until 1994. The EU welcomed two Scandinavian countries (Sweden and Finland) in January 1995. Also, a significant banking crisis took place from 1988 to 1993 in Norway, Sweden and Finland. During this period, a referendum, on joining the European Union, was held in Norway on 27 and 28 November 1994. The outcome of the referendum was negative and Norway remained a member of the EEA. The European Economic Area was officially established in 01 January 1994. The first breakpoint differs among the examined countries, based on the results of multiple breakpoints unit root test of Silvestre *et al.* (2009) (see section 5.2). In specific, the breakpoint for Iceland and Sweden is January 1994. On the other hand, the cut point for Denmark and Norway is January 1997.

b) ***01 January 1995 or 1997 to 31 December 2001:***

The particular period is named as the pre-Eurozone era. During this period, the leaders of the member-states of the EU attempted to integrate economically and financially the nature of the union. The output of this effort was the creation of the Euro Area which took its physical form with the circulation of the euro on 01 January 2002. The ex-currencies of the 12-initial founding member of the Euro Area had completely stopped to circulate on 28 February 2002. The second breakpoint differs here also, due to the results of the unit root test of Silvestre *et al.* (2009), as we have described previously.

c) ***01 January 2002 to 31 December 2008:*** During this period, the Euro Area took its physical form and four new member-states adopted the European common currency. In addition, this era is characterized as the most prosperous and thriving after the end of the World War II in Europe. This era covers completely the thriving period of modern human history for advanced economies. The circulation of the euro, the development of the technology and the excessive connection of the international banking system created an economic development of six continuous years. We selected to end this period on 31st December 2008 according to the results of Silvestre et al (2009) unit root test. Also, the majority of the EU countries commenced to face difficulties in their economy after the end of 2008, since the global financial crisis arrived in Europe in 2009.

d) ***01 January 2009 to 30 September 2017:*** This period is characterized by the presence of the contagion of the global financial crisis of 2008 in the EU and the emergence of the Eurozone debt crisis of 2010. The debt crisis in the Euro Area forced the reformation

of the EU. Specifically, Greece was the first member of the EMU which faced significant difficulties to refinance its debt. The European Institutions and Eurogroup were informed in late 2009s about this situation. During this period, primarily, the pilot European Financial Stability Facility (EFSF) was generated (June 2010) in order to safeguard the cohesion of the EU and secondly, the EFSF was replaced by the permanent European Stability Mechanism (ESM) in September 2012. The German Minister of Finance, recently (August 2017) announced the intentions of German government, in order to transform the ESM into a European Monetary Fund (EMF) in the distant future. Finally, the banking union in the EU was agreed in 2014. The banking union consists of two main initiatives, the Single Supervisory Mechanism (SSM) and Single Resolution Mechanism (SRM) (ECB, 2017).

Our empirical evidence was provided by using two preliminary tests and two advanced econometric models. In the beginning, we tested the stationarity of the time series by using the unit root of Silvestre, Kim and Perron (2009). Also, we auxiliary consulted the research of Kim and Perron (2009). This unit root test allows the calculation of multiple breakpoints in time series. We used this stationarity unit root test in order to provide evidence about our decision to divide our sample into four periods. The results of this test are displayed in the next sections. Additionally, the second diagnostic test is the Johansen's Co-integration test, with structural breaks, including a deterministic trend. The use of this test is a prerequisite in order to investigate if the time series are co-integrated in the long-run (Johansen et al. 2000). This co-integration test took place, in order to examine if there is a long-term tendency between the real effective exchange rate of euro and the REER of each examined Nordic currency. The presence of co-integration is a prerequisite, in order to take our analysis to the next step. If we provide evidence, that a co-integration takes place, then we are eligible to utilize the Error Correction Model (Engle *et al*, 1987). We present the mathematical expression of our methodology at the next sections. Finally, we pattern the errors of the ECM by using the asymmetric generalized dynamic conditional correlation model, which permits for series-specific news and conditional asymmetries in correlation dynamics. The ADCC specification is well suited to examine correlation dynamics among different asset classes and investigate the presence of asymmetric responses in conditional variances and correlations to negative returns (Cappiello *et al.*, 2006). In effect, the ADCC-

GARCH estimations in our study highlight evidence of the asymmetric effects of positive and negative shocks on volatilities and correlations of REER variables.

The use of Error Correction Model is most suitable when we wish to explore simultaneously a dynamic short-term or long-term linkage among a group of variables. On contrary, we decided not use the Vector Error Correction Model (VECM) because this statistic procedure is used when there is not co-integration condition among the examined series. VECM is most suitable to explore short-term relationships only (Brooks, 2014).
In this research, the mathematic expression of the Error Correction Model is the following:

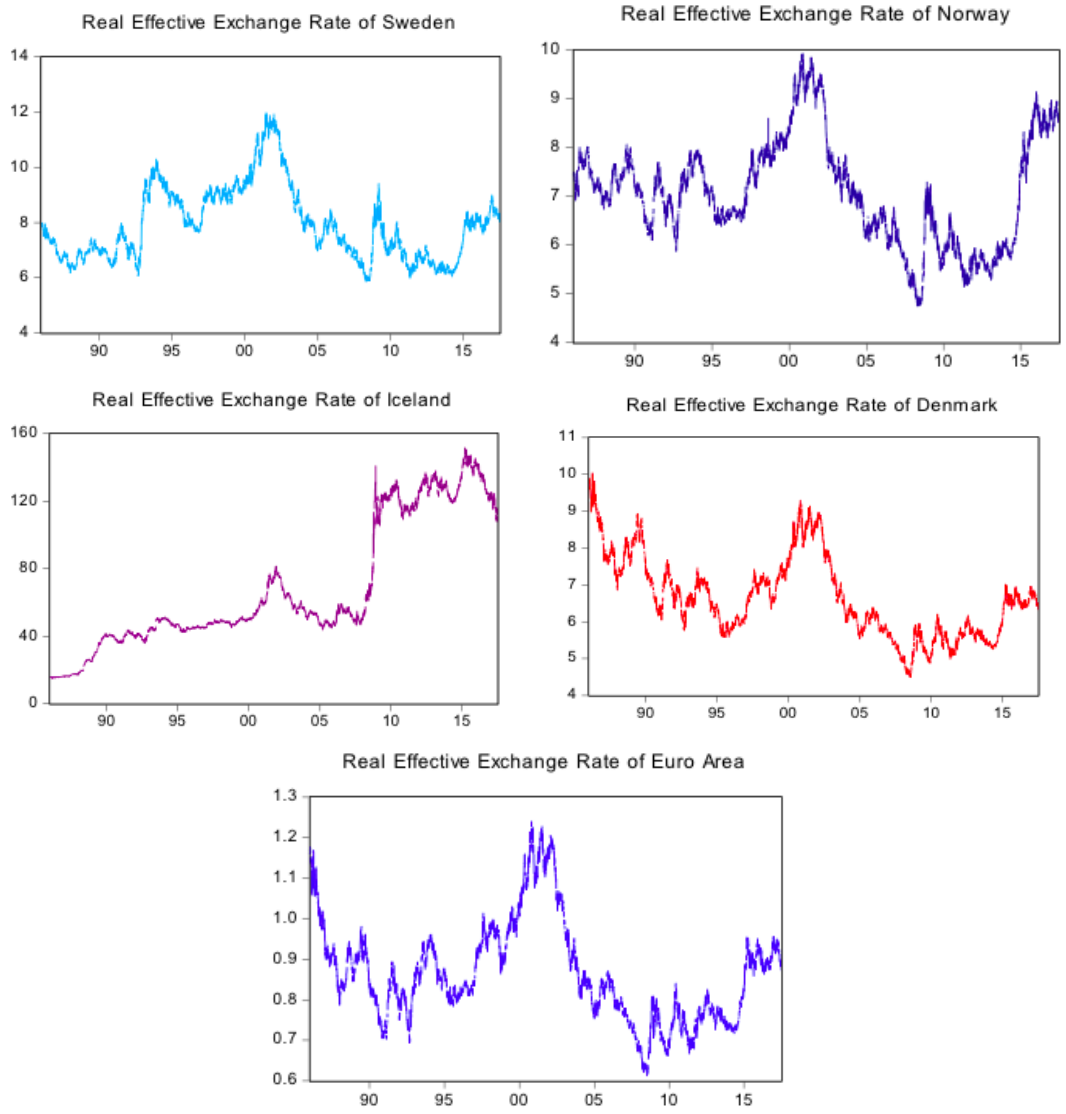
$$\boldsymbol{\Delta(REER_i) = \omega + \varphi * EC_{i-1} + \beta * \Delta(REER_{i-1}) + \delta * \Delta(EUR_{i-1}) + \varepsilon_i (43)}$$

where, the dependent variable REERi represents the real effective exchange rate of the Danish krone (DKK), or the Icelandic koruna (ISK), or the Norwegian krone (NOK) or the Swedish koruna (SEK) against a basket of currencies. The independent variable is the real effective exchange rate of the euro (EUR) against a basket of currencies.

This section provides evidence about the diagnostics test of our empirical analysis. In particular, we present the findings of timeline analysis, Silvestre, Kim and Perron (2009) unit root multiple breakpoint test, as well as the result of the co-integration with structural breakpoints testing (Johansen, 2000).

Figure 14 shows the historical evolution of the real effective exchange rate (REER) of each examined country from 1986 to third trimester 2017. The timelines reveal that there is a clear long-term economic behavior among the euro, the Swedish krona and the Norwegian krone and the Danish krone. However, we cannot support the same for Iceland. The use of the Johansen co-integration test would offer the appropriate evidence about the existence of a dynamic interrelationship between the euro and the Icelandic krona in the long-run.

Figure 14: Timeline Analysis of REER



Note: The figures report the movement of real effective exchange rates against a basket of currencies from 01/01/1986 to 30/09/2017. The data was extracted from the official database of the Federal Reserve System®.

The exploration of a random walk (unit root) is very important in time series analysis. A stationarity test is a prerequisite before executing a co-integration test. We ran a Silvestre, Kim and Perron (2009) three breakpoints stationarity test. We included an intercept and a trend in test equation. The Silvestre, Kim and Perron test was executed by using value of the real effective exchange rate (REER) of each currency.

Table 40 presents the results of Silvestre, Kim and Perron test. We discovered that time series are stationary according to t-statistic and probability value criteria.

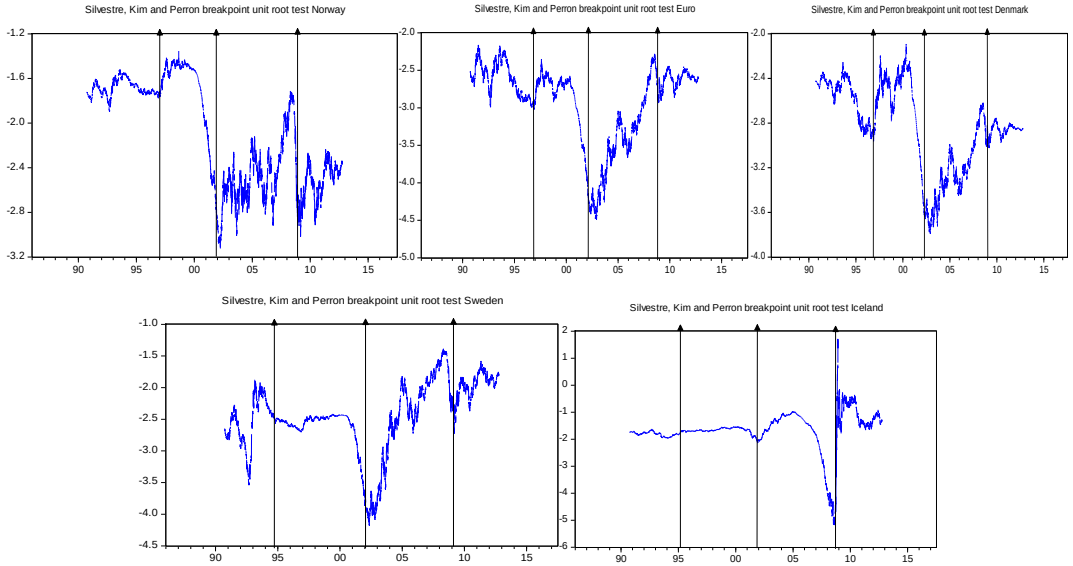
Table 40: Estimation Results of Silvestre, Kim and Perron unit root test in levels and in first differences					
Series – Values	**MZ_a^{GLS}**	**MZ_t^{GLS}**	**MSB^{GLS}**	**MP_T^{GLS}**	**Break Dates**
In level					
EUR	-19.24 (-32.11)	-2.869 (-4.043)	0.139 (0.122)	13.45 (7.32)	January 1997, December 2001, December 2008
DKK	-15.99 (-31.02)	-2.793 (-3.932)	0.171 (0.129)	13.22 (6.89)	January 1997, January 2002, December 2008
ISK	-6.49 (-32.94)	-1.507 (-3.993)	0.318 (0.142)	53.42 (7.68)	December 1994, December 2001, January 2009
NOK	-22.85 (-33.87)	-3.574 (-4.027)	0.133 (0.125)	9.52 (8.01)	January 1997, January 2002, December 2008
SEK	-27.52 (-34.02)	-3.391 (-4.075)	0.122 (0.117)	11.76 (7.59)	December 1994, January 2002, January 2009
In First Difference					
ΔEUR	-37.22 (-32.64)	-4.256 (-4.041)	0.113 (0.123)	6.72 (7.32)	March 1997, February 2002, November 2008
ΔDKK	-33.95 (-32.99)	-4.096 (-4.029)	0.124 (0.126)	7.08 (7.34)	December 1996, January 2002, January 2009
ΔISK	-39.17 (-32.51)	-4.471 (-4.085)	0.111 (0.119)	6.39 (7.61)	February 1995, February 2002, October 2008
ΔNOK	-35.78 (-30.43)	-4.634 (-4.033)	0.115 (0.126)	6.56 (7.47)	January 1997, March 2002, December 2008
ΔSEK	-41.21 (-33.38)	-4.653 (-4.079)	0.108 (0.127)	5.95 (7.22)	December 1994, February 2002, January 2009

Note: critical values in the parentheses at 0.05 level

The results of the Sivlestre *et al.* (2009) unit root with structural breaks test (in levels and in first differences) are reported in Table 40. The results show that all the series are integrated with first order I(1). This means that all the series are non-stationary in level

and stationary in the first difference. Furthermore, the results indicate strong evidence for the presence of three structural breaks inside these time series. The break dates differ between variables. Specifically, according to in levels sequence, the first break date corresponds to January 1997 for all variables except Iceland and Sweden where the break is in January 1995. The second break date is the same between variables and it corresponds to January 2002. Finally, the third break date corresponds around to January 2009. Particularly, figure 14 shows the three breakpoints of each time series that we used. The main characteristic of each time series is that the second and third break point is the same, around 01/01/2002 and 01/01/2009, respectively. Also, there are two time series which have a breakpoint around 01/01/1995. On the other hand, there are three time series which show a cut point around 01/01/1997. Therefore, we have selected these dates as the three breakpoints, in order to create the three sub periods that we have already described in section 3. The following figure (15) presents the breakpoints of each time series according to the Silvestre, Kim and Perron (2009) unit root test. The breakpoints are presented with the use of arrows.

Figure 15: Silvestre, Kim and Perron Breakpoints Unit Root Test



Note: The figures show the breakpoints of Silvestre, Kim and Perron (2009) unit root test. The arrows indicate the exact breakpoint dates.

The results of Johansen Co-integration testing with structural breaks are presented in Table 41 to Table 44. We used the real effective exchange rate of each currency, in order to discover if the series are co-integrated in the long-run. We selected the

deterministic trend assumption of test that there is a trend and an intercept in co-integrating equations (CE) and no intercept in VAR with three lags according to Schwarz criterion.

Table 41: Johansen's Co-integration Structural Breaks Test in series DKK and EUR				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value a=0.1**	**Probability**
None	0.000458	3.761	2.706	0.0524*
At most 1	0.001191	13.549	13.429	0.0962

Note: (*) denotes statistically significant at 0.1 level

The results of Johansen's Co-integration test with structural breaks show that there is a long-term tendency between the euro and the Danish krone. This trend takes place during the entire period at 10% level of significance.

Table 42: Johansen's Co-integration Structural Breaks Test in series ISK and EUR				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value a=0.1**	**Probability**
None	0.000419	3.442	2.706	0.0664*
At most 1	0.001185	13.185	13.429	0.1253

Note: (*) denotes statistically significant at 0.1 level

Moreover, we found out that a similar behavior exists between the Icelandic krona and the euro. These two currencies are co-integrated during the examined period at 10% level of significance.

Table 43: Johansen's Co-integration Structural Breaks Test in series NOK and EUR				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value a=0.01**	**Probability**
None	0.002231	21.417	19.937	0.0061***
At most 1	0.000374	3.071	6.635	0.0797

Note: (***) denotes statistically significant at 0.01 level

A co-integration takes place between the euro and the Norwegian krone during the total period at 1% level of significance.

Table 44: Johansen's Co-integration Structural Breaks Test in series SEK and EUR				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value a=0.01**	**Probability**
None	0.002022	20.264	19.937	0.0077***
At most 1	0.000443	3.637	6.635	0.0969

Note: (***) denotes statistically significant at 0.01 level

The findings of Johansen's Co-integration test with structural breaks express that there is a long-term tendency between the euro and the Swedish krone. This trend takes place during the total period at 1% level of significance.

8.4. Empirical Results

During this section, we provide the empirical evidence about the advanced econometric procedures of this paper. As we previously displayed, the Error Correction Model is suitable in order to explore short- and long-term interrelationships among a group of variables and the condition of their equilibrium. The ECM can take both bivariate and multivariate forms. We have decided to use the bivariate form because our independent variable is the REER of euro.
The tables below present our findings during the total period, as well as, the four sub-periods.

