ARE OPTIMUM CURRENCY AREA (OCA) THEORY CRITERIA ENDOGENOUS TO REGIME CHANGE? THE CASE OF THE ECONOMIC AND MONETARY UNION (EMU) BEFORE AND AFTER 1999.

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DECLARATION

I certify that this work has not been accepted in substance for any degree, and is not concurrently being submitted for any degree other than that of Doctor of Philosophy in Economics being studied at the University of Greenwich. I also declare that this work is the result of my own investigations except where otherwise identified by references and that I have not plagiarised the work of others.

Signatures

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Abstract

The study aims to establish whether or not the Optimum Currency Area (OCA) theory criteria are endogenous to regime change. To reach this aim I used data on eleven of the Economic and Monetary Union (EMU) countries, the United Kingdom (UK) and the United States (US), and I investigate two linked issues: the first is related to the OCA preconditions and it addresses the questions: if and to what extent the EMU members had satisfied the fulfilment OCA theory criteria before they joined the EMU; the second is related to the working of an OCA and it addresses the question of whether or not EMU membership has prompted a process of endogenous convergence. In particular, I examine whether adjustments have taken place through real wages or unemployment channels both before and after the establishment of the EMU in 1999 and the extent of convergence between the EMU members. I compare the findings of the EMU members versus the two non-EMU countries: the UK and the US. The comparison is carried out using two sets of indicators, each of which measures different aspects of OCA dimensions: the first set of indices measures the degree of convergence/divergence reached before and after 1999 and the extent of the endogenous convergence process prompted by the OCA; this set includes indices such as the correlation coefficient, the cross-country coefficient of variation, the asymmetry index and the persistence index. The second set of indicators comes from the econometric estimates and analysis of vector error correction and reduced-form VAR models, impulse response functions and variance decomposition; these indicators enable me to compare the responses of each national economy to relative demand, relative supply and policy shocks, and to compare the time persistence of these responses before and after the EMU. These indicators also allow identifying differences across the EMU national economies in terms of degree of convergence and divergence pre and post OCA. From these examinations I conclude that: (i) before 1999, the EMU members did not satisfy a large number of the OCA pre-requisites even though these economies tended to be more compliant with such criteria than non EMU countries such as the UK and the US; (ii) before 1999, there was an evident difference in the degree of OCA-compliance between a core group of members consisting of Germany, Italy, France and the Netherlands and a peripheral group consisting of Belgium, Ireland, Austria, Finland, Greece, Portugal and Spain; (iii) the establishment of the EMU has constituted a regime change that instigated an endogenous convergence process for some but not all of the EMU members,

particularly in the labour market for countries such as Austria, Belgium, Finland, Germany, Ireland, Portugal and Spain mainly due to policy coordination; (iv) the process of endogenous convergence has been stronger and faster with respect to business cycle and the competitive index, with a discernible tendency for the nominal rather than real adjustment in international trade and the labour market variables; (v) however, the evidence of endogenous convergence has not been strong enough to eliminate differences between the core and peripheral members of the EMU – mainly because of faster convergence across the former group relative to the latter and because of more nominal rather than real channel-based adjustments across countries.

Table of Contents (The Chapters)

ACRONYMS

ACF	Autocorrelation Function
ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
BK	Baxter and King
BP	Band Pass
CA	Current Account
CPI	Consumer Price Index
ECB	European Central Bank
ECM	Error Correction Model
ECU	European Currency Unit
EMU	Economic and Monetary Union
ERM	Exchange Rate Mechanism
EU	European Union
FEVD	Forecast Error Variance Decomposition
FIML	Full Information Maximum Likelihood
FPE	Final Predictor Error
GDP	Gross Domestic Product
GMM	Generalised Method of Moments
GNP	Gross National Product
HCIP	Harmonised Index of Consumer Prices
HP	Hodrick-Prescott
IMF	International Monetary Fund
ILO	International Labour Organisation
IRF	Impulse Response Function
KPSS	Kwiatkowski–Phillips–Schmidt–Shin
LFS	Labour Force Survey
ML	Maximum Likelihood
NAIRU	Non-Accelerating Inflation Rate of Unemployment
REER	Real Effective Exchange Rate
OCA	Optimum Currency Area

OECD	Organisation for Economic Co-operation and Development
OIRF	Orthogonalised Impulse Response Function
SBIC	Schwarz' Bayesian Information Criterion
SGP	Stability and Growth Pact
SMP	Single Market Programme
SVAR	Structural Vector Autoregression
UK	United Kingdom
US	United States
VAR	Vector Autoregression
VECM	Vector Error Correction Model

DATA & SOURCES

Table showing the variables, sources, frequency, measurement and format used

Variables	Source	Frequency	Real or Nominal	Levels/Difference
Consumer Price Index (CPI)	Datastream	Quarterly	Real	Levels and per cent change
Domestic and World Interest rates	Bank of Internation Settlements	Quarterly	Nominal	Per cent
Employment Rate	Eurostat	Quarterly	Nominal	Differences
Exports	OECD	Quarterly	Nominal	Levels
Government Consumption Expenditure	OECD	Quarterly	Nominal	Levels
Gross Domestic Product	Datastream	Quarterly	Real	Differences
Imports	OECD	Quarterly	Nominal	Levels
Nominal Effective Exchange Rate	IMF	Quarterly	Nominal	Levels
Output Gap	Datastream	Quarterly	Real	Per cent
Productivity (real GDP/hours worked)	OECD	Quarterly	Real	Differences
Strictness of Employment Protection	OECD	Quarterly	Nominal	Levels
Unemployment Rate	Eurostat	Quarterly	Nominal	Differences
Wages	OECD	Quarterly	Real	Differences

ONE:
INTRODUCTION

It was uncertain whether the Economic and Monetary Union (EMU) constituted an Optimum Currency Area (OCA) before 1999 (see, for example Bayoumi and Eichengreen, 1993, 1994, 1996). Partly due to this uncertainty, economists raised the question as to whether the OCA indicators can be considered as endogenous to the regime change resulting from the establishment of a currency union. According to Frankel and Rose (1998), the "examination of historical data gives a misleading picture of a country's suitability for entry into a currency union, since the OCA theory criteria are endogenous", (page 2). In other words, waiting for two economies to be 'in phase' before adopting the same currency is only one part of the path towards an OCA since using a common currency may also induce the economies (i.e., the economic actors in relevant countries) to behave in a manner that would reduce the cost of membership in a monetary union.

The fulfilment of the OCA theory criteria explores the criteria as well as the costs and benefits of entering/forming a currency union. In addition, the fulfilment of the OCA theory criteria can be viewed as a tool for finding an answer to the question on how to choose the optimum exchange rate regime. It should be mentioned, however, that there is no widely accepted algorithm or index to indicate unambiguously whether a country should join a currency area or not. In fact, there is no standard theory of optimum currency areas, but rather several approaches that have been inspired by Mundell's (1961) seminal paper.

The theory of optimum currency areas (OCA), was developed by Mundell (1961), McKinnon (1963), and Kenen (1969), and has become particularly popular for analyses of the costs and benefits of monetary integration, in particular with reference to the EMU. Mundell argued that if the exchange rate regime within a region causes unemployment in one part of the region, or if it forces another part of the same region to accept inflation as the cure for unemployment, then this regime is not optimal. Mundell also postulated that real wage flexibility may also be a substitute for exchange rates. McKinnon (1963), unlike

Mundell (1961), distinguished factor mobility in two distinct senses – as geographic factor mobility among regions, (which Mundell (1961) had in mind) and factor mobility among industries.

While the formal literature on endogenous OCA theory analysis is of recent vintage, several of the considerations at issue have long been a matter of dispute among economists and political officials. As Coeure (2004) argues "the endogeneity of OCA theory criteria has been at the very heart of the political debate on the EMU. This debate has opposed the 'French' view that monetary union per se would accelerate the integration of European markets and a 'German' view that monetary union should only be the 'crowning' of the integration of European markets" (pp.342-343). Recent analysis of endogeneity of OCA theory criteria suggests it is indeed difficult to draw clear cut theoretical conclusions. Willett, Permpoon and Wihlborg (2009) argue that economic processes are affected by the political economy and rigidities created by political forces, rent seeking behaviour and unwillingness to give up established privileges. Thus a political economy approach which refers to how political forces affect the choice of policies, provides a different method of analysing the endogenous OCA processes. The political economy refers to how political forces affect the choice of policies. They quote: "What we need to know more about is the relative strength of such opposing considerations. It is important to recognise that if countries are not already close to fulfilling the OCA theory criteria then it is not sufficient that endogenous responses just go in the right direction. They must be sufficiently strong to make a major difference," (page 5).

The OCA theory criteria stress the importance of similarity of shocks and business cycles to facilitate the process of monetary policy implementation. It also stresses that gains are determined from the degree of openness, McKinnon (1963). A higher degree of openness in the economy, leads to a higher likelihood that the foreign prices of tradable will be transmitted to the domestic cost of living. This effect would cause the reduction of money illusion, so that wage contracts and prices will be highly influenced by the exchange rate. So, changes in the exchange rate would cause adjustments in those variables, implying that changes in the exchange rate are less efficient in changing the terms of trade and less useful as an adjustment mechanism. Frankel and Rose (1998) also stress the importance of degree of openness to endogenous OCA convergence. Closer trade relations result in a convergence of business cycles. Further, similar business cycles create good preconditions for policy integration and the creation of a currency area. However, this view is not universally shared in literature. For example, Krugman (1993) stated that, as countries become integrated to a higher degree, they specialise more. However, Kenen (2000) and Hughes, Hallett and Piscitelli (2001) argued that Frankel and Rose's results should be interpreted cautiously. Kenen (2000) showed in a framework of the Keynesian model that the correlation between two countries' output changes increases unambiguously with the intensity of trade links between these countries, but this does not necessarily mean that asymmetric shocks are reduced as well. Therefore, it is not trade relations alone which causes the convergence of business cycles in an OCA. Indeed, Frankel and Rose's hypothesis underlines that bilateral trade is mainly intra-industry trade, although this indicator does not enter directly in their analysis. Both Frankel and Rose (1998) who initiated the debate on trade intensity have certain limitations in their work. Indeed, the direction of causality is unknown but a certain degree of convergence does cause higher trade intensity. Kenen (2000), Kose and Yi (2001) criticised Frankel and Rose (1998) stating that trade links alone do not ensure the convergence of business cycles.

Even though Mundell (1961), McKinnon (1963) and Kenen (1969) are considered to be the most important authors from the traditional phase, a few more authors who contributed to the OCA theory also deserve to be mentioned. This second wave includes Corden (1972), Mundell (1973), Ishiyama (1975) and Tower and Willet (1976). Also included are Ishiyama (1975) and Tower and Willet (1976). Corden (1972), who defined a currency area as a complete exchange rate union, argued that joining a common currency area with a group of partner countries causes a loss of direct control over the monetary policy and the exchange rate. The loss is important if one believes that the monetary policy is effective for economic stability for example, in its use for controlling inflation. This means that if the country is hit by a negative demand shock, it is unable to use the monetary and exchange rate policy in order to facilitate the adjustment of relative wages and prices, so any adjustment has to be conducted through increased unemployment, reduction of nominal wages and prices or through fiscal policy (or some other expenditure absorption policy) restrictions. So, Corden (1972) considered wage and price flexibility the most important criteria in forming a common currency area because they responded faster to asymmetric shocks. He also pointed out that, if countries have different inflation rate preferences, formation of a common currency area can be costly. Ishiyama (1975) was one of the first to acknowledge that there should not be only one criterion in determining an OCA; he also proposed that it is in the interests of each country to evaluate the costs and benefits of entering a common currency area. He also identifies other criteria to consider, such as differences in inflation rates and wage increases among the countries forming the common currency area that result from different social preferences.

With the advent of monetary union in Europe, a new wave of ideas emerged, one of which was the effectiveness of monetary policy. Some new views have amended Corden's argument that joining a currency area causes a loss of direct control over the monetary policy and exchange rate. For instance, Alesina, Barro and Tenreyero (2002) argued that the costs of giving up monetary policy independence are lower if the association of shocks between countries are higher. Mélitz (1991) points out that if countries are confronted with identical shocks, they might need different policy responses to such shocks due to differences in their initial economic positions. Calvo and Reinhart (2002) represent something that was later named the "fear of floating" literature. In their work, the "fear of floating" refers to countries that announce their intention to adopt a floating exchange rate but do not actually abstain altogether from intervening in foreign exchange markets because they fear the economic consequences of large currency swings. Both of them and others emphasise that if a country is unable to use the monetary policy adequately, the loss of monetary policy will not entail a significant cost.

Among many criteria for joining/forming a common currency area, one has quite an influential status in this modern phase and that is the synchronisation of business cycles. This means that if the business cycles of members of a currency area are synchronised, the cost of not having its own monetary policy that would fight against disturbances is minimised. The synchronisation of business cycles is an important element in the research of, for example, the endogeneity of OCA theory criteria (Frankel and Rose, 1997), intensity of bilateral trade and correlation of business cycle (Frankel and Rose, 1996), monetary integration as disciplinary effect (Buti and Suardy, 2000) and specialisation hypothesis (Krugman, 1993).

Various economists have contributed to the understanding of OCA theory literature, however, there is still room for further research. As Krugman (1995) emphasised, a vast majority of the optimum currency area literature has concentrated on the balance of payments adjustment costs (macroeconomic effects) under fixed and flexible exchange rates. However, microeconomic benefits and costs still remain insufficiently explored. One of the most important contributions is the endogeneity hypothesis, which implies that if countries enter a common currency area, they can satisfy the fulfilment of the OCA theory criteria *ex post*, even if it did not satisfy it *ex ante*. This means that increased integration between members of the common currency area will move them above the OCA line. Also, besides labour mobility, the difference between labour market institutions is important as a different degree of labour market centralisation can cause the need for a different approach to the monetary policy. Lastly, the business cycle synchronisation is an important consideration because synchronised business cycles indicate that the timing and nature of the shocks experienced by individual members are similar – and as such adoption of a common monetary policy would be less costly. Or, stated differently, synchronised business cycles may indicate that the advantages of having an autonomous monetary policy may be less significant than what the cost-benefit analysis of OCAs may suggest.

The debate on the theory of optimum currency areas (OCAs) has generated a significant amount of interest particularly as governments have progressively worked towards the aim of achieving economic cohesion in Europe since Mundell's (1961) pioneering work. Since the inception of the original work, theorists have contributed to the debate to develop our understanding both empirically and theoretically. However, one aspect of OCA theory began to evolve as the realisation of the economic and monetary union grew closer during the 1990s – this was the endogenous fulfilment of the OCA theory criteria, this being the degree to which these criteria are fulfilled as opposed to the actual criteria themselves. The concept of this was that even if countries may not have fulfilled the OCA theory criteria prior to joining, they may have fulfilled these criteria thereafter.

The initial work on endogenous OCA was performed by Frankel and Rose (1998), however, many studies followed using similar analysis on trade flows to establish endogeneity in monetary unions. These studies are discussed in the literature review in chapter two. Studies on this debate are relatively new with some areas requiring better understanding both theoretically and empirically. There have been debates on the effect of the euro on EU trade flows between both euro and non euro nations. After four or five years since the inception of the EMU, studies by Flam and Nordström (2006) and De Nardis and Vicarelli (2003) suggested that the general finding was that bilateral trade among euro members had increased moderately relative to GDP, however, it is uncertain about how much of this had been due to the formation of the EMU. Later studies by Berger and Nitsch (2008) showed that there had been a small increase in trade within the euro area. They state that this increase is simply a continuation of a long-run trend, probably linked to the broader set of EU's economic integration policies.

Most economists who have contributed to the endogeneity debate in the context of the EMU have relied mainly on the EMU's trade effects as the main driver of endogenous convergence. Even those who have examined the effect of regime change in a wider sense have examined the dynamics of a limited number of variables, usually clustered around particular markets (e.g. the labour market) or policy issues (e.g., monetary and exchange rate policy indicators) or types of convergence (e.g., real versus nominal convergence). My inspiration and motivation is two-fold: (i) to contribute to the debate by re-visiting the existing work and establishing the areas that I identify to have either been thin in its composition or not examined; (ii) assessing whether or not the fulfilment of the OCA theory criteria are endogenous to regime change.

1.1 The aims and objectives

To reach the first objective to study endogenous convergence, I propose to focus on the following aspects: (a) whether the EMU members had satisfied the fulfilment of the OCA theory criteria before 1999; (b) whether the establishment of the EMU has instigated an endogenous process of adjustment and convergence conducive to lower costs of EMU membership. To investigate aspects of OCA pre-requisites, I relate the regime change to endogeneity of the fulfilment of the OCA theory criteria by assuming that the establishment of the EMU constitutes a structural break that affects: (i) the capacity of national governments to use monetary and exchange rate policies with the purpose of addressing idiosyncratic demand and supply shocks; (ii) the effectiveness of the exchange rate as a means of absorbing shocks that affect competitiveness; and (iii) the price and wage-setting behaviour of firms and trades unions, who would be less able to induce the government to counterbalance the adverse effects on competitiveness of their pricing decisions and wage settlements. I consider these criteria to be the most important because the concept of economic and monetary union involves surrendering national policy instruments and establishing effective coordination policies after the formation of a monetary union.

In my study, regime change refers to: (i) changes in the ‘rules of the game’ that affect the behaviour of governments, firms and households; and (ii) changes in the level of market integration and competition which affects the behaviour of consumers, firms, workers, households and institutions such as trade unions. Given this definition of the regime change, endogeneity refers to the extent to which the establishment of the EMU has instigated: (i) similarities among member states with respect to macroeconomic indicators such as inflation, GDP growth rates, the output gap and competitiveness index; and (ii) adjustment through real wages or the exchange rate rather than employment, unemployment or trade). OCA theory criteria suggest that similarities of business cycles are crucial for a successful monetary union. Macroecomonic indicators such as GDP growth rates and inflation rates for example are the most widely used indicators of macroeconomic performance and if these indicators show similar cycles, then policy implementation in a monetary union is therefore facilitated. OCA theory criteria also suggest that wage flexibility is a crucial factor for a successful monetary union rather than a rise in unemployment which is often more expensive.

In my analysis, the endogeneity of fulfilment of the OCA theory criteria derives from the effect of the EMU on the decisions of the economic actors, including governments, firms and wage-setters. Simply stated, the EMU would reduce governments’ ability to accommodate the pricing decisions and wage settlements of the private sector because of reduced monetary and exchange rate policy autonomy. If a country’s prices or wages increase at faster rates relative to the rest of the monetary union, that country would become less competitive and experience reduced market shares and higher levels of unemployment. Given this information, price and wage-setters can be expected to revise their pricing decisions and wage claims such that the adverse effects of their decisions on trade performance and unemployment levels are minimised.

Much of the literature has focused on trade intensity in explaining endogenous OCA theories since the initial debate by Frankel and Rose (1998). My study extends this debate by analysing a wider set of indicators and markets where the effect of the EMU as a regime change can be examined. This wider set includes (i) the extent of convergence and divergence before and after the EMU with respect to four variables (see section 4.2 for details of the variables); (ii) the speed of adjustment in and effectiveness of the exchange rate in correcting trade imbalances, and; (iii) the extent of labour market flexibility in Europe. The empirical chapters addressing these issue areas examine not only the extent of convergence/divergence before and after the EMU, but also the extent to which adjustments to shocks take place through real wages or unemployment. The implications of the findings should be interpreted as follows: the EMU members can be expected to incur lower costs of membership (i.e., the EMU would be closer to an OCA) the higher are the levels of convergence before the EMU, the higher is the speed of convergence after the EMU, and the higher is the incidence of adjustment to shocks through nominal rather than real channels.

1.12 The thesis structure

The thesis is divided into seven chapters. Chapter one introduces the thesis. Here, I identify the gaps that exist and how I intend to address these gaps. Finally, I explain my main contribution to the debate; chapter two presents the literature review on the OCA theory and the EMU, the convergence debate, the exchange rate and international trade which discusses the issues of openness and current account adjustment, and monetary unions and the labour market with a focus on the European experience; chapter three discusses the methodologies used in all the statistical calculations; chapters four, five and six examine and present the empirical results while chapter seven provides an overall conclusion.

In chapter four, I use four examination methods: the pair-wise correlation coefficient, the cross country coefficient of variation; the asymmetry index and persistence. These methods are fully explained in the methodology chapter. In this chapter (empirical chapter four), I assess the degree to which convergence occurred before 1999 and if no convergence was observed, the degree to which convergence (thus possible endogenous convergence) was established thereafter. If business cycles were not synchronised before 1999 but were after the formation of the monetary union, then there would be some evidence of endogenous convergence. There may be instances where convergence has been more evident before 1999 or divergence may be prevalent in both periods. These instances would not be compatible with the endogeneity of fulfilment of the OCA theory criteria and would provide evidence of significant costs/risks for the countries involved. The findings will enable me to assess the degree of convergence/divergence before and after the EMU and the extent to which the establishment of the EMU has instigated a process of endogenous convergence. Further, I compare the findings of the EMU countries with those of the UK and the US in order to establish whether or not endogenous convergence resulted from the change in the 'rules of the game' or whether the process was brought about by other forces not specifically related to the regime change.

In empirical chapter five on the exchange rate behaviour and its effects on international trade, I use a combination of impulse response functions, variance decompositions and the long-run cointegration approaches. The cointegration approach enables me to assess the effects on trade balances following exchange rate changes. The impulse response functions (IRFs) enable me to assess exchange rate behaviour following relative demand, supply and monetary shocks and thus assess the absorption properties of the exchange rate. The variance decomposition analysis enables me to establish the contribution (in per cent terms) of different shocks to exchange rate movements. This exercise has enabled me to address two issues that are not analysed adequately in the literature: (i) the extent to which the exchange rate reacts to changes in relative demand and supply - i.e., the magnitude of the response - before and after the EMU; and (ii) the speed with which the exchange rate returns to equilibrium after the shock - i.e., the duration of the adjustment to shocks – before and after the EMU. The findings in this chapter should be interpreted as follows. First, if the exchange rate is effective in correcting trade imbalances before the EMU, and a country's own post-EMU real exchange rate adjusts to reduce any current account imbalances thereafter, the cost of EMU membership may be expected to be high and the behaviour of the exchange rate may not be endogenous to regime change. Secondly, if the exchange rate reacts to changes in relative demand and relative supply and it takes a long time to return to the original equilibrium (where the starting point is at equilibrium), and these properties persist after the EMU, the cost of EMU membership may be expected to be high and the behaviour of the exchange rate may not be endogenous to regime change.

In empirical chapter six, I use a combination of reduced-form VAR techniques to assess the responses to the European labour market to changes in labour demand and impulse response functions to determine whether the labour markets for each EMU country adjusts through real wages or employment/unemployment) channels. These methods combine all the methods usually discussed separately in the literature and provide a general assessment across indicators and issue areas. This chapter provides an additional contribution to the literature, which tended to focus on intra-EMU labour mobility as the main indicator of labour market flexibility and adjustment to idiosyncratic shocks. Whilst intra-EMU labour mobility is a valid criterion that is compatible with the traditional OCA theory, the focus on this criterion tends to yield pessimistic findings given the stylised fact of low labour mobility within the euro area. However, the extent to which national labour markets adjust to idiosyncratic shocks through the real wage or employment/unemployment channels is equally important and provides additional information about whether or not the EMU has constituted a regime change that affects wage-setting behaviour in the labour market. Hence, this chapter extends the literature and provides additional evidence on the costs of labour market adjustments before and after the EMU. The findings in this chapter should be interpreted as follows: (i) if national labour markets react to changes in the derived demand for labour (i.e. to changes in real GDP) through employment/unemployment rather than wages and if such reactions persist after the EMU, the cost of membership is high and the establishment of the EMU does not constitute a regime change conducive to endogenous adjustment; (ii) if the impulse responses of the national labour markets to demand, supply and monetary shocks display high magnitudes and long durations (usually more than four quarters), the costs of EMU membership can be expected to be high; and (iii) the evidence of endogenous change is weak if impulse responses remain high and persistent after the EMU.

Chapter seven is the concluding chapter where I provide an overall summary of my findings. My findings and contributions to the exiting work are threefold. First, I extend the time span for my empirical research by ten years to 2008. The data do not extend beyond 2008 due to the cut-off point that I had to adopt when I started building up the dataset. Although the cut-off in 2008 implies that the endogeneity argument cannot be tested during the crisis years, the length of the period I have studied goes beyond most studies whose post-EMU period ends in the early 2000s. Secondly, I use a wider range of measures, methods and metrics not used in previous studies, including impulse response functions, variance decompositions and the long-run cointegration analysis where appropriate. Finally, I have examined endogeneity as an outcome of regime change rather than as a function of trade integration only.

TWO:
LITERATURE REVIEW

2.1 Introduction

The pre-EMU debate during the 1990s was also dominated by the so-called 'nominal convergence' of fiscal and monetary indicators that became a prerequisite for an economy to join the EMU. Although public debates at that time were questioning the relative merits of 'nominal' versus 'real' convergence, it was widely viewed that participation in the EMU would nevertheless speed-up both types of convergence in many ways. Dyson (2000) for example, argued that the EMU was expected to catalyse convergence not only of markets, but also of policymaking institutions and welfare-state provision. Duisenberg, (2001) remarked that the single currency will enhance regional growth and prosperity by helping the Small and Medium-sized Enterprises (SMEs) and promoting more trade opportunities which may involve convergence or divergence.

Optimum Currency Area (OCA) theory put forward by Mundell (1961) predicted that this institutional architecture must rely on strong economic integration between member countries, in areas such as mobility of labour, economic openness, financial integration, flexibility of prices and wages, similarity of inflation rates, diversification in production and consumption, fiscal integration and political integration (for surveys, see Tavlas, 1993; Mongelli, 2002; and Dellas and Tavlas, 2009). When asymmetric shocks hit national economies that have formed a currency union, OCA theory suggests a number of channels of adjustment, for example wages and prices. The higher the level of integration or flexibility in those variables, the quicker and more complete the adjustment would be.

2.2 A brief history of The Economic and Monetary Union (EMU) and its objectives

The Economic and Monetary Union (EMU) is among the most intensively researched steps in the history of European integration. Since the goal of the EMU was endorsed by the Hague Summit in 1969, and especially since it was revived by the European Council in Hannover in 1988, a complex and extensive body of work on the EMU has grown. Much of this research has taken the form of cost-benefit analysis, with economists weighing the expected gains from a single currency against its expected negative side-effects. On the benefit side, there has been widespread discussion of both the microeconomic advantages of a single currency – including transaction-cost savings, reduced uncertainty and greater price. On the cost side, the macroeconomics of adjustment to country-specific shocks and country-specific responses to shocks has dominated academic discussions.

The EMU is the agreement among the participating member states of the European Union (EU) to adopt a single currency and monetary system. The European Council agreed to name this single European currency the Euro. The European states propelled the idea that the creation of the EMU and a single European market could advance economic and social unity among the people of Europe and propel Europe to greater prominence in the international community. In 1979, the European Council adopted the European Monetary System, known as EMS, which employed an exchange rate mechanism, or ERM, to encourage participating countries to keep fluctuations of their currency exchange rates within certain margins (±2.25 per cent of the central rates, with the exception of the Italian lira, the Spanish peseta, the Portuguese escudo and the pound sterling, which were allowed to fluctuate by ±6 per cent). In the event of the maximum fluctuation margin being reached, central banks had to intervene by buying or selling the currency to avoid the margin being exceeded. The permissible limits of the ERM were derived from the European Currency Unit, or ECU, a referential currency calculated from an average of the participating countries' national currencies.

In 1992, the Maastricht Treaty was signed and subsequently ratified by all of the member states. Denmark, France and Ireland approved the treaty by a public vote, although Denmark had originally rejected the Treaty and voted again, while other countries ratified the treaty through a legislative vote. The Treaty set up the conditions, or "convergence criteria," which each member state in the European Union must meet before it could join the EMU. To participate in the initial formation of the EMU, each member-state had to meet the following five convergence criteria by 1998: (i) the national legislation governing the country's financial system had to be compatible with the treaty provisions controlling the European System of Central Banks and in particular the national central bank had to be deemed 'independent'; (ii) the country had to achieve a rate of inflation within 1.5% of the rates in the three participating countries with the lowest rates; (iii) the country had to have its government deficits at below 3% of its Gross National Product (GNP) and the public debt not to exceed 60% of GDP; (iv) the country had to keep its currency exchange rates with the limits defined by the ERM for at least two years; and (v) the country had to keep its interest rates within 2% of the rates in the three participating countries with the lowest rates.

In the run up to the EMU, it became clear that some countries clearly had not met the criteria but were still allowed to join. A research-based policy analysis article by De Grauwe (2009) analysed the failures of certain countries' fulfilment of the convergence criteria even though they were allowed to join. De Grauwe stated that the convergence criteria were political instruments and not economically vital measures. He stated that these criteria were largely ignored in 1998 so as to facilitate the creation of the euro zone. Certain criteria were not met, for example, Germany, Greece, and Austria's debt ratio exceeded 60% (increasing in the year before entry). Belgium, Spain, Italy and the Netherland's debt ratios exceeded the limit although their ratios were falling in the year before entry. Budget deficits in some countries (for example Greece and Spain) did not meet the criteria. De Grauwe (2009) states that there were issues with the budget deficit figures in that they were manipulated. In the case of Greece, as it transpired later, there was fraud involved. In other cases (Belgium, France, Italy), "creative accounting" permitted these countries to hide the true level of the budget deficits. As a result, even though these countries did not achieve the criteria, they were allowed to join.

Countries that met the convergence criteria were required to join, unless as in the case of the UK, they had secured an opt-out. These conditions for EMU membership were considered necessary because when the member states join the EMU, domestic economic crises in one member state may affect all of the other member-states differently if, for example, convergence had been achieved by some countries but not all. In this scenario, a single policy tool for each country may not be successful in obtaining for example, economic stability for all countries. The convergence criteria established by the Maastricht Treaty, (the criteria for European Union member states to enter the third stage of European Economic and Monetary Union (EMU) and adopt the euro as their currency) have, however, been generating controversies among economists and policy makers alike especially in relation to the criterion of fiscal stabilisation. The fiscal stabilisation controversies have revolved around several issues ranging from the relative arbitrariness of the convergence criteria to their theoretical validity and their practical (political) applicabillty.

Since Mundell’s (1961) first publication, many economists have sought to examine the relevance of the fulfilment of the OCA theory criteria particularly with respect to the EMU. I analyse these in detail further in this section. The four often cited criteria for a successful currency union are: (i) labour mobility across the region. This includes physical ability to travel (visas, workers' rights, etc.), lack of cultural barriers to free movement (such as different languages) and institutional arrangements, (such as the ability to have superannuation transferred throughout the region), mobility of other factors of production, such as capital; (ii) openness where no tariffs exist with capital mobility and price and wage flexibility across the region; (iii) a risk sharing system such as an automatic fiscal transfer mechanism to redistribute money to areas/sectors which have been adversely affected by economic downswings. This usually takes the form of taxation redistribution to less developed areas of a country/region. Building on the seminal work by Mundell (1961), the literature beginning with Kenen (1969) has argued that monetary unions must be embedded in adequate federal fiscal institutions that provide insurance against asymmetric shocks among the member states. In a report, Delors (1989) argued that the lack of exchange rate flexibility would cause tensions within the monetary union that may even lead to a breakdown of the union if no such adjusting institution was installed. Delors (1989) recommended binding limits on national budget deficits and the coordination of national fiscal policies so as to establish a union-wide arrangement absorbing asymmetric shocks among the member states. The latter recommendation, however, was ignored in the Maastricht Treaty and only the limits on national budget deficits and public debts were anchored in the Stability and Growth Pact. To emphasise his concern about the missing of a fiscal arrangement dealing with asymmetric shocks, Feldstein (1997), in his article on the European Economic and Monatary Union claimed that, on balance, an economic and monetary union would be an economic liability. The gains from reduced transformation costs would be small and might, when looked at from the global point of view, be negative. The lowering of transactions costs would be to some degree offset by the costs of establishing the new currency. At the same time, the EMU would increase cyclical instability, raising the cyclical unemployment rate, Feldstein (1997). The so-called

MacDougall Report (1977), a study of the feasibility of the EMU, already put forward the creation of a central or federal fiscal arrangement that would automatically redistribute taxes or transfers among the member states in order to absorb the effects of asymmetric shocks. In particular, it suggested that a system of built in stabilisers should work through a federal or central budget that collects taxes from a prospering state and pays transfers to a state in recession. These transfers could either be among national governments or directly among private sectors, i.e. households and firms; (iv) participant countries that have similar business cycles. When one country experiences a boom or recession, other countries in the union are likely to follow. This allows the shared central bank to promote growth in downturns and to contain inflation in boom periods. Should countries in a currency union have idiosyncratic business cycles, then optimal monetary policy may diverge and union participants may be made worse off under a joint central bank.

2.3 The fulfilment of the OCA theory criteria and European monetary integration

Starting with Mundell's (1961) seminal paper, OCA theory has been developed during the 1960s in order to determine the optimum scope of an economic area with fixed exchange rates and common monetary policies. Based on a full employment equilibrium model with some nominal wage and price rigidities, this approach focuses on the trade-off between the reduction of transaction costs within a single currency area and the increase in adjustment costs in terms of employment and inflation associated with the loss of the exchange rate as an adjustment instrument in the case of asymmetric shocks. According to the contributions to OCA theory, the exchange rate can be given up as an adjustment instrument if: (i) shocks are symmetric or; (ii) there are adequate adjustment mechanisms in factor, goods and financial markets to cope with asymmetric shocks. Even in the presence of rigid wages and prices, countries may then be able to gain from the beneficial effects of a currency union, i.e. from the reduction of information and transaction costs as well as the elimination of exchange rate risks.

Applying these criteria to the countries to become the EMU and taking the US as a reference for an OCA, it is by now widely acknowledged that the EMU could not be considered to be an OCA at its start in 1999 (Frankel, 2000). Among others, especially Eichengreen (1997) it has shown that shocks have tended to be more asymmetric in Europe

than in the US, but that labour market and financial market integration has been more developed among US regions than among the potential EMU member countries. Arestis/McCauley/Sawyer (2001) and Arestis et al. (2001, 2002) have confirmed a tendency towards nominal convergence of inflation rates, interest rates and budget deficit-GDP ratios across potential EMU member countries during the 1990s, but real variables had not converged at all until 1999. Real GDP growth rates among potential member countries of the EMU differed widely without a tendency towards convergence. Output gaps also differed continuously indicating a considerable amount of cyclical divergence. Unemployment rates remained at a high and continuously divergent state during the 1990s.
Contrary to this view, Frankel and Rose (1998) argued that the fulfilment of the OCA theory criteria will be largely endogenous to shifts in the economic policy regime. Following Lucas' (1976) critique of the theory of economic policy, they suppose that market participants will adapt to changes in the economic policy regime. According to their view, the similarities of shocks and cycles between countries are crucially dependent on the extent of intra-industrial trade among each other. As the extent of trade will be enhanced by a common currency due to the elimination of exchange rate risks and the reduction of information as well as transaction costs, they conclude that the fulfilment of the OCA theory criteria are more likely to be satisfied *ex post* than *ex ante*. Schelkle (2001) carried the argument one step further by questioning the validity of convergence as a precondition. She asked how we can explain the fact that countries enter into a process of monetary integration if convergence is not a precondition, but rather a result of monetary integration. Considering the exchange rate not as an economic policy instrument that can be used for adjustment purposes, but rather as an asset price which is susceptible to stock-flow dynamics and expectations, the attempts to reduce exchange rate instabilities, uncertainties and asymmetries between countries are identified as driving forces behind monetary integration.

2.4 Indicators of convergence: issues of measurement and assessment

In the OCA theory literature, two kinds of endogeneities have been highlighted; (i) between business cycle synchronisation and trade integration and; (ii) between business cycle synchronisation and financial integration. Here, endogeneity is premised on the assumption that monetary integration implies a change in the structure of relationships among the members of the integration area.

The analysis of business cycle synchronisation in the EMU has focused basically on three issues: (i) the assessment of synchronisation in the EMU-12, which led to detection of a period of convergence from the 1990s (Angeloni and Dedola, 1999; Massmann and Mitchell, 2003; Darvas and Szapari, 2005; Afonso and Furceri, 2008); and some evidence of increasing heterogeneity during the recession of 2000-2002 (Fidrmuc and Korhonen, 2004); (ii) there was issue as to whether there was a core-periphery clustering within the emerging EMU. Here there was some agreement on the existence of a core group of countries that shows higher synchronisation; (iii) issue concerned the idiosyncrasy of the European synchronisation vis-a-vis the world-wide business cycle. The literature provides some evidence for the disappearance of the European differential during the 1990s, diluting the European business cycle within a global cycle (Artis, 2003, Perez et al., 2007).

Recently, Crespo-Cuaresma and Fernandez-Amador (2010) developed a comprehensive methodology based on sigma-convergence (which is a measure of the levels of dispersion across economies) analysis that offers answers to all these issues within the same framework. They analysed the dynamics of cyclical dispersion in Europe for the period 1960-2008, extracting the demand shocks and the demand components of Gross Domestic Product (GDP) from quarterly real GDP and Consumer Price Index (CPI) series for all members of the EMU-12 using the methodology for the estimation of demand and supply shocks developed by Blanchard and Quah (1989). They found that the euro zone had converged to a stable lower level of dispersion across business cycles throughout 1980s and the beginning of the 1990s. Studies by Hendrikx and Chapple (2002) on the EMU country's average inflation rates from 1991 to 2001 concluded that the level of dispersion had not markedly increased since the start of the EMU. Mentz and Sebastian (2003) set out to measure inflation convergence in the euro area between 1993 and 2002. Basing their studies on the Johansen test they found no real evidence of inflation convergence took place even after the EMU and the introduction of the Euro. This seemed to suggest that inflation convergence was not necessary prior to monetary union. This, however, begs the question: how can monetary policy be implemented satisfactorily if inflation levels are not synchronised? Inflation convergence was a pre-condition for the euro, however, this was not observed by all countries between 1993 and 2002. This was in part due to the turbulence of the ERM in the 1990s, Holmes (2002). De Grauwe (1992) illustrated that if competitiveness of certain EMS countries continued to decline, devaluations would be required in the 1990s, and convergence of national inflation rates would be postponed.

Various authors have tried to assess and explain the level or absence of business-cycle convergence and synchronisation with respect to other economic indicators. Artis and Zhang (1997) in their study of international business cycles and the ERM addressed the question of whether the exchange rate mechanism (ERM) has implied an increasing conformity among the business cycles of the participant countries. Two sub-samples are analysed, corresponding to the periods before and after the formation of the ERM. The Hodrick–Prescott (HP) filter was used to obtain the cyclical component of industrial production indices. They showed that the cycles in the ERM countries had become more synchronised with the German cycle. Angeloni and Dedola (1999) in their study on economic and policy convergence among EU countries compared business cycle fluctuations of output, industrial production, stock indices and prices across countries in various sub-samples. These fluctuations are recovered using the HP filter and 1-quarter and 4-quarters logarithmic differences of industrial production, real GDP, domestic consumption and gross fixed investment, the GDP deflator and the Consumer Price Index for the EMU area (excluding Germany) over the 1970-1997 period. They concluded that no major inconsistencies or conflicts in the conduct of the single monetary policy should arise as a consequence of divergences in economic performance or policy objectives among the participating countries. This conclusion by Angeloni and Dedola (1999) suggested the existence of encouraging signs regarding the success of the monetary union. Also, they add to the analysis the comparison of correlation between supply and demand shocks across countries in the same sub-samples. The shocks are estimated applying the bivariate structural vector autoregressive (VAR) methodology of Bayoumi and Eichengreen (1993). In this case the previous conclusion would not be valid, since no evidence was found on higher degrees of association of the identified shocks in the more recent period. Jelnikar & Murmayer (2008) examined the hypothesis of conditional convergence within the EU 15 countries between 1995 and 2007. Their study used both sigma and beta convergence calculation methods. Beta convergence measures the speed at which countries grow and catch up with each other whereas sigma convergence measures dispersion amongst economies. They found strong evidence of gradual convergence during this period. However, Tsagkanos and Botsaris (2006) in their analysis of the same EU15 countries, although from 1960 to 2003, found increasing divergence in GDP per capita using the coefficient of variation technique. Roubini (2006) examined growth differentials in the EMU between 1999 and 2005 and found output gap divergence amongst the EMU countries. Roubini cited this divergence and comments that it is leading to tensions in fiscal and monetary policy. Given the growth slowdown and the political difficulties of fiscal adjustment when growth is mediocre, larger fiscal deficits are emerging in many countries which lag behind, Roubini (2006). Wynne and Koo (2000) studied differences and similarities between business cycles in the European Union and business cycles in the Federal Reserve districts in the US between 1960 and 1994. The business cycle fluctuations were recovered using the Band-Pass (BP) filter proposed by Baxter and King (1999). They compared business cycle fluctuations of output, employment and prices using simple linear correlation estimated by Generalised Method of Moments (GMM). They concluded that the USA can be taken as a model of what Europe might look like in a monetary union. Belo (2001) studied cyclical convergence in the euro zone between 1960 and 1999 using several parametric and non-parametric statistics to investigate whether annual output cycles obtained with the HP filter have converged to the euro area cycle. The analysis of convergence was made by considering two and sometimes three sub-samples. He concluded that there was in general an increase in the various measures of association employed, identifying the patterns documented by Wynne and Koo (2000) in the analysis of the European Union. Additionally, Belo (2001) identified a leading cycle from the US and the UK, when compared with the euro area. However, if the time shifts in the cross-correlation functions are taken into account, then the UK displays a strong association with the euro area in the period 1979–99, whereas in the case of the US this association is modest. Doyle and Faust (2002) studied co-movements among the growth rates of the G-7 countries between 1970 and 2002q1. They also document a low contemporaneous correlation between the HP-filtered GDP of the US when compared with that of the largest economies of the euro area, especially in the 1990s. This was not the case when the comparison is made with the UK.

Also in line with this kind of static analysis, but focusing on G-7 countries, Monfort et al. (2003) studied co-movement in activity, measured by GDP and industrial production between 1972 and 2002. They proposed a dynamic factor model aimed at isolating common and area-specific factors. They rank countries according to two measures of synchronisation: the share of each country's total variance of real GDP growth explained by the variance of the common factor and, alternatively, the correlation between the common factor and the real GDP growth series. They suggest that there are also important area-specific factors, notably a Continental Europe factor (Germany, France and Italy), a North American factor (US and Canada) with Japan and the UK somewhat isolated. The leading nature of the North American factor, when compared with the Continental Europe factor, is also pointed out. Resorting to a broader set of data (not only real GDP growth) for the G-7 countries between 1979q1 and 2002q4, and using a Bayesian panel VAR model with convenient time variations, Canova, Ciccarelli, and Ortega (2007) also identify a world cycle but show that, apart from an increase in synchronicity in the late 1990s, there is weak evidence in support of a distinct European business cycle or of its emergence. Koopman and Azevedo (2008) analysed the degree of business cycle convergence in Europe using five EMU countries (Germany, France, Italy, Spain and the Netherlands) and the UK and US. They also analysed the euro area (12 countries) from 1971:q1 to 2010:q1. They use various methods including the multivariate unobserved component model which has the advantage of having different shift lengths at different periods. For instance, the shift between two variables can be relatively large in one period and relatively small in another period. It is particularly interesting to investigate whether business cycles of, for example, European countries are in the process of synchronisation. This implies that the cyclical processes of two business cycle components are shifted from each other by a small number of time-points in earlier years while they match (without shifts) in more recent years.

Various studies examining the correlation of cyclical indicators over time in the countries in the euro area come to diverging conclusions. A good illustration of this line of research is the controversy between Artis and Zhang (1997, 1999), who concluded that European business cycles had become more synchronised, and Inklaar and De Haan (2001), who studied European business cycles between 1960 and 1997, found that cycles were better correlated (against Germany) in the period 1971–1979 than in the period 1979–1987. They argue that this is inconsistent with Artis and Zhang's (1999) view that increased monetary integration, specifically after the creation of the European ERM in 1979, and business cycle synchronisation are positively related. Massmann and Mitchell (2004) studied business cycles of the twelve euro zone countries. They reconsidered the evidence that sparked this controversy, using forty years of monthly industrial production data and eight different measures for the business cycle. They computed pair-wise correlation coefficients between the twelve countries' business cycles using a Generalised Method of Moments (GMM) estimator that also yields an associated measure of uncertainty. This uncertainty of measurement is the doubt that exists about the result of any measurement. The uncertainty is therefore the quantification of the doubts of the measurement result. To examine the evolution of this estimate over time Massmann and Mitchell (2004) use a series of rolling windows, rather than windows of fixed width. Interestingly, Massmann and Mitchell (2004) found that there had been periods of convergence and periods of divergence. The estimated mean correlation coefficient between the twelve European 'growth' business cycles is on average positive and significant, but there has been considerable volatility of output. The mean correlation between the twelve European countries 'growth' business cycles had been trending upwards until the mid-1970s, reaching peaks of around 0.8 for most measures of the business cycle. Then, correlation in general fell to zero (inferring no correlation) in the mid to late 1980s and this figure is not statistically significant although the figure stated by the authors is economically significant, lending support to Inklaar and De Haan's (2001) finding that correlations of euro area countries with Germany were higher in 1971–1979 than 1979–1987. Correlation then rose in the late 1980s before slumping quite rapidly in the early 1990s. The estimates for the most recent period suggest that correlation between the twelve European cycles is statistically positive, and has risen from the trough in the early 1990s. Similarly, Altavilla (2004) studied cyclical behaviour among the EMU countries between 1980 and 2002 and reported evidence that after 1991, synchronisation of some EMU countries had increased. Darvas and Szapary (2004) studied eight of the EMU members and also found evidence in support of more business cycle synchronisation in the euro area since the run-up period to the EMU. The authors not only focus upon GDP, but also analyse synchronisation of the major expenditure and sectoral components of GDP. These components are: private consumption, investments, exports, imports, industrial production and services. Their results suggest that Austria, Belgium, France, Germany, Italy and the Netherlands show a high degree of synchronisation according to all the measures used. In their work, Darvas and Szapary (2004) correlated the euro area cycle with a component of that cycle. They found that synchronisation has significantly increased between 1993–1997 and 1998–2002. Portugal, Finland and Ireland show the lowest correlation with the euro area cycle, particularly for consumption and services.

It should be pointed out, however, that when correlations are calculated with respect to a euro-area aggregate, an upward bias is created since all countries are, by definition, included in the aggregate. This bias may be quite substantial for the bigger countries. This criticism also applies to Agresti and Mojon (2001) who studied business cycle synchronisation in the euro area between 1970 and 2000 and found that the business cycle fluctuations of GDP, consumption and investment of most euro area countries were, even before stage three of the EMU, highly synchronised with, respectively, the business cycle fluctuations of GDP, consumption and investment of the euro area. Overall the evidence on changes in the amount of business cycle synchronisation is mixed and it partly depends on the periods distinguished and the benchmark that is used. However, most of the current evidence suggests that periods of greater and lesser synchronisation tend to alternate. Nevertheless, there is some evidence that during the 1990s, business cycle synchronisation in the euro area has increased. Hence, this is an indication to me that further research is required to assess the level of convergence/divergence since then. My research contributes to the debate by, (i) the use of new indicators rather than the more contemporary indicators such as real GDP. I use for example the competitiveness index; (ii) the use of new techniques to measure synchronicity such as the asymmetry index and impulse responses which assess not only magnitude and direction of responses to economic shocks but also the time taken for the effects of such shocks to die out. The length and hence persistence of the resulting shocks is particularly important because it highlights the countries which take longer for shocks to die out which could lead to more costly methods of adjustment if the effect of a shock is prolonged.

After the "early OCA theory" was mapped out, several weaknesses and limitations started emerging, for example; (i) Robson (1987) noted how several OCA properties were difficult to measure unambiguously; (ii) OCA properties were also difficult to evaluate against each other: i.e. the OCA theory as a whole lacked a unifying framework. One could still end up drawing different borders for a currency area by referring to different OCA properties. Tavlas (1994) calls this the "problem of inconclusiveness", as OCA properties may point in different directions: for example, a country might be quite open in terms of reciprocal trade with a group of partner countries indicating that a fixed exchange rate regime is preferable, or even monetary integration, with its main trading partners. However, the same country might display a low mobility of factors of production, including labour, vis-à-vis these trading partners, suggesting instead that a flexible exchange rate arrangement might be desirable; (iii) Tavlas (1994) also observed that there can be a "problem of inconsistency". For example, small economies, which are generally more open, should preferably adopt a fixed exchange rate, or even integrate monetarily, with their main partners following the openness property. However, the same small economies are more likely to be less differentiated in production than larger ones. In this case they would be better candidates for flexible exchange rates according to the diversification in production property. Conversely, McKinnon (1969) noted that more differentiated economies were generally larger and have smaller trade sectors; (iv) after the seminal contributions on the diverse OCA properties, the analytical framework behind the OCA theory started weakening, all its main tenets were called into question by new theoretical and empirical advancements. Economists and policy-makers looking at the OCA theory could not find clear answers to the question as to whether Europe should proceed towards complete monetary integration, and which countries would be fit to join; (v) the "One Market, One Money" report by Emerson et al. (1992) pointed out that there would be no ready-to-use theory for assessing the costs and benefits of economic and monetary union. The OCA theory had, in their view, provided important early insights but offers only a narrow and outdated analytical framework to define the optimum economic and monetary competencies of a given "area" such as the EU: i.e., it is unable to tell which countries should share a single currency. The latter EMU question is more complex than the OCA question; (vi) studies investigating OCA properties are by necessity backward-looking. They cannot reflect a change in policy preferences, or a switch in policy regime such as monetary unification. Instead, in the second half of the 1990s, several authors started raising the issue of the endogenous effects of monetary integration: i.e., whether sharing a single currency may set in motion forces bringing countries closer together. This is the "endogeneity of OCA" but also the "exogeneity of OCA". The intuition is that a single currency sets in motion some virtuous processes increasing the integration of euro area countries over time, thereby improving the rating of one or more OCA properties; (vii) while most OCA studies are applied to sovereign countries, OCAs may not correspond to national frontiers. Due to non-homogeneities within countries the analysis among groups of countries is not always informative (see Ishiyama (1975) and Alesina, Barro and Tenreyro (2002) for a more recent discussion). In fact, several OCA properties have also been investigated at the intra-national level, i.e. "regions" within sovereign countries: e.g. the US States, German Länders, Spanish provinces or Italian regions (see Obstfeld and Peri (1998)) and Boldrin and Canova (2001). Such "regions" lack the nominal devaluation option that is a privilege of sovereign countries and have to rely on other adjustment mechanisms.

About fifty years have passed since the founding of the OCA theory. Its basic pioneering intuitions were remarkably strong. In fact, we still discuss all OCA properties. However, over recent decades the OCA theory has witnessed several ups and downs. Between the early 60s and mid-1970s, the early OCA theory had been completely mapped out. Several weaknesses and limitations of the analytical framework behind the OCA theory then started to emerge and the theory fell into neglect from the mid-1970s to the mid 1980s. It was difficult to find clear normative implications for the European monetary integration process and the stabilisation framework underlying it started crumbling. In the second half of the 1980s, the OCA theory missed an important appointment (as the discussion in the next section more clearly illustrates). When monetary integration made the formidable leap forward, the OCA theory could not deliver a clear view (Emerson et al. (1992)). In the event, plans for economic and monetary integration along three stages of the EMU (with the launch of the euro in 1999) went ahead but the OCA theory had a limited direct input.

2.5 The drivers of convergence

Silvestre and Mendonca (2007) analysed previous work on the relationship between trade intensity and convergence. They used a similar econometric model proposed by Frankel and Rose which was based on GDP and bilateral imports/exports annual data collection from Chelem Database for fourteen countries for the EU in the period between 1967 and 2003. Their findings support the positive effect that supports Frankel and Rose (1998) endogeneity argument in the fact that trade flows are assisting the convergence process. They added that Frankel and Rose (1998) implied the Lucas critique (1976) to the analysis of optimum currency areas arguing that business cycle correlation is endogenous and trade between states are affected by policies. Intuitively, this means that business cycles of the countries belonging to a monetary union are affected after integration by centralised monetary policy but also by an increase in trade flows. This relationship between trade intensity and business cycles correlation, in a theoretical point of view, is able to assume positive or negative signs. If there is an inter-industry specialisation based on comparative advantages, then cycles tend to be less symmetrical and the coefficient tends to be negative, Mendonca (2007). In this case, if there are general cycles in demand, most if not all sectors would be affected. Member countries of a currency area would become more diversified and hence more vulnerable to asymmetric shocks as the trade integration process evolves, resulting in less synchronisation of business cycles in the long run, Mendonca (2007). In the opposite way, if the specialisation process is mainly intra-industry as argued by Krugman (Krugman (1993) developed the intra-industry trade growth arguments)), i.e., the bulk of the trade flows are within the same sector, cycles will be more correlated and the coefficient is positive.

Other contributions to business cycle symmetry include a study by Kenen (2000) who argued that an increased positive correlation across business cycles can be a consequence of the trade integration but that it does not mean that shock asymmetries have decreased. Hughes Hallet, and Piscitelli (1999) showed that a monetary union can accelerate the cycles convergence but only when a sufficient symmetry in the monetary transmission exists, namely through prices and salaries. Fridmuc (2001) tested the endogeneity hypothesis with a regression similar to that originally proposed by Frankel and Rose but including a structural variable-intra-industry trade – and concluded that there is a positive relationship between this variable and business cycles correlation. So, because intra-industry trade is positively related to bilateral trade intensity, the endogeneity hypothesis holds.

Contrary to the above study, Corsetti and Pesenti (2002) showed that theoretically, a monetary union could become optimum ex-post even without an intra-industry specialisation process. Corsetti and Pesenti (2002) argued that profit-maximising producers in a currency area adopt endogenous pricing strategies that make real exchange rate fluctuations from differences in inflation within a currency union costly. In their model, exporters choose the degree of exchange rate pass-through onto export prices given monetary policy rules, and monetary authorities choose optimal policy rules taking firms' pass-through as given. Babetski (2004) studied enlargement countries and verified that trade integration leads, in general, to a wider symmetry of the demand shocks but, in supply shocks, it depends on the country considered. He concluded also that a reduction in exchange rate volatility has a positive effect in demand shocks convergence and, at least in what concerns these shocks, confirms the endogeneity hypothesis.

The literature review has highlighted many of the findings in the convergence debate which are relatively mixed. This may indicate many of the problems surrounding the methods of measuring convergence and the use of satisfactory indicators. I highlight some of these issues in section 4.1.2 which relates to the methodological and theoretical issues. The main findings in the literature are that the endogenous process does exist to a certain extent depending on the nature of the countries' structure and their areas of specialism. My research contributes to the literature by analysing the evidence over a longer time period. Measurements of convergence in the post-EMU period tend to be limited to a four to five year period. I extend the analysis to ten years. Finally, I use a wider and hence more informative set of convergence measures in my examinations. This allows not only for more reliable estimations but also for more consistent comparison with respect to the level of convergence before and after the established of the EMU in 1999.

2.6 The exchange rate and international trade: issues of openness and current account (CA) adjustment

OCA theory suggests that economies looking to adopt a single currency should also have a high degree of trade openness. De Grauwe (2007) explained that a highly open economy reduces the probability of asymmetric shocks occurring. If a country's currency depreciates, prices of exports (in foreign currency) fall representing a movement along the demand curve and a shift to the right of the supply curve as foreign demand increases. An economy with a high degree of trade openness also increases welfare gains associated with the elimination of transaction costs and decision errors from conducting business with foreign currencies, however, this is only for trade within the currency union. A highly open economy can use exchange rate policy like depreciation to overcome an adverse shock, such as a recession. Depreciation raises the price of imports and to that degree lowers real income. The more open to trade with other members of the currency union, the higher the price rise. But, when a country adopts a common currency, it relinquishes the exchange rate policy. There are greater benefits of adopting a common currency for a more open (to trade) economy as the cost of giving up exchange rate policy is low. This relates mainly to trade between members. When countries are open to trade and trade heavily with each other, giving up the exchange rate entails no serious loss of policy independence, McKinnon (1963).

A central question when considering the costs and benefits of joining a monetary union is the role of the exchange rate in the economic adjustment process. If an independent flexible exchange rate was a mechanism that allowed the domestic economy to adjust to shocks and disturbances, then the loss of this mechanism as a result of joining a monetary union would entail a cost. It should be noted that in a flexible exchange rate system, there is the issue of how the exchange rate moves and the relevant forces that influence the exchange rate. My review of the literature concentrates on exchange rate stabilisation where authors have used the exchange rate depreciation effect to assess the outcome to countries' trade balances and hence openness together with other VAR methodologies where countries' responses to shocks are analysed in order to assess the absorption effects and hence the usefulness of the exchange rate regime.

Early theorists such as Meade (1950), Friedman (1953), and Scitovsky (1958) advocated flexible exchange rates, telling that in the short run, exchange rate adjustment can substitute for the inflexible relative price adjustment of home and foreign produced goods to restore the external and internal equilibrium of an economy. The effect through which, they pointed out, flexible rates help to stabilise one economy facing adverse shocks from within and from abroad is the expenditure switching effect of depreciation. For example, an increase in the relative price of home produced goods resulting from an adverse home output shock raises the cost of living of home households, reducing home consumption. For the purpose of short-run stabilisation, policy makers are able to increase money supply and depreciate the exchange rate to induce agents across countries to switch to relatively cheap home-produced goods, stimulating exports and home production, and increasing home income and consumption. It was this effect that Obstfeld and Rogoff (2000, 2002) emphasised greatly as the major advantageous feature of flexible exchange rates when they objected against the creation of the Economic and Monetary Union as of January 1, 1999 and argued for adopting flexible rates in the world trading economies. Friedman (1953, pp180), however, himself acknowledges that if the rise in relative prices of foreign goods means a rise in the cost of living of home households, this in turn gives rise to a demand for wage increases.

The elasticity model of the balance of trade (Krueger, 1983) has shown the existence of a theoretical relationship between exchange rate and the trade balance. Empirically, various studies have been conducted to assess the influence of exchange rate on trade balance, with the objective of providing valuable inputs to policy makers on the effectiveness of exchange rate policy such as devaluation-based adjustment policies (effected through nominal exchange rate) to balance a country's foreign trade (see, for example, Greenwood, 1984; Himarios, 1989; Rose and Yellen, 1989; Bahmani-Oskooee, 1991; Mahdavi and Sohrabian, 1993; Arize, 1994; Buluswar et al., 1996; Rahman and Mustafa, 1996; Rahman et al., 1997; Wei, 1999; Baharumshah, 2001; Bahmani-Oskooee, 2001; Lal and Lowinger, 2002; Singh, 2002).

In theory, nominal depreciation/appreciation of exchange rate is assumed to change the real exchange rate (see, for instance, Himarios, 1989; Bahmani-Oskooee, 2001) and thus has a direct effect on the trade balance. Specifically, Bahmani-Oskooee (2001) noted that in an effort to gain international competitiveness and help to improve its trade balance, a country may adhere to devaluation or allow her currency to depreciate. Devaluation or depreciation increases exports by making exports relatively cheaper, and discourages imports by making imports relatively more expensive, thus improving trade balance. However, many economists believe there is a short-run phenomenon dubbed the "J-curve" effect in the movement of trade balance, in which there will be an initial deterioration before a country's trade balance eventually improves. A common explanation for this time path adjustment is based on the existence of contracts in international trade, in particular export contracts are written in domestic currency units and import contracts are written in foreign currency units. As a result, the price effects work faster than volume effects following the devaluation or depreciation of a country's exchange rate. The role of the exchange rate in macroeconomic adjustment has been a feature of the debate over whether the UK should join the Economic and Monetary Union (EMU). Currie (1997) argued that exchange rates do tend to play a useful role, but also incorporate a large arbitrary and disruptive element.

Vamvoukas (2005) examined the suitability of the Marshall-Lerner (ML) presentation as a sufficient condition to assess the links between the real effective exchange rate and the trade balance. He concluded that the ML condition does not hold in the case of Portugal and Spain, indicating that devaluations do not cause positive and significant changes in real variables such as the trade balance. Shirvani and Wilbratte (1997) examined the G7 countries (with the exception of the US) between May 1975 and August 1990 using the Full Information Maximum Likelihood (FIML) cointegration method by Johansen and Juselius (1990). They found that the countries, with the exception of Italy showed an improvement in the trade balance following a depreciation. They concluded by mentioning that devaluation of the lira may be followed by higher domestic prices, which reverse the beneficial effects of devaluation on the trade balance in the long run.

OCA theory highlights the circumstances in which flexible nominal exchange rates can play an important role in aiding adjustment. However, these particular circumstances may not often apply. For example, Buiter (1999) set out circumstances under which flexible exchange rates may not, in practice, serve as a useful adjustment mechanism because nominal exchange rate flexibility does not provide adjustment to imbalances caused by long-term real rigidities in the economy and over the short and medium term the nominal exchange rate often fails to play a stabilisation role; and instead, in the short and medium term the exchange rate is frequently an exogenous source of shocks to the economy. Other empirical assessments include Cobham (2002) who argued that exchange rate changes have not generally helped to stabilise the economy. He analysed whether movements in sterling were expected or welcomed by the UK monetary authorities.

Funke (2000) and Artis and Ehrmann (2000) drew conclusions from their studies on whether it would be advisable for the UK to join the EMU. Artis and Ehrmann (2000) studied the role of the exchange rate as a shock absorber using four countries between January 1974 and December 1998. They examined the UK, Canada, Sweden and Denmark and argued that their results provided grounds both in favour of joining and against it. Monetary policy in the UK was found to have had an impact on the real economy and so can be a useful stabiliser. On the other hand, they argued that other findings suggested that the exchange rate has a limited stabilising role. Consequently, they argued that the loss of exchange rate flexibility in joining a monetary union would not be costly. Funke (2000) studied the reaction of the real exchange rate to relative demand, supply and monetary shocks in the euro area and the UK between 1981:q1 and 1997:q4. Funke (2000) also interpreted his findings and suggested that the exchange rate had not played a shock absorber role. De Grauwe (2004) stressed that in some of Mundell's (1973) papers, in a world of non-stationary expectations, exchange rate movements do not function as stabilising instruments in the face of asymmetric shocks. Instead they are likely to be an independent source of volatility. His seminal paper on optimal currency areas focused on asymmetric shocks and flexibility of labour markets. Assuming sticky prices and wages, Mundell (1973) analysed macroeconomic adjustment of demand shifts between regions (countries). Within this Keynesian framework, Mundell (1973) concluded that countries that face large asymmetric shocks would find it costly to lose their monetary and exchange rate policies when entering monetary union. These costs, however, would be reduced if these countries were characterised by wage flexibility and labour mobility.

