Undergraduate Economic Review

Volume 3 | Issue 1 Article 6

2007

A Study of Monetary Transmission Mechanism Convergence and Monetary Policy Effectiveness among Core EMU Members from 1991-2006

Bennett Surajat
Carleton College

A Study of Monetary Transmission Mechanism Convergence and Monetary Policy Effectiveness among Core EMU Members from 1991-2006

Abstract

In this paper, I study how the implementation of the European Monetary Union (EMU), which involves the adoption of a single currency and a common monetary policy by all members, impacted its core members (Germany, Spain, France and Italy). Specifically, I examine how the implementation of the EMU affected the core members' experience with macroeconomic shocks and consequently, how effective a common monetary policy is in meeting their individual economic objectives. I use SVARs (Structural Vector Autoregressions) to model the core members' experience with EMU integration. Using SVARs, I generate impulse response graphs (IRGs) to illustrate how macroeconomic shocks propagate through the monetary transmission mechanisms (MTMs) of the different core EMU countries

Undergraduate Economic Review

A publication of Illinois Wesleyan University

Vol. III – 2006 - 2007

Title "A Study of Monetary Transmission Mechanism Convergence and Monetary Policy Effectiveness among Core EMU Members from 1991-2006"

Author Bennett Surajat

Affiliation Carleton College

Abstract In this paper, I study how the implementation of the European Monetary Union (EMU), which involves the adoption of a single currency and a common monetary policy by all members, impacted its core members (Germany, Spain, France and Italy). Specifically, I examine how the implementation of the EMU affected the core members' experience with macroeconomic shocks and consequently, how effective a common monetary policy is in meeting their individual economic objectives. I use SVARs (Structural Vector Autoregressions) to model the core members' experience with EMU integration. Using SVARs, I generate impulse response graphs (IRGs) to illustrate how macroeconomic shocks propagate through the monetary transmission mechanisms (MTMs) of the different core EMU countries

A Study of Monetary Transmission Mechanism Convergence and Monetary Policy Effectiveness among Core EMU Members from 1991-2006

Bennett Surajat*

Carleton College

Current version: March 29, 2007

Abstract

In this paper, I study how the implementation of the European Monetary Union (EMU), which involves the adoption of a single currency and a common monetary policy by all members, impacted its core members (Germany, Spain, France and Italy). Specifically, I examine how the implementation of the EMU affected the core members' experience with macroeconomic shocks and consequently, how effective a common monetary policy is in meeting their individual economic objectives. I use SVARs (Structural Vector Autoregressions) to model the core members' experience with EMU integration. Using SVARs, I generate impulse response graphs (IRGs) to illustrate how macroeconomic shocks propagate through the monetary transmission mechanisms (MTMs) of the different core EMU countries

JEL: E52, E58, E44

Keywords: Monetary policy, monetary transmission mechanism, Euro area

* Senior at Carleton College. This paper is written as a senior integrative exercise for Department of Economics. Email: surajatb@carleton.edu. Special thanks to Pavel Kapinos for his helpful comments.

`

Introduction

In this paper, I study how the implementation of the European Monetary Union (EMU), which involves the adoption of a single currency and a common monetary policy by all members, impacted its core members (Germany, Spain, France and Italy). Specifically, I examine how the implementation of the EMU affected the core members' experience with macroeconomic shocks and consequently, how effective a common monetary policy is in meeting their individual economic objectives. The EMU stands as one of the most significant macroeconomic experiments of our time. It represents the largest, in economic and demographic terms, economic and monetary union ever attempted. The core members make up a dominant portion of the EMU's economic output and its decision-making process and thus, an analysis of their EMU integration experience highlights the dynamics behind developments in the EMU. The core members' EMU experiences also offer insight for potential EMU members and provide a reference point for other monetary or economic and monetary unions around the world.

I use Structural Vector Autoregressions (SVARs) to model the core members' experience with EMU integration. Using SVARs, I generate impulse response graphs (IRGs) to illustrate how macroeconomic shocks propagate through the monetary transmission mechanisms (MTMs) of the different core EMU countries. Since the euro and the single monetary policy came into effect on January 1st 1999, I perform this exercise on two sub-samples: 1991-1997 and 2000-2006 to describe MTMs before and after the implementation of the common currency and the single monetary policy. By comparing IRGs of individual core EMU members across the two time periods, I can

`

gauge their MTMs' evolutions and find evidence for or against MTM convergence and consequently, monetary policy success.

In this paper, I find more evidence for than against convergence from comparing the evolutions of MTMs. While exchange rate and domestic interest rate components point towards convergence, inflation heterogeneity is increasing in the inflation component. My results also support monetary policy success in the EMU and pre-EMU period, even though there are no marked changes between the two periods. Evidence for monetary success puts fiscal policies as the prime suspect for diverging inflation MTM components among core EMU members.

This paper is organized as follows. Section I outlines the literature surrounding the EMU as well as the use of SVARs to model MTMs of EMU members. Section II details the model specification and Section III presents my findings, provides interpretations for these findings and relates them to the current literature. Section IV offers suggestions for future research and Section V concludes.

I Literature Review

It is important to understand the context of the EMU to appreciate this paper's results. Thus, I open this section with a discussion of conditions surrounding the formulation and implementation of the EMU. Specifically, I explain why symmetry of shocks to members is an important feature of a successful monetary and economic union and argue why MTM homogeneity is a good predictor for the symmetry of shocks. I disclose the reasons for employing the SVAR to model MTMs and my specification of the SVARs. Lastly, I summarize results of research that examine similar issues to this paper and discuss how their findings relate to the results of this paper.

`

The European Monetary System (EMS) preceded the EMU. The EMS was an agreement between various European nations to fix their national currencies with each other within certain bands. The purpose of this exercise was to minimize currency fluctuations and the resulting disruption of trade. Mundell (1963) argues that an open economy can choose two of the following three properties: monetary independence, fixed exchange rates and free flow of goods and services. Since the EMS was based on fostering greater flow of goods and services through fixed exchange rates, it followed that EMS members had to sacrifice monetary independence and embrace a single monetary policy. It is against this backdrop that the EMU, an agreement to adopt a common currency and a single monetary policy, was founded.

Compared to the EMS, the EMU imposes further constraints on national economic policies by imposing a common monetary policy on its members. The success of the common monetary policy depends on the symmetry of shocks to the national economies of EMU members because the symmetry of shocks defines the homogeneity of national economic needs. The common monetary policy is based on EMU-wide economic objectives and disadvantages members whose economic needs differ substantially from that of the aggregate EMU economy. Thus, symmetric shocks allow the European Central Bank (ECB) to set a single monetary policy that better addresses EMU members' national economic objectives.

One way to measure this symmetry is by analyzing the MTMs of the EMU and observing how they change with time. MTMs describe how shocks propagate through macroeconomic variables and homogeneous (heterogeneous) MTMs indicate that shocks have symmetric (asymmetric) effects on the economies that the MTMs represent. The

`

more symmetric (asymmetric) the shocks are, the more effective (ineffective) the common monetary policy is in managing the EMU national economies. Thus, evidence of converging (diverging) MTMs indicate increasing aptitude (inaptitude) of the single monetary policy in managing the economies represented by the MTMs.

I use SVARs