Table 45 shows the findings of the ECM for Denmark. The dependent variable is the REER of the Danish krone and the control variable is the REER of the euro. During the total period, we observe that the short-term factor (β) is negative. The same tendency takes place for all sub-periods. This implies that the REER of the euro influences negatively the REER in Denmark in the short-run. On the other hand, the long-term parameter (δ) is positive for the total period, as well as, during the sub-periods. This happens because the Danish krone is traditionally bound to a basket of European currencies (only euro after 1999). Especially, the Danish krone was fixed to a basket of European currencies during the 1980s (1st period). This was formalized in the European Monetary System (EMS). Prior to that, Denmark had participated in the "European currency snake" in the years after the collapse of the Bretton Woods system. This means that the most of the EEC countries agreed, in 1972, to maintain stable exchange rates, by preventing exchange rate fluctuations of more than 2.25%. During the second period, we observe that the long-term factor increased, despite the decision of Denmark to obtain an opt-out right from the participation in the EMU. However, the Danish Central Bank (DCB) decided to participate in the second stage of the EMU by maintaining a fixed exchange rate against the German mark and then against the euro (after 1999). According to Abildgren (2010), the Danish Central Bank announced that, it was important to create a solid framework for price stability in the euro area, making it an

appropriate anchor for the Danish fixed-exchange-rate policy. Also, Denmark had an interest in developing an expedient framework for exchange rate cooperation between the euro area and the non-euro area member states. Thirdly, Denmark had a general interest in the formulation of the ground rules for Stage 3 of EMU to ensure that Denmark would be able to adopt the single currency at a later stage on the same terms as those applying to the initial euro area member states.

Table 45: Estimation Results of Error Correction Model - DKKvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
α	-0.0004 (-0.89)	0.0003 (0.20)	0.0041 (0.55)	0.0024 (0.47)	-0.0016 (-0.80)
EC	-0.0019 (-1.64)	-0.0026 (-1.24)	0.0087 (0.39)	0.0174 (0.81)	-0.0091 (-1.18)
β	-0.209 (-5.19)*	-0.099 (-1.59)	-0.261 (-2.52)*	-0.169 (-2.60)*	-0.265 (-7.33)*
δ	1.99 (7.08)*	1.27 (2.38)*	1.97 (2.63)*	1.17 (2.47)*	2.89 (9.69)*

Note: (*) denotes statistically significant at 0.05 level

Additionally, we observe that the value of the long-term factor reduced during the third period, where the euro physically had been circulated. This may happen due to the Danish referendum on 28 September 2000, where the majority of the people rejected the participation of Denmark in the Euro Area. After this historical event, the politicians in Demark paused occupying with a possible Danish Eurozone membership. However, the Danish krone remained a member of the ERM II. In fact, this fixed exchange rate against the euro removed several monetary tools from the Danish Central Bank and a small monetary union between the Eurozone and Denmark was implemented.

It is clear that the long-term parameter increased significantly during the 4th period (debt crisis in the Euro Area). This may occur due to the monetary policy of the Danish Central Bank. The DCB decided to reduce the interest rate of the Danish krone from 1% in 2010 to -0.65% in 2017. This monetary policy took place in order to safeguard the fixed exchange rate of the Danish krone against the euro. It was observed that thousands of people and investors began to demand the Danish krone by exchanging

their euros due to the uncertainty of Eurozone cohesion after 2010. Also, during the 4th period, we observe similar monetary policy between the DCB and the ECB, as well as, the inflation rate in Denmark and in the Euro Area followed the same tendency. Therefore, it is logical to have a higher long-term parameter of the ECM during the 4th period. Finally, we observe that the equilibrium (EC) factor is not statistically significant during the total period, as well as, the sub-periods. This means that there is a constant and continuous equilibrium between the REER of Denmark and the REER of Euro Area. In fact, the Danish krone is completely bound to the European common currency.

Table 46 indicates the results of the ECM for Iceland. The dependent variable is the REER of the Icelandic krona and the independent variable is the REER of the euro. The findings of our analysis show that the short-term factor is not statistically significant during the overall period. This tendency remained approximately the same from 1994 to 2009 (1st and 2nd period). This means that the REER of the euro has no impact on the REER of the Icelandic krona. On the other hand, this parameter is negative from 1986 to 1993 and from 2010 to 2017. The euro presents a negative effect on the Icelandic krona. Additionally, an equilibrium between the euro and the Icelandic krona takes place from 1986 to 2009. However, a disequilibrium (negative direction) exists at the 4th period. As, we have already pointed out, the long-term factor is the most important parameter to our analysis. The results clearly present that a strictly negative effect takes place from 1986 to 2009. This factor increased continuously (upturn trend) during the examined period. Historically, Icelandic governments showed no attention or political will concerning a possible EU membership of Iceland. Particularly, the Icelandic governments opposed to the EU because they wanted a political and economic flexibility. Therefore, the Icelandic governments decided to participate in the Economic European Area (EEA) in order to benefit from the European Single Market. Apart from EEA, Iceland has signed the Schengen Area Agreement and the European Free Trade Association (EFTA). The Icelandic economy had been thriving until 2008, when the global financial crisis of 2008 crushed the Icelandic economic “miracle”. Thus, it was expected to observe an upturn tendency of the long-term parameter. Despite its geographical position, Iceland has increased trade relationships with the EU.

Table 46: Estimation Results of Error Correction Model - ISKvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
α	0.0148 (-1.83)	0.0031 (0.22)	0.0232 (2.25)*	0.0359 (0.89)	0.1277 (2.03)*
EC	-0.0004 (-1.59)	-0.0004 (-1.19)	0.0009 (1.69)	-0.0006 (-0.34)	-0.0026 (-2.17)*
β	-0.149 (-1.11)	-0.168 (-6.58)*	-0.069 (-1.16)	-0.193 (-1.01)	-0.122 (-4.04)*
δ	-28.32 (6.15)*	-16.38 (16.63)*	-13.51 (8.06)*	-6.64 (3.09)*	7.42 (12.58)*

Note: (*) denotes statistically significant at 0.05 level

According to the Observatory of Economic Complexity (2016), Iceland exports 21% to the Netherlands, 11% to the UK and 10% to Germany. Also, Iceland imports goods 9.6% from Norway, 8.5% from Germany and 7.5% from the United States. This means that the Icelandic economy is more vulnerable to the European economy. During the 4th period, we found out that the euro influences positively the Icelandic krona in the long-run. This may have occurred due to the official application of the Icelandic government for the EU membership in July 2009. The Icelandic government believed that a EU participation would assist the economy to recover fast without the implementation of unpopular austerity measures. However, the negotiations with the EU were paused unofficially in July 2013, from the new-elected government of that time. On 12 March 2015, the Foreign Minister of Iceland stated that he had sent a letter to the EU withdrawing the application for membership, without the approval of the Althing (Icelandic Parliament), although the European Union stated that Iceland had not formally withdrawn the application. In 2017, Iceland's newly elected government announced that it would hold a vote in parliament on whether to hold a referendum on resuming EU membership negotiations. Under the recent (2017) political aspect of view, it is very unclear if Iceland could be a member of the EU in the near future. Our empirical evidence supports the outcome that the Icelandic economy is more and more integrated to EU economy and a possible participation would be beneficial. However, our evidence is not enough to totally support this tendency.

Table 47 provides evidence for Norway. We used the Norwegian REER as a dependent

variable of the ECM and the REER of the euro as a control variable. The outcome of our analysis shows that an equilibrium (EC) takes place between the euro and the Norwegian krone from 1986 to 2017. The overall short-term spillover effect is negative which means that the euro influences negatively the Norwegian krone in the short-run. However, this phenomenon is not valid from 1986 to 2001. Moreover, the long-term factor is positive, showing a downturn trend from 1986 to 2009. Historically, Norway applied for European Economic Communities (EEC) membership in 1962 and in 1967, but France rebuffed Britain's application and the accession negotiations with Norway. In 1972 and 1994, the Norwegian government held a referendum about EEC and EU membership, respectively. The majority of Norwegians rejected a possible EEC/EU membership, despite the will of the Norwegian governments.

Table 47: Estimation Results of Error Correction Model - NOKvsEUR

Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
α	0.0002 (0.35)	0.0001 (0.13)	0.0012 (1.09)	-0.0019 (-1.42)	0.0014 (1.31)
EC	-0.0011 (-0.85)	-0.0022 (-0.76)	-0.0096 (-1.84)	-0.0014 (-0.39)	-0.0006 (-0.38)
β	-0.092 (-3.71)*	-0.091 (-1.58)	-0.026 (-0.81)	-0.067 (-2.13)*	-0.128 (-3.65)*
δ	1.24 (5.94)*	1.16 (2.75)*	0.50 (1.99)*	0.68 (2.02)*	2.55 (6.16)*

Note: (*) denotes statistically significant at 0.05 level

The status of this membership is in favor of the Norwegian economy because the country enjoys the benefits of the European Single Market without being obliged to accept the decision of the European Parliament or the European Council. In addition, the positive relationship between the NOK and the euro may exist due to a similar monetary policy which has been followed by the Norwegian Central Bank (Norges Bank) and the European Central Bank (ECB). In fact, the NCB reacted positively to the decision of the ECB according to the interest rates policy. We observed that the long-term impact increased rapidly (2.55) during the fourth period. This may occur due to two reasons. Firstly, the NCB followed the monetary policy of ECB, and secondly Norway raised the trade linkages with the EU member states. According to Observatory

of Economic Complexity (2016), Norway exports 17% to Germany, 17% to the UK and 12% to the Netherlands. Also, Norway imports goods 12% from Sweden, 11% from Germany and 9.8% from China. This means that the Norwegian economy is more bound to the European economy. In summary, the main outcome of the long-term parameter reveals that the Norwegian economy was positively integrated in the European economy from 1986 to 2017. Despite this strong economic and trade bond between the EU and Norway, there is not a political will for EU membership at this time (2018). This appears to be very logical because the majority of Norwegians wish a higher independence of their country. Also, 56% of the Norwegian GDP comes from petroleum and gas products. Hence, Norway does not need any financial assistance from the EU via its findings.

Table 48 displays the empirical results for Sweden. By following the same procedure, we used the ECM model and the dependent variable is the REER of Swedish krona and the independent variable is the REER of the euro. According to the empirical results, the adjustment speed back to equilibrium seems to be statistically insignificant during the examined periods. This means that the Euro Area and Sweden enjoys a long-term equilibrium. It is clear that the REER of the euro shows a positive impact on the REER of the Swedish krona in the short-run. The impact is zero (statistically insignificant) during the first two periods. This happens because Sweden became a member-state of the EU in 1995. Consequently, the linkages between Sweden and other member-states of the EU were not strong. On the other hand, we observe that the REER of the euro influences positively the REER of Swedish krona in the long-run. The effect is continuously increasing. This event occurs because the economic and trade interrelationships between the EU and Sweden increased significantly when Sweden join the EU. According to the Observatory of Economic Complexity (2016), Sweden exports 11% to Germany, 7.6% to Denmark and 7.5% to the UK. Also, Sweden imports goods 18% from Germany, 8.4% from the Netherlands, and 7.4% from Denmark. This means that the Swedish economy is influenced significantly by the European economy since the EU is its major trade partner. Furthermore, the Swedish economy is influenced by the Finnish economy because there are common borders between the countries. Common borders support and aid the trade relationships.

Finland is a member-state of the Euro Area. Also, Sweden has strong trade and economic relationships with Germany and other Euro Area member, such as the

Netherlands. Finally, it is important to mention that there are plenty of Swedish cities across the Finnish-Swedish borders where the euro has been unofficially circulated for commercial transactions since 2009.

Table 48: Estimation Results of Error Correction Model - SEKvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
α	0.0001 (0.08)	0.0007 (0.62)	0.0047 (2.34)*	0.0013 (0.61)	-0.0009 (-0.69)
EC	-0.0012 (-1.22)	0.0006 (0.66)	-0.0071 (-1.79)	-0.0086 (-1.19)	-0.0049 (-1.36)
β	0.064 (-2.61)*	0.029 (0.39)	0.033 (1.08)	0.092 (-2.79)*	0.189 (-7.18)*
δ	1.05 (4.84)*	0.24 (0.45)	0.41 (3.64)*	1.16 (2.76)*	3.05 (11.24)*

Note: (*) denotes statistically significant at 0.05 level

Therefore, this condition increases the integration of the Swedish economy with the Euro Area. In conclusion, we could point out that, despite the Swedish referendum of 2003, where the majority of Swedish rejected the euro, the major political parties in Sweden, including the formerly governing coalition Alliance for Sweden (except the Center Party) and the currently governing Social Democratic party, which won the 2014 election, are in principle in favor of introducing the euro. There are strong political indications that present a possible Swedish partnership in the EMU in the distant future. Our empirical results highly support that an economic integration takes place between the Euro Area and Sweden. Hence, it is not unlikely to see Sweden being the 20th member of the Eurozone.

The ADCC-GARCH methodology expresses a multivariate GARCH model which estimates volatility asymmetry, volatility persistence and the leverage effect. The formula of the ECM was used as the mean equation and the typical mathematical expression of ADCC-GARCH model, as the variance equation. Particularly, we re-estimated ECM with ADCC-GARCH errors in order to capture leptokurtosis, skewness and volatility clustering and asymmetry. It is important to mention that we used the

GJR-GARCH model (Glosten *et al.* 1993) as an auxiliary in order to estimate the leverage effect of the ADCC-GARCH. The new GARCH model could be named as an ECM-ADCC-GARCH(1,1).

Table 49 estimates the ADCC-GARCH(1,1) results with 1 asymmetric order by using in the mean equation the Danish REER as the dependent variable and the REER of the euro as the control variable.

Table 49: Estimation Results of ADCC-GARCH - DKKvsEUR

Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
Constant	0.0004	0.0009	0.0001	0.0003	0.0002
	(1.38)	(1.24)	(4.38)*	(2.65)*	(3.25)*
ARCH	0.108	0.087	0.176	0.033	0.048
	(8.05)*	(3.32)*	(6.02)*	(5.70)*	(7.07)*
γ	-0.004	0.0006	0.125	-0.003	-0.03
	(-1.04)	(0.052)	(5.37)*	(-0.35)	(-3.40)*
GARCH	0.787	0.711	0.641	0.965	0.963
	(8.56)*	(3.99)*	(15.15)	(6.69)*	(16.99)*
λ1	0.023	0.064	0.044	0.013	0.01
	(48.60)*	(3.15)*	(22.17)*	(6.30)*	(5.45)*
λ2	0.973	0.935	0.941	0.975	0.985
	(12.90)*	(11.8)*	(33.92)*	(21.66)*	(7.51)*

Note: (*) denotes statistically significant at 0.05 level

The sum of ARCH and GARCH coefficients is not very close to unity, expressing that the Danish krone's volatility shocks are not quite persistent, especially from 1986 to 2001. Also, the coefficient of the lagged squared is positive and statistically significant. Thus, we are able to support that a strong GARCH effect is apparent. The coefficient of lagged conditional variance is statistically significant, but its value is lower than the unity. This supports that the impact of the "old" news on volatility is significant. The magnitude of the GARCH coefficient is medium from 1986 to 2001 and high from 2002 to 2017. This means that there is a medium memory in the variance (1st and 2nd period) and a long memory in the variance during the 3rd and 4th period. The γ parameter (leverage effect) is not statistically significant from 1986 to 1993 and 2001 to 2009

indicating that bad/good news of the euro has no impact on the volatility of the Danish krone. On the contrary, the γ parameter is positive from 1994 to 2001 expressing that the news effect is asymmetric and the bad news of the euro has larger effect on the volatility of the Danish krone than the good news. Finally, we observe that the volatility asymmetry is negative from 2009 to 2017 indicating that the good news of the euro has a larger impact on the Danish krone's volatility than the bad news. The sum of λ1 and λ2 parameters is below the unity. This means that the structural stability conditions of the ADCC-GARCH are fulfilled.

Table 50 estimates the ADCC-GARCH(1,1) results with 1 asymmetric order by using in the mean equation the Icelandic REER as the dependent variable and the REER of the euro as the control variable. A typical ADCC-GARCH formula is used for the conditional variance equation. The sum of ARCH and GARCH coefficients is not very close to unity from 1986 to 2001 and 2009 to 2017, expressing that the Icelandic krona's volatility shocks are not quite persistent. An opposite phenomenon takes place from 2002 to 2008 where Iceland enjoyed the most prosperous and thriving era after the World War II. Also, the coefficient of the lagged squared is positive and statistically significant.