Most studies use Structural Vector Autoregression (SVAR) techniques in an attempt to establish the extent to which the exchange rate acts as a stabiliser in economies. However, the studies disagree in their results. The source of the disagreement seems to be the strategy that is used. In a seminal paper, Clarida and Gali (1994) examined the importance of nominal shocks in explaining real exchange rate fluctuations by examining Germany, Canada, Japan and the UK between March 1973 and January 1992. They used a long-run triangular identification scheme proposed by Blanchard and Quah (1989) and King et al. (1991). The nominal shocks are identified by assuming that such shocks do not affect real variables, i.e. the real exchange rate or output, in the long run. Doing this, they find that demand shocks explain the majority of the variance in the real exchange rate and that the exchange rate acts as a shock absorber.

Chadha and Prasad (1997) applied the Clarida and Gali (1994) approach to the Japanese yen–U.S. dollar exchange rate between 1975 and 1996 and also found that demand shocks play a crucial role in explaining fluctuations, although supply shocks were also important. On the other hand, Artis and Ehrmann (2000) estimate structural VARs and identify monetary policy and exchange rate shocks. The purpose of the study was to examine the idea that an independent money and exchange rate allows for effective shock-absorption. Their study found that the exchange rate mostly seems to reflect shocks originating in the foreign exchange market itself, i.e. the exchange rate is a source of shocks rather than simply a shock absorber. Canzoneri, Valles, and Vinals (1996) reach a similar conclusion. They estimated VARs for a number of European countries and checked whether the most important shocks in explaining the variance decomposition of output were also the most important in explaining exchange rate fluctuations. Supply shocks explained most of the movement in output but could hardly explain any variation in exchange rates. This, in turn, suggested that the loss of exchange rate flexibility in a monetary union was less costly in terms of macroeconomic stability. Overall, there is not yet a consensus on the issue of the ability to distinguish between real and nominal sources of exchange rate movements. A crucial aspect in the structural VAR literature is the identification strategy used.

Several papers empirically examined the EMU effect on intra euro zone trade in recent years. Micco, Stein, and Ordoñez (2003); De Nardis and Vicarelli (2003); Barr, Breedon, and Miles (2003); Flam and Nordstrom (2003 and 2006); Berger and Nitsch (2005) were some of those papers. Without exceptions, these papers found the euro effect on intra-euro zone trade to be positive and economically significant. However, it must be noted that these papers only covered a three year data period although the 2006 paper by Flam and Nordstrom is an updated version of their 2003 findings. Micco, Stein, and Ordoñez (2003) was not only among the first papers to examine the effect of the EMU on euro zone trade as a whole but also their paper was one of two papers found in the literature that investigated whether the EMU effect is fairly widespread among euro zone countries. Using information on bilateral trade on twenty two developed countries from 1992 to 2002 (hence based on at most three years experience during which time, whilst the euro was used for financial transactions, it was not used for other within country transactions), they found that the EMU had a positive - and significantly different than zero - effect on the trade of Austria, Belgium-Luxembourg, France, Germany, Ireland, Italy, the Netherlands, and Spain. In the case of Finland, the effect of the EMU on its trade is found to be positive but not statistically different than zero. In the case of Portugal, it is found to be negative. Even though Micco, Stein, and Ordoñez (2003) concluded that there were important differences across countries regarding the EMU effect on trade, they did not offer any insights as to why that may have been the case.

Aristotelous (2006) was the other paper found in the literature that analyses the EMU effect on the bilateral trade of each EMU country while emphasising the potential differences across them. Using a panel of data from 1992 to 2003, he found that the impact of the EMU on trade was positive and statistically significant for Belgium/Luxembourg, Finland, Germany, Ireland, the Netherlands, Portugal, and Spain. For Italy the effect was positive, but not statistically significant. For Austria, France, and Greece, the effect of the EMU on their trade to the euro zone was negative and statistically significant. Aristotelous (2006) theorised that the differentiated effect of the EMU on trade may have arisen because the EMU countries differed in terms of their trade composition, level of economic development, and degree of trade openness. He concluded that the most likely source of the EMU differential effect on trade was a country's degree of trade openness - with the EMU countries characterised by a greater degree of trade openness and enjoying greater benefits compared to countries that are not so open. Even though a country's degree of trade openness could be a source of the differential effect of the EMU on trade, Aristotelous (2006) did not provide any empirical support for that claim, nor did he demonstrate how Austria's, France's, and Greece's trade openness can explain the negative and statistically significant effect of the EMU on their trade with other euro zone countries.

2.7 Monetary unions and the labour market: the European experience

Early OCA theorists suggested that when nominal prices and wages are flexible between and within countries contemplating a single currency, the transition towards adjustment following a disturbance (in this section the terms shocks and disturbance are used interchangeably) is less likely to be associated with sustained unemployment in one country and/or inflation in another. This will in turn diminish the need for nominal exchange rate adjustments (Friedman (1953)). Alternatively, if nominal prices and wages are downwardly rigid some measure of real flexibility could be achieved by means of exchange rate adjustments. In this case the loss of direct control over the nominal exchange rate instrument represents a cost (Kawai (1987)). Price and wage flexibility are particularly important in the very short run to facilitate the adjustment process following a shock. Permanent shocks will in turn entail permanent changes in real prices and wages.

Orthodox literature suggests that the removal of many labour market regulations will result in better economic performances in Europe. Unemployment will decrease and output will increase, Oliver Blanchard and Francesco Giavazzi (2003). However, there is a vast body of literature which disputes the line of argument that de-regulation will benefit economic performance (see Siebert 1997 and Heckman 2002 for example). They suggest that rigidity-inducing institutions amongst other issues are responsible for high unemployment using "over-generous" benefits as an example. The formation of the Economic and Monetary Union (EMU) has caused considerable changes on the European monetary and financial markets, Favero et al., (2000). Furthermore, however, it is often argued that it could also have fundamental consequences for the organisation and the functioning of European labour markets, where this alleged impact is attributed to various sources. First, it is argued that the formation of the EMU will initiate new or accelerate existing processes that will change the economic environment on the product and on the labour markets. The elimination of exchange rate fluctuations, for example, will lead to a further increase in product market integration, to an intensification of competition, and of de-regulation Burda, (1999); Andersen et al., (2000). In addition, the use of a common currency could boost euro area-wide price transparency, thereby exposing national firms to a higher level of competitive pressure. All of this will then translate into changes on the labour market by increasing the elasticity of (derived) labour demand and by reducing monopoly profits and thus the possibility of rent-sharing arrangements between employers and employees Nickell, (1999). While these lines of argument emphasise the effect of the EMU on the economic environment, they typically assume that the institutional structures stay the same.

A second class of literature focuses on institutional changes and structural reforms that would be brought about by the changes in the economic environment and the shifts in the incentive structure associated with these developments. In particular it was argued that the EMU membership could increase the incentives to move towards higher levels of both national and transnational wage-bargaining coordination, Holden (1999) although the feasibility of such reforms is rather dubious, Calmfors (2000). While these arguments refer only to reforms of wage-bargaining institutions, there exists a small literature that deals with the prospective effects of the EMU on the general structure of European labour markets. Saint-Paul and Bentolila, (2000) argued that the unfavourable unemployment situation in many European countries can be best described as a socio-political equilibrium where a group of insiders has designed labour market institutions that are in their interest while leading to higher unemployment among the outsiders. A change of these institutions is difficult due to the power of the insiders and the political costs associated with possible reforms, Saint-Paul and Bentolila (2000): They argue that the EMU could help solve the European unemployment problem, by providing an exogenous shock that will rock the status quo in a way that favours reforms. The authors do not state which direction for reforms, however, literature usually assumes that reforms may be beneficial even though this suggestion seems judgmental and lacking strong evidence. A number of authors have pointed to the fact that the loss of autonomous monetary policy will leave national governments no other choice than to reform and make their labour markets flexible, Bean (1998). Sibert and Sutherland (2000) and Calmfors (1998) have argued to the contrary that the EMU could weaken the incentives for national labour market reform since Sibert and Sutherland, (2000).

In the mid 1990s it was argued that the OCA-criteria are endogenous, (De Grauwe, 1997; Fatás 1997). In particular, business cycle correlation might rise with stronger trade ties which could be triggered by the introduction of a common currency. Asymmetric shocks could therefore become less likely. Monastiriotis and Zartaloudis (2010) studied four mechanisms through which the establishment of the common currency and the functioning of the EMU can impact on the labour markets, both within the euro zone and of the new member-states. They argue that the theory and empirics of the link between the EMU and labour market flexibility are not conclusive. Huber (2004) analysed the evolution of regional unemployment rates, wages and participation rates in seven candidate countries for accession to the European Union (EU) in the 1990s. He concluded that the candidate countries may be deemed equally suited for monetary union as current EMU member-states with respect to labour market adjustment mechanisms. In particular, the higher responsiveness of wages to regional labour market conditions suggests that candidate countries may find it easier to adjust to asymmetric shocks. However, this conclusion, depends on the assumptions that shocks in the candidate countries are equally asymmetric and equally persistent as are shocks in the member-states and that labour market adjustment mechanisms are not endogenous to integration into the EMU.

The main channels through which countries can adjust to adverse demand, supply and monetary shocks without rising unemployment are: labour mobility, real wage flexibility, monetary and fiscal policy, capital mobility and exchange rate movements. I refer to the above type of shocks as they are the most commonly examined in the literature. Since the often cited study of Blanchard and Katz (1992) it is well known that region-specific shocks in the US are to a great degree absorbed by the high mobility of the American labour force. Workers who have lost their jobs due to a negative shock, move to more prospering regions thus reducing the unemployment rate in the respective state back to the national average. Comparing countries in Europe with states in the US, a similar capacity to absorb negative country-specific shocks would imply a very high mobility of the labour force between countries in Europe. Deeply entrenched cultural and language barriers impede workers from moving easily between countries in Europe. Hence, the Economic and Monetary Union must rely on other mechanisms to absorb negative shocks without rising unemployment. As real wage flexibility is the only other channel which relies on market forces, this would be the most desirable alternative. In this instance, the reaction of real wages to adverse shocks would lay the foundation to a recovery and a return to the pre-shock unemployment level. Wage reductions may move a firm down its demand for labour curve, but also reduce aggregate demand, thereby lowering demand for labour.

Real wage flexibility has been an issue in Europe at least since the late 1980s when persistent unemployment became the number one topic of economic policy in Europe. The mainstream approach to estimating real wage flexibility still appears to be the one proposed by Layard, Nickell and Jackman (1991). Based on the well known framework of the labour market with a wage setting and a price setting schedule, they estimated structural wage and price equations across OECD countries. In their original results, the degree of real wage flexibility differs considerably between countries in Europe. Essentially, countries can be put into three groups. Italy, Sweden and Austria have highly flexible real wages according to these results and the latter two have highly centralised and regulated labour markets. France, Belgium, the Netherlands, Ireland, and Finland exhibit a medium level of real wage flexibility, whereas Spain, Denmark, Germany, and the UK are beset by highly rigid real wages. Viñals and Jimeno (1996) proposed to estimate real wage rigidities by resorting to the Blanchard-Quah method. The method involved the introduction of an identification scheme based on long-run restrictions. In their methodology there are two shocks, an aggregate demand shock and an aggregate supply disturbance. The restriction used to identify is that aggregate demand has no effects on the long-run level of output, i.e. demand shocks are transitory on output. The idea behind such a restriction is the existence of vertical aggregate supply curve. The above methodology is combined with a structural VAR approach. The model is composed of a labour demand equation and a real wage equation according to which real wages depend on current and lagged unemployment. The advantage of the Blanchard-Quah method lies in the fact that not only the effects on current unemployment are taken into account but rather the whole adjustment path to a wage-push shock. The measure for real wage rigidity is then a combination of the initial response of unemployment to a transitory wage-push shock and the mean lag reflecting the adjustment path to such a shock.

Other studies on wage flexibility include Posen and Gould (2006) who investigated the EMU effect on wage restraint—the degree to which wage increases do or do not exceed productivity growth. They studied twenty one countries including the twelve euzo zone members plus Denmark, Sweden, the UK, Australia, Canada, Japan, Norway, Switzerland and the United States, Luxembourg, Norway and Switzerland between 1991 and 1998 (the pre-EMU period) and 1999 to 2004 (the post-EMU period). They found that Italy showed a substantial increase in wage restraint following the formation of the EMU. Girardi and Paruolo (2010) studied wages and prices before and after monetary union in the UK, Germany, France, Spain and Italy between 1988 and 2009 and found that the speed of adjustment of unemployment and wages is on average faster for the EMU countries in the EMU period. This may reflect some of the anticipated positive effects of the monetary union over national labour markets and price-level adjustment. Dellas and Tavlas (2003) studied wage rigidities in an asymmetric, three-country model (France, Germany and the UK) between 1970 and 1999 and compared monetary union to flexible exchange rates. They found that countries with high nominal wage rigidities benefit from a monetary union, especially when they join other similarly rigid countries. Countries with relatively more flexible wages lose when they form a union with more rigid wage countries.

There is a small amount of literature which attempts to answer the endogenous questions with reference to labour markets. After the EMU, some studies have concluded that there is a certain amount of wage flexibility in Europe but the studies have not assessed the unemployment versus wages issue in the face of asymmetric shocks for each individual country. My study contributes by carrying out a full study in this area and assesses whether unemployment or real wages are responsible for the adjustment process within the eleven EMU countries. This method, using impulse responses specifically targets these two variables because they are the main drivers used in the adjustment process – unemployment being a more costly variable because it induces welfare costs and wages which is a less costly adjustment mechanism. My study also uses up-to-date data which includes the full ten years after monetary union. This allows for a comprehensive and more robust set of results in answering the endogenous question.

2.8 Concluding remarks

In my introduction and literature review I have provided a discussion on the endogenous theories in OCAs with respect to the EMU and how the regime change alters the behaviour of economic agents. In their seminal work, Bayoumi and Eichengreen (1993) provided a new methodology to disentangle short-term shock disturbances on prices and output from long-run adjustments in a currency area. Since then, the measure of symmetric shock responses is the correlation coefficient of de-trended level aggregates, usually output. The authors compared US and European business cycles with respect to various demand and supply shocks and found (i) the US-regional framework to be more flexible than the European Union, and (ii) core European Union to be more flexible than periphery Union (Southern member countries). The idea of convergence over time which brings about symmetric shocks is central to the effective workings of a monetary union. The convergence debate has brought about mixed results and theorists have concluded that endogenous OCA are present to a certain extent although this is dependent on countries' structures and coordinated policies.

THREE:
METHODOLOGY

3.1 Introduction

For all examinations, the time period is sub-divided into two. The first is the ten years prior to the formation of the EMU (1988 to 1998) and the second is the period after the formation of the EMU (1999 to 2008). The reason for the sub-division is to measure pre-EMU behaviour of economic agents in both periods and look for evidence of endogenous behaviour thereafter. The countries to be examined are the eleven EMU countries and will include the UK and the US. The eleven EMU countries considered are the original ten out of eleven EMU members as of 2002 (excluding Luxembourg due to its size) plus Greece, despite the fact that it was not a member as of 1999. The countries are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Spain and Portugal. In my analysis, I compare the eleven member-states with the UK and the US because this may provide an insight as to whether there were some more general forces which were changing the degrees of convergence and correlation amongst the countries and whether the EMU could be seen as related with the changes in convergence and correlation. For example, if the correlations for the UK and US are in line with the changing patterns in the correlations between the EMU members, then some more general forces may be changing the degrees of convergence. However, if the UK and US showed greater evidence of divergence with the EMU members, then the changing pattern of convergence may be due to the change in coordination policies after 1999 which were not applicable to and did not affect the UK and the US. For all the examinations, the frequency of data are quarterly which enables the investigation to be more accurate than using annual data as they have more ‘points’ of observation during the time period. Where applicable, I indicate the examinations where some countries have been omitted because of insufficient or unavailability of data.

3.2 The Hodrick-Prescott Filter

The Hodrick-Prescott (1980) filter is often applied to economic time series data as part of the study of business cycles. Most measures of synchronicity are based on de-trending methods which in effect remove trend, thus leaving the cyclical component. In my analysis, I mention where the data have been seasonally adjusted. In time series analyses, seasonal adjustments are often performed to ‘even out’ periodic swings in statistical data. These can be due to adverse weather conditions, strikes or in the case of Germany, reunification of two regions within a country. The Hodrick-Prescott (1980) filter is an ad hoc fixed, two-sided moving average filter that optimally extracts the stochastic trend (unit root), moving smoothly over time. The smoothness of cyclical component is calculated taking the sum of squares of its second difference. The Hodrick-Prescott filter depends on one important variable, a smoothness parameter often referred to as λ.

The properties of the HP filter have been analysed by for example King and Rebelo (1993) and Ehglen (1998), from the viewpoint of optimal signal extraction. HP yields a decomposition that is optimal into orthogonal components that can be regarded as “trend” and “cycle.” However, estimated components will not obey the same generating processes as the corresponding “true” components, and a further line of enquiry, as in Harvey and Jaeger (1993) and Cogley and Nason (1995), is to consider the stochastic properties of the estimated components induced by the filter. In his analysis of business cycles, Michael Artis (2003) used the Hodrick-Prescott filter technique. He analysed the business cycles for the UK, US, Germany and the EU15 using real GDP data between 1975 and 2001. One attraction of the HP filter is that it may be applied to non-stationary time series (series containing one or more unit roots in their autoregressive representation), a relevant concern for many macroeconomic and financial time series.

In my examinations using the Hodrick-Prescott (HP) filter, I will use a smoothing parameter of 1600. Hodrick and Prescott suggest that this is a reasonable choice for quarterly data. One criticism of this filter, however, refers to its sensitivity to end-point observations, which can exert an undue influence on the trend estimated over the previous observations; to minimise this it is common to supply the filter with forecast data going beyond the end point of the sample (as was performed by Artis (2003) in his EMU 2003 study of Optimum Currency Area theory, using European Commission forecasts of the variables in question). In this research, I have chosen to maximise the length of the post-EMU period instead of going beyond the end point for two reasons. First, the longer time period the more likely it is to capture the impact of the business cycle fluctuations. Hence, I considered the inclusion of 2008 as the first year of the financial crisis as a significant source of information. Secondly, I do not rely on the HP filter as the only method of analysing business cycle convergence. I draw on the evidence from the HP method together with other methods to arrive at a conclusion about the extent of convergence before and after the EMU.

3.2.1 The correlation coefficient

A simple form of business cycle testing is the correlation coefficient of each country with the other EMU members plus the UK and the US. The variables to be tested are in the next chapter, chapter four. The correlation coefficient is the strength of association of a variable of for example, a country pair in a specific time period. The values of the correlation coefficient lie between +1 and -1 where +1 indicates that the strength of association is perfectly positively related and -1 indicates a perfect negative relationship. Each coefficient is indicated by a statistically significant level at either five or ten percent.

3.2.2 The Cross Country Coefficient of Variation

The cross country coefficient of variation in my research is used to calculate the dispersion of a variable over time among the EMU countries. I use this methodology in the empirical chapter four as one of the tests for convergence. My methodology is as follows. I have taken each variable separately to work out the coefficient of variation across the countries. There are three steps in this methodology. The first is to calculate the standard deviation of the sample and the second is to calculate the mean of the sample. The sample in this case is the values (of for example real GDP) of the eleven EMU countries at each point at time, t (hence the cross-country definition). Having established this, I perform the third step – that is to divide the standard deviation by the mean and then multiply this value by 100. Once all values are computed, one can determine the convergence patterns. From this calculation, values nearer zero show greater convergence whilst values further away from zero show greater divergence. For each of the figures, I provide an average coefficient for each sub-period. This is a snapshot indicating the average level of variation for each sub-period. Simply stated, in the period before the EMU, the lower the coefficient, the more convergent the cycle, and in the period after the EMU, the lower the coefficient, the more likely the possibility of endogenous convergence.

3.2.3 Persistence

Persistence is defined as the economic analogue of inertia in physics. Inertia may be defined as the resistance of a body to changing its velocity (direction and rate of speed) unless acted upon by an external force. An economic variable is said to be persistent if, other things being equal, it shows a tendency to stay near where it has been recently, absent other economic forces that move it elsewhere. In the case of inflation for example, the rate of change of the price level tends to remain constant (inflation tends to be persistent) in the absence of an economic "intervention" to move it from its current level. It must be noted that there may be other factors influencing price inflation, for example, global inflation or wage inflation. In terms of economic shocks, the dynamic effect of any shocks depends on the persistence of the series: for highly persistent series, the shock has a long-lasting effect, while for weakly persistent series the effect of the shock diminishes sooner.

Persistence defined in this way reflects a mixture of the effects of various shocks and the effects of transmission mechanism through which these shocks pass on to the economies. Persistence measures do not allow the differentiation between type of shocks and transmission mechanisms but gives an aggregate picture. This is still relevant because it gives an indication as to whether one series is more or less persistent that the other. If one series is more persistent than the other, then there is divergence in terms of either shock or transmission mechanisms or both. The adjustment cost will then be higher under a monetary union. Some shocks could have longer-term effects while others might diminish sooner, and some economies could react to a given shock differently than another. Therefore, this simple measure does not allow the identification of the relative importance of various shocks and the way the economies react to them; rather this measure reflects the aggregate effect of the similarities of shocks and their transmission. Therefore, my initial concern will not be whether or not the frequencies are high or low but whether or not they are similar. The OCA theory criteria, which states that countries have similar cycles, is important because countries that exhibit a high degree of persistent cycles relative to low persistence cycles, for example high inflation for long periods, would benefit from higher interest rates to be able to maintain the ECB's inflation target of below two percent. This would not be beneficial for countries which experience low persistent levels if rates were higher for longer periods as they may be unproductive in the long term. My research will concentrate on the similarity of persistence amongst the thirteen countries observed. For each variable, I have not used filtering techniques as I am measuring the actual fluctuations for each series.

3.2.4 The Asymmetry Index

The asymmetry index (the term index is not calculated in the same method as for example, the Comsumer Price Index – rather it is a term used to refer to a normalised measure of a difference between two quantities, in my case, two countries) is sometimes referred to as the Business Cycle Index. The aymmetry index is computed to explain the symmetry for each of the countries vis-a-vis each other. My computation of the asymmetry index follows the method applied by Larsson and Sikstrom (2009) in their analysis of symmetries in Nordic countries. The first step is to de-trend the data using the HP filter and to standardise the de-trended series. At this point each country has a business cycle value for each time, t of the series. The asymmetry index is then computed by taking the absolute value of the difference at each time, t between the value of country A's business cycle and country B's business cycle. There is only one value per country pair at each point in time. The values range from 0 to +2 where a value of +2 implies that two countries have experienced opposite business cycles and a value of 0 indicates that two countries have experienced identical business cycles. A downward or an upward trend would have information about increasing or descreasing business cycles synchronisation between two countries. If the symmetry index falls over time, then one can interpret this as both countries becoming more synchronised.

3.2.5 Orthogonalised Impulse Responses Functions (IRFs)

The Impulse Response Functions (IRFs) methodology is used extensively in empirical chapters five and six. In empirical chapter five, I use IRFs to assess primarily the absorption mechanisms of exchange rates and secondly the time taken for the effects of the shock to die out. In empirical chapter six, I use IRFs to determine whether the real wage or unemployment plays the greater role in the adjustment process following asymmetric shocks.

In signal processing, the impulse response, or IRF of a dynamic system is its output when presented with a brief input signal, called an impulse. More generally, an impulse response refers to the reaction of any dynamic system in response to some external change. In this case, the impulse response describes the reaction of the system as a function of time (or possibly as a function of some other independent variable that parameterises the dynamic behaviour of the system). In economics, and especially in contemporary macroeconomic modelling, impulse response functions describe how the economy reacts over time to exogenous impulses, which economists usually call 'shocks', and are often modelled in the context of a vector autoregression model. Impulses that are often treated as exogenous changes ranging from policy changes to structural changes for instance: changes in fiscal policies (government spending, tax rates, and other fiscal policy parameters), changes in the monetary policies (monetary base or other monetary policy parameters), changes in productivity or other technological parameters; and changes in preferences, such as the degree of impatience. Impulse response functions describe the reaction of endogenous macroeconomic variables such as output, consumption, investment, and employment to exogenous changes at the time of the shock and over subsequent points in time.

3.2.6 Unit root tests

Most time series data are non stationary, exhibiting trending behaviour. In statistical terms, a stationary time series is one whose statistical properties such as mean, variance, autocorrelation, are all constant over time hence they do not depend on the date t, Hamilton (1994). In order to test for stationarity, I have used the Augmented Dickey Fuller (1979) test method. To conduct a unit root test for stationary, I have used the Augmented Dickey-Fuller (ADF) test to examine each of the variables for the presence of a unit root (an indication of non-stationary), since it can handle both first order as well as higher order auto-regressive processes, by including the first difference in lags in the test in such a way that the error term is distributed as white noise. The test formula for the ADF is shown below:

$$\Delta Y_t = \alpha+\rho Y_{t-1} + \sum^{j}_{t-1} \gamma\Delta\ Y_{t-1} + \mu_t \qquad (3.1)$$

where, Y is the series to be tested; ρ is the test coefficient; and j is the lag length chosen for ADF such that μt is empirical white noise. Here the significance of ρ is tested against the null. Thus if the null hypothesis of non-stationary cannot be rejected, the variables are differenced until they become stationary, that is until the existence of a unit root is rejected, before proceeding to test for co-integration.

My analysis includes both with and without the trend criteria. Once a series has been tested for a unit root and the null has not been rejected (i.e. the series is non-stationary), the first difference is taken as time series econometrics works with stationary variables. Here, the first difference is the numeric difference between the values from one time period to the next. Once the first difference has been established, the series is tested again for a unit root. The series should be stationary or usually termed, stationary in the first difference. In this test, no trend is included since a trend in levels becomes a constant in first differences.

A second test is the Kwiatkowski, Phillips, Schmidt and Shin (1992) KPSS test. This test is well known for being the most powerful test, Ahamada (2003). In this test, the null hypothesis is that a unit root does not exist. This is the opposite of the Dickey Fuller test where the hypothesis is that a unit root does exist. The series is expressed as the sum of deterministic trend, random walk, and stationary error, and the test is the LM test of the hypothesis that the random walk has zero variance. KPSS type tests are intended to complement unit root tests, such as the Dickey Fuller. By testing both the unit root hypothesis and the stationarity hypothesis, one can distinguish series that appear to be stationary, series that appear to have a unit root, and series for which the data (or the tests) are not sufficiently informative to be sure whether they are stationary or integrated. The KPSS tests all lags simultaneously. For KPSS tests, the null hypothesis states that the variable is trend stationary. If the test statistic is higher than the critical value, then the null hypothesis is rejected. The series is said to be non-stationary. If the test statistic is lower than the critical value, then we cannot reject the null hypothesis. The critical value is usually chosen at the one per cent level. The series is stationary. In the empirical part of the thesis, I will outline which method of stationary testing I have used and the reasons why.

3.2.7 Cointegration tests

The purpose of the cointegration test is to determine whether a group of non-stationary series are cointegrated or not. A linear combination of two or more non-stationary series may be stationary. Thus, if such a stationary linear combination exists, the non-stationary time series are said to be cointegrated. A common example is where the individual series are first-order integrated (I(1)) but some (cointegrating) vector of coefficients exists to form a stationary linear combination of them. There are a few popular tests for establishing cointegration amongst variables. There is a more powerful and popular test to establish cointegrating relationships amongst variables. Another test for cointegration is the Engle-Granger (1987) test. This is a less powerful approach than the Augmented Dickey test. Researchers Bahmani-Oskooee (1991, 1992, 1994); Rose and Yellen (1989), and Rose (1991) found this to be the case. The problems with the Engle-Granger approach are well known. First, the cointegration results depend on the choice of the dependent variable, itself an arbitrary process. Second, in cases in which there are several cointegrating vectors, the Engle-Granger approach may produce an estimate which is a linear combination of these several vectors, thus raising an identification problem. Third, the approach is static and does not account for dynamic interrelationships among the variables. Finally, the estimated cointegrating coefficients have nonstandard distributions and therefore cannot be used for tests of hypotheses on true coefficient values. To deal with the above problems, Johansen and Juselius (1990) have proposed a multivariate cointegration approach that does not require the prior choice of the dependent variable, explicitly tests for the number of the cointegrating vectors, and yields maximum likelihood estimates of these vectors. In addition, the Johansen-Juselius test permits one to directly test the significance of key variables.

The Johansen-Juseluis (1988) method tests for the reduced rank indicated by the symbol Π. The rank of the matrix represents the number of cointegrating vectors that exist. That is to say, it represents the number of unique stationary linear combinations of the non-stationary variables. If the rank is greater than zero and less than full (a full rank indicates the maximum number of cointegrating vectors), then the variables are cointegrated with the number of cointegrating vectors equal to the rank. If the rank is equal to zero, then there are no cointegrating relations between the variables. To test the number of cointegrating vectors, I begin with the null hypothesis that there are no cointegrating vectors. This is the r = 0 in the rank summary. Here, if the trace statistic is lower than the critical value, I then stop testing there. The summary indicates that the null hypothesis of no cointegrating vectors cannot be rejected. If the trace statistic is higher than the critical value, the hypothesis of no cointegrating vectors at that level (r = 0) must be rejected and I move onto the next rank, r = 1. This process continues until the trace statistic is lower than the critical value, where the process ends.

3.2.8 Vector Error Correction models

I use this method in chapter five to estimate the effects of the trade balance following a depreciation/appreciation in the exchange rate. The VECM model is a linear representation of the joint stochastic process that generates the variables. Each of the variables in the model is considered endogenous, comprising two components: a linear function of the past realisation of all variables in the system (including a variable's own lagged values), as well as an unpredictable innovation component. Sims (1982) and Todd (1990)) recommend the use of these models as a useful alternative to "structural" modelling. An error correction model (ECM) is estimated on the basis of the theory of cointegration. I adopted the ECM approach because it offers statistical criteria by which one can link the short-run dynamics with the long-run relationship.

I have adopted the ECM estimation procedure as suggested by Johansen and Juselius (1998). This has been a popular method in determining long-run relationships between variables. The procedure is based on a unified framework for; (i) determining the number of cointegrating vectors; (ii) providing the maximum-likelihood (ML) estimates of the cointegrating vectors and; (iii) providing adjustment parameters in a multivariate cointegrating system. Once the number of cointegrating vectors has been established and the unique vector identified, the error correction term (or ECM) is estimated. The error correction term is the speed of adjustment towards equilibrium. Johansen and Juselius (1998) procedure allows the researcher to choose the appropriate vector according to a priori theory and statistically significant levels.

3.2.9 Lag choice

When running VAR regressions on time-series data, a lag criterion is used becsuse, for example, in my analysis of exchange rate behaviour, when trying to establish the determinants of the exchange rate, it is likely that the value of this year's exchange rate is dependent on last year's exchange rate. In order to determine how many lags to use, several selection criteria are available. The two most common are the Akaike Information Criterion (AIC) and the Schwarz' Bayesian Information Criterion (SIC/BIC/SBIC).

Another lag choice selection is the Final Predictor Error which was first introduced by Akaike (1969). To possibly find an alternative solution other than the traditional criteria, and improve the performance of forecast by the AR approximation methodology, Moon, Perron and Wang (2007) proposed the modified FPE1 criterion. Then, by considering the effective number of observations and the degrees of freedom adjustment for the estimated variance, the authors defined another new criterion: the modified FPE2. According Moon, Perron and Wang (2007), the two new criteria obtained by applying the suitable value of fractional differencing number d can improve the forecasting accuracy and reduce the lag length of the model. Namely, it can improve both the efficiency and simplicity of using the AR approximation model for long memory series. In general, the selection criteria are classified depends on the efficiency and consistency. The efficient criteria (e.g. AIC, AICC and FPE) emphasise selecting the model that can produce the least mean square prediction error; hence it helps to create the best finite-dimensional approximation model when the true model is of infinite dimension, Huang (2008). Akaike's Final Prediction Error (FPE) is defined by the following equation:

$$FPE = V\left(\frac{1+d/N}{1-d/N}\right) \tag{3.2}$$

where V is the loss function, d is the number of estimated parameters, and N is the number of values in the estimation data set. The toolbox (a statistical toolbox is a collection of ‘tools’ often in the form of commands which support a wide range of common statistical tasks. These commands are built into the system for or by the user) and assumes that the final prediction error is asymptotic for d<<N and uses the following approximation to compute FPE:

$$FPE = V\left(1 + {}^{2d}\!/_{N}\right) \tag{3.3}$$

The loss function V is defined by the following equation:

$$V = \det\left(\frac{1}{N}\sum_{1}^{N}\varepsilon\left(t,\theta_N\right)\left(\varepsilon\left(t,\theta_N\right)\right)^T\right) \tag{3.4}$$

where Θ_N represents the estimated parameters.

3.2.10 The Reduced-Form VAR

I use a reduced-form VAR model in empirical chapter six to determine the effects on labour markets variables to exogenous shocks to real GDP. Monetary policy making in central banks requires a profound understanding of the way the economy reacts to the shocks that continually bombard it. Banks call upon a wide range of economic models to help them in this undertaking. Since the pioneering work of Sims (1980), vector autoregressive (VAR) models have been used extensively by applied researchers, (e.g Prasad (1988) in his determination of labour market adjustment in the US and Canada) forecasters and policymakers to address a range of economic issues. These models comprise equations explaining a small number of key macroeconomic variables where each equation includes the same set of explanatory variables, lagged values of all the variables in the system. The basic VAR is therefore unable to tell us about the detailed structure of the relationship or shocks, which is what the policymaker really wants to know, as it is a `reduced-form' model. To unpack the shocks hitting the system and their effects on the economy, we need to `identify' the model with extra assumptions. Although VARs have been very successful in capturing the dynamic properties of macroeconomic time-series data, the decomposition of these statistical relationships back to coherent economic stories is still subject to a vigorous debate. However, the outcomes of the VAR analysis depend crucially on these assumptions and the various competing identification restrictions cannot be easily tested against the data. Even though several procedures have been proposed in the literature, shock identification remains a highly controversial issue.

The ability of using VAR models to address key macroeconomic policy questions depends crucially on the identification of the reduced-form residuals. Even though several procedures have been proposed in the literature, shock identification remains a highly controversial issue. To illustrate the identification problem, consider the following stylised structural model:

$$A_0Y_t = A(L)^hY_t + ŋ_t \qquad (3.5)$$

$$Y_t = A_0^{-1} A(L)^hY_t + A_0^{-}1ŋt \qquad (3.6)$$

where Y_t is a (n*1) vector of endogenous variables, A_0 is a (n*n) matrix of coefficients, A(L)h = $A_1L+....+A_hL^h$ is a h^{th} order lag polynomial and E(ŋtŋ$_t$ ') = I gives the variance-covariance matrix of the structural innovations. Equation 3.5 is the structural model and equation 3.6 is the corresponding reduced-form representation. The key parameters of interest are A_0 and A(L). However, the sampling information in the data is not sufficient to identify both A_0 and A(L) separately without further identifying restrictions. There is an infinite combination of A_0 and A(L) all imply exactly the same probability distribution for the observed data. To see this, pre-multiplying the model in 1 by a full rank matrix Q leads to the following new model:

$$QA_0Y_t = QA(L)Y_t + Qŋ_t \qquad (3.7)$$

$$Y_t = A_0^{-1}Q^{-1}QA(L)Y_t + A_0^{-1} Q^{-1}Qŋ_t \qquad (3.8)$$

The reduced-form representation of the two models in equations 3.6 and 3.7 are exactly the same. That implies both models in 3.5 and 3.7 are observationally equivalent. Without additional assumptions identifying restrictions, no conclusions regarding the structural behaviour of the `true' model can be drawn from the data.

3.3 Chapter conclusions

I have outlined a variety of methods and metrics necessary for my examinations to determine whether or not the fulfilment of the OCA theory criteria is endogenous to regime change. All the methodologies have been used in the literature, however, they have not been used extensively to answer the question of endogeneity within OCAs. For example, many of the business cycle tests such as the correlation coefficient, coefficient of variation and persistence have been used to answer questions pertaining to business cycle anaylsis. However, I have not seen these methods used to answer questions of endogeneity of the fulfilment of the OCA theory criteria. I have introduced a new method – the asymmetry index in my analysis of business cycle symmetries within the EMU countries, the UK and the US, only previously used to measure business cycle symmetries in the Nordic countries by Larrson (2009). With each methodology, I have indicated whether or not the coefficient is statistcally or indeed economically significant. Where the statistical significance is not calculated, for example the asymmetry index, I have indicated the range of values to be observed and how I interpret these values. By examining both periods, these methods should assist me in determining whether or not the issue relating to the fulfilment of the OCA theory criteria have been endogenous to the regime change.

FOUR

The convergence empirical chapter

4.1 Introduction

The study of growth rates synchronisation has been an important issue for the ECB for a number of reasons: (i) the fulfilment of the OCA theory criterion suggests that similar growth rates in member-states will ease the problems associated with the differential impact of monetary policy on these countries; (ii) not only do growth rates matter, but also the dynamics of growth also matters - thus the idea that similar frequency growth cycles between countries in a monetary union will also ease the problems of implementing monetary policy across a collection of member-states or countries; (iii) fulfilment of the OCA theory criteria also suggests that even without this increased synchronicity of business and growth cycles, increased mobility of factors of production can counter this and so aid implementation of monetary policy as resources can flow from one country to another to offset the differential impact of monetary policy.

With the advent of the single market in the EU after 1992, labour and capital mobility have increased, but it is still widely acknowledged that language and cultural barriers impose greater barriers to mobility of factors of production than they do in many other monetary unions (such as the US or Canada); (iv) another offset to lack of synchronisation can be found in autonomy of fiscal policy, perhaps at a national or member state level, or at the supra-national level. This has caused considerable concerns in the euro area in past years, as the Stability and Growth pact (SGP) appeared to severely limit member state fiscal policy so as to counterbalance ECB monetary policy and its differential impact on certain member-states, dependent largely on debt levels and any existing structural budget deficit considerations (for example Germany); (v) there is also a feedback effect involved, as a single monetary policy should impact all member states' growth rates across the euro area implying that an OCA might be created endogenously.

In the following sections in this empirical chapter, I use several methods (described in section 1.12) to establish the degree of convergence in the participating EMU countries and provide evidence of endogenous convergence. By analysing the countries using macroeconomic variables which represent the best indicators of performance, I am able to ascertain the level of convergence prior to the structural change in 1999 and examine evidence of endogenous convergence thereafter. From this, we can gain a better understanding of the implications/difficulties of monetary union and the endogenous behaviour of the participating countries.

4.1.1 The convergence debate: theoretical and methodology issues

Early studies such as Burns and Mitchell (1946) defined business cycles as sequences of expansions and contractions in the levels of either total output or employment (which were evaluated without any type of preliminary de-trending). This is the position advocated by the (so-called) classical cycle approach (dominant in NBER studies of business cycles). The classical approach consists of finding the turning points in an aggregate series typically, the (log) level of real GDP in order to identify peaks and troughs. Following this principle, Harding and Pagan (2002) argue that this traditional cycle measure has the advantage that the results are independent of how the researchers decide to decompose the series between trend (or permanent component) and the cycle itself. They developed an algorithm. Their algorithm meets the following two conditions: (i) first, peaks and troughs must alternate and (ii) it designs a censoring rule that requires a complete cycle to last at least five quarters. The methodology developed by Harding and Pagan (2002) allows us to recognise peaks and troughs in the GDP series.

A central feature of much combined theoretical and empirical work on business cycles since Lucas's (1977) influential article on 'Understanding Business Cycles' has been to define business cycles as deviations of real GDP from trend. The economic setting involves viewing the business cycle occurring in industrial market economies experiencing sustained growth. Furthermore, the pattern of analysis in the 1990s in identifying the stylised facts of business cycles largely has the procedure adopted by Kydland and Prescott (1990). In Kydland and Prescott's (1990) study of the US cyclical experience, they state that they follow Lucas in defining business cycles as the deviations of real aggregate from trend. They complete Lucas's definition by providing an explicit procedure for calculating a time series trend that successfully mimics the smooth curves most business cycles researchers would draw through plots of data. They followed Lucas (1977) in viewing the business cycle facts as the statistical properties of the co-movements of deviations from the trend of various economic aggregates with those of real output.

A general objective of business cycle synchronisation assessment is to see whether the selected key variables have remained consistently pro, counter or acyclical with those of real GDP (or output). It may be useful to know for theoretical and empirical studies the cyclical behaviour of key variables during business cycles. A question usually raised is whether the use of the data available of a single series such as real GDP is the most appropriate series to provide a proxy for the business cycle. Various studies have provided different results. One important reason contributing to the contrasting or conflicting conclusions drawn concerning the pro, counter or acyclical movements of key variables could be the relatively poor or varying quality of an econometric variable and also the use of a single series such as real GDP to represent the business cycle. Moreover, the series itself may have been subjected to more or less important revisions, Boehm (1998). Boehm (1998) stated that the real requirement is a precise and accurate measure of the aggregate economic activity of a nation as soon as possible after the event.

In forming a monetary union, structural effects and problems associated with a single monetary policy for the euro area as a whole have to be considered. Firstly, these problems are associated with an incomplete synchronisation of the business cycle across the euro area and with the fact that the EMU member countries display different long-run trend rates of growth and inflation. This means that the ECB has to apply its single instrument, the interest rate on main refinancing operations, to an economic area with quite different growth, unemployment and inflation rates (Arestis et al., 2002). For this reason, the application of a single instrument to the whole area will certainly have different effects. Secondly, the problem of asymmetric effects of a single monetary policy will be intensified by different monetary transmission mechanisms across the euro area due to different goods, labour and especially financial market structures. For the countries wishing to participate in the EMU, Cecchetti (1999) has shown that countries with many small banks, less healthy banking systems, and poorer direct capital access display a greater sensitivity to monetary policy shocks than countres with larger, more developed banking systems. As financial structure depends on the legal systems, especially on the laws governing shareholder and creditor rights and on the enforcement of those laws, and as these legal systems vary a lot across the euro area, the introduction of the euro cannot be expected to be an immediate catalyst for the harmonisation of financial structure and hence the monetary transmission process across the euro area. This position is reinforced by Mihov's (2001) VAR analysis of the effects of monetary policy shocks on real GDP growth and inflation in Europe and the US in the 1980s and 1990s. He finds diverse responses to a change in monetary policies across Europe depending on different financial structures which then affect the relative importance of interest rate and credit channels.

4.2 The variables

Real Gross Domestic Product (GDP)

I have used real GDP in my first examination as it is a measure of economic activity. The rate of change of GDP is regarded as the best indicator of growth of economic activity. The real GDP data are extracted from the Datastream statistics database in seasonally adjusted form. The data are taken in levels then calculated on a quarter on quarter percentage change. For all countries, real GDP is calculated as the total aggregate value of production activity of goods and services for each country.

The Output Gap

The output gap is the difference between the economy's actual output and the level of production it can achieve with existing labour, capital, and technology without putting sustained upward pressure on inflation. The potential output gap data are extracted from the Datastream statistics database and are reported quarterly. In my examinations, I use two methods of output gap calculation. They are: (i) the potential from actual output (calculated as the ratio of actual and potential real GDP using the production function calculated by Datastream) and; (ii) the real GDP from trend method. I do this to compare the two more popular measures of output gap calculations. The potential from actual output gap calculation methodology is one which estimates the potential output using a production function relationship and estimates of the factor inputs available to the economy including total factor productivity and potential employment which in part depends on one estimate of the structural rate of unemployment (NAIRU). This method needs more information and assumptions about economic interrelationships but it is less mechanical and more directly relevant to macroeconomic assessment. Real GDP from trend method estimates the output gap by subtracting the real GDP de-trended data from the real GDP series using the HP filter. The trend reflects a broad long-term growth curve around which output fluctuates. It is often regarded as a measure of potential output, although this view is not unanimously held (see e.g. Canova, 1998). The assessments are done in the same way for all countries and are therefore consistent and comparable.

The Consumer Price Index

The data are extracted from the Datastream statistics database, are reported quarterly and are seasonally adjusted. These data are available monthly, however, for the purpose of maintaining consistency throughout the study, I have decided to use quarterly data. In my calculations, I have used the inflation rate which is the per cent change in the price of goods and services from one period to the next. I have taken the CPI data then calculated the quarterly per cent change.

The Competitiveness Index

The competitiveness index is a value which indicates the degree to which a country is competitive. I use the competitiveness index because it is a popular variable used to measure competitiveness. Examples are Neary (2006) who reviewed alternative approaches to measuring an economy’s cost competitiveness and Bayoumi, Harmsen and Turunen (2011) who measured euro area export performance and competitiveness. In my analysis, I use the real effective exchange rate. This variable measures the trading position of an individual country relative to its partners and as such offers a good indication about changes in its competitive position. The dataset takes into account not only changes in market exchange rates, but also variations in relative price levels (using, respectively, consumer prices and unit labour costs in manufacturing), and therefore can be used as an indicator of competitiveness, OECD System of National Accounts 93 (2010). The indicator is taken from the OECD statistics database and is reported on a quarterly basis. The change in a country's index of relative consumer prices between two years is obtained by comparing the change in the country's consumer price index (converted into US dollars at market exchange rates) to a weighted average of changes in its competitors' consumer price indices (also expressed in US dollars), using the weighting matrix for the current year (based on the importance of bilateral trade).

4.3 Empirical results: Correlation coefficients

Real Gross Domestic Product (GDP)

When comparing before and after monetary union it is important to find out whether the pre-EMU correlation coefficient and the post-EMU correlation coefficient are significantly different. Significantly different in this case is where for example, the pre-EMU coefficient is weak and the post-EMU correlation is strong. Also, if a country pair (or average coefficient with the other countries) shows a moderate (between 0.2 and 0.5) correlation or strong (above 0.5) in one period and a negative correlation in the other period, they can be said to be significantly different. One has to make a judement as to what constitutes a strong, moderate or weak association as there is no agreed figure in the literature. I consider a weak association to be a coefficient below 0.2.

Below, figures 4.1, 4.2 and 4.3 show the correlation coefficient for the quarter on quarter percentage change in real GDP. In the figures, I provide statistically significant levels – one star for significance at the five per cent level and two stars for significance at the one per cent level. In all the correlations, I show an average value of the coefficients for the countries. This provides a 'snapshot' showing the extent to which the countries are correlated. In my analysis, in comparing and interpreting the convergence tests before and after the inception of the EMU, there are limitations in the methodologies within this chapter due to the broader trends that have occurred globally during the same period and these trends may have had considerable influences on trends and business cycles of the EMU countries and the UK and US. As well as the two sub periods, I have computed results for the whole period. This computation does not indicate levels of convergence at a particular time within the period. Rather, the computation shows the correlation coefficients for the time period indicated.

Figure 4.1

Pairwise cross correlation coefficient of the quarterly percentage change in real GDP between 1988 and 2008

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	UK	US
Austria	1												
Belgium	0.212	1											
Finland	.337**	.260*	1										
France	.604**	0.181	.541**	1									
Germany	.278*	-0.005	-0.201	.240*	1								
Greece	0.112	.815**	0.08	0.146	.253*	1							
Ireland	0.097	.611**	.333**	0.147	-.244*	.509**	1						
Italy	.564**	.322**	.444**	.729**	.314**	0.214	.352**	1					
Netherlands	.463**	0.139	.425**	.513**	0.135	-0.043	-0.021	.391**	1				
Portugal	.410**	.514**	.286**	.539**	.227*	.647**	.497**	.581**	0.147	1			
Spain	0.078	-.675**	0.163	0.185	-0.181	-.770**	-.495**	0.025	.318**	-.307**	1		
UK	.332**	0.089	.673**	.508**	-0.079	0.05	.354**	.488**	.332**	.410**	.262*	1	
US	.281*	0.055	.482**	.453**	-0.084	-0.124	0.076	.300**	.355**	0.204	.274*	.566**	1
Average Corr	0.314	0.209	0.318	0.398	0.054	0.157	0.184	0.393	0.262	0.346	-0.093	0.332	0.237

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.2

Pairwise cross correlation coefficient of the quarterly percentage change in real GDP between 1988 and 1998

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	UK	US
Austria	1												
Belgium	0.118	1											
Finland	0.138	0.235	1										
France	.598**	0.095	.412**	1									
Germany	0.197	-0.089	-.406**	0.161	1								
Greece	0.113	.831**	0.096	0.147	0.226	1							
Ireland	0.034	.627**	.342*	0.082	-.306*	.540**	1						
Italy	.400**	0.286	0.229	.623**	0.204	0.254	.412**	1					
Netherlands	0.205	0.017	.383*	.341*	-0.128	-0.157	-0.134	0.046	1				
Portugal	.320*	.501**	0.188	.465**	0.131	.685**	.524**	.516**	-0.15	1			
Spain	-0.079	-.775**	0.097	0.131	-0.243	-.837**	-.574**	-0.151	.305*	-.447**	1		
UK	0.002	-0.015	.624**	0.267	-.336*	0.02	.375*	0.218	0.122	0.257	0.232	1	
US	0.004	-0.113	.501**	0.245	-.379*	-0.255	-0.008	-0.008	0.198	-0.018	.379*	.517**	1
Average Corr	0.17	0.143	0.236	0.297	-0.08	0.138	0.159	0.252	0.087	0.247	-0.163	0.19	0.08

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.3

Pairwise cross correlation coefficient of the quarterly percentage change in real GDP between 1999 and 2008

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	UK	US
Austria	1												
Belgium	.757**	1											
Finland	.595**	.713**	1										
France	.609**	.696**	.739**	1									
Germany	.519**	.462**	.550**	.496**	1								
Greece	0.237	.312*	0.277	.355*	0.212	1							
Ireland	.390*	.521**	.437**	.494**	.318*	0.143	1						
Italy	.685**	.747**	.759**	.828**	.616**	0.249	.448**	1					
Netherlands	.653**	.664**	.566**	.673**	.613**	0.294	.385*	.671**	1				
Portugal	.640**	.680**	.659**	.780**	.487**	.468**	.486**	.793**	.657**	1			
Spain	.495**	.453**	.418**	.417**	0.301	0.12	0.245	.513**	.552**	.484**	1		
UK	.626**	.661**	.753**	.760**	.587**	.380*	.508**	.763**	.558**	.823**	.442**	1	
US	.459**	.627**	.555**	.630**	0.289	0.072	.446**	.522**	.436**	.566**	0.211	.640**	1
Average Corr	0.555	0.607	0.585	0.623	0.454	0.26	0.401	0.632	0.56	0.626	0.387	0.625	0.454

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

For the whole period in figure 4.1, the UK shows positive correlations with the EMU members although the associations are generally overall not strong. From this analysis, it is clear that real GDP growth rates in the post-EMU period are in most cases, significantly different to the period before the EMU. The post-EMU coefficients for Austria, Belgium, Finland, France, the Netherlands, Portugal, Spain, the UK and the US are strong in comparison to the moderate or weak coefficients in the period before. Ireland has a positive coefficient in the post-EMU period but a negative coefficient in the pre-EMU period.

The period prior to the EMU shows that the correlations are overall lower judging by the average values in all countries. With reference to the UK, this period shows a strong correlation with Finland (.624) which is statistically significant at the one per cent - this being the only strongly correlated country, weaker correlation with France and Italy (.267 and .218 respectively), which is not statistically significant but economically significant - but a negative and weak correlation with Germany (-.336), statistically significant at the five per cent level. Indeed, in many studies, Germany was seen as the benchmark upon which countries assessed their macroeconomic performance. This is highlighted in the work of Bayoumi and Eichengreen (1993) who introduced the coinage of the core and periphery in the work on correlation on demand and supply shocks in European countries. In each case, the centre country was taken to be Germany and the results ranked (with

Germany at 100) and the remainder of the European countries were shown in descending order of closeness to Germany. Further work on the core and periphery was carried out by Taylor (1995) using other variables representing labour market flexibility or Artis and Zhang (2001) using cluster analysis. In each case, the core country was Germany with the EMU countries assessed reporting membership coefficients. In my results, the period after the EMU shows higher correlations with all countries. The UK is strongly correlated to Germany, France and Italy (.587, .760 and .763 respectively), all statistically significant at the one per cent level. Greece had relatively weak correlations throughout the series with the exception of the relationship with Belgium showing strong correlations in both periods (.831 prior to the EMU, (statistically significant at the one per cent level), .312 after the EMU, (statistically significant at the five per cent level) and .815 for the whole period (statistically significant at the one per cent level)).

The average coefficients in the post-EMU period are substantially higher. I used the one and five per cent levels as measures of statistical significance to a zero correlation. My results are similar to the results of Artis (2003) who investigated business cycles using real GDP growth rates in various European countries including Sweden, Denmark and Switzerland and non European countries including Canada and Japan. He predominantly concentrated on the UK versus the EU15 (which include non EMU members) and found a positive correlation (.73) to the EU15. The technique he used was the Baxter-King (BK) Filter (1999), (a variation to the Hodrick-Prescott filter) from nominal GDP growth rates, however, although his techniques are similar to mine, the period he studied was the run up to the EMU. More recent studies carried out by Darvas and Szapary (2004) using the EMU countries find evidence in support of more business cycle synchronisation in the euro area since the advent of monetary union. These authors not only focus upon GDP, but also analysed synchronisation of the major expenditure and sectoral components of GDP. Their results suggest that Austria, Belgium, France, Germany, Italy and the Netherlands show a high degree of synchronisation after the EMU.

In my overall analysis, the series display a higher degree of correlation in the pre-EMU period. The average correlation for the period before the EMU for real GDP series is .135 compared to the average period after the EMU of .520. In the real GDP series, there is some evidence of endogenous convergence overall, however, this may be due to more general forces after 1999. I conclude this because the change in convergence in the UK and the US is in line with that of the EMU countries. If the change in the UK and US showed greater divergence, then this increase in convergence between the EMU countries may be fully due to the coordination policies after 1999. In my analysis, the strengths of association and thus the levels of convergence before the EMU were relatively weak as shown by the overall averages, however, the strengths of association after the EMU were much stronger. Therefore from these results, there is evidence of endogenous behaviour from all countries. Overall, every country analysed shows better convergence since the formation of the EMU. Most studies use simple (Pearson) correlation coefficients of the cyclical part of GDP for this purpose but other measures have been suggested in the literature as well, such as the dynamic correlation measure of Croux et al. (2001), the phase-adjusted correlations of Koopman and Azevedo (2003) and the concordance index of Harding and Pagan (2002). Indeed, Koopman and Azevedo (2003) studied business cycles correlation using five EMU countries (Germany, France, Italy, Spain and the Netherlands) and the UK and US. They also analysed the euro area (12 countries) from 1971:q1 to 2110:q1 and found that France and Germany display a high degree of association with the euro area across the sample. Spain, Italy and the Netherlands had a relevant increase in the association with the euro area, reaching levels of association close to those of Germany and France in the end of the sample. Spain and Italy became more synchronised with the euro area while the Netherlands displayed a small lead in the end of the sample.

The Output gap

A number of techniques for measuring potential output and output gap have been developed. However, many researchers believe that none are completely satisfactory. These differences are evident from the results of many empirical studies showing that different methodologies and assumptions for estimating a country's potential output and output gap produce different results, for example de Brouwer (1998); Dupasquier, Guay and St-Amant (1999); Scacciavillani and Swagel (1999); and Cerra and Saxena (2000). The difficulty arises since neither potential output nor output gap is directly observable. Moreover, these measures must be derived from their hypothesised determinants and other information, such as observable variables that are thought to be correlated to the potential output and output gap, Laxton and Tetlow (1992). The difficulty is compounded by the fact that there is increasing evidence suggesting that output series are best characterised as integrated series, Nelson and Plosser (1982). Therefore the presence of stochastic component does not allow the potential output to be treated as simply a deterministic component.

The data are taken from eight of the thirteen countries. This is due to the unavailability of data from Austria, Belgium, Greece, Portugal and Spain. The examined countries here are Finland, France, Germany, Ireland, Italy, the Netherlands, UK and US. Some importance has indeed been based on the output gap being an important stabilising factor, Svensson (1997) states, due to the effect of the output gap on inflation, an optimal inflation-targeting policy implies a monetary policy response to the output gap. In addition, the central bank may want to stabilise the output gap per se. Figures 4.4, 4.5 and 4.6 show the output gap correlation coefficient results.

Figure 4.4

Pairwise cross correlation coefficient of the Output Gap quarterly data between 1988 and 2008 using the HP filter

	Finland	*France*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*UK*	*US*
Finland	*1*							
France	*.835***	*1*						
Germany	*.453***	*.597***	*1*					
Ireland	*.652***	*.475***	*.289***	*1*				
Italy	*.928***	*.950***	*.504***	*.457***	*1*			
Netherlands	*.433***	*.402***	*.747***	*.566***	*.282***	*1*		
UK	*.962***	*.757***	*.329***	*.458***	*.909***	*.242**	*1*	
US	*.946***	*.646***	*.318***	*.688***	*.774***	*.450***	*.922***	*1*
Average corr	*0.744*	*0.666*	*0.462*	*0.512*	*0.686*	*0.446*	*0.654*	*0.677*

Data Source: Datastream statistics database

**. Correlation is significant at the 0.05 level (2-tailed).*
***. Correlation is significant at the 0.01 level (2-tailed).*

Figure 4.5

Pairwise cross correlation coefficient of the Output Gap quarterly data between 1988 and 1998 using the HP filter

	Finland	France	Germany	Ireland	Italy	Netherlands	UK	US
Finland	1							
France	.819**	1						
Germany	.794**	.995**	1					
Ireland	.704**	.490**	.527**	1				
Italy	.938**	.953**	.928**	.527**	1			
Netherlands	.469**	.325*	.385**	.954**	.298*	1		
UK	.987**	.761**	.723**	.614**	.916**	.352*	1	
US	.957**	.625**	.599**	.758**	.800**	.531**	.960**	1
Average corr	0.809	0.709	0.707	0.653	0.764	0.472	0.759	0.747

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.6

Pairwise cross correlation coefficient of the Output Gap quarterly data between 1999 and 2008 using the HP filter

	Finland	France	Germany	Ireland	Italy	Netherlands	UK	US
Finland	1							
France	.989**	1						
Germany	.899**	.921**	1					
Ireland	-.355*	-.389*	-.704**	1				
Italy	.891**	.855**	.686**	-0.165	1			
Netherlands	.580**	.656**	.805**	-.633**	0.185	1		
UK	.652**	.536**	.350*	0.122	.775**	-0.143	1	
US	0.152	0.097	0.042	0.274	-0.123	0.248	0.306	1
Average corr	0.544	0.523	0.428	-0.246	0.443	0.242	0.371	0.142

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The overall results for the whole period in figure 4.4 shows largely positively correlations between all participating countries. The average coefficients in the post-EMU period are significantly different to the period before the EMU. Five of the eight countries show higher average coefficients in the pre-EMU period than in the post-EMU period. These countries are: Germany, Ireland, Italy, the UK andb the US.

In the post-EMU period shown in figure 4.6, Ireland now exhibits negatively correlated results with Finland (.-355), France (.-389), Germany (.-704), Italy (.165), and the Netherlands (.-633). These values are statistically significant at the five per cent level with the exception of Germany and the Netherlands which is statistically significant at the one per cent level and Italy which is economically rather than statistically significant. The UK shows strong associations with the participating with the exception of the Netherlands (-.143), which is economically significant. The results using the HP filter technique demonstrate that there was a high degree of association prior to and after monetary union with the exception of Ireland. OCA theory criteria require output gaps amongst participating countries to be similar and the results support this theory. There is clear evidence of less synchronisation in the post-EMU period even though average coefficients (with the exception of Ireland) are positive. Consistent with my findings are that of Giorno et al (1995) who calculated the output gap using the Cobb-Douglas production function based on the trends of production factors and found that Euro member countries were highly correlated in the years leading up to 1999 but particularly between 1999 and 2001 with the noticeable exception of Greece and the Netherlands. Also, a similar OECD (2002) study conducted using a modified version of the phase-average trend (PAT) developed by the NBER using a filtering technique applied to the industrial production index found that most euro area countries' business cycles showed the highest degree of synchronicity in 2000 although correlations were weaker thereafter. The results from previous studies seem to suggest that synchronicity may have been achieved through a long period of integration amongst the European countries. The average convergence level after the EMU is lower than the average after the EMU (0.305 and 0.702 respectively) with the UK and the US also showing lower average convergence coefficients after 1999.

This analysis gives rise to the issue of fiscal policies in the EMU countries since the 1990s in terms of the restrictive and pro-cyclical stance of EMU fiscal policies. There has been a falling trend in the dispersion of budget deficit-GDP-ratios since the early 1990s, (Hein and Truger, 2005). One might want to conclude that the trend is explained by the uniform prescriptions for all countries, which reduced national fiscal policies' capacity to react to country specific shocks. This can be challenged for two reasons. First, the reduction of the dispersion largely follows from the convergence of government net interest payments (in percent of GDP) during the consolidation process of the 1990s, in combination with interest rate convergence across the EMU. The dispersion of the primary deficit-GDP-ratios (budget deficits without government net interest payments) used to be substantially lower than the dispersion of the deficit-GDP-ratios during the 1980s, with the latter converging towards the former during the 1990s. Second, the decrease in the dispersion of the primary deficits might well be explained by the observable decrease in output gap dispersion, indicating that there was no need for more asymmetric fiscal policies during this period. This picture, however, has changed recently. In the face of the persistent growth slow down since 2001 countries close to and above the three per cent limit (such as Germany, Italy, France and Portugal) are forced to use restrictive fiscal policies, thereby further widening their negative output gaps, whereas other countries are able to stabilise their economies through deficit spending. These different behavioural patterns give rise to the coefficients being less convergent after the EMU. From these results, output gap convergence seemed to have been achieved before 1999 with the cycles showing less convergence afterwards. Therefore from this output gap analysis, the results would suggest that the fulfilment of the OCA theory criteria is not endogenous to regime change.

Below, figures 4.7, 4.8 and 4.9 are the results for the output gap correlation coefficients using the trend real GDP estimate.

Figure 4.7

Pairwise cross correlation coefficient using real GDP from trend method of quarterly data between 1988 and 2008

	Finland	France	Germany	Ireland	Italy	Netherlands	UK	US
Finland	1							
France	.717**	1						
Germany	-.238*	.234*	1					
Ireland	.738**	.512**	-.262*	1				
Italy	.652**	.835**	.310**	.630**	1			
Netherlands	.617**	.800**	.342**	.284**	.647**	1		
UK	.809**	.607**	-0.169	.720**	.586**	.446**	1	
US	.599**	.591**	-0.185	.336**	.341**	.501**	.713**	1
Average corr	0.556	0.613	0.004	0.422	0.571	0.519	0.53	0.413

Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.8

Pairwise cross correlation coefficient using real GDP from trend method of quarterly data between 1988 and 1998

	Finland	France	Germany	Ireland	Italy	Netherlands	UK	US
Finland	1							
France	.603**	1						
Germany	-.652**	-0.004	1					
Ireland	.754**	.480**	-.479**	1				
Italy	.566**	.804**	0.027	.701**	1			
Netherlands	.519**	.742**	-0.006	0.242	.585**	1		
UK	.803**	.380*	-.660**	.761**	.402**	0.146	1	
US	.548**	0.277	-.646**	0.241	0.011	0.129	.643**	1
Average corr	0.449	0.469	-0.346	0.386	0.441	0.336	0.354	0.172

Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.9

Pairwise cross correlation coefficient using real GDP from trend method of quarterly data between 1999 and 2008

	Finland	France	Germany	Ireland	Italy	Netherlands	UK	US
Finland	1							
France	.914**	1						
Germany	.636**	.585**	1					
Ireland	.742**	.730**	.442**	1				
Italy	.810**	.870**	.681**	.710**	1			
Netherlands	.828**	.865**	.703**	.506**	.696**	1		
UK	.849**	.825**	.546**	.797**	.746**	.637**	1	
US	.757**	.778**	0.164	.652**	.504**	.603**	.793**	1
Average corr	0.781	0.795	0.536	0.654	0.716	0.691	0.741	0.607

Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

All the coefficients in the post-EMU period are significantly different to the period before the EMU. For the whole series 1988 – 2008, Germany shows on average the weakest correlations with the other countries. The average here is .004. Germany shows a negatively correlated series with Ireland, the UK and the US. Excluding Germany, the average correlation here is 0.517. This is lower than the full series which uses the production function to calculate the output gap which has an average correlation of .61. In the period prior to the EMU, the trend real GDP series again shows that Germany has the lowest average correlation, -.346. This is in contrast with the production function calculation where the average is .707. For the trend series, the remaining countries show positive correlations for this sub-period. In the period after the EMU, all correlation coefficients are positive, including that of Germany. The average is .690 which is lower than that of the production function technique where the average is .31. In the sub-period prior to the EMU in the real GDP trend series the coefficient values are lower than the post-EMU sub-period even though the values indicate reasonably high levels of association and therefore convergence, with the exception of Germany. This is in contrast with the results using the actual versus potential method of output gap calculation where the average pre-EMU sub-period was higher than the post-EMU sub-period at .702 and .31 respectively. Using the trend method, I can conclude that most countries achieved substantial levels of convergence in the run up to the EMU and even greater convergence thereafter. The UK and the US also have higher average coefficients after 1999 which is similar to that of the EMU countries. Here, because there is evidence of strong convergence in both periods (with the exception of the divergence in Germany *ex-ante*), one cannot conclude that the improved convergence has been brought about by an endogenous process after 1999. Also, the evidence of increasing convergence in the UK and the US (similar to the EMU countries) shows that there may have been other general forces leading to the increasing convergence levels. Using the potential to actual output gap calculation, convergence seems to have been achieved before the EMU. Here, strong convergence is observed in both periods, however, even though there is stronger post-EMU convergence, I cannot conclude that this improvement has been brought about by an endogenous process.

The Inflation Rate

The third variable is the inflation rate. I show below in figures 4.10, 4.11 and 4.12 the three different periods as in the previous examinations.

Figure 4.10

Pairwise cross correlation coefficient of CPI percentage change quarterly data between 1988 - 2008

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Spain	Portugal	UK	US
Austria	1												
Belgium	.738**	1											
Finland	.456**	.484**	1										
France	.642**	.664**	.710**	1									
Germany	.819**	.549**	.371**	.534**	1								
Greece	.632**	.350**	.611**	.664**	.669**	1							
Ireland	0.201	.289**	.358**	.221*	0.042	-0.211	1						
Italy	.630**	.408**	.646**	.783**	.594**	.909**	-0.064	1					
Netherlands	.401**	.305**	-0.023	-0.008	.425**	0.125	.250*	0.079	1				
Spain	.555**	.356**	.794**	.747**	.540**	.900**	0.031	.877**	0.042	1			
Portugal	.739**	.562**	.703**	.844**	.650**	.827**	0.15	.906**	0.104	.881**	1		
UK	.509**	.465**	.728**	.762**	.563**	.846**	-0.016	.819**	0.016	.827**	.777**	1	
US	.552**	.645**	.736**	.783**	.354**	.592**	0.188	.649**	-0.151	.694**	.775**	.695**	1
Average corr	0.573	0.484	0.547	0.612	0.509	0.576	0.112	0.603	0.13	0.603	0.659	0.582	0.543

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.11

Pairwise cross correlation coefficient of CPI percentage change quarterly data between 1988 - 1998

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Spain	Portugal	UK	US
Austria	1												
Belgium	.743**	1											
Finland	.324*	.509**	1										
France	.563**	.708**	.822**	1									
Germany	.830**	.633**	0.216	.427**	1								
Greece	.807**	.758**	.695**	.837**	.627**	1							
Ireland	.311*	.468**	.651**	.605**	.301*	.451**	1						
Italy	.668**	.652**	.667**	.915**	.455**	.834**	.604**	1					
Netherlands	.555**	.438**	-0.266	-0.05	.713**	0.294	0.038	0.027	1				
Spain	.612**	.680**	.908**	.899**	.426**	.869**	.664**	.829**	-0.036	1			
Portugal	.752**	.732**	.723**	.900**	.544**	.849**	.698**	.936**	0.12	.892**	1		
UK	.492**	.628**	.770**	.877**	.428**	.861**	.615**	.805**	0.127	.839**	.770**	1	
US	.459**	.673**	.850**	.899**	0.188	.793**	.502**	.807**	-0.185	.890**	.800**	.814**	1
Average corr	0.593	0.635	0.572	0.7	0.482	0.723	0.492	0.683	0.147	0.706	0.726	0.669	0.624

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.12

Pairwise cross correlation coefficient of CPI percentage change quarterly data between 1999 - 2008

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Spain	Portugal	UK	US
Austria	1												
Belgium	.830**	1											
Finland	.618**	.598**	1										
France	.702**	.723**	0.309	1									
Germany	.838**	.748**	.589**	.688**	1								
Greece	.584**	.653**	.359*	.710**	.512**	1							
Ireland	.526**	0.245	.707**	0.303	.356*	.389*	1						
Italy	.636**	.697**	.574**	.782**	.679**	.565**	.436**	1					
Netherlands	0.295	0.196	.410**	0.064	.335*	.396*	.421**	.494**	1				
Spain	0.225	0.02	0.212	0.207	.442**	.550**	.585**	.456**	.687**	1			
Portugal	.716**	.686**	.443**	.726**	.687**	.408*	.449**	.699**	0.204	.451**	1		
UK	.341*	.587**	.420**	.374*	.376*	0.066	-0.012	0.271	-0.172	-0.252	0.273	1	
US	.620**	.686**	.415**	.512**	.455**	-0.083	0.26	.436**	-0.114	0.086	.809**	.382*	1
Average corr	0.577	0.555	0.471	0.508	0.558	0.425	0.388	0.56	0.268	0.305	0.546	0.221	0.372

Data Source: Datastream statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The coefficients in the post-EMU period are overall not significantly different to the period before the EMU. The UK, US and Greece show coefficients that are significantly different in both periods. Although Finland and Germany show coefficients that are significantly different in both periods by my definition, these coefficients are reasonably close to 0.5 and I therefore make a judgement that the associations were similar in both periods for these two countries.

The overall results for the whole period between 1988 and 2008 show overall strong average associations between most countries with the exception of Belgium, Ireland and the Netherlands who exhibit weaker correlations. The UK exhibits strong associations with most countries with the exception of Ireland, the Netherlands and Belgium. For the period prior to the EMU, strong correlations still exist with the exception of the Netherlands which still shows a weak association with most countries with the exception of Germany (.713), Austria (.555) both statistically significant at the one per cent. Inflation rates in the UK are positively correlated with the EMU members particularly with France (.877), statistically significant at the one per cent level. Germany shows strong associations with all countries with the exception of the US which shows a weak correlation. In the period after the EMU, Germany still maintains strong correlations with all countries. The Netherlands also shows weak associations with some of the EMU members (association with France is .064, however, it is not statistically significant at either the one or five per cent levels) and is negatively associated with the UK and the US. The UK still shows a strong association in the post-EMU period with the exception of the Netherlands and Spain (-.172 and -.252 respectively), although not statistically significant. In the post-EMU series, most countries show evidence of stronger association, however, the correlations appear to be lower than in the pre-EMU period. This is seen by the lower average coefficients between 1999 and 2008. Overall, my analysis shows that correlation was achieved before the EMU but the series became less correlated thereafter. The UK and the US also show lower correlation averages, similar to the EMU countries. Therefore, I conclude that because there is greater pre-EMU correlation, the results would suggest that the fulfilment of the OCA theory criteria is not endogenous to regime change.

Although correlation techniques do not fully identify whether or not countries had converged, I have used the correlation coefficients as a ‘starting point’ to assess the extent to which countries’ business cycles were synchronised at two different time periods. My analysis is consistent with many previously done, such as Mentz and Sebastian (2003), who examined the degree of inflation convergence between the EU member-states. They used the Johansen test and concluded that no complete convergence of inflation rates is observed, however, there is a degree of divergence between some member-states (although they do not specify which ones). Numerous other studies such as Rogers et al. (2001); Engel and Rogers (2004); Weber and Beck (2005); Faber and Stokman (2005); Busetti, et al. (2007) found evidence of inflation convergence within the euro-zone in the mid-1990s. However, some studies show different results. Honohan and Lane (2004) have indicated a sharp convergent pattern in the EMU countries since the Euro was established whereas Duarte (2003) indicated divergence which began in late 1998. Overall, based on the evidence, the average correlations show improved synchronisation cycles before the EMU. The average correlation is 0.659 compared to 0.339 after the EMU. All countries show less convergence after the EMU, however, there are still generally high levels of association after 1999 with the exception of Greece, the Netherlands and Portugal with either weaker or negative associations. Based on this evidence, although relatively high associations are observed between most countries, inflation convergence was present in the run up to the EMU and also after the structural break, albeit with lower associations and thus endogenous convergence cannot be concluded here.

Competitiveness Index

Figures 4.13, 4.14 and 4.15 below show the competitive index using the real effective exchange rate.

Figure 4.13

Pairwise correlation coefficient for the Competitive Index between 1988 - 2008 using the Real Effective Exchange Rate

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	UK	US
Austria	1												
Belgium	0.1473	1											
Finland	0.6288*	-0.4006*	1										
France	0.8901*	0.1908	0.6535*	1									
Germany	0.1377	0.2415**	-0.2371**	0.1272	1								
Greece	-0.4397*	0.1951	-0.5750*	-0.4069*	0.6121*	1							
Ireland	0.9136*	-0.0492	0.7618*	0.9275*	-0.0436	-0.5819*	1						
Italy	-0.1601	0.1995	0.0671	-0.1267	-0.7306*	-0.3207*	-0.0791	1					
Netherlands	0.2099	0.6544*	-0.0505	0.1984	-0.1262	-0.0886	0.087	0.6283*	1				
Portugal	-0.5317*	0.6295*	-0.8264*	-0.5324*	0.2234**	0.5809*	-0.6800*	0.2152**	0.3060*	1			
Spain	-0.2486**	0.6411*	-0.3547*	-0.1734	-0.3646*	0.0237	-0.2733**	0.7689*	0.6165*	0.6891*	1		
UK	-0.7848*	-0.1178	-0.4698*	-0.8377*	-0.3626*	0.2173**	-0.8083*	0.4639*	0.1159	0.4523*	0.3662*	1	
US	0.1354	-0.7576*	0.3943*	-0.0289	0.1841	-0.0139	0.1581	-0.5586*	-0.6976*	-0.5591*	-0.7849*	-0.2038	1
Average corr	0.075	0.1311	-0.034	0.073	-0.028	-0.066	0.027	0.031	0.154	-0.003	0.0755	-0.164	-0.227

Data Source: OECD statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.14

Pairwise correlation coefficient for the Competitive Index between 1988 - 1998 using the Real Effective Exchange Rate

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	UK	US
Austria	1												
Belgium	0.4184*	1											
Finland	0.183	-0.4655*	1										
France	0.6353*	0.4541*	0.3223**	1									
Germany	-0.1901	0.7149*	-0.7474*	0.0504	1								
Greece	-0.5774*	0.3673**	-0.7430*	-0.4253*	0.7483*	1							
Ireland	0.7156*	-0.0578	0.5697*	0.6652*	-0.5736*	-0.8552*	1						
Italy	0.115	-0.5626*	0.7735*	0.0218	-0.8418*	-0.6477*	0.5336*	1					
Netherlands	0.6584*	0.2486	0.3004**	0.5805*	-0.0581	-0.5388*	0.5781*	0.2192	1				
Portugal	-0.1698	0.6506*	-0.7258*	-0.2126	0.7291*	0.7579*	-0.5189*	-0.4583*	-0.1828	1			
Spain	0.1409	0.3093**	0.0771	0.0803	-0.0165	0.0982	0.0836	0.4104*	0.1127	0.5348*	1		
UK	-0.4187*	-0.7022*	0.301**	-0.6523*	-0.4848*	-0.0667	-0.2713	0.4734*	-0.1053	-0.3077**	-0.0758	1	
US	-0.0014	-0.6631*	0.4147*	-0.3689**	-0.6954*	-0.4157*	0.1329	0.6138*	0.0106	-0.4731*	-0.0019	0.6658*	1
Average corr	0.125	0.059	0.021	-0.09	-0.11	-0.191	0.08	0.054	0.152	-0.03	0.146	-0.137	-0.06

Data Source: OECD statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

Figure 4.15

Pairwise correlation coefficient for the Competitive Index between 1999 - 2008 using the Real Effective Exchange Rate

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	UK	US
Austria	1												
Belgium	0.5442*	1											
Finland	0.2994	-0.5757*	1										
France	0.6488*	0.8631*	-0.3146**	1									
Germany	0.3566**	-0.4452*	0.8589*	-0.3181**	1								
Greece	0.1266	-0.1274	0.3512**	-0.1465	0.6564*	1							
Ireland	0.6898*	0.6349*	-0.0634	0.7734*	-0.2281	-0.4378*	1						
Italy	0.4557*	0.9746*	-0.6663*	0.8105*	-0.5696*	-0.2565	0.6457*	1					
Netherlands	0.6896*	0.9447*	-0.3775**	0.8021*	-0.1601	0.1204	0.5956*	0.8908*	1				
Portugal	0.4870*	0.9498*	-0.6241*	0.7115*	-0.373**	-0.0444	0.4746*	0.9285*	0.9325*	1			
Spain	0.3213**	0.9422*	-0.7608*	0.7860*	-0.6869*	-0.3383**	0.6159*	0.9813*	0.8179*	0.8927*	1		
UK	0.0571	0.1151	-0.2858	0.158	-0.0518	-0.0769	-0.1134	0.0961	0.0756	0.246	0.1175	1	
US	-0.4343*	-0.9464*	0.6652*	-0.8723*	0.6019*	0.3282**	-0.6955*	-0.9660*	-0.8328*	-0.8753*	-0.9744*	-0.1942	1
Average corr	0.353	0.322	-0.124	0.325	-0.03	0.01	0.24	0.277	0.375	0.31	0.227	0.02	-0.44

Data Source: OECD statistics database

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The coefficients in the post-EMU period are not significantly different to the period before the EMU although the coefficients in the post-EMU period are moderately higher. France, however, shows a significant difference in both periods with a moderate correlation in the post-EMU period and a negative correlation in the period before. In figure 4.13, the average correlations show that Finland, Germany, Greece, Portugal and the UK are negatively related to the remaining countries. The remaining countries countries show positive average correlations, however, these correlations are relatively weak. In the period before the EMU (figure 4.14), the average associations are still relatively weak, with evidence of divergence between, in some countries: France (-.09), Germany, (-.11) Greece (-.191), Portugal (-.03), UK (-.137) and the US (-.06). The Netherlands shows the highest average correlation (.152). The post-EMU period (figure 4.15) there is evidence of stronger correlations between the countries. This is clearly seen by the average correlations in each country. Austria, Belgium, France, the Netherlands and Portugal show positive coefficients between .31 and .17. Ireland, Italy and Spain show coefficient between .227 and .277. However, Finland, Germany and the US show divergence in this period. Overall, the evidence suggests that competitiveness became more convergent in the period after the EMU. With the loss of the exchange rate after monetary union, the UK and the US show a negative association with the remainder of the EMU countries as these two countries still possess the exchange rate to adjust for external imbalances. We can take an example of the

UK experiencing an increase in the wage rate. This increase in the wage rate may have the effect of increasing the general price level. In this case the UK has the ability to correct this increase in the general price level by depreciating the exchange rate, therefore maintaining competitiveness with its trading partners. Post-EMU, the participating EMU countries in a monetary union have lost the ability to correct external imbalances. From my analysis, the UK and the US correlations with the EMU countries exhibit greater negative correlations than the pre-EMU period. The correlation coefficients of the EMU countries with each other after monetary union are stronger. Based on the strength of associations using the real effective exchange rate, few countries achieved synchronicity and therefore convergence before the EMU, however, the structural change brought about coordination policies which lead to more synchronised cycles amongst the EMU countries. In this analysis, the UK and the US show weak and negative coefficients. Therefore I can conclude that the endogenous process may have been brought about by the coordination policies alone and not more general forces.

4.3.1 The Cross Country Coefficient of Variation: Real GDP growth rates

Figure 4.16 shows the Cross Country Coefficient of Variation calculations for the quarterly change in real GDP for the period 1988 – 2008. In all my calculations, I provide the average coefficient of variation for each sub-period.

Figure 4.16

Pre EMU

Quarters	MEAN	StDEV	CofV
Q2 1988	0.90	1.32	146.33
Q3 1988	2.27	2.44	107.78
Q4 1988	1.69	2.09	123.44
Q1 1989	0.60	2.36	389.85
Q2 1989	0.79	0.85	107.50
Q3 1989	0.44	0.78	178.75
Q4 1989	1.33	1.21	90.48
Q1 1990	1.33	2.55	191.83
Q2 1990	0.46	0.87	187.24
Q3 1990	0.32	1.01	318.77
Q4 1990	0.34	1.69	504.21
Q1 1991	1.04	4.45	426.34
Q2 1991	0.43	1.06	245.19
Q3 1991	0.71	2.16	301.98
Q4 1991	0.67	1.11	167.36
Q1 1992	0.97	1.01	104.35
Q2 1992	-0.53	1.42	266.62
Q3 1992	0.69	1.43	206.85
Q4 1992	-1.40	4.92	352.07
Q1 1993	0.92	4.00	435.36
Q2 1993	0.52	0.55	104.64
Q3 1993	1.01	1.46	145.45
Q4 1993	1.20	1.30	108.19
Q1 1994	1.06	0.90	84.59
Q2 1994	2.14	2.84	132.64
Q3 1994	1.10	1.17	107.08
Q4 1994	1.11	0.67	60.64
Q1 1995	6.02	12.62	209.62
Q2 1995	0.37	1.49	400.73
Q3 1995	0.99	1.61	162.43
Q4 1995	0.51	0.65	127.06
Q1 1996	0.61	1.44	234.07
Q2 1996	0.91	0.75	82.64
Q3 1996	0.82	0.95	116.35
Q4 1996	0.63	0.62	98.02
Q1 1997	1.24	1.42	114.27
Q2 1997	1.36	0.88	64.66
Q3 1997	0.89	0.50	56.23
Q4 1997	1.32	0.78	59.64
Q1 1998	0.84	0.78	93.82
Q2 1998	0.77	0.53	68.25
Q3 1998	0.81	0.91	113.50
Q4 1998	0.55	0.97	175.38
Average coefficient of variation			180.75

Post EMU

Quarters	MEAN	StDEV	CofV
Q1 1999	1.37	1.64	120.03
Q2 1999	0.95	0.75	78.73
Q3 1999	1.49	1.33	89.01
Q4 1999	1.27	0.54	42.66
Q1 2000	0.93	0.54	57.85
Q2 2000	1.10	1.05	95.26
Q3 2000	0.73	0.60	81.81
Q4 2000	0.87	0.79	91.25
Q1 2001	0.72	0.72	100.59
Q2 2001	0.24	0.48	204.63
Q3 2001	0.20	0.47	238.89
Q4 2001	0.42	0.53	126.08
Q1 2002	0.65	0.95	146.78
Q2 2002	0.57	0.31	54.08
Q3 2002	0.54	0.88	161.76
Q4 2002	0.30	0.57	192.25
Q1 2003	0.36	0.84	232.27
Q2 2003	0.39	0.64	164.51
Q3 2003	0.59	0.47	81.04
Q4 2003	0.97	1.30	134.26
Q1 2004	0.81	0.52	64.41
Q2 2004	0.72	0.35	49.21
Q3 2004	0.50	0.46	92.33
Q4 2004	0.61	0.69	113.09
Q1 2005	0.37	0.68	185.55
Q2 2005	0.91	0.60	66.27
Q3 2005	0.66	0.62	94.12
Q4 2005	0.78	0.51	65.01
Q1 2006	0.95	0.62	65.92
Q2 2006	0.96	0.54	56.00
Q3 2006	0.67	0.50	74.33
Q4 2006	0.70	0.63	89.40
Q1 2007	1.44	1.72	119.54
Q2 2007	0.41	0.72	174.70
Q3 2007	0.54	0.35	65.49
Q4 2007	0.62	0.52	83.79
Q1 2008	0.54	0.73	135.43
Q2 2008	0.14	0.43	302.12
Q3 2008	-0.38	0.39	-101.40
Q4 2008	-1.99	1.32	-66.28
Average coefficient of variation			115.54

Coefficient of variation = (Standard deviation/Mean)x100

Data Source: Datastream statistical database

In figure 4.16, the period prior to the EMU shows particularly higher percentages especially during the period 1989 to 1991, this being a period of recession in Europe. Asymmetries are realised here as countries grew at different rates. Also, the German unification of the early 1990s helped to create GDP asymmetries in Europe. German, French and Italian GDP levels experienced a much slower growth rate than the other countries. In the period after reunification leading to the mid 1990s, the results show similar levels of variation. In part, the UK had surrendered its membership of the ERM and allowed its currency to devalue. This led to higher GDP levels relative to its EU counterparts whose exchange rates were still aligned with Germany. In the period after the EMU, figure 4.16 shows more evidence of better convergence ratios particularly after 2003. In the period after the EMU, the results show better convergence. My results are consistent with those of Jelnikar Murmayer (2008) who examined the EU15 countries between 1995 and 2007 and found strong evidence of gradual convergence during this period[1]. However, Tsagkanos and Botsaris (2006) in their analysis of the same EU15 countries although from 1960 to 2003 found increasing divergence in GDP per capita using the coefficient of variation technique. In my analysis, the pre-EMU average coefficient of variation is 180.75 compared to the coefficient of variation of 115.54 after the EMU. Based on this evidence, as the analysis in the pre-EMU period shows mostly divergent behaviour in comparison to the post-EMU period, which shows greater convergence, using the GDP series, the results support the argument that the fulfilment of the OCA theory criteria is endogenous to regime change.

[1] Their study differs by the fact that they used both sigma and beta convergence calculation methods. Sigma convergence refers to a reduction in the dispersion of levels of income across economies. This procedure measures the dispersion around a determined average. If the dispersion is decreasing, that means that the countries are becoming increasingly similar to each other. Beta-convergence on the other hand refers to a situation whereby poorer economies grow faster than richer ones.

Cross Country Coefficient of Variation: The Output Gap (Percentage of real GDP)

Figure 4.17

Pre EMU

Quarters	MEAN	STD DEV	C of V
Q1 1988	0.60	2.41	403.10
Q2 1988	0.76	2.31	302.21
Q3 1988	1.20	2.43	203.68
Q4 1988	1.66	2.60	156.73
Q1 1989	1.98	2.43	122.73
Q2 1989	2.27	2.54	112.24
Q3 1989	2.50	2.44	97.92
Q4 1989	2.60	1.97	75.82
Q1 1990	2.92	1.68	57.55
Q2 1990	2.63	1.35	51.08
Q3 1990	2.18	1.28	58.76
Q4 1990	1.17	1.45	123.55
Q1 1991	0.41	1.45	356.75
Q2 1991	0.18	1.31	722.50
Q3 1991	-0.84	1.83	216.72
Q4 1991	-1.02	2.53	248.88
Q1 1992	-0.86	2.69	312.63
Q2 1992	-1.63	2.57	157.51
Q3 1992	-2.15	2.95	136.98
Q4 1992	-2.49	2.78	111.49
Q1 1993	-3.13	2.58	82.41
Q2 1993	-3.47	2.73	78.71
Q3 1993	-3.37	2.32	68.91
Q4 1993	-3.40	2.27	66.70
Q1 1994	-2.97	2.15	72.37
Q2 1994	-2.43	2.10	86.37
Q3 1994	-2.06	2.00	97.41
Q4 1994	-1.79	2.19	122.06
Q1 1995	-1.61	1.61	100.25
Q2 1995	-1.50	1.50	100.18
Q3 1995	-1.38	1.47	106.88
Q4 1995	-1.41	1.18	83.73
Q1 1996	-1.67	1.35	80.45
Q2 1996	-1.37	1.18	86.29
Q3 1996	-1.34	1.22	90.59
Q4 1996	-1.15	0.93	81.27
Q1 1997	-1.03	1.01	97.81
Q2 1997	-0.38	0.97	253.03
Q3 1997	-0.31	0.65	212.44
Q4 1997	0.28	0.87	316.99
Q1 1998	0.21	0.69	328.11
Q2 1998	0.15	0.66	431.08
Q3 1998	0.19	0.77	397.80
Q4 1998	0.40	0.93	229.72
Average coefficient of Variation			175.01

Post EMU

Quarters	MEAN	STD DEV	C of V
Q1 1999	0.36	1.30	355.70
Q2 1999	0.42	1.49	350.81
Q3 1999	0.77	1.43	184.63
Q4 1999	1.44	1.31	90.55
Q1 2000	1.55	0.86	55.33
Q2 2000	2.06	1.17	56.55
Q3 2000	1.83	0.89	48.72
Q4 2000	1.97	1.37	69.59
Q1 2001	1.94	1.22	63.09
Q2 2001	1.18	0.77	65.49
Q3 2001	0.52	0.69	133.65
Q4 2001	0.13	0.48	369.48
Q1 2002	-0.33	0.43	129.61
Q2 2002	-0.09	0.69	760.34
Q3 2002	-0.14	1.10	813.16
Q4 2002	-0.41	1.07	259.22
Q1 2003	-0.96	0.80	83.34
Q2 2003	-1.09	1.08	99.78
Q3 2003	-0.98	0.87	88.68
Q4 2003	-0.37	1.76	482.78
Q1 2004	-0.25	1.15	459.28
Q2 2004	-0.24	0.97	398.78
Q3 2004	-0.39	0.81	205.58
Q4 2004	-0.28	1.11	396.91
Q1 2005	-0.46	1.14	248.35
Q2 2005	-0.26	0.90	345.08
Q3 2005	0.34	0.87	258.96
Q4 2005	0.45	0.96	211.81
Q1 2006	1.10	1.21	109.40
Q2 2006	1.52	0.82	53.54
Q3 2006	1.59	1.03	64.44
Q4 2006	1.62	0.52	32.12
Q1 2007	2.54	2.02	79.39
Q2 2007	2.17	0.99	45.31
Q3 2007	2.20	0.74	33.75
Q4 2007	2.35	1.15	49.08
Q1 2008	2.28	1.25	54.58
Q2 2008	1.34	1.17	87.28
Q3 2008	0.36	1.24	342.83
Q4 2008	-2.36	1.81	76.74
Average coefficient of Variation			202.84

Coefficient of variation = (Standard deviation/Mean)x100

Data Source : Datastream statistics database

The results in figure 4.17 show the variations amongst the countries are greater in the period after the EMU than the period before. The average coefficient prior to the EMU is 175.01 and 202.84 after the EMU, evidence of increased divergence. However, the last few years of this sample (2006 quarter 2) shows an increasing convergence. The average coefficient here is 83.55. The period between 2001 quarter 4 and 2005 quarter 4 is the period which shows large divergence with an average coefficient of 330.07. From my results, there is evidence of divergence amongst the EMU countries. This is in line with the correlation coefficient results (particularly using the potential from actual real GDP method) showing weaker associations after the EMU and from the evidence here using the output gap data, the fulfilment of the OCA theory criteria is not endogenous to regime change.

My findings are similar to that of Roubini (2006) who analysed the output gap developments in the countries of the euro area since the beginning of the Economic and Monetary Union (EMU) and found a greater dispersion amongst the EMU countries. Roubini (2006) cites this divergence and comments that it is leading to tensions in fiscal and monetary policy. Given the growth slowdown and the political difficulties of fiscal adjustment when growth is mediocre, larger fiscal deficits are emerging in many countries which lag behind, Roubini (2006). These persistent violations of the Growth and Stability Pact are a medium-term threat to where there is no ‘bailout’ rule. Also, economic divergence and the tensions it is creating leads to political pressures on the European Central Bank to do more to stimulate growth. Further, the study says that this growth divergence is becoming a serious threat to the EMU. As an increasing number of European observers are suggesting, different countries are coping differently to these challenges.

Coefficient of Variation: The Inflation Rate

Figure 4.18

Pre EMU

Quarters	Mean	Stdev	C of V
Q1-1988	5.17	4.07	78.82
Q2-1988	5.24	4.08	77.95
Q3-1988	5.31	4.09	77.15
Q4-1988	5.38	4.11	76.43
Q1-1989	5.44	4.12	75.79
Q2-1989	5.50	4.14	75.23
Q3-1989	5.55	4.15	74.77
Q4-1989	5.59	4.16	74.41
Q1-1990	5.61	4.16	74.12
Q2-1990	5.62	4.16	73.90
Q3-1990	5.62	4.14	73.72
Q4-1990	5.59	4.12	73.58
Q1-1991	5.55	4.08	73.48
Q2-1991	5.49	4.03	73.40
Q3-1991	5.42	3.97	73.35
Q4-1991	5.32	3.90	73.31
Q1-1992	5.22	3.82	73.29
Q2-1992	5.09	3.73	73.28
Q3-1992	4.96	3.63	73.26
Q4-1992	4.82	3.53	73.22
Q1-1993	4.67	3.41	73.14
Q2-1993	4.51	3.29	73.01
Q3-1993	4.35	3.17	72.81
Q4-1993	4.19	3.04	72.52
Q1-1994	4.03	2.91	72.14
Q2-1994	3.87	2.77	71.66
Q3-1994	3.71	2.64	71.07
Q4-1994	3.56	2.50	70.37
Q1-1995	3.41	2.37	69.54
Q2-1995	3.26	2.24	68.57
Q3-1995	3.12	2.11	67.46
Q4-1995	2.99	1.98	66.17
Q1-1996	2.86	1.85	64.69
Q2-1996	2.75	1.73	63.01
Q3-1996	2.64	1.61	61.13
Q4-1996	2.53	1.50	59.04
Q1-1997	2.44	1.39	56.77
Q2-1997	2.36	1.28	54.35
Q3-1997	2.29	1.19	51.85
Q4-1997	2.23	1.10	49.34
Q1-1998	2.18	1.02	46.88
Q2-1998	2.15	0.96	44.59
Q3-1998	2.12	0.90	42.53
Q4-1998	2.11	0.86	40.77
Average coefficient of Variation			67.63

Post EMU

Quarters	Mean	Stdev	C of V
Q1 1999	2.10	0.83	39.35
Q2 1999	2.11	0.81	38.29
Q3 1999	2.12	0.80	37.57
Q4 1999	2.14	0.80	37.15
Q1 2000	2.17	0.80	36.94
Q2 2000	2.20	0.81	36.89
Q3 2000	2.23	0.82	36.92
Q4 2000	2.25	0.83	36.97
Q1 2001	2.28	0.84	37.02
Q2 2001	2.30	0.85	37.03
Q3 2001	2.31	0.85	37.02
Q4 2001	2.32	0.86	36.96
Q1 2002	2.32	0.86	36.86
Q2 2002	2.32	0.85	36.71
Q3 2002	2.32	0.85	36.51
Q4 2002	2.32	0.84	36.26
Q1 2003	2.31	0.83	35.95
Q2 2003	2.30	0.82	35.58
Q3 2003	2.29	0.81	35.16
Q4 2003	2.29	0.79	34.69
Q1 2004	2.29	0.78	34.15
Q2 2004	2.29	0.77	33.54
Q3 2004	2.29	0.75	32.86
Q4 2004	2.30	0.74	32.09
Q1 2005	2.32	0.72	31.23
Q2 2005	2.33	0.71	30.29
Q3 2005	2.36	0.69	29.26
Q4 2005	2.38	0.67	28.19
Q1 2006	2.41	0.65	27.10
Q2 2006	2.45	0.64	26.05
Q3 2006	2.48	0.62	25.10
Q4 2006	2.53	0.61	24.35
Q1 2007	2.57	0.61	23.86
Q2 2007	2.62	0.62	23.73
Q3 2007	2.67	0.64	23.98
Q4 2007	2.72	0.67	24.64
Q1 2008	2.78	0.71	25.67
Q2 2008	2.83	0.76	27.01
Q3 2008	2.89	0.83	28.59
Q4 2008	2.94	0.89	30.34
Average coefficient of Variation			32.45

Coefficient of Variation = (Standard deviation/Mean)×100

Data source: Datastream statisticaldatabase

My results show increasing convergence patterns from the start of the period prior to the EMU. Variation levels start at 78 per cent in the first quarter of 1988 and finish at the end of the fourth quarter in 2008. My findings are consistent with the work of Weber and Beck (2005). They used sigma convergence methods (explained in section 2.4) in their study of the EMU countries prior to and after monetary union that fiscal policy and institutional factors such as changes in CPI composition/weights are responsible for the convergence dynamics in the years before 1998. Another factor that has probably played an important role is inflation expectations that were adjusted downward in the years immediately before the introduction of the euro. My analysis has established convergence after the EMU. The average coefficient of variation before the EMU is 67.63 compared to the average post-EMU coefficient of variation of 32.45. The results show that the series have gradually converged in the run up to the EMU and the convergence process has improved beyond the EMU. From this analysis, the inflation rates were converging in the run up to the EMU, (and had converged prior to 1999).

This analysis is important as inflation rates are ECB's economic indicator in their monetary policy decision making process. If inflation rates are similar amongst the EMU members, policy setting would be facilitated. However, member-states might experience a divergence of the national inflation rate due to national policies. Put differently, member-states' governments may design and implement national policies that could move the national inflation rate away from the aggregate euro area inflation rate. A prime example is national fiscal policy that – although its scope is limited by the Stability and Growth Pact (SGP), it can put pressure on a member state's rate of inflation. Economic theory suggests that regional inflation dispersion in a monetary union is principally an adjustment mechanism through which regional economic imbalances are corrected. Consequently, regional inflation divergence should be a temporary phenomenon (Arnold and Kool, 2001 and Cecchetti et al., 2000). This observation by the authors could be challenged as the USA shows that there is still inflation divergence amongst the states. The identity of the states exhibiting high inflation, however, continues to change. Further work on inflation convergence includes a study by Hendrikx and Chapple (2002) on EMU countries' average inflation rates from 1991 to 2001. Their study concluded that the level of dispersion had not markedly increased since the start of the EMU. One must observe that these authors only had at most three years data, therefore their study may be subject to limitations. My results incorporate data spanning a much longer period. Although the results of Hendrikx and Chapple (2002) are similar to my findings, they used the minimum and maximum method coefficient of variation method. The minimum coefficient of variation is derived by the assumption that of the twelve EMU member-states, exactly ten are at the observed average inflation rate. From the two countries remaining, one country is located on the minimum inflation rate and one country is positioned on the maximum observed inflation rate. They also derived the maximum coefficient of variation given the observed maximum and minimum inflation rates and positioning half of the countries on the minimum and half of the countries on the maximum inflation rate, inflating the coefficient of variation to its maximum.

4.3.2 Persistence

The most widely used measure of persistence is achieved by the use of the autocorrelation function (ACF). Autocorrelation refers to the correlation of a time series with its own past values. Autocorrelation is also sometimes called “lagged correlation” or “serial correlation”, which refers to the correlation between members of a series of numbers arranged in time. Positive autocorrelation might be considered a specific form of “persistence”, a tendency for a system to remain in the same state from one observation to the next. For the examinations, I use the suggested lag length of three lags except for the real GDP variable which uses two lags, Fagan et al. (2001) and Smets and Wouters (2002). Previous work by the authors suggests that it takes two time lags for GDP to respond to a shock. They therefore use this lagged period. Fagan et al. (2001) and Smets and Wouters (2002) suggest that the maximum response to a monetary policy shock occurs within four or five quarters from the shock. They therefore agree that the lagged periods for the variables are appropriate.

In previous examinations of persistence, authors Darvas and Szapáry (2007) use real GDP series in their assessment of persistence amongst the EMU and several Eastern European countries. For the competitive index, inflation rate and the output gap, I measure the persistence levels on a non de-trended basis so that the actual fluctuation for each series can be seen and compared. The following figures below show the autocorrelations with their lagged periods. For the real GDP growth, the lagged period is two as chosen by

Ragacs, Steinberger and Zagler (1998) when analysing Austria's persistent fluctuations in order to discriminate between different growth models. A lag is a transformation that brings past values of a series into the current case. The case prior to the current case is a lag of 1; two cases prior to the current case is a lag of 2; and so on. The coefficients range from +1 to -1 with +1 being maximum persistence and -1 being no persistence at all. The figures below show the autocorrelation function (ACF) at each lag. In the results, I have calculated the variation of the resulting coefficients for the EMU countries at each lag only where the coefficients are statistically significant. The variation will facilitate an assessment as to the degree to which the series varies between countries. Series with lower variations show a more synchronised cycle and conversely, series with higher variations show a less synchronised cycle. Cycles which are more persistent will display longer lasting effects of shocks. However, if countries show more convergent behaviour, then being hit by a change such as a policy implementation may experience better outcomes than countries that do not show convergence behaviour. In my analysis, I have looked at cycles without specifing that there are cycles which are internally generated and others which result from external shocks. Those which are generated by external shocks result in cycles only if they conform to a cyclical pattern.

Figure 4.19: Real GDP change in persistence (growth rates)

		Full period 1988 to 2008	Pre EMU	Post EMU
Second Order Autocorrelation (2 lags)				
Country	Lags	ACF	ACF	ACF
Austria	L1	0.5808*	0.645*	0.53*
	L2	0.035*	0.155*	-0.057*
Belgium	L1	0.056*	0.03	0.33*
	L2	0.0055	-0.0156	0.173*
Finland	L1	0.463*	0.671*	0.097
	L2	0.478*	0.696*	0.079
France	L1	0.4037*	0.488*	0.321*
	L2	0.368*	0.394*	0.342**
Germany	L1	0.2733*	0.219	0.12
	L2	0.189**	0.124	0.032
Greece	L1	0.0242	0.0019	-0.019
	L2	-0.134	-0.1662	0.029
Ireland	L1	-0.137	-0.162	-0.185
	L2	0.2992*	0.2977**	0.241
Italy	L1	0.428*	0.349*	0.5002*
	L2	0.264*	0.238*	0.292*
Netherlands	L1	0.266*	-0.042	0.473*
	L2	0.172*	0.0481	0.221*
Portugal	L1	0.098	-0.055	0.625*
	L2	0.157	0.0916	0.384*
Spain	L1	-0.0001	-0.0035	-0.01
	L2	-0.0471	0.08	0.1651
UK	L1	0.528*	0.59*	0.452*
	L2	0.294*	0.388*	0.18*
US	L1	0.308*	0.39*	0.2013
	L2	0.299*	0.294*	0.0274**
Variation of series	L1	89.435	123.598	94.778
	L2	96.545	108.554	67.718

** Denotes significance at the 5 per cent level*
*** Denotes significance at the 10 per cent level*

Data Source: Datastream statistics database

The persistence levels for the whole period show similarities in three tiers. Finland, France, Italy, the UK and the US are in the first group with the highest coefficients, Germany and the Netherlands are the second tier with coefficients lower than the first tier countries. The coefficients for the remaining countries are not statistically significant at either the five or ten per cent levels. The evidence shows that persistence for the whole period is not similar in all cases. In the period before the EMU, Finland and France show a relatively high level of persistence at 0.696, 0.671 and 0.448, 0.394, all statistically significant at the five per cent level. Italy's coefficients are lower with both lags showing 0.349 and 0.238 and the

US showing 0.39, 0.294, again statistically significant at the five per cent level (the inference here is that the coefficients are different from zero). The other countries (with statistically significant levels) show relatively low persistence levels. Again, there is little evidence of similarities amongst the whole series but some countries show similarities. In the period after the EMU, France shows positive values of 0.321, 0.342 for both lags at five and ten per cent significance respectively and Italy shows coefficients of 0.5, 0.292, the Netherlands shows 0.473, 0.221 and Portugal with 0.625, 0.384, all statistically significant at the five per cent level. The other countries display much lower values. In their work on the similarities of business cycles, Darvas and Szapáry (2007) found some of the EMU countries displayed similar persistence GDP levels. They found the autocorrelation coefficients rather 'scattered'. They do, however, indicate some similarities and an overall greater convergence between the EMU states. I highlight the fact that this analysis does not deal with the transmission mechanism by which the shocks pass-through nor does it deal with the effects of any shocks per se, but the similarities of persistence. Based on the autocorrelation coefficients from the period after the EMU, there is moderate evidence of change between both sub periods. The real GDP series shows divergence in the pre-EMU period but better convergence in the period after 1999. Also, the UK and the US coefficients in the post-EMU period are correlated with the EMU countries. Thus, I can conclude that there is evidence of endogenous behaviour, however, the change is not overwhelming after 1999 and as a result of the UK and US being more correlated with the EMU countries, there may have been other general forces leading to these similarities with the member states.

The Output Gap persistence

I have computed the persistence levels using two methods of calculating the output gap. Figure 4.20 uses the potential real GDP to actual real GDP and figure 4.21 uses the trend method. The lag choice is three as chosen by Coenen (2003), when observing output gap and inflation persistence. Again, emphasis is placed on similarities of the cycles and their policy implications. Below, I show in figure 4.20 the persistence levels for the three periods as before.

Figure 4.20: Output Gap persistence (using the potential to actual real GDP)

		Full period 1988 to 2008	Pre EMU	Post EMU
Third Order Autocorrelation (3 lags)				
Country	*Lags*	*ACF*	*ACF*	*ACF*
Finland	*L1*	*0.963**	*0.966**	*0.751**
	L2	*0.91**	*0.91**	*0.575**
	L3	*0.833**	*0.824**	*0.419**
France	*L1*	*0.917**	*0.95**	*0.794**
	L2	*0.814**	*0.863**	*0.63**
	L3	*0.684**	*0.748**	*0.432**
Germany	*L1*	*0.856**	*0.625**	*0.902**
	L2	*0.711**	*0.37**	*0.77**
	L3	*0.568**	*0.279**	*0.611**
Ireland	*L1*	*0.831**	*0.944**	*0.342**
	L2	*0.768**	*0.83**	*0.283**
	L3	*0.648**	*0.677**	*0.062**
Italy	*L1*	*0.91**	*0.935**	*0.755**
	L2	*0.78**	*0.844**	*0.519**
	L3	*0.643**	*0.724**	*0.282**
Netherlands	*L1*	*0.913**	*0.862**	*0.947**
	L2	*0.837**	*0.746**	*0.851**
	L3	*0.718**	*0.621**	*0.729**
UK	*L1*	*0.922**	*0.945**	*0.611**
	L2	*0.837**	*0.871**	*0.353**
	L3	*0.736**	*0.771**	*0.19**
US	*L1*	*0.885**	*0.91**	*0.778**
	L2	*0.761**	*0.781**	*0.614**
	L3	*0.622**	*0.637**	*0.449**
Variation of series	*L1*	*4.589*	*12.619*	*25.642*
	L2	*7.576*	*22.180*	*33.323*
	L3	*11.932*	*25.513*	*54.620*

** Denotes significance at the 5 per cent level*
*** Denotes significance at the 10 per cent level*

Data Source: Datastream statistics database

Figure 4.21: Output Gap persistence (using the real GDP from trend method)

		Full period 1988 to 2008	**Pre EMU**	**Post EMU**
Third Order Autocorrelation (3 lags)				
Country	*Lags*	*ACF*	*ACF*	*ACF*
Finland	*L1*	*0.78**	*0.9**	*0.521**
	L2	*0.641**	*0.742**	*0.412**
	L3	*0.481**	*0.541**	*0.34**
France	*L1*	*0.782**	*0.86**	*0.7**
	L2	*0.591**	*0.66**	*0.5**
	L3	*0.385**	*0.433**	*0.228**
Germany	*L1*	*0.744**	*0.761**	*0.695**
	L2	*0.522**	*0.53**	*0.485**
	L3	*0.353**	*0.353**	*0.33**
Ireland	*L1*	*0.692**	*0.753**	*0.37**
	L2	*0.58**	*0.645**	*0.263**
	L3	*0.41**	*0.473**	*0.0637**
Italy	*L1*	*0.755**	*0.79**	*0.688**
	L2	*0.502**	*0.532**	*0.427**
	L3	*0.252**	*0.27**	*0.192**
Netherlands	*L1*	*0.842**	*0.806**	*0.845**
	L2	*0.431**	*0.676**	*0.66**
	L3	*0.543**	*0.58**	*0.531**
UK	*L1*	*0.69**	*0.9**	*0.4744**
	L2	*0.431**	*0.71**	*0.13**
	L3	*0.27**	*0.543**	*-0.03**
US	*L1*	*0.744**	*0.8**	*0.71**
	L2	*0.543**	*0.56**	*0.51**
	L3	*0.352**	*0.29**	*0.344**
Variation of series	*L1*	*6.605*	*7.108*	*24.817*
	L2	*14.109*	*12.921*	*38.408*
	L3	*25.826*	*27.5*	*50.742*

** Denotes significance at the 5 per cent level*
*** Denotes significance at the 10 per cent level*

Data Source: Datastream statistics database

In the countries sampled, there is evidence of similarities in the autocorrelation coefficients predominantly in the pre-EMU period. However, in the full period 1988 to 2008, the persistence levels are not only high across the countries but similar. All the statistical levels are statistically significant at the five per cent level. In the period prior to the EMU in figure 4.20, Germany shows a lower persistent level than the other countries. Germany's coefficients are 0.625, 0.37, 0.279 for all lags. The remaining countries sampled show similar coefficients. Billmeier (2004) in his work on the output gap concluded that in his sample, France had consistently the lowest variation in his sample which reflects actual growth in line with growth of potential output, and little cyclical fluctuation. Billmeier

(2004) sampled the output gap of five EMU countries including France and the UK to measure the usefulness of the output gap as an indicator. He concluded that it rarely provides useful information and that there is no single best measurement. In my analysis, using the trend method, in the period prior to the EMU, only Italy and the US show levels below 0.3 in the third lag. Finland, the Netherlands and the UK show autocorrelation coefficients above 0.5. The remainder show coefficients between 0.3 and 0.5. The coefficients for the first two lags are fairly similar. However, in the period after the EMU, Ireland shows a low coefficient value of 0.06 and Italy at 0.19 in the third lag. The Netherlands shows the highest coefficient at 0.53 with the remaining countries showing coefficients between 0.2 and 0.5. A divergent pattern also emerges for the first two lags amongst the countries. France, Germany, Italy, the Netherlands and the US show higher lag 1 values, with Ireland and the UK showing lower coefficients. For both methods, in the pre-EMU period, the UK and the US are both similar to the EMU members, however, in the post-EMU period, the UK is more correlated with Finland, France and Germany and the US is more correlated with Ireland and Italy. Overall, the series after the EMU is more divergent overall as shown by the levels of variation after the EMU which are larger. Therefore from the output gap analysis using both methods of output gap calculation, the fulfilment of the OCA theory criteria is not endogenous to regime change.

Inflation persistence (the inflation rate)

The theory of inflation persistence has been widely debated amongst economists and the study of the EMU countries entering a monetary union has increased the understanding of this topic. The lag choice is three as chosen by Coenen (2003). There are several definitions of inflation persistence. For instance Batini and Nelson (2002); Batini (2002) distinguish three different types of persistence: (1) "positive serial correlation in inflation", (2) "lags between systematic monetary policy actions and their (peak) effect on inflation"; and (3) "lagged responses of inflation to non-systematic policy actions (i.e. policy shocks)". In turn, Willis (2003) defines persistence as the "speed with which inflation returns to baseline after a "shock". Various authors have attempted to assess the inflation persistence issue pre and post-EMU. O'Reilly and Whelan (2005) use Hansen's (1999) unbiased mean estimate of the sum of autoregressive coefficients for a rolling window. They use data up to 2002:4 and find no change in inflation persistence over the sample period. The sample here only assesses data up to 2002 however, possibly considered not a long period of time after the advent of the EMU. Below, I present in figure 4.22 the autocorrelation functions for the sample period 1988 to 2008. All the values are statistically significant at the five per cent level.

Figure 4.22: Inflation persistence (the inflation rate)

		Full period 1988 to 2008	Pre EMU	Post EMU
Third Order Autocorrelation (3 lags)				
Country	*Lags*	*ACF*	*ACF*	*ACF*
Austria	*L1*	*0.917**	*0.909**	*0.8**
	L2	*0.811**	*0.826**	*0.512**
	L3	*0.69**	*0.751**	*0.191**
Belgium	*L1*	*0.81**	*0.819**	*0.757**
	L2	*0.573**	*0.649**	*0.42**
	L3	*0.364**	*0.535**	*0.112**
Finland	*L1*	*0.958**	*0.959**	*0.885**
	L2	*0.891**	*0.902**	*0.72**
	L3	*0.814**	*0.839**	*0.547**
France	*L1*	*0.896**	*0.897**	*0.684**
	L2	*0.8**	*0.746**	*0.383**
	L3	*0.715**	*0.75**	*0.13**
Germany	*L1*	*0.913**	*0.882**	*0.732**
	L2	*0.823**	*0.756**	*0.539**
	L3	*0.73**	*0.625**	*0.355**
Greece	*L1*	*0.913**	*0.942**	*0.527**
	L2	*0.947**	*0.865**	*0.215**
	L3	*0.913**	*0.78**	*0.002**
Ireland	*L1*	*0.896**	*0.866**	*0.838**
	L2	*0.714**	*0.639**	*0.594**
	L3	*0.523**	*0.388**	*0.329**
Italy	*L1*	*0.969**	*0.926**	*0.776**
	L2	*0.923**	*0.826**	*0.41**
	L3	*0.869**	*0.712**	*0.073**
Netherlands	*L1*	*0.877**	*0.854**	*0.897**
	L2	*0.747**	*0.714**	*0.776**
	L3	*0.613**	*0.581**	*0.643**
Portugal	*L1*	*0.969**	*0.962**	*0.765**
	L2	*0.953**	*0.911**	*0.53**
	L3	*0.894**	*0.853**	*0.246**
Spain	*L1*	*0.915**	*0.914**	*0.494**
	L2	*0.861**	*0.834**	*-0.189**
	L3	*0.786**	*0.749**	*-0.125**
UK	*L1*	*0.954**	*0.941**	*0.8**
	L2	*0.894**	*0.865**	*0.53**
	L3	*0.831**	*0.774**	*0.396**
US	*L1*	*0.812**	*0.91**	*0.56**
	L2	*0.694**	*0.797**	*0.345**
	L3	*0.571**	*0.691**	*0.126**
Variation of series	*L1*	*5.717*	*4.669*	*17.872*
	L2	*13.695*	*11.155*	*31.485*
	L3	*22.627*	*18.880*	*74.838*

** Denotes significance at the 5 per cent level*
*** Denotes significance at the 10 per cent level*

Data Source: Datastream statistics database

From the evidence here, the full period from 1988 to 2008 shows inflation persistence to be high with all countries showing levels above 0.5 with the exception of Belgium, 0.364 at lag 3. All the values are statistically significant. In all the series, there are similarities in all the countries in this period. The pre-EMU period is fairly similar to the full period analysed. Only Ireland shows an autocorrelation coefficient below 0.5 at lag 3 with a coefficient at 0.388. In the post-EMU period, Spain shows coefficients which are divergent from the remaining countries. The coefficients are 0.494, -0.189, -1.25 at each of the three lags. Austria, Belgium, France, Greece, Italy and the US show low lag 3 coefficient values of 0.191, 0.112, 0.13, 0.002, 0.073 and 0.126 respectively. At each lag, there is a greater divergent pattern which shows that the countries' output gaps using the trend method were less convergent after the-EMU. An explanation may be the adoption of inflation targeting by the ECB. Levin, Natalucci, and Piger (2004) argue that the adoption of inflation targeting lowers the degree of inflation persistence in major industrial countries. Furthermore, Caggione and Castelnuvo (2007) analyse inflation persistence in a panel of 20 OECD economies by means of the sample AutoCorrelation Functions (ACFs) in the autocorrelation function domain. They support the notion that inflation targeting reduces (long-run) inflation persistence.

The prominent study of O'Reilly and Whelan (2005) analyses both deflator and HICP (Harmonised Index of Consumer Prices) inflation rates and uses Hansen's (1999) unbiased mean estimate of the sum of autoregressive coefficients for a rolling window. They use data up to 2002:4 and found no change in inflation persistence over the sample period. Angeloni et al. (2006) also find no change in inflation persistence after the start of the EMU. However, Tillmann (2008) measured inflation as the annualised quarterly percentage change of the underlying euro area price index. To test for a change in inflation persistence with the start of the monetary union, he analysed a pre-EMU sample covering 1970:1 to 1998:4, which is then contrasted to a post-EMU sample ranging from 1999:1 to 2006:4. He found that inflation persistence is lower between 1999 and 2006. Conversely, Angeloni and Aucremanne (2006) in their assessment of inflation persistence between 1985Q1 and 2004Q4 covering six countries (Spain, Germany, France, Italy Belgium and Austria). Finland and Germany's inflation rates display a highly persistent series as opposed to France, Italy and Spain which show little or no persistence. Again, the countries showed similar persistent levels before the EMU displaying greater convergence, however, after the EMU, there is evidence of divergence with two groups of countries, one with coefficients below 0.2. They are: Austria, Belgium, France, Greece, Italy and the US. Germany, Ireland and the UK show coefficients between 0.3 and 0.4 and Finland and Germany show coefficients above 0.5. Although countries show that persistence is lower after the EMU, the divergence of the series shows that in terms of the lasting effects of shocks, countries would be affected differently and policy setting would be more difficult. Using the persistence method for the inflation rates, the fulfilment of the OCA theory criteria is not endogenous to regime change.

4.3.3 The Asymmetry Index

In the next section, I have analysed the output gap using the asymmetry index method. This method provides similar answers to the answers obtained using the cross country coefficient of variation method. When I assessed the four variables, real GDP, output gap, inflation rates and the competitive index, I found that the only variable which showed a greater variation in the period after the EMU was the 'output gap'. Therefore I have chosen to further bolster my results by assessing the country on country symmetries using the same output gap data. Please see section 3.1.4 for a full explanation of the methodology. Below is a summary figure (figure 4.23) showing the average index for each country against the others for the two sub periods. To the right of the analysis for each country, I have shown the total average for the sub periods. I have attached the full figures and graphs for each country showing the index value for each in the Figures and graphs (figures 40(a) to 47(b)) in the appendix.

Figure 4.23: The asymmetry index between six EMU countries and including the UK and US

Asymmetry Index table showing the average values of each country versus the rest of the countries sampled for the Output Gap for two sub periods, pre and post EMU

Country								
Finland versus	*France*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*UK*	*US*	*Average*
Average pre EMU	0.81	0.81	0.77	0.38	1.04	0.79	0.32	0.70
Average post EMU	0.56	0.86	1.05	0.28	0.94	0.38	0.25	0.62
France versus	*Finland*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*UK*	*US*	*Average*
Average pre EMU	0.81	0.72	1.11	0.75	1.09	0.80	1.03	0.90
Average post EMU	0.56	0.97	0.61	0.84	0.80	0.26	0.50	0.65
Germany versus	*Finland*	*France*	*Ireland*	*Italy*	*Netherlands*	*UK*	*US*	*Average*
Average pre EMU	0.81	0.72	0.53	0.85	0.46	0.84	0.89	0.73
Average post EMU	0.86	0.97	1.57	0.80	0.65	1.08	1.01	0.99
Ireland versus	*Finland*	*France*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*US*	*Average*
Average pre EMU	0.77	1.11	0.53	0.90	0.30	0.76	0.60	0.71
Average post EMU	1.05	0.61	1.57	1.33	1.10	0.67	0.93	1.04
Italy versus	*Finland*	*France*	*Germany*	*Ireland*	*Netherlands*	*UK*	*US*	*Average*
Average pre EMU	0.38	0.75	0.85	0.90	1.12	0.79	0.69	0.78
Average post EMU	0.28	0.84	0.80	1.33	1.06	0.66	0.44	0.77
Netherlands versus	*Finland*	*France*	*Germany*	*Ireland*	*Italy*	*UK*	*US*	*Average*
Average pre EMU	1.04	1.09	0.46	0.30	1.12	0.80	0.89	0.82
Average post EMU	0.94	0.80	0.65	1.10	1.06	0.97	0.88	0.91
UK versus	*Finland*	*France*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*US*	*Average*
Average pre EMU	0.79	0.80	0.84	0.76	0.79	0.80	0.71	0.79
Average post EMU	0.38	0.26	1.08	0.67	0.66	0.97	0.34	0.62
US versus	*Finland*	*France*	*Germany*	*Ireland*	*Italy*	*Netherlands*	*UK*	*Average*
Average pre EMU	0.32	1.03	0.89	0.60	0.69	0.89	0.71	0.73
Average post EMU	0.25	0.50	1.01	0.93	0.44	0.88	0.34	0.62

Data Source: Datastream statistics database

The above figure shows all the output gap results. Looking at the figures for the UK (figure 46a in the annex), the results display asymmetry with all the countries at the start of the first quarter of 1988, after which convergence near and during the European recession at the start of the 1990s is observed. After the EMU, the symmetries improve in the UK with France and Finland, however, symmetries with Ireland and Italy seem to be achieved in the years leading up to 2008. Symmetry with France, Germany and the Netherlands show that the UK has become more divergent after 2006 with these countries. Overall, the results do not show total symmetry between the EMU countries and the UK in the period after the EMU. In the period after the EMU, the UK has an average symmetry of 0.70 post-EMU and 0.62 after the EMU, has become more convergent. Germany's symmetry with the other EMU nations and the US shows periods of divergence after 2006. Asymmetries exist with Finland, France, Italy and the US at the start of the period. The period leading up so the EMU overall show that Germany became more converged, however, symmetries with France, Ireland, the Netherlands, the UK and the US were more diverged. Germany's average symmetry before the EMU is 0.73 and 0.99 after the EMU, leading to a conclusion of greater divergence after the EMU of Germany with the other countries. In the period prior to the EMU, France displays both convergence and divergence. At the start of the period, France's symmetries with Finland, Italy and the US, shows near symmetry followed by asymmetry up to the recession period at the start of the 1990s. With all the EMU countries, France shows moderate symmetries, however, after 2006, more divergence is observed. France's average symmetry with the other countries before the EMU is 0.9 and 0.65 after the EMU.

Overall, there is evidence of less asymmetry after the EMU but in many cases, there is still divergence between the countries examined. Italy's symmetric values do not lead to a conclusion that there has been convergence or divergence before or after monetary union. The average value before the EMU is 0.78 and .077 after the EMU. The results in this case are inconclusive. The results for Ireland show greater divergence after the EMU. The average index value is 0.71 before the EMU and 1.04 after the EMU. Ireland's results show divergence from 2004 onwards. The Netherlands also shows greater overall divergence after the EMU. The results show that the average index before the EMU is 0.82 and 0.91 after the EMU. Finland, however, shows an average index of 0.70 before the EMU against an average of 0.62 after the EMU. In conclusion, four of the countries show greater convergence after the EMU. These countries are Finland, France, the UK and the US. Germany Ireland and the Netherlands are the three countries which show greater divergence after the EMU. Italy shows neither convergence nor divergence. The results for the UK and the US show evidence of convergence with the UK's pre-EMU average of 0.79 and post-EMU average of 0.62. The US shows a pre-EMU average of 0.73 and a post-EMU average of 0.62. Of the six European countries observed, only two (Finland and France) show convergence Therefore, for the output gap, there is no conclusive evidence that the fulfilment of the OCA theory criteria is endogenous to regime change. This supports my findings in the cross country coefficient of variation method calculated in section 4.3.2.

4.4 Chapter conclusions

For most of the examinations, there is evidence of synchronisation/similarities amongst many of the participating countries before the formation of monetary union. From the analysis, it is clear that some countries adhered to EMU discipline in the run up to the EMU and in some cases thereafter. For all the pair-wise correlation coefficients, the general observation was that convergence had occurred in the pre-EMU period. Also, I observed some evidence of divergence in the post-EMU period. There are instances where convergence has been more evident before 1999 (as seen by the inflation rate and output gap results using the difference between potential and actual real GDP). In these instances, the results would not be compatible with the endogeneity of the fulfilment of the OCA theory criteria and would provide evidence of significant costs/risks for the countries involved. Also, there is evidence of divergence in some countries after the post-EMU period (as seen by the competitveness indicator showing negative coefficients).

The coefficient of variation showed that the output gap (using the actual to potential calculation method) became more divergent after 1999. In order to bolster my results, I used the asymmetry index method to analyse the country versus country symmetry for the output gap. I used this method for the output gap only as this was the only variable to show greater divergence after the EMU using the coefficient of variation method. The results showed slightly greater divergence after the EMU (in line with the coefficient of variation results).

Using autocorrelation to measure persistence levels, only the real GDP series shows endogenous behaviour, however, the UK and the US showed coefficients which were similar to that of the EMU countries, therefore even though endogenous behaviour was observed in the real GDP series, there may have been other general forces which contributed to the increasing level of convergence. Overall, I have assessed thirteen countries using various methods in order to answer the research hypothesis which states that the fulfilment of the OCA theory criteria is endogenous to regime change. I find that the results are fairly mixed, however, overall more of the examinations indicate that fulfilment of the OCA theory criteria is not endogenous to regime change. Due to the mixed set of results which do not provide overwhelming conclusions, it is necessary to move to the next chapter which observes the exchange rate as a policy tool and the economic performances of countries before and after 1999 where the exchange rate could be used as a method of adjustment.