Table 50: Estimation Results of ADCC-GARCH - ISKvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
Constant	0.0002	0.0002	0.0002	0.0003	0.0001
	(14.51)	(10.24)*	(4.13)*	(10.78)*	(2.85)*
ARCH	0.06	0.384	0.107	0.136	0.195
	(32.55)*	(5.65)*	(9.11)*	(20.19)*	(4.09)*
γ	-0.025	-0.10	-0.06	-0.16	-0.01
	(-11.03)*	(-1.55)	(-5.37)*	(-11.75)*	(0.64)
GARCH	0.954	0.022	0.618	0.822	0.476
	(10.91)*	(0.21)	(11.68)*	(11.85)*	(3.19)*
λ1	0.040	0.031	0.032	0.03	0.029
	(8.45)*	(4.44)*	(2.12)*	(5.55)*	(4.45)*
λ2	0.908	0.959	0.956	0.964	0.939
	(3.21)*	(8.12)*	(9.78)*	(3.78)*	(5.59)*

Note: (*) denotes statistically significant at 0.05 level

Thus, we are able to support that a strong GARCH effect is apparent. The coefficient of lagged conditional variance is statistically significant, but its price is lower than the one. This means that the effect of the "old" news on volatility is significant.
The size of the GARCH coefficient is low from 1986 to 2001 and 2009 to 2017. This indicates that there is a short memory in the variance of the Icelandic krona during these eras. On the other hand, the size of the GARCH coefficient is medium from 2002 to 2008. This supports that there is a medium memory in the variance of the Icelandic krona.
The γ parameter is not statistically significant from 1986 to 1993 and 2009 to 2017 indicating that the impact of the bad or the good news on the volatility of Icelandic krona is symmetric. On the other hand, we provide evidence that the news' impact is asymmetric from 1994 to 2008 and the good news of the euro has larger effect on the volatility of the Icelandic krona instead of the bad news. In fact, an overvaluation of the euro has larger impact on the Icelandic than a devaluation during these periods. The sum of λ1 and λ2 parameters is below the unity. This means that the structural stability conditions of the ADCC-GARCH are met.

Table 51 estimates the ADCC-GARCH(1,1) results with 1 asymmetric order by using in the mean equation the Norwegian REER as the dependent variable and the REER of the euro as the independent variable. A typical ADCC-GARCH formula is used for the conditional variance equation.
The sum of ARCH and GARCH effect is not very close to one from 1986 to 2001 indicating that Norwegian krone's volatility shocks are not quite persistent. A totally different phenomenon takes place from 2002 to 2017. The coefficient of the lagged squared is positive and statistically significant. Thus, we are able to support that a strong GARCH effect is clear. Moreover, the size of the GARCH coefficient is high from 2002 to 2017. This indicates that a long memory in the variance exists during these periods. However, the GARCH coefficient is low from 1986 to 2001. Hence, we could support that a short memory in the variance takes place. The γ parameter represents the leverage effect on the conditional variance. The factor of volatility asymmetry is not statistically significant from 1986 to 1993 and from 2001 to 2017. This means that the bad or the good news of the euro does not influence the volatility of the Norwegian krone. Also, the leverage effect is negative from 1994 to 2001, expressing that good news of the euro has higher effect on the volatility of the Norwegian krone than the bad news. This

phenomenon may be linked with the participation of Norway in the European Economic Area in 1994. The sum of λ1 and λ2 parameters is below the unity. This means that the structural stability conditions of the ADCC-GARCH are met.

Table 51: Estimation Results of ADCC-GARCH - NOKvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
Constant	0.0001	0.0001	0.0001	0.0002	0.0002
	(0.77)	(1.85)	(2.07)	(-0.70)	(2.68)*
ARCH	0.137	0.189	0.172	0.017	0.035
	(9.09)*	(4.18)*	(5.24)*	(4.46)*	(5.35)*
γ	-0.008	0.019	-0.069	-0.008	0.003
	(-1.99)*	(1.67)	(-6.61)*	(-1.01)	(0.27)
GARCH	0.822	0.624	0.627	0.974	0.959
	(10.91)*	(4.70)*	(5.33)*	(6.47)*	(14.22)*
λ1	0.029	0.038	0.026	0.034	0.034
	(7.77)*	(5.12)*	(2.87)*	(3.33)*	(4.56)*
λ2	0.964	0.952	0.967	0.934	0.943
	(3.94)*	(2.98)*	(3.99)*	(6.66)*	(2.56)*

Note: (*) denotes statistically significant at 0.05 level

Table 52 presents the ADCC-GARCH(1,1) results with 1 asymmetric order by using in the mean equation the Swedish REER as the dependent variable and the REER of the euro as the independent variable. A typical ADCC-GARCH formula is used for the conditional variance equation. We observe that the sum of ARCH and GARCH coefficients is not very close to unity from 1986 to 2001 expressing that the Swedish krona's volatility shocks are quite persistent.

A totally different phenomenon takes place from 2002 to 2017 where the volatility of Swedish krona is more persistent against the shocks of euro's volatility. Furthermore, the magnitude of the GARCH coefficient is low and stable within the first two periods. Therefore, we may support that a short memory in the conditional variance exists and the "old" news of volatility has no effect. On the other hand, the GARCH effect is high from 2002 to 2017 where a long memory in the conditional variance takes place. The γ parameter, which represents the leverage effect on the conditional variance, is

statistically significant and negative from 1986 to 2017. This means that the good news of the euro has larger impact on the volatility of the Swedish krona than the bad news. Actually, an overvaluation of the euro influences more the Swedish krona instead of a devaluation of the European common currency. The sum of λ1 and λ2 parameters is below the unity. This means that the structural stability conditions of the ADCC-GARCH are met.

Table 52: Estimation Results of ADCC-GARCH - SEKvsEUR					
Parameter	**Total period**	**1st period**	**2nd period**	**3rd period**	**4th period**
Constant	0.0001 (0.19)	0.0009 (2.29)*	0.0001 (1.87)	0.0003 (2.83)*	0.0003 (2.84)*
ARCH	0.125 (9.09)*	0.184 (5.79)*	0.097 (3.14)*	0.042 (6.51)*	0.036 (4.51)*
γ	-0.021 (-4.72)*	-0.03 (-3.01)*	-0.04 (-3.54)*	-0.02 (-2.37)*	-0.05 (2.64)*
GARCH	0.868 (11.23)*	0.601 (5.37)*	0.581 (3.08)*	0.961 (14.81)*	0.955 (12.99)*
λ1	0.019 (6.59)*	0.035 (7.33)*	0.044 (2.55)*	0.031 (5.89)*	0.031 (3.45)*
λ2	0.971 (9.32)*	0.942 (8.12)*	0.927 (6.78)*	0.951 (7.77)*	0.951 (4.52)*

Note: (*) denotes statistically significant at 0.05 level

8.5 Conclusions

The Treaty of Maastricht (1992) was the vital keystone to the European integration. In fact, it had transformed the European Communities into the European Union. The next step of that time was the establishment of the Economic and Monetary Union among the member-states of the Euro Area. The European integration successfully accelerated from 2002 to 2009, since the Euro Area welcomed four new member states (Cyprus, Malta, Slovenia and Slovakia). The global financial crisis of 2008 did not shock the cohesion of the Euro Area, despite the economic recession. The sovereign debt crisis of 2010 was the most important hit which raised discussion about the potential endurance of the monetary union. Despite the difficulties where the Euro Area suffered

from 2010 to 2015, it was proved that the euro is too hard to "die". The leaders of the Euro Area decided to safeguard the union by establishing new institutions, such as the ESM. The reinforcement of the Euro Area did not persuade other EU member-states to adopt the European common currency. For instance, the Scandinavian economies have no structural weakness and they are eligible to join the Eurozone. However, the people and their governments are very sceptical to a possible EMU participation.

The aim of this paper is to explore if the Scandinavian economies are bound to the European economy (Euro Area). We combined the ECM with the ADCC-GARCH in order to discover any possible spillover effects among the euro and the Scandinavian countries. Also, we explored if the volatility responses of the euro have large impacts on the volatility of the Scandinavian currencies. Our empirical results highly support that there are historical positive interrelationships between the euro and the Norwegian krone, the euro and the Swedish krona, and the euro and the Danish krone. However, we did not find enough evidence that a similar phenomenon takes place for Iceland. On the contrary, Iceland is negatively integrated with the European economy despite the participation of the country in the European Economic Area. The empirical evidence of our study is aligned with the findings of Pesaran *et al.* (2007), as well as, Reade and Volz (2009).

The outcomes of the present paper provide important evidence to academia, EU policy makers, international institutions (IMF, World Bank, BIS), investors, risk managers, multinational companies (MNCs) and individual people across the globe. A potential entry of Scandinavian countries in the Euro Area would definitely change the balances in the international markets and in the modern world. Especially, due to the fact that the economic magnitude of Norway and Sweden is high, we could possibly assume that the exchange rate of the euro would be overvalued against other leading currencies, such as the US dollar (USD), the Great Britain pound (GBP) and the Japanese Yen (JPY). Furthermore, a possible euro partnership of Iceland and Denmark would increase the borders of the Euro Area to the Northern Atlantic Ocean (Iceland) and to the Northern American Continent (Greenland, as a province of Denmark). Except the economic and political influence of the Euro Area to America, a potential enlargement of the Eurozone would influence the investors and the speculators. The investments will be paid back at a different currency. Also, the speculators would earn reduced profits, because the euro is a more stable currency. A possible enlargement of the Euro Area

will aid the multinational enterprises (MNEs), as well as, the small and medium-sized enterprises (SMEs) to diminish their exchange risk when they plan to transfer money (corporate transactions). The asset and liability (ALM) risk managers could achieve an efficient matching or hedging of their portfolios, in order to be able to predict more accurately the potential economic behaviour of the euro. Lastly, the depositors will see their savings being converted to a different currency.

In conclusion, the outcome of this paper may influence the politicians and the policy makers in Norway and Iceland to rethink firstly their participation in the EU and the adoption of the euro in the distant future. In addition, the Swedish and Danish government may re-evaluate their participation in the Euro Area by holding a second euro referendum at their countries. Finally, the findings of this paper may influence the Swedish National Bank (Sveriges Riksbank) to create a fixed exchange rate between the Swedish koruna and the euro by following the monetary strategy of the Danish National Bank (Danmarks Nationalbank) (ERM II participation). Actually, we are able to indicate that the Norwegian government may reconsider the present status of Norway (EEA member). A possible next step should be the entrance in the EU, since its economy is bound to the Euro Area economy. Additionally, there are strong evidence that the Swedish economy is totally linked, under the social, political and economic aspect of view, with the Euro Area. Therefore, a potential step might be a participation to ERM II or EMU. In fact, the Danish economy shows similar behaviour, as Sweden. This means that Denmark would be more benefited by entering in the EMU, since the country enjoys no monetary or exchange rate independence. Finally, Iceland is neutral or semi-negative entering to the EU. Additionally, we did not discover enough evidence which are able to support that a potential EU status would be beneficial to the Icelandic economy. Actually, the country has recently recovered from the economic and financial catastrophe of 2008 crisis. Nevertheless, the parameter of politics is really important, but this is out of the aims of the current research.

Chapter 9. The 12-founding Eurozone member states

9.1 Introduction

In 1999, the Euro Area took its physical form and the circulation of the euro took place on 01/01/2002. At that time, 12 members of the EU were willing to adopt the single European currency. Nowadays (2017), the Euro Area consists of 19 member-states. Only during the Roman Empire, the European continent shared a common currency for the first and the last time. Therefore, the euro was not only a single currency but a historical challenge also. The adoption of the euro was expected to lead to the prosperity of the Euro Area countries. However, the debt crisis of 2010 in the Euro Area revealed the serious problems of the Euro. The majority of the Eurozone countries benefited from the adoption of the euro. According to the World Bank (2017), the euro boosted significantly the economic growth for Greece, Ireland, Luxembourg, Spain, Portugal, Finland, the Netherlands and Belgium from 2002 to 2008. However, Italy was the only country which has been less favoured by the euro (0,77% - GDP growth rate). On the other hand, the economic recession of 2008 in Euro Area hit the most vulnerable economies of the monetary union. In fact, Greece faced an average economic downturn equal to -4,14% per year from 2009 to 2015. The basic question is if the European monetary union is still able to protect the economic and social prosperity of all citizens in the Euro Area during the difficult times of a recession. The truth is that the Euro Area needs reconstruction. For instance, Gomes (2018) highly support that the EU policy makers and leader must follow this direction in order to assure the sustainability of the European Monetary Union (EMU) in the long-run.

Papanikos (2015) used the Real Effective Exchange Rate (REER henceforth) of the euro in order to examine how an overvalued or undervalued euro influenced the GDP growth in Greece and Germany. Also, Rusek (2012) discovered that the introduction of the euro in Southern Europe undermined its competitiveness. On the other hand, an undervalued euro (instead of a German mark) was beneficial for Germany because it accelerated the economy's competitiveness growth and boosted exports. Candau *et al* (2014) suggest that the real effective exchange rate (REER) is stationary around a trend and provides evidence of (i) an appreciation of the REER, but (ii) no permanent overvaluation of the currency. Durand and Lopez (2013) proposed that the

competiveness of France and Germany increased due to the circulation of the euro. Opposite results emerged for Spain and Greece. Finally, Mirdala (2016) discovered that Greece, Portugal and Spain lost a significant part of their competiveness by joining the Euro Area. Consequently, Also, the balance of current account deficits emerged for these countries. On the other hand, the introduction of the euro was in favour of the Dutch, German and Austrian economies. Recently, Afonso and Jalles (2017) attempted to provide evidence about the fiscal sustainability in the Euro Area. They assessed the time-varying features of fiscal sustainability in the euro area via revisiting the empirical relationship between the primary budget surplus and the debt-to-GDP ratio. Quere and Coulibaly (2014) examined the contribution of market regulations to the dynamics of the real exchange rate within the European Union. Egger and Pfaffermayr (2013) discovered that the European Integration and the three EU enlargements were in favour of the core-EU member states, especially in terms of trade. Finally, Cheikh and Rault (2016) provided an update on the exchange rate pass-through (ERPT) estimates for 12-euro area (EA) countries. Actually, their results notice that the distinction between "peripheral" and "core" EA economies in terms of pass-through has significantly decreased over the last two decades.

The purpose of this study is to explore the impact of the real effective exchange rate of each Euro Area country on the nominal exchange rate of the euro. Additionally, the basic question that needs an answer is if the euro behaves like the German mark. In fact, we would like to explore if the euro is a currency which fits perfectly for all Euro Area countries. Therefore, we would discover if the euro assisted to a greater integration in the EU by following the idea and the methodology of Stoupos and Kiohos (2017). Specifically, we investigate whether the impact of German economy is greater on the economic behaviour of the euro than the rest Euro Area countries. Therefore, we used a bivariate regression model and we combined this model with the Asymmetric Component ARCH model. We produced an innovative binary linear regression (BLR) AC-ARCH model. A similar approach was used by Grossman and Orlov (2014) in order to study the dynamics of the overall volatility of exchange rates and its high-frequency, most economically destabilizing components.

Our empirical results show that the countries of the Eurozone core influence more the nominal exchange rate of the euro instead of the periphery countries. In addition, the euro is more vulnerable to the volatility shocks of the German and French real exchange

rate. In fact, the German economy plays the most important role in the behaviour and the volatility of the euro.

9.2 The Background for the founding members of the Eurozone

The Maastricht Treaty established five rules for admission to the euro zone. Three rules requiring convergence in nominal indicators and two rules requiring fiscal discipline. The way these rules were written forced countries to converge on the lowest inflation rates in the zone (European Commission, 1993).

The Maastricht criteria ensure that high-inflation countries attain credibility by demonstrating their commitment to low inflation before they are allowed in. This process supposedly prevents governments with a propensity for high inflation from entering the Eurozone. All current euro members successfully satisfied these rules to gain membership, and the end result was marked inflation convergence.

The influence of Germany in the Euro Area increased significantly after the European debt crisis of 2010. Germany is the largest economy of the Eurozone by having a contribution of 3,033 billions of euros as nominal GDP (Eurostat, 2016). The second largest economy of the Euro Area is France (2,181 billions of euros as nominal GDP). (Eurostat, 2016). During 2010-2012, four member states of the Euro Area (Cyprus, Greece, Ireland and Portugal) demanded the economic assistance and solidarity of their partners in the monetary union in order to avoid official default. The European Leaders decided the temporary establishment of the European Financial Stability Faculty (EFSF) and the permanent establishment of the European Stability Mechanism (ESM). According to ESM (2017), the financial safety net of EFSF was 779,8 billions of euros. The contribution of Germany was 211,11 billions of euros or 27,1% of the total amount. The contribution of France was 158,5 billions of euros or 20,3% of the total amount and the contribution of Italy (third largest economy of the Euro Area) was 139,3 billions of euros or 17,86% of the total amount. Additionally, the establishment of the ESM did not change the distribution of the contribution. Therefore, we observed that Germany contributes the highest portion of funds for the European financial safety nets. According to IMF (2015), Germany possesses 68,2 billion of euros of Greek public debt. It is equal to 26,9% of the total Greek government debt and it means that Germany is the largest lender to the Greek Government. These events changed the power balance

in the EU by manifesting the leading role of Germany. Undoubtedly, the German political influence is prevalent within the political institutions in the EU, such as the Eurogroup and the European Stability Mechanism. German policy influence became obvious in the period from 2010 to 2017. The results of this research play a significant contribution for the economic behaviour of the euro from 2002 to 2015. Particularly, we intend to examine if the nominal exchange rate of the euro is more influenced by the real exchange rate (RER) of Germany instead of the other member-states of the Eurozone. We should also examine if the volatility of the German RER has more impact on the economic behaviour of the euro. Therefore, we shall discover that the German economy has always been playing a first and an important role on the euro from the beginning of its own creation. We decided to use the real exchange rate because the RER considers any changes in relative prices and shows what can actually be purchased with a currency. This means that the RER is normally trade-weighted. A country's RER is an important measure when assessing its trade capabilities and current import/export situation (Catao, 2007). The RER can be used to measure the equilibrium value of a country's currency, identify the underlying factors of a country's trade flow, look at any changes in international price or cost competition, and allocate incentives between tradable and non-tradable sectors. Therefore, the real exchange rate is an important tool which reflects the real condition of an economy (Catao, 2007). Additionally, when there are fluctuations in the price levels and the nominal exchange rate is fixed or does not automatically adjust, we have what is known as real exchange rate appreciation and depreciation. Real exchange rate appreciation creates a situation known as real exchange rate overvaluation. Due to a fixed or restrained nominal exchange rate not in line with the current price level the real exchange rate has become overvalued. Such overvaluation can lessen export (goods and capital) growth; domestic goods and capital are, in real terms more expensive. On the other hand, the appreciation will increase imports (goods and services) because imports have become cheaper in real terms. Overvaluation can be harmful to an economy and must be taken into consideration when examining exchange rate regimes (Paraskevopoulos and Paschakis, 2000).

The opposite of real appreciation is real depreciation. This occurs when the domestic price level is higher than the foreign price level. The higher domestic price level means that the domestic price level over the foreign price level will be greater than one. As a result, the real exchange rate depreciates; it takes more domestic currency to buy foreign currency. The result of this depreciation is that exports of goods and capital

have increased while imports of goods and capital have decreased. Real depreciation creates what is known as real exchange rate undervaluation. The unresponsiveness of the nominal exchange rate to a higher domestic price level causes depreciation of the real exchange rate. If this depreciation persists, exports (goods and capital) will become in real terms, less expensive and therefore increase while imports (goods and capital), which are more expensive in real terms, will decrease (Paraskevopoulos and Paschakis, 2000).

9.3 Data and Methodology

In this study, we decided to use the RER of the Euro *vis-a-vis* the US Dollar (USD) for the initial twelve members of the Euro Area and the nominal exchange rate of the euro *vis-a-vis* the US dollar. In fact, we decided to use the real exchange rate in order to discover the pragmatic economic situation in each Euro Area country. The common characteristic of Austria, Belgium, Finland, France, Greece, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain is that they became the first EU countries where the euro had been physically circulated on January the 1st 2002. These countries have a common nominal exchange rate, but the real exchange rate differs. The data has been made by the authors by using the theory of real exchange rates. In particular, we used the following formula:

$$\boldsymbol{e_R = e * \frac{P_f}{P_h}} \ (\mathbf{44})$$

Where, e_R is the real exchange rate of a country, e is the nominal exchange rate, the P_f is the general price level of goods and services of host country (Eurozone) and P_h is the general price level of good and service of home country (United States).

The real exchange rate is the nominal exchange rate adjusted for the changes in purchasing power of the currencies concerned from base period 0. It is important that P_f and P_h are the percentage changes in the Consumer Price Index (CPI) from the base period. Essentially, P_f and P_h are the inflation rates of the respective nations from base period 0.

We assumed that our home country is the United States, and as such, our currency is the US dollar. The data of the nominal exchange rate of the euro against the US dollar was collected from the official database of the European Central Bank (ECB) and the

total price levels for each country (Eurozone and United States) was gathered from the official database of the Bank for International Settlements (BIS). We collected 3,436 observations from 01 January 2002 to 31 March 2015 in a daily basis (last available data).

The dataset was divided into three periods. The turning points were produced by using important historical dates of the contemporary financial world.

a) 01 January 2002 to 09 August 2007

During this period, the circulation of the euro took place and the modern world enjoyed the most thriving and prosperous years after the end of 2nd World War. However, this economic boom was terminated when the financial crisis of 2007-2012 appeared with a downturn in economic activity. The first phase of this crisis has been characterized as liquidity crisis when BNP Paribas terminated withdrawals from three hedge funds on 09 August 2007.

b) 10 August 2007 to 30 April 2010

This period is related with the global financial crisis of 2007. In particular, we examine the behaviour of the euro and the real exchange rates after the beginning of the financial crisis of 2007 and before the start of the debt crisis in the Euro Area. During this period, a vast economic recession occurred in the majority of advanced countries, especially in the United States, the United Kingdom and the Euro Area.

c) 01 May 2010 to 31 March 2015

The present period is known as the sovereign debt crisis in the Eurozone. Particularly, after months of rumours, the ex-Prime Minister of Greece, George Papandreou, demanded the financial assistance of the European Commission, the European Central Bank and the International Monetary Fund in order to avoid the bankruptcy of the Greek State. During this era, four countries of the Euro Area (Cyprus, Greece, Ireland and Portugal) signed Memoranda of Understanding. The European Commission, the Eurogroup and the European Council decided to establish firstly the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM) afterwards in order to secure the sustainability of the Euro Area.

Our empirical results were made by using a bivariate regression model and an asymmetric component generalized autoregressive conditional heteroscedasticity (AC-GARCH) model. The bivariate regression model was executed by using robust least squares (RLS) methodology (Andersen, 2008). AC-GARCH model is appropriate in order to investigate short- and long-term volatility persistence, volatility clustering and volatility asymmetry (Engle and Lee, 1999).

Our bivariate regression model utilized the natural logarithmic value of the nominal exchange rate of the euro against the US dollar as an endogenous variable (Ashley, 2012). The exogenous variable is the natural logarithmic value of the real exchange rate of each Euro Area country.

$$\boldsymbol{ln(NER)_t = \alpha_0 + \beta_1 * ln(RER)_t + u_t} \ \boldsymbol{(45)}$$

Where, NER is the nominal exchange rate of the euro against the US dollar and RER is the real exchange rate of each euro member-state.

We used the logarithmic expression because its small changes in the log of a variable are directly interpretable as percentage changes, to a very close approximation, in econometrics. This means that the prediction accuracy of the impulse responses would be higher and more qualitative.

9.4 Empirical Results

This section presents the empirical findings of our research and it is divided into three parts. The first part shows the historical timeline of the nominal exchange rate of the euro against the US dollar and the real exchange rate of the initial twelve (12) Euro Area member states. The second part displays the results of the annual inflation of the Southern Eurozone countries (Portugal, Italy, Greece and Spain), where their economies were more vulnerable during the Euro Area debt crisis in 2010. The third part presents the bivariate regression analysis for each country and for each period. Finally, the last part is related with the empirical evidence of the Asymmetric Component GARCH model (AC-GARCH).

Figure 15 presents the historical development of the nominal exchange rates of the euro against the US dollar, as well as, the real exchange rates of the 12 Euro Area member states against the US dollar. The first characteristic of the timeline is that the nominal

exchange rate of the EUR/USD operates as a mean of the real exchange rates of the 12 Euro Area countries. The second feature is that the euro was stronger against the US dollar for Central west economies of the Euro Area from January 2002 to December 2006.

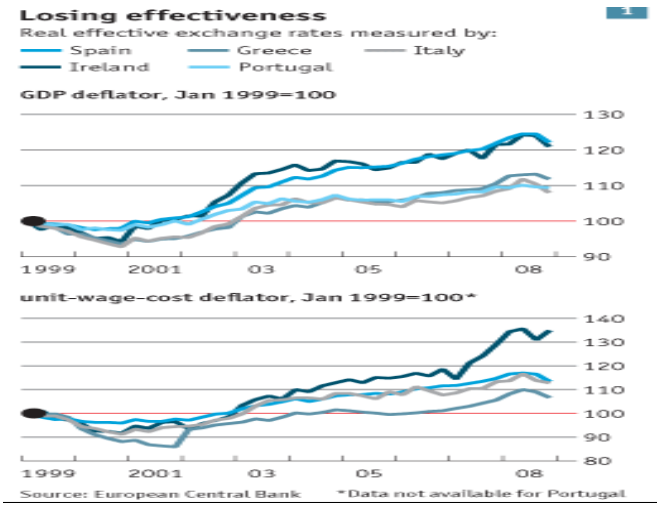
On the other hand, the euro was weaker against the US dollar for Mediterranean countries, such as Greece and Spain. Particularly, a US dollar had lower value at the core Euro Area countries. On the contrary, a US dollar had greater value at the periphery Euro Area countries. The third characteristic is that the real exchange rates of Ireland and Greece behaved totally different than the rest Euro Area countries. Particularly, the US dollar is stronger in Greece from June 2005 to December 2008, where the Greek real exchange rate does not follow the tendency of the Euro Area-12. In addition, we observe a similar attitude for Ireland. Particularly, the Irish real exchange rate does not follow the real exchange rates of the rest Eurozone countries from June 2006 to December 2008. Figure 1 reveals that all five (Ireland, Spain, Portugal, Greece, Italy) peripheral Eurozone members experienced impressive increases of the real exchange rate 10-25% using the GDP deflator as a proxy for inflation and 10-35% using the unit wage cost deflator. This led to a loss in terms of competiveness.

We decided to use data from 1999 to 2008 in order to show how the periphery countries of the Eurozone lost their competitiveness during the thriving decade (1999-2008) before the outbreak of the global financial crisis in 2008. After this crisis, the majority of Euro Area periphery countries implemented fiscal austerity measures in order to re-stabilize their economy through the internal depreciation of their wage cost and general prices. In particular, one could observe that the entrance of Ireland in the Euro Area increased the wage cost by 35%. In the same period the labour cost in Italy Spain and Portugal increased by 15% and by 8% in Greece. It is beyond doubt that the EMU membership of the EU periphery countries led to a boom of their price levels, as well as, in their labour cost. This led to a loss in terms of economy's competitiveness for these countries.

The fourth feature of the timeline is that there is an integrated long-term tendency at the real exchange rate of all Euro Area countries from January 2009 to June 2013. It is clear that the real exchange rates of the Euro Area members follow precisely the economic behaviour of the nominal exchange rate of the euro against the US dollar. The fifth characteristic is related with the Greek real exchange rate. Particularly, we

observe that Greece is the only country which escape from the integrated long-term trend of the real exchange rates from June 2013 to March 2015. The real exchange rate of each Eurozone country follows the attitude of the euro, except Greece. This event might be related with the implementation of Memoranda of Understanding. Greece faced a dramatic reduction in the general price level. Also, Greece faced a significant deflation during this period. Thus, the combination of the economic downturn with the deflation was extremely catastrophic to the Greek economy.

Figure 16: The evolution of the real effective exchange rates for the peripheral Eurozone countries (1999-2008)



Source: European Central Bank (2017)

The current section displays the historical evaluation of the inflation rate in the Euro Area countries of the Mediterranean Sea. We decided to focus on these countries because they present different structure at their economy. Moreover, the Euro Area debt crisis revealed that these countries are more vulnerable to external economic shocks the Euro Area core.

In figure 17 we observe that the inflation rate in Portugal, Italy, Spain and Greece remained quite steady from 2002 to 2007. However, the global financial crisis of 2008 reduced the total available income by decreasing the general prices level. Also, the inflation rate in these countries increased from 2010 to 2012, especially due to the authority measured where had been implemented at these countries. At the end, we observe a swift reduction of the inflation rate from 2012 to 2015.

Figure 17: Timeline of the nominal rate EUR/USD and the real exchange rates of Euro Area-12 countries from 01.01.2002 to 31.03.2015

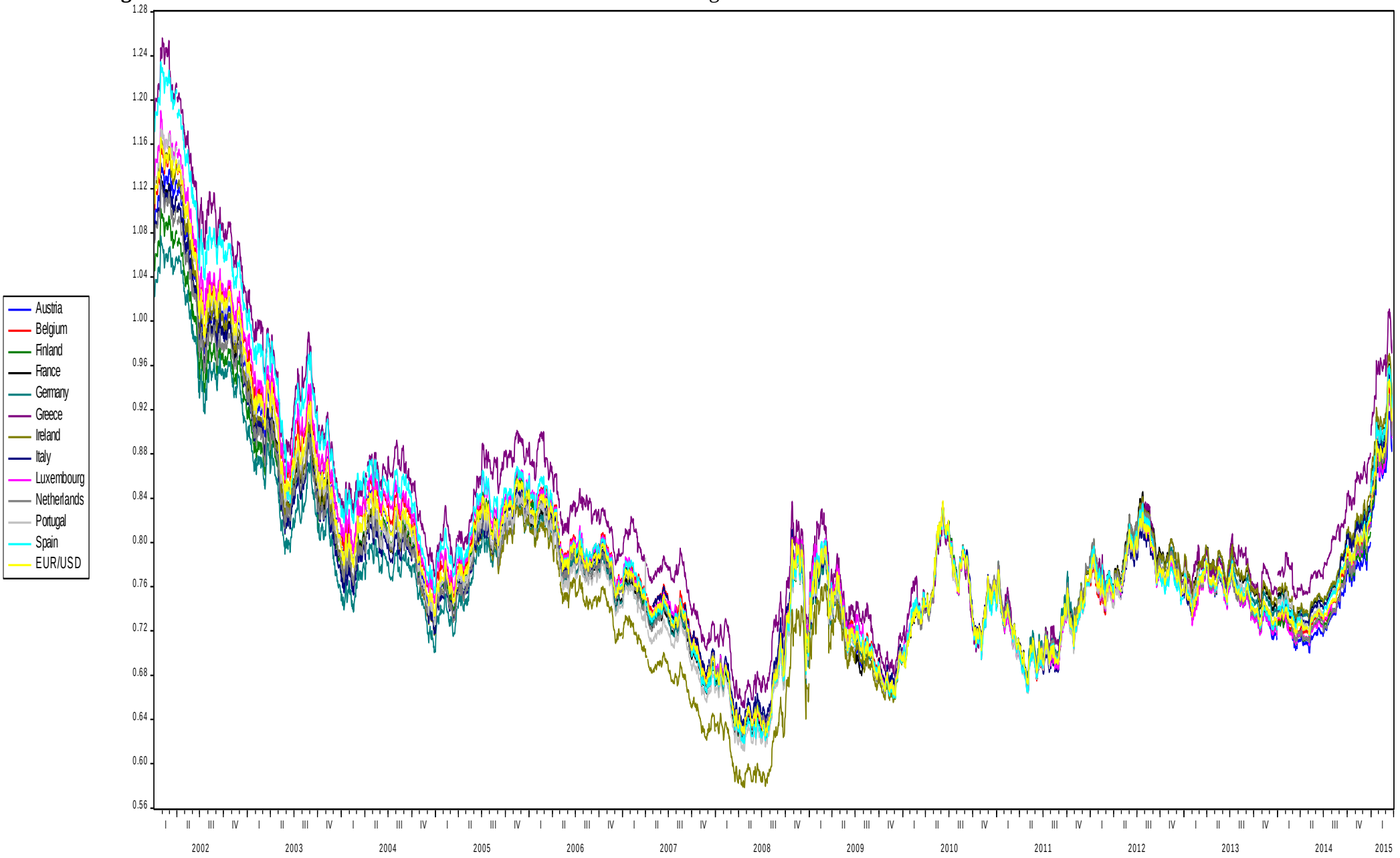
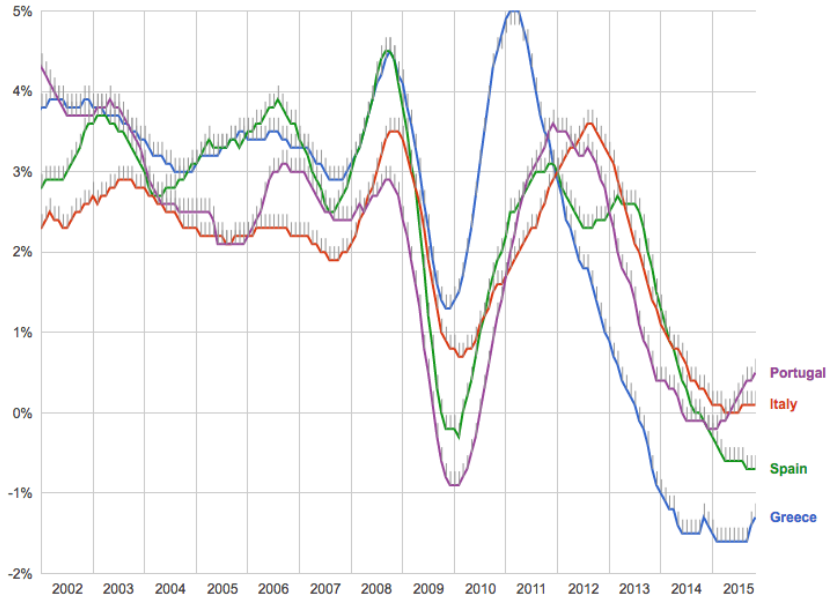


Figure 18: Timeline of annual harmonized inflation index from 2002 to 2015 in Portugal, Italy, Greece and Spain



Source: World Bank (2016)

The North-South divergence within EMU has to do with the fact that the two European regions diverge (or stay apart) on inflation. This is a serious problem given that the whole Euro project was based on converging inflation rates not only until the introduction of the single currency, but on a permanent and sustainable fashion thereafter. The 'North' and 'South' of the Eurozone have very different "varieties of capitalism' and as a result:

- The South has a tendency to relatively rapid inflation because of the rapid wage increases partly attributed to the dynamism of their trade unions (family-state capitalism) whereas the North enjoys the synergetic harmony of the stake-holder capitalism.

- The North tends to invest much more than the South in R&D and has developed high technology, export oriented and competitive industrial sectors, whereas the South not only failed to expand the exports of it's low-medium technology sectors, but had to fight against the exports of emerging economies to Europe.

Consequently, the "two Europes" display massive divergences in their balances of current account.

Figure 19: Timeline of annual harmonized inflation index from 2002 to 2015 in the Euro Area (12)

Source: Eurostat (2016)

The figure above presents the inflation rate in the Euro Area (12) from 2002 to 2015. We observe that the inflation rate remained steady from 2002 to 2008. After this period, the general price index faced 1% decrease until 2010. Also, the inflation rate in the Euro Area (12) increased from 2010 to 2013. At the end, we observe a significant reduction to the historical low of 0,5% in 2015. In fact, the Euro Area is close to the deflation.