FIVE

The exchange rate and international trade empirical chapter

5.1 Introduction

An implicit assumption of the OCA approach is that the adjustment to a shock when there is not a currency union can come through exchange rate changes. A crucial consequence of belonging to an OCA is the surrender of a nominal exchange rate, which is a powerful tool when a country needs to stabilise the economy against idiosyncratic shocks. The assessment of whether a country should relinquish its exchange rate and join a currency union with one or more partners then requires a cost benefit analysis, Krugman (1990). Since there are benefits from having a common currency, the analysis turns on whether those benefits would outweigh the costs of foregoing the potential stabilisation effects of a country's own exchange rate. A different situation clearly arises if the foreign exchange market fails to offer any stabilisation benefit and, still more, if that market happens to provide an important independent source of shocks. Moreover, it may be that the exchange rate is actually an important independent source of shocks. The latter is suggested by Buiter (2000) who views exchange rate flexibility as a source of shocks and instability as well as (or even rather than) a mechanism for responding effectively to fundamental shocks originating elsewhere. Buiter's view, if true, would undermine the OCA implicit assumption that exchange rate changes are a way of adjusting to shocks.

5.2 The exchange rate debate: A few theoretical and methodology issues

In my examination of the EMU countries' responses to shocks and the composition of shocks corresponding to the movement in the exchange rate, I have used a four variable Vector Autoregressive (VAR) framework. Examples of work in this area are Clarida and Gali (1994) who examine the importance of nominal shocks in explaining real exchange rate fluctuations, Funke (2000) who examined the UK and the euro Area and Chadha and Prasad (1997). I have divided the shocks (statistical error terms) into three categories: those affecting demand, supply and the monetary sector. This is further explained in section 5.6.1 (IRFs) which discusses the empirical methodology. I shall explain this in more detail later in the chapter. There are two reasons for this. First, as Faust and Leeper (1994) argue, the aggregation of multiple shocks into one shock is appropriate only if the underlying shocks affect the variable of interest in precisely the same fashion. Thus, it is important to distinguish between those shocks because their effects are likely to be substantially different. Second, correlation of demand shocks reflects exchange rate policy and is not invariant to the exchange rate regime, while supply shocks are considered to be more structural and less sensitive to the choice of an exchange rate arrangement. It is more convincing for a region to form an OCA if supply shocks are highly symmetric within a region. Thus it is important to disentangle demand and supply shocks.

5.3 The variables

The Real Effective Exchange Rate

The Real Effective Exchange Rate is taken from the IMF statistics database and is used in all the examinations in this chapter. The IMF definition states: the REER index represents the ratio of an index of a currency's period average exchange rate to a trade-weighted geometric average of exchange rates for the currencies of selected countries. In this case, the major trading partners are taken from twenty-six countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Australia, Canada, Denmark, Hong Kong SAR, Israel, Japan, Korea, New Zealand, Norway, Singapore, Sweden, Switzerland, United Kingdom, and United States. To be more precise: the REER is calculated as the geometric average of nominal bilateral rates (units of the domestic currency per unit of foreign currency) with weights reflecting the relative importance of the other currencies, as measured by trade flows between the relevant countries. The Real Effective Exchange Rate index represents a nominal effective exchange rate index adjusted for relative movements in national price or cost indicators of the home country, selected countries, and the euro area. An increase in the REER variable indicates a depreciation of the domestic currency. Each REER is specific to that country and all the exchange rates are between one EMU member country and other EMU member country plus the rest of the world.

Imports and Exports

These data are compiled by the OECD and have been extracted on a quarterly basis for my study and are seasonally adjusted. I use this in my determination of the trade balance following exchange rate changes. All countries' trade figures are goods and services with the rest of the world. Imports consist of: (i) imports for direct domestic consumption; (ii) withdrawals from bonded warehouses and free zones for domestic consumption (special trade only); and (iii) imports into bonded warehouses and free zones (general trade only). Exports consist of: (i) exports of national products; (ii) exports without transformation of goods which had already been counted as special imports; and (iii) exports from bonded warehouses or free zones of goods which have not been transformed since import (general trade only).

World and domestic real GDP

Please see the real GDP data from the previous chapter in section 4.2. I use this in my determination of the trade balance following exchange rate changes. For the world real GDP series, I have taken the aggregate data from the twenty-six countries and euro area as a group. These twenty-six advanced economies are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Australia, Canada, Denmark, Hong Kong SAR, Israel, Japan, Korea, New Zealand, Norway, Singapore, Sweden, Switzerland, United Kingdom, and United States. To construct the foreign real GDP data for country 'a' for example, for each time period I subtract the real GDP data from country 'a' from the aggregate real GDP as the aggregate real GDP includes the data of country 'a'. For the purpose of comparability, I have used the Datastream function to convert the real GDP into US dollars since the world income from the IMF is denominated in US dollars.

Government consumption expenditure (change in relative demand)

These data are extracted from the OECD statistical database and are used in the IRF and FEVD examinations. The variable is widely used in the literature particularly with introducing impulse response functions. Noteable examples are Artis and Ehrmann (2000) in their study of exchange rates being an absorber of shocks, Thomas and Belanger (1997) in a similar study using Sweden as their source of investigation and Blanchard and Perotti

(2002) whose methods have been followed by numerous researchers. Note that relative demand used is taken as the difference between the domestic and foreign demand (domestic minus foreign). This methodology is standard in the literature when introducing shocks to a dependant variable, particularly in the study of exchange rate behaviour, e.g. Wang (2004). The data are seasonally adjusted and extracted on a quarterly basis. Total government consumption expenditure consists of expenditure, including imputed expenditure incurred by general government on both individual consumption goods and services and collective consumption services.

Productivity (change in relative supply)

This variable is calculated as real GDP divided by total hours worked (taken from the OCED statistics database) and are used in the IRF and FEVD examinations. The OECD calculation of hours worked (OECD annual) is determined by the total number of hours worked over the year divided by the average number of people in employment. The data are intended for comparisons of trends over time. Part-time workers are covered as well as full-time workers. Hours actually worked per person in employment are according to National Accounts concepts for 16 countries: Austria, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Korea, Norway, the Slovak Republic, Spain, Sweden, Switzerland and Turkey. Secretariat estimates for Belgium, Ireland, Luxembourg, the Netherlands (for total employment only) and Portugal for annual hours worked based on the European Labour Force Survey (LFS).

Domestic and world interest rates (change in relative interest rate)

The interest rates are all extracted on a quarterly basis and are actual policy interest rates (base rates) from each of the central banks and are used in the IRF and FEVD examinations. As the rates for the G7 countries are required, the rates for Canada and Japan are also taken. Some of the interest rates were given via electronic mail upon my request from the various central banks. All interest rates are available from me upon request. To construct the foreign interest rate, I adopt a method used by Barro and Sala-i-Martin (1990) and applied by Bergin and Sheffrin (2000) where weights based on trade shares of each country with each of the G7 countries are used. The share of trade of each country with each of the seven G7 countries is taken from the International Trade Centre website. The calculation for country ‘a’ for each time series point is thus:

$$a_t = \text{Japan}_i^{(wi)} + \text{Canada}_i^{(wi)} + \text{US}_i^{(wi)} + \text{France}_i^{(wi)} + \text{Germany}\ _i^{(wi)} + \text{Italy}_i^{(wi)} + \text{UK}_i^{(wi)} \quad (5.1)$$

where ‘a’ is the country under analysis; ‘i’ is the base rate of the observed G7 country; ‘w_i’ is the weight based on trade of country ‘a’ with the G7 country. The share of trade for each country with the G7 countries is calculated using both imports and exports. The figures are taken at the midpoint for the period. The web pages allowed the data to be extracted from 2001 and beyond.

The trade balance and exchange rate changes

My first task is to examine the extent to which the exchange rate changes affected trade balances before and after the EMU. In the advent of a single currency, the way in which a country’s own real exchange rate can vary but this does not mean that the post-EMU exchange rate will have a different effect on trade imbalances. Therefore, the question is: after 1999, did the EMU countries’ own real exchange rate adjust to reduce current account imbalances?

Before performing the regressions, I conduct unit root tests on the variables. The variables are: imports and exports (as the X/M ratio), the real effective exchange rate, domestic and foreign real GDP (in USD). The tests on the X/M are conducted on the ratio. The real GDP is converted into US dollars using an exchange rate function contained within Datastream statistics database. This is an automatic calculation using the base year average prices. This is done to preserve consistency with the base year and to avoid mixing changes in real GDP with changes in the value of the US dollar, a practice adopted by Juvenal (2008). Before establishing if there is a unit root in each variable, I establish the lag criteria. I then use the lag number to establish the unit roots using the ADF and the KPSS test methods, the rank of cointegrating equations and the actual regression itself. The results of the ADF tests can be seen in figures 5 to 11 in the appendix. The results of the lag length and cointegration tests can be seen in figures 12 to 37 in the individual country tables.

Once the characteristic testing is complete and if long-run relationships between the variables have been extablished, I use the regression using the Vector Error Correction (VEC) model. In my analysis, one of the methodological practices is the existence of restrictions imposed on the alpha and beta coefficients by the statistical package. The restrictions allow the full identification of the alpha and beta coefficients. I have specified the below equation:

$$\Delta z_t = a + bt - \alpha\beta z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta z_{t-i} + \upsilon_t \quad (5.2)$$

where z_t are the endogenous variables; $\alpha\beta$ are matrices containing the long-run adjustment coefficients and coefficients for the cointegrating relationships; Γ_i is the matrix with coefficients associated with the short-run dynamic effects; *a,b* are vectors with coefficients associated to the intercepts and trends; υ_t is a vector with innovations. Identifying α and β requires r^2 restrictions where r is the number of cointegrating vectors. The Johansen Full Information Maximum Likelihood (FIML) identifies α and β parameters by imposing r^2 atheoretical restrictions.

5.4 The trade model

In my trade model, I have included four variables. The variables are (i) the export to import ratio (calculated as exports divided by imports (X/M)); (ii) the real effective exchange rate; (iii) domestic GDP and: (iv) real GDP. Hence the final trade model for determining the trade balance and exchange relationship is:

$$Ln(X/M)_t = \beta_0 + \beta_1 Ln(X/M)_{(t-1)} + \beta_2 LnREER_{(t-1)} + \beta_3 LnY_{(t-1)} + \beta_4 LnY^*_{(t-1)} + u_i \quad (5.3)$$

In this model β_0 is the intercept; Ln = the log of the variables; Ln(X/M) = natural log of the trade balance; LnRER = the natural log of the real effective exchange rate; LnY= natural log of the domestic income; LnY* = natural log of the world income. A priori theory assumes that in the event of a currency depreciation, the trade balance should increase. The domestic real GDP is negatively related to the trade balance because as domestic incomes increase, more foreign goods are demanded thus reducing the trade balance. The foreign real GDP is positively related to the trade balance because as foreign incomes increase, more domestic goods are purchased causing the trade balance to increase.

5.5. The trade balance and exchange rate depreciation: the results

In this section, I use the multivariate cointegration approach by Johansen Juselius (1990). This method allows me to choose the appropriate vector according to economic theory and statistical significance. Each vector has an error correction term which must be statistically significant at the five or ten per cent level and the coefficient must be less than one. An ECM less than one in absolute terms suggests that the model returns to equilibrium. Conversely, an ECM greater than one suggests that the model does not return to equilibrium. At this point, the vector must be rejected as this suggests that the equation is unstable. An error correction term which is not statistically significant and/or greater than one should also be rejected. All the results for the countries examined are summarised below. Here, I provide a figure (figure 5.1) showing the two coefficients - the error correction coefficient and the long-run coefficient (exports/imports). I also denote where the coefficient is statistically significant at the five and ten per cent level with one or two stars respectively.

Figure 5.1 shows the overall impact of the trade balance reactions with their long-run coefficients. The error correction coefficient (ecm) level is shown with its statistically significant level. The ecm is the speed of adjustment towards equilibrium in the long run. Therefore, from figure 5.1 below, it is clear that Finland's speed of adjustment is the fastest reactor with an ecm coefficient of -0.162 in the pre-EMU period. To establish the trade balance reaction to a depreciation for example for Germany, the effect is an increase by 0.363. The ecm 0.019 is statistically significant at the five per cent level and is less than one. In the country figures (figures 12 to 24 (pre-EMU) and figures 25 – 37 (post-EMU)) in the appendix, I include; the lag length selection criteria. (These are chosen by the Akaike's Information Criterion with the highest value - a technique specified by the software); the cointegration tests; the cointegrating vectors; the cointegrating (ecm) equations with their coefficients and statistically significant levels; the short-run adjustment parameters and the diagnostic tests. Within these figures, I highlight in bold and the grey shaded area which vector has been selected.

Figure 5.1

The Long Run and Error Correction coefficients for 13 countries following a one per cent depreciation in the Real Effective Exchange Rate

Period before EMU			Period after EMU		
Country	Long Run Coefficient	Error Correction Coefficient	Country	Long Run Coefficient	Error Correction Coefficient
Austria	0.130	0.070*	Austria	No effect	-
Belgium	0.266	0.023*	Belgium	No effect	-
Finland	0.360	0.162*	Finland	0.062	-0.085*
France	0.15	-0.02*	France	0.437	-0.055*
Germany	0.363	0.019*	Germany	0.353	-0.049*
Greece	No effect	-	Greece	No effect	-
Ireland	No effect	-	Ireland	No effect	-
Italy	0.070	0.08**	Italy	0.349	0.0329*
Netherlands	0.520	0.037*	Netherlands	0.244	0.0293*
Portugal	No effect	-	Portugal	No effect	-
Spain	No effect	-	Spain	No effect	-
UK	0.015	0.058*	UK	0.559	0.093*
US	0.120	0.033*	US	No effect	-

**Denotes significance at the 5 per cent level*
***Denotes significance at the 10 per cent level*

Data Sources: OECD, IMF, Datastream

Of the eleven EMU countries, I find that seven countries in the period prior to the EMU showed an improvement in the trade balance following a depreciation in the real effective exchange rate. These countries are Austria, Belgium, Finland, France, Germany, Italy, and the Netherlands. There was no effect in the trade balance in Greece, Ireland, Portugal and Spain. Finland, Germany and Italy are statistically significant at the five per cent level. Only Italy's coefficient is statistically significant at the ten per cent level. For the non EMU countries, the UK and the US showed an improvement in the trade balance in both periods. The UK shows a coefficient of 0.015 which is statistically significant at the five per cent level and the US shows a coefficient of 0.120 which is also statistically significant at the five per cent level. My findings for the UK show that there is an improvement in the trade balance following a depreciation in the exchange rate. This is consistent with the UK in 1992 where the country had no option but to leave the Exchange Rate Mechanism (ERM). This recessionary period provided the UK an opportunity to devalue the currency, leading to the cheaper price of exports and thus a subsequent recovery thereafter. Thus from the UK point of view, the flexible exchange rate regime was preferred.

In the period after the EMU, five of the eleven EMU countries showed an improvement in the trade balance following a depreciation in the real effective exchange rate. These countries are: Finland, France, Germany, Italy and the Netherlands and Spain. The resulting ecm coefficients for Italy and Spain are all statistically significant at the five per cent level in this period. Of the countries that showed a trade balance improvement in both periods, the trade balances of Finland, Germany and the Netherlands are lower in the post-EMU period that in the pre-EMU period. Simply stated, for these countries, the post-EMU exchange rate is less effective in improving the trade balance. The result for Germany is only marginally different for both periods in that the pre-EMU coefficient is 0.363 and the post-EMU period and 0.352. France and Italy show that a depreciation in the exchange rate resulted in a better improvement in the trade balance in the period after the EMU than in the period before. The results for Ireland, Greece, Portugal and Spain show that the real effective exchange rate in both periods had no effect on the trade balance. Here, the error correction coefficient is not statistically significant at either the five or ten per cent level. The UK's trade balance shows a lower coefficient in the period before the EMU (0.015), than in the period after the EMU (0.559). Both coefficients are statistically significant at the five per cent level. The US shows an improvement in the exchange rate in the period before the EMU, however, there is no effect in the period after the EMU. Generally, the results show that a depreciation in the exchange rate after the EMU had a lesser impact on the trade balance. In that period, the exchange rate movements did not vary in the same way as in the pre-EMU period to reduce current account imbalances.

5.6 Impulse Response Funtion (IRF)

Prior to conducting the IRF examinations, I carried out the unit root and cointegration tests on all the variables. With the exception of a few borderline cases (unit root tests), all variables show non stationarity in levels and stationary in first difference using the KPSS test. This situation arose in a few of the test statistics, however, I am satisfied with the quality of the data available and the subsequent unit root tests performed. The full results for these tests can be seen in figures 1 to 4 in the appendix. Figure 38 in the appendix shows the long run long-run cointegrating relationship in the model. The number of cointegrating equations is indicated in the 'rank' column. The general rule is that if there is at least one cointegrating equation shown then there is a long-run relationship. My examinations, however, concentrate on the short-run changes in the dependent variable following a one per cent increase in each of the independent variables. This takes the form of a temporary shock to the system.

5.6.1 Econometric methodology

I have adopted a similar methodology as used by Artis and Ehrmann (2000) in their work which attempted to ascertain the behaviour of the real effective exchange rates in response to shocks in the UK, Canada, Sweden and Denmark. The exchange rate model is specified as follows:

$$\text{Exchange Rate} = f\ [D\text{-}D^*,\ S\text{-}S^*,\ R\text{-}R^*] \qquad (5.4)$$

I have set up a VAR model (as above in 5.4) where all variables are taken in logs with the exception of the interest rate. Therefore the real effective exchange rate is a function of the relative demand, relative supply and relative interest rate. (For both the demand and supply variables, I have taken the G7 country's indices as the foreign variable and the world interest rate as the foreign interest rate). This model implies that the set of variables are subject to a vector of structural shocks, ε the error term. These are comprised of $\varepsilon_t = [\varepsilon^d_t, \varepsilon^s_t, \varepsilon^r_t]$ where ε^d_t indicates a demand shock, ε^s_t indicates a supply shock and ε^r_t indicates a monetary shock. Please note that the examinations are done using the 'standard' exchange rate model whereby domestic demand, supply and monetary shock variables are relative to the outside world. This follows the methodology by several economists (e.g. Wang 2004) who determined that the variables are relative to partner trade countries because both domestic and external macroeconomic conditions should affect the real exchange rate. It is understood that the shock is the error term as explained above, however, I shall refer to these as demand, supply and monetary shocks in the same way as in all the literature, e.g Wang (2004). To establish the partner countries for relative demand and supply shocks, I use the data which come from the G7 index supplied by the OECD. To construct the foreign interest rate, I adopt a method discussed in section 4.2. In this SVAR system, the dependent variable is the real effective exchange rate, the shocks are the explanatory variables.

The IRF procedure

In this analysis, all the variables are taken in logs with the exception of the interest rate. I analyse the maximum response from a temporary shock. The graphs for each of the responses are in figures 48 and 49 and indicate 95 per cent upper and lower bands as seen by the dashed lines. The solid line indicates the actual response of the dependent variable. In this analysis, I have measured the maximum response of the real effective exchange rate under the heading 'maximum effect' in the results below. I also assess the period this effect takes place and document this under the heading 'lag time'. Where possible, I have taken the maximum effect to be 'effective' above 0.1 per cent. In nearly all cases as can be seen in the figure, the effects are generally above 0.1 per cent. I have chosen the period the effect of the shock starts to die out to be at the point where the per cent change is less than 0.1 per cent. In some cases, the maximum effect occurs in lags beyond the first lag, i.e lag two or three. In this case, when calculating the length of the adjustment process, I take the first per cent change above 0.1 and use that as the start of the calculation point and the end point to be the period where the per cent change is less than 0.1. All the results are shown in the figure below. The significance/reliability of these responses is given by the 95 per cent confidence bands. If the bands straddle the line at zero, then the resulting coefficients are not statistically significant/reliable. None of the responses straddle the line, therefore the results can be considered reliable. The induced impulses in all cases are a one per cent increase in demand, supply and monetary shock. The expected signs are: an increase in demand produces an appreciation in the real effective exchange rate, an increase in supply depreciates the exchange rate and an increase in monetary policy depreciates the real effective exchange rate. Figure 5.2 provides a summary of the responses of the real effective exchange rate from each of the three shocks.

Figure 5.2: IRF summary (Real Effective Exchange Rate responses)

Impulse responses of the Real Effective Exchange Rate following a one per cent increase in demand, supply and monetary shocks between two sub periods, 1988q1 and 2008q4

DEMAND SHOCK

	Pre EMU			*After EMU*				
Country	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Effect higher /lower after EMU*	*Adjustment Longer/Shorter after EMU*
Austria	*0.03*	*1*	*1*	*-0.07*	*1*	*2*	*Higher*	*Longer*
Belgium	*-0.38*	*2*	*2*	*-0.04*	*3*	*1*	*Higher*	*Shorter*
Finland	*0.54*	*2*	*3*	*0.43*	*1*	*2*	*Lower*	*Shorter*
France	*-0.29*	*2*	*4*	*-0.06*	*1*	*1*	*Lower*	*Shorter*
Germany	*0.48*	*1*	*5*	*0.12*	*1*	*3*	*Lower*	*Shorter*
Greece	*-0.32*	*2*	*3*	*0.34*	*2*	*2*	*Higher*	*Shorter*
Ireland	*-0.36*	*2*	*4*	*-0.41*	*2*	*2*	*Higher*	*Shorter*
Italy	*1.20*	*1*	*2*	*-0.26*	*1*	*3*	*Lower*	*Longer*
Netherlands	*0.15*	*1*	*4*	*0.21*	*1*	*2*	*Higher*	*Shorter*
Portugal	*0.38*	*1*	*5*	*-0.05*	*1*	*1*	*Lower*	*Shorter*
Spain	*-0.52*	*1*	*4*	*0.16*	*2*	*3*	*Lower*	*Shorter*
UK	*-0.31*	*2*	*3*	*0.20*	*1*	*2*	*Lower*	*Shorter*
US	*0.48*	*1*	*4*	*0.04*	*1*	*1*	*Lower*	*Shorter*

SUPPLY SHOCK

	Pre EMU			*Post EMU*				
Country	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Effect higher /lower after EMU*	*Adjustment Longer/Shorter after EMU*
Austria	*0.15*	*2*	*3*	*-0.09*	*3*	*1*	*Lower*	*Shorter*
Belgium	*-0.23*	*2*	*3*	*-0.09*	*1*	*1*	*Lower*	*Shorter*
Finland	*0.27*	*2*	*3*	*-0.27*	*2*	*2*	*Higher*	*Shorter*
France	*-0.20*	*1*	*6*	*-0.27*	*1*	*4*	*Higher*	*Shorter*
Germany	*-0.29*	*1*	*4*	*-0.54*	*2*	*2*	*Higher*	*Shorter*
Greece	*-0.39*	*2*	*5*	*-0.35*	*2*	*4*	*Lower*	*Shorter*
Ireland	*0.55*	*2*	*4*	*-0.23*	*2*	*1*	*Lower*	*Shorter*
Italy	*-0.61*	*2*	*2*	*-0.21*	*2*	*2*	*Lower*	*No change*
Netherlands	*-0.25*	*1*	*2*	*-0.48*	*2*	*2*	*Higher*	*No change*
Portugal	*0.52*	*2*	*3*	*-0.21*	*2*	*2*	*Lower*	*Shorter*
Spain	*0.29*	*2*	*1*	*-0.46*	*2*	*5*	*Higher*	*Longer*
UK	*-0.65*	*1*	*3*	*0.63*	*1*	*3*	*Lower*	*No change*
US	*-0.41*	*1*	*4*	*-0.70*	*1*	*3*	*Higher*	*Shorter*

MONETARY SHOCK

	Pre EMU			*Post EMU*				
Country	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Maximum effect (per cent)*	*Lag time*	*End of adjustment process (lags)*	*Effect higher /lower after EMU*	*Adjustment Longer/Shorter after EMU*
Austria	*0.22*	*2*	*3*	*-0.13*	*1*	*2*	*Lower*	*Shorter*
Belgium	*-0.36*	*1*	*5*	*-0.45*	*1*	*3*	*Higher*	*Shorter*
Finland	*-0.57*	*1*	*6*	*-0.15*	*2*	*4*	*Lower*	*Shorter*
France	*0.23*	*1*	*3*	*-0.20*	*1*	*4*	*Lower*	*Longer*
Germany	*0.22*	*2*	*4*	*-0.28*	*1*	*3*	*Higher*	*Shorter*
Greece	*-0.40*	*1*	*2*	*-0.13*	*1*	*2*	*Lower*	*No change*
Ireland	*0.92*	*1*	*4*	*-0.24*	*1*	*2*	*Lower*	*Shorter*
Italy	*0.31*	*3*	*3*	*-0.24*	*1*	*1*	*Lower*	*Shorter*
Netherlands	*-0.20*	*1*	*3*	*-0.55*	*1*	*3*	*Higher*	*No change*
Portugal	*0.51*	*1*	*5*	*-0.17*	*1*	*3*	*Lower*	*Shorter*
Spain	*0.61*	*1*	*4*	*-0.09*	*2*	*5*	*Lower*	*Longer*
UK	*-0.50*	*2*	*2*	*-0.56*	*2*	*2*	*Higher*	*No change*
US	*-0.50*	*1*	*4*	*0.37*	*1*	*2*	*Lower*	*Shorter*

Data Sources: IMF, OECD, Bank of International Settlements

In the summary figure 5.2 above, following a temporary demand shock (a one percent increase in the demand shock variable), it is clear to see that of the eleven EMU countries, six have recorded a response to the shock greater in the period before the EMU than after. Austria, Belgium, Greece, Ireland and the Netherlands recorded a higher magnitude after the EMU. Therefore, in the flexible exchange rate system, the individual currencies are a greater absorber following a one unit increase in demand. Italy has the highest value with a 1.2 per cent change. In the case of Spain, a temporary demand shock results in a 0.52 per cent currency depreciation. Finland and Germany show a 0.54 and 0.47 per cent appreciation respectively. Overall, the demand shock shows that the real effective exchange rate absorbs the economic shock better in the pre-EMU period. The lower magnitude of the shock in the post-EMU period in six countries suggests the behaviour of these countries is endogenous to regime change. In the case of a temporary supply shock, an increase in supply results in greater responses in six of the eleven EMU countries before monetary union. These countries are: Austria, Belgium, Greece, Ireland Italy and Portugal. The five countries which display a lower magnitude to the supply shock after the EMU suggests the behaviour of these countries is endogenous to regime change. The analysis of the monetary shock is important because in a fixed exchange rate system, countries lose this autonomous policy setting tool. Clearly, from the examination, seven of the countries would be affected negatively following the loss of the exchange rate. Only Belgium, Germany and the Netherlands do not show endogenous behaviour whilst the remaining countries, Austria, Finland, France, Greece, Ireland, Italy, Portugal and Spain show evidence of an endogenous process.

In the analysis, I have identified the response length times for the currencies by indicating whether or not the adjustment process is longer, shorter or the same after the EMU. For the demand shocks, of the eleven member countries, nine showed a shorter adjustment period, two showed a longer period of adjustment (Austria and Italy). For the supply shock, eight countries (Austria, Belgium, Finland, France, Germany, Greece Ireland and Portugal) showed a shorter period of adjustment and one country (Spain) showed a longer period of adjustment with two countries (Italy and the Netherlands) showing no change in both periods. For the monetary shock, seven countries (Austria, Belgium, Finland, Germany, Ireland, Italy and Portugal) showed a shorter period of adjustment after the EMU and only one country (Spain) showed a longer period of adjustment with three countries (Greece, the Netherlands and the UK) showing no change.

Generally, the results for the UK and the US were mixed. The effects of demand shock in the post-EMU period were lower in the UK and in the US. The supply shock showed a higher response in the US and lower response in the UK. The monetary shock showed a higher response in the UK after the EMU but a lower response in the US. Also, the duration after the demand shocks in both countries was shorter, the duration following a supply shock was shorter for the US but longer for the UK but the reverse in seen after a monetary shock where the UK takes longer to adjust in the period after the EMU but shorter in the case of the US. Overall, the results for all the examinations show that the period of adjustment is shorter in the period after the EMU than before. These results indicate that the euro-based but country-adjusted real effective exchange rate is actually a more effective shock-absorbing variable than before when the real effective exchange rate was based on national currencies. Hence, the loss of national currency has become less costly due to endogenous change in the behaviour or the economic actors (i.e., wage and price-setters) in labour and good markets. Hence, the shock-absorbing capacity of the real effective exchange rate is considered to be endogenous to regime change.

I have further devised a figure (figure 5.3) defining the two adjustment periods. This figure is defined by short and medium-term adjustments. The short-term adjustment period is defined as a period of adjustment of four lags or less and the medium adjustment period is defined as five lags or more.

Figure 5.3

Table showing the number of EMU countries with short and medium-term lengths of adjustment

	Before EMU	*After EMU*
Demand shock	*2 medium-term* *9 short-term*	*0 medium-term* *11 short-term*
Supply shock	*2 medium-term* *9 short-term*	*1 medium-term* *10 short-term*
Monetary Shock	*3 medium-term* *8 short-term*	*1 medium-term* *10 short-term*

Short-term: 4 lags or less
Medium-term: 5 lags or more

Data Sources: IMF, OECD, Bank of International Settlements

The figure shows the number of countries in each period with their corresponding lengths of adjustment times denoted by short or medium-term adjustments. The demand shock shows more medium-term adjustments in the pre-EMU period than the post-EMU period with two and zero respectively. For the supply shock, there are two medium-term adjustments in the pre-EMU period and one in the post-EMU period. The monetary shock again shows three medium-term adjustments in the pre-EMU period and one in the post-EMU period. From the analysis, more countries take longer to adjust to economic shocks in the pre-EMU period than the period thereafter. These results indicated that the euro-based but country-adjusted real effective exchange rate is actually a more effective shock-absorbing variable than before when the real effective exchange rate was based on national currencies. Hence, the shock-absorbing capacity of the exchange rate is considered to be endogenous to regime change.

5.7 Cholesky Forecast Error Variance Decompositions

Another measure of the effect of the innovations in variable ‘k’ on variable ‘j’ is the Forecast Error Variance Decompositions (FEVD). This method, which is also known as innovation accounting, measures the fraction of the error in forecasting variable ‘j’ after ‘h’ periods that is attributable to the orthogonalised innovations in variable ‘k’. Because deriving the Forecast Error Variance Decomposition requires orthogonalising the u_t innovations, the Forecast Error Variance Decomposition is always predicated upon a choice of P. Lutkepohl (2005) shows that the h-step forecast error can be written as:

$$_{t+h} - \widehat{\mathbf{y}}_t(h) = \sum_{i=0}^{h-1} \mathbf{\Phi}_i \mathbf{u}_{t+h-i} \tag{5.5}$$

where y_{t+h} is the value observed at time t + h and $\hat{y}_t(h)$ is the h-step-ahead predicted value for y_{t+h} that was made at time, t. Because the u_t are contemporaneously correlated, their distinct contributions to the forecast error cannot be ascertained. However, if we choose a ‘P’ such that $\Sigma = PP'$, as above, we can orthogonalise the u_t into $w_t = P^{-1}u_t$. We can then ascertain the relative contribution of the distinct elements of w_t. Thus we can rewrite (5.5) as:

$$\mathbf{y}_{t+h} - \widehat{\mathbf{y}}_t(h) = \sum_{i=0}^{h-1} \mathbf{\Phi}_i \mathbf{P}\mathbf{P}^{-1}\mathbf{u}_{t+h-i}$$
$$= \sum_{i=0}^{h-1} \mathbf{\Theta}_i \mathbf{w}_{t+h-i} \quad (5.6)$$

Because the forecast errors can be written in terms of the orthogonalised errors, the forecast error variance can be written in terms of the orthogonalised error variances. Forecast-error variance decompositions measure the fraction of the total forecast-error variance that is attributable to each orthogonalised shock. Once the dynamics of the model is established, it is necessary to order the variables. This is done for the purposes of establishing if one time series is useful for forecasting another using the Granger Causality test. Once the VAR is 'fitted', we may want to know whether one variable "Granger-causes" another (Granger 1969). A variable *x* is said to Granger-cause a variable *y* if, given the past values of *y*, past values of *x* are useful for predicting *y*. A common method for testing Granger causality is to regress *y* on its own lagged values and on lagged values of *x* and test the null hypothesis that the estimated coefficients on the lagged values of *x* are jointly zero. Failure to reject the null hypothesis is equivalent to failing to reject the hypothesis that *x* does not Granger-cause *y*. Variables that are not caused by any other variables in the system will be placed first in the list of ordering. The remaining variables are ordered according the lowest chi squared value first with the target variable placed last in the ordering.

The tasks

The variables and lag criteria I have used are exactly the same as used in the impulse response analysis. Therefore, the real effective exchange rate is a function of the relative demand, supply and nominal interest rate as before. All the variables are taken in logs with the exception of the interet rate. Variance decomposition analysis allows me to establish how much of the shock is due to itself and in this case, the other three demand, supply and monetary shocks, thus, the variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Therefore, the variance decomposition provides information of each random innovation in affecting the variables in the VAR. Since non-orthogonal factorisation will yield decompositions that do not satisfy an adding up property (to 100 per cent), the choice of factorisation is limited to Cholesky orthogonal factorisations. In figure 5.5 below, the format displays a separate variance decomposition for each endogenous variable. The column labelled 'S.E.', contains the forecast error of the variable at the given forecast horizon. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. The remaining columns give the percentage of the forecast variance due to each innovation, with each row adding up to 100 per cent. The first period decomposition for the dependent variable is usually due to its own innovation.

I have divided the variance decomposition figures into two parts. The first is figure 5.4 which is the short-term period where I observe the first four lags. The second is figure 5.5 which are the remaining periods and I denote as being the medium term which is a five to ten lag period. The figures show the pre and post-EMU period. From this, I compare whether the shocks have become more convergent/endogenous or divergent.

Figure 5.4: The Variance Decomposition – Short-term results

Variance Decompositions of demand, supply and monetary shocks contributing to a change in the Real Exchange Rate in the short-term for both periods

The short-term period: 4 lags or less

PRE-EMU						*POST-EMU*					
Country											
Austria						*Austria*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
1	0.01	51.41	30.76	13.12	4.71	1	0.01	25.17	0.00	57.86	16.97
2	0.01	46.01	27.65	20.75	5.58	2	0.01	22.09	1.68	47.60	28.63
3	0.01	49.50	24.99	18.47	7.04	3	0.01	18.31	2.61	52.30	26.79
4	0.02	49.76	22.75	16.88	10.61	4	0.01	14.10	5.35	50.19	30.36
Belgium						*Belgium*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
1	0.02	8.47	5.47	64.71	21.34	1	0.01	15.57	3.97	79.84	0.62
2	0.02	8.59	8.50	63.96	18.95	2	0.01	10.82	14.61	72.18	2.39
3	0.02	8.72	8.51	63.20	19.57	3	0.01	10.07	11.16	55.21	23.55
4	0.02	8.79	8.81	62.39	20.01	4	0.02	7.61	26.56	47.35	18.48
Finland						*Finland*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
1	0.01	36.43	0.00	26.16	37.41	1	0.01	13.54	0.00	74.48	11.98
2	0.03	19.11	42.73	16.36	21.80	2	0.01	13.38	23.40	52.91	10.32
3	0.03	14.80	50.40	12.82	21.98	3	0.01	13.17	22.93	53.08	10.83
4	0.03	15.14	43.09	15.05	26.71	4	0.02	12.09	23.28	48.18	16.44
France						*France*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
1	0.01	10.32	2.21	83.33	4.13	1	0.01	10.32	2.21	83.33	4.13
2	0.02	3.59	1.45	86.52	8.44	2	0.02	3.59	1.45	86.52	8.44
3	0.02	5.72	2.55	79.16	12.57	3	0.02	5.72	2.55	79.16	12.57
4	0.03	6.96	8.49	67.52	17.03	4	0.03	6.96	8.49	67.52	17.03
Germany						*Germany*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
1	0.01	42.39	1.18	55.11	1.32	1	0.01	25.58	0.70	73.00	0.72
2	0.02	26.40	3.29	33.78	36.53	2	0.01	24.41	1.58	68.17	5.84
3	0.02	25.48	3.00	34.58	36.94	3	0.02	16.01	6.66	27.20	50.13
4	0.02	32.02	2.84	31.33	33.80	4	0.03	10.55	18.49	17.38	53.58
Greece						*Greece*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
1	0.02	38.81	0.20	8.66	52.33	1	0.01	7.88	45.14	4.57	42.41
2	0.02	35.83	21.10	7.76	35.32	2	0.01	6.91	53.90	15.47	23.72
3	0.03	36.49	23.28	7.18	33.05	3	0.02	5.04	61.68	14.26	19.03
4	0.03	31.43	36.62	6.88	25.07	4	0.02	4.78	56.05	18.12	21.05
Ireland						*Ireland*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
1	0.03	43.11	0.26	53.90	2.73	1	0.02	11.35	29.04	59.58	0.03
2	0.03	35.98	0.85	44.54	18.62	2	0.02	11.07	31.56	56.88	0.49
3	0.03	34.23	0.75	46.77	18.25	3	0.02	10.38	30.04	59.11	0.48
4	0.03	27.01	17.73	36.19	19.07	4	0.03	4.94	24.46	68.58	2.02

Italy						Italy					
Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY	Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY
1	0.02	68.59	13.48	14.30	3.63	1	0.01	5.93	0.30	93.53	0.24
2	0.03	25.63	62.96	6.41	5.00	2	0.01	3.11	11.75	84.99	0.15
3	0.04	24.92	42.06	6.65	26.37	3	0.02	1.34	9.70	86.81	2.15
4	0.06	42.45	25.01	17.06	15.47	4	0.03	1.23	8.18	88.05	2.54
Netherlands						Netherlands					
Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY	Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY
1	0.01	78.39	0.01	20.49	1.12	1	0.02	24.92	1.13	70.41	3.55
2	0.02	45.29	42.10	11.49	1.12	2	0.02	19.57	2.92	73.04	4.48
3	0.02	45.04	41.36	11.35	2.26	3	0.02	17.80	3.25	75.07	3.88
4	0.02	44.61	35.02	9.40	10.97	4	0.02	19.75	5.35	66.99	7.91
Portugal						Portugal					
Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY	Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY
1	0.01	23.59	0.74	45.68	30.00	1	0.01	31.39	25.68	42.68	0.25
2	0.02	6.58	65.29	15.51	12.62	2	0.01	23.06	19.50	36.67	20.77
3	0.02	6.14	59.93	22.86	11.07	3	0.01	15.88	14.89	45.27	23.96
4	0.02	5.26	48.61	32.54	13.59	4	0.02	8.30	11.41	28.18	52.11
Spain						Spain					
Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY	Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY
1	0.02	49.96	0.13	29.23	20.68	1	0.01	6.43	46.59	44.62	2.36
2	0.02	44.36	0.36	27.81	27.47	2	0.01	8.66	46.53	41.05	3.75
3	0.03	27.44	0.16	59.45	12.95	3	0.01	18.10	42.88	35.40	3.61
4	0.03	34.68	0.60	50.73	13.99	4	0.01	19.09	41.21	32.37	7.33
UK						UK					
Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY	Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY
1	0.03	20.66	16.29	0.43	62.61	1	0.03	35.34	23.31	41.20	0.15
2	0.03	13.10	45.31	0.83	40.77	2	0.04	22.02	25.19	32.83	19.96
3	0.04	11.89	42.59	9.16	36.37	3	0.04	19.31	24.76	37.57	18.36
4	0.04	11.82	42.48	9.10	36.60	4	0.04	19.21	25.74	39.07	15.98
US						US					
Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY	Lags	S.E.	NEER	DEMAND	SUPPLY	MONETARY
1	0.02	95.95	0.91	2.38	0.76	1	0.03	70.35	29.53	0.13	0.00
2	0.03	60.61	0.84	4.83	33.72	2	0.03	68.37	28.00	3.19	0.44
3	0.03	57.44	1.44	9.46	31.65	3	0.04	52.57	27.55	15.36	4.51
4	0.04	49.41	5.55	8.09	36.95	4	0.04	45.60	33.07	17.37	3.96

Figure 5.5: The Variance Decomposition –Medium-term results

Variance Decompositions of demand, supply and monetary shocks contributing to a change in theReal Exchange Rate in the medium-term for both periods

The medium-term period: 5 lags or more

Country											
		PRE-EMU							*POST-EMU*		
The medium-term											
Austria						*Austria*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	*0.02*	*41.03*	*36.33*	*13.83*	*8.81*		*0.01*	*12.28*	*4.59*	*60.31*	*22.82*
6	*0.02*	*39.77*	*35.55*	*16.13*	*8.55*		*0.02*	*6.53*	*7.51*	*72.09*	*13.87*
7	*0.02*	*37.11*	*32.89*	*22.59*	*7.42*		*0.02*	*8.56*	*7.57*	*67.18*	*16.68*
8	*0.02*	*28.21*	*44.07*	*21.59*	*6.13*		*0.02*	*8.76*	*9.98*	*63.15*	*18.11*
9	*0.02*	*27.62*	*43.14*	*22.68*	*6.55*		*0.02*	*8.71*	*11.15*	*66.15*	*13.99*
10	*0.02*	*27.41*	*41.15*	*25.26*	*6.18*		*0.02*	*7.90*	*23.90*	*57.58*	*10.63*
Belgium						*Belgium*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	*0.02*	*8.82*	*9.22*	*61.25*	*20.71*	*5*	*0.02*	*7.95*	*25.80*	*47.05*	*19.21*
6	*0.02*	*8.62*	*9.02*	*62.14*	*20.22*	*6*	*0.02*	*8.84*	*19.26*	*55.67*	*16.23*
7	*0.02*	*8.61*	*8.67*	*61.83*	*20.89*	*7*	*0.02*	*10.66*	*22.34*	*45.20*	*21.80*
8	*0.02*	*9.85*	*8.48*	*61.76*	*19.90*	*8*	*0.03*	*9.08*	*31.78*	*41.41*	*17.73*
9	*0.03*	*9.70*	*9.54*	*58.59*	*22.17*	*9*	*0.03*	*9.34*	*30.01*	*39.29*	*21.36*
10	*0.03*	*8.89*	*9.18*	*51.43*	*30.49*	*10*	*0.03*	*8.86*	*29.07*	*37.49*	*24.58*
Finland						*Finland*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	*0.04*	*12.41*	*55.07*	*13.36*	*19.16*	*5*	*0.02*	*12.10*	*22.51*	*49.34*	*16.05*
6	*0.04*	*10.79*	*54.61*	*13.34*	*21.25*	*6*	*0.02*	*11.80*	*27.78*	*45.69*	*14.73*
7	*0.05*	*8.56*	*43.60*	*20.25*	*27.59*	*7*	*0.02*	*10.21*	*30.18*	*38.70*	*20.91*
8	*0.05*	*8.37*	*42.57*	*20.79*	*28.27*	*8*	*0.02*	*8.14*	*25.99*	*36.34*	*29.52*
9	*0.05*	*8.40*	*41.81*	*22.53*	*27.25*	*9*	*0.02*	*7.19*	*23.87*	*40.57*	*28.37*
10	*0.06*	*10.45*	*43.12*	*19.07*	*27.36*	*10*	*0.03*	*8.76*	*16.35*	*38.25*	*36.64*
France						*France*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	*0.03*	*8.74*	*7.43*	*58.03*	*25.80*	*5*	*0.03*	*8.74*	*7.43*	*58.03*	*25.80*
6	*0.04*	*14.27*	*5.87*	*43.04*	*36.82*	*6*	*0.04*	*14.27*	*5.87*	*43.04*	*36.82*
7	*0.05*	*18.09*	*2.76*	*38.90*	*40.24*	*7*	*0.05*	*18.09*	*2.76*	*38.90*	*40.24*
8	*0.07*	*24.49*	*2.23*	*25.23*	*48.05*	*8*	*0.07*	*24.49*	*2.23*	*25.23*	*48.05*
9	*0.11*	*20.17*	*2.28*	*34.94*	*42.61*	*9*	*0.11*	*20.17*	*2.28*	*34.94*	*42.61*
10	*0.14*	*24.51*	*1.58*	*22.19*	*51.72*	*10*	*0.14*	*24.51*	*1.58*	*22.19*	*51.72*
Germany						*Germany*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	*0.02*	*33.03*	*3.19*	*29.99*	*33.79*	*5*	*0.03*	*12.64*	*20.05*	*15.89*	*51.43*
6	*0.02*	*31.81*	*4.75*	*31.57*	*31.87*	*6*	*0.04*	*14.09*	*25.89*	*8.30*	*51.72*
7	*0.03*	*28.83*	*4.20*	*32.56*	*34.41*	*7*	*0.05*	*8.39*	*28.59*	*8.41*	*54.61*
8	*0.03*	*28.25*	*5.65*	*31.26*	*34.83*	*8*	*0.06*	*7.43*	*24.44*	*7.15*	*60.98*
9	*0.03*	*26.28*	*5.20*	*36.19*	*32.32*	*9*	*0.06*	*9.92*	*26.35*	*6.10*	*57.63*
10	*0.03*	*25.89*	*5.31*	*36.94*	*31.86*	*10*	*0.10*	*8.01*	*27.55*	*3.48*	*60.96*
Greece						*Greece*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	*0.03*	*32.58*	*34.37*	*6.36*	*26.69*	*5*	*0.02*	*4.01*	*49.16*	*27.21*	*19.62*
6	*0.03*	*32.02*	*35.23*	*6.33*	*26.42*	*6*	*0.02*	*3.80*	*49.58*	*29.56*	*17.06*
7	*0.03*	*31.68*	*34.59*	*6.15*	*27.57*	*7*	*0.02*	*3.14*	*49.93*	*28.06*	*18.87*
8	*0.03*	*31.04*	*33.50*	*6.19*	*29.28*	*8*	*0.02*	*3.23*	*43.85*	*30.07*	*22.86*
9	*0.03*	*30.87*	*33.34*	*6.67*	*29.13*	*9*	*0.03*	*3.74*	*40.12*	*34.91*	*21.23*
10	*0.03*	*30.27*	*32.90*	*8.55*	*28.28*	*10*	*0.03*	*5.38*	*32.64*	*43.17*	*18.81*
Ireland						*Ireland*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	*0.04*	*32.19*	*19.04*	*32.75*	*16.02*	*5*	*0.04*	*4.14*	*44.22*	*49.92*	*1.72*
6	*0.04*	*30.14*	*22.55*	*32.11*	*15.20*	*6*	*0.07*	*3.33*	*45.84*	*48.28*	*2.54*
7	*0.04*	*29.02*	*20.04*	*37.73*	*13.20*	*7*	*0.10*	*2.10*	*39.60*	*56.93*	*1.37*
8	*0.04*	*29.04*	*19.51*	*36.80*	*14.65*	*8*	*0.16*	*2.76*	*43.34*	*53.17*	*0.73*
9	*0.05*	*30.37*	*25.89*	*30.94*	*12.80*	*9*	*0.25*	*2.78*	*43.96*	*52.58*	*0.68*
10	*0.05*	*27.55*	*22.87*	*37.67*	*11.91*	*10*	*0.40*	*2.59*	*43.33*	*53.40*	*0.68*

Italy						*Italy*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	0.06	42.25	24.47	17.76	15.52	5	0.03	0.83	5.17	81.86	12.14
6	0.07	39.86	28.03	16.66	15.44	6	0.03	0.84	4.45	76.80	17.91
7	0.07	37.65	29.87	17.33	15.16	7	0.04	0.64	4.97	66.03	28.36
8	0.07	35.67	32.40	16.52	15.40	8	0.05	0.47	8.24	65.11	26.18
9	0.07	34.43	31.41	16.44	17.72	9	0.07	0.27	10.17	68.29	21.27
10	0.08	35.39	30.59	17.54	16.48	10	0.08	0.22	9.52	72.55	17.71

Netherlands						*Netherlands*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	0.02	45.97	31.34	7.39	15.30	5	0.02	19.91	5.45	66.81	7.83
6	0.02	40.19	40.22	6.93	12.67	6	0.03	14.99	10.64	60.32	14.05
7	0.02	33.41	36.13	19.73	10.74	7	0.03	12.63	11.64	51.30	24.42
8	0.03	28.23	38.34	20.34	13.09	8	0.03	16.59	11.18	48.56	23.68
9	0.03	28.76	33.08	17.34	20.82	9	0.03	17.55	10.92	45.54	26.00
10	0.03	33.09	29.58	16.00	21.32	10	0.04	14.77	17.76	37.93	29.54

Portugal						*Portugal*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	0.02	4.39	50.07	32.97	12.57	5	0.03	4.70	5.48	30.87	58.96
6	0.02	4.16	47.45	34.39	14.00	6	0.04	3.00	2.73	22.40	71.87
7	0.02	3.94	49.01	32.54	14.51	7	0.08	4.10	2.83	29.22	63.85
8	0.03	3.72	50.62	31.69	13.98	8	0.13	2.29	1.58	28.61	67.51
9	0.03	3.64	49.41	29.15	17.80	9	0.26	2.12	2.08	31.34	64.46
10	0.03	3.49	47.89	30.48	18.13	10	0.48	1.96	2.14	31.17	64.73

Spain						*Spain*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	0.03	31.79	3.41	53.07	11.73	5	0.01	17.08	40.89	28.09	13.95
6	0.04	31.08	3.22	53.91	11.78	6	0.02	15.45	37.89	33.70	12.95
7	0.04	31.36	3.29	53.82	11.53	7	0.02	18.72	31.56	29.49	20.23
8	0.04	28.11	4.50	56.61	10.79	8	0.02	18.61	31.19	32.33	17.86
9	0.04	26.65	4.67	55.17	13.51	9	0.02	19.81	30.25	31.83	18.11
10	0.04	25.05	6.30	56.14	12.52	10	0.02	20.15	29.64	32.01	18.19

UK						*UK*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	0.04	11.00	38.18	15.94	34.87	5	0.05	17.99	25.85	39.66	16.50
6	0.04	10.51	36.81	18.43	34.25	6	0.05	18.82	25.67	39.24	16.27
7	0.04	11.11	33.61	18.32	36.97	7	0.05	18.72	25.42	39.74	16.12
8	0.05	9.64	33.26	26.89	30.21	8	0.05	19.51	27.64	38.54	14.31
9	0.05	9.24	31.45	30.89	28.41	9	0.05	19.86	29.90	35.69	14.55
10	0.05	9.31	31.32	29.41	29.96	10	0.05	21.00	29.95	34.41	14.65

US						*US*					
Lags	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*	*Lags*	*S.E.*	*NEER*	*DEMAND*	*SUPPLY*	*MONETARY*
5	0.04	44.59	6.26	15.51	33.63	5	0.04	44.03	32.11	17.35	6.50
6	0.04	38.58	5.53	25.81	30.08	6	0.04	47.99	29.86	15.89	6.26
7	0.04	37.22	5.41	27.65	29.72	7	0.05	46.88	27.61	18.56	6.96
8	0.04	37.18	5.43	27.55	29.85	8	0.05	43.75	28.95	21.57	5.73
9	0.04	38.60	5.22	27.22	28.96	9	0.06	40.33	32.96	21.74	4.97
10	0.04	37.99	6.35	26.88	28.78	10	0.06	38.63	34.04	22.57	4.76

Data Sources: IMF, OECD, Bank of International Settlements

For the period before the EMU, seven lags were suggested by the AIC criteria for all countries and six lags for the period after the EMU. In order to simplify the interpretation of the shocks, I have further divided the shocks into low, medium and high with respect to the contributions to the movement in the exchange rate. The results of these are shown in figures 5.6 and 5.7 illustrated below.

Figure 5.6: Short-term Variance Decompositions

Table shows a ranking of the contributions to the movement in the Real Exchange Rate in terms of a low, medium or high level contribution

	Pre-EMU			Post-EMU		
	Demand	**Supply**	**Monetary**	**Demand**	**Supply**	**Monetary**
Austria	*High*	*Medium*	*Low*	*Low*	*High*	*Medium*
Belgium	*Low*	*High*	*Medium*	*Medium*	*High*	*Low*
Finland	*High*	*Low*	*Medium*	*Medium*	*High*	*Low*
France	*Low*	*High*	*Medium*	*Low*	*High*	*Medium*
Germany	*Low*	*Medium*	*High*	*Medium*	*Low*	*High*
Greece	*High*	*Low*	*Medium*	*High*	*Low*	*Medium*
Ireland	*Low*	*High*	*Medium*	*Medium*	*High*	*Low*
Italy	*High*	*Medium*	*Low*	*Medium*	*High*	*Low*
Netherlands	*High*	*Low*	*Medium*	*Low*	*High*	*Medium*
Portugal	*High*	*Medium*	*Low*	*Low*	*Medium*	*High*
Spain	*Low*	*High*	*Medium*	*High*	*Medium*	*Low*
UK	*High*	*Low*	*Medium*	*Medium*	*High*	*Low*
US	*Low*	*Medium*	*High*	*High*	*Medium*	*Low*

	Pre-EMU		Post-EMU
Demand	*7 High, 0 Medium, 6 low*	*Demand*	*3 High, 6 Medium, 4 Low*
Supply	*4 High, 5 Medium, 4 Low*	*Supply*	*8 High, 3 Medium, 2 Low*
Monetary	*2 High, 8 Medium, 3 Low*	*Monetary*	*2 High, 4 Medium, 8 Low*

Data Sources: IMF, OECD, Bank of International Settlements

Figure 5.7: Medium-term Variance Decompostions

Table shows a ranking of the contributions to the movement in the Real Effective Rate in terms of a low, medium or high level contribution

	Pre-EMU			Post-EMU		
	Demand	**Supply**	**Monetary**	**Demand**	**Supply**	**Monetary**
Austria	High	Medium	Low	Low	High	Medium
Belgium	Low	High	Medium	Medium	High	Low
Finland	High	Low	Medium	Low	High	Medium
France	Low	Medium	High	Low	Medium	High
Germany	Low	Medium	High	Medium	Low	High
Greece	High	Low	Medium	High	Medium	Low
Ireland	Medium	High	Low	Medium	High	Low
Italy	High	Medium	Low	Low	High	Medium
Netherlands	High	Low	Medium	Low	High	Medium
Portugal	High	Medium	Low	Low	Medium	High
Spain	Low	High	Medium	Medium	High	Low
UK	High	Low	Medium	Medium	High	Low
US	Low	Medium	High	High	Medium	Low

	Pre-EMU		Post-EMU
Demand	7 High, 1 Medium, 5 low	Demand	2 High, 5 Medium, 6 Low
Supply	3 High, 6 Medium, 4 low	Supply	8 High, 4 Medium, 1 Low
Monetary	3 High, 6 Medium, 4 Low	Monetary	3 High, 5 Medium, 6 Low

Data Sources: IMF, OECD, Bank of International Settlements

I shall analyse both the short and medium term separately. In the short-term analysis, the pre-EMU demand shocks contribute to most of the real effective exchange rate movement as shown by seven countries. In the post-EMU period, the contribution of the demand shock is now less, shown by three countries, a major reduction. However, the demand shock contributes at a medium level in none of the countries before the EMU but six in the period thereafter. The supply shocks only contribute the highest to a movement in the real effective exchange rate in four countries in the pre-EMU period but the change in the post-EMU period is that the supply shock now contributes the most to the real effective exchange rate movement in eight countries. In the case of the monetary shock, two countries contribute the most to the movement in the real effective exchange rate in the pre-EMU period. In the period after the EMU, there is no change as two countries contribute most to the exchange rate movement. There is a decline in the contribution of monetary shocks from the pre-EMU period to the post EMU period. Eight countries contribute at the medium level in the pre-EMU period, however, this is reduced to four in the period thereafter. The number of low contributing countries increases from three in the pre-EMU period to eight in the post-EMU period. After the EMU the real effective exchange rate tended to absorb demand or supply shocks rather than monetary shocks.

In the medium-term analysis, the demand shocks contribute the most in seven countries in the pre-EMU period but this is reduced to two thereafter. For the supply shock, three countries contribute to most of the real effective exchange rate movement and this rises to eight in the post-EMU period. Also, there are six countries which contribute at the medium level in the pre-EMU period, however, this is reduced to four in the period after the EMU. The monetary shock shows that in the pre-EMU period, three countries contribute the highest to the real effective exchange rate movement. This remains the same in the period after the EMU, however, there are six medium-term contributions in the pre-EMU period and five in the period after. The number of low contribution countries rises from four in the pre-EMU period to six in the period after. From the medium-term observations, there is some evidence of a decline in the contribution of monetary shocks leading to a movement in the real effective exchange rate from the pre-EMU period to the post-EMU period. Hence the conclusion here is that after the EMU the real effective exchange rate tended to absorb demand or supply shocks rather than monetary shocks.

Various studies have assessed the variance decomposition using the three shocks similar to my study. Canzoneri et al. (1996) used a two and a three variable SVAR as a vehicle for studying the stabilising role of the exchange rate. They used six countries, Austria, the Netherlands, France, Italy, Spain and the UK. Using quarterly data from 1970 to 1985, they found that nominal shocks explained most of the exchange rate movement. Funke (2000) analysed the UK in relation to euro land using quarterly data from 1980q1 to 1997q4. He used the ECU/£ exchange rate as the dependent variable and used an identification scheme based on Clarida and Gali (1994) and found that the exchange rate is driven predominantly by demand shocks. My research reaches a similar conclusion to this study in that I find that demand shocks in in seven countries in the pre-EMU period contribute the most to the movement in the real effective exchange rate. I, however, use the real effective exchange rate and not a bilateral exchange rate as used in Funke's (2000) study.

5.8 Chapter conclusions

In my examination of the trade balance reactions following a depreciation in the exchange in the pre-EMU period, I found that in seven of the eleven EMU countries, (Austria, Belgium, Finland, France, Germany, Italy and the Netherlands) the trade balance showed an improvement following a depreciation in the real effective exchange rate. A depreciation had no effect on the trade balance for the remainder. In the period after the EMU, the exchange rate depreciation tended to have a lesser impact on the trade balance in Finland, Germany and the Netherlands, however, the trade balance had a greater impact in France and Italy. In this post-EMU period, the exchange rate movements did not vary as much as in the pre-EMU period to reduce current account imbalances.

The impulse response function analysis was also conclusive, I found that most countries' shocks in the pre-EMU period were associated with high levels of exchange rate responses indicating that the real effective exchange rate was effective in absorbing demand, supply and monetary shocks. These countries stood to incur costs due to loss of the exchange rate as a policy instrument. The overall finding here is that the fulfilment of the OCA theory criterion relating to the exchange rate is endogenous to regime change. With respect to the duration of the adjustment process after the shock, the countries overall showed the process of adjustment to be less in the post-EMU period and therefore I conclude that the euro-based but country-adjusted real effective exchange rate is actually a more effective shock-absorbing variable than before when the real effective exchange rate was based on national currencies. Hence, the shock-absorbing capacity of the real effective exchange rate is considered to be endogenous to regime change.

In the variance decompositions examination overall, in the post-EMU period, the number of countries where monetary shocks contributed to the real effective exchange rate movements had fallen; whereas the number of countries with higher contributions from demand and supply shocks had increased. This shows that, in the post-EMU period, the real effective exchange rate tended to absorb demand or supply shocks rather than monetary shocks. Therefore, the loss of the exchange rate as a policy tool may not imply high costs for the EMU members to the extent that balance of payments disequilibria are caused by idiosyncratic monetary shocks. As such, there is some evidence of regime-dependent endogenous change in the effectiveness of the real effective exchange rate in absorbing monetary shocks. The declining contribution of monetary shocks in the post-EMU period indicates that the loss of national monetary policy autonomy has become less costly because the real effective exchange rate is now less necessary to act as an absorber of idiosyncratic monetary shocks.

SIX
The European labour market empirical chapter

6.1 Introduction

Mundell (1961) focused on labour mobility and wage flexibility as possible avenues for adjustment following economic shocks. Mundell did not specify whether wages were real or nominal but discussed wages in general. The main adjustment mechanism under a fixed exchange rate regime described by Mundell (1961) is that of wage flexibility to respond to shocks with an asymmetric impact on demand across the currency area. The argument is based on a simple analysis of supply, demand and the role of prices in a perfectly competitive market. Thus, if demand suddenly shifted away from the products of Country A towards Country B's products, this would cause output in Country A to fall and unemployment to rise. The increased rate of unemployment will cause workers to moderate their wage claims and therefore result in a relatively cheaper cost of production in Country A. In Country B, on the other hand, the increased demand for its goods causes unemployment to fall and as a result, its employers are faced with higher wage claims. This process will make goods produced in Country A more competitive (the cheaper labour costs can be fed through into lower prices), while the reverse is true for Country B. The overall effect of this mechanism is the same as that of an exchange rate adjustment: demand for the two countries' products is rebalanced; wage adjustments allow both economies to return to current account equilibrium. A sufficient degree of wage flexibility therefore renders a currency area optimal by allowing it to adjust to shocks and prevent long-run disequilibria.

Since large-scale labour mobility is absent as an adjustment mechanism in Europe, at least for now, concerns focus on the flexibility of labour markets, and especially wages, to establish whether the EMU labour market is able to adjust following economic shocks. While wages in Europe could not be considered upwardly rigid, a number of studies confirm the general view that the converse is true. Abraham (1994) in her study of labour market adjustment in the US and Germany found that a fall in productivity of one per cent translated into a fall in real wages of only 0.29 per cent and finds little or no relation between regional real wage levels and the unemployment rates. Even a change in regional unemployment rates does not seem to cause sufficient real wage adjustments to absorb a negative shock. There does not therefore, seem to be sufficient downward flexibility of real wages to ensure that the euro zone is an optimum currency area – thus, the EMU may not be sustainable given the current structure of member-states' economies. Downward rigidity of real wages, especially in the short run, is blamed mainly on the negotiated nature of wages, which are laid down in wage contracts, often for several years, making short-run wage variations difficult if not impossible. In the long run, wages can be lowered to a certain extent mainly in northern European countries, where labour markets are characterised by their consensus-based approach to wage setting, Abraham (1994). In her work, Abraham refers to real wages rather than nominal wages and then real wages relative to productivity. In southern European countries and France and Germany, downward real wage rigidity tends to persist even in the long-run. This downward shift in the wage share, particularly in Germany would suggest that real wages fall relative to productivity. Many observers, (for example Babecky et al (2009) in the study on institutional factors' determination of wage rigidity; Dickens et al. (2007) who analysed data from sixteen European countries between the 1970s and 2000s; Holden and Wulfsberg (2007 and 2008) in their study of strict employment protection and high levels of unionisation in OECD nineteen countries) estimate that in these countries, a large part of unemployment is caused by institutional rigidities such as burdensome wage negotiations and employment regulations rendering labour markets less flexible, Abraham (1994).