This section presents the empirical results of a bivariate linear regression analysis by using the methodology of Robust Least Squares (RLS). Robust regression is an alternative to Ordinary Least Squares (OLS) regression when data are contaminated with outliers or influential observations, and it can also be used for the purpose of detecting influential observations (Audibert and Catoni, 2011). The dependent variable (endogenous) is the natural logarithmic value of the nominal exchange rate of the euro against the US dollar. The control variable (exogenous) is the natural logarithmic value of the real exchange rate of each Euro Area country. The table 53 presents the results of independent variables' coefficient. The z-statistic values are in the parenthesis. We observe that the empirical results of the bivariate regression analysis show that the real exchange rates of the core Eurozone countries influence more the nominal exchange rate of the euro against the US dollar than the euro-periphery. In particular, the impact of the real exchange rate of the Eurozone core countries on the nominal exchange rate of the euro has been found to be falling through time (Austria, Finland, France,

Germany, Italy and the Netherlands). On the other hand, the impact of the real exchange rate of the euro-periphery (Greece, Portugal and Spain) has increased over time.

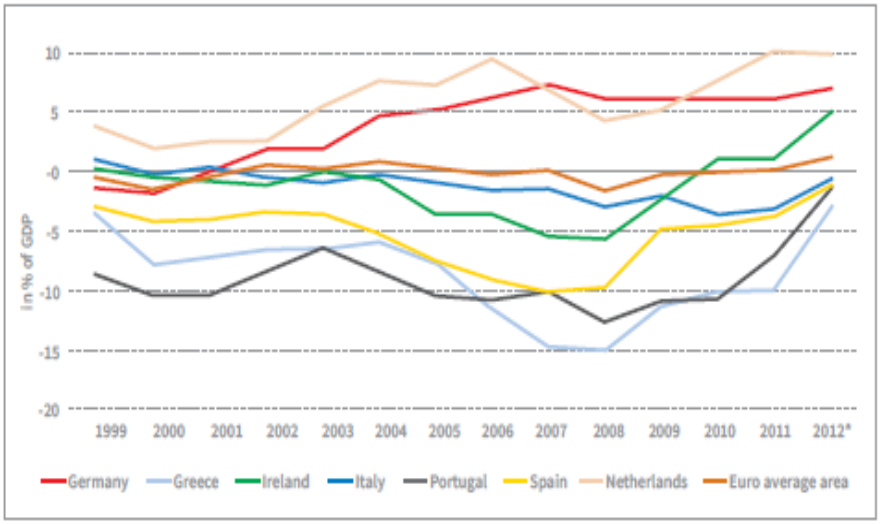
Table 53: Bivariate Linear Regression with Robust Least Squares (RLS)				
Euro Area-12	*Overall*	*1st Period*	*2nd Period*	*3rd Period*
Austria	1.021 (100.56)*	1.046 (102.23)*	0.984 (531.71)*	0.927 (222.50)*
Belgium	0.981 (835.61)*	1.023 (909.30)*	0.978 (273.65)*	0.981 (691.71)*
Finland	1.104 (565.44)*	1.138 (333.06)*	0.999 (272.22)*	0.974 (363.48)*
France	1.058 (308.96)	1.037 (126.12)*	0.963 (327.79)*	0.943 (271.58)*
Germany	1.180 (275.21)*	1.154 (266.99)*	1.065 (6.77)*	0.988 (480.97)*
Greece	0.898 (311.21)*	0.948 (462.91)*	1.046 (106.80)*	0.731 (79.52)*
Ireland	0.895 (216.98)*	0.909 (358.20)*	0.725 (55.87)*	0.905 (210.33)*
Italy	1.091 (58.48)*	1.057 (346.35)*	1.108 (276.78)*	0.962 (276.05)*
Luxembourg	0.954 (687.21)*	0.988 (667.28)*	0.968 (451.53)*	0.956 (335.27)*
Netherlands	1.089 (654.83)*	1.074 (582.98)*	1.009 (293.74)*	0.987 (216.74)*
Portugal	0.973 (682.54)*	0.945 (693.64)*	0.911 (151.67)*	0.951 (302.98)*
Spain	0.881 (665.05)*	0.896 (360.70)*	0.927 (250.81)*	0.930 (319.50)*

Note: (*) denotes statistically significant at 0.05 level

However, we found out that the present impact reduced drastically in specific periods. For instance, the impact of the Greek real exchange rate has fallen during the third period. This occurs because the Greek economy is in economic crisis from 2010 to 2016. The main reason of the Greek economic crisis was the financial unavailability of the Greek public debt. Furthermore, the impact of the Irish real exchange rate faced a similar reduction during the second period. This happens because Ireland was in economic recession from 2008 to 2012. The basic reason of the Irish economic crisis was the collapse of the real estate sector. Also, Ireland has the highest budget deficit in 2010, which was equal to -32,1% of Irish GDP.

From Figure 20 one can derive that the Eurozone members of the periphery which experienced higher inflation rates and consequently a loss in competiveness due to the increasing real exchange rates, also suffered a deterioration in their balances of current account (up to a deficit of 15% as a percentage of GDP for Greece). Countries of the North however with low inflation rates enjoyed a fall in the real exchange rates, an increase in competiveness and current account surpluses between 5-10% as a percentage of GDP in cases.

Figure 20: Balance of current account divergence



Source: Eurostat (2016)

We decided to use the Asymmetric Component GARCH model. The mean equation of the AC-GARCH model is based on the return of the examined variables. The dependent variable is the return of the nominal exchange rate of the euro against the US dollar. The control variable is the return of the real exchange rate of the euro against the US dollar. However, the real exchange rate is different for each Eurozone country. Therefore, multiple AC-GARCH models were executed. AC-GARCH model is appropriate in order to investigate short- and long-term volatility persistence, volatility clustering and leverage effect Engle and Lee (1999). The current model expresses the process of conditional variance and allows mean reversion to a time-varying ρ. Also, it describes conditional variance to react asymmetrically to return shocks. Particularly, we utilized a AC-GARCH(1,1) including the threshold term (γ). The z-statistic values are in the parenthesis in the tables.

Table 54 presents the empirical findings of AC-GARCH(1,1) model of the total period for each Euro Area country. The ρ parameter shows the time-varying long-term volatility. We observe that the value of this component is approximately equal to unity for all countries. This means that the long-term volatility memory of the euro is highly persistent against the shocks' of the real exchange rate of all Eurozone countries. However, this parameter is extremely low for Germany. This indicates that the long-term volatility of the nominal exchange rate of the euro is not persistent against the shocks' of the German real exchange rate. Therefore, Germany influences more the volatility of the euro. The φ parameter shows the difference between an ARCH and GARCH effect. The α coefficient shows the ARCH effect, which presents the volatility sensitiveness against the shocks of the real exchange rate. The value of α parameter is positive for all countries. Thus, we expect that the volatility of the euro is more sensitive to large shocks. However, an opposite effect exists for Austria.

Table 54: Asymmetric Component GARCH– Total Period (01/01/2002 - 31/03/2015)

Euro Area - 12	ω	ρ	φ	α	γ	β
Austria	0.0090 (1.10)	0.998 (505.90)*	0.103 (27.40)*	-0.023 (-3.68)*	0.141 (13.37)*	-0.680 (-17.56)*
Belgium	0.0055 (1.94)	0.997 (746.85)*	0.220 (33.77)*	0.530 (126.83)*	-0.131 (-27.64)*	0.118 (15.40)*
Finland	0.0005 (0.80)	0.999 (687.11)*	0.085 (20.07)*	0.154 (9.93)*	0.336 (26.37)*	0.138 (9.44)*
France	0.0003 (1.02)	0.997 (564.23)*	0.155 (18.19)*	0.262 (3.89)*	-0.011 (22.45)*	-0.219 (-11.14)*
Germany	0.0001 (21.99)*	0.660 (99.41)*	0.054 (6.77)*	0.078 (14.43)*	0.080 (19.33)*	0.853 (160.27)*
Greece	0.0006 (9.64)*	0.986 (709.47)*	0.097 (29.62)*	0.118 (9.11)*	0.202 (16.58)*	0.237 (9.83)*
Ireland	0.0005 (4.01)*	0.998 (1729.19)*	0.106 (63.06)*	0.295 (44.93)*	0.101 (12.60)*	-0.060 (-5.90)*
Italy	0.0003 (1.42)	0.998 (605.31)*	0.112 (21.50)*	0.079 (6.50)*	0.265 (33.56)*	0.268 (11.03)*
Luxembourg	0.0004 (5.62)*	0.994 (1013.77)*	0.094 (37.53)*	0.161 (12.16)*	0.208 (27.33)*	0.212 (11.01)*
Netherlands	0.0001 (9.09)*	0.980 (459.59)*	0.130 (20.12)*	0.187 (11.99)*	0.389 (31.64)*	0.060 (6.78)*
Portugal	0.0068 (7.69)*	1.000 (83.57)*	0.050 (99.05)*	0.119 (8.12)*	0.079 (4.15)*	0.027 (1.35)
Spain	0.0004 (3.36)*	0.991 (489.03)*	0.118 (7.19)*	0.311 (53.74)*	0.060 (15.29)*	0.528 (37.39)*

Note: (*) denotes statistically significant at 0.05 level

A characteristic of long-term component is that it changes relatively slowly over time. Additionally, the γ parameter is the threshold term which shows the leverage effect. Particularly, its value is positive for all Eurozone countries, except Belgium and France. This means that the bad news of the real exchange rate of each country has a larger impact on the volatility of the euro than the good news. On the other hand, the leverage effect is negative for Belgium and France. This indicates that the good news of the real exchange rate of these Eurozone countries has a greater effect on the volatility of the euro instead of the bad news.

Table 55: Asymmetric Component GARCH– 1st period (01/01/2002 – 09/08/2007)						
Euro Area - 12	ω	ρ	φ	α	γ	β
Austria	0.0800 (0.998)	1.000 (141.54)*	0.120 (29.11)*	-0.060 (-7.62)*	0.118 (6.45)*	0.957 (66.66)*
Belgium	-0.0001 (-11.22)	1.000 (14.72)*	0.145 (128.80)*	0.119 (30.06)*	0.014 (7.05)*	-0.780 (-107.07)*
Finland	0.0001 (7.72)*	0.977 (353.45)*	0.170 (14.59)*	0.050 (3.91)*	0.235 (16.91)*	0.632 (32.02)*
France	0.0003 (0.90)	0.993 (134.05)*	0.231 (17.19)*	0.090 (5.15)*	0.110 (7.74)*	-0.536 (-18.77)*
Germany	0.0001 (3.17)*	0.660 (241.09)*	0.054 (12.61)*	0.078 (1.99)*	0.081 (4.28)*	0.853 (5.86)*
Greece	0.0008 (10.24)*	0.922 (124.16)*	0.168 (20.77)*	0.152 (24.80)*	-0.053 (-11.13)*	0.853 (121.68)*
Ireland	0.0005 (4.07)*	0.965 (121.41)*	0.058 (2.96)*	0.063 (2.31)*	0.050 (3.33)*	0.898 (39.41)*
Italy	0.0001 (5.78)*	0.954 (120.79*)	0.307 (22.94)*	0.124 (6.83)*	-0.231 (-12.94)*	0.577 (9.03)*
Luxembourg	0.0004 (9.60)*	0.994 (4.85)*	0.094 (21.14)*	0.161 (34.67)*	0.207 (-8.10)*	0.213 (151.49)*
Netherlands	0.0002 (7.16)*	0.962 (182.74)*	0.200 (12.96)*	0.007 (0.33)	0.262 (14.08)*	0.639 (25.64)*
Portugal	0.0001 (2.75)*	0.994 (628.84)*	0.075 (6.58)*	0.276 (13.17)*	-0.178 (-10.87)*	0.733 (32.81)*
Spain	0.0003 (3.94)*	0.993 (572.65)*	0.078 (19.89)*	0.104 (4.77)*	0.133 (6.14)*	0.332 (6.46)*

Note: (*) denotes statistically significant at 0.05 level

Finally, the β parameter presents the transitory or the short-term component of the conditional variance. Particularly, the main role of this short-run component being to pick up the temporary increase in volatility after large shocks. The empirical results suggest that the short-term volatility of the euro is highly persistent to the shocks of the real exchange rate of Germany and partially Spain. However, the short-term volatility

of the euro is extremely vulnerable against the shocks' of the real exchange rates of the rest euro countries. Finally, the real exchange rate of Portugal has no impact on the short-term volatility of the euro.

Table 55 presents the empirical findings for the 1st period (before global financial crisis 2007-2008). We observe that the long-term volatility (ρ) persistence is extremely high against the volatility shocks' of the real exchange rate of all Eurozone countries, except Germany. This means that the volatility of the German real exchange rate influences more the nominal exchange rate of the euro. In addition, the α parameter expresses the ARCH effect and it is related with the volatility clustering.
The coefficients are positive for all euro countries, except Austria. Hence, we expect that the volatility of the euro is more sensitive to large shocks of each real exchange rate. The volatility asymmetry is negative for Greece, Italy and Portugal. This means that that the good news of the real exchange rate of these Eurozone countries has a larger impact on the volatility of the euro instead of the bad news. A completely opposite effect takes place for the rest of the euro member-states. Finally, the β parameter expresses the short-term volatility persistence. We observe that the volatility of the euro is highly persistent against the shocks of the real exchange rate of the majority of the Euro Area countries. However, an opposite effect takes place for the real exchange rates of Belgium, France, Luxembourg and Spain.

Table 56 shows the results of the Asymmetric Component ARCH (1,1) for 2nd period. We observe that the ρ parameter is statistically significant only for Austria France, Germany, Greece and Ireland. Therefore, the long-term volatility is completely persistent against the shocks' of the Austrian, Greek and Irish real exchange rate. Moreover, the long-run volatility is partially and low persistent against the shocks' of the French and German real exchange rate. The volatility clustering is positive for France, Germany and Ireland. This means that the volatility of the euro is more sensitive to large shocks of the real exchange rate of these countries. An opposite effect exists for Greece. On the contrary, the volatility clustering is not sensitive for the rest Euro Area countries. The leverage effect is positive for France, Germany, Greece, Ireland and Portugal expressing that that the bad news of the real exchange rate of these Eurozone countries has a larger impact on the volatility of the euro instead of the good news. On the other hand, the news of the Austrian, Belgian, Finnish, Italian, Dutch and

Spanish real exchange rate has no influence on the volatility of the euro. Finally, the transitory parameter indicates high short-term volatility persistence of the euro against the shocks of the Greek and Portuguese real exchange rates. The short-term volatility persistence of the euro is not high against the shocks of the real exchange rate of France, Germany and Ireland.

Table 56: Asymmetric Component GARCH– 2nd period (10/08/2007 – 30/04/2010)						
Euro Area - 12	ω	ρ	φ	α	γ	β
Austria	0.0001 (28.97)*	0.986 (2.04)*	0.125 (0.68)	0.087 (0.47)	0.096 (1.25)	0.012 (0.10)
Belgium	0.0002 (19.35)*	0.500 (0.88)	0.040 (0.27)	0.097 (0.61)	0.040 (1.64)	0.016 (0.08)
Finland	0.0001 (26.68)*	0.495 (1.65)	0.035 (1.32)	-0.049 (-1.63)	0.009 (1.11)	0.015 (0.03)
France	0.0001 (1.89)	0.466 (140.29)*	0.261 (3.90)*	0.537 (9.71)*	0.106 (8.71)*	0.232 (3.75)*
Germany	0.0002 (37.77)*	0.458 (0.76)	0.131 (0.45)	0.052 (-0.82)	0.114 (-0.40)	0.451 (0.01)
Greece	-0.0001 (46.63)*	0.727 (16.53)*	0.030 (9.63)*	-0.048 (-10.06)*	0.013 (4.34)*	0.841 (32.64)*
Ireland	0.0000 (6.90)*	0.984 (4.47)*	0.184 (3.49)*	0.113 (2.29)*	0.321 (7.50)*	0.373 (6.38)*
Italy	0.0001 (41.33)*	0.372 (0.29)	0.005 (0.02)	0.067 (1.07)	0.273 (9.86)*	-0.007 (-0.19)
Luxembourg	0.0002 (36.83)*	0.451 (0.48)	0.006 (0.15)	0.004 (0.09)	0.143 (4.84)*	-0.045 (-0.58)
Netherlands	0.0003 (13.21)*	0.500 (0.92)	0.040 (0.35)	0.040 (0.31)	0.040 (1.73)	0.016 (0.04)
Portugal	-0.0002 (41.81)*	0.443 (0.65)	0.027 (0.13)	-0.045 (-0.22)	0.010 (3.08)*	0.611 (3.07)*
Spain	0.0002 (47.21)*	-0.041 (-0.02)	0.026 (0.02)	-0.035 (-0.02)	-0.006 (-1.71)	0.063 (0.06)

Note: (*) denotes statistically significant at 0.05 level

Table 57 illustrates the empirical findings of AC-GARCH(1,1) for the third period. The ρ parameter shows that the long-term volatility persistence of the euro is high against the shocks' of Austrian, Greek, Irish and Dutch real exchange rates. An opposite effect exists for the real exchange rates of Belgium, Finland, France, Germany and Portugal. The volatility clustering is positive for Austrian, Belgium, Finland, Greece, Ireland, Luxembourg and Netherlands indicating that the euro is more sensitive to large shocks of the real exchange rate of these countries. The volatility asymmetry is positive for Austria, Belgium, Germany, Ireland, Italy, Netherlands, Portugal and Spain. This

means that the bad news of the real exchange rate of these Eurozone countries has a larger impact on the volatility of the euro instead of the good news. On the other hand, the leverage effect is negative for Finland, Greece and Luxembourg. Therefore, the good news of the real exchange rate of these Eurozone countries has a greater impact on the volatility of the euro instead of the bad news. No leverage effect takes place for France. Finally, there is not a transitory effect of none Eurozone countries in the short-run.