The tasks

In the next sections, I carry out two types of empirical investigations to establish the extent of labour market flexibility before and after the EMU. First, I use a reduced-form vector auto-regressive (VAR) model to assess the reactions of employment, unemployment and real wage growth rates to a change in real GDP. I use the real GDP growth rate as the 'shock' variable. I assume that the real GDP growth shock represents exogenous shocks to labour demand - following the study by Prasad (1998). This implies that short-run variation in aggregate labour market quantities and prices is primarily determined by labour demand shocks. The resulting coefficients will enable me to establish the relative flexibility of the European labour market by calculating and examining the resulting coefficients. In this part of the study, I apply a positive demand shock (using the real GDP growth rates for the demand shock variable). A high coefficient suggests a flexible labour market whereas a low coefficient would suggest an inflexible labour market. Secondly, I estimate impulse response functions to assess whether the adjustment in the labour market is realised via the employment/unemployment channel or the real wage channel. If real wages adjust more than unemployment, then the cost in a monetary union should be reduced as rates of unemployment are less affected by shocks. I also examine the speed of adjustment of the real wage variable because this is an important factor in the adjustment process. The speed at which wages fall determines the extent to which the cost of unemployment can be avoided. If prior to monetary union, countries showed unemployment to be the less important factor in the adjustment process but wages became the more prominent avenue for adjustment, then I can conclude that the fulfilment of the OCA's labour market flexibility criterion is endogenous to regime change. By studying the pre and post-EMU periods, I can determine if there has been a switch from an unemployment channel in the pre-EMU period to a wage channel in the post-EMU period (indicating that the countries have followed the new 'rules of the game') and hence assess if the process has indeed been endogenous to regime change.

6.2 The labour market flexibility debate: A few theoretical and methodology issues

The effects of monetary integration in the labour markets carry a number of theoretical/ methodological problems and underpinnings. Labour market institutions are indeed at the core of interest in most of the recent studies analysing the impact of monetary integration on the real side of the EMU economies, Tyrowicz (2009). A very important distinction has to be made. There are two separate dimension of this analysis: (i) the effect on the flexibility of nominal wages in the case of macroeconomic shocks, and thus on the cyclical sensitivity of employment and output; and (ii) the effect on equilibrium real wages, and thus on equilibrium unemployment. On the other hand, monetary union can have two types of effects: direct (by altering incentives for all agents within the existing institutions) or indirect (by altering institutions), Tyrowicz (2009).

The Blanchard and Katz model

My empirical strategy is to use vector autoregression techniques to perform a multivariate analysis of aggregate labour market adjustment for each country. The methodology is similar to that employed by Blanchard and Katz (1992) who study state-level labour market dynamics in the United States. Prasad (1998) also used this strategy in his analysis of labour market adjustment in the United States and Canada. The Blanchard and Katz (1992) model specification allows for all forms of adjustment, including labour mobility. Many economists have adopted the employment, unemployment and nominal and real wage models as a benchmark in their analyses of adjustments within labour markets but have modified the models to their own specifications. Blanchard and Katz (1992) produced two basic models. They began with a full employment model, (the authors do not state what is meant by 'full employment' at sectoral level especially as full employment is rarely achieved, however, they use this assumption to facilitate the explanation of their models) then subsequently produced a second model allowing for unemployment and other extensions. In their examinations, they discuss wages in nominal terms. In the model, they thought of each state as producing, at any point in time, a given bundle of products. Production takes place under constant returns to labour, meaning that average product of labour is constant and the demand for each product is downward sloping. Blanchard and Katz (1992) point out that in states that become attractive to workers, there begins a steady flow of workers to that state which leads to a lower nominal wage, which in turn triggers a steady flow of new jobs and sustains growth. This is the generation of the relationship between wages and employment. In their simple model, they specify the demand for labour in state *i* at time, *t* as,

$$w_{it} = -dn_{it} + z_{it}, \tag{6.1}$$

where w_{it} is the relative wage, n_{it} is relative employment, and z_{it} is the position of the labour demand curve. All variables are in logarithms and measured relative to their relative U.S. counterparts. The coefficient d is positive, reflecting the downward sloping demand for each product. Under the assumption of full employment, employment n_{it} is given at any point in time, so that movements in z translate into movements in w. Those movements in wages, however, trigger two adjustment mechanisms involving workers and products. These are captured in their two other assumptions. They first formalise the movement in z as,

$$z_{i,t+1} - z_{it} = -aw_{it} + x_{di} + \epsilon^{d}_{i,t+1}, \tag{6.2}$$

where x_{di} is a constant, $\epsilon^{d}_{i,t+1}$ is white noise, a is a positive parameter and x_{di} is the drift term which captures the drift in demand for individual products. Consider first the case where a is equal to zero, which corresponds to the case where each state keeps the same bundle of products over time. Demand for individual products grows at different rates and shocks to relative demand are for the most part permanent. Different products experience technological progress at different rates and relative technological shocks are also for the most part permanent. Thus relative derived demands for labour for each product are likely to have both a unit root and a drift component. If states produce fixed bundles of goods, those properties will translate to state-relative derived demands for labour. This is what the above equation yields when a is equal to zero. Given the wage, the derived demand for labour in state i follows a random walk with drift. The authors refer to ϵ^{d}_{it} as the innovation to labour demand.

The authors assume that location/creation decisions also depend on wages. This is what is captured by the parameter a: everything else being equal, lower wages makes a state more attractive. Firms' location decisions are a function of current and future expected wages. The obvious implication is that firms will respond less to current wages if wages are expected to return to their state-specific mean. The authors then formalise the movement of the labour force, n as,

$$n_{i,t+1} - n_{it} = bw_{it} + x_{si} + \epsilon^{s}_{i,t+1}, \tag{6.3}$$

where x_{si} is a constant, ϵ^{s}_{it} is white noise, and b is a positive parameter. The above equation allows migration to depend on three terms: the relative wage, a drift term, and a stochastic component. The drift term, x_{si}, captures amenities, those non-wage factors that affect migration. The term ϵ^{s}_{it+1} captures movements in exogenous migration such as changes in immigration laws that lead to increased migration. The authors refer to ϵ^{s}_{it} as the innovation in labour supply. The wage term captures the effects of wages on migration.

Under the assumptions, states exhibit different growth rates. Supply and demand innovations permanently affect employment. Average relative wages differ across states, but relative wages are stationary. To see this, Blanchard and Katz (1992) can solve for wages to get:

$$w_{i,t+1} = (1 - db - a)\, w_{it} + (x_{di} - dx_{si}) + (\epsilon^d_{i,t+1} - d\epsilon^s_{i,t+1}), \tag{6.4}$$

so that the average relative wage is given by,

$$\overline{w}_i = (1/(a + db))\, x_{di} - (d/(a+db))\, x_{si}. \tag{6.5}$$

employment can be solved to get,

$$\Delta n_{i,t+1} = (1 - db - a)\, \Delta n_{it} + (bx_{di} + ax_{si}) + (b\epsilon^d_{i,t+1} + \epsilon^s_{i,t+1} - (1-a)\, \epsilon^s_{it}), \tag{6.6}$$

so that trend employment growth is given by,

$$\overline{\Delta n}_i = (b/(a + db))\, x_{di} + (a/(a + db))\, x_{si}. \tag{6.7}$$

As long as there is either labour or product mobility (a or b > 0), relative wages follow a stationary process around state-specific means, with the innovations to labour demand and to labour supply as forcing terms.

Blanchard and Katz now relax the assumption that wages adjust so as to maintain full employment. Under any realistic description of wage determination, the adjustment process is likely to involve movements in unemployment, as well as in wages. To capture that, they modify the model as follows:

$$\begin{aligned} w_{it} &= -d(n^*_{it} - u_{it}) + z_{it}; \\ cw_{it} &= -u_{it}; \\ n^*_{i,t+1} - n^*_{it} &= bw_{it} - gu_{it} + x_{si} + \epsilon^s_{i,t+1}; \\ z_{i,t+1} - z_{it} &= -aw_{it} + x_{di} + \epsilon^d_{i,t+1}. \end{aligned} \tag{6.8}$$

The variable n_{it}* stands for the logarithm of the labour force in state *i* at time *t*, and u_{it} is the unemployment rate in state *i* at time *t*, defined as the ratio of unemployment to employment, so that the logarithm of employment is approximately given by n_{it}* - u_{it}. Their specification of labour demand in the first equation is the same as before, but is now expressed as a relation between unemployment and the wage, given the labour force. The second equation states that in the simplest possible way, higher unemployment leads to lower wages. The third equation allows labour mobility to depend not only on relative wages, but also on relative unemployment.

The Blanchard and Katz (1992) model inspired Prasad (1998) to derive a system of equations shown below. Prasad (1998) studied labour market adjustment in the United States and Canada. He made the assumption that employment growth shocks represent exogenous shocks to labour demand. This implies that short-run variation in aggregate labour market quantities and prices is primarily determined by labour demand shocks. He analysed below the relationship between employment growth, wage growth and the employment rate using the following system of three equations:

Employment model: $\Delta\%e_t = \alpha_0 + \alpha_1\Delta\%e_{t-1} + \alpha_2\Delta\%w_{t-1} + \epsilon_{1t}$ (6.9)

Wage model: $\Delta\%w_t = \alpha_0 + \alpha_1\Delta\%e_{t-1} + \alpha_2\Delta\%w_{t-1} + \alpha_3 ur_{t-1} + \alpha_4\Delta\%prod_{t-1} + \epsilon_{2t}$ (6.10)

Unemployment model: $ur_t = \alpha_0 + \alpha_1\Delta\%e_{t-1} + \alpha_2\Delta\%w_{t-1} + \alpha_3 ur_{t-1} + \alpha_4 ui_{t-1} + \epsilon_{3t}$ (6.11)

where Δe is the aggregate employment growth rate; Δw denotes average real wage growth; $\Delta prod$ is labour productivity growth; ur is the aggregate unemployment rate; ui is the unemployment insurance index; and ‘t’ is the index for time. To control for supply effects, he includes labour productivity growth as a determinant of real wage model. This system of equations inspired me to adopt the same methodology, however, I have innovated by using real GDP variable for labour demand. I have also included the inflation rate (calculated as the quarterly per cent change from the CPI data) for each of the calculations. The inclusion of the inflation rate in my analysis is due to the relationship between inflation and employment. If the rate of inflation is rising, countries may become less competitive thus reducing output and employment. Hence the inflation rate is an important variable in these calculations. The results can be seen in figure 6.1. For my regressions where I use the real wage rate, in order to obtain the real wage rate, I have divided the nominal wage by the price level then calculated the per cent change. The results of these are in figure 6.2.

My inspiration to use real GDP arose as a labour demand variable arises from the study by Akkemik (2007) who examined the response of employment to GDP growth in Turkey.

Akkemik (2007) in his paper stated that the macroeconomic relation between economic growth and employment has been a focus of concern. The famous Okun's law, for instance, related positive GDP growth with a decline in the unemployment rate. It is important to note that the Blanchard and Katz model analysed one US state relative to the other. My model recognises and analyses the EMU members individually.

One OCA theory criterion suggests that wages should be sufficiently flexible in the advent of economic shocks and that wage flexibility may be a substitute for exchange rate for countries in a monetary union, Mongelli (2008). If in a response to increasing unemployment, local wages and consequently prices of domestic products fall, the competitiveness of that country should improve. Therefore the speed at which the real wages fall determines unemployment costs of asymmetric shocks in a monetary union. Implications of OCA theory for empirical work are straightforward. Countries with more flexible real wages are better prepared to enter a union. Countries with real wage rigidities should consider whether benefits from the EMU participation outweigh possible costs due to labour market maladjustments. Also, did the EMU countries converge to similar wage bargaining behaviour after the EMU and also, which countries behaved differently in the new regime?

6.3 The variables

For all the variables, I indicate what they measure and where they are used. The examinations are in two parts: (i) the reduced-form VARs and; (ii) the impulse responses functions estimation. All the variables I use in the reduced-form VAR are growth rates. The variables I use in the impulse responses are also growth rates. For the reduced-form VARs, I use the employment rate, unemployment rate, real wage rate, employment protection and the productivity growth rate. In addition, for the VAR estimation I have taken the real GDP growth rate to represent the change in labour demand. For the impulse response functions examination, I use employment, unemployment and wages. Here, real GDP is used to represent the 'shock' variable.

The employment rate

The employment rate is taken from the Eurostat statistics database and is the number of people employed as a percentage of the labour force. I use this data as the dependant variable in the reduced-form VAR regressions to estimate employment flexibility. The earliest data commences in 1992. Employment growth is the reference indicator to measure the overall employment levels and the trends of persons employed. Comparability across countries is considered as high. Quarterly data for the euro area and the European Union are derived from all countries for which the respective quarterly data are available. All the available quarterly data from member-states are summed up in order to calculate indicators to be used for the estimation of euro area and European Union aggregates. No data was available for the US from Eurostat for the employment growth rate.

The unemployment rate

These data are taken from Eurostat and are reported quarterly. I use this as the dependent variable in the reduced-form VAR regressions to estimate unemployment flexibility. I also use the unemployment rate as one of the explanatory variables in my estimation of the wage rate flexibility. The unemployment rate is the number of people unemployed as a percentage of the labour force. The labour force is the total number of people employed and unemployed. The data are calculated on a monthly basis. Eurostat checks the quality and consistency of data transmitted by National Statistical Institutes. Eurostat calculates Labour Force Survey results and they are then validated by the Member-states.

Real GDP and real GDP growth rate (please see section 4.2 on real GDP variable explanation)

The real GDP growth rate is used as the labour demand variable in the reduced-form VAR regressions. In the impulse response functions analysis, I use the real GDP growth rates as the labour demand variable.

Employment Protection (Unemployment insurance)

These data are taken from the OECD statistical database and are reported quarterly. The employment protection is proxied by the ‘strictness of employment protection’ data. I use this variable as one of the explanatory variables in the estimation of the unemployment rate regressions. The OECD indicators of employment protection measure the procedures and costs involved in dismissing individuals or groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts. The indicators have been compiled using contributions from officials from OECD member countries and selected emerging economies and advice from labour law experts from the International Labour Organisation (ILO).

Real Wages (OECD Hourly earnings Manufacturing Index 2005=100)

These data are extracted quarterly from the OECD statistics database. I use this as the dependant variable in my estimation of wage flexibility and in the impulse response function analysis (IRFs). I also use this as one of the explanatory variables in my estimation of both the employment and unemployment rate flexibility. The real wage rate is usually calculated as nominal wage divided by the price index for each country. The data includes earnings series in manufacturing and for the private economic sector. Mostly the sources of the data are business surveys covering different economic sectors, but in some cases administrative data are also used. The target series for hourly earnings correspond to seasonally adjusted average total earnings paid per employed person per hour, including overtime pay and regularly recurring cash supplements.

The Consumer Price Index (Please see section 4.2)

Productivity (see section 5.3)

These data are used as one of the explanatory variables in my estimation of wage flexibility in the VAR regressions. I use the quarterly per cent change for my regressions.

6.4. The empirical results: Growth rates reduced VAR regressions

Stationary tests are not conducted here as growth rates are stationary. Prior to calculating the reduced-form VAR coefficients, I calculate the lag length criteria required for the regressions. The results of the lag lengths are show in figure 39. The results for the reaction to an increase in the real GDP growth rate are shown below. I indicate the statistical significance for each coefficient with one star denoting statistical significance at the five per cent level and two stars denoting statistical significance at the ten per cent level. Figure

6.1 shows the employment and unemployment reactions to an increase in the real GDP growth rate. Figure 6.2 shows the effects of a real GDP shock on the real wage rate.

Figure 6.1: The summary figure below shows the effects of a real GDP shock on the Employment and Unemployment rate

Multivariate analysis of labour market adjustments in 12 countries for the two time periods
The table shows the resulting coefficients for the reaction of employment and unemployment following an increase in the real GDP growth rate. The table also shows the real effect (the inflation rate)

Employment

Country	***Before EMU***			***After EMU***	
	gdp(t-1)	*cpi(t-1)*		*gdp(t-1)*	*cpi(t-1)*
Austria	*0.039*	*-0.067*	*Austria*	*0.176**	*-0.154*
Belgium	*0.316*	*-1.955*	*Belgium*	*-0.005*	*-0.355*
Finland	*0.156**	*-0.096*	*Finland*	*0.127**	*-0.010*
France	*0.235**	*0.010*	*France*	*0.108**	*0.010*
Germany	*0.005*	*-0.416**	*Germany*	*0.072*	*0.192*
Ireland	*-0.312*	*1.433*	*Ireland*	*0.061**	*-0.264***
Italy	*0.068***	*-0.130*	*Italy*	*0.064***	*-0.048*
Netherlands	*-0.630*	*-1.064*	*Netherlands*	*0.256**	*-0.214*
Portugal	*0.261**	*-0.338*	*Portugal*	*0.067**	*-0.030*
Spain	*-0.007*	*0.200**	*Spain*	*0.004*	*0.055*
UK	*0.092**	*-0.016*	*UK*	*0.099**	*0.009*
US	*0.079***	*-0.067*	*US*	*0.145**	*-0.102*

Unemployment

Country	***Before EMU***			***After EMU***	
	gdp(t-1)	*cpi(t-1)*		*gdp(t-1)*	*cpi(t-1)*
Austria	*0.210*	*-0.039*	*Austria*	*-0.619**	*-0.141*
Belgium	*-0.077**	*0.024*	*Belgium*	*-0.621***	*-0.041*
Finland	*-0.133**	*-0.194***	*Finland*	*-0.039**	*0.005*
France	*-0.1138*	*0.040*	*France*	*-0.131**	*-0.011*
Germany	*0.001*	*0.015*	*Germany*	*-0.120**	*-0.007*
Ireland	*-0.138**	*0.267*	*Ireland*	*-0.073**	*0.040*
Italy	*-0.337*	*0.003*	*Italy*	*-0.959**	*0.056*
Netherlands	*-0.128**	*0.188*	*Netherlands*	*-0.104**	*-0.014*
Portugal	*-0.790**	*-0.033*	*Portugal*	*-0.416**	*0.046*
Spain	*-0.128**	*-0.176***	*Spain*	*-0.117**	*0.023*
UK	-0.127*	*-0.040*	*UK*	*-0.090**	*0.0004*
US	*-0.098**	*0.192**	*US*	*-0.123**	*0.030*

Data Sources: Eurostat, OECD, Datastream

** Denotes significance at the 5 per cent level*
*** Denotes significance at the 10 per cent level*

Figure 6.2: The summary figure below shows the effects of a real GDP shock on the real wage rate.

Multivariate analysis of labour market adjustments in 12 countries for the two time periods
The table shows the resulting coefficients for the reaction of the real wage rate (nominal/price level) following an increase in the real GDP growth rate

Real Wages (using nominal/price level)

Before EMU		***After EMU***	
	gdp(t-1)		*gdp(t-1)*
Austria	*0.260*	*Austria*	*1.325*
Belgium	*0.306*	*Belgium*	*0.309**
Finland	*0.478**	*Finland*	*-0.051*
France	*0.386**	*France*	*-1.229*
Germany	*0.284*	*Germany*	*0.346*
Ireland	*0.546*	*Ireland*	*0.327*
Italy	*0.065*	*Italy*	*0.524*
Netherlands	*0.582*	*Netherlands*	*0.708*
Portugal	*0.081*	*Portugal*	*-0.515*
Spain	*0.329*	*Spain*	*1.084*
UK	*0.030*	*UK*	*0.216*
US	*-0.076*	*US*	*0.214**

Data Sources: Eurostat, OECD, Datastream

** Denotes significance at the 5 per cent level*
*** Denotes significance at the 10 per cent level*

The principal mechanisms involved in equilibrating the labour market in response to exogenous shocks include wage adjustment, changes to employment levels and changes to unemployment rates. The relationship between a positive increase in real GDP to the employment rate is positive (employment increases when demand increases); negative between unemployment and real GDP (unemployment decreases when demand increases) and positive between nominal wages and real GDP (wages increases in a new round of wage bargaining when demand increases).

In this analysis, Greece has been omitted as data were unavailable. For the employment results Austria, Belgium, Germany, Ireland, the Netherlands and Spain show no statistical significance at the five or ten per cent statistically significant levels in the pre-EMU period. Only Belgium, Germany and Spain show no statistical significance in the period after the EMU. Of the series which show levels of significance in both periods, France shows a decrease in the employment growth rate with a coefficient before the EMU of 0.235 and 0.108 after following an increase in the real GDP growth rate. Finland, Italy and Portugal show lower coefficients in the post-EMU period. Finland and Italy show slightly lower coefficients, however, Portugal's coefficient is a larger decrease from a pre-EMU coefficient of 0.261 to 0.067 thereafter. The UK also shows a slight increase in the employment coefficient from a pre-EMU coefficient of 0.092 to a post-EMU coefficient of 0.099, both coefficients are statistically significant at the five per cent level. In the period after monetary union, nine countries sampled showed statistically significant levels. The effects of real GDP on employment can be summarised as follows. First, the cross-country variation in the estimated effects generally remains similar both before and after the EMU. In Finland, Germany, Italy, Spain and the UK, the coefficients showed little change. Hence, the employment effect of real GDP tended to remain country-specific in both periods, with the implication that labour market adjustment through the employment channel may not be endogenous to regime change. Secondly, adjustment through the employment channel has become less prominent (i.e., the estimated coefficients are generally smaller) in eight countries after the EMU: Belgium, Finland, France, Ireland, Italy, the Netherlands, Portugal and Spain. However, it has become more substantial in four countries: Austria, Germany, UK and the US. These results reinforce the previous conclusion that labour market adjustment to real GDP shocks may not be endogenous to regime change.

The impact of an increase in real GDP on the unemployment rate is more conclusive. The coefficients in the period before the EMU are more varied, ranging from -0.001 (for Germany) to -0.79 (for Portugal). In the period after the EMU, Austria, Belgium, France, Germany, Italy and the US show higher coefficients. All the countries showed a statistical significance level at either the five or ten per cent. Of the countries sampled only Finland, Ireland, the Netherlands Portugal, Spain and the UK show lower coefficients after the EMU. The effects of real GDP on unemployment can be summarised as follows. An increase in real GDP results in falls in the rates of unemployment – both before and after the EMU. The effects of the real GDP shock tend to be smaller in the post-EMU period than the pre-EMU period as shown by six of the countries sampled. The adjustments in Austria, Belgium, France, Germany, Italy and the US are more prominent in the post-EMU period (as shown by the larger coefficients). These countries adjust through the unemployment channels in the period after the EMU more than in the period before. The UK and the US show statistically significant values in both periods however, the coefficient is smaller in the UK but slightly larger in the US. The UK shows that the adjustment through the unemployment channel was less prominent after the EMU, however, the US differs with the adjustment in unemployment being more prominent.

The impact of an increase in real GDP on the real wage is shown in figure 6.2. Here, there are fewer coefficients of statistical significance. Finland, France (pre-EMU), Belgium and the US (post-EMU) are the only countries showing statistically significant coefficients. For Finland, the pre-EMU coefficient is 0.478 and for France the coefficient is 0.386. The post-EMU coefficient in Finland, however, is lower but negative, however, France shows a higher negative coefficient. These post-EMU coefficients are not statistically significant at either the five or ten per cent levels. The real GDP shock after the EMU in these two countries results in a decrease in Finland and increase in France although the coefficients are not statistically significant. Belgium shows a coefficient of 0.306 before the EMU, (not statistically significant) however, the coefficient is marginally higher at 0.309 and statistically significant in the period after the EMU. For this real wage calculation method, the effects of a real GDP shock can be summarised as follows. The coefficients tended to be higher in the post-EMU period indicating that the labour market adjustment through the real wage channel may not be endogenous to regime change. The countries which exhibit higher coefficients are Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal, Spain, the UK and the US. Both the UK and the US also show a flexible wage clearing labour market as shown by the higher coefficients in the period after the EMU.

Because many of the coefficients are not statistically significant, it is difficult to reach a solid conclusion relating to the flexibility of real wages after the structural break. Indeed, some of the coefficients do not follow the expected outcome in terms of the sign. These findings are not sufficient to arrive at a definite conclusion about whether labour market adjustment is endogenous to regime change or not. In light of these results, it is important to move to the next task which uses impulse response functions to provide a much more comprehensive analysis of any endogenous process. The IRF analysis allows for a much more detailed study because it enables me to trace the path of the shock in terms of both its magnitude and duration.

6.4.1 Orthogonalised Impulse Response Functions (IRFs)

In order to effectively trace the path of the shocks and provide a more conclusive assessment of the responses to changes in demand, I run impulse response functions in this section. Recent theoretical work has argued that monetary uncertainty may have some positive effects when it influences the behaviour of other macroeconomic players, Gruner et al. (2005). Accordingly, monetary uncertainty may lead to wage restraint and hence to lower inflation and unemployment. If labour unions cannot be certain how their wage setting behaviour will affect the central bank's behaviour, they tend to be less aggressive and more cautious in formulating wage demands. According to this argument, risk-averse labour unions take into account that increased wage demands could lead to a higher variance of inflation and employment when the central bank's reaction is less predictable. Therefore, ambiguous monetary policy reduces wage inflation if wage setting is coordinated. This theoretical argument has so far not been scrutinised empirically.

The IRF results

Here, I apply and produce the results for a one per cent negative shock GDP to employment, unemployment and real wages. In this assessment, I am interested in responses to asymmetric shocks. I therefore consider developments for each member state that diverge from the euro area average. For example, relative variation in annual French employment is the difference between the variation in annual French employment and the variation in annual employment for the euro area as a whole. I adopt this for unemployment and real wages also. Having retrieved the data, I generate the first difference for the VAR. The VAR models use the same variables as I outlined earlier from the Blanchard and Katz (1992) models for employment, unemployment and wages. I am interested in determining the maximum magnitude of the shocks and the length of time taken for the effect of the shock to 'die out'. As this is a temporary shock, two lags are sufficient (see the previous chapters on IRFs) to trace the path of the shock. I again use a maximum of ten periods as this is a temporary shock to the system. The expected signs of the coefficients are the opposite to the reduced-form VAR outlined earlier. A negative shock to employment and real wages produces a negative coefficient whilst a negative shock to unemployment produces a positive coefficient. Here, Greece is omitted from the analysis as no wage data were available. The US is not analysed here as it is does not experience the same shocks as Europe. In the analysis, all countries experience the same real GDP shock and the results of these are provided in figure 6.3 below.

Figure 6.3: IRF summary (responses to employment, unemployment and real wages)

The table shows the responses of Employment, Unemployment and Wages in 11 countries following a temporary one per cent negative real GDP shock between two sub periods, 1988q1 and 2008q4

Employment

	Pre EMU			After EMU				
Country	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Effect higher /lower after EMU*	*Adjustment Longer/Shorter after EMU*
Austria	*-0.84*	*2*	*6*	*-0.26*	*3*	*5*	*Lower*	*Shorter*
Belgium	*-0.7*	*3*	*4*	*-0.07*	*1*	*9*	*Lower*	*Longer*
Finland	*-0.71*	*2*	*5*	*-0.26*	*1*	*3*	*Lower*	*Shorter*
France	*-0.76*	*2*	*4*	*-0.29*	*1*	*1*	*Lower*	*Shorter*
Germany	*-0.71*	*2*	*8*	*-0.16*	*1*	*7*	*Lower*	*Shorter*
Ireland	*-0.48*	*2*	*7*	*-0.32*	*1*	*1*	*Lower*	*Shorter*
Italy	*-0.87*	*2*	*7*	*-0.31*	*1*	*3*	*Lower*	*Shorter*
Netherlands	*-0.21*	*2*	*3*	*-0.31*	*1*	*4*	*Higher*	*Longer*
Portugal	*-0.8*	*2*	*6*	*-0.35*	*1*	*1*	*Lower*	*Shorter*
Spain	*-0.84*	*2*	*3*	*-0.063*	*1*	*5*	*Lower*	*Longer*
UK	*-1.12*	*2*	*8*	*-1.09*	*1*	*6*	*Lower*	*Shorter*

Unemployment

	Pre EMU			After EMU				
Country	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Effect higher /lower*	*Adjustment Longer/Shorter*
Austria	*1.1*	*1*	*4*	*0.11*	*1*	*7*	*Lower*	*Longer*
Belgium	*0.99*	*1*	*4*	*0.027*	*1*	*7*	*Lower*	*Longer*
Finland	*0.106*	*1*	*4*	*0.15*	*1*	*7*	*Lower*	*Longer*
France	*1.2*	*1*	*3*	*0.85*	*2*	*5*	*Lower*	*Longer*
Germany	*1.1*	*1*	*3*	*0.34*	*1*	*3*	*Lower*	*No change*
Ireland	*0.94*	*1*	*3*	*0.18*	*1*	*3*	*Lower*	*No change*
Italy	*0.93*	*1*	*3*	*0.17*	*1*	*7*	*Lower*	*Longer*
Netherlands	*0.63*	*1*	*3*	*0.11*	*1*	*3*	*Lower*	*No change*
Portugal	*1.03*	*1*	*3*	*0.31*	*1*	*2*	*Lower*	*Shorter*
Spain	*0.13*	*1*	*3*	*0.54*	*2*	*4*	*Lower*	*Longer*
UK	*1.2*	*1*	*5*	*0.7*	*2*	*4*	*Lower*	*Shorter*

Wages

	Pre EMU			After EMU				
Country	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Maximum effect (per cent)*	*Lag time*	*Length of adjustment process (lags)*	*Effect higher /lower*	*Adjustment Longer/Shorter*
Austria	*-0.44*	*1*	*2*	*-1.32*	*1*	*2*	*Higher*	*No change*
Belgium	*-0.42*	*1*	*4*	*-1.7*	*1*	*1*	*Higher*	*Shorter*
Finland	*-1.8*	*1*	*3*	*-1.3*	*3*	*2*	*Lower*	*Shorter*
France	*-0.73*	*1*	*7*	*-0.21*	*4*	*3*	*Lower*	*Shorter*
Germany	*-1.4*	*2*	*3*	*-1.6*	*2*	*3*	*Higher*	*No change*
Ireland	*-0.82*	*1*	*6*	*-3.2*	*1*	*5*	*Higher*	*Shorter*
Italy	*-0.35*	*3*	*3*	*-0.07*	*2*	*2*	*Lower*	*Shorter*
Netherlands	*-0.73*	*1*	*6*	*-0.09*	*3*	*2*	*Lower*	*Shorter*
Portugal	*-0.54*	*4*	*3*	*-2.9*	*3*	*3*	*Higher*	*No change*
Spain	*-0.82*	*2*	*4*	*-1.4*	*3*	*6*	*Higher*	*Longer*
UK	*-0.9*	*1*	*5*	*-0.6*	*2*	*4*	*Lower*	*Shorter*

Data Sources: Eurostat, OECD, Datastream

The employment variable results show that in ten of the eleven EMU countries, a negative demand shock after a monetary union affects the countries' employment levels less shown by the fact that the magnitude of the coefficients are lower. The individual IRF graphs are shown on figures 50 and 51 in the appendix. The effects of a shock in the unemployment variable are lower for all countries after the EMU. Unemployment levels adjust more in the period before monetary union. In the real wage variable, four of the eleven EMU countries show that real wages in a monetary union adjust to a lesser extent. Austria, Belgium, Germany, Ireland, Portugal and Spain show that after the EMU, real wages react more than in the previous period which implies that real wages were more flexible after 1999 in these countries.

Real wages versus unemployment channels of adjustment

The figure below shows a real wages versus unemployment analysis for both sub periods and indicates which variable played the greater role in the adjustment process. Figure 6.4 is derived from the IRF summary figure for the three induced shocks.

Figure 6.4

Analysis of Wages versus Unemployment in 11 countries in the pre and post-EMU periods
The analysis shows the variable (wages or unemployment) which reacts with the higher magnitude following a one per cent negative real GDP shock and thus played the greater part in the adjustment process

Country	*Pre EMU*	*Post EMU*
Austria	*Unemployment*	*Wages*
Belgium	*Wages*	*Wages*
Finland	*Wages*	*Wages*
France	*Unemployment*	*Unemployment*
Germany	*Wages*	*Wages*
Ireland	*Unemployment*	*Wages*
Italy	*Unemployment*	*Unemployment*
Netherlands	*Wages*	*Unemployment*
Portugal	*Unemployment*	*Wages*
Spain	*Wages*	*Wages*
UK	*Unemployment*	*Unemployment*

Data Sources: Eurostat, OECD, Datastream

In the period before the EMU, real wages played the greater part in the adjustment process in Belgium, Finland, Germany, the Netherlands and Spain. In my examination, Austria, France, Ireland, Italy, Portugal and the UK, the unemployment variable played the greater role in the adjustment process. This examination shows that there was an overall process of endogenous behaviour in the seven countries where real wages play the prominent role in the adjustment process. The seven countries show that wage bargaining coordination policies provided an endogenous process after the EMU. Only France, Italy, the Netherlands and the UK shows evidence of unemployment being the greater adjustment variable. Next, I identify the reasons for this.

In the Netherlands, wage growth in the sheltered sectors increased substantially when favourable economic conditions arose, namely a drop in unemployment and increases in labour demand, because employers could not tie wage demands in these sectors to more competitive sectors. The Netherlands' state-sponsored coordination system failed to keep wage growth under control in prosperous times. Only in 2003, during an economic slump were employers able to use a reactive social pact to enforce wage moderation on all sectors.

The French labour market is characterised by typical European institutions of wage-setting, namely a low unionisation rate but a very large coverage of collective agreements, a multi-level wage bargaining process with a strict hierarchy among these levels, and a significant proportion of minimum-wage workers. In France unions are very weak and by most accounts too weak to count for much in collective bargaining. The wage bargaining system is largely organised around the needs of the large firms in France, who set wages for their workers as a function of relative real unit labour costs, or, put differently, taking into account relative productivity of the French plants in their multinational organisation. These wages are then proposed to the unions in branch-level bargaining rounds, and extended by the Ministry of Labour to cover the sector as a whole, Hancke (2002).

My results on Italian wage behaviour is consistent with Posen and Gould (2006) who investigated the EMU effect on wage restraint—the degree to which wage increases do or do not exceed productivity growth. They found that Italy showed a substantial increase in wage restraint following the formation of the EMU. There are a set of theories which discuss the determinants of wage restraint which are proposed by monetary economists and central bankers suggesting positive structural effects from the EMU (e.g., European

Monetary Institute 1998). This set of theories apply to the Italian labour market. In this framework, in economies where the central bank's commitment to price stability was less than credible, unions and workers had less incentive to take into account the costs of their own pursuit of inflationary nominal wage settlements. On the one hand, their real wages were more likely to be eroded by increases in inflation, which would arise out of others' wage and price expectations (and negotiations), so union negotiators would feel they had more at risk from wage restraint; on the other hand, the likelihood of short-term costs to employment from "excessive" wage settlements would be lower because the central bank would be less credible in its threats to tighten policy should wage pressures rise. This is the converse of the Bundesbank story behind the first set of theories discussed and as such is usually thought of as applying to Italy, for example, in the post-war period through the 1970s (or later). A rise in the credibility of central banks' commitment to price stability should therefore induce greater wage restraint by reducing the fear that restraint will be self-defeating and increasing the fear that the central bank will not accommodate nominal wage increases. This theory's empirical prediction is that wage restraint should increase most for those countries that have the greatest increases in monetary credibility, whether through membership in the EMU or through other means (such as the adoption of an inflation target).

I also examine the speed of adjustment by taking the lag time of the highest magnitude of the response. This is seen in the IRF summary figure for the three induced shocks. A longer lag time suggests a slower speed of response to a shock whereas a shorter lag time suggests a quicker response. Of the EMU countries, the speed of response of real wages in the period before the EMU in Ireland, Portugal and Spain is slower than the speed of the unemployment variable. My results show that Austria, Ireland and Portugal switched to wages being the greater adjustment channel after the EMU from unemployment in the period before. In Belgium, Finland, Germany and Spain, real wages in the period before and after the EMU became the greater adjustment channel. In total, seven of the eleven countries examined show that the fulfilment of the OCA theory criteria is endogenous to regime change from this analysis.

Girardi and Paruolo (2010) studied real wages and prices in Europe before and after monetary union in the UK, Germany, France, Spain and Italy and found that the speed of adjustment of unemployment and wages is on average faster for the EMU countries in the EMU period. This may reflect some of the anticipated positive effect of the monetary union over national labour markets and price-level adjustment. For the UK, unemployment and wages have a similar speed of adjustment before and after the onset of the EMU. Their findings relating to the speed of adjustment is similar to my study. The UK, Germany, France and Italy in the period after monetary union show the speed of adjustment is quicker although slower in Spain. The speed of adjustment of real wages in my study in the UK is quicker although slower in Germany and Spain but the same in Italy and France. Girardi and Paruolo (2010) used a system of generalised impulse response functions. This method is slightly different to mine in that the orthogonalised impulses I use takes into account the causality of one variable affecting another. The results overall in both studies are similar. Girardi and Paruolo (2010) conclude that the EMU appears to have had the effect of bringing the EMU countries more in line with one another.

Dellas and Tavlas (2003) studied nominal wage rigidities and compared monetary union to flexible exchange rates in an asymmetric, three-country model with active monetary policy. Unlike the traditional OCA literature, they found that countries with high nominal wage rigidities benefit from monetary union, especially when they join other similarly rigid countries. Countries with relatively more flexible nominal wages lose when they form a union with more rigid nominal wage countries. They studied France, Germany and the UK and find that nominal wage asymmetries across these three countries dominate other types of asymmetries (in shocks, monetary policy etc.) in welfare comparisons. Although Dellas and Tavlas (2003) methodology is different to my study in the fact that they use a three country model using calibration techniques, however, they still find that the joining of a monetary union is beneficial. In my study I find that seven of the eleven countries use real wages rather than unemployment in the adjustment process. This portrays wage flexibility following the regime change and benefits those participating countries.

Calmfors and Johanson (2002) model says that if the EMU membership increases macroeconomic variability (because of a loss of stabilising monetary policy), then the EMU membership is likely to strengthen the incentives for wage indexation, thus meaning that nominal wages will be more flexible. Similarly, contract length may be shortened. This finding is consistent with my conclusion that nominal wages after the structural break overall have been flexible in most EMU countries. Calmfors and Johanson (2002) also point out that wage indexation is more likely if indexation decisions are taken in a decentralised rather than in a centralised fashion. Gagnon (2005) proposed to verify Calmfors and Johanson's (2002) predictions with empirical evidence. Gagnon (2005) used quarterly data with the sample periods 1970Q1 to 2003Q4 for the euro zone, 1970Q1 to 2004Q2 for Germany, France, the Netherlands, and Sweden, and 1960Q1 to 2004Q2 for the United States and United Kingdom. Gagnon (2005) used the General Method of Moments method (GMM) to analyse Calmfors and Johanson's (2002) predictions and found that the EMU membership would result in more flexibility of the wage variable, consistent with my study which uses IRFs to assess two time periods.

6.5 Chapter conclusions

From the reduced-form calculation, the results were fairly mixed. The employment effect of a real GDP shock remained country-specific in both periods with the implication that the labour market adjustment through the employment channel may not be endogenous to regime change. The effects of a real GDP shock to unemployment tended to be smaller in the post-EMU period than in the pre-EMU period. The results indicated that the labour market adjustment to real GDP shocks may not be endogenous to regime change. Finally the effects of a real GDP shock to real wages tended to be higher in the post-EMU period indicating that labour market adjustment mostly occurred through the real wage channel. Using the impulse response functions to assess the main channels of adjustment, I found that most of the EMU countries' adjustment was through the real wage channel. In conclusion, from the two tasks; (i) reduced-form VAR and; (ii) impulse response functions, I found the following: in the reduced-form VAR analysis, I could not conclude conclusively that wages had become more flexible after monetary union due to the fact that the results produced only three countries with statistically significant coefficients after the EMU. I therefore moved onto IRF tests. Here, the examinations show that countries' real wages became more flexible after 1999 for seven countries of the eleven countries analysed. From my analysis, I conclude that the fulfilment of the OCA theory criterion relating to wage flexibility is endogenous to regime change.

SEVEN:
CONCLUSION

The premise of the Optimal Currency Areas (OCA) theory criteria is that in order to reduce the costs and maximise the expected benefits of monetary integration there should be a high degree of factors such as wage and price flexibility and business cycle similarities amongst the countries setting up the currency area. Following the seminal work by Mundell (1961), the question of endogenous OCA proposed by Frankel and Rose (1998) arose. Using various methods in three empirical chapters, I have attempted to establish if the fulfilment of the OCA theory criteria is endogenous to the change in regime in 1999. The results were presented and discussed in empirical chapters four, five and six.

My study has analysed eleven EMU countries and the UK and US in two sub periods to determine whether or not the OCA theories are endogenous to the regime change in 1999. Much of the evidence suggests that fulfilment OCA theory criteria is endogenous to regime change, however, this evidence is not conclusive. This is characterised by instances where some member-states show evidence of divergence since 1999 (for example, the correlation coefficient of the competitiveness indicator using the labour cost method where divergence is observed after 1999). Also, policy coordination has resulted in some countries not conforming to the new 'rules of the game' as seen by the labour market adjustment analysis with Italy, France and the Netherlands pursuing unemployment as their main channel of adjustment.

Overall, my study has found that here is also a pre-EMU core and peripheral group of countries, the core consisting of Germany, France, Italy and the Netherlands and a periphery group consisting of Austria, Belgium, Ireland, Finland, Greece, Portugal and Spain. The establishment of the EMU provided an endogenous process for some of the EMU countries but not all, particularly in the labour market for countries Austria, Belgium, Finland, Germany, Ireland, Portugal and Spain mainly due to policy coordination. Endogenous convergence has been characterised by higher levels of convergence between countries with respect to real GDP and the competitive index and faster adjustment of economic indicators such as the competitive index and to some extent wages after demand, supply and policy shocks. Even though there is evidence of endogenous behaviour amongst the EMU countries, it was not strong enough to eliminate the divergence between the core and peripheral group of countries due to the faster convergence and better adjustment to economic shocks through the real wage rather than unemployment channel of the core group of countries.

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THE APPENDIX (LIST OF FIGURES)

Figure 1: KPSS test: The relative demand shock using the government consumption expenditure (2 sub periods)

KPSS test for the relative demand shock for both sub periods before and after EMU

The Critical Levels: 10%: 0.119 5% : 0.146 2.5%: 0.176 1% : 0.216

			1988 - 1998		1999 - 2008	
			Test in levels	Test in first difference	Test in levels	Test in first difference
Austria	Lags		Test Statistic	Test Statistic	Test Statistic	Test Statistic
		0	0.712	0.0849	0.976	0.0482
		1	0.385	0.101	0.514	0.0923
		2	0.273	0.0993	0.355	0.0902
		3	0.218	0.109	0.278	0.0887
Belgium	Lags					
		0	0.501	0.0789	0.612	0.0596
		1	0.292	0.117	0.342	0.0753
		2	0.211	0.155	0.246	0.0679
		3	0.169	0.148	0.202	0.0711
Finland	Lags					
		0	0.869	0.0902	0.355	0.0275
		1	0.456	0.106	0.233	0.0368
		2	0.316	0.103	0.188	0.0539
		3	0.247	0.1	0.163	0.0496
France	Lags					
		0	0.617	0.139	0.814	0.105
		1	0.339	0.135	0.428	0.123
		2	0.244	0.113	0.297	0.109
		3	0.2	0.107	0.232	0.102
Germany	Lags					
		0	0.262	0.0595	0.807	0.0283
		1	0.162	0.073	0.453	0.0449
		2	0.127	0.0868	0.323	0.0685
		3	0.11	0.1	0.255	0.0861
Greece	Lags					
		0	0.393	0.046	0.317	0.0402
		1	0.23	0.0629	0.198	0.0437
		2	0.168	0.0803	0.16	0.0497
		3	0.135	0.079	0.143	0.0538
Ireland	Lags					
		0	0.205	0.0456	0.385	0.163
		1	0.125	0.0516	0.214	0.158
		2	0.0959	0.0582	0.153	0.147
		3	0.0813	0.059	0.123	0.129
Italy	Lags					
		0	0.65	0.225	0.359	0.0829
		1	0.342	0.18	0.223	0.131
		2	0.238	0.153	0.167	0.122
		3	0.186	0.133	0.139	0.122
Netherlands	Lags					
		0	0.388	0.048	0.657	0.058
		1	0.22	0.0593	0.356	0.0619
		2	0.161	0.0585	0.253	0.0662
		3	0.133	0.0596	0.202	0.065
Portugal	Lags					
		0	0.551	0.0577	0.277	0.131
		1	0.328	0.0788	0.148	0.0975
		2	0.246	0.0922	0.106	0.0738
		3	0.205	0.105	0.0874	0.0645
Spain	Lags					
		0	0.676	0.0246	0.891	0.0589
		1	0.411	0.0415	0.472	0.0588
		2	0.301	0.0482	0.33	0.0558
		3	0.244	0.0515	0.26	0.0626
UK	Lags					
		0	0.145	0.0286	0.336	0.0382
		1	0.0999	0.0436	0.203	0.0555
		2	0.0805	0.0605	0.152	0.0711
		3	0.0683	0.0574	0.124	0.0717
US	Lags					
		0	0.485	0.135	0.571	0.0532
		1	0.27	0.144	0.324	0.087
		2	0.195	0.141	0.23	0.0939
		3	0.159	0.147	0.182	0.087

Figure 2: KPSS test: The relative supply shock using productivity (real GDP/ hours worked - 2 sub periods)

KPSS test for Production for both sub periods before and after EMU

The Critical Levels: 10%: 0.119 5% : 0.146 2.5%: 0.176 1% : 0.216

		1988 - 1998		1999 - 2008	
		Test in levels	Test in first difference	Test in levels	Test in first difference
Austria	Lags	Test Statistic	Test Statistic	Test Statistic	Test Statistic
	0	0.221	0.039	0.354	0.19
	1	0.129	0.0442	0.204	0.172
	2	0.0964	0.0434	0.151	0.16
	3	0.0821	0.0438	0.125	0.15
Belgium	Lags				
	0	0.185	0.0529	0.336	0.179
	1	0.106	0.056	0.196	0.161
	2	0.0795	0.0536	0.146	0.156
	3	0.0676	0.0528	0.121	0.148
Finland	Lags				
	0	0.178	0.0337	0.332	0.196
	1	0.109	0.0396	0.195	0.177
	2	0.0852	0.0422	0.146	0.167
	3	0.0748	0.0454	0.121	0.157
France	Lags				
	0	0.222	0.0336	0.307	0.203
	1	0.133	0.0401	0.178	0.178
	2	0.101	0.0403	0.132	0.164
	3	0.0875	0.0417	0.11	0.153
Germany	Lags				
	0	0.312	0.0469	0.319	0.191
	1	0.18	0.0513	0.187	0.169
	2	0.135	0.0526	0.14	0.16
	3	0.114	0.0531	0.116	0.151
Ireland	Lags				
	0	0.4	0.0844	0.311	0.184
	1	0.223	0.0832	0.184	0.182
	2	0.163	0.0823	0.136	0.177
	3	0.135	0.0861	0.112	0.161
Italy	Lags				
	0	0.27	0.0559	0.311	0.181
	1	0.152	0.0588	0.184	0.168
	2	0.111	0.0584	0.138	0.16
	3	0.0925	0.0577	0.115	0.152
Netherlands	Lags				
	0	0.294	0.0367	0.343	0.176
	1	0.171	0.041	0.199	0.16
	2	0.128	0.0412	0.149	0.157
	3	0.109	0.0415	0.123	0.149
Portugal	Lags				
	0	0.559	0.0335	0.323	0.168
	1	0.336	0.0433	0.19	0.156
	2	0.253	0.0476	0.143	0.149
	3	0.213	0.0532	0.119	0.142
Spain	Lags				
	0	0.487	0.0404	0.383	0.186
	1	0.279	0.0425	0.219	0.169
	2	0.209	0.0446	0.161	0.159
	3	0.176	0.0486	0.132	0.15
UK	Lags				
	0	0.396	0.0257	0.282	0.22
	1	0.239	0.0277	0.178	0.193
	2	0.189	0.0317	0.138	0.177
	3	0.167	0.0358	0.117	0.162

Figure 3: KPSS test: The relative monetary shock using the country's base interest rates

KPSS test for the relative interest rates for both sub periods before and after EMU

The Critical Levels: 10%: 0.119 5% : 0.146 2.5%: 0.176 1% : 0.216

			1988 - 1998		1999 - 2008	
			Test in levels	Test in first difference	Test in levels	Test in first difference
Austria	Lags		Test Statistic	Test Statistic	Test Statistic	Test Statistic
		0	0.635	0.32	0.563	0.151
		1	0.334	0.237	0.297	0.118
		2	0.234	0.188	0.209	0.101
		3	0.186	0.164	0.167	0.094
Belgium	Lags					
		0	0.572	0.0863	0.56	0.151
		1	0.324	0.119	0.295	0.118
		2	0.236	0.126	0.208	0.101
		3	0.192	0.142	0.166	0.0938
Finland	Lags					
		0	0.53	0.11	0.554	0.15
		1	0.289	0.0943	0.292	0.117
		2	0.206	0.0803	0.206	0.1
		3	0.167	0.0829	0.164	0.0933
France	Lags					
		0	0.56	0.0854	0.554	0.15
		1	0.307	0.0883	0.292	0.116
		2	0.221	0.0861	0.206	0.0997
		3	0.17	0.087	0.164	0.0932
Germany	Lags					
		0	0.893	0.313	0.552	0.15
		1	0.465	0.267	0.291	0.116
		2	0.322	0.21	0.205	0.0998
		3	0.252	0.171	0.164	0.0933
Greece	Lags					
		0	0.866	0.122	0.896	0.21
		1	0.456	0.123	0.466	0.164
		2	0.317	0.12	0.325	0.148
		3	0.248	0.117	0.256	0.133
Ireland	Lags					
		0	0.418	0.0484	0.519	0.156
		1	0.238	0.048	0.273	0.12
		2	0.176	0.0464	0.192	0.103
		3	0.147	0.0501	0.154	0.0967
Italy	Lags					
		0	0.206	0.0527	0.546	0.15
		1	0.122	0.0612	0.288	0.117
		2	0.092	0.0562	0.203	0.1
		3	0.0787	0.0529	0.162	0.0935
Netherlands	Lags					
		0	0.778	0.433	0.554	0.149
		1	0.407	0.319	0.292	0.117
		2	0.283	0.241	0.205	0.0999
		3	0.223	0.2	0.164	0.0934
Portugal	Lags					
		0	0.56	0.0325	0.565	0.152
		1	0.325	0.0506	0.298	0.118
		2	0.235	0.0472	0.209	0.101
		3	0.192	0.0595	0.167	0.0941
Spain	Lags					
		0	0.468	0.112	0.562	0.151
		1	0.257	0.0788	0.296	0.118
		2	0.189	0.0664	0.208	0.101
		3	0.16	0.0635	0.166	0.094
UK	Lags					
		0	0.511	0.214	0.436	0.146
		1	0.273	0.171	0.249	0.127
		2	0.196	0.158	0.182	0.114
		3	0.158	0.149	0.149	0.103
US	Lags					
		0	0.838	0.216	0.541	0.334
		1	0.43	0.16	0.282	0.22
		2	0.296	0.134	0.196	0.167
		3	0.229	0.116	0.154	0.137

Figure 4: KPSS test: Real Effective Exchange Rate

KPSS test for the real exchange rate for both sub periods before and after the EMU (conversion from nominal exchange rates)

The Critical Levels: 10%: 0.119 5% : 0.146 2.5%: 0.176 1% : 0.216

			1988 - 1998				1999 - 2008	
			Test in levels	Test in first difference			Test in levels	Test in first difference
Austria	Lags		Test Statistic	Test Statistic	Lags		Test Statistic	Test Statistic
		0	0.156	0.418		0	0.0468	0.0958
		1	0.0922	0.225		1	0.0498	0.0689
		2	0.0708	0.164		2	0.0476	0.0617
		3	0.062	0.138		3	0.0473	0.0599
Belgium	Lags				Lags			
		0	0.421	0.195		0	0.0496	0.0889
		1	0.255	0.113		1	0.0681	0.091
		2	0.192	0.0853		2	0.0822	0.0926
		3	0.163	0.0726		3	0.0729	0.0841
Finland	Lags				Lags			
		0	0.266	0.574		0	0.0507	0.101
		1	0.16	0.309		1	0.0482	0.0966
		2	0.129	0.22		2	0.0569	0.0955
		3	0.115	0.177		3	0.0658	0.0909
France	Lags				Lags			
		0	0.257	0.484		0	0.0506	0.109
		1	0.166	0.276		1	0.0769	0.105
		2	0.128	0.207		2	0.0949	0.101
		3	0.109	0.175		3	0.0765	0.0923
Germany	Lags				Lags			
		0	0.756	0.251		0	0.0802	0.0558
		1	0.423	0.148		1	0.0836	0.0699
		2	0.304	0.112		2	0.0794	0.0751
		3	0.246	0.0942		3	0.0705	0.0665
Greece	Lags				Lags			
		0	0.915	0.125		0	0.0871	0.0431
		1	0.48	0.0822		1	0.0716	0.0447
		2	0.336	0.0695		2	0.0693	0.0483
		3	0.265	0.0651		3	0.0703	0.0487
Ireland	Lags				Lags			
		0	0.152	0.312		0	0.103	0.118
		1	0.0892	0.168		1	0.093	0.0827
		2	0.0694	0.122		2	0.0829	0.0738
		3	0.062	0.101		3	0.0762	0.0717
Italy	Lags				Lags			
		0	0.559	0.333		0	0.0932	0.109
		1	0.295	0.181		1	0.0639	0.081
		2	0.21	0.135		2	0.0531	0.0737
		3	0.17	0.116		3	0.0489	0.0733
Netherlands	Lags				Lags			
		0	0.733	0.387		0	0.153	0.108
		1	0.412	0.217		1	0.139	0.13
		2	0.296	0.158		2	0.137	0.145
		3	0.237	0.127		3	0.133	0.117
Portugal	Lags				Lags			
		0	0.487	0.275		0	0.128	0.0649
		1	0.287	0.162		1	0.128	0.0605
		2	0.221	0.121		2	0.134	0.0574
		3	0.189	0.103		3	0.133	0.0585
Spain	Lags				Lags			
		0	0.619	0.171		0	0.0397	0.0516
		1	0.345	0.114		1	0.0432	0.059
		2	0.253	0.0933		2	0.0476	0.0606
		3	0.207	0.0851		3	0.0512	0.059
UK	Lags				Lags			
		0	0.411	0.141		0	0.186	0.0755
		1	0.222	0.0843		1	0.142	0.0553
		2	0.16	0.0687		2	0.123	0.0494
		3	0.131	0.0654		3	0.113	0.0508
US	Lags				Lags			
		0	0.187	0.189		0	0.0647	0.0676
		1	0.106	0.121		1	0.0585	0.0661
		2	0.0807	0.096		2	0.0604	0.0661
		3	0.0697	0.0852		3	0.0575	0.065

Figure 5: ADF test: Austria – Greece (1988 – 1998)

Unit root test results for 13 countries between 1988 and 1998 using the Augmented Dickey Fuller method

Austria				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.988*	*-0.977*	*-0.374*	*0.947*
reer	*-1.555*	*-1.974*	*-1.315*	*0.615*
Y(dom)	*-1.091*	*-1.165*	*-3.197*	*0.917*
Y(for)	*-2.139*	*-0.783*	*-0.787*	*0.967*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-7.982*	*0.000*		
reer	*-4.771*	*0.000*		
Y(dom)	*-6.917*	*0.000*		
Y(for)	*-8.267*	*0.000*		
C-Value at 1%	*-3.634*			

Belgium				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.368*	*0.598*	*-1.883*	*0.664*
reer	*-2.278*	*0.179*	*-0.967*	*0.948*
Y(dom)	*-1.466*	*0.551*	*-2.958*	*0.144*
Y(for)	*-2.150*	*0.225*	*-0.792*	*0.966*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-10.077*	*0.000*		
reer	*-4.260*	*0.000*		
Y(dom)	*-6.627*	*0.000*		
Y(for)	*-8.256*	*0.000*		
C-Value at 1%	*-3.634*			

Finland				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.986*	*0.293*	*-0.882*	*0.958*
reer	*-2.074*	*0.255*	*-1.263*	*0.897*
Y(dom)	*-1.594*	*0.487*	*-1.693*	*0.754*
Y(for)	*-2.157*	*0.222*	*-0.776*	*0.968*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-8.050*	*0.000*		
reer	*-3.711*	*0.002*		
Y(dom)	*-7.152*	*0.000*		
Y(for)	*-8.239*	*0.000*		
C-Value at 1%	*-3.634*			

France				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.461*	*0.553*	*-1.411*	*0.858*
reer	*-2.462*	*0.125*	*-0.349*	*0.988*
Y(dom)	*-3.280*	*0.016*	*-3.079*	*0.111*
Y(for)	*-2.067*	*0.258*	*-0.848*	*0.961*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-8.460*	*0.000*		
reer	*-4.160*	*0.000*		
Y(dom)	*-6.907*	*0.000*		
Y(for)	*-8.284*	*0.000*		
C-Value at 1%	*-3.634*			

Germany				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-2.661*	*0.081*	*-2.536*	*0.310*
reer	*-0.851*	*0.804*	*-1.342*	*0.877*
Y(dom)	*-2.587*	*0.096*	*-1.604*	*0.791*
Y(for)	*-2.025*	*0.276*	*-0.934*	*0.952*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-7.852*	*0.000*		
reer	*-5.448*	*0.000*		
Y(dom)	*-6.602*	*0.000*		
Y(for)	*-8.305*	*0.000*		
C-Value at 1%	*-3.634*			

Greece				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.245*	*0.654*	*-1.386*	*0.865*
reer	*-4.082*	*0.001*	*-1.725*	*0.740*
Y(dom)	*-1.021*	*0.745*	*-1.067*	*0.934*
Y(for)	*-2.163*	*0.220*	*-0.783*	*0.967*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-12.526*	*0.000*		
reer	*-4.604*	*0.000*		
Y(dom)	*-7.032*	*0.000*		
Y(for)	*-8.243*	*0.000*		
C-Value at 1%	*-3.634*			

Figure 6: ADF test: Ireland – US (1988 – 1998)

Ireland				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-0.054*	*0.954*	*-3.348*	*0.059*
reer	*-2.675*	*0.079*	*-2.680*	*0.245*
Y(dom)	*-1.358*	*0.602*	*-2.062*	*0.567*
Y(for)	*-2.137*	*0.230*	*-0.783*	*0.967*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Stationary Test Statistics				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-9.060*	*0.000*		
reer	*-4.708*	*0.000*		
Y(dom)	*-6.196*	*0.000*		
Y(for)	*-8.234*	*0.000*		
C-Value at 1%	*-3.634*			

Italy				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.037*	*0.739*	*-0.745*	*0.970*
reer	*-1.580*	*0.494*	*-1.153*	*0.920*
Y(dom)	*-1.426*	*0.570*	*-2.954*	*0.145*
Y(for)	*-2.027*	*0.275*	*-0.884*	*0.958*
C-Value at 1%	*-3.668*			*-4.279*
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-6.967*	*0.000*		
reer	*-4.605*	*0.000*		
Y(dom)	*-6.511*	*0.000*		
Y(for)	*-8.262*	*0.000*		
C-Value at 1%	*-3.634*			

Netherlands				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.434*	*0.566*	*-0.952*	*0.950*
reer	*-1.727*	*0.417*	*-0.203*	*0.992*
Y(dom)	*-2.659*	*0.081*	*-3.100*	*0.106*
Y(for)	*-2.134*	*0.231*	*-0.796*	*0.966*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-7.444*	*0.000*		
reer	*-4.792*	*0.000*		
Y(dom)	*-6.870*	*0.000*		
Y(for)	*-8.249*	*0.000*		
C-Value at 1%	*-3.634*			

Portugal				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.608*	*0.480*	*-1.967*	*0.619*
reer	*-1.091*	*0.719*	*-3.337*	*0.060*
Y(dom)	*-1.235*	*0.658*	*-3.587*	*0.031*
Y(for)	*-2.141*	*0.228*	*-0.783*	*0.967*
C-Value at 1%	*-3.675*		*4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-8.864*	*0.000*		
reer	*-4.156*	*0.001*		
Y(dom)	*-7.620*	*0.000*		
Y(for)	*-8.231*	*0.000*		
C-Value at 1%	*-3.634*			

Spain				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.373*	*0.595*	*-0.582*	*0.980*
reer	*-1.141*	*0.699*	*-2.510*	*0.323*
Y(dom)	*-0.607*	*0.870*	*-1.841*	*0.685*
Y(for)	*-2.161*	*0.221*	*-0.771*	*0.968*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-7.270*	*0.000*		
reer	*-5.022*	*0.000*		
Y(dom)	*-6.656*	*0.000*		
Y(for)	*-8.255*	*0.000*		
C-Value at 1%	*-3.634*			

UK				
Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.988*	*0.292*	*-0.977*	*0.947*
reer	*-1.555*	*0.506*	*-1.974*	*0.615*
Y(dom)	*-1.091*	*0.719*	*-1.165*	*0.917*
Y(for)	*-2.139*	*0.229*	*-0.783*	*0.967*
C-Value at 1%	*-3.675*		*-4.279*	
AIC Suggested lag length 6				
Variables in first difference	*Test statistic*	*P value*		
X/M	*-7.982*	*0.000*		
reer	*-4.771*	*0.000*		
Y(dom)	*-6.917*	*0.000*		
Y(for)	*-8.267*	*0.000*		
C-Value at 1%	*-3.634*			

US				
Log Variables in levels	*Test statistic*	*P value*	*With trend*	*P Value*
X/M	*-1.705*	*0.429*	*-2.192*	*0.495*
reer	*-0.350*	*0.918*	*-2.666*	*0.250*
Y(dom)	*2.483*	*0.999*	*-0.574*	*0.980*
Y(for)	*-1.357*	*0.603*	*-0.211*	*0.991*
C-Value at 1%	*-3.675*			*-4.279*
AIC Suggested lag length 6				
Log Variables in first difference	*Test statistic*	*P value*		
X/M	*-6.233*	*0.000*		
reer	*-5.846*	*0.000*		
Y(dom)	*-3.843*	*0.003*		
Y(for)	*-7.910*	*0.000*		
C-Value at 1%	*-3.634*			

Figure 7: ADF test: Austria – Greece (1999 – 2008)