Table 57: Asymmetric Component GARCH– 3rd period (01/05/2010 – 31/03/2015)						
Euro Area - 12	ω	ρ	φ	α	γ	β
Austria	0.0001 (27.57)*	0.842 (35.47)*	0.059 (3.02)*	0.183 (5.60)*	0.224 (11.74)*	-0.016 (-2.55)*
Belgium	0.0005 (103.08)*	0.485 (4.37)*	-0.030 (-2.48)*	0.034 (2.46)*	0.090 (7.30)*	0.010 (0.54)
Finland	0.0002 (19.20)*	0.553 (3.40)*	0.094 (0.73)	0.303 (2.54)*	-0.096 (-3.86)*	0.036 (0.57)
France	0.0004 (59.53)*	0.500 (2.11)*	0.040 (0.66)	0.040 (0.76)	0.040 (1.51)	0.016 (0.08)
Germany	0.0000 (64.02)*	0.491 (2.60)*	0.027 (0.86)	0.034 (0.91)	0.292 (16.60)*	0.007 (0.22)
Greece	0.0004 (5.74)*	0.987 (253.26)*	0.066 (15.27)*	0.099 (6.60)*	-0.172 (-9.26)*	-0.369 (-4.96)*
Ireland	-0.0002 (19.09)*	0.907 (138.68)*	0.086 (5.61)*	0.102 (4.98)*	0.203 (10.44)*	0.066 (1.09)
Italy	0.0001 (52.48)*	0.500 (1.12)	0.040 (0.38)	0.040 (0.36)	0.040 (1.79)	0.016 (0.05)
Luxembourg	0.0003 (44.77)*	0.383 (1.79)	0.035 (0.62)	0.303 (5.30)*	-0.210 (-14.14)*	-0.013 (-0.21)
Netherlands	-0.003 (20.83)*	0.956 (49.84)*	0.011 (2.85)*	0.314 (8.29)*	0.227 (10.28)*	-0.009 (-1.97)*
Portugal	0.000 (44.18)*	0.431 (9.72*	0.042 (0.46)	0.159 (1.67)	0.080 (2.74)*	0.012 (0.21)
Spain	0.002 (63.92)*	0.515 (0.47)	-0.005 (-0.21)	-0.005 (-0.10)	0.425 (28.99)*	-0.018 (-1.34)

Note: (*) denotes statistically significant at 0.05 level

9.5 Conclusions

The euro is the greatest success in Europe after the end of the World War II. In fact, the European common currency was made in order to bring economic prosperity in the member-states, increase their economic robustness and lead to the inevitable political integration in the EU. However, the European debt crisis in 2010 revealed plenty of

inaccuracies within the Euro Area. The euro has been transformed into a "doomed" currency. The weak countries of the Euro Area (periphery) discovered that a hard currency is not beneficial during economic recession. On the other hand, the strong countries of the Eurozone (core) endured the shocks of the European debt crisis. The impossible situation of the Euro-South could be summarized as follows:

- To achieve a sustainable external balance, Portugal and Greece needed to devalue by 35 and 30% respectively, Spain by 20% and Italy by10-15%. (Wolf, 2012).
- One can imagine how long that would take by differential inflation (internal devaluation) which is the policy imposed to Greece by the IMF and the European institutions.

Our empirical results revealed that the real exchange rates of the core Eurozone more influence the nominal exchange rate of the euro. Germany and France play a leading role on the configuration of the euro nominal exchange rate. However, their influence has decreased over time. In addition, we discovered that the real exchange rate of Greece, Portugal and Spain increased over time. This means that these countries lost their competiveness since their products/services became more expensive. On the other hand, we found out that the circulation of the euro boosted the competiveness of the core Euro Area. For instance, Austria, Finland, France, Germany and the Netherlands enjoyed a lower real exchange rate. Thus, their exports faced an inevitable increase. Furthermore, it is important to mention that Greece regained its competiveness during the third period. This occurred due to austerity measures and the sign of Memoranda of Understanding (three). This means that Greek economy regained a small part of their competiveness due to the extreme austerity which have been implemented by the Greek Government from 2010 to 2016. In fact, Greece faced a devaluation of its domestic price because it was not eligible to undervalue the nominal exchange rate of the euro. In addition, a Greek exodus (GREXIT) from the European monetary union would be catastrophic for the Greek society and economy, because Greece has not the appropriate financial instruments in order to re-issue a new currency. However, this strict fiscal policy created multiple anomalies in the Greek economy, such as continuous economic recession, high unemployment rate and deflation. In conclusion, we quote that the empirical results of our research are totally aligned with the findings of Rusek (2012) and Mirdala (2016). In addition, we discovered similar results with Durand and Lopez

(2013) concerning of the increase of German and French competiveness of their economy after the circulation of the euro. Finally, we should point out that the Euro Area contains de facto two different groups, core and periphery. Actually, we provide evidence that a competitive divergence exists in the Euro Area. There is a high necessity for symmetric adjustment. Our results are totally aligned with the empirical findings of Giannelis and Koukouritakis (2017). Furthermore, Gibson *et al.* (2014) claim that the European monetary union requires an adjustment mechanism that will eliminate external imbalances. Therefore, the leaders of the Euro Area should decide if they wish more economic and political integration or two Eurozones. The recent (March 2017) White Paper presentation of European Commission's President Jean-Claude Juncker's for the future of the European Union clearly reflects wishful thinking and nostalgia for the shiny days of the euro. Alas it gets more and more obvious that the way things are, one single currency no longer fits all.

Chapter 10. Bulgaria, Estonia and Lithuania

10.1 Introduction

The Post-Communist of the EU entered in the European Union during the 5th Enlargement of the EU in 2004. Actually, eight Central and Eastern European countries (the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia), plus two Mediterranean countries (Malta and Cyprus) joined on 1 May 2004. This was the largest single enlargement in terms of people, and number of countries, though not in terms of GDP. The less developed nature of these countries was of concern to some of the older member states. Some countries, such as the UK, immediately opened their job market to the accession states, whereas most others placed temporary restrictions on the rights of work of the citizens of these states to their countries. On 1st January 2007, the EU also welcomed two Balkan countries, Bulgaria and Romania, which were a part of the 5th EU Enlargement. However, these states faced a series of restrictions as to their citizens not fully enjoying working rights on the territory of some of the older EU members.

The main purpose of this research is to examine if the EU membership influences positively Bulgaria, Estonia and Lithuania. Also, we would like to examine of the economy of these countries were more integrated to the European economy, due to their EU participation. Finally, we shall explore if Lithuania and Estonia entered hopefully to the Euro Area. At first glance, we could assume that these countries have no common characteristics. However, there are two ordinary features; Post-Communist countries of the EU; and they have fixed nominal exchange rate against the euro.

As the Bulgarian lev was fixed to the Deutsche Mark at par, the lev's peg effectively switched to the euro, at the rate of 1.95583 leva = 1 euro, which is the Deutsche Mark's fixed exchange rate to euro. On the occasion of the signing of the EU accession treaty on 25 April 2005, the Bulgarian National Bank issued a commemorative coin with a face value of 1.95583 leva, giving it a nominal value of exactly 1 euro. Bulgaria is not still a member of the Euro Area.

Initially, the Estonian kroon was pegged to the Deutsche Mark at a rate of 8 krooni = 1 Deutsche Mark. After the introduction of the euro the fixed exchange rate of 1.95583 DEM to EUR led to an exchange rate of 15.64664 krooni to the euro. On 28 June 2004, as Estonia joined the ERM II-system, the central parity of the Estonian kroon was

revalued (by less than 0.001%) to 15.6466 krooni per euro. Estonia became a member of the Euro Area on 1st January 2011.

From 1 April 1994 to 1 February 2002, the litas was pegged to the U.S. dollar at the rate of 4 to 1 (the litas was stable around 3.9 for half a year before the rate was fixed). The main reasons for this fixation was little trust in the emerging monetary system, fear of high fluctuations in currency exchange rates, desire to attract foreign investors, and International Monetary Fund recommendations. The peg was renewable every year. For a while a peg was considered to a basket of currencies: The European Currency Unit. On 2 February 2002 the litas was pegged to the euro at a rate of 3.4528 to 1 (1 LTL = 0.28962 EUR); this rate was not expected to change until the litas was completely replaced by the euro on 1 January 2015.

During the completion of this research, we used the real exchange rates of Bulgaria, Estonia and Lithuania against the US dollar in order to answer our aims. Actually, we would like to examine if there are possible linkages between the real exchange rates of the Post-communist countries and the real exchange rate of the euro. We utilized a combination of the Error Correction Model (ECM) with the Threshold GARCH. Therefore, we created an innovative model, so called, ECM-TGARCH. The main characteristic of this model is that it reveals possible short- and long-term linkages among a group of variables and if their system is in equilibrium. Additionally, we could examine the volatility responses and the leverage effect. Basically, we inspired the research of Stoupos and Kiohos (2017), who combined the ECM with EGARCH model.

Kalcheva (2003) investigates to what extent the economies of Estonia and Bulgaria are affected by a strong appreciation (depreciation) of the euro as their anchor currency. She argues that currency risk cannot be neglected in transition countries pegged to euro. Cuaresma *et al.* (2010) used the exchange rates of Bulgaria, Croatia and Romania and they discovered that strong and persistent exchange rate misalignment may be a hindering factor in the period prior and during ERM II participation and bears the risk of speculative attacks. Errit and Uuskula (2014) studies the effect of a monetary policy shock in the euro area on the main Estonian economic and financial variables between 2000 and 2012. They found out that a monetary policy shock also has strong and sluggish effects on the housing loan and consumer credit interest rates. The estimated reaction of Estonian GDP and the GDP deflator-based inflation rate is about four times stronger than the reaction of euro area-wide aggregates. Feldmann (2013) explores the

origins of the currency board and shows how institutions, interests, and ideas have contributed to Estonian exceptionalism in macroeconomic policy and to euro adoption. The author demonstrates that the Estonian experience can shed light on the political prerequisites of internal devaluations, which may be of great relevance both to current and future Central and Eastern European euro area members. In addition, Jurgutyte (2014) supports that the adoption of the Euro for Lithuania should therefore be of less concern than previously anticipated based on experiences from the years before the Lithuanian currency was fixed to the US dollar. Rubio and Comunale (2017) presented a two-country monetary union new Keynesian general equilibrium model with housing and collateral constraints calibrated for Lithuania and the rest of the euro area. In terms of macroprudential policies, their results show that the optimal policy in Lithuania with respect to the euro area may have a different intensity and that it delivers substantial benefits in terms of financial stability. Also, Stakenas and Stasiukynaite (2017) examined the effect of a (standard) monetary policy shock in the euro area on the Lithuanian economy. Their results suggest a stronger impact of monetary policy than that estimated using the Lithuanian model and a quite considerable degree of variation over time in the strength of monetary policy transmission. Finally, Rubio and Comunale (2018) studied the implications of macroprudential policies for macroeconomic and financial stability in Lithuania and the rest of the euro area. The results show that both rules are effective in making the financial system more stable in both countries, and especially in Lithuania and an extended Taylor rule is effective in reducing the volatility of credit but comes with a cost in terms of higher inflation volatility.

In summary, our empirical results indicate that the there is a negative short- and long-term relationship between the Bulgarian Lev and the euro. Actually, the EU membership of Bulgaria did not help the integration of the country with the Euro Area. This means that Bulgaria is not ready to join the EMU, from a financial viewpoint. On the other hand, our empirical evidence highly supports that there is neutral short-term effect of the euro on the ex-currencies of Estonia and Lithuania. The long-term impact is positive with an upturn tendency. This means that these countries were ready to be members of the Euro Area, since their economy was bound with the European economy.

10.2 Dataset Analysis and Methodology

The present research uses the real exchange rates of two member-states currencies (Estonia and Lithuania) in the Eurozone and one member-state currency (Bulgaria) of the EU. Estonia and Lithuania joined the monetary union at different dates, but they have been participating in the EU since 01 May 2004. On the other hand, Bulgaria is not a member of the Euro Area, but it has been participating in the EU since 01 January 2007. These three countries seem to have no logical relationship. However, they show two features; Post-Communist countries of the EU and pegged exchange rate against the euro.

Particularly, we explore any possible relationships among the Euro, the Bulgarian Lev, the Lithuanian Litas and the Estonian Kroon. The examination period is different among the currencies (Table 55).

Table 58: Data Presentation (Source: European Central Bank)

Countries	Period	Acronym	Measure
Euro Area	01/01/99 – 31/12/17	EUR	€/$
Bulgaria	01/01/99 – 31/12/17	BGN	лв/$
Estonia	01/01/99 - 31/12/10	EEK	Kr/$
Lithuania	01/01/99 – 31/12/14	LTL	Lt/$

This happens because Estonia and Lithuania had adopted the euro, as its own currency, at different dates when they fulfilled the euro convergence criteria. Also, Bulgaria is still not a member of the Euro Area. Essentially, our dataset covers a period of 19 years in daily basis. The data was gathered from the official database of the European Central Bank (ECB). The real exchange rate of each currency is calculated per US dollar (USD).

The data has been made by the authors by using the theory of real exchange rates. In particular, we used the following formula:

$$e_R = e * \frac{P_f}{P_h} \quad (46)$$

Where, e_R is the real exchange rate of a country, e is the nominal exchange rate, the P_f is the general price level of goods and services of host country (Eurozone/Bulgaria/Estonia/Lithuania) and P_h is the general price level of good and service of home country (United States).

The real exchange rate is the nominal exchange rate adjusted for the changes in purchasing power of the currencies concerned from base period 0. It is important that P_f and P_h are the percentage changes in the Consumer Price Index (CPI) from the base period. Essentially, P_f and P_h are the inflation rates of the respective nations from base period 0.

We decided to use the US dollar because it is historically the most tradable currency across the globe. The international markets still use more frequent the US dollar as their currency in order to receive and give payments. The dataset was divided into two periods in order to investigate the special features of each era. The cut point is the date of 01 May 2004 for Lithuania and Estonia when these countries entered in the EU. Additionally, the cut point is the date 01 January 2007 for Bulgaria when the countries became a member of the EU. Also, we explore the total period for each country in order to discover the overall trend.

The two periods are the following:

a) 01 January 1999 to 30 April 2004 or 31 December 2006

During this period the examined countries were not member-states of the European Union. Therefore, they had limited trade and economic relationships with the 15 countries of the EU. This happens because Estonia, Lithuania and Bulgaria are Post-Communist countries, historically they had strong political, economic and trade relationships with Russia. Finally, these countries had limited access to European Single Market as not participating in the union. Thus, no free trade flows were able to take place (quotas, taxes and custom fees).

b) 01 May 2004 or 01 January 2007 to 31 December 2010 or 2014 or 2017

The present period is related with the adoption of the euro for Lithuania and Estonia However, each examined country had adopted the euro at different dates. The aim of

this era is to investigate the impact of the EU membership on the economy of each country. In addition, Bulgaria is not a member of the Euro Area during this period. We used the most recent (2017) available data for the real exchange rate of Bulgaria. The performance of each economy is measured by using the impact of the real exchange rate of the euro on the (old) currency of each country.

The use of Error Correction Model is most suitable when we wish to explore simultaneously a dynamic short-term or long-term linkage among a group of variables. On the contrary, we decided not use the Vector Error Correction Model (VECM) because this statistic procedure is used when there is not co-integration condition among the examined series. VECM is most suitable to explore short-term relationships only (Brooks, 2014).
In specific, we used the following multivariate model in our research in order to explore short-term and long-term dynamics among the examined variables.

$$\boldsymbol{\Delta\left(ln(CUR_t)\right) = \omega + \varphi EC_{t-1} + \psi\left(\Delta ln(CUR_{t-1})\right) + \theta\left(\Delta(ln(EUR_{t-1})\right) + \varepsilon_t (47)}$$

where, the dependent variable lnCURt represents the natural logarithmic value of the real exchange rate of the Bulgarian Lev (BGN), or Estonian Kroon (EEK), or Lithuanian Litas (LTL), against the US dollar (USD). The independent variable (lnEURt) is the natural logarithmic value of the real exchange rate of euro (EUR) against the US dollar (USD).

We used the logarithmic expression because its small changes in the log of a variable are directly interpretable as percentage changes, to a very close approximation, in econometrics. This means that the prediction accuracy of the impulse responses would be higher and more qualitative.
The examination of a unit root is particularly important in time series analysis. This test is executed both in levels and 1st difference. The empirical results (table 59) reveal that each series is stationary in 1st difference.
Therefore, we are able to use Johansen Co-integration test in order to examine if the series are co-integrated in the long run. We used a trend and an intercept in the equation of the Augmented Dickey-Fuller test.

Table 59: Estimation Results of Augmented Dickey Fuller Test (ADF)		
Series	**t-statistic(levels)**	**t-statistic(1st difference)**
Euro	-1.477	-70.599*
Bulgarian Lev	-1.486	-70.654*
Estonian Kroon	-0.959	-55.784*
Lithuanian Litas	-1.721	-65.265*

Note: (*) denotes statistically significant at 0.01 level

Tables 60, 61 and 62 show the empirical findings of the co-integration analysis. The co-integration test was executed by using the linear deterministic trend. We selected the deterministic trend assumption of test that there is trend and intercept in co-integrating equations (CE) and no intercept in VAR with one lag only. VAR selects a system of equations with 1 lag for each variable. The empirical findings of tables 60, 61 and 62 highly supports that there is at most one co-integrated vector at a level of significance equal to 0.01 (a=0.01). Therefore, we cannot reject the null hypothesis of co-integration test.

Table 60: Johansen's Co-integration Structural Breaks Test in ln series BGN and EUR				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value**	**Probability**
None	0.005602	29.871	15.494	0.0002*
At most 1	0.000451	2.221	3.842	0.1362

Note: (*) denotes statistically significant at 0.01 level

In specific the results of Johansen's Co-integration test show that there is a long-term tendency between the euro and the Bulgarian Lev.