Unit root test results for 13 countries between 1999 and 2008 using the Augmented Dickey Fuller method

Austria

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-2.528	0.1087	0.1087	0.9471
reer	-1.997	0.288	0.288	0.6153
Y(dom)	-1.634	0.4655	0.4655	0.9173
Y(for)	-0.734	0.8379	0.8379	0.9671
C-Value at 1%	-3.696		-4.279	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-9.007	0.000
reer	-4.475	0.000
Y(dom)	-4.357	0.000
Y(for)	-5.067	0.000
C-Value at 1%	-3.662	

Belgium

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-0.276	0.9288	-1.987	0.6084
reer	-1.793	0.384	-2.791	0.2003
Y(dom)	-1.679	0.442	-2.535	0.3105
Y(for)	-0.73	0.8388	-3.17	0.0905
C-Value at 1%	-3.696		-4.306	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-12.131	0.000
reer	-4.626	0.000
Y(dom)	-4.315	0.000
Y(for)	-5.069	0.000
C-Value at 1%	-3.662	

Finland

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-0.509	0.8903	-1.808	0.7007
reer	-1.954	0.3071	-2.67	0.2487
Y(dom)	-1.572	0.4975	-2.424	0.3668
Y(for)	-0.736	0.8372	-3.167	0.0911
C-Value at 1%	-3.696		-4.306	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-12.405	0.000
reer	-4.983	0.0017
Y(dom)	-4.263	0.000
Y(for)	-5.067	0.000
C-Value at 1%	-3.662	

France

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	0.186	0.9715	-1.823	0.6936
reer	-1.29	0.6336	-2.37	0.3958
Y(dom)	-1.262	0.6465	-1.777	0.716
Y(for)	-0.477	0.8964	-2.521	0.3178
C-Value at 1%	-3.689		-4.279	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-6.226	0.000
reer	-4.426	0.000
Y(dom)	-4.408	0.000
Y(for)	-5.102	0.000
C-Value at 1%	-3.662	

Germany

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-2.935	0.0415	-1.677	0.7607
reer	-2.116	0.2382	-2.535	0.3107
Y(dom)	-1.707	0.4273	-2.832	0.1853
Y(for)	-0.675	0.853	-3.189	0.0866
C-Value at 1%	-3.696		-4.306	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-6.762	0.000
reer	-4.66	0.000
Y(dom)	-4.344	0.000
Y(for)	-5.122	0.000
C-Value at 1%	-3.662	

Greece

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-1.685	0.4387	-2.486	0.335
reer	-2.24	0.1921	-2.948	0.1472
Y(dom)	-1.674	0.4445	-2.283	0.4435
Y(for)	-0.736	0.8373	-3.168	0.0911
C-Value at 1%	-3.696		-4.306	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-6.961	0.000
reer	-4.1	0.000
Y(dom)	-4.554	0.000
Y(for)	-5.065	0.000
C-Value at 1%	-3.662	

Figure 8: ADF test: Ireland – US (1999 – 2008)

Ireland

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-2.003	0.2853	-2.004	0.5991
reer	-1.576	0.4958	-2.88	0.1691
Y(dom)	-1.824	0.3684	-1.585	0.7983
Y(for)	-0.735	0.8376	-3.172	0.0901
C-Value at 1%	-3.675		-4.306	

AIC Suggested lag length 5

Stationary Test Statistics

Log Variables in first difference	Test statistic	P value
XM	-4.955	0.000
reer	-4.546	0.000
Y(dom)	-4.678	0.000
Y(for)	-5.067	0.000
C-Value at 1%	-3.662	

Italy

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-0.525	0.887	-2.711	0.2316
reer	-2.364	0.152	-2.722	0.2269
Y(dom)	-1.78	0.3905	-2.262	0.4551
Y(for)	-0.694	0.8482	-3.194	0.0856
C-Value at 1%	-3.696			-4.306

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-6.881	0.000
reer	-4.754	0.000
Y(dom)	-4.409	0.000
Y(for)	-5.088	0.000
C-Value at 1%	-3.634	

Netherlands

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-1.964	0.3026	-1.305	0.8867
reer	-1.785	0.388	-2.701	0.2358
Y(dom)	-1.543	0.5121	-2.806	0.1946
Y(for)	-0.729	0.8391	-3.168	0.0909
C-Value at 1%	-3.696		-4.306	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-8.717	0.000
reer	-4.581	0.000
Y(dom)	-4.539	0.000
Y(for)	-5.07	0.000
C-Value at 1%	-3.662	

Portugal

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-2.421	0.136	-1.943	0.6322
reer	-1.049	0.7349	-2.419	0.3693
Y(dom)	-1.324	0.618	-1.869	0.6707
Y(for)	-0.516	0.8888	-2.497	0.3294
C-Value at 1%	-3.689		-3.564	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-6.101	0.000
reer	-4.62	0.001
Y(dom)	-4.652	0.000
Y(for)	-5.064	0.000
C-Value at 1%	3.662	

Spain

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-1.146	0.6962	-2.193	0.4938
reer	-1.559	0.5043	-2.696	0.2378
Y(dom)	-1.551	0.508	-2.23	0.473
Y(for)	-0.72	0.8414	-3.185	0.0875
C-Value at 1%	-3.696		-4.306	

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-7.439	0.000
reer	-4.549	0.000
Y(dom)	-3.372	0.000
Y(for)	-5.123	0.000
C-Value at 1%	-3.662	

UK

Variables in levels	Test statistic	P value	With trend	P Value
XM	-1.133	0.7017	-3.912	0.0117
reer	-1.493	0.5368	-0.984	0.9462
Y(dom)	-1.948	0.3098	-0.532	0.9821
Y(for)	-0.62	0.8663	-3.301	0.0661
C-Value at 1%	-3.696		-4.306	

AIC Suggested lag length 5

Variables in first difference	Test statistic	P value
XM	-5.825	0.000
reer	-2.691	0.000
Y(dom)	-2.816	0.000
Y(for)	-5.214	0.000
C-Value at 1%	-3.662	

US

Log Variables in levels	Test statistic	P value	With trend	P Value
XM	-1.256	0.6493	0.566	0.997
reer	-1.388	0.5879	-2.691	0.2399
Y(dom)	-1.301	0.6287	-0.699	0.9732
Y(for)	-0.897	0.789	-3.591	0.0306
C-Value at 1%	-3.696			-4.306

AIC Suggested lag length 5

Log Variables in first difference	Test statistic	P value
XM	-5.688	0.000
reer	-2.334	0.000
Y(dom)	-3.892	0.002
Y(for)	-5.733	0.000
C-Value at 1%	-3.534	

Figure 9: KPSS test: Import/Export ratio (2 sub-periods)

KPSS test for the Import/Export ratio for both sub periods before and after EMU

The Critical Levels: 10%: 0.119 5% : 0.146 2.5%: 0.176 1% : 0.216

			1988 - 1998				1999 - 2008	
			Test in levels	Test in first difference			Test in levels	Test in first difference
Austria	Lags		Test Statistic	Test Statistic	Lags		Test Statistic	Test Statistic
		0	0.595	0.014		0	0.354	0.0304
		1	0.401	0.0306		1	0.248	0.0523
		2	0.304	0.0329		2	0.192	0.052
		3	0.256	0.046		3	0.167	0.052
Belgium	Lags				Lags			
		0	0.494	0.0442		0	0.394	0.0313
		1	0.303	0.0785		1	0.259	0.0777
		2	0.231	0.069		2	0.189	0.0701
		3	0.191	0.0752		3	0.156	0.0716
Finland	Lags				Lags			
		0	0.494	0.0556		0	0.302	0.0272
		1	0.303	0.0724		1	0.227	0.0778
		2	0.231	0.0915		2	0.17	0.0806
		3	0.191	0.123		3	0.142	0.0968
France	Lags				Lags			
		0	0.354	0.0594		0	0.386	0.0407
		1	0.213	0.0812		1	0.225	0.0422
		2	0.161	0.0816		2	0.173	0.0524
		3	0.137	0.09		3	0.146	0.0555
Germany	Lags				Lags			
		0	0.778	0.0596		0	0.592	0.0481
		1	0.416	0.0751		1	0.345	0.0575
		2	0.291	0.0713		2	0.256	0.0651
		3	0.229	0.0715		3	0.21	0.0636
Greece	Lags				Lags			
		0	0.0975	0.0139		0	0.434	0.0477
		1	0.099	0.0343		1	0.25	0.0594
		2	0.0894	0.0479		2	0.181	0.0629
		3	0.0825	0.0419		3	0.147	0.0655
Ireland	Lags				Lags			
		0	0.257	0.0319		0	0.729	0.141
		1	0.161	0.0501		1	0.401	0.141
		2	0.124	0.0564		2	0.286	0.141
		3	0.106	0.059		3	0.227	0.136
Italy	Lags				Lags			
		0	0.429	0.0971		0	0.157	0.0156
		1	0.24	0.108		1	0.0966	0.0258
		2	0.174	0.101		2	0.0754	0.0558
		3	0.142	0.0971		3	0.0668	0.0547
Netherlands	Lags				Lags			
		0	0.438	0.043		0	0.656	0.0562
		1	0.256	0.0521		1	0.408	0.0647
		2	0.19	0.0566		2	0.31	0.0631
		3	0.157	0.0597		3	0.251	0.0645
Portugal	Lags				Lags			
		0	0.404	0.0481		0	0.522	0.0385
		1	0.239	0.0672		1	0.311	0.0559
		2	0.177	0.0781		2	0.231	0.0676
		3	0.145	0.0882		3	0.188	0.0764
Spain	Lags				Lags			
		0	0.399	0.179		0	0.341	0.0875
		1	0.231	0.206		1	0.203	0.109
		2	0.171	0.197		2	0.153	0.123
		3	0.141	0.184		3	0.125	0.119
UK	Lags				Lags			
		0	0.583	0.0516		0	0.103	0.0392
		1	0.336	0.0689		1	0.0636	0.0378
		2	0.247	0.0759		2	0.052	0.0395
		3	0.202	0.0691		3	0.0486	0.0463
US	Lags				Lags			
		0	0.611	0.0875		0	0.848	0.0669
		1	0.343	0.0894		1	0.462	0.0799
		2	0.25	0.116		2	0.326	0.0916
		3	0.203	0.124		3	0.258	0.0788

Figure 10: KPSS test: Domestic real GDP (2 sub-periods)

KPSS test for Domestic Income for both sub periods before and after EMU

The Critical Levels: 10%: 0.119 5% : 0.146 2.5%: 0.176 1% : 0.216

		1988 - 1998			1999 - 2008	
		Test in levels	Test in first difference		Test in levels	Test in first difference
Austria	Lags	Test Statistic	Test Statistic	Lags	Test Statistic	Test Statistic
	0	0.326	0.0396	0	0.388	0.146
	1	0.189	0.0439	1	0.229	0.129
	2	0.141	0.0445	2	0.173	0.127
	3	0.119	0.0454	3	0.146	0.124
Belgium	Lags			Lags		
	0	0.273	0.0485	0	0.35	0.146
	1	0.16	0.0512	1	0.209	0.131
	2	0.12	0.0496	2	0.159	0.13
	3	0.102	0.048	3	0.134	0.126
Finland	Lags			Lags		
	0	0.273	0.043	0	0.369	0.144
	1	0.16	0.0497	1	0.222	0.127
	2	0.12	0.0494	2	0.17	0.125
	3	0.102	0.0512	3	0.144	0.122
France	Lags			Lags		
	0	0.277	0.0387	0	0.322	0.15
	1	0.162	0.0429	1	0.194	0.134
	2	0.122	0.0434	2	0.148	0.132
	3	0.104	0.0447	3	0.125	0.128
Germany	Lags			Lags		
	0	0.428	0.0456	0	0.348	0.142
	1	0.242	0.0484	1	0.209	0.125
	2	0.179	0.0511	2	0.16	0.124
	3	0.149	0.0515	3	0.135	0.122
Greece	Lags			Lags		
	0	0.266	0.0606	0	0.315	0.138
	1	0.155	0.0678	1	0.189	0.124
	2	0.117	0.0707	2	0.145	0.124
	3	0.0986	0.0718	3	0.122	0.12
Ireland	Lags			Lags		
	0	0.402	0.0966	0	0.269	0.153
	1	0.222	0.0947	1	0.174	0.144
	2	0.161	0.0914	2	0.138	0.145
	3	0.132	0.0947	3	0.119	0.134
Italy	Lags			Lags		
	0	0.316	0.0641	0	0.294	0.133
	1	0.177	0.0667	1	0.179	0.12
	2	0.129	0.068	2	0.138	0.12
	3	0.106	0.0671	3	0.117	0.117
Netherlands	Lags			Lags		
	0	0.253	0.0382	0	0.383	0.156
	1	0.148	0.0421	1	0.227	0.139
	2	0.112	0.043	2	0.172	0.136
	3	0.0963	0.0444	3	0.145	0.132
Portugal	Lags			Lags		
	0	0.535	0.0515	0	0.557	0.0352
	1	0.311	0.0636	1	0.322	0.0425
	2	0.229	0.0688	2	0.239	0.0486
	3	0.189	0.0746	3	0.198	0.0532
Spain	Lags			Lags		
	0	0.437	0.0374	0	0.417	0.151
	1	0.253	0.0394	1	0.246	0.123
	2	0.191	0.0442	2	0.186	0.122
	3	0.161	0.0485	3	0.156	0.121
UK	Lags			Lags		
	0	0.512	0.039	0	0.272	0.221
	1	0.297	0.0425	1	0.174	0.194
	2	0.223	0.0489	2	0.136	0.177
	3	0.186	0.0551	3	0.116	0.162
US	Lags			Lags		
	0	0.899	0.138	0	0.242	0.187
	1	0.474	0.105	1	0.146	0.164
	2	0.331	0.0886	2	0.112	0.137
	3	0.261	0.0829	3	0.0967	0.127

Figure 11: KPSS test: Foreign real GDP (2 sub-periods)

KPSS test for the Foreign Income for both sub periods before and after EMU

The Critical Levels: 10%: 0.119 5% : 0.146 2.5%: 0.176 1% : 0.216

		1988 - 1998			1999 - 2008	
		Test in levels	Test in first difference		Test in levels	Test in first difference
	Lags	Test Statistic	Test Statistic	Lags	Test Statistic	Test Statistic
Austria						
	0	0.591	0.0256	0	0.374	0.101
	1	0.356	0.0353	1	0.218	0.0915
	2	0.266	0.0486	2	0.165	0.098
	3	0.218	0.0536	3	0.137	0.0979
Belgium	Lags			Lags		
	0	0.594	0.0256	0	0.374	0.101
	1	0.358	0.0354	1	0.218	0.0913
	2	0.268	0.0487	2	0.165	0.0979
	3	0.219	0.0537	3	0.137	0.0978
Finland	Lags			Lags		
	0	0.594	0.0256	0	0.375	0.102
	1	0.357	0.0352	1	0.218	0.0916
	2	0.267	0.0485	2	0.165	0.0982
	3	0.219	0.0536	3	0.137	0.0981
France	Lags			Lags		
	0	0.591	0.0262	0	0.374	0.0989
	1	0.355	0.0363	1	0.217	0.0893
	2	0.265	0.0499	2	0.164	0.0958
	3	0.216	0.0545	3	0.137	0.0959
Germany	Lags			Lags		
	0	0.573	0.0261	0	0.369	0.0981
	1	0.347	0.0362	1	0.214	0.0887
	2	0.261	0.0495	2	0.162	0.0952
	3	0.214	0.0538	3	0.135	0.0953
Greece	Lags			Lags		
	0	0.593	0.0255	0	0.375	0.102
	1	0.357	0.0351	1	0.218	0.0917
	2	0.268	0.0484	2	0.165	0.0982
	3	0.219	0.0534	3	0.137	0.0981
Ireland	Lags			Lags		
	0	0.593	0.0258	0	0.375	0.101
	1	0.356	0.0356	1	0.218	0.0915
	2	0.266	0.0489	2	0.165	0.098
	3	0.218	0.0539	3	0.138	0.0979
Italy	Lags			Lags		
	0	0.596	0.0275	0	0.376	0.101
	1	0.354	0.038	1	0.218	0.0913
	2	0.263	0.0516	2	0.165	0.0978
	3	0.214	0.0559	3	0.137	0.0978
Netherlands	Lags			Lags		
	0	0.592	0.0257	0	0.374	0.0994
	1	0.356	0.0354	1	0.217	0.0896
	2	0.267	0.0488	2	0.164	0.0962
	3	0.218	0.0537	3	0.137	0.0962
Portugal	Lags			Lags		
	0	0.59	0.0256	0	0.372	0.0289
	1	0.355	0.0353	1	0.239	0.0414
	2	0.266	0.0485	2	0.185	0.059
	3	0.218	0.0536	3	0.155	0.0646
Spain	Lags			Lags		
	0	0.605	0.0259	0	0.371	0.0998
	1	0.362	0.0358	1	0.216	0.0905
	2	0.27	0.0493	2	0.164	0.0973
	3	0.221	0.0543	3	0.136	0.0973
UK	Lags			Lags		
	0	0.639	0.0271	0	0.346	0.0924
	1	0.377	0.0377	1	0.2	0.085
	2	0.278	0.0521	2	0.15	0.0934
	3	0.226	0.0568	3	0.125	0.0926
US	Lags			Lags		
	0	0.784	0.0273	0	0.36	0.0781
	1	0.442	0.0372	1	0.209	0.0769
	2	0.32	0.0521	2	0.157	0.0917
	3	0.256	0.0571	3	0.129	0.0909

Figure 12: Trade balance/exchange rate results – Austria (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Austria — *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7
List of variables included in the unrestricted VAR:
LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	470.0279	358.0279*	267.8165
6	446.3602	350.3602	273.0362
5	417.2723	337.2723	272.8356
4	403.0058	339.0058	287.4565
3	384.6198	336.6198	297.9578
2	378.899	346.899	321.1243
1	365.0929	349.0929	336.2055
0	72.0656	72.0656	72.0656

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept
List of eigenvalues in descending order:
.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	70.204	28.27
r<= 1	r = 2	27.3176	22.04
r<= 2	r = 3	17.0808*	15.87
r<= 3	r = 4	9.0779	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by
Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =3.
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept

	Vector 1	**Vector 2**	Vector 3
LXM	-1	**-1**	-1
LREER	-2.1752	**0.1298**	-0.6156
LYDOM	-0.49092	**1.4043**	-86.214
LYFOR	1.7489	**-0.83906**	138.2644

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.0065701	0.035906	-.18298[.858]
ecm2(-1)	0.070094	0.035906	1.9522[.079]
ecm3(-1)	-0.030115	0.035906	-.83872[.421]

Short Run adjustment Parameters
ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM
37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	1.0687	0.66825	1.5993[.138]
dLREER1	2.5927	1.3916	1.8631[.089]
dLYDOM1	0.3327	0.19904	1.6716[.123]
dLYFOR1	-2.0356	1.0772	-1.8896[.085]
dLXM2	1.0128	0.52073	1.9450[.078]
dLREER2	2.8754	1.5772	1.8231[.096]
dLYDOM2	0.44813	0.18504	2.4218[.034]
dLYFOR2	-2.6308	1.1352	-2.3174[.041]
dLXM3	0.64608	0.41595	1.5532[.149]
dLREER3	2.0999	1.2882	1.6302[.131]
dLYDOM3	0.39341	0.19092	2.0606[.064]
dLYFOR3	-2.4299	1.0584	-2.2957[.042]
dLXM4	0.35463	0.32346	1.0964[.296]
dLREER4	1.684	1.5283	1.1019[.294]
dLYDOM4	0.12873	0.18603	.69196[.503]
dLYFOR4	-1.0144	0.85528	-1.1860[.261]
dLXM5	0.036847	0.25566	.14412[.888]
dLREER5	1.3086	1.1838	1.1055[.293]
dLYDOM5	0.40119	0.19541	2.0531[.065]
dLYFOR5	-1.6594	0.76197	-2.1778[.052]
dLXM6	0.20099	0.20728	.96967[.353]
dLREER6	0.79607	1.1531	.69039[.504]
dLYDOM6	0.35841	0.21645	1.6559[.126]
dLYFOR6	-0.88398	0.57371	-1.5408[.152]

Diagnostics Test (F version)

R-Squared	0.71
D-Watson Test statistic	1.85
Serial Correlation	0.081
Functional Form	0.085
Heteroskedasticity	0.634

Figure 13: Trade balance/exchange rate results – Belgium (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Belgium *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
7	478.6573	366.6573*	276.4459
6	453.2754	357.2754	279.9513
5	439.3459	359.3459	294.9091
4	418.3323	354.3323	302.7829
3	397.1419	349.1419	310.4799
2	378.5954	346.5954	320.8207
1	355.0419	339.0419	326.1546
0	30.9406	30.9406	30.9406

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2	Vector 3	**Vector 4**
LXM	-1	-1	-1	**-1**
LREER	6.5037	-2.2394	2.1446	**0.26586**
LYDOM	2.3968	-1.5297	-0.98715	**0.09532**
LYFOR	-5.2916	4.5133	3.4158	**0.46441**

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.052982	0.02175	2.4360[.319]
ecm2(-1)	-0.012572	0.02175	-.57803[.577]
ecm3(-1)	-0.036585	0.02175	-1.6821[.127]
ecm4(-1)	0.022951	0.02175	1.0552[.038]

****

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	45.8337	28.27
r<= 1	r = 2	29.8352	22.04
r<= 2	r = 3	19.1298	15.87
r<= 3	r = 4	15.5573*	9.16

****

** denotes selected rank*

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

****

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.59882	0.31296	-1.9134[.088]
dLREER1	0.26442	0.7329	.36078[.727]
dLYDOM1	-0.75605	0.30093	-2.5124[.033]
dLYFOR1	1.2474	0.67606	1.8451[.098]
dLXM2	-0.058459	0.34909	-.16746[.871]
dLREER2	-0.020708	0.90188	-.022961[.982]
dLYDOM2	-0.40284	0.24551	-1.6408[.135]
dLYFOR2	1.2433	0.65645	1.8940[.091]
dLXM3	0.14854	0.41365	.35911[.728]
dLREER3	0.71183	0.85927	.82842[.429]
dLYDOM3	-0.38104	0.2566	-1.4850[.172]
dLYFOR3	1.4345	0.8462	1.6952[.124]
dLXM4	0.99093	0.66431	1.4917[.170]
dLREER4	1.1351	1.1104	1.0222[.333]
dLYDOM4	-0.71882	0.36039	-1.9946[.077]
dLYFOR4	1.7022	1.029	1.6542[.132]
dLXM5	1.3164	0.79815	1.6494[.133]
dLREER5	-0.43977	1.109	-.39653[.701]
dLYDOM5	-0.44498	0.29754	-1.4955[.169]
dLYFOR5	1.1904	0.80458	1.4795[.173]
dLXM6	0.43005	0.44014	.97706[.354]
dLREER6	-1.9305	0.99163	-1.9468[.083]
dLYDOM6	0.11619	0.20572	.56480[.586]
dLYFOR6	0.3364	0.49896	.67420[.517]

****

Diagnostics Test (F version)

R-Squared	0.83
D-Watson Test statistic	2.53
Serial Correlation	0.122
Functional Form	0.564
Heteroskedasticity	0.591

Figure 14: Trade balance/exchange rate results – Finland (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Finland — *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	423.9134	311.9134*	221.702
6	400.7731	304.7731	227.449
5	381.3672	301.3672	236.9305
4	361.2731	297.2731	245.7238
3	342.5726	294.5726	255.9106
2	332.4171	300.4171	274.6424
1	311.787	295.787	282.8997
0	-4.5548	-4.5548	-4.5548

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	123.6607	28.27
r<= 1	r = 2	24.9079	22.04
r<= 2	r = 3	22.6539	15.87
r<= 3	r = 4	14.4767*	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3	Vector 4
LXM	**-1**	-1	-1	-1
LREER	**0.36459**	-9.156	-1.0721	-0.91378
LYDOM	**-0.12458**	-4.2767	0.30895	0.2126
LYFOR	**2.0709**	-18.3592	0.98529	1.7804

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.16262	0.020473	7.9428[.000]
ecm2(-1)	0.047274	0.020473	2.3091[.046]
ecm3(-1)	-0.01993	0.020473	-.97348[.356]
ecm4(-1)	0.0016901	0.020473	.082551[.936]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.11105	0.9325	.11909[.908]
dLREER1	-0.28598	0.55977	-.51088[.621]
dLYDOM1	0.49531	0.73622	.67278[.516]
dLYFOR1	-1.3806	1.5954	-.86539[.407]
dLXM2	0.08505	0.97214	.087488[.932]
dLREER2	-0.72657	0.84737	-.85744[.411]
dLYDOM2	0.25548	0.6062	.42145[.682]
dLYFOR2	-0.22178	1.4624	-.15166[.882]
dLXM3	-0.35409	0.90727	-.39029[.705]
dLREER3	-0.96202	1.1286	-.85241[.414]
dLYDOM3	0.37664	0.52203	.72150[.487]
dLYFOR3	1.3254	1.3246	1.0006[.341]
dLXM4	-0.3898	0.89255	-.43673[.672]
dLREER4	-0.64574	0.99794	-.64707[.532]
dLYDOM4	-0.072665	0.83194	-.087344[.932]
dLYFOR4	1.5054	3.2367	.46511[.652]
dLXM5	0.037005	0.79745	.046405[.964]
dLREER5	-0.097833	0.77417	-.12637[.902]
dLYDOM5	0.083021	0.6457	.12858[.900]
dLYFOR5	0.68985	3.7794	.18253[.859]
dLXM6	-0.24763	0.54017	-.45843[.656]
dLREER6	-0.337	0.72272	-.46629[.651]
dLYDOM6	0.22922	0.33546	.68331[.510]
dLYFOR6	0.41433	2.0908	.19817[.847]

Diagnostics Test (F version)

R-Squared	0.96
D-Watson Test statistic	2.16
Serial Correlation	0.43
Functional Form	0.003
Heteroskedasticity	0.08

Figure 15: Trade balance/exchange rate results – France (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

France *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	506.9246	394.9246*	304.7132
6	465.3709	369.3709	292.0468
5	444.0992	364.0992	299.6625
4	433.0574	369.0574	317.508
3	416.5987	368.5987	329.9367
2	404.9405	372.9405	347.1658
1	390.5061	374.5061	361.6187
0	70.661	70.661	70.661

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	63.9329	28.27
r<= 1	r = 2	54.3093	22.04
r<= 2	r = 3	18.7849	15.87
r<= 3	r = 4	10.1171*	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	**Vector 2**	Vector 3	Vector 4
LXM	-1	**-1**	-1	-1
LREER	-2.3763	**0.14892**	-20.9125	5.9752
LYDOM	-2.0899	**-0.26774**	7.7345	0.78546
LYFOR	2.9806	**1.0734**	-18.9487	-0.08954

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.03184	0.011008	-2.8926[.018]
ecm2(-1)	-0.021028	0.011008	-1.9103[.088]
ecm3(-1)	0.0040458	0.011008	.36755[.722]
ecm4(-1)	0.014988	0.011008	1.3616[.206]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.10497	0.34734	.30220[.769]
dLREER1	-0.92487	0.38338	-2.4124[.039]
dLYDOM1	0.03821	0.10007	.38185[.711]
dLYFOR1	-0.78648	0.31585	-2.4901[.034]
dLXM2	0.29086	0.22728	1.2797[.233]
dLREER2	0.77822	0.32647	2.3837[.041]
dLYDOM2	-0.31847	0.09359	-3.4028[.008]
dLYFOR2	0.23873	0.32568	.73300[.482]
dLXM3	-0.36134	0.22489	-1.6068[.143]
dLREER3	-0.69995	0.36983	-1.8926[.091]
dLYDOM3	-0.24325	0.11595	-2.0979[.065]
dLYFOR3	0.41068	0.33345	1.2316[.249]
dLXM4	-0.016908	0.27414	-.061675[.952]
dLREER4	-0.141	0.4096	-.34423[.739]
dLYDOM4	-0.057523	0.12507	-.45991[.656]
dLYFOR4	-0.052367	0.40689	-.12870[.900]
dLXM5	0.29159	0.25257	1.1545[.278]
dLREER5	0.55704	0.47433	1.1744[.270]
dLYDOM5	-0.20412	0.12465	-1.6375[.136]
dLYFOR5	0.57536	0.40917	1.4062[.193]
dLXM6	-0.074266	0.20506	-.36217[.726]
dLREER6	-0.93863	0.34985	-2.6829[.025]
dLYDOM6	-0.015893	0.093233	-.17046[.868]
dLYFOR6	-0.0006747	0.31601	-.0021351[.998]

Diagnostics Test (F version)

R-Squared	0.85
D-Watson Test statistic	2.31
Serial Correlation	0.262
Functional Form	0.345
Heteroskedasticity	0.249

Figure 16: Trade balance/exchange rate results – Germany (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Germany *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
7	533.2095	421.2095*	330.9981
6	467.1516	371.1516	293.8275
5	444.7413	364.7413	300.3045
4	406.141	342.141	290.5916
3	388.6556	340.6556	301.9936
2	373.0865	341.0865	315.3118
1	362.4321	346.4321	333.5447
0	51.6819	51.6819	51.6819

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Estimated Cointegrated Vectors in Johansen Estimation shown by
Cointegration with restricted intercepts and no trends in the VAR

****

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2	Vector 3	Vector 4
LXM	**-1**	-1	-1	-1
LREER	**0.36322**	2.8714	-1.1016	0.96727
LYDOM	**-1.3841**	1.8366	0.38598	-1.6702
LYFOR	**0.99483**	-3.0857	-1.3282	1.5813

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.019543	0.020314	.96204[.004]
ecm2(-1)	-0.076499	0.020314	-3.7658[.361]
ecm3(-1)	-0.043782	0.020314	-2.1553[.060]
ecm4(-1)	0.019332	0.020314	.95164[.366]

****

Cointegration with restricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept
List of eigenvalues in descending order:
.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	120.4181	28.27
r<= 1	r = 2	69.7416	22.04
r<= 2	r = 3	27.5968	15.87
r<= 3	r = 4	12.5986*	9.16

****

** denotes selected rank*

Short Run adjustment Parameters
ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

****

Dependent variable is dLXM
37 observations used for estimation from 1989Q4 to 1998Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.75455	0.47909	-1.5750[.150]
dLREER1	0.5674	0.77282	.73420[.482]
dLYDOM1	-0.32347	0.45833	-.70576[.498]
dLYFOR1	-0.17306	0.5422	-.31919[.757]
dLXM2	-0.83115	0.60608	-1.3714[.203]
dLREER2	0.42752	0.79038	.54090[.602]
dLYDOM2	-0.37304	0.41647	-.89570[.394]
dLYFOR2	-0.297	0.55867	-.53162[.608]
dLXM3	-0.55904	0.50841	-1.0996[.300]
dLREER3	0.71691	0.93792	.76437[.464]
dLYDOM3	-0.48579	0.48273	-1.0063[.341]
dLYFOR3	-0.68622	0.47735	-1.4376[.184]
dLXM4	-0.40968	0.50064	-.81832[.434]
dLREER4	-0.54828	0.81826	-.67006[.520]
dLYDOM4	-0.10377	0.47344	-.21919[.831]
dLYFOR4	-1.3439	0.67368	-1.9949[.077]
dLXM5	-0.25173	0.3438	-.73219[.483]
dLREER5	0.20366	0.80156	.25408[.805]
dLYDOM5	-0.38631	0.51419	-.75129[.472]
dLYFOR5	-0.54306	0.78408	-.69261[.506]
dLXM6	0.10191	0.28023	.36366[.725]
dLREER6	-0.4812	0.61283	-.78521[.453]
dLYDOM6	-0.33171	0.32663	-1.0156[.336]
dLYFOR6	-0.24902	0.55177	-.45131[.662]

****

Diagnostics Test (F version)

R-Squared	0.89
D-Watson Test statistic	2.13
Serial Correlation	0.16
Functional Form	0.686
Heteroskedasticity	0.872

Figure 17: Trade balance/exchange rate results – Greece (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Greece *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	392.2832	280.2832*	190.0718
6	343.4662	247.4662	170.1421
5	323.0811	243.0811	178.6444
4	310.4854	246.4854	194.936
3	289.9966	241.9966	203.3345
2	280.115	248.115	222.3403
1	267.8217	251.8217	238.9344
0	-38.9743	-38.9743	-38.9743

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	82.5854	28.27
r<= 1	r = 2	45.616*	22.04
r<= 2	r = 3	14.8448	15.87
r<= 3	r = 4	5.5907	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =2.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2
LXM	-1	-1
LREER	0.1002	-3.4836
LYDOM	0.13019	0.56335
LYFOR	0.8365	-0.49668

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.0046576	0.12859	.036220[.972]
ecm2(-1)	0.13214	0.12859	1.0276[.326]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.39611	1.0656	.37174[.717]
dLREER1	2.2793	2.8963	.78699[.448]
dLYDOM1	-0.73873	0.51191	-1.4431[.177]
dLYFOR1	2.6392	2.2249	1.1862[.261]
dLXM2	0.65538	0.87494	.74905[.470]
dLREER2	2.3605	3.2202	.73305[.479]
dLYDOM2	-0.10783	0.37949	-.28415[.782]
dLYFOR2	2.0473	2.3509	.87086[.402]
dLXM3	0.83462	0.76849	1.0861[.301]
dLREER3	-0.30313	4.0453	-.074934[.942]
dLYDOM3	-0.33579	0.36457	-.92105[.377]
dLYFOR3	2.1607	2.4427	.88455[.395]
dLXM4	0.22239	0.7699	.28886[.778]
dLREER4	3.2327	4.9058	.65896[.523]
dLYDOM4	-0.25702	0.46503	-.55269[.592]
dLYFOR4	-0.62617	2.9083	-.21530[.833]
dLXM5	0.38267	0.6492	.58944[.567]
dLREER5	-2.9079	5.3249	-.54610[.596]
dLYDOM5	-0.30319	0.42126	-.71972[.487]
dLYFOR5	0.15712	3.0317	.051826[.960]
dLXM6	0.12443	0.37948	.32788[.749]
dLREER6	4.8441	4.8521	.99835[.340]
dLYDOM6	-0.23796	0.36146	-.65834[.524]
dLYFOR6	-2.5121	2.523	-.99567[.341]

Diagnostics Test (F version)

R-Squared	0.82
D-Watson Test statistic	2.2
Serial Correlation	0.471
Functional Form	0.052
Heteroskedasticity	0.038

Figure 18: Trade balance/exchange rate results – Ireland (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Ireland — *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
7	453.5805	341.5805*	251.3691
6	418.0838	322.0838	244.7598
5	388.2245	308.2245	243.7878
4	356.9665	292.9665	241.4172
3	338.1956	290.1956	251.5335
2	323.3909	291.3909	265.6162
1	308.2675	292.2675	279.3802
0	-3.7497	-3.7497	-3.7497

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	81.6491	28.27	25.8
r<= 1	r = 2	30.4779	22.04	19.86
r<= 2	r = 3	24.3278	15.87	13.81
r<= 3	r = 4	19.6377*	9.16	7.53

****

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2	Vector 3	Vector 4
LXM	-1	-1	-1	-1
LREER	2.2134	4.33	1.4381	2.2371
LYDOM	-0.41961	-0.3438	-0.74873	-0.16724
LYFOR	0.66715	1.3788	-0.2849	1.8724

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.013896	0.025198	.55146[.595]
ecm2(-1)	-0.0060421	0.025198	-.23978[.816]
ecm3(-1)	-0.0072373	0.025198	-.28721[.780]
ecm4(-1)	0.062652	0.025198	2.4863[.035]

****

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

****

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.072627	0.71484	.10160[.921]
dLREER1	-1.4005	1.3002	-1.0772[.309]
dLYDOM1	-0.13006	0.15004	-.86685[.409]
dLYFOR1	-0.41321	0.5178	-.79801[.445]
dLXM2	-0.1804	0.74668	-.24160[.815]
dLREER2	0.93472	1.3632	.68569[.510]
dLYDOM2	-0.03069	0.16345	-.18776[.855]
dLYFOR2	-0.48502	0.54847	-.88431[.400]
dLXM3	0.37482	0.67542	.55494[.592]
dLREER3	-1.6925	1.0822	-1.5639[.152]
dLYDOM3	0.12508	0.19953	.62690[.546]
dLYFOR3	-1.8463	0.56923	-3.2435[.010]
dLXM4	0.043451	0.56318	.077153[.940]
dLREER4	0.48321	0.82313	.58704[.572]
dLYDOM4	-0.19682	0.14071	-1.3988[.195]
dLYFOR4	0.70025	0.75304	.92990[.377]
dLXM5	-0.40234	0.52327	-.76890[.462]
dLREER5	-0.89433	0.56067	-1.5951[.145]
dLYDOM5	0.11465	0.10807	1.0609[.316]
dLYFOR5	-0.46012	0.69175	-.66515[.523]
dLXM6	0.11215	0.37664	.29778[.773]
dLREER6	0.0582	0.67044	.086809[.933]
dLYDOM6	-0.054478	0.11701	-.46560[.653]
dLYFOR6	0.11125	0.49752	.22360[.828]

****

Diagnostics Test (F version)

R-Squared	0.86
D-Watson Test statistic	2.2
Serial Correlation	0.12
Functional Form	0.194
Heteroskedasticity	0.514

Figure 19: Trade balance/exchange rate results – Italy (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Italy — *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	445.315	333.315*	243.1036
6	409.5772	313.5772	236.2532
5	387.7201	307.7201	243.2834
4	370.6543	306.6543	255.1049
3	353.9185	305.9185	267.2564
2	336.8009	304.8009	279.0262
1	323.488	307.488	294.6006
0	6.4042	6.4042	6.4042

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	62.226	28.27
r<= 1	r = 2	44.6223	22.04
r<= 2	r = 3	28.9676*	15.87
r<= 3	r = 4	7.6557	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =3.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3
LXM	**-1**	-1	-1
LREER	**0.065993**	-1.0404	2.6684
LYDOM	**-0.46791**	0.16856	-1.2238
LYFOR	**0.3293**	2.1291	3.7145

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.079534	0.039551	2.0109[.072]
ecm2(-1)	-0.042571	0.039551	-1.0763[.307]
ecm3(-1)	-0.031099	0.039551	-.78631[.450]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	1.2114	0.80732	1.5006[.164]
dLREER1	-0.75802	0.76761	-.98751[.347]
dLYDOM1	0.55249	0.42868	1.2888[.226]
dLYFOR1	-1.3268	1.1371	-1.1668[.270]
dLXM2	1.1715	0.69914	1.6756[.125]
dLREER2	0.51861	0.70059	.74025[.476]
dLYDOM2	0.068879	0.36934	.18649[.856]
dLYFOR2	-0.95858	1.0964	-.87431[.402]
dLXM3	0.88864	0.54113	1.6422[.132]
dLREER3	-0.64802	0.9138	-.70915[.494]
dLYDOM3	0.58007	0.36774	1.5774[.146]
dLYFOR3	-2.1523	1.1884	-1.8110[.100]
dLXM4	0.63773	0.56346	1.1318[.284]
dLREER4	-0.086006	0.6807	-.12635[.902]
dLYDOM4	0.49041	0.3771	1.3005[.223]
dLYFOR4	-1.7462	1.2773	-1.3671[.202]
dLXM5	0.97141	0.49023	1.9815[.076]
dLREER5	-0.31201	0.64878	-.48091[.641]
dLYDOM5	0.59748	0.30346	1.9689[.077]
dLYFOR5	-2.4478	1.0549	-2.3203[.043]
dLXM6	0.58351	0.4502	1.2961[.224]
dLREER6	-0.60492	0.60591	-.99837[.342]
dLYDOM6	0.40111	0.3357	1.1948[.260]
dLYFOR6	-0.96153	1.1827	-.81297[.435]

Diagnostics Test (F version)

R-Squared	0.63
D-Watson Test statistic	1.84
Serial Correlation	0.981
Functional Form	0.032
Heteroskedasticity	0.81

Figure 20: Trade balance/exchange rate results – Netherlands (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Netherlands *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	513.1881	401.1881*	310.9767
6	469.2189	373.2189	295.8948
5	445.1939	365.1939	300.7572
4	426.8708	362.8708	311.3214
3	403.0692	355.0692	316.4072
2	396.0466	364.0466	338.272
1	383.7318	367.7318	354.8444
0	83.0016	83.0016	83.0016

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	73.4898	28.27
r<= 1	r = 2	52.775	22.04
r<= 2	r = 3	15.8228	15.87
r<= 3	r = 4	12.1316*	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3	Vector 4
LXM	**-1**	-1	-1	-1
LREER	**0.51839**	-0.42468	0.66495	-0.70782
LYDOM	**-0.046113**	-0.30804	0.63746	-0.21095
LYFOR	**0.48094**	1.2249	-0.94019	1.3778

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.037	0.014248	2.5969[.029]
ecm2(-1)	-0.02965	0.014248	-2.0811[.067]
ecm3(-1)	-0.024578	0.014248	-1.7251[.119]
ecm4(-1)	0.008794	0.014248	.61723[.552]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	2.2378	0.8101	2.7623[.022]
dLREER1	-0.25657	0.64614	-.39708[.701]
dLYDOM1	0.31074	0.19373	1.6039[.143]
dLYFOR1	-1.5456	0.80356	-1.9234[.087]
dLXM2	1.5871	0.58857	2.6965[.025]
dLREER2	-0.57667	0.54107	-1.0658[.314]
dLYDOM2	0.28402	0.16912	1.6794[.127]
dLYFOR2	-1.4817	0.79086	-1.8735[.094]
dLXM3	1.5992	0.59562	2.6849[.025]
dLREER3	0.6928	0.44155	1.5690[.151]
dLYDOM3	0.077646	0.19421	.39981[.699]
dLYFOR3	-0.52113	0.81971	-.63575[.541]
dLXM4	1.0766	0.45202	2.3818[.041]
dLREER4	0.038186	0.55674	.068589[.947]
dLYDOM4	0.1132	0.19422	.58282[.574]
dLYFOR4	-0.53845	0.73505	-.73254[.482]
dLXM5	0.76184	0.43071	1.7688[.111]
dLREER5	0.75317	0.47093	1.5993[.144]
dLYDOM5	-0.012372	0.13818	-.089529[.931]
dLYFOR5	-0.30255	0.68806	-.43971[.671]
dLXM6	0.84447	0.36873	2.2902[.048]
dLREER6	-0.023654	0.59418	-.039809[.969]
dLYDOM6	0.22092	0.15783	1.3997[.195]
dLYFOR6	-0.55193	0.50225	-1.0989[.300]

Diagnostics Test (F version)

R-Squared	0.84
D-Watson Test statistic	2.812
Serial Correlation	0.121
Functional Form	0.733
Heteroskedasticity	0.962

Figure 21: Trade balance/exchange rate results – Portugal (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Portugal *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	460.9713	348.9713*	258.7599
6	420.2296	324.2296	246.9055
5	408.7896	328.7896	264.3529
4	376.7609	312.7609	261.2116
3	368.2045	320.2045	281.5425
2	361.005	329.005	303.2304
1	347.4792	331.4792	318.5918
0	31.275	31.275	31.275

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	94.9123	28.27
r<= 1	r = 2	48.4314	22.04
r<= 2	r = 3	18.9774*	15.87
r<= 3	r = 4	5.9103	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =3.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3
LXM	-1	-1	-1
LREER	-0.698	2.6276	-1.299
LYDOM	3.6646	-2.2754	0.15894
LYFOR	20.3696	-3.5791	0.97344

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.037156	0.033147	-1.1210[.289]
ecm2(-1)	-0.024998	0.033147	-.75417[.468]
ecm3(-1)	-0.027068	0.033147	-.81663[.433]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.87832	0.39702	-2.2123[.051]
dLREER1	-0.72113	0.66476	-1.0848[.303]
dLYDOM1	-0.43506	0.33462	-1.3002[.223]
dLYFOR1	0.25412	1.113	.22833[.824]
dLXM2	-0.26348	0.55085	-.47832[.643]
dLREER2	-0.36637	0.6787	-.53982[.601]
dLYDOM2	-0.061211	0.39396	-.15537[.880]
dLYFOR2	-1.1625	0.98259	-1.1831[.264]
dLXM3	-0.15755	0.48015	-.32812[.750]
dLREER3	0.74829	0.77095	.97061[.355]
dLYDOM3	-0.24034	0.3072	-.78238[.452]
dLYFOR3	-0.66201	1.0243	-.64628[.533]
dLXM4	0.17914	0.37978	.47168[.647]
dLREER4	0.3532	0.90962	.38829[.706]
dLYDOM4	-0.41371	0.27024	-1.5309[.157]
dLYFOR4	-0.063398	1.1936	-.053114[.959]
dLXM5	0.47534	0.30246	1.5716[.147]
dLREER5	1.4062	0.88917	1.5815[.145]
dLYDOM5	-0.24235	0.36165	-.67013[.518]
dLYFOR5	1.1368	0.9837	1.1557[.275]
dLXM6	0.2955	0.22343	1.3226[.215]
dLREER6	-0.84019	0.87193	-.96360[.358]
dLYDOM6	0.27562	0.33559	.82129[.431]
dLYFOR6	-0.037743	0.6923	-.054518[.958]

Diagnostics Test (F version)

R-Squared	0.8
D-Watson Test statistic	2.2
Serial Correlation	0.754
Functional Form	0.537
Heteroskedasticity	0.911

Figure 22: Trade balance/exchange rate results – Spain (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Spain *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
7	432.1215	320.1215*	229.9101
6	397.3671	301.3671	224.043
5	377.835	297.835	233.3983
4	360.3553	296.3553	244.8059
3	351.1589	303.1589	264.4969
2	338.4029	306.4029	280.6283
1	326.1868	310.1868	297.2994
0	-13.6058	-13.6058	-13.6058

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	70.6195	28.27
r<= 1	r = 2	33.4998	22.04
r<= 2	r = 3	20.7132	15.87
r<= 3	r = 4	14.7557*	9.16

****

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2	Vector 3	Vector 4
LXM	-1	-1	-1	-1
LREER	-0.1309	-1.4955	-0.80635	1.2671
LYDOM	0.3277	0.26354	-0.10674	-0.011
LYFOR	-0.2125	0.37836	1.1143	2.3527

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.083862	0.0443	1.8931[.091]
ecm2(-1)	-0.041664	0.0443	-.94051[.372]
ecm3(-1)	-0.1067	0.0443	-2.4086[.039]
ecm4(-1)	0.0064818	0.0443	.14632[.887]

****

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

****

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.26294	0.42068	-.62503[.547]
dLREER1	-0.50101	0.70551	-.71014[.496]
dLYDOM1	0.16514	0.26492	.62335[.549]
dLYFOR1	-1.2257	1.2121	-1.0112[.338]
dLXM2	0.11884	0.44627	.26630[.796]
dLREER2	-0.82004	0.76507	-1.0719[.312]
dLYDOM2	0.071277	0.27721	.25713[.803]
dLYFOR2	-0.75482	1.3748	-.54904[.596]
dLXM3	0.050343	0.41371	.12169[.906]
dLREER3	-0.02325	0.52167	-.044568[.965]
dLYDOM3	0.38535	0.37368	1.0312[.329]
dLYFOR3	-1.5721	1.7467	-.90003[.392]
dLXM4	-0.037635	0.34828	-.10806[.916]
dLREER4	0.298	0.54004	.55181[.595]
dLYDOM4	0.5542	0.40643	1.3636[.206]
dLYFOR4	-2.2489	1.79	-1.2564[.241]
dLXM5	-0.22873	0.31255	-.73181[.483]
dLREER5	0.018733	0.52742	.035519[.972]
dLYDOM5	0.31127	0.28737	1.0832[.307]
dLYFOR5	-2.2817	1.4765	-1.5454[.157]
dLXM6	-0.23714	0.33518	-.70748[.497]
dLREER6	-0.25198	0.60675	-.41528[.688]
dLYDOM6	0.065785	0.24263	.27113[.792]
dLYFOR6	-1.3702	0.90127	-1.5202[.163]

****

Diagnostics Test (F version)

R-Squared	0.7
D-Watson Test statistic	2.42
Serial Correlation	0.114
Functional Form	0.094
Heteroskedasticity	0.604

Figure 23: Trade balance/exchange rate results – UK (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

UK *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	487.614	375.614*	285.4026
6	463.5066	367.5066	290.1826
5	407.1876	327.1876	262.7509
4	381.7345	317.7345	266.1851
3	372.9569	324.9569	286.2949
2	357.8662	325.8662	300.0916
1	342.9166	326.9166	314.0293
0	26.2826	26.2826	26.2826

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	125.7757	28.27
r<= 1	r = 2	62.8378	22.04
r<= 2	r = 3	21.0298	15.87
r<= 3	r = 4	10.3816*	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	**Vector 2**	Vector 3	Vector 4
LXM	-1	**-1**	-1	-1
LREER	-0.187	**0.01545**	1.2356	-0.1023
LYDOM	0.2964	**0.68108**	-2.3718	7.9595
LYFOR	-0.2476	**2.4688**	0.3921	3.7831

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.023653	0.017787	1.3298[.216]
ecm2(-1)	0.058144	0.017787	3.2689[.010]
ecm3(-1)	-0.039782	0.017787	-2.2366[.052]
ecm4(-1)	-0.00102	0.017787	-.057319[.956]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.97826	0.47954	-2.0400[.072]
dLREER1	0.34157	0.35258	.96876[.358]
dLYDOM1	0.24607	0.45835	.53686[.604]
dLYFOR1	0.45723	0.5513	.82937[.428]
dLXM2	-0.57113	0.5499	-1.0386[.326]
dLREER2	0.28732	0.31245	.91958[.382]
dLYDOM2	0.19186	0.45274	.42378[.682]
dLYFOR2	0.67944	0.48198	1.4097[.192]
dLXM3	-0.28366	0.35452	-.80011[.444]
dLREER3	0.33799	0.2731	1.2376[.247]
dLYDOM3	0.24699	0.38514	.64130[.537]
dLYFOR3	0.44229	0.85025	.52019[.615]
dLXM4	-0.20198	0.24126	-.83720[.424]
dLREER4	0.069361	0.43678	.15880[.877]
dLYDOM4	0.42587	0.41671	1.0220[.333]
dLYFOR4	-0.25899	0.67378	-.38439[.710]
dLXM5	-0.29499	0.25073	-1.1765[.270]
dLREER5	-0.19298	0.45833	-.42104[.684]
dLYDOM5	0.40413	0.41151	.98208[.352]
dLYFOR5	-0.40403	0.79423	-.50871[.623]
dLXM6	-0.077574	0.377	-.20577[.842]
dLREER6	0.12021	0.35999	.33394[.746]
dLYDOM6	0.0057554	0.28564	.020149[.984]
dLYFOR6	-0.12294	0.50363	-.24411[.813]

Diagnostics Test (F version)

R-Squared	0.87
D-Watson Test statistic	1.8121
Serial Correlation	0.43
Functional Form	0.786
Heteroskedasticity	0.437

Figure 24: Trade balance/exchange rate results – US (1988 – 1998)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

US *Period analysed 1988 to 1998*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
7	529.7717	417.7717*	327.5603
6	494.5471	398.5471	321.223
5	469.5297	389.5297	325.093
4	456.6678	392.6678	341.1184
3	441.457	393.457	354.7949
2	433.2621	401.2621	375.4874
1	414.535	398.535	385.6477
0	27.2137	27.2137	27.2137

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 37 observations from 1989Q4 to 1998Q4. Order of VAR = 7

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	97.0366	28.27
r<= 1	r = 2	50.7751	22.04
r<= 2	r = 3	31.9848	15.87
r<= 3	r = 4	11.0331*	9.16

****

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

37 observations from 1989Q4 to 1998Q4. Order of VAR = 7, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2	Vector 3	Vector 4
LXM	**-1**	-1	-1	-1
LREER	**0.3115**	-0.7052	-1.3585	0.11587
LYDOM	**1.2253**	-1.6506	-0.27319	0.087677
LYFOR	**-0.1963**	-5.7595	-1.4972	0.016039

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.053349	0.021562	2.4742[.035]
ecm2(-1)	-0.025903	0.021562	-1.2013[.260]
ecm3(-1)	-0.02741	0.021562	-1.2712[.236]
ecm4(-1)	0.033273	0.021562	1.5431[.157]

****

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(7)

****

Dependent variable is dLXM

37 observations used for estimation from 1989Q4 to 1998Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.58288	0.30913	1.8855[.092]
dLREER1	1.1551	0.85333	1.3536[.209]
dLYDOM1	-0.39396	1.3336	-.29540[.774]
dLYFOR1	1.3344	0.62345	2.1404[.061]
dLXM2	0.80978	0.34305	2.3605[.043]
dLREER2	1.3933	0.84796	1.6432[.135]
dLYDOM2	0.27785	1.3062	.21272[.836]
dLYFOR2	1.2971	0.59043	2.1968[.056]
dLXM3	0.53493	0.30573	1.7497[.114]
dLREER3	2.1709	0.90605	2.3961[.040]
dLYDOM3	-3.2405	1.6173	-2.0037[.076]
dLYFOR3	1.8741	0.69831	2.6837[.025]
dLXM4	0.36057	0.33239	1.0848[.306]
dLREER4	2.3824	0.99013	2.4062[.039]
dLYDOM4	-0.50721	1.6214	-.31283[.762]
dLYFOR4	2.2034	0.815	2.7036[.024]
dLXM5	0.85739	0.50411	1.7008[.123]
dLREER5	0.29875	0.6848	.43625[.673]
dLYDOM5	3.0047	2.0507	1.4652[.177]
dLYFOR5	1.0112	0.62248	1.6244[.139]
dLXM6	0.79988	0.50095	1.5967[.145]
dLREER6	0.4002	0.66728	.59975[.563]
dLYDOM6	2.1015	1.8871	1.1136[.294]
dLYFOR6	0.53567	0.45486	1.1777[.269]

****

Diagnostics Test (F version)

R-Squared	0.82
D-Watson Test statistic	2.26
Serial Correlation	0.383
Functional Form	0.884
Heteroskedasticity	0.355

Figure 25: Trade balance/exchange rate results – Austria (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Austria — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model
****
Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6
List of variables included in the unrestricted VAR:
LXM LREER LYDOM LYFOR
****

Order	LL	AIC	SBC
6	563.6199	413.6199*	290.8009
5	500.2818	375.2818	272.9326
4	450.8855	350.8855	269.0062
3	425.5359	350.5359	289.1264
2	417.4279	367.4279	326.4883
1	394.497	369.497	349.0272
0	65.8923	65.8923	65.8923

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix
****
Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept
List of eigenvalues in descending order:
.96932 .74335 .61155 .21848 0.00
****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	65.7314	29.68
r<= 1	r = 2	17.9313*	15.41
r<= 2	r = 3	0.251	3.76

****
** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by
Cointegration with restricted intercepts and no trends in the VAR
****
35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =2.
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept
****

	Vector 1	Vector 2
LXM	**-1**	-1
LREER	**0.045921**	-4.5675
LYDOM	**0.62365**	-4.7044
LYFOR	**-0.62749**	5.3699

****
Chosen vector shown in bold

Cointegrating Equations
****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.057889	0.020137	2.8747[.007]
ecm2(-1)	-0.010942	0.020137	-.54336[.590]

****

Short Run adjustment Parameters
ECM for variable LXM estimated by OLS based on cointegrating VAR(6)
****
Dependent variable is dLXM
35 observations used for estimation from 2000Q2 to 2008Q4
****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.0223	0.8945	0.02 [0.98]
dLREER1	0.9380	0.7303	1.28 [0.199]
dLYDOM1	0.8810	0.6642	1.33 [0.185]
dLYFOR1	0.4477	0.6787	0.66 [0.51]
dLXM2	0.3241	0.4588	0.71 [0.48]
dLREER2	-3.6413	3.6430	-1 [0.318]
dLYDOM2	-3.3757	2.6553	-1.27 [0.204]
dLYFOR2	-2.8922	2.7121	-1.07 [0.286]
dLXM3	-2.4932	2.9100	-0.86 [0.392]
dLREER3	-1.1993	2.3174	-0.52 [0.605]
dLYDOM3	3.3397	3.7255	0.9 [0.37]
dLYFOR3	2.7014	2.3207	1.16 [0.244]
dLXM4	1.7211	2.1553	0.8 [0.425]
dLREER4	1.7475	2.5061	0.7 [0.486]
dLYDOM4	0.8073	2.2272	0.36 [0.717]
dLYFOR4	0.7266	2.6413	1.03 [0.302]
dLXM5	0.8023	4.3814	1.1 [0.273]
dLREER5	0.6252	5.8161	1.14 [0.255]
dLYDOM5	4.2378	3.8535	1.1 [0.271]
dLYFOR5	0.7702	2.5736	1.46 [0.143]

****

Diagnostics Test (F version)

R-Squared	0.185
D-Watson Test statistic	2.137
Serial Correlation	0.122
Functional Form	0.670
Heteroskedasticity	0.799

Figure 26: Trade balance/exchange rate results – Belgium (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Belgium — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
6	524.9471	374.9471*	252.1281
5	482.6295	357.6295	255.2804
4	457.9685	357.9685	276.0891
3	414.3651	339.3651	277.9556
2	397.3883	347.3883	306.4487
1	371.4559	346.4559	325.9861
0	18.6145	18.6145	18.6145

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	67.3763	29.68
r<= 1	r = 2	25.6575*	15.41
r<= 2	r = 3	2.8423	3.76

****

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =2.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2
LXM	**-1**	-1
LREER	**0.050781**	-0.9089
LYDOM	**0.26165**	-0.0383
LYFOR	**-0.45481**	28.128

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.045999	0.012093	3.8039[.001]
ecm2(-1)	-8.34E-04	0.012093	-.068979[.945]

****

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

****

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.1771	0.3412	0.52 [0.604]
dLREER1	0.3479	0.2585	1.35 [0.178]
dLYDOM1	0.5664	0.2647	2.14 [0.032]
dLYFOR1	0.2515	0.2699	0.93 [0.351]
dLXM2	0.0692	0.1999	0.35 [0.729]
dLREER2	-0.7310	0.8918	-0.82 [0.412]
dLYDOM2	-0.6505	0.6031	-1.08 [0.281]
dLYFOR2	-0.8117	0.6020	-1.35 [0.178]
dLXM3	-1.2143	0.7380	-1.65 [0.1]
dLREER3	-0.0187	0.8244	-0.02 [0.982]
dLYDOM3	1.3334	0.9720	1.37 [0.17]
dLYFOR3	0.9972	0.7248	1.38 [0.169]
dLXM4	1.2402	0.6627	1.87 [0.061]
dLREER4	1.5110	0.8313	1.82 [0.069]
dLYDOM4	0.0683	0.9496	0.07 [0.943]
dLYFOR4	-1.8595	0.7199	-2.58 [0.01]
dLXM5	-0.6110	0.9195	-0.66 [0.506]
dLREER5	-0.8334	0.6598	-1.26 [0.207]
dLYDOM5	-0.4483	0.8483	-0.53 [0.597]
dLYFOR5	0.1008	0.9573	0.11 [0.916]

****

Diagnostics Test (F version)

R-Squared	0.553
D-Watson Test statistic	1.847
Serial Correlation	0.424
Functional Form	0.120
Heteroskedasticity	0.774

Figure 27: Trade balance/exchange rate results – Finland (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Finland — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6
List of variables included in the unrestricted VAR:
LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
6	540.3761	390.3761*	267.5572
5	404.2928	279.2928	176.9437
4	374.7408	274.7408	192.8615
3	335.7348	260.7348	199.3253
2	312.0188	262.0188	221.0792
1	290.8393	265.8393	245.3695
0	-51.6106	-51.6106	-51.6106

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept
List of eigenvalues in descending order:
.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	35.6321	29.68
r<= 1	r = 2	17.1696	15.41
r<= 2	r = 3	4.1066*	3.76

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by
Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =3.
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3
LXM	**-1**	-1	-1
LREER	**0.061937**	-2.4982	3.0996
LYDOM	**-0.60248**	-2.6526	1.7888
LYFOR	**0.27902**	2.8414	-2.7242

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.085443	0.02449	-3.4889[.001]
ecm2(-1)	0.035924	0.02449	1.4669[.152]
ecm3(-1)	-0.002532	0.02449	-.10339[.918

Short Run adjustment Parameters
ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM
35 observations used for estimation from 2000Q2 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.7985	0.4797	0.096 [-1.66]
dLREER1	-0.4109	0.4399	0.35 [-0.93]
dLYDOM1	-0.0955	0.3593	0.79 [-0.27]
dLYFOR1	0.2848	0.2525	0.259 [1.13]
dLXM2	0.3885	0.1771	0.028 [2.19]
dLREER2	1.7686	2.0853	0.396 [0.85]
dLYDOM2	1.6136	1.9709	0.413 [0.82]
dLYFOR2	-1.5920	2.0319	0.433 [-0.78]
dLXM3	-4.2499	1.8149	0.019 [-2.34]
dLREER3	-3.8725	1.4997	0.01 [-2.58]
dLYDOM3	-2.0485	2.2896	0.371 [-0.89]
dLYFOR3	-2.5446	2.1308	0.232 [-1.19]
dLXM4	0.9812	2.1833	0.653 [0.45]
dLREER4	3.9393	1.8595	0.034 [2.12]
dLYDOM4	3.7002	1.5762	0.019 [2.35]
dLYFOR4	1.0470	1.0326	0.311 [1.01]
dLXM5	1.8350	0.8641	0.034 [2.12]
dLREER5	1.5899	1.0961	0.147 [1.45]
dLYDOM5	1.2689	0.9609	0.187 [1.32]
dLYFOR5	0.5683	1.0012	0.57 [0.57]

Diagnostics Test (F version)

R-Squared	0.589
D-Watson Test statistic	2.032
Serial Correlation	0.808
Functional Form	0.110
Heteroskedasticity	0.963

Figure 28: Trade balance/exchange rate results – France (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

France — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
6	591.3983	441.3983*	318.5794
5	528.6615	403.6615	301.3123
4	486.9862	386.9862	305.1069
3	448.9257	373.9257	312.5163
2	427.8176	377.8176	336.878
1	404.532	379.532	359.0622
0	53.1342	53.1342	53.1342

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	33.4385*	29.68
r<= 1	r = 2	12.1454	15.41
r<= 2	r = 3	0.3016	3.76

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =1.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1
LXM	**-1**
LREER	**0.43733**
LYDOM	**0.14983**
LYFOR	**-0.40251**