Table 61: Johansen's Co-integration Structural Breaks Test in ln series LTL and EUR				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value**	**Probability**
None	0.007613	37.191	15.495*	0.0000*
At most 1	0.001310	5.446	3.842	0.0196

Note: (*) denotes statistically significant at 0.01 level

Moreover, we found out that a similar behavior exists between the Lithuanian Litas and the euro. These two currencies are co-integrated during the examined period.

Table 62: Johansen's Co-integration Structural Breaks Test in ln series EEK and EUR				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**Critical Value**	**Probability**
None	0.007124	27.538	15.495	0.0098*
At most 1	0.000286	0.8924	3.841	0.3448

Note: (*) denotes statistically significant at 0.01 level

A co-integration takes place between the euro and the Estonian Kroon during the total period.

10.3 Empirical Results

Table 63 presents the estimation results of Error Correction Model for the Bulgarian Lev. The dependent variable is the real exchange rate of the Bulgarian Lev (BGN) against the US dollar (USD) and the control variable is the real exchange rate of the Euro (EUR) against the US dollar (USD).

One interesting feature of the results reposted in Table 63 is the speed with which the exchange rate adjusts to its equilibrium value (φ). The empirical evidence of ECM supports that a disequilibrium exists between the real exchange rate of BGN/USD and the real exchange rate of EUR/USD before the participation of Bulgaria in the EU. The adjustment speed back to equilibrium is 9,4% (statistically significant) and then the 9,4% of a deviation from the error correction mechanism is corrected within 1 day before EU membership. Additionally, it is obvious that the euro influences negatively the Bulgarian lev in the short-run. This means that possible reductions of the euro influenced positively (overvaluation) the real exchange rate between the Bulgarian lev and the US dollar. Also, the long-term dynamics reveals a negative tendency between the Bulgarian lev and the euro before EU membership. Therefore, opposite sign bilateral effects took place between the euro and the Bulgarian lev in the long run. Furthermore, we observe that there are negative short-term linkages between the euro and Bulgarian lev after EU participation.

This means that possible fluctuations of the euro have negative impact on the real exchange rate between the Bulgarian lev and the US dollar. Also, a negative adjustment speed back to equilibrium takes place after EU membership (disequilibrium). Its value is equal to -0.179 or -17,9% which indicates that -17,9% of a deviation from the error correction mechanism is corrected within 1 day.

Table 63: Estimation Results of Error Correction Model - BGNvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ω	-0.003 (-0.046)	0.005 (13.27)*	0.001 (0.78)
ψ	-0.495 (-7.34)*	-0.492 (-4.53)*	-0.477 (-2.05)*
φ	0.095 (219.08)*	0.094 (168.40)*	-0.179 (-1.56)
θ	-0.492 (-7.28)*	-0.493 (-4.58)*	-0.479 (-2.06)*

Note: (*) denotes statistically significant at 0.05 level

The most important finding is that the long-term dynamics after EU participation between the variables are strictly negative. This indicates that possible increases of the euro have negative impact on the real exchange rate between the BGN and the USD. Actually, whereas the euro increases, the real exchange rate of the BGN/USD decreases. This may occur because the Central Bank of Bulgaria followed different monetary policy instead of the European Central Bank from 1999 to 2017. Especially, the interest rate of Bulgarian Lev was significantly higher than the interest rate of euro until 2009. Also, the inflation of Bulgaria was extremely high (10%-15%) from 1999 to 2009. On the other hand, the Euro Area enjoyed a stable inflation which was close to 2-3%. The Bulgarian inflation did not follow the inflation behavior of the Euro Area from 2010 to 2017. Actually, the Bulgarian inflation presents high volatility in a range from -1% to 5%.

Table 64 displays the estimation results of Error Correction Model for the Estonian Kroon. The dependent variable is the real exchange rate of the Estonian Kroon (EEK) against the US dollar (USD) and the control variable is the real exchange rate of the Euro (EUR) against the US dollar (USD).

We observe that the coefficients short- (ψ), long-term (θ) and the error correction term (φ) is statistically significant for each period, except the total period where the coefficients ψ and θ are not significant. Particularly, the real exchange rate of the euro has no short-term effect on the real exchange rate of the Estonian Kroon for the entire

period. However, the impact is negative during the first period where Estonia was not a member of the EU.

Table 64: Estimation Results of Error Correction Model - EEKvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ω	0.003 (0.81)	0.004 (12.98)	-0.004 (-6.57)*
ψ	0.231 (-0.95)	-0.027 (-2.68)*	-0.037 (-2.18)*
φ	-0.023 (0.94)	0.001 (5.98)*	0.001 (3.09)*
θ	0.056 (2.10)*	0.029 (2.72)*	0.037 (2.14)*

Note: (*) denotes statistically significant at 0.05 level

Also, the short-term impact of the euro on the Estonian Kroon is negative when Estonia joined the EU in May 2004. We observe that the long-term effect of the euro on the Estonian Kroon is positive when Estonia became a member of the EU. This means that the euro influences positively the past currency of Estonia. The impact became greater after the EU membership of the country. Also, the coefficient of error correction term (ECT) expresses that an upwards adjustment during the 1st and 2nd period is expected. The adjustment speed is extremely low (close to zero). The adjustment speed back to equilibrium is approximately zero and then the 0% of a deviation from the error correction mechanism is corrected within 1 day between Estonian Kroon and the euro. This may occur because the Estonian Central Bank followed similar monetary policy as the European Central Bank in order to became a member of the Euro Area. Also, the Estonian Kroon entered in the ERM II on 28th June 2004. The Lithuanian economy presents steady inflation rate from 2010 to 2017. The stabilization of the inflation rate was very important for the participation of the country in the European Monetary Union.

Table 65 shows the estimation results of Error Correction Model for the Lithuanian Litas. The dependent variable is the real exchange rate of the Lithuanian Litas (LTL)

against the US dollar (USD) and the control variable is the real exchange rate of the Euro (EUR) against the US dollar (USD).

Specifically, the short-term effect of the euro is neutral (statistically insignificant) on the Lithuanian Litas during the 1st period. The impact changes to positive during the 2nd period. Actually, the magnitude of the euro on the past increases significantly during the second period when Lithuania became a member of the EU. Additionally, the long-term impact of the real exchange rate of the euro is positive on the rela exchange rate of the Lithuanian Litas. The effect remains positive within the two periods, but it is clear that the magnitude's effect increases during the 2nd period. Particularly, the entrance of Lithuania in the EU influenced positively the dynamic relationship between the euro and the Lithuanian Litas. The adjustment speed back to equilibrium is approximately zero and then the 0% of a deviation from the error correction mechanism is corrected within 1 day between the ex-Lithuanian currency and the euro. This may occur because the Lithuanian Central Bank followed similar monetary policy as the European Central Bank in order to became a member of the Euro Area in 2015. Also, the Estonian Kroon entered in the ERM II on 28th June 2004. The Estonian economy presents stable inflation rate from 2004 to 2017. The stabilization of the inflation rate was very important for the participation of the country in the Eurozone.

Moreover, we decided to combine two econometric procedures in order to create an ECM-TGARCH model. Particularly, the Error Correction Model (ECM) was used as a mean equation and the typical mathematical expression of TGARCH model as the conditional variance equation. We used the errors of the ECM in order to run a GJR-GARCH (1,1) with 1 threshold. TGARCH is the most suitable in order to explore leverage effect as well as the impact of the bad and the good news on the volatility.

The properties of the TGARCH model are very similar to the EGARCH model which both are able to capture the asymmetric effect of positive and negative shocks. The TGARCH and the EGARCH may both be considered for the same series and it is hard to distinguish a criterion for choosing either one of the two models (Xekalaki and Degiannakis, 2010).

Table 66 shows the empirical evidences of TGARCH methodology for Bulgaria. We used in mean equation the real exchange rate of the Bulgarian Lev as the dependent variable and the real exchange rate of the euro as the independent variable. In addition, we utilized the errors of the ECM in order to execute a TGARCH(1,1) with 1 threshold.

The sum of ARCH and GARCH coefficients is very close to unity, expressing that Bulgarian Lev's volatility shocks are quite persistent.

Table 65: Estimation Results of Error Correction Model - LTLvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
ω	-0.008 (-0.97)	-0.003 (-2.27)*	0.001 (1.19)
ψ	-0.005 (-0.19)	-0.059 (-1.55)	0.065 (2.49)*
φ	0.002 (2.91)*	0.002 (2.51)*	0.002 (2.06)*
θ	0.011 (2.19)*	0.009 (2.93)*	0.065 (2.49)*

Note: (*) denotes statistically significant at 0.05 level

Also, the coefficient of the lagged squared is positive and statistically significant. Thus, we are able to support that strong GARCH effect is apparent. The coefficient of lagged conditional variance is statistically significant, but its price is lower than the one. This means that the effect of the "old" news on volatility is significant. The size of the GARCH coefficient is medium. This indicates that there is a medium memory in the variance within the two periods.

The present effect seems to have an upturn tendency within the two periods. The γ parameter is positive during the 1st period indicating that the news' impact is asymmetric and the bad news of the euro has larger effect on the volatility of the Bulgarian Lev. Finally, the γ parameter is neutral (statistical insignificant) during the 2nd period indicating that the news' impact is symmetric and the bad and the good news of the euro has similar effect on the volatility of the Bulgarian Lev.

Table 67 presents the empirical results of a TGARCH model by using in mean equation the real exchange rate of the Estonian Kroon as the dependent variable and the real exchange rate of the euro as the control variable.

The sum of ARCH and GARCH coefficients is approximately close to unity, expressing that the Estonian Kroon's volatility shocks are medium persistent. Also, the coefficient

of the lagged squared is positive and statistically significant. Thus, we are able to support that strong GARCH effect is apparent.

Table 66: Estimation Results of Threshold GARCH - BGNvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0033 (12.64)*	-0.0005 (-7.73)*	0.0006 (15.40)*
ARCH	0.172 (15.17)*	0.225 (5.99)*	0.302 (2.15)*
γ	0.085 (4.17)*	0.067 (-3.46)*	-0.261 (-1.87)
GARCH	0.794 (26.79)*	0.569 (22.17)*	0.638 (-2.67)*

Note: (*) denotes statistically significant at 0.05 level

The coefficient of lagged conditional variance is statistically significant, but its value is lower than the unity. This supports that the impact of the "old" news on volatility is significant. Also, the magnitude of the GARCH coefficient is medium. This means that there is a medium memory in the variance. The present effect seems to have an upturn tendency within the two periods.

Table 67: Estimation Results of Threshold GARCH - EEKvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0038 (0.45)	0.0004 (0.73)	0.0004 (0.66)
ARCH	0.151 (3.64)*	0.158 (2.36)*	0.167 (2.78)*
γ	0.052 (0.32)	0.048 (0.20)	0.053 (0.24)
GARCH	0.605 (22.04)*	0.681 (14.62)*	0.703 (16.42)*

Note: (*) denotes statistically significant at 0.05 level

The γ parameter (leverage effect) is neutral (statistical insignificant) during the 1st and

the 2nd period indicating that the news' impact is symmetric and the bad and the good news of the euro has similar effect on the volatility of the Estonian Kroon.

Table 68 presents the empirical findings of TGARCH methodology by using only one threshold in the equation. We used the errors of the Error Correction Model (mean equation) in order to execute a TGARCH(1,1) (conditional variance equation). The dependent variable in the ECM equation was the real exchange rate of the Lithuanian Litas and the control variable was the real exchange rate of the euro.

Table 68: Estimation Results of Threshold GARCH - LTLvsEUR			
Parameter	**Total period**	**1st period**	**2nd period**
Constant	0.0018 (2.45)*	0.0019 (19.24)*	0.0014 (54.45)*
ARCH	0.131 (8.94)*	0.205 (7.51)*	0.185 (11.57)*
γ	0.473 (6.52)*	0.059 (1.27)	0.515 (27.06)*
GARCH	0.803 (12.79)*	0.713 (14.19)*	0.749 (55.38)*

Note: (*) denotes statistically significant at 0.05 level

We observe that the sum of ARCH and GARCH coefficients is very close to unity, expressing that the Lithunian Litas' volatility shocks are quite persistent. Furthermore, the magnitude of the GARCH coefficient is high and stable within the two periods. Therefore, we may support that a long memory in the variance exists during these periods. This effect seems to have an upturn trend within the two periods. The γ parameter, which represents the leverage effect on the conditional variance, is not statistically significant for the 1st period. This means that the bad or the good news of the euro has no impact on the volatility of the Lithuanian Litas. Finally, the γ parameter is positive during the 2nd period indicating that the news' impact is asymmetric and the bad news of the euro has a larger effect on the volatility of the Lithuanian Litas.

10.4 Conclusions

The aim of the present research is to re-explore the Euro Area participation of Estonia and Lithuania. Also, we examine if Bulgaria could be a member of the European Monetary Union. Particularly, we wanted to discover if these new member-states of the EU favoured by the EU membership and if they are/were ready to enter in the Euro Area. We used the real exchange rates of two member-states of the Eurozone, Estonia and Lithuania, which have adopted the euro recently. Also, we used the real exchange rate of non-member of the Euro Area (Bulgaria) in order to approve that this country is not eligible yet to adopt the European common currency.

Our empirical findings are based on three pillars, volatility shocks persistence, leverage effects and short-term/long-term linkages. The results of the Error Correction Model support that there is a neutral short-term impact of the euro on the old currencies of Estonia and Lithuania. On the other hand, the short-term effect of the euro seems to be negative on the Bulgarian Lev, despite the EU membership.

Moreover, we observed a greater positive and long-term impact of the euro on the Estonian and Lithuanian currencies after the EU membership of these countries. On the contrary, we discovered that the join of Bulgaria in the EU had a negative and a long-term impact in the relationship between the euro and the Bulgarian currency. As a matter of fact, the EEK, the LTL and the EUR seem to be a same currency in response to US dollar.

Moreover, the ECM-TGARCH(1,1) results highly support that the volatility shocks are quite persistent for each country. The leverage effect is neutral for Lithuania and Estonia before their EU membership. Thus, the bad news of the euro had similar effect on the volatility of their old currency. Also, the leverage effect is positive for Bulgaria, indicating that good news of the euro has lower impact on the volatility of the Bulgarian Lev. In addition, we discovered that the leverage effect is positive only for Estonia and Lithuania after their join in the EU. On the other hand, it is clear that there is no leverage effect between the euro and the Bulgarian Lev during the second period.

In conclusion, our results express that the adoption of the euro was completely in favour for Estonia and Lithuania since their currencies followed the fluctuation of the euro. This is reasonable because Estonia and Lithuania followed similar monetary policy, as the European Central Bank and they made great efforts in order harmonize and stabilize their inflation rate. Our results are against the empirical evidence of Kalcheva (2003),

who proposed a totally different direction for Estonia and Bulgaria On the other hand, we could mention that our findings are aligned with the studies of Cuaresma *et al.* (2010), Errit and Uuskula (2014) and Jurgutyte (2014) concerning of Lithuania. Finally, we agree with the outcome of Stakenas and Stasiukynaite (2017) research.

In summary, our estimation is the adoption of the euro significantly aided the economies of Post-Communist countries, such as Lithuania and Estonia. On the other hand, we arise plenty of doubts regarding to a potential circulation of the euro in Bulgaria, since the country is not ready yet to participate in the EMU, from a financial viewpoint.

Our opinion is that the Estonia and Lithuania should continue to improve the economic and political relations with the other members of the union in order to avoid side-effects due to Euro Area membership. At the end, Bulgaria should focus more to this direction if they wish to participate in the EMU without any collateral losses. Otherwise, they would face the fortune of Greece because the euro is a really strong currency and it is not suitable for weak and vulnerable economies of Europe which have no sufficient adjustments.

Chapter 11. The Epilogue

The EU may be characterized as the most important achievement of the modern European history. The EU has been forged upon the ashes of the World War II which was completely catastrophic for the European continent. The majority of the European countries has lived in peace for 70 years. Undoubtedly, the EU played an important role to this direction by maintaining social stability and boosting economic prosperity. Nevertheless, the EU still remains as an economic, geostrategic and political alliance in Europe. In fact, there is no political integration and its member-states act sometimes independently without taking into account the council or the opinion of the European Council and the European Commission. For instance, the recent immigration crisis (2015) reveal the weakness of the EU. Hungary decided to construct a wire wall across its borders in order to stop the immigrants to trespass its borders. Also, there are member-states, such as Poland, which are against the immigration policy of the EU. Additionally, the 2010 sovereign debt crisis in the Euro Area found its member-states unprepared to manage this kind of crisis. The bodies of the EU initially thought that the Memoranda of Understanding (MoU) were a solution. However, the outcome was extremely devastated for the countries which signed the MoUs. For instance, the GDP per capita of Greece shrunk by 44% from 2008 to 2017. Also, the Cypriot GDP per capita decreased by 34%, the Portuguese GDP per capita fell by 20% and the Spanish GDP per capita reduced by 26% during the same period. The majority of the Mediterranean member-states of the Euro Area has been forced to implement extreme austerity measures in order to manage their national deficit and preserve its membership in the Eurozone.

Nevertheless, the acts of the EU bodies during the debt crisis increased the euro-sceptical voices across Europe. Plenty of parties have taken a stand against the European Union and the euro. For instance, we observed the power increase of several radical right parties in France, Austria, Greece and Germany. The outcome of the anti-social behaviour of the EU was the UK referendum on 23rd 2016, where the majority of British people (52%) voted against the participation of the UK in the EU. Undoubtedly, the outcome of the UK referendum has shocked the foundation of the EU, since it's the first time in the EU history where a member-states decided to leave the alliance. The UK is not a founding member of the EU, but it is one of the most important countries and economies in the European continent.