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.055293	0.015445	-3.5800[.001]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	1.1434	0.4110	0.3378 [0.3378]
dLREER1	0.6329	0.3610	0.08 [1.75]
dLYDOM1	0.1534	0.2359	0.515 [0.65]
dLYFOR1	0.2775	0.1921	0.149 [1.44]
dLXM2	0.1887	0.1933	0.329 [0.98]
dLREER2	3.1919	1.6518	0.053 [1.93]
dLYDOM2	3.9141	1.9540	0.045 [2]
dLYFOR2	0.4608	1.3931	0.741 [0.33]
dLXM3	1.8715	1.3703	0.172 [1.37]
dLREER3	1.8268	1.3423	0.174 [1.36]
dLYDOM3	-2.3520	1.6273	0.148 [-1.45]
dLYFOR3	-3.4625	1.8685	0.064 [-1.85]
dLXM4	0.0253	1.4563	0.986 [0.02]
dLREER4	-2.0292	1.4438	0.16 [-1.41]
dLYDOM4	-2.2860	1.5290	0.135 [-1.5]
dLYFOR4	-3.0259	1.3234	0.022 [-2.29]
dLXM5	-1.1997	1.5309	0.433 [-0.78]
dLREER5	-1.2334	1.5682	0.432 [-0.79]
dLYDOM5	0.5569	1.5524	0.72 [0.36]
dLYFOR5	3.1399	1.4675	0.032 [2.14]

Diagnostics Test (F version)

R-Squared	0.442
D-Watson Test statistic	2.189
Serial Correlation	0.435
Functional Form	0.169
Heteroskedasticity	0.655

Figure 29: Trade balance/exchange rate results – Germany (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Germany *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
6	559.1324	409.1324*	286.3134
5	509.6156	384.6156	282.2665
4	459.021	359.021	277.1417
3	425.0912	350.0912	288.6817
2	409.5933	359.5933	318.6537
1	388.7865	363.7865	343.3167
0	40.8192	40.8192	40.8192

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	57.1316	29.68
r<= 1	r = 2	22.0973*	15.41
r<= 2	r = 3	3.4306	3.76

****

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =2.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	**Vector 2**
LXM	-1	**-1**
LREER	-0.24311	**0.35275**
LYDOM	-0.89148	**2.639**
LYFOR	0.96156	**-2.5094**

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.030077	0.022058	1.3635[.182]
ecm2(-1)	-0.049748	0.022058	-2.2553[.031]

****

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

****

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.1637153	0.2969073	0.55 [0.581]
dLREER1	0.0418914	0.3450649	0.12 [0.903]
dLYDOM1	-0.1622435	0.2410429	-0.67 [0.501]
dLYFOR1	-0.2778794	0.2364803	-1.18 [0.24]
dLXM2	-0.3574709	0.2600932	-1.37 [0.169]
dLREER2	-1.491077	1.600329	-0.93 [0.351]
dLYDOM2	-1.392576	1.30679	-1.07 [0.287]
dLYFOR2	-0.1395927	1.437588	-0.1 [0.923]
dLXM3	-0.7070549	1.253043	-0.56 [0.573]
dLREER3	-0.3809141	1.278557	-0.3 [0.766]
dLYDOM3	1.688183	1.616769	1.04 [0.296]
dLYFOR3	1.480785	1.393715	1.06 [0.288]
dLXM4	-0.1351973	1.512676	-0.09 [0.929]
dLREER4	0.4023499	1.374331	0.29 [0.77]
dLYDOM4	0.18691	1.417139	0.13 [0.895]
dLYFOR4	0.3161385	0.8508095	0.37 [0.71]
dLXM5	0.4766847	0.9757524	0.49 [0.625]
dLREER5	0.8950048	1.086823	0.82 [0.41]
dLYDOM5	2.176798	1.220437	1.78 [0.074]
dLYFOR5	1.044313	1.080377	0.97 [0.334]

****

Diagnostics Test (F version)

R-Squared	0.220
D-Watson Test statistic	2.137
Serial Correlation	0.264
Functional Form	0.666
Heteroskedasticity	0.466

Figure 30: Trade balance/exchange rate results – Greece (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Greece — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
6	473.6534	323.6534*	200.8344
5	423.8587	298.8587	196.5095
4	364.6427	264.6427	182.7634
3	338.3384	263.3384	201.9289
2	315.5932	265.5932	224.6536
1	285.0937	260.0937	239.6239
0	-97.4863	-97.4863	-97.4863

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	87.4597	29.68
r<= 1	r = 2	35.44*	15.41
r<= 2	r = 3	0.6795	3.76

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =2.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2
LXM	-1	-1
LREER	-4.8831	-49.0948
LYDOM	-2.5931	-19.6431
LYFOR	0.1114	0.1476

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.0044068	0.046453	-.094865[.925]
ecm2(-1)	0.020713	0.046453	.44588[.658

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.0077	0.1870	0.04 [0.967]
dLREER1	0.4697	0.2700	1.74 [0.082]
dLYDOM1	0.3214	0.2847	1.13 [0.259]
dLYFOR1	0.8490	0.2742	3.1 [0.002]
dLXM2	0.7144	0.2245	3.18 [0.001]
dLREER2	-1.9424	1.6939	-1.15 [0.252]
dLYDOM2	-0.8341	1.7038	-0.49 [0.624]
dLYFOR2	1.3830	1.2763	1.08 [0.279]
dLXM3	1.2512	1.1452	1.09 [0.275]
dLREER3	0.9787	1.0785	0.91 [0.364]
dLYDOM3	1.2968	1.8374	0.71 [0.48]
dLYFOR3	0.7176	1.8298	0.39 [0.695]
dLXM4	-0.9272	1.3454	-0.69 [0.491]
dLREER4	-0.8105	1.1783	-0.69 [0.492]
dLYDOM4	-1.1678	1.2030	-0.97 [0.332]
dLYFOR4	2.8172	1.2076	2.33 [0.02]
dLXM5	2.0103	0.9870	2.04 [0.042]
dLREER5	-0.6509	0.8672	-0.75 [0.453]
dLYDOM5	-2.7867	0.9584	-2.91 [0.004]
dLYFOR5	-0.8547	1.1347	-0.75 [0.451]

Diagnostics Test (F version)

R-Squared	0.341
D-Watson Test statistic	2.076
Serial Correlation	0.729
Functional Form	0.621
Heteroskedasticity	0.001

Figure 31: Trade balance/exchange rate results – Ireland (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Ireland — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
6	552.464	402.464*	279.645
5	478.2825	353.2825	250.9334
4	407.8916	307.8916	226.0123
3	377.9595	302.9595	241.55
2	357.9158	307.9158	266.9762
1	328.6369	303.6369	283.1671
0	-20.5438	-20.5438	-20.5438

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	81.6491	47.6979	29.68
r<= 1	r = 2	30.4779	19.755	15.41
r<= 2	r = 3	24.3278	6.2239*	3.76

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =3.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3
LXM	-1	-1	-1
LREER	2.773	2.5531	-1.1396
LYDOM	-0.097895	0.15938	-0.13601
LYFOR	-1.5434	-1.5504	0.81187

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.058173	0.03448	1.6872[.102]
ecm2(-1)	-0.063922	0.03448	-1.8539[.073]
ecm3(-1)	-0.046333	0.03448	-1.3438[.189]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.1999	0.5595	0.36 [0.721]
dLREER1	0.2224	0.5370	0.41 [0.679]
dLYDOM1	0.3705	0.4764	0.78 [0.437]
dLYFOR1	0.0150	0.4665	0.03 [0.974]
dLXM2	0.3023	0.3862	0.78 [0.434]
dLREER2	1.1427	0.9235	1.24 [0.216]
dLYDOM2	0.9382	0.8914	1.05 [0.293]
dLYFOR2	0.2240	0.7069	0.32 [0.751]
dLXM3	-0.0685	0.7229	-0.09 [0.925]
dLREER3	-0.4291	0.5823	-0.74 [0.461]
dLYDOM3	-0.7874	1.2254	-0.64 [0.521]
dLYFOR3	-0.7865	1.2164	-0.65 [0.518]
dLXM4	-0.2531	1.1144	-0.23 [0.82]
dLREER4	0.1629	1.0641	0.15 [0.878]
dLYDOM4	0.6182	0.7492	0.83 [0.409]
dLYFOR4	-1.7177	1.8424	-0.93 [0.351]
dLXM5	-0.1576	1.6578	-0.1 [0.924]
dLREER5	-0.5202	1.8270	-0.28 [0.776]
dLYDOM5	-0.1656	1.4529	-0.11 [0.909]
dLYFOR5	-1.5587	1.2601	-1.24 [0.216]

Diagnostics Test (F version)

R-Squared	0.233
D-Watson Test statistic	1.647
Serial Correlation	0.258
Functional Form	0.865
Heteroskedasticity	0.206

Figure 32: Trade balance/exchange rate results – Italy (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Italy — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6
List of variables included in the unrestricted VAR:
LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
6	590.6489	440.6489*	317.83
5	513.0915	388.0915	285.7424
4	458.5126	358.5126	276.6333
3	422.514	347.514	286.1045
2	397.5271	347.5271	306.5874
1	370.0865	345.0865	324.6167
0	-17.8277	-17.8277	-17.8277

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept
List of eigenvalues in descending order:
.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	68.0905	29.68
r<= 1	r = 2	29.726	15.41
r<= 2	r = 3	11.6618*	3.76

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by
Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =3.
List of variables included in the cointegrating vector:
LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3
LXM	**-1**	-1	-1
LREER	**0.34902**	0.68527	-0.094557
LYDOM	**-0.85688**	2.926	-1.5916
LYFOR	**0.45383**	-2.7254	1.316

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.032974	0.017134	1.9245[.064]
ecm2(-1)	0.024471	0.017134	1.4282[.163]
ecm3(-1)	-0.023	0.017134	-1.3424[.189]

Short Run adjustment Parameters
ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM
35 observations used for estimation from 2000Q2 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.4042	0.2643	1.53 [0.126]
dLREER1	0.4696	0.3310	1.42 [0.156]
dLYDOM1	0.3790	0.3062	1.24 [0.216]
dLYFOR1	0.5214	0.3054	1.71 [0.088]
dLXM2	0.2404	0.2830	0.85 [0.396]
dLREER2	1.3704	2.2068	0.62 [0.535]
dLYDOM2	-2.0862	1.6276	-1.28 [0.2]
dLYFOR2	-0.2351	2.0808	-0.11 [0.91]
dLXM3	-1.0018	1.7814	-0.56 [0.574]
dLREER3	1.5742	1.7093	0.92 [0.357]
dLYDOM3	-1.8199	2.1209	-0.86 [0.391]
dLYFOR3	2.3822	1.6054	1.48 [0.138]
dLXM4	0.1872	2.1274	0.09 [0.93]
dLREER4	1.4738	1.8165	0.81 [0.417]
dLYDOM4	-1.2927	1.7922	-0.72 [0.471]
dLYFOR4	1.9348	1.1972	1.62 [0.106]
dLXM5	-0.0111	1.3027	-0.01 [0.993]
dLREER5	0.8775	1.2710	0.69 [0.49]
dLYDOM5	-1.6249	1.2731	-1.28 [0.202]
dLYFOR5	-1.1503	1.3048	-0.88 [0.378]

Diagnostics Test (F version)

R-Squared	0.244
D-Watson Test statistic	1.986
Serial Correlation	0.958
Functional Form	0.729
Heteroskedasticity	0.688

Figure 33: Trade balance/exchange rate results – Netherlands (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Netherlands *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
6	619.4304	469.4304*	346.6114
5	540.8945	415.8945	313.5454
4	499.5972	399.5972	317.7179
3	449.6969	374.6969	313.2874
2	431.5403	381.5403	340.6007
1	413.7594	388.7594	368.2895
0	58.7686	58.7686	58.7686

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	66.9184	29.68
r<= 1	r = 2	27.6686	15.41
r<= 2	r = 3	9.7045*	3.76

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =3.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	**Vector 2**	Vector 3
LXM	-1	**-1**	-1
LREER	0.42157	**0.24445**	3.997
LYDOM	0.62902	**0.042816**	4.0952
LYFOR	-0.64348	**-0.1624**	-5.0194

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.016956	0.012112	-1.4000[.171]
ecm2(-1)	0.029028	0.012112	2.3967[.023]
ecm3(-1)	-0.012637	0.012112	-1.0434[.305]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.2966	0.5157	-0.58 [0.565]
dLREER1	-0.6058	0.5653	-1.07 [0.284]
dLYDOM1	-0.3618	0.5162	-0.7 [0.483]
dLYFOR1	0.2453	0.4287	0.57 [0.567]
dLXM2	0.2118	0.3308	0.64 [0.522]
dLREER2	2.2523	1.3442	1.68 [0.094]
dLYDOM2	3.1921	1.3458	2.37 [0.018]
dLYFOR2	2.7021	1.2060	2.24 [0.025]
dLXM3	1.5254	1.2668	1.2 [0.229]
dLREER3	1.0111	0.9979	1.01 [0.311]
dLYDOM3	-2.1522	1.3675	-1.57 [0.116]
dLYFOR3	-3.0602	1.3364	-2.29 [0.022]
dLXM4	-2.7454	1.1409	-2.41 [0.016]
dLREER4	-1.5469	1.2911	-1.2 [0.231]
dLYDOM4	-1.0662	1.0333	-1.03 [0.302]
dLYFOR4	0.1545	0.3925	0.39 [0.694]
dLXM5	-0.1050	0.3988	-0.26 [0.792]
dLREER5	0.6043	0.4318	1.4 [0.162]
dLYDOM5	0.1315	0.4745	0.28 [0.782]
dLYFOR5	-0.0957	0.4350	-0.22 [0.826]

Diagnostics Test (F version)

R-Squared	0.440
D-Watson Test statistic	2.047
Serial Correlation	0.161
Functional Form	0.448
Heteroskedasticity	0.233

Figure 34: Trade balance/exchange rate results – Portugal (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Portugal *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
6	612.2023	462.2023*	339.3833
5	500.7235	375.7235	273.3744
4	462.5343	362.5343	280.655
3	414.6418	339.6418	278.2323
2	401.2423	351.2423	310.3026
1	386.637	361.637	341.1672
0	31.4707	31.4707	31.4707

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	46.816	29.68
r<= 1	r = 2	16.5311*	15.41
r<= 2	r = 3	3.0838	3.76

****

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =2.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2
LXM	-1	-1
LREER	0.33629	-4.7272
LYDOM	0.80012	-8.8261
LYFOR	-0.6629	7.1953

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.033705	0.024186	1.3936[.173]
ecm2(-1)	0.042881	0.024186	1.7729[.086]

****

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

****

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.1507	0.3073	0.49 [0.624]
dLREER1	0.0642	0.2779	0.23 [0.817]
dLYDOM1	0.1033	0.3114	0.33 [0.74]
dLYFOR1	-0.0227	0.2555	-0.09 [0.929]
dLXM2	-0.2890	0.2422	-1.19 [0.233]
dLREER2	-1.8170	0.5634	-3.23 [0.001]
dLYDOM2	-1.1617	0.6749	-1.72 [0.085]
dLYFOR2	-1.6444	0.5943	-2.77 [0.006]
dLXM3	-1.5084	0.6831	-2.21 [0.027]
dLREER3	0.3533	0.6223	0.57 [0.57]
dLYDOM3	2.0801	0.6056	3.43 [0.001]
dLYFOR3	1.0062	0.7381	1.36 [0.173]
dLXM4	1.6761	0.6300	2.66 [0.008]
dLREER4	1.0956	0.7339	1.49 [0.136]
dLYDOM4	-0.7231	0.6970	-1.04 [0.299]
dLYFOR4	-2.2947	1.2039	-1.91 [0.057]
dLXM5	-0.6931	1.0783	-0.64 [0.52]
dLREER5	0.3970	0.9729	0.41 [0.683]
dLYDOM5	1.8987	0.7787	2.44 [0.015]
dLYFOR5	2.8262	0.9375	3.01 [0.003]
dLXM6	0.2955	0.22343	1.3226[.215]
dLREER6	-0.84019	0.87193	-.96360[.358]
dLYDOM6	0.27562	0.33559	.82129[.431]
dLYFOR6	-0.037743	0.6923	-.054518[.958]

****

Diagnostics Test (F version)

R-Squared	0.682
D-Watson Test statistic	1.930
Serial Correlation	0.948
Functional Form	0.661
Normality Heteroskedasticity	0.417

Figure 35: Trade balance/exchange rate results – Spain (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

Spain *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
6	512.2556	362.2556*	239.4366
5	459.1293	334.1293	231.7802
4	423.5721	323.5721	241.6928
3	396.915	321.915	260.5055
2	374.4345	324.4345	283.4948
1	357.6702	332.6702	312.2003
0	-24.529	-24.529	-24.529

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Based on 35 observations from 2000Q2 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	33.4066*	29.68
r<= 1	r = 2	11.2745	15.41
r<= 2	r = 3	3.5935	3.76

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =1.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1
LXM	-1
LREER	0.3724
LYDOM	-0.1321
LYFOR	0.4122

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.0062794	0.020639	-.30425[.763]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM

35 observations used for estimation from 2000Q2 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	-0.7724	0.8121	1 [0.318]
dLREER1	-0.4117	0.6621	-0.95 [0.342]
dLYDOM1	-0.1611	0.5966	-0.62 [0.534]
dLYFOR1	-0.1962	0.4659	-0.27 [0.787]
dLXM2	-0.3930	0.4792	-0.42 [0.674]
dLREER2	-2.1333	1.2908	-0.82 [0.412]
dLYDOM2	-1.5141	1.4026	-1.65 [0.098]
dLYFOR2	-1.2185	1.1465	-1.08 [0.28]
dLXM3	0.2688	0.7628	-1.06 [0.288]
dLREER3	-0.2386	0.5979	0.35 [0.725]
dLYDOM3	1.8114	1.3286	-0.4 [0.69]
dLYFOR3	1.4324	1.3359	1.36 [0.173]
dLXM4	1.1064	1.0144	1.07 [0.284]
dLREER4	0.2685	0.7209	1.09 [0.275]
dLYDOM4	0.3306	0.4929	0.37 [0.71]
dLYFOR4	0.0409	1.5462	0.67 [0.502]
dLXM5	0.7659	1.2387	0.03 [0.979]
dLREER5	1.4891	1.3598	0.62 [0.536]
dLYDOM5	-1.7766	1.2338	1.1 [0.273]
dLYFOR5	-1.3979	1.1222	-1.44 [0.15]

Diagnostics Test (F version)

R-Squared	0.284
D-Watson Test statistic	2.051
Serial Correlation	0.864
Functional Form	0.775
Normality Heteroskedasticity	0.481

Figure 36: Trade balance/exchange rate results – UK (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

UK *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

Based on 33 observations from 2000Q4 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

Order	LL	AIC	SBC
7	475.8639	363.8639*	280.0595
6	410.1924	314.1924	242.36
5	368.9393	288.9393	229.079
4	343.2362	279.2362	231.3479
3	331.5335	283.5335	247.6173
2	327.2053	295.2053	271.2612
1	311.1005	295.1005	283.1284
0	4.6679	4.6679	4.6679

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

33 observations from 2000Q4 to 2008Q4. Order of VAR = 6.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	151.7046	28.27
r<= 1	r = 2	87.6545	22.04
r<= 2	r = 3	24.8124	15.87
r<= 3	r = 4	12.6191*	9.16

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by Cointegration with restricted intercepts and no trends in the VAR

35 observations from 2000Q2 to 2008Q4. Order of VAR = 6, chosen r =4.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

	Vector 1	Vector 2	Vector 3	Vector 4
LXM	**-1**	-1	-1	-1
LREER	**0.55915**	-13.4431	-0.066138	-1.0623
LYDOM	**2.9172**	9.4805	-0.24423	-3.553
LYFOR	**-0.4487**	-18.6187	0.077966	5.9703

Chosen vector shown in bold

Cointegrating Equations

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	0.092741	0.013761	6.7393[.001]
ecm2(-1)	-0.025029	0.013761	-1.8188[.129]
ecm3(-1)	0.02194	0.013761	1.5943[.172]
ecm4(-1)	0.013349	0.013761	.97003[.377]

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

Dependent variable is dLXM

33 observations used for estimation from 2000Q4 to 2008Q4

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.55713	0.32697	1.7039[.149]
dLREER1	0.5742	0.6645	.86411[.427]
dLYDOM1	-4.3796	0.82675	-5.2973[.003]
dLYFOR1	8.1019	1.6364	4.9512[.004]
dLXM2	0.46994	0.30158	1.5582[.180]
dLREER2	-0.47252	0.6047	-.78142[.470]
dLYDOM2	-4.1142	0.78638	-5.2319[.003]
dLYFOR2	5.1044	1.2338	4.1372[.009]
dLXM3	0.10188	0.28783	.35397[.738]
dLREER3	0.21628	0.58008	.37285[.725]
dLYDOM3	-3.9326	0.76454	-5.1437[.004]
dLYFOR3	3.4768	0.73587	4.7248[.005]
dLXM4	0.63211	0.23185	2.7264[.041]
dLREER4	0.75987	0.49333	1.5403[.184]
dLYDOM4	-2.8961	0.6506	-4.4514[.007]
dLYFOR4	1.132	0.49947	2.2664[.073]
dLXM5	0.76359	0.21115	3.6163[.015]
dLREER5	-0.66898	0.42277	-1.5824[.174]
dLYDOM5	-1.7352	0.56589	-3.0663[.028]
dLYFOR5	0.058185	0.59302	.098117[.926]
dLXM6	0.19186	0.23722	.80876[.455]
dLREER6	-1.2606	0.46906	-2.6875[.043]
dLYDOM6	-0.82507	0.30837	-2.6756[.044]
dLYFOR6	0.81032	0.39058	2.0746[.093]

Diagnostics Test (F version)

R-Squared	0.98
D-Watson Test statistic	2.45
Serial Correlation	0.189
Functional Form	0.498
Normality (LM version)	0.668
Heteroskedasticity	0.793

Figure 37: Trade balance/exchange rate results – US (1999 – 2008)

Multivariate Cointegration analysis to determine the relationship between the Real Effective Exchange Rate and the Trade Balance

US — *Period analysed 1999 to 2008*

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

****

Based on 33 observations from 2000Q4 to 2008Q4. Order of VAR = 6

List of variables included in the unrestricted VAR:

LXM LREER LYDOM LYFOR

****

Order	LL	AIC	SBC
7	572.3796	460.3796*	376.5752
6	496.0858	400.0858	328.2534
5	471.5803	391.5803	331.72
4	440.3268	376.3268	328.4386
3	421.6258	373.6258	337.7096
2	394.9005	362.9005	338.9564
1	377.762	361.762	349.7899
0	29.7471	29.7471	29.7471

AIC=Akaike Information Criterion SBC=Schwarz Bayesian Criterion

** denotes selected lag order*

Cointegration with restricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

Based on 33 observations from 2000Q4 to 2008Q4. Order of VAR = 6

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

List of eigenvalues in descending order:

.96932 .74335 .61155 .21848 0.00

****

Null	Alternative	Statistic	95% Critical Value
r = 0	r = 1	91.4294	23.92
r<= 1	r = 2	69.2722	17.68
r<= 2	r = 3	15.7887*	11.03
r<= 3	r = 4	2.6528	4.16

****

** denotes selected rank*

Estimated Cointegrated Vectors in Johansen Estimation shown by

Cointegration with restricted intercepts and no trends in the VAR

****

33 observations from 2000Q4 to 2008Q4. Order of VAR = 6, chosen r =3.

List of variables included in the cointegrating vector:

LXM LREER LYDOM LYFOR Intercept

****

	Vector 1	Vector 2	Vector 3
LXM	-1	-1	-1
LREER	2.2239	-0.47162	4.8178
LYDOM	-4.188	2.5033	-6.9974
LYFOR	3.1559	-2.4044	4.7291

****

Chosen vector shown in bold

Cointegrating Equations

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
ecm1(-1)	-0.014123	0.01912	-.73863[.488]
ecm2(-1)	0.019027	0.01912	.99515[.358]
ecm3(-1)	-0.036126	0.01912	-1.8895[.108]

****

Short Run adjustment Parameters

ECM for variable LXM estimated by OLS based on cointegrating VAR(6)

****

Dependent variable is dLXM

33 observations used for estimation from 2000Q4 to 2008Q4

****

Regressor	Coefficient	Std. Error	T-Ratio (Prob)
dLXM1	0.50411	0.75138	.67092[.527]
dLREER1	-1.1124	0.65438	-1.7000[.140]
dLYDOM1	-3.9242	2.0786	-1.8879[.108]
dLYFOR1	-0.63321	0.59718	-1.0603[.330]
dLXM2	0.048005	0.39001	.12309[.906]
dLREER2	0.36695	0.81489	.45031[.668]
dLYDOM2	0.99739	1.5375	.64872[.541]
dLYFOR2	0.076366	0.54215	.14086[.893]
dLXM3	0.085645	0.40095	.21361[.838]
dLREER3	0.45978	0.78028	.58925[.577]
dLYDOM3	1.0161	2.582	.39355[.708]
dLYFOR3	0.61914	0.57291	1.0807[.321]
dLXM4	-0.27548	0.36862	-.74733[.483]
dLREER4	1.3734	0.82166	1.6715[.146]
dLYDOM4	-1.9693	2.6503	-.74307[.486]
dLYFOR4	0.91295	0.59112	1.5444[.173]
dLXM5	0.25971	0.44749	.58038[.583]
dLREER5	0.085139	1.0473	.081296[.938]
dLYDOM5	-1.6633	2.2305	-.74569[.484]
dLYFOR5	0.57396	0.65457	.87686[.414]
dLXM6	0.071656	0.48911	.14650[.888]
dLREER6	0.60679	0.7865	.77151[.470]
dLYDOM6	-1.714	2.5434	-.67387[.525]
dLYFOR6	0.35683	0.52383	.68119[.521]

****

Diagnostics Test (F version)

R-Squared	0.85
D-Watson Test statistic	2.52
Serial Correlation	0.51
Functional Form	0.965
Normality (LM version)	0.952
Heteroskedasticity	0.748

Figure 38: Cointegration results for the Real Effective Exchange Rate and demand, supply and monetary shocks

Cointegration Test results for the Real Effective Exchange Rate and the temporary Demand, Supply and Monetary shock variables
This table shows the test statistic, the 95 per cent critical values and the rank of cointegrating vectors

Country	Pre EMU			Post EMU		
	Test Statistic	95% Critical Value	Rank	Test Statistic	95% Critical Value	Rank
Austria	16.8953	15.41	3	8.3678	3.76	4
Belgium	7.4232	3.7600	4	18.2671	3.76	3
Finland	10.1761	3.7600	4	36.4779	29.68	3
France	37.0041	15.41	3	10.7952	3.76	4
Germany	25.6971	15.41	3	6.8848	3.76	4
Greece	8.2894	3.76	4	18.798	3.76	2
Ireland	19.5301	3.76	3	9.4602	3.76	4
Italy	41.1023	15.41	2	50.5043	15.41	2
Netherlands	8.2840	3.76	4	46.0333	29.68	2
Portugal	26.5236	3.76	3	69.649	29.68	2
Spain	9.8921	3.76	4	5.5541	3.76	4
UK	54.4495	29.68	2	12.0427	15.41	4
US	7.9082	3.76	4	22.5155	3.76	3

Data Sources: IMF, OECD, Bank of International Settlements

Figure 39: Lag structure for employment, unemployment and real wages growth rates

Lag structure for employment, unemployment and wage growth regressions for both time periods

Country	Employment		Unemployment		Wages	
	Pre EMU	Post EMU	Pre EMU	Post EMU	Pre EMU	Post EMU
Austria	1	1	1	1	4	1
Belgium	4	1	2	1	1	1
Finland	1	2	1	1	1	1
France	1	1	1	1	1	1
Germany	1	1	1	1	1	1
Ireland	3	1	2	3	1	4
Italy	1	1	1	1	1	1
Netherlands	1	1	2	4	2	1
Portugal	1	1	1	1	1	1
Spain	1	1	1	1	1	1
UK	1	2	1	2	1	1
US	1	1	1	1	2	1

Figure 40(a): Asymmetry Index Finland versus the rest

Finland versus the rest

Pre EMU

Quarters	France	Germany	Ireland	Italy	letherland.	UK	US
Q1 1988	0.40	2.04	2.49	0.16	2.81	1.42	0.14
Q2 1988	0.18	1.83	2.25	0.09	2.51	1.32	0.08
Q3 1988	0.04	1.63	2.01	0.03	2.21	1.21	0.01
Q4 1988	0.26	1.42	1.76	0.04	1.90	1.12	0.05
Q1 1989	0.48	1.20	1.52	0.10	1.60	1.02	0.11
Q2 1989	0.69	0.99	1.28	0.17	1.30	0.92	0.17
Q3 1989	0.89	0.77	1.04	0.23	1.01	0.84	0.23
Q4 1989	1.08	0.54	0.81	0.29	0.72	0.76	0.29
Q1 1990	1.26	0.31	0.59	0.35	0.45	0.69	0.34
Q2 1990	1.41	0.08	0.38	0.41	0.18	0.63	0.38
Q3 1990	1.55	0.15	0.18	0.46	0.06	0.58	0.41
Q4 1990	1.67	0.37	0.00	0.50	0.28	0.54	0.43
Q1 1991	1.77	0.58	0.15	0.54	0.48	0.51	0.44
Q2 1991	1.84	0.77	0.29	0.57	0.66	0.50	0.43
Q3 1991	1.88	0.94	0.40	0.59	0.80	0.50	0.41
Q4 1991	1.89	1.09	0.49	0.59	0.91	0.51	0.37
Q1 1992	1.88	1.20	0.56	0.58	1.00	0.53	0.32
Q2 1992	1.84	1.29	0.61	0.56	1.05	0.56	0.26
Q3 1992	1.77	1.35	0.63	0.52	1.08	0.60	0.20
Q4 1992	1.68	1.38	0.64	0.48	1.08	0.64	0.13
Q1 1993	1.58	1.39	0.64	0.42	1.07	0.69	0.07
Q2 1993	1.45	1.38	0.63	0.37	1.04	0.74	0.00
Q3 1993	1.32	1.35	0.61	0.31	1.00	0.79	0.06
Q4 1993	1.18	1.30	0.58	0.24	0.95	0.83	0.11
Q1 1994	1.04	1.25	0.56	0.18	0.91	0.87	0.16
Q2 1994	0.90	1.18	0.53	0.12	0.86	0.91	0.21
Q3 1994	0.76	1.11	0.51	0.07	0.82	0.94	0.24
Q4 1994	0.63	1.02	0.50	0.01	0.79	0.96	0.28
Q1 1995	0.49	0.93	0.50	0.05	0.77	0.98	0.30
Q2 1995	0.37	0.83	0.50	0.12	0.76	0.98	0.33
Q3 1995	0.25	0.73	0.50	0.18	0.76	0.98	0.35
Q4 1995	0.14	0.63	0.52	0.25	0.77	0.97	0.37
Q1 1996	0.05	0.53	0.54	0.32	0.79	0.95	0.40
Q2 1996	0.04	0.43	0.57	0.39	0.82	0.92	0.42
Q3 1996	0.10	0.34	0.60	0.45	0.87	0.88	0.45
Q4 1996	0.14	0.25	0.64	0.52	0.92	0.84	0.48
Q1 1997	0.17	0.17	0.68	0.58	0.98	0.80	0.51
Q2 1997	0.17	0.09	0.73	0.63	1.05	0.75	0.54
Q3 1997	0.15	0.03	0.77	0.68	1.12	0.70	0.57
Q4 1997	0.12	0.03	0.82	0.72	1.19	0.66	0.60
Q1 1998	0.07	0.08	0.86	0.75	1.26	0.61	0.63
Q2 1998	0.01	0.12	0.91	0.77	1.32	0.56	0.65
Q3 1998	0.06	0.15	0.95	0.78	1.38	0.52	0.66
Q4 1998	0.14	0.18	1.00	0.77	1.43	0.48	0.67

Post EMU

Quarters	France	Germany	Ireland	Italy	letherland.	UK	US
Q1 1999	0.22	0.19	1.04	0.76	1.46	0.44	0.67
Q2 1999	0.29	0.20	1.08	0.73	1.48	0.40	0.65
Q3 1999	0.37	0.21	1.12	0.69	1.47	0.37	0.63
Q4 1999	0.44	0.21	1.15	0.64	1.45	0.35	0.59
Q1 2000	0.50	0.22	1.18	0.59	1.40	0.33	0.53
Q2 2000	0.54	0.23	1.20	0.54	1.32	0.31	0.47
Q3 2000	0.57	0.26	1.22	0.48	1.22	0.30	0.39
Q4 2000	0.59	0.29	1.23	0.43	1.10	0.29	0.31
Q1 2001	0.59	0.33	1.24	0.38	0.96	0.29	0.22
Q2 2001	0.58	0.38	1.24	0.34	0.79	0.29	0.13
Q3 2001	0.56	0.44	1.24	0.31	0.61	0.30	0.05
Q4 2001	0.54	0.51	1.24	0.29	0.42	0.32	0.02
Q1 2002	0.50	0.58	1.24	0.27	0.23	0.33	0.07
Q2 2002	0.47	0.66	1.24	0.26	0.03	0.35	0.12
Q3 2002	0.43	0.73	1.23	0.25	0.15	0.38	0.14
Q4 2002	0.40	0.80	1.23	0.25	0.33	0.40	0.15
Q1 2003	0.37	0.86	1.22	0.25	0.48	0.43	0.15
Q2 2003	0.35	0.91	1.22	0.26	0.62	0.46	0.12
Q3 2003	0.34	0.94	1.21	0.26	0.72	0.48	0.08
Q4 2003	0.34	0.95	1.21	0.26	0.80	0.50	0.04
Q1 2004	0.34	0.94	1.20	0.25	0.85	0.52	0.02
Q2 2004	0.36	0.90	1.19	0.25	0.86	0.54	0.07
Q3 2004	0.38	0.84	1.18	0.24	0.84	0.54	0.13
Q4 2004	0.41	0.75	1.17	0.22	0.79	0.55	0.18
Q1 2005	0.44	0.63	1.16	0.21	0.70	0.55	0.22
Q2 2005	0.48	0.48	1.14	0.19	0.59	0.54	0.26
Q3 2005	0.53	0.30	1.12	0.16	0.45	0.53	0.28
Q4 2005	0.57	0.09	1.10	0.14	0.28	0.51	0.29
Q1 2006	0.62	0.14	1.07	0.12	0.09	0.49	0.29
Q2 2006	0.66	0.38	1.03	0.10	0.13	0.46	0.27
Q3 2006	0.71	0.65	0.99	0.08	0.35	0.44	0.23
Q4 2006	0.75	0.92	0.93	0.07	0.59	0.40	0.19
Q1 2007	0.79	1.20	0.87	0.07	0.84	0.37	0.13
Q2 2007	0.82	1.48	0.80	0.07	1.10	0.33	0.05
Q3 2007	0.85	1.77	0.72	0.08	1.36	0.29	0.03
Q4 2007	0.87	2.05	0.64	0.10	1.62	0.25	0.12
Q1 2008	0.89	2.33	0.54	0.12	1.88	0.21	0.22
Q2 2008	0.90	2.61	0.44	0.15	2.13	0.16	0.33
Q3 2008	0.91	2.89	0.34	0.18	2.39	0.11	0.44
Q4 2008	0.92	3.16	0.24	0.21	2.65	0.07	0.55

Figure 40(b) Asymmetry Index graphs – Finland versus the rest

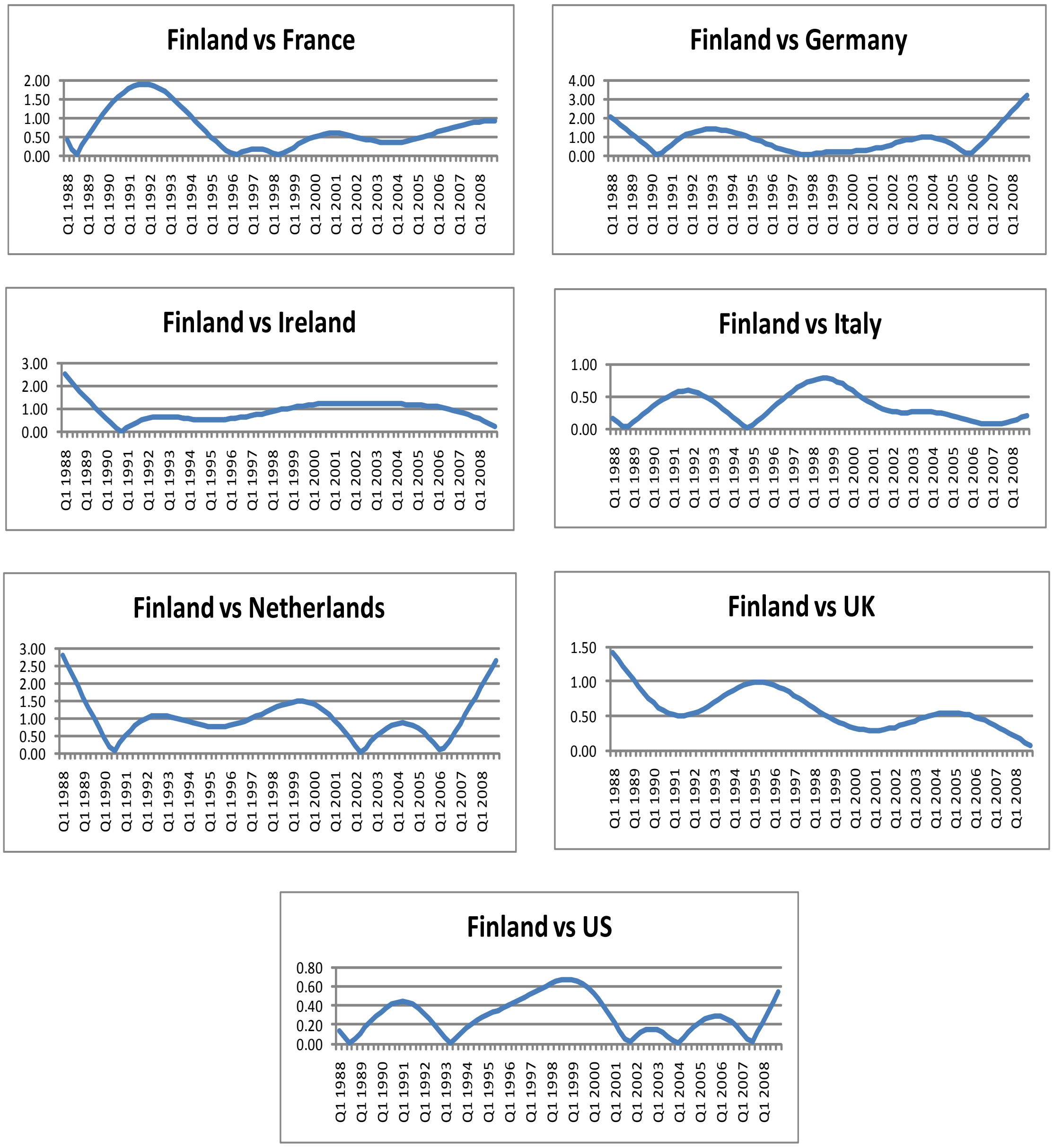

Figure 41(a): Asymmetry Index France versus the rest

France versus the rest

Pre EMU

Quarters	Finland	Germany	Ireland	Italy	N'lands	UK	US
Q1 1988	0.40	1.64	2.09	0.24	2.41	1.82	0.54
Q2 1988	0.18	1.65	2.07	0.09	2.33	1.50	0.26
Q3 1988	0.04	1.67	2.05	0.07	2.25	1.17	0.03
Q4 1988	0.26	1.68	2.02	0.22	2.16	0.85	0.31
Q1 1989	0.48	1.68	2.00	0.37	2.08	0.54	0.59
Q2 1989	0.69	1.68	1.97	0.52	1.99	0.24	0.86
Q3 1989	0.89	1.66	1.93	0.66	1.90	0.05	1.12
Q4 1989	1.08	1.62	1.89	0.79	1.80	0.32	1.37
Q1 1990	1.26	1.57	1.84	0.90	1.70	0.57	1.59
Q2 1990	1.41	1.50	1.79	1.01	1.60	0.79	1.79
Q3 1990	1.55	1.41	1.74	1.10	1.49	0.98	1.96
Q4 1990	1.67	1.30	1.68	1.17	1.39	1.13	2.10
Q1 1991	1.77	1.19	1.61	1.23	1.28	1.25	2.21
Q2 1991	1.84	1.07	1.55	1.27	1.18	1.33	2.27
Q3 1991	1.88	0.94	1.48	1.29	1.08	1.38	2.29
Q4 1991	1.89	0.81	1.41	1.30	0.98	1.38	2.27
Q1 1992	1.88	0.68	1.32	1.30	0.89	1.35	2.20
Q2 1992	1.84	0.55	1.24	1.28	0.79	1.28	2.11
Q3 1992	1.77	0.42	1.14	1.25	0.70	1.17	1.97
Q4 1992	1.68	0.30	1.04	1.21	0.60	1.04	1.82
Q1 1993	1.58	0.19	0.93	1.15	0.51	0.89	1.64
Q2 1993	1.45	0.08	0.83	1.09	0.42	0.72	1.46
Q3 1993	1.32	0.03	0.71	1.02	0.32	0.54	1.27
Q4 1993	1.18	0.12	0.60	0.94	0.23	0.35	1.07
Q1 1994	1.04	0.21	0.49	0.86	0.13	0.17	0.88
Q2 1994	0.90	0.28	0.37	0.78	0.04	0.01	0.70
Q3 1994	0.76	0.34	0.25	0.70	0.06	0.18	0.52
Q4 1994	0.63	0.40	0.13	0.62	0.17	0.34	0.35
Q1 1995	0.49	0.44	0.00	0.55	0.28	0.48	0.19
Q2 1995	0.37	0.47	0.13	0.48	0.39	0.62	0.04
Q3 1995	0.25	0.49	0.26	0.43	0.51	0.73	0.10
Q4 1995	0.14	0.49	0.38	0.39	0.63	0.83	0.23
Q1 1996	0.05	0.49	0.50	0.36	0.74	0.90	0.35
Q2 1996	0.04	0.47	0.60	0.35	0.86	0.95	0.46
Q3 1996	0.10	0.44	0.70	0.36	0.97	0.98	0.55
Q4 1996	0.14	0.39	0.78	0.38	1.06	0.99	0.62
Q1 1997	0.17	0.33	0.85	0.41	1.15	0.97	0.68
Q2 1997	0.17	0.26	0.90	0.46	1.22	0.92	0.71
Q3 1997	0.15	0.18	0.92	0.53	1.27	0.86	0.73
Q4 1997	0.12	0.09	0.94	0.60	1.31	0.78	0.72
Q1 1998	0.07	0.01	0.93	0.68	1.33	0.68	0.70
Q2 1998	0.01	0.11	0.92	0.76	1.33	0.57	0.66
Q3 1998	0.06	0.21	0.89	0.84	1.32	0.46	0.60
Q4 1998	0.14	0.31	0.86	0.91	1.29	0.34	0.53

Post EMU

Quarters	Finland	Germany	Ireland	Italy	N'lands	UK	US
Q1 1999	0.22	0.41	0.83	0.97	1.24	0.22	0.45
Q2 1999	0.29	0.50	0.79	1.02	1.18	0.11	0.36
Q3 1999	0.37	0.58	0.75	1.06	1.10	0.00	0.26
Q4 1999	0.44	0.65	0.71	1.08	1.01	0.09	0.15
Q1 2000	0.50	0.72	0.68	1.09	0.90	0.17	0.04
Q2 2000	0.54	0.77	0.66	1.08	0.78	0.23	0.07
Q3 2000	0.57	0.83	0.65	1.05	0.65	0.27	0.18
Q4 2000	0.59	0.88	0.64	1.02	0.51	0.30	0.28
Q1 2001	0.59	0.92	0.64	0.97	0.36	0.30	0.37
Q2 2001	0.58	0.96	0.66	0.93	0.21	0.29	0.45
Q3 2001	0.56	1.00	0.68	0.87	0.05	0.26	0.51
Q4 2001	0.54	1.04	0.71	0.82	0.11	0.22	0.55
Q1 2002	0.50	1.08	0.74	0.77	0.28	0.17	0.58
Q2 2002	0.47	1.12	0.77	0.73	0.43	0.11	0.59
Q3 2002	0.43	1.16	0.80	0.69	0.59	0.06	0.58
Q4 2002	0.40	1.20	0.83	0.65	0.73	0.00	0.55
Q1 2003	0.37	1.24	0.85	0.63	0.86	0.06	0.52
Q2 2003	0.35	1.26	0.87	0.61	0.97	0.10	0.48
Q3 2003	0.34	1.28	0.87	0.60	1.07	0.14	0.43
Q4 2003	0.34	1.29	0.87	0.60	1.14	0.17	0.38
Q1 2004	0.34	1.28	0.86	0.60	1.19	0.18	0.33
Q2 2004	0.36	1.26	0.83	0.60	1.22	0.18	0.29
Q3 2004	0.38	1.22	0.80	0.62	1.22	0.16	0.25
Q4 2004	0.41	1.16	0.76	0.63	1.20	0.14	0.23
Q1 2005	0.44	1.07	0.72	0.65	1.15	0.10	0.22
Q2 2005	0.48	0.96	0.66	0.67	1.07	0.06	0.22
Q3 2005	0.53	0.82	0.60	0.69	0.97	0.00	0.24
Q4 2005	0.57	0.66	0.53	0.71	0.85	0.06	0.28
Q1 2006	0.62	0.48	0.45	0.74	0.70	0.13	0.33
Q2 2006	0.66	0.28	0.37	0.76	0.54	0.20	0.40
Q3 2006	0.71	0.06	0.28	0.79	0.36	0.27	0.48
Q4 2006	0.75	0.17	0.18	0.82	0.16	0.35	0.56
Q1 2007	0.79	0.41	0.08	0.86	0.05	0.42	0.66
Q2 2007	0.82	0.66	0.02	0.89	0.27	0.49	0.77
Q3 2007	0.85	0.92	0.13	0.93	0.51	0.56	0.88
Q4 2007	0.87	1.18	0.24	0.97	0.74	0.62	0.99
Q1 2008	0.89	1.44	0.35	1.01	0.99	0.68	1.11
Q2 2008	0.90	1.71	0.46	1.05	1.23	0.74	1.23
Q3 2008	0.91	1.97	0.57	1.09	1.48	0.80	1.35
Q4 2008	0.92	2.24	0.68	1.13	1.72	0.85	1.47

Figure 41(b): Asymmetry Index graphs France versus the rest

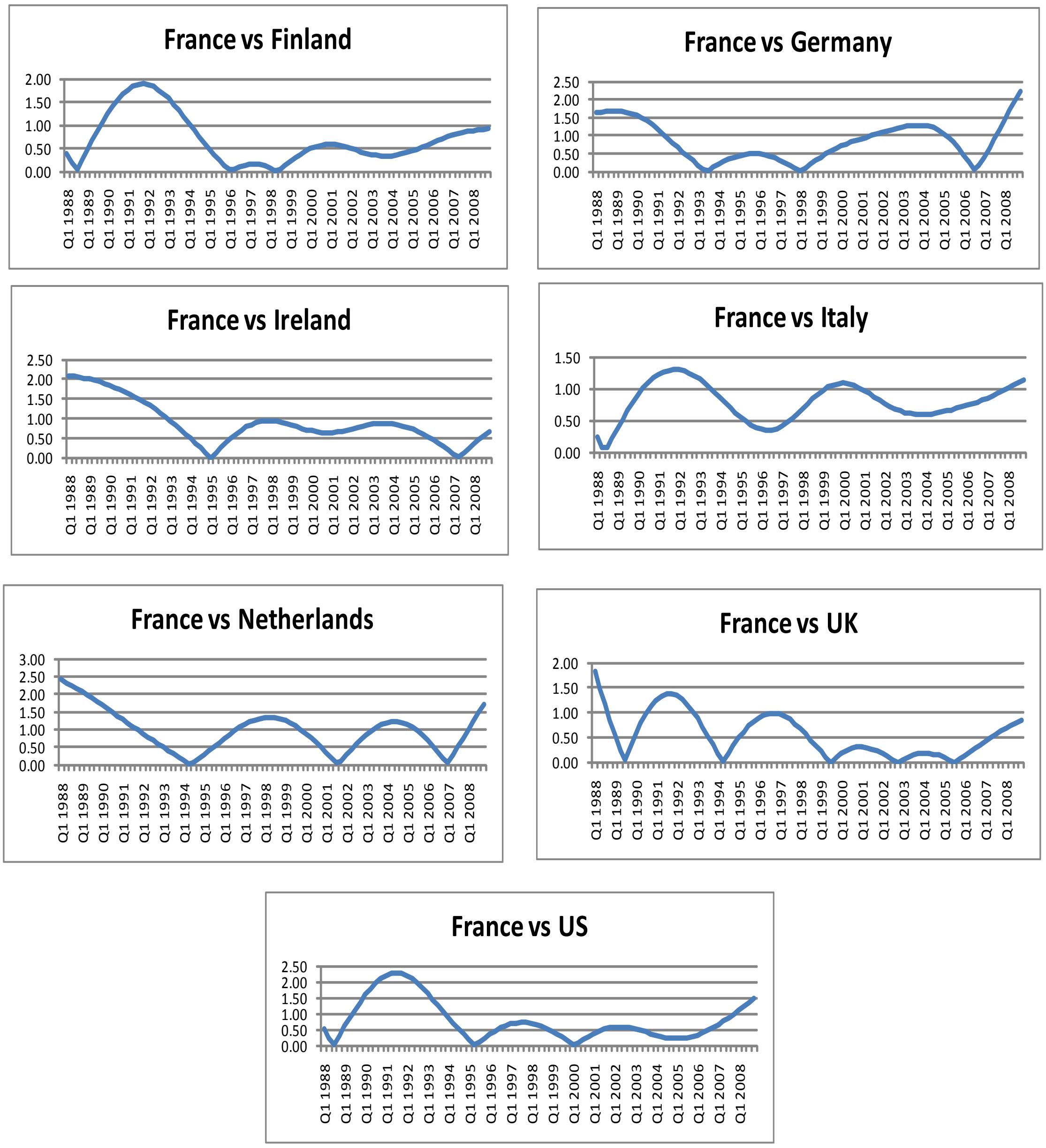

Figure 42(a): Asymmetry Index Germany versus the rest

Germany versus the rest

Pre EMU

Quarters	Finland	France	Ireland	Italy	N'lands	UK	US
Q1 1988	2.04	1.64	0.45	1.88	0.77	3.46	2.18
Q2 1988	1.83	1.65	0.41	1.74	0.67	3.15	1.91
Q3 1988	1.63	1.67	0.38	1.60	0.58	2.84	1.64
Q4 1988	1.42	1.68	0.35	1.46	0.49	2.53	1.37
Q1 1989	1.20	1.68	0.32	1.31	0.40	2.22	1.09
Q2 1989	0.99	1.68	0.29	1.16	0.32	1.91	0.81
Q3 1989	0.77	1.66	0.28	1.00	0.24	1.60	0.53
Q4 1989	0.54	1.62	0.27	0.83	0.18	1.30	0.25
Q1 1990	0.31	1.57	0.28	0.66	0.14	1.00	0.02
Q2 1990	0.08	1.50	0.30	0.49	0.10	0.71	0.30
Q3 1990	0.15	1.41	0.33	0.31	0.09	0.43	0.56
Q4 1990	0.37	1.30	0.37	0.13	0.08	0.17	0.80
Q1 1991	0.58	1.19	0.43	0.04	0.09	0.06	1.02
Q2 1991	0.77	1.07	0.48	0.20	0.11	0.27	1.20
Q3 1991	0.94	0.94	0.54	0.36	0.14	0.44	1.35
Q4 1991	1.09	0.81	0.60	0.50	0.17	0.57	1.46
Q1 1992	1.20	0.68	0.65	0.62	0.21	0.67	1.53
Q2 1992	1.29	0.55	0.69	0.73	0.24	0.73	1.56
Q3 1992	1.35	0.42	0.72	0.83	0.27	0.75	1.55
Q4 1992	1.38	0.30	0.74	0.91	0.30	0.74	1.52
Q1 1993	1.39	0.19	0.75	0.97	0.32	0.70	1.46
Q2 1993	1.38	0.08	0.75	1.01	0.34	0.64	1.38
Q3 1993	1.35	0.03	0.74	1.04	0.35	0.56	1.29
Q4 1993	1.30	0.12	0.72	1.06	0.35	0.47	1.19
Q1 1994	1.25	0.21	0.69	1.06	0.34	0.37	1.09
Q2 1994	1.18	0.28	0.65	1.06	0.32	0.27	0.98
Q3 1994	1.11	0.34	0.59	1.04	0.28	0.16	0.86
Q4 1994	1.02	0.40	0.52	1.01	0.23	0.06	0.75
Q1 1995	0.93	0.44	0.44	0.98	0.16	0.05	0.63
Q2 1995	0.83	0.47	0.34	0.95	0.08	0.15	0.51
Q3 1995	0.73	0.49	0.23	0.91	0.02	0.24	0.38
Q4 1995	0.63	0.49	0.11	0.88	0.13	0.33	0.26
Q1 1996	0.53	0.49	0.01	0.85	0.26	0.41	0.13
Q2 1996	0.43	0.47	0.14	0.82	0.39	0.48	0.01
Q3 1996	0.34	0.44	0.26	0.79	0.53	0.54	0.11
Q4 1996	0.25	0.39	0.39	0.77	0.67	0.59	0.23
Q1 1997	0.17	0.33	0.52	0.75	0.82	0.63	0.35
Q2 1997	0.09	0.26	0.63	0.73	0.96	0.66	0.45
Q3 1997	0.03	0.18	0.74	0.71	1.09	0.68	0.55
Q4 1997	0.03	0.09	0.85	0.69	1.22	0.69	0.63
Q1 1998	0.08	0.01	0.94	0.67	1.34	0.69	0.71
Q2 1998	0.12	0.11	1.03	0.65	1.44	0.68	0.77
Q3 1998	0.15	0.21	1.11	0.62	1.53	0.67	0.82
Q4 1998	0.18	0.31	1.17	0.60	1.60	0.65	0.85

Post EMU

Quarters	Finland	France	Ireland	Italy	N'lands	UK	US
Q1 1999	0.19	0.41	1.23	0.57	1.65	0.63	0.86
Q2 1999	0.20	0.50	1.28	0.53	1.68	0.61	0.86
Q3 1999	0.21	0.58	1.33	0.48	1.68	0.58	0.83
Q4 1999	0.21	0.65	1.36	0.43	1.66	0.56	0.80
Q1 2000	0.22	0.72	1.40	0.37	1.62	0.55	0.75
Q2 2000	0.23	0.77	1.43	0.30	1.56	0.54	0.70
Q3 2000	0.26	0.83	1.47	0.23	1.48	0.55	0.65
Q4 2000	0.29	0.88	1.52	0.14	1.39	0.58	0.59
Q1 2001	0.33	0.92	1.56	0.05	1.28	0.62	0.55
Q2 2001	0.38	0.96	1.62	0.04	1.17	0.67	0.51
Q3 2001	0.44	1.00	1.68	0.13	1.05	0.74	0.49
Q4 2001	0.51	1.04	1.75	0.22	0.93	0.82	0.49
Q1 2002	0.58	1.08	1.82	0.31	0.81	0.91	0.51
Q2 2002	0.66	1.12	1.89	0.40	0.69	1.01	0.54
Q3 2002	0.73	1.16	1.96	0.48	0.58	1.11	0.59
Q4 2002	0.80	1.20	2.03	0.55	0.47	1.20	0.65
Q1 2003	0.86	1.24	2.09	0.61	0.38	1.29	0.72
Q2 2003	0.91	1.26	2.13	0.65	0.29	1.37	0.79
Q3 2003	0.94	1.28	2.15	0.68	0.22	1.42	0.86
Q4 2003	0.95	1.29	2.16	0.69	0.15	1.46	0.91
Q1 2004	0.94	1.28	2.14	0.69	0.09	1.46	0.96
Q2 2004	0.90	1.26	2.10	0.66	0.04	1.44	0.98
Q3 2004	0.84	1.22	2.02	0.60	0.00	1.38	0.97
Q4 2004	0.75	1.16	1.92	0.53	0.04	1.30	0.93
Q1 2005	0.63	1.07	1.79	0.42	0.08	1.17	0.85
Q2 2005	0.48	0.96	1.62	0.29	0.11	1.01	0.74
Q3 2005	0.30	0.82	1.42	0.13	0.15	0.82	0.58
Q4 2005	0.09	0.66	1.19	0.05	0.18	0.60	0.38
Q1 2006	0.14	0.48	0.93	0.26	0.22	0.35	0.15
Q2 2006	0.38	0.28	0.65	0.48	0.26	0.08	0.12
Q3 2006	0.65	0.06	0.34	0.73	0.29	0.21	0.41
Q4 2006	0.92	0.17	0.01	0.99	0.33	0.51	0.73
Q1 2007	1.20	0.41	0.33	1.27	0.36	0.83	1.07
Q2 2007	1.48	0.66	0.68	1.55	0.39	1.15	1.43
Q3 2007	1.77	0.92	1.04	1.85	0.41	1.47	1.80
Q4 2007	2.05	1.18	1.42	2.15	0.43	1.80	2.17
Q1 2008	2.33	1.44	1.79	2.45	0.46	2.13	2.55
Q2 2008	2.61	1.71	2.17	2.76	0.48	2.45	2.94
Q3 2008	2.89	1.97	2.54	3.06	0.50	2.77	3.32
Q4 2008	3.16	2.24	2.92	3.37	0.51	3.09	3.71

Figure 42(b): Asymmetry Index graphs Finland versus the rest

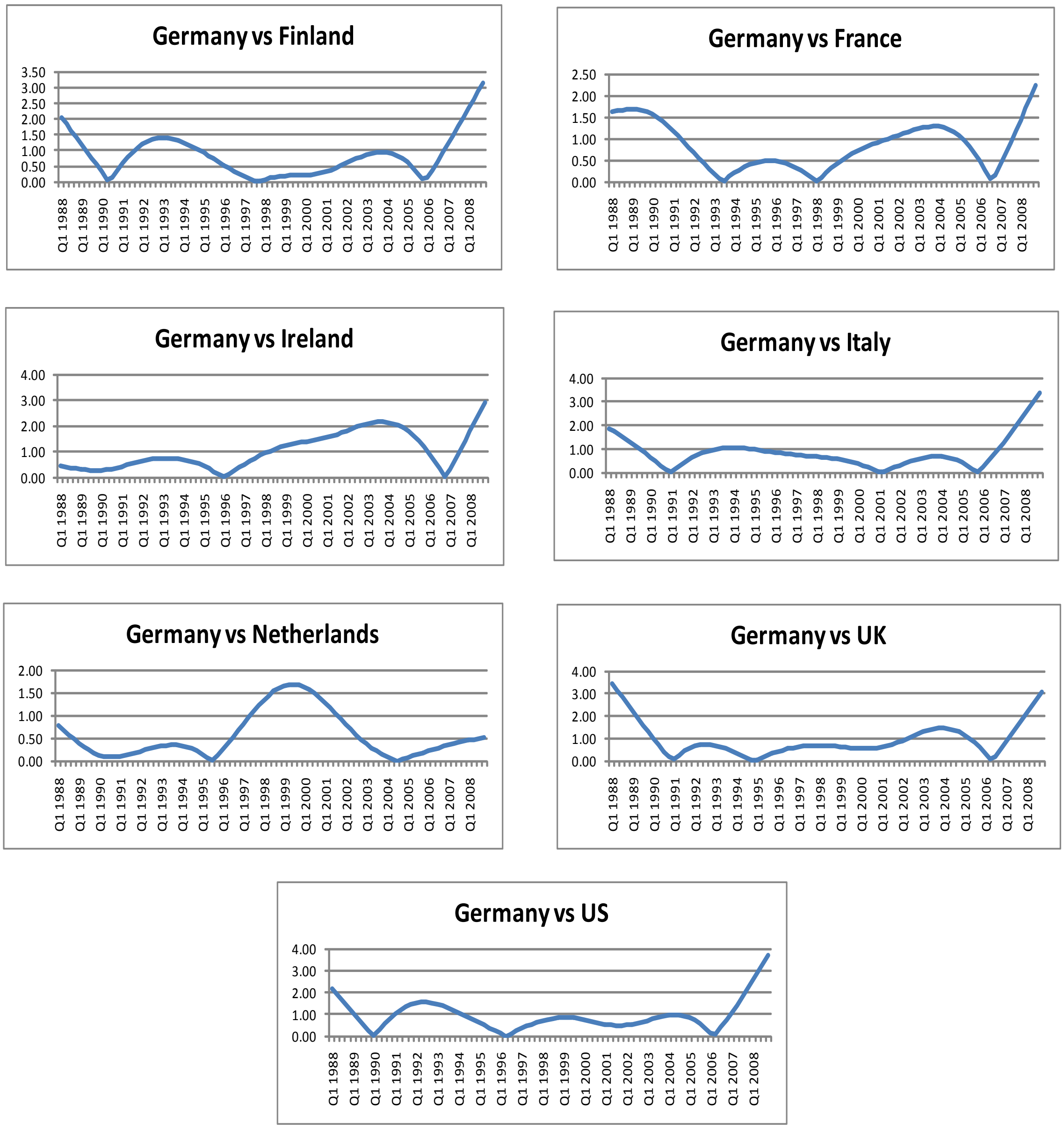

Figure 43(a): Asymmetry Index Ireland versus the rest

Ireland versus the rest

Pre EMU

Quarters	Finland	France	Germany	Italy	N'lands	UK	US
Q1 1988	2.49	2.09	0.45	2.33	0.32	3.91	2.63
Q2 1988	2.25	2.07	0.41	2.15	0.26	3.56	2.32
Q3 1988	2.01	2.05	0.38	1.98	0.20	3.22	2.02
Q4 1988	1.76	2.02	0.35	1.80	0.14	2.88	1.71
Q1 1989	1.52	2.00	0.32	1.62	0.08	2.54	1.41
Q2 1989	1.28	1.97	0.29	1.45	0.02	2.20	1.11
Q3 1989	1.04	1.93	0.28	1.27	0.03	1.88	0.81
Q4 1989	0.81	1.89	0.27	1.10	0.09	1.57	0.52
Q1 1990	0.59	1.84	0.28	0.94	0.14	1.27	0.25
Q2 1990	0.38	1.79	0.30	0.78	0.19	1.00	0.00
Q3 1990	0.18	1.74	0.33	0.64	0.24	0.76	0.23
Q4 1990	0.00	1.68	0.37	0.51	0.29	0.54	0.43
Q1 1991	0.15	1.61	0.43	0.39	0.33	0.36	0.59
Q2 1991	0.29	1.55	0.48	0.28	0.37	0.22	0.72
Q3 1991	0.40	1.48	0.54	0.19	0.40	0.10	0.81
Q4 1991	0.49	1.41	0.60	0.10	0.42	0.02	0.86
Q1 1992	0.56	1.32	0.65	0.02	0.44	0.02	0.88
Q2 1992	0.61	1.24	0.69	0.05	0.44	0.04	0.87
Q3 1992	0.63	1.14	0.72	0.11	0.44	0.03	0.83
Q4 1992	0.64	1.04	0.74	0.17	0.44	0.00	0.78
Q1 1993	0.64	0.93	0.75	0.22	0.43	0.05	0.71
Q2 1993	0.63	0.83	0.75	0.26	0.41	0.11	0.63
Q3 1993	0.61	0.71	0.74	0.30	0.39	0.18	0.55
Q4 1993	0.58	0.60	0.72	0.34	0.37	0.25	0.47
Q1 1994	0.56	0.49	0.69	0.37	0.35	0.32	0.39
Q2 1994	0.53	0.37	0.65	0.41	0.33	0.38	0.33
Q3 1994	0.51	0.25	0.59	0.45	0.31	0.43	0.27
Q4 1994	0.50	0.13	0.52	0.49	0.29	0.46	0.23
Q1 1995	0.50	0.00	0.44	0.55	0.27	0.48	0.19
Q2 1995	0.50	0.13	0.34	0.61	0.26	0.49	0.17
Q3 1995	0.50	0.26	0.23	0.68	0.25	0.47	0.15
Q4 1995	0.52	0.38	0.11	0.77	0.25	0.45	0.15
Q1 1996	0.54	0.50	0.01	0.86	0.25	0.40	0.14
Q2 1996	0.57	0.60	0.14	0.95	0.26	0.35	0.14
Q3 1996	0.60	0.70	0.26	1.06	0.27	0.28	0.15
Q4 1996	0.64	0.78	0.39	1.16	0.28	0.20	0.16
Q1 1997	0.68	0.85	0.52	1.26	0.30	0.12	0.17
Q2 1997	0.73	0.90	0.63	1.36	0.32	0.03	0.18
Q3 1997	0.77	0.92	0.74	1.45	0.35	0.07	0.20
Q4 1997	0.82	0.94	0.85	1.54	0.37	0.16	0.21
Q1 1998	0.86	0.93	0.94	1.61	0.40	0.25	0.23
Q2 1998	0.91	0.92	1.03	1.68	0.41	0.35	0.26
Q3 1998	0.95	0.89	1.11	1.73	0.42	0.44	0.29
Q4 1998	1.00	0.86	1.17	1.77	0.43	0.52	0.33

Post EMU

Quarters	Finland	France	Germany	Italy	N'lands	UK	US
Q1 1999	1.04	0.83	1.23	1.80	0.42	0.60	0.37
Q2 1999	1.08	0.79	1.28	1.81	0.39	0.68	0.43
Q3 1999	1.12	0.75	1.33	1.81	0.36	0.74	0.49
Q4 1999	1.15	0.71	1.36	1.79	0.30	0.80	0.56
Q1 2000	1.18	0.68	1.40	1.77	0.22	0.85	0.64
Q2 2000	1.20	0.66	1.43	1.74	0.12	0.89	0.73
Q3 2000	1.22	0.65	1.47	1.70	0.01	0.92	0.83
Q4 2000	1.23	0.64	1.52	1.66	0.13	0.94	0.92
Q1 2001	1.24	0.64	1.56	1.62	0.28	0.95	1.02
Q2 2001	1.24	0.66	1.62	1.58	0.45	0.95	1.11
Q3 2001	1.24	0.68	1.68	1.55	0.63	0.94	1.19
Q4 2001	1.24	0.71	1.75	1.53	0.82	0.93	1.26
Q1 2002	1.24	0.74	1.82	1.51	1.01	0.91	1.31
Q2 2002	1.24	0.77	1.89	1.50	1.20	0.88	1.35
Q3 2002	1.23	0.80	1.96	1.49	1.39	0.86	1.38
Q4 2002	1.23	0.83	2.03	1.48	1.56	0.83	1.38
Q1 2003	1.22	0.85	2.09	1.48	1.71	0.79	1.37
Q2 2003	1.22	0.87	2.13	1.47	1.84	0.76	1.34
Q3 2003	1.21	0.87	2.15	1.47	1.94	0.73	1.30
Q4 2003	1.21	0.87	2.16	1.46	2.01	0.70	1.24
Q1 2004	1.20	0.86	2.14	1.45	2.05	0.68	1.18
Q2 2004	1.19	0.83	2.10	1.44	2.05	0.66	1.12
Q3 2004	1.18	0.80	2.02	1.42	2.02	0.64	1.05
Q4 2004	1.17	0.76	1.92	1.39	1.96	0.62	0.99
Q1 2005	1.16	0.72	1.79	1.37	1.86	0.61	0.93
Q2 2005	1.14	0.66	1.62	1.33	1.73	0.61	0.88
Q3 2005	1.12	0.60	1.42	1.29	1.57	0.60	0.84
Q4 2005	1.10	0.53	1.19	1.24	1.38	0.59	0.81
Q1 2006	1.07	0.45	0.93	1.19	1.15	0.58	0.78
Q2 2006	1.03	0.37	0.65	1.13	0.91	0.57	0.76
Q3 2006	0.99	0.28	0.34	1.07	0.63	0.55	0.75
Q4 2006	0.93	0.18	0.01	1.01	0.34	0.53	0.75
Q1 2007	0.87	0.08	0.33	0.94	0.03	0.50	0.75
Q2 2007	0.80	0.02	0.68	0.87	0.29	0.47	0.75
Q3 2007	0.72	0.13	1.04	0.80	0.63	0.43	0.75
Q4 2007	0.64	0.24	1.42	0.73	0.98	0.39	0.76
Q1 2008	0.54	0.35	1.79	0.66	1.33	0.34	0.76
Q2 2008	0.44	0.46	2.17	0.59	1.69	0.28	0.77
Q3 2008	0.34	0.57	2.54	0.52	2.05	0.23	0.78
Q4 2008	0.24	0.68	2.92	0.45	2.40	0.17	0.79

Figure 43(b): Asymmetry Index graphs Ireland versus the rest

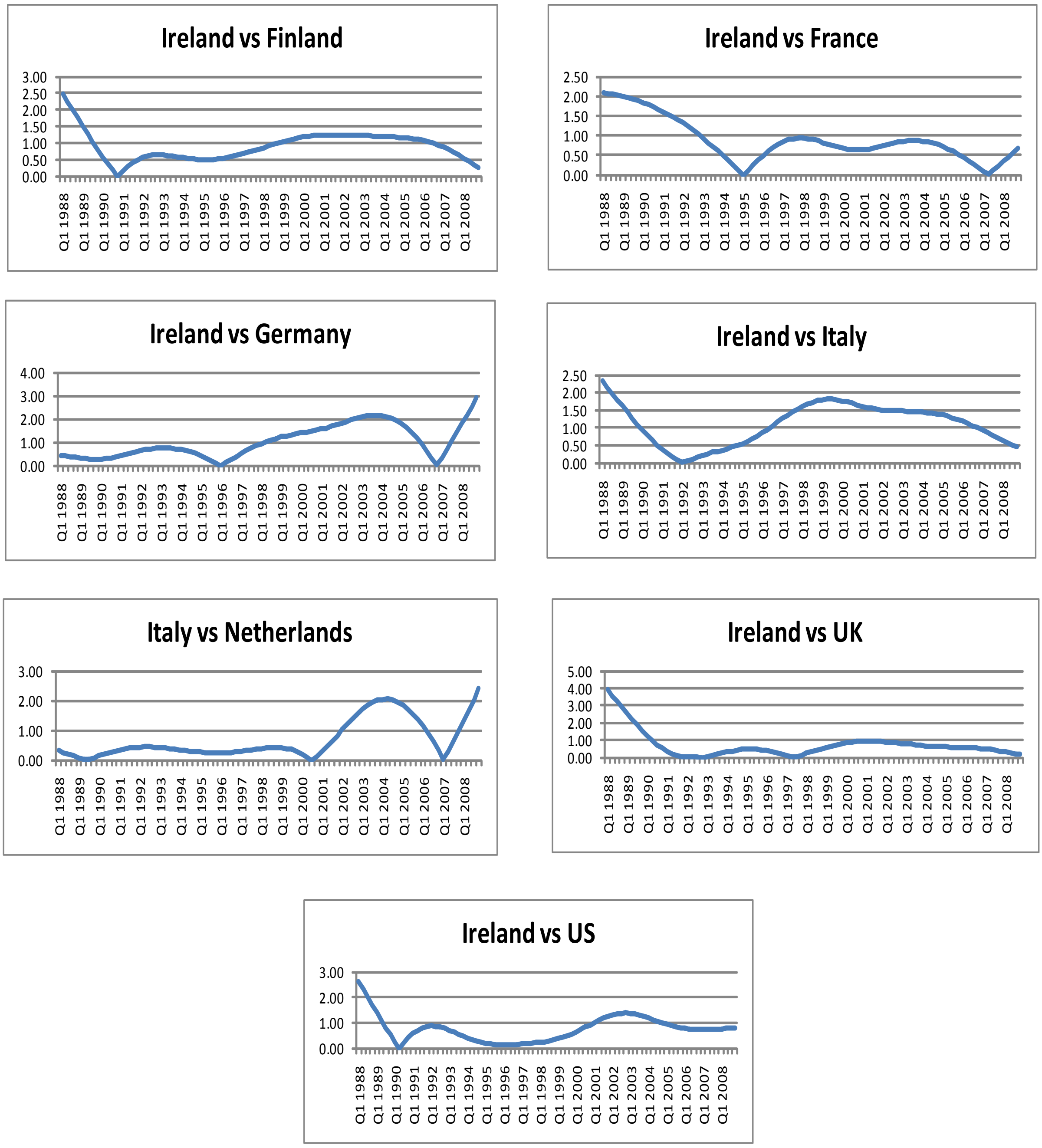

Figure 44(a): Asymmetry Index Italy versus the rest

Italy versus the rest

Quarters	Pre EMU Finland	France	Germany	Ireland	N'lands	UK	US
Q1 1988	0.16	0.24	1.88	2.33	2.65	1.58	0.30
Q2 1988	0.09	0.09	1.74	2.15	2.41	1.41	0.17
Q3 1988	0.03	0.07	1.60	1.98	2.18	1.24	0.04
Q4 1988	0.04	0.22	1.46	1.80	1.94	1.08	0.09
Q1 1989	0.10	0.37	1.31	1.62	1.71	0.91	0.22
Q2 1989	0.17	0.52	1.16	1.45	1.47	0.76	0.34
Q3 1989	0.23	0.66	1.00	1.27	1.24	0.61	0.46
Q4 1989	0.29	0.79	0.83	1.10	1.02	0.46	0.58
Q1 1990	0.35	0.90	0.66	0.94	0.80	0.34	0.69
Q2 1990	0.41	1.01	0.49	0.78	0.59	0.22	0.78
Q3 1990	0.46	1.10	0.31	0.64	0.40	0.12	0.87
Q4 1990	0.50	1.17	0.13	0.51	0.22	0.04	0.93
Q1 1991	0.54	1.23	0.04	0.39	0.06	0.03	0.98
Q2 1991	0.57	1.27	0.20	0.28	0.09	0.07	1.00
Q3 1991	0.59	1.29	0.36	0.19	0.21	0.08	0.99
Q4 1991	0.59	1.30	0.50	0.10	0.32	0.08	0.96
Q1 1992	0.58	1.30	0.62	0.02	0.42	0.05	0.90
Q2 1992	0.56	1.28	0.73	0.05	0.49	0.01	0.82
Q3 1992	0.52	1.25	0.83	0.11	0.55	0.08	0.72
Q4 1992	0.48	1.21	0.91	0.17	0.61	0.17	0.61
Q1 1993	0.42	1.15	0.97	0.22	0.64	0.27	0.49
Q2 1993	0.37	1.09	1.01	0.26	0.67	0.37	0.37
Q3 1993	0.31	1.02	1.04	0.30	0.69	0.48	0.25
Q4 1993	0.24	0.94	1.06	0.34	0.71	0.59	0.13
Q1 1994	0.18	0.86	1.06	0.37	0.72	0.69	0.02
Q2 1994	0.12	0.78	1.06	0.41	0.74	0.79	0.08
Q3 1994	0.07	0.70	1.04	0.45	0.76	0.88	0.18
Q4 1994	0.01	0.62	1.01	0.49	0.79	0.96	0.27
Q1 1995	0.05	0.55	0.98	0.55	0.82	1.03	0.36
Q2 1995	0.12	0.48	0.95	0.61	0.87	1.10	0.44
Q3 1995	0.18	0.43	0.91	0.68	0.94	1.16	0.53
Q4 1995	0.25	0.39	0.88	0.77	1.01	1.21	0.62
Q1 1996	0.32	0.36	0.85	0.86	1.11	1.26	0.71
Q2 1996	0.39	0.35	0.82	0.95	1.21	1.30	0.81
Q3 1996	0.45	0.36	0.79	1.06	1.32	1.34	0.91
Q4 1996	0.52	0.38	0.77	1.16	1.44	1.36	1.00
Q1 1997	0.58	0.41	0.75	1.26	1.56	1.38	1.09
Q2 1997	0.63	0.46	0.73	1.36	1.68	1.39	1.18
Q3 1997	0.68	0.53	0.71	1.45	1.80	1.39	1.25
Q4 1997	0.72	0.60	0.69	1.54	1.91	1.38	1.32
Q1 1998	0.75	0.68	0.67	1.61	2.01	1.36	1.38
Q2 1998	0.77	0.76	0.65	1.68	2.09	1.33	1.42
Q3 1998	0.78	0.84	0.62	1.73	2.16	1.30	1.44
Q4 1998	0.77	0.91	0.60	1.77	2.20	1.25	1.44

Quarters	Post EMU Finland	France	Germany	Ireland	N'lands	UK	US
Q1 1999	0.76	0.97	0.57	1.80	2.22	1.20	1.43
Q2 1999	0.73	1.02	0.53	1.81	2.21	1.13	1.38
Q3 1999	0.69	1.06	0.48	1.81	2.16	1.06	1.32
Q4 1999	0.64	1.08	0.43	1.79	2.09	0.99	1.23
Q1 2000	0.59	1.09	0.37	1.77	1.99	0.92	1.12
Q2 2000	0.54	1.08	0.30	1.74	1.86	0.85	1.00
Q3 2000	0.48	1.05	0.23	1.70	1.71	0.78	0.87
Q4 2000	0.43	1.02	0.14	1.66	1.53	0.72	0.74
Q1 2001	0.38	0.97	0.05	1.62	1.34	0.67	0.60
Q2 2001	0.34	0.93	0.04	1.58	1.13	0.64	0.48
Q3 2001	0.31	0.87	0.13	1.55	0.92	0.61	0.36
Q4 2001	0.29	0.82	0.22	1.53	0.71	0.60	0.27
Q1 2002	0.27	0.77	0.31	1.51	0.50	0.60	0.19
Q2 2002	0.26	0.73	0.40	1.50	0.29	0.61	0.14
Q3 2002	0.25	0.69	0.48	1.49	0.10	0.63	0.11
Q4 2002	0.25	0.65	0.55	1.48	0.08	0.66	0.10
Q1 2003	0.25	0.63	0.61	1.48	0.23	0.68	0.11
Q2 2003	0.26	0.61	0.65	1.47	0.36	0.71	0.13
Q3 2003	0.26	0.60	0.68	1.47	0.47	0.74	0.17
Q4 2003	0.26	0.60	0.69	1.46	0.54	0.76	0.22
Q1 2004	0.25	0.60	0.69	1.45	0.59	0.78	0.27
Q2 2004	0.25	0.60	0.66	1.44	0.61	0.78	0.32
Q3 2004	0.24	0.62	0.60	1.42	0.60	0.78	0.37
Q4 2004	0.22	0.63	0.53	1.39	0.56	0.77	0.40
Q1 2005	0.21	0.65	0.42	1.37	0.50	0.75	0.43
Q2 2005	0.19	0.67	0.29	1.33	0.40	0.72	0.45
Q3 2005	0.16	0.69	0.13	1.29	0.28	0.69	0.45
Q4 2005	0.14	0.71	0.05	1.24	0.13	0.65	0.43
Q1 2006	0.12	0.74	0.26	1.19	0.03	0.61	0.41
Q2 2006	0.10	0.76	0.48	1.13	0.23	0.56	0.37
Q3 2006	0.08	0.79	0.73	1.07	0.44	0.52	0.32
Q4 2006	0.07	0.82	0.99	1.01	0.66	0.48	0.26
Q1 2007	0.07	0.86	1.27	0.94	0.91	0.44	0.19
Q2 2007	0.07	0.89	1.55	0.87	1.17	0.40	0.12
Q3 2007	0.08	0.93	1.85	0.80	1.44	0.37	0.05
Q4 2007	0.10	0.97	2.15	0.73	1.71	0.35	0.02
Q1 2008	0.12	1.01	2.45	0.66	2.00	0.33	0.10
Q2 2008	0.15	1.05	2.76	0.59	2.28	0.31	0.18
Q3 2008	0.18	1.09	3.06	0.52	2.57	0.29	0.26
Q4 2008	0.21	1.13	3.37	0.45	2.85	0.27	0.34

Figure 44(b): Asymmetry Index graphs Italy versus the rest

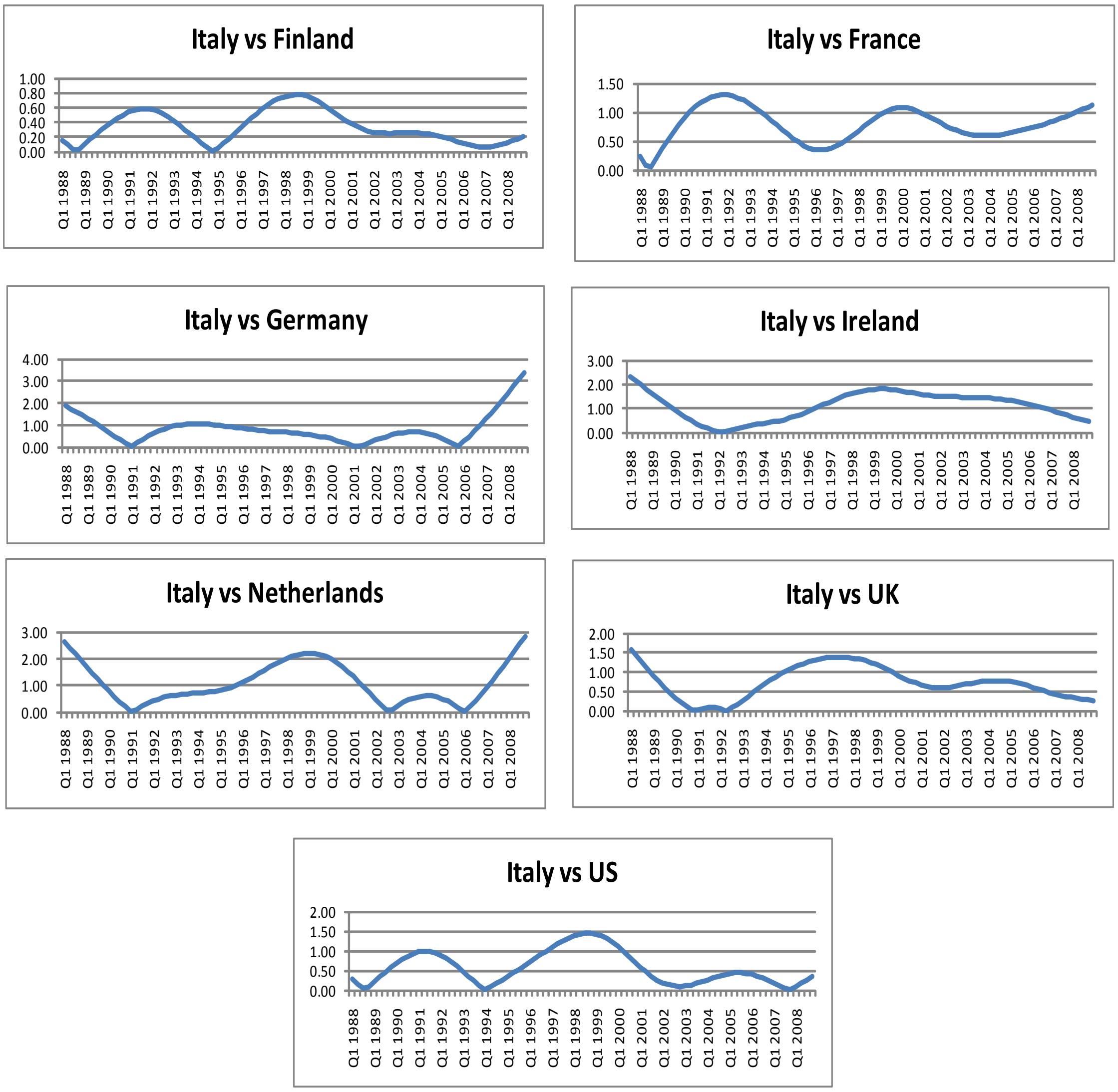

Figure 45(a): Asymmetry Index Netherlands versus the rest

Netherlands versus the rest

Pre EMU

Quarters	Finland	France	Germany	Ireland	Italy	UK	US
Q1 1988	2.81	2.41	0.77	0.32	2.65	4.23	2.95
Q2 1988	2.51	2.33	0.67	0.26	2.41	3.82	2.58
Q3 1988	2.21	2.25	0.58	0.20	2.18	3.42	2.22
Q4 1988	1.90	2.16	0.49	0.14	1.94	3.02	1.85
Q1 1989	1.60	2.08	0.40	0.08	1.71	2.62	1.49
Q2 1989	1.30	1.99	0.32	0.02	1.47	2.23	1.13
Q3 1989	1.01	1.90	0.24	0.03	1.24	1.85	0.78
Q4 1989	0.72	1.80	0.18	0.09	1.02	1.48	0.44
Q1 1990	0.45	1.70	0.14	0.14	0.80	1.13	0.11
Q2 1990	0.18	1.60	0.10	0.19	0.59	0.81	0.19
Q3 1990	0.06	1.49	0.09	0.24	0.40	0.52	0.47
Q4 1990	0.28	1.39	0.08	0.29	0.22	0.25	0.72
Q1 1991	0.48	1.28	0.09	0.33	0.06	0.03	0.92
Q2 1991	0.66	1.18	0.11	0.37	0.09	0.15	1.09
Q3 1991	0.80	1.08	0.14	0.40	0.21	0.30	1.21
Q4 1991	0.91	0.98	0.17	0.42	0.32	0.40	1.29
Q1 1992	1.00	0.89	0.21	0.44	0.42	0.46	1.32
Q2 1992	1.05	0.79	0.24	0.44	0.49	0.49	1.31
Q3 1992	1.08	0.70	0.27	0.44	0.55	0.48	1.28
Q4 1992	1.08	0.60	0.30	0.44	0.61	0.44	1.22
Q1 1993	1.07	0.51	0.32	0.43	0.64	0.38	1.14
Q2 1993	1.04	0.42	0.34	0.41	0.67	0.30	1.04
Q3 1993	1.00	0.32	0.35	0.39	0.69	0.21	0.94
Q4 1993	0.95	0.23	0.35	0.37	0.71	0.12	0.84
Q1 1994	0.91	0.13	0.34	0.35	0.72	0.03	0.75
Q2 1994	0.86	0.04	0.32	0.33	0.74	0.05	0.66
Q3 1994	0.82	0.06	0.28	0.31	0.76	0.12	0.58
Q4 1994	0.79	0.17	0.23	0.29	0.79	0.17	0.52
Q1 1995	0.77	0.28	0.16	0.27	0.82	0.21	0.47
Q2 1995	0.76	0.39	0.08	0.26	0.87	0.23	0.43
Q3 1995	0.76	0.51	0.02	0.25	0.94	0.22	0.41
Q4 1995	0.77	0.63	0.13	0.25	1.01	0.20	0.39
Q1 1996	0.79	0.74	0.26	0.25	1.11	0.16	0.39
Q2 1996	0.82	0.86	0.39	0.26	1.21	0.09	0.40
Q3 1996	0.87	0.97	0.53	0.27	1.32	0.01	0.42
Q4 1996	0.92	1.06	0.67	0.28	1.44	0.08	0.44
Q1 1997	0.98	1.15	0.82	0.30	1.56	0.18	0.47
Q2 1997	1.05	1.22	0.96	0.32	1.68	0.30	0.51
Q3 1997	1.12	1.27	1.09	0.35	1.80	0.41	0.55
Q4 1997	1.19	1.31	1.22	0.37	1.91	0.53	0.59
Q1 1998	1.26	1.33	1.34	0.40	2.01	0.65	0.63
Q2 1998	1.32	1.33	1.44	0.41	2.09	0.76	0.67
Q3 1998	1.38	1.32	1.53	0.42	2.16	0.86	0.71
Q4 1998	1.43	1.29	1.60	0.43	2.20	0.95	0.75

Post EMU

Quarters	Finland	France	Germany	Ireland	Italy	UK	US
Q1 1999	1.46	1.24	1.65	0.42	2.22	1.02	0.79
Q2 1999	1.48	1.18	1.68	0.39	2.21	1.07	0.82
Q3 1999	1.47	1.10	1.68	0.36	2.16	1.10	0.85
Q4 1999	1.45	1.01	1.66	0.30	2.09	1.10	0.86
Q1 2000	1.40	0.90	1.62	0.22	1.99	1.07	0.87
Q2 2000	1.32	0.78	1.56	0.12	1.86	1.01	0.86
Q3 2000	1.22	0.65	1.48	0.01	1.71	0.93	0.83
Q4 2000	1.10	0.51	1.39	0.13	1.53	0.81	0.79
Q1 2001	0.96	0.36	1.28	0.28	1.34	0.67	0.74
Q2 2001	0.79	0.21	1.17	0.45	1.13	0.50	0.66
Q3 2001	0.61	0.05	1.05	0.63	0.92	0.31	0.56
Q4 2001	0.42	0.11	0.93	0.82	0.71	0.11	0.44
Q1 2002	0.23	0.28	0.81	1.01	0.50	0.11	0.30
Q2 2002	0.03	0.43	0.69	1.20	0.29	0.32	0.15
Q3 2002	0.15	0.59	0.58	1.39	0.10	0.53	0.01
Q4 2002	0.33	0.73	0.47	1.56	0.08	0.73	0.17
Q1 2003	0.48	0.86	0.38	1.71	0.23	0.91	0.34
Q2 2003	0.62	0.97	0.29	1.84	0.36	1.07	0.50
Q3 2003	0.72	1.07	0.22	1.94	0.47	1.21	0.64
Q4 2003	0.80	1.14	0.15	2.01	0.54	1.31	0.76
Q1 2004	0.85	1.19	0.09	2.05	0.59	1.37	0.86
Q2 2004	0.86	1.22	0.04	2.05	0.61	1.40	0.93
Q3 2004	0.84	1.22	0.00	2.02	0.60	1.38	0.97
Q4 2004	0.79	1.20	0.04	1.96	0.56	1.34	0.97
Q1 2005	0.70	1.15	0.08	1.86	0.50	1.25	0.93
Q2 2005	0.59	1.07	0.11	1.73	0.40	1.13	0.85
Q3 2005	0.45	0.97	0.15	1.57	0.28	0.97	0.73
Q4 2005	0.28	0.85	0.18	1.38	0.13	0.79	0.57
Q1 2006	0.09	0.70	0.22	1.15	0.03	0.57	0.37
Q2 2006	0.13	0.54	0.26	0.91	0.23	0.34	0.14
Q3 2006	0.35	0.36	0.29	0.63	0.44	0.08	0.12
Q4 2006	0.59	0.16	0.33	0.34	0.66	0.19	0.41
Q1 2007	0.84	0.05	0.36	0.03	0.91	0.47	0.72
Q2 2007	1.10	0.27	0.39	0.29	1.17	0.76	1.04
Q3 2007	1.36	0.51	0.41	0.63	1.44	1.06	1.39
Q4 2007	1.62	0.74	0.43	0.98	1.71	1.37	1.74
Q1 2008	1.88	0.99	0.46	1.33	2.00	1.67	2.10
Q2 2008	2.13	1.23	0.48	1.69	2.28	1.97	2.46
Q3 2008	2.39	1.48	0.50	2.05	2.57	2.28	2.83
Q4 2008	2.65	1.72	0.51	2.40	2.85	2.58	3.19

Figure 45(b): Asymmetry Index graphs Netherlands versus the rest

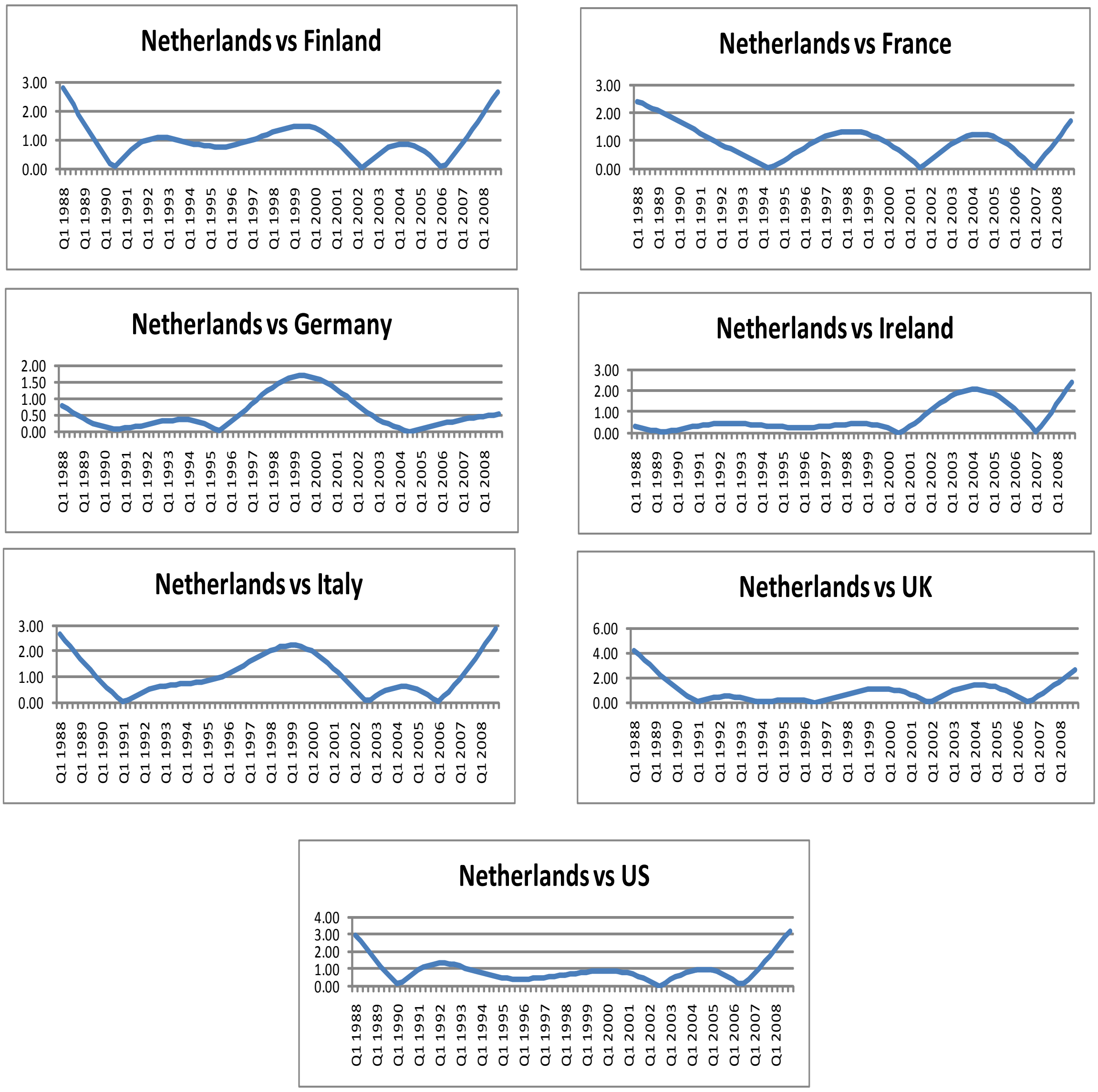

Figure 46(a): Asymmetry Index UK versus the rest

The UK versus the rest

Pre EMU

Quarters	Finland	France	Germany	Ireland	Italy	N'lands	US
Q1 1988	1.42	1.82	3.46	3.91	1.58	4.23	1.28
Q2 1988	1.32	1.50	3.15	3.56	1.41	3.82	1.24
Q3 1988	1.21	1.17	2.84	3.22	1.24	3.42	1.20
Q4 1988	1.12	0.85	2.53	2.88	1.08	3.02	1.17
Q1 1989	1.02	0.54	2.22	2.54	0.91	2.62	1.13
Q2 1989	0.92	0.24	1.91	2.20	0.76	2.23	1.10
Q3 1989	0.84	0.05	1.60	1.88	0.61	1.85	1.07
Q4 1989	0.76	0.32	1.30	1.57	0.46	1.48	1.04
Q1 1990	0.69	0.57	1.00	1.27	0.34	1.13	1.02
Q2 1990	0.63	0.79	0.71	1.00	0.22	0.81	1.00
Q3 1990	0.58	0.98	0.43	0.76	0.12	0.52	0.99
Q4 1990	0.54	1.13	0.17	0.54	0.04	0.25	0.97
Q1 1991	0.51	1.25	0.06	0.36	0.03	0.03	0.95
Q2 1991	0.50	1.33	0.27	0.22	0.07	0.15	0.93
Q3 1991	0.50	1.38	0.44	0.10	0.08	0.30	0.91
Q4 1991	0.51	1.38	0.57	0.02	0.08	0.40	0.88
Q1 1992	0.53	1.35	0.67	0.02	0.05	0.46	0.86
Q2 1992	0.56	1.28	0.73	0.04	0.01	0.49	0.83
Q3 1992	0.60	1.17	0.75	0.03	0.08	0.48	0.80
Q4 1992	0.64	1.04	0.74	0.00	0.17	0.44	0.78
Q1 1993	0.69	0.89	0.70	0.05	0.27	0.38	0.76
Q2 1993	0.74	0.72	0.64	0.11	0.37	0.30	0.74
Q3 1993	0.79	0.54	0.56	0.18	0.48	0.21	0.73
Q4 1993	0.83	0.35	0.47	0.25	0.59	0.12	0.72
Q1 1994	0.87	0.17	0.37	0.32	0.69	0.03	0.71
Q2 1994	0.91	0.01	0.27	0.38	0.79	0.05	0.71
Q3 1994	0.94	0.18	0.16	0.43	0.88	0.12	0.70
Q4 1994	0.96	0.34	0.06	0.46	0.96	0.17	0.69
Q1 1995	0.98	0.48	0.05	0.48	1.03	0.21	0.68
Q2 1995	0.98	0.62	0.15	0.49	1.10	0.23	0.66
Q3 1995	0.98	0.73	0.24	0.47	1.16	0.22	0.63
Q4 1995	0.97	0.83	0.33	0.45	1.21	0.20	0.59
Q1 1996	0.95	0.90	0.41	0.40	1.26	0.16	0.55
Q2 1996	0.92	0.95	0.48	0.35	1.30	0.09	0.49
Q3 1996	0.88	0.98	0.54	0.28	1.34	0.01	0.43
Q4 1996	0.84	0.99	0.59	0.20	1.36	0.08	0.36
Q1 1997	0.80	0.97	0.63	0.12	1.38	0.18	0.29
Q2 1997	0.75	0.92	0.66	0.03	1.39	0.30	0.21
Q3 1997	0.70	0.86	0.68	0.07	1.39	0.41	0.13
Q4 1997	0.66	0.78	0.69	0.16	1.38	0.53	0.05
Q1 1998	0.61	0.68	0.69	0.25	1.36	0.65	0.02
Q2 1998	0.56	0.57	0.68	0.35	1.33	0.76	0.09
Q3 1998	0.52	0.46	0.67	0.44	1.30	0.86	0.15
Q4 1998	0.48	0.34	0.65	0.52	1.25	0.95	0.19

Post EMU

Quarters	Finland	France	Germany	Ireland	Italy	N'lands	US
Q1 1999	0.44	0.22	0.63	0.60	1.20	1.02	0.23
Q2 1999	0.40	0.11	0.61	0.68	1.13	1.07	0.25
Q3 1999	0.37	0.00	0.58	0.74	1.06	1.10	0.25
Q4 1999	0.35	0.09	0.56	0.80	0.99	1.10	0.24
Q1 2000	0.33	0.17	0.55	0.85	0.92	1.07	0.21
Q2 2000	0.31	0.23	0.54	0.89	0.85	1.01	0.16
Q3 2000	0.30	0.27	0.55	0.92	0.78	0.93	0.09
Q4 2000	0.29	0.30	0.58	0.94	0.72	0.81	0.02
Q1 2001	0.29	0.30	0.62	0.95	0.67	0.67	0.07
Q2 2001	0.29	0.29	0.67	0.95	0.64	0.50	0.16
Q3 2001	0.30	0.26	0.74	0.94	0.61	0.31	0.25
Q4 2001	0.32	0.22	0.82	0.93	0.60	0.11	0.33
Q1 2002	0.33	0.17	0.91	0.91	0.60	0.11	0.41
Q2 2002	0.35	0.11	1.01	0.88	0.61	0.32	0.47
Q3 2002	0.38	0.06	1.11	0.86	0.63	0.53	0.52
Q4 2002	0.40	0.00	1.20	0.83	0.66	0.73	0.56
Q1 2003	0.43	0.06	1.29	0.79	0.68	0.91	0.58
Q2 2003	0.46	0.10	1.37	0.76	0.71	1.07	0.58
Q3 2003	0.48	0.14	1.42	0.73	0.74	1.21	0.57
Q4 2003	0.50	0.17	1.46	0.70	0.76	1.31	0.54
Q1 2004	0.52	0.18	1.46	0.68	0.78	1.37	0.51
Q2 2004	0.54	0.18	1.44	0.66	0.78	1.40	0.46
Q3 2004	0.54	0.16	1.38	0.64	0.78	1.38	0.42
Q4 2004	0.55	0.14	1.30	0.62	0.77	1.34	0.37
Q1 2005	0.55	0.10	1.17	0.61	0.75	1.25	0.32
Q2 2005	0.54	0.06	1.01	0.61	0.72	1.13	0.28
Q3 2005	0.53	0.00	0.82	0.60	0.69	0.97	0.24
Q4 2005	0.51	0.06	0.60	0.59	0.65	0.79	0.22
Q1 2006	0.49	0.13	0.35	0.58	0.61	0.57	0.20
Q2 2006	0.46	0.20	0.08	0.57	0.56	0.34	0.20
Q3 2006	0.44	0.27	0.21	0.55	0.52	0.08	0.20
Q4 2006	0.40	0.35	0.51	0.53	0.48	0.19	0.22
Q1 2007	0.37	0.42	0.83	0.50	0.44	0.47	0.24
Q2 2007	0.33	0.49	1.15	0.47	0.40	0.76	0.28
Q3 2007	0.29	0.56	1.47	0.43	0.37	1.06	0.32
Q4 2007	0.25	0.62	1.80	0.39	0.35	1.37	0.37
Q1 2008	0.21	0.68	2.13	0.34	0.33	1.67	0.43
Q2 2008	0.16	0.74	2.45	0.28	0.31	1.97	0.49
Q3 2008	0.11	0.80	2.77	0.23	0.29	2.28	0.55
Q4 2008	0.07	0.85	3.09	0.17	0.27	2.58	0.62

Figure 46(b): Asymmetry Index graphs UK versus the rest

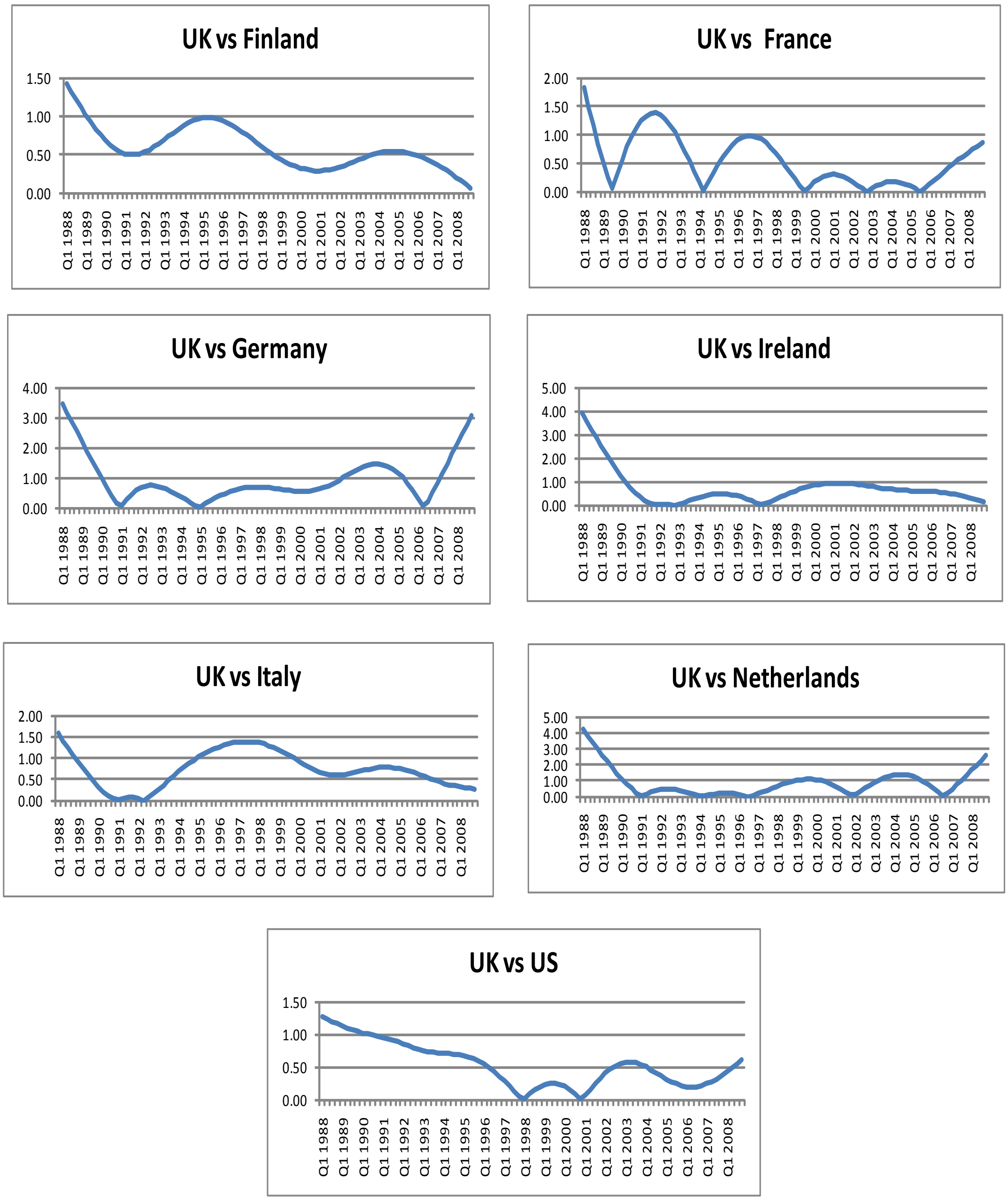

Figure 47(a): Asymmetry Index US versus the rest

US versus the rest

Pre EMU

Quarters	Finland	France	Germany	Ireland	Italy	Ietherland.	UK
Q1 1988	0.14	0.54	2.18	2.63	0.30	2.95	1.28
Q2 1988	0.08	0.26	1.91	2.32	0.17	2.58	1.24
Q3 1988	0.01	0.03	1.64	2.02	0.04	2.22	1.20
Q4 1988	0.05	0.31	1.37	1.71	0.09	1.85	1.17
Q1 1989	0.11	0.59	1.09	1.41	0.22	1.49	1.13
Q2 1989	0.17	0.86	0.81	1.11	0.34	1.13	1.10
Q3 1989	0.23	1.12	0.53	0.81	0.46	0.78	1.07
Q4 1989	0.29	1.37	0.25	0.52	0.58	0.44	1.04
Q1 1990	0.34	1.59	0.02	0.25	0.69	0.11	1.02
Q2 1990	0.38	1.79	0.30	0.00	0.78	0.19	1.00
Q3 1990	0.41	1.96	0.56	0.23	0.87	0.47	0.99
Q4 1990	0.43	2.10	0.80	0.43	0.93	0.72	0.97
Q1 1991	0.44	2.21	1.02	0.59	0.98	0.92	0.95
Q2 1991	0.43	2.27	1.20	0.72	1.00	1.09	0.93
Q3 1991	0.41	2.29	1.35	0.81	0.99	1.21	0.91
Q4 1991	0.37	2.27	1.46	0.86	0.96	1.29	0.88
Q1 1992	0.32	2.20	1.53	0.88	0.90	1.32	0.86
Q2 1992	0.26	2.11	1.56	0.87	0.82	1.31	0.83
Q3 1992	0.20	1.97	1.55	0.83	0.72	1.28	0.80
Q4 1992	0.13	1.82	1.52	0.78	0.61	1.22	0.78
Q1 1993	0.07	1.64	1.46	0.71	0.49	1.14	0.76
Q2 1993	0.00	1.46	1.38	0.63	0.37	1.04	0.74
Q3 1993	0.06	1.27	1.29	0.55	0.25	0.94	0.73
Q4 1993	0.11	1.07	1.19	0.47	0.13	0.84	0.72
Q1 1994	0.16	0.88	1.09	0.39	0.02	0.75	0.71
Q2 1994	0.21	0.70	0.98	0.33	0.08	0.66	0.71
Q3 1994	0.24	0.52	0.86	0.27	0.18	0.58	0.70
Q4 1994	0.28	0.35	0.75	0.23	0.27	0.52	0.69
Q1 1995	0.30	0.19	0.63	0.19	0.36	0.47	0.68
Q2 1995	0.33	0.04	0.51	0.17	0.44	0.43	0.66
Q3 1995	0.35	0.10	0.38	0.15	0.53	0.41	0.63
Q4 1995	0.37	0.23	0.26	0.15	0.62	0.39	0.59
Q1 1996	0.40	0.35	0.13	0.14	0.71	0.39	0.55
Q2 1996	0.42	0.46	0.01	0.14	0.81	0.40	0.49
Q3 1996	0.45	0.55	0.11	0.15	0.91	0.42	0.43
Q4 1996	0.48	0.62	0.23	0.16	1.00	0.44	0.36
Q1 1997	0.51	0.68	0.35	0.17	1.09	0.47	0.29
Q2 1997	0.54	0.71	0.45	0.18	1.18	0.51	0.21
Q3 1997	0.57	0.73	0.55	0.20	1.25	0.55	0.13
Q4 1997	0.60	0.72	0.63	0.21	1.32	0.59	0.05
Q1 1998	0.63	0.70	0.71	0.23	1.38	0.63	0.02
Q2 1998	0.65	0.66	0.77	0.26	1.42	0.67	0.09
Q3 1998	0.66	0.60	0.82	0.29	1.44	0.71	0.15
Q4 1998	0.67	0.53	0.85	0.33	1.44	0.75	0.19

Post EMU

Quarters	Finland	France	Germany	Ireland	Italy	Ietherland.	UK
Q1 1999	0.67	0.45	0.86	0.37	1.43	0.79	0.23
Q2 1999	0.65	0.36	0.86	0.43	1.38	0.82	0.25
Q3 1999	0.63	0.26	0.83	0.49	1.32	0.85	0.25
Q4 1999	0.59	0.15	0.80	0.56	1.23	0.86	0.24
Q1 2000	0.53	0.04	0.75	0.64	1.12	0.87	0.21
Q2 2000	0.47	0.07	0.70	0.73	1.00	0.86	0.16
Q3 2000	0.39	0.18	0.65	0.83	0.87	0.83	0.09
Q4 2000	0.31	0.28	0.59	0.92	0.74	0.79	0.02
Q1 2001	0.22	0.37	0.55	1.02	0.60	0.74	0.07
Q2 2001	0.13	0.45	0.51	1.11	0.48	0.66	0.16
Q3 2001	0.05	0.51	0.49	1.19	0.36	0.56	0.25
Q4 2001	0.02	0.55	0.49	1.26	0.27	0.44	0.33
Q1 2002	0.07	0.58	0.51	1.31	0.19	0.30	0.41
Q2 2002	0.12	0.59	0.54	1.35	0.14	0.15	0.47
Q3 2002	0.14	0.58	0.59	1.38	0.11	0.01	0.52
Q4 2002	0.15	0.55	0.65	1.38	0.10	0.17	0.56
Q1 2003	0.15	0.52	0.72	1.37	0.11	0.34	0.58
Q2 2003	0.12	0.48	0.79	1.34	0.13	0.50	0.58
Q3 2003	0.08	0.43	0.86	1.30	0.17	0.64	0.57
Q4 2003	0.04	0.38	0.91	1.24	0.22	0.76	0.54
Q1 2004	0.02	0.33	0.96	1.18	0.27	0.86	0.51
Q2 2004	0.07	0.29	0.98	1.12	0.32	0.93	0.46
Q3 2004	0.13	0.25	0.97	1.05	0.37	0.97	0.42
Q4 2004	0.18	0.23	0.93	0.99	0.40	0.97	0.37
Q1 2005	0.22	0.22	0.85	0.93	0.43	0.93	0.32
Q2 2005	0.26	0.22	0.74	0.88	0.45	0.85	0.28
Q3 2005	0.28	0.24	0.58	0.84	0.45	0.73	0.24
Q4 2005	0.29	0.28	0.38	0.81	0.43	0.57	0.22
Q1 2006	0.29	0.33	0.15	0.78	0.41	0.37	0.20
Q2 2006	0.27	0.40	0.12	0.76	0.37	0.14	0.20
Q3 2006	0.23	0.48	0.41	0.75	0.32	0.12	0.20
Q4 2006	0.19	0.56	0.73	0.75	0.26	0.41	0.22
Q1 2007	0.13	0.66	1.07	0.75	0.19	0.72	0.24
Q2 2007	0.05	0.77	1.43	0.75	0.12	1.04	0.28
Q3 2007	0.03	0.88	1.80	0.75	0.05	1.39	0.32
Q4 2007	0.12	0.99	2.17	0.76	0.02	1.74	0.37
Q1 2008	0.22	1.11	2.55	0.76	0.10	2.10	0.43
Q2 2008	0.33	1.23	2.94	0.77	0.18	2.46	0.49
Q3 2008	0.44	1.35	3.32	0.78	0.26	2.83	0.55
Q4 2008	0.55	1.47	3.71	0.79	0.34	3.19	0.62

Figure 47(b): Asymmetry Index graphs US versus the rest

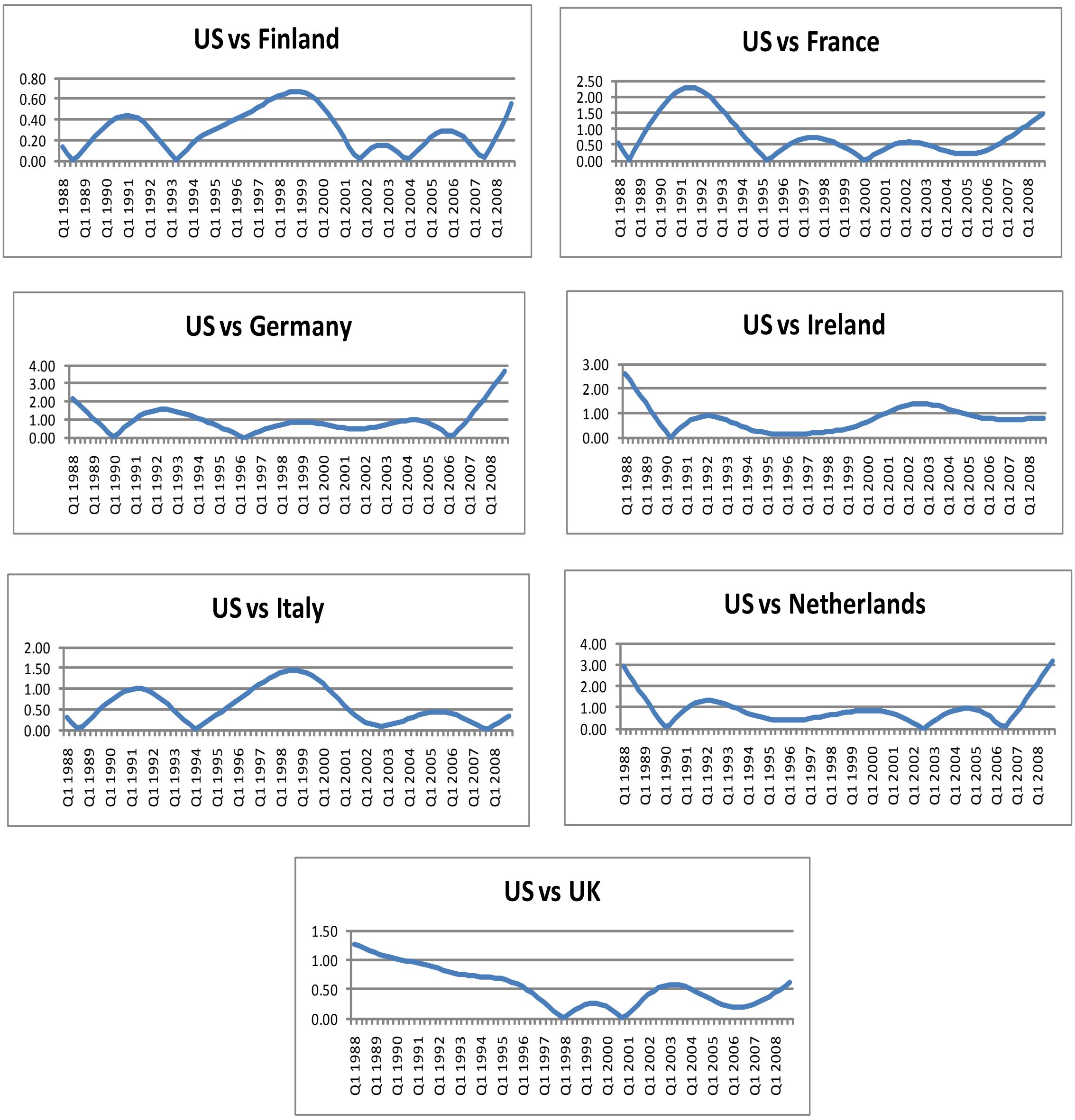

Figure 48: Impulse responses for the real effective exchange rate, demand, supply and monetary shocks (1988 -1998)

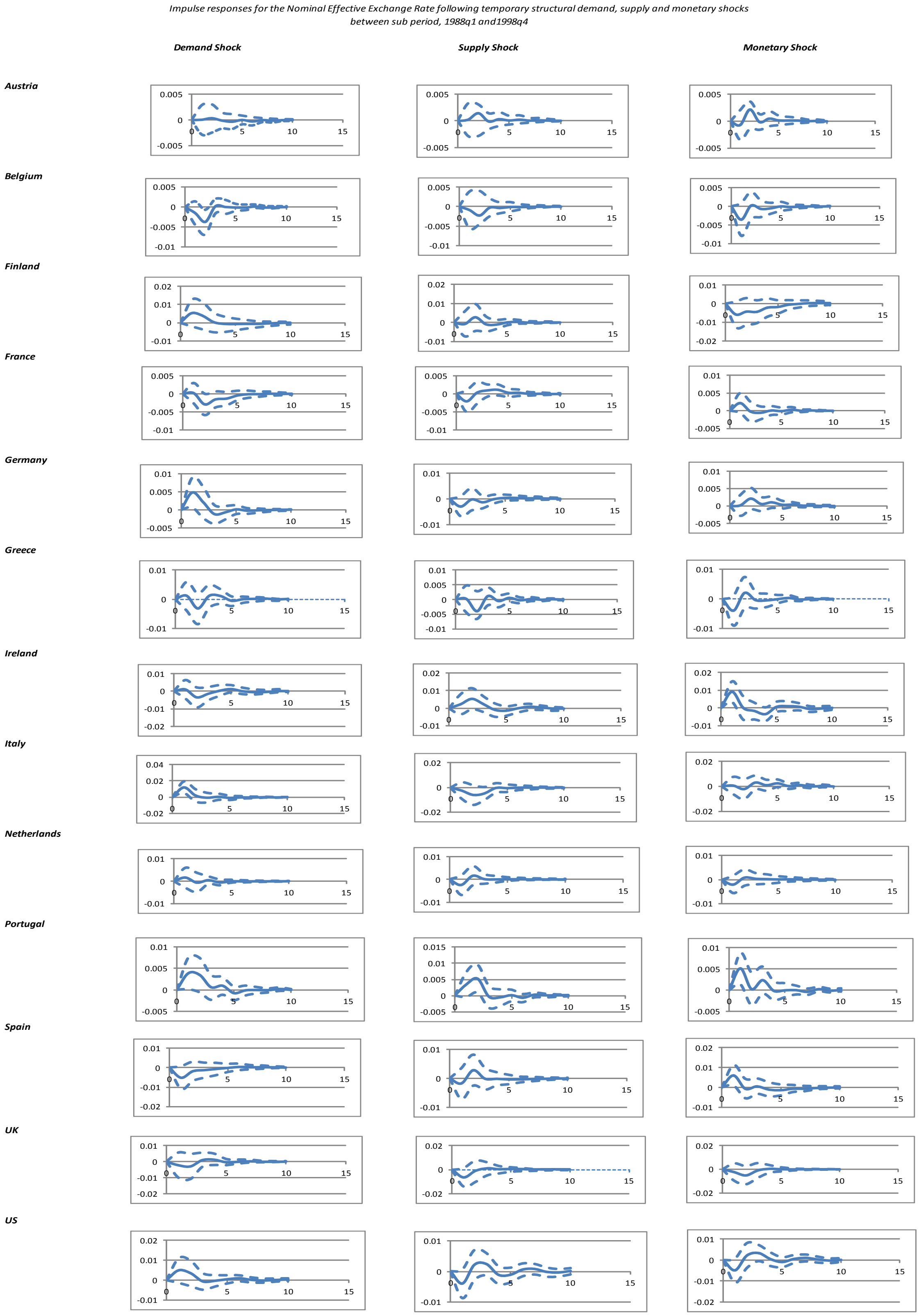

Figure 49: Impulse responses for the real effective exchange rate (demand, supply and monetary shocks (1999 – 2008))

Figure 50: Impulse responses for employment, unemployment and real wages (2 sub periods) – Austria – Germany

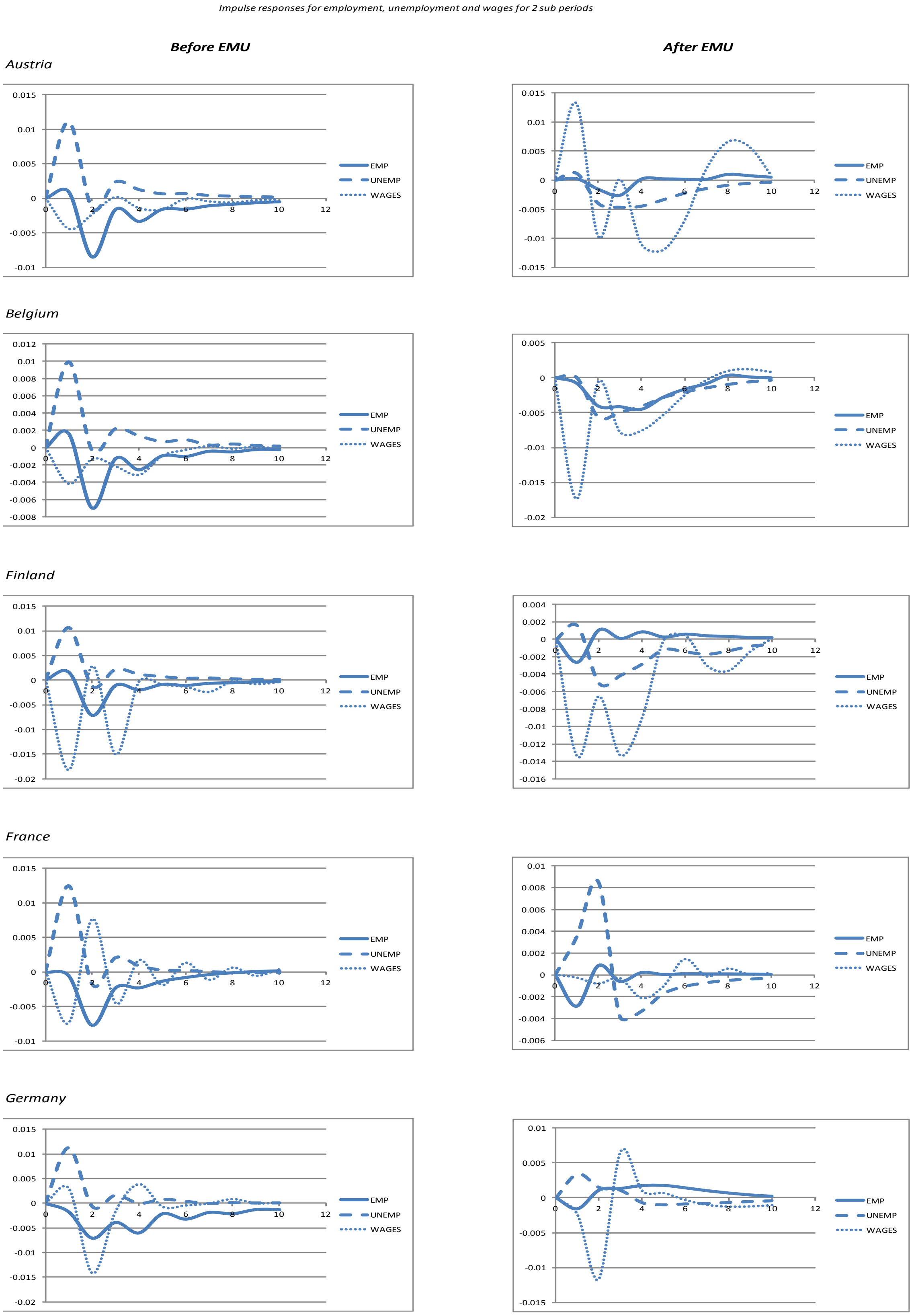

Figure 51: Impulse response for employment, unemployment and wages (2 sub periods) – Ireland - UK