The euro is one of the most crucial components of the European Project. Historically speaking, the European Continent had shared a common currency since 117 A.D. where the Roman Empire was at its greatest extent. However, the sovereign debt crisis of 2010 and the austerity measures discouraged plenty of EU members to participate in the European Monetary Union. The most important argument against the euro was the devastating consequences of the Euro-crisis in Greece, Cyprus and Portugal. The euro was proven as a strong currency for weak economies, which do not have the tools to deal with a financial crisis. Actually, a currency of a monetary union cannot be depreciated since there is a single Central Bank. Therefore, there are two solutions; an internal depreciation (prices and income); an exodus from the monetary union.
The debt crisis of 2010 has paused the expansion of the Euro Area, since the last state, which joined the EMU, was Lithuania on 01 January 2015. The aim of the current doctoral thesis was to explore which non-euro countries of the EU are ready to join the Euro Area, under financial viewpoint. In addition, we investigated if the present 19 members of the Eurozone belong in the monetary union. Finally, we explored if there are countries of the European Economic Area which are eligible to adopt the euro when they entered in the European Union. Our basic methodology was the Error Correction Model (Engle *et al,* 1987) and the family GARCH models. Specifically, we combined the ECM (mean equation) with GARCH models (conditional variance equation). From the financial viewpoint, we would like to find out the impact of the euro on the currencies of the EU and EEA member-states. We used the nominal exchange rates, the real exchange rates and the real effective exchange rates in order to produce our empirical results.

In the beginning, we would like to present the costs of joining the Euro Area:

Loss of independent monetary policy. In the Euro, interest rates are set by ECB but may be inappropriate for UK economy. For example, the 2008 recession hit the UK harder than other European countries because of our exposure to the financial sector. The ECB increased interest rates earlier than in the UK. This could have pushed the UK into a double-dip recession.

Loss of ability to depreciate currency in recession. In the Euro, there is no possibility to devalue. If you have higher inflation than other European countries (e.g. higher wage growth, lower productivity growth) you will soon become uncompetitive. This has been

a major problem for European countries such as Greece, Spain and Portugal. There decline in competitiveness has led to lower exports and lower economic growth, contributing to their decline in tax revenues. From 2008-10, the UK benefited from a 20% devaluation in sterling which helped to restore competitiveness. Without this devaluation, the recession could have been worse.

Growth and stability pact limits expansionary fiscal policy in the recession. In theory, the growth and stability pact limits the amount of government borrowing, therefore making it harder to escape recession. The EU's response to the fiscal crisis is to make stronger treaty legislation to penalise countries who have deficits which are too big. But, spending cuts can push economies into recession. Austerity policies of 2011-14 were a factor in prolonging the recession in southern Europe.

No Lender of Last Resort. In the Euro, the ECB is unwilling to act as lender of last resort. This causes greater pressure on government bond yields and puts pressure on countries to pursue austerity (spending cuts) which create lower economic growth. Lender of last resort.

Can't leave. Greece experienced great financial hardship in Euro, with a drastic recession. However, the costs of leaving the Euro were too high, and they had to accept stringent spending cuts and conditions from Europe to receive a partial bailout. This also damaged feelings of national pride and democracy as the government had little influence over economic policy.

Furthermore, we would like to display the benefits of joining the Euro Area:

When the EU was founded in 1957, the Member States concentrated on building a 'common market' for trade. However, over time it became clear that closer economic and monetary co-operation was needed for the internal market to develop and flourish further, and for the whole European economy to perform better, bringing more jobs and greater prosperity for Europeans. In 1991, the Member States approved the Treaty on European Union (the Maastricht Treaty), deciding that Europe would have a strong and stable currency for the 21st century.

The benefits of the euro are diverse and are felt on different scales, from individuals and businesses to whole economies. They include:

- More choice and stable prices for consumers and citizens

- Greater security and more opportunities for businesses and markets
- Improved economic stability and growth
- More integrated financial markets
- A stronger presence for the EU in the global economy
- A tangible sign of a European identity

Many of these benefits are interconnected. For example, economic stability is good for a Member State's economy as it allows the government to plan for the future. But economic stability also benefits businesses because it reduces uncertainty and encourages companies to invest. This, in turn, benefits citizens who see more employment and better-quality jobs.

The single currency brings new strengths and opportunities arising from the integration and scale of the euro-area economy, making the single market more efficient.

Before the euro, the need to exchange currencies meant extra costs, risks and a lack of transparency in cross-border transactions. With the single currency, doing business in the euro area is more cost-effective and less risky.

Meanwhile, being able to compare prices easily encourages cross-border trade and investment of all types, from individual consumers searching for the lowest cost product, through businesses purchasing the best value service, to large institutional investors who can invest more efficiently throughout the euro area without the risks of fluctuating exchange rates. Within the euro area, there is now one large integrated market using the same currency.

The scale of the single currency and the euro area also brings new opportunities in the global economy. A single currency makes the euro area an attractive region for third countries to do business, thus promoting trade and investment. Prudent economic management makes the euro an attractive reserve currency for third countries, and gives the euro area a more powerful voice in the global economy.

Scale and careful management also bring economic stability to the euro area, making it more resilient to so-called external economic 'shocks', i.e. sudden economic changes that may arise outside the euro area and disrupt national economies, such as worldwide oil price rises or turbulence on global currency markets. The size and strength of the euro area make it better able to absorb such external shocks without job losses and lower growth.

The euro does not bring economic stability and growth on its own. This is achieved first through the sound management of the euro-area economy under the rules of the Treaty and the Stability and Growth Pact (SGP), a central element of Economic and Monetary Union (EMU). Second, as the key mechanism for enhancing the benefits of the single market, trade policy and political co-operation, the euro is an integral part of the economic, social and political structures of today's European Union.

The Czech Republic, Hungary and Poland are pushing the Euro adoption process towards an unknown future, despite the fact that, within the last few years, some of them have been able to participate in the in ERM II mechanism, for a period of at least two years before they can qualify to adopt the Euro.

The Hungarian Minister for National Economy recently said that Hungary cannot abandon its long-term intention of joining the Eurozone, but that there is no rush. What benefits would there be if the three countries met the Maastricht criteria?

"The Czech economy would benefit the most, from joining the Eurozone, as it would cut transaction costs and exchange rate volatility, for this small economy. It is very open and the Eurozone is its largest trading partner, according to Head of CEE Macro/Fixed Income Research of Erste Group, tells Emerging Europe.

He stated*: "While many of these arguments are also valid for Hungary, its economy and, especially the labour market, are not so flexible. Plus, Hungary does not have as big a fiscal space as the Czech Republic, which would allow it to run counter-cyclical policy during the downturn. The Czech Republic is much more converged, in terms of income and price levels and that is why a common monetary policy would be less than sub-optimal for a low-income country where a large part of price convergence is*

underway. The Polish economy is relatively closed and would benefit less from being a Eurozone member".

"The Eurozone must be renewed, stabilised and its earlier attraction restored, in light of the difficulties and internal problems which have surfaced in the past years", wrote the state secretary at the Ministry for National Economy. He claimed that*: "The introduction of the Euro may only become a timely matter if Hungary's level of economic development approaches the average of the other Eurozone countries. Otherwise, Hungary could be the loser similar to some Mediterranean countries".*

Naturally, there are other drawbacks, too. Erste Group's representative says that by joining the Eurozone, the countries would lose their independent monetary policy and thus their ability to smooth their economic cycles on their own. He added: *"However, we could see that interest rate policies in the CEE have been closely linked and influenced by the European Central Bank's (ECB) actions and that the possibility of letting currency depreciate was probably the strongest monetary channel during the crisis".*

That is why, countries which decide to join the Eurozone, should think how they are going to absorb or counterbalance the shocks, if they cannot use the exchange rate channel. Their fiscal position and the banking sector have to be in a good shape and measures should be put in place which avoid pro-cyclically in both areas.

"Joining the Eurozone right now would have some political costs, as new members will need to pay up front payments into rescue funds and it is still not clear what the final setup of the Eurozone will look like and if the continued future existence of Eurozone will require larger fiscal transfers.

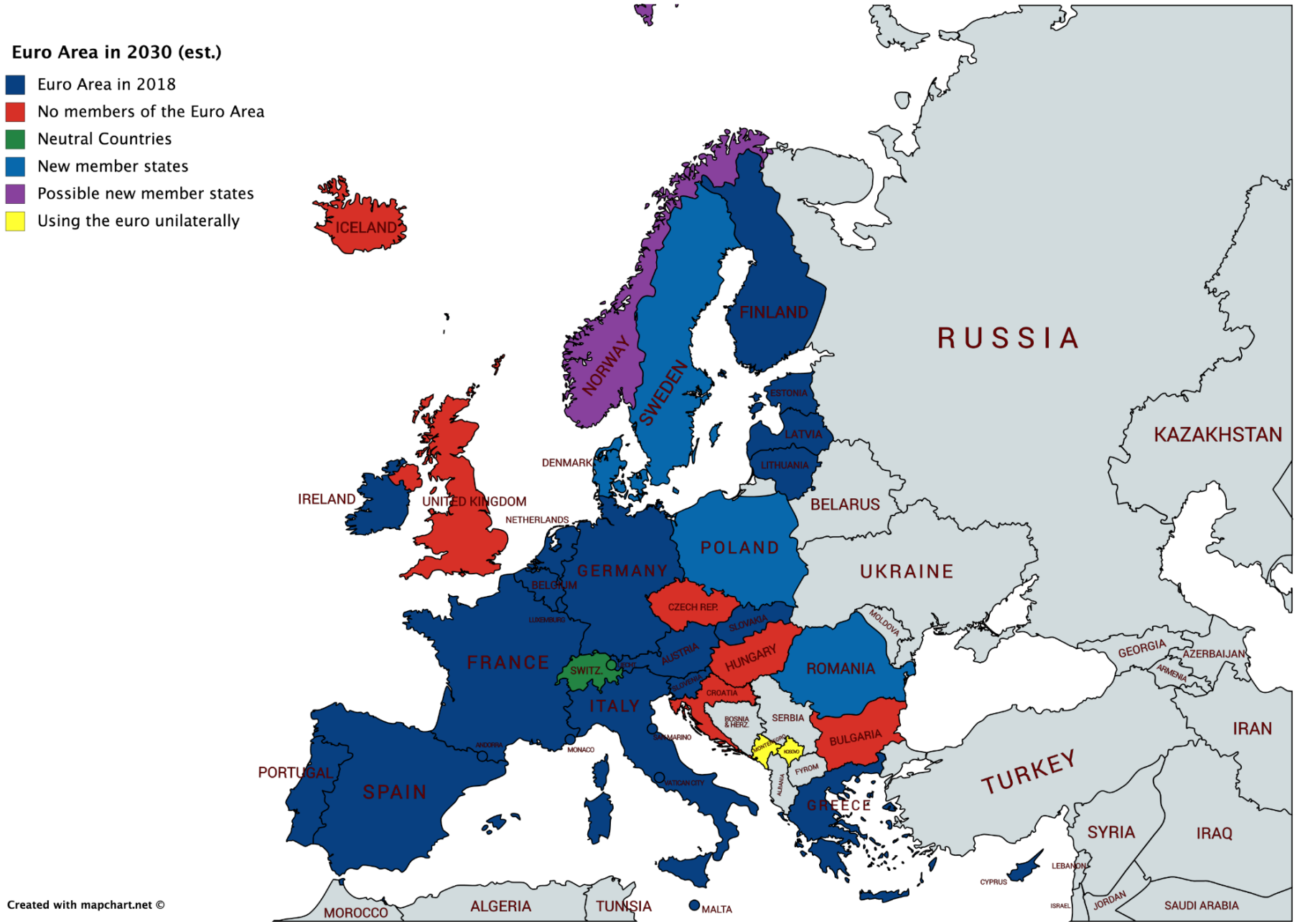
Not joining the Eurozone would also have its costs, internationally, because countries that gained their EU membership, similarly committed to joining the Eurozone, after meeting the Maastricht criteria. Thus, any reluctance to join could be seen as a refusal of deeper integration and also as unfinished homework. Some Western-European politicians are beginning to become tired of the cherry-picking of some CEE countries. So, it could be that the Cohesion Policy will be redesigned, after 2020, in such a way

that only countries which show their solidarity (are already Eurozone members or clearly heading towards it) and fulfil their commitment to integration (in the migration crisis) would be eligible for Cohesion Funds.
Moreover, our empirical evidence highly supports that (see, also, Figure 21):

a) There is a significant cohesion in the Euro Area among its member-states. France, Germany and Italy play the most important role on the nominal exchange rate of the euro.
b) There are countries of the EU which are not ready to join the Euro Area, under a financial viewpoint, since the euro has a negative impact on their currencies. In specific, the countries are the Czech Republic, the United Kingdom, Hungary, Croatia and Bulgaria.
c) There are countries of the EU which are ready to join the Euro Area, under a financial viewpoint, since the euro has a positive impact on their currencies. In specific, the countries are Romania, Poland, Sweden and Denmark. It seems that the currencies of these countries are bound with the financial behaviour of the euro.
d) The countries of the EEA show different results. Particularly, Norway could technically participate in the Euro Area, since its currency is financially bound to the euro. On the other hand, Iceland could not be a member of the Eurozone, since the euro has a negative impact on its currency. At the end, Switzerland presents a financial independence, since the euro has a neutral impact on the Swiss franc.
e) The European monetary union possibly will expand further in the European continent, since there are plenty of evidence which claim that "the euro is too strong to "die".

In conclusion, we would present a map of Europe which shows the Euro Area until 2030. We point out that this map is based on our empirical results, from the financial viewpoint. This means that we do not take into account the political factor and the interests of each country's government. Therefore, our analysis is beyond politics and diplomacy, since we are focused on the behaviour of the pragmatic economy. The condition of the economy is daily presented by the reaction of currency in the financial markets.

Figure 21: Euro Area enlargement in 2030 (est.)



According to our empirical evidence, we believe that the Euro Area will welcome four-member states (Denmark, Sweden, Poland and Romania) until 2030. The recent elections (2018) in Germany and France have accelerated the official talks among the Euro Area member-states regarding to the establishment of a European Monetary Fund. French policy makers are in favour to the legislation of a Euro Area Minister of Finance. Also, the banking union is an important step towards a genuine Economic and Monetary Union. It allows for the consistent application of EU banking rules in the participating countries. The new decision-making procedures and tools help to create a more transparent, unified and safer market for banks. This means that the member-states, which do not adopt the euro, have higher possibilities to join the EMU, especially when their currencies are bound to euro.

Our empirical results show that Norway could possibly enter in the Euro Area, since its currency is technically connected to euro. However, Norway is not a member of the EU and it cannot join the EMU. This is a decision of Norwegian policy makers, if they wish to more integrated their country with Europe.

On the other hand, our findings indicate that there are five members-states of the EU (United Kingdom, Bulgaria, Croatia, Czech Republic and Hungary) and one member-states of the EEA (Iceland) which could not join the EMU, from a financial viewpoint. This occurs because their currencies are not bound to euro and, also, euro has a negative impact on their exchange rates. Finally, there is only one member-state of the EEA (Switzerland) which shows an independence from euro. Actually, the impact of euro on the Swiss franc is zero, therefore a neutrality condition takes place.

Before concluding, we would like to point out that our results are aligned with the research of Siskos (2014) where he explored the impact of the exchange rate regime in the EU countries. He suggested that the Euro Area is partially an optimum currency area (OCA). Also, he supports that there are plenty of EU countries which decided to participate in the Euro Area, basically for political and economic reasons. However, the majority of the periphery EU countries paid the price of their quick and unprepared decision. Finally, he proposes that the EU must pause to use the power of the older Euro Area members, against the interest of the new member-states. Actually, a power of balance must be maintained.

In summary, we strongly believe that the Euro Area will officially contain 23 member-states until 2030. Particularly, the EMU will welcome Denmark, Sweden, Poland and

Romania. Nevertheless, it shall happen if the policy makers and the governments would use the reaction of the pragmatic economy. This means that the use of political interests may have a different impact on the enlargement of the Euro Area. In 2017, the European Commission officially announced that the European institutions and bodies will assist the member states in adopting the common euro currency, offering new tools for structural reforms, and establishing a European Monetary Fund.

Lastly, we consider that, from an academic point of view, it would be interesting to explore the dynamics and volatility responses between the euro and the currencies of the EU candidate countries, such as Turkey, Albania, FYROM (est. the Republic of Northern Macedonia) and Serbia. Nevertheless, it is not an aim of this research. We hope that the potential researcher shall examine if these countries are eligible to join the euro, from the financial viewpoint, in the near future. This arises new discussions for a potential research topic. However, the future research should take into account if the EU leaders will continue the expansion of the union to the Balkan Peninsula or to Turkey. There are plenty of European policy makers who disagree with the possible Balkans Enlargement. In addition, we should take into account that the Russian Federation is very sceptical about the participation of Serbia and FYROM in the EU, since these countries are its traditional allies. Albania, still, shows a lack of reforms which would open the road towards the EU. On the other hand, Turkey has made plenty of actions which undermine its European future. Especially, it occurred due to the unofficial transformation of the Turkish Republic into a Turkish Sultanate. At the end, we should mention that the European Elections of 2019 shall change the balance of power in the EU where it would lead to a stepwise transformation. We reckon that these discussions shall commence in 2020 by leading to the deepest integration of the EU (politically, economically and socially). For instance, the establishment of a European Monetary Fund (EMF) and the appointment of a Euro Area Minster of Finance are the most important challenges of the EU Agenda for the second decade of the 21st century.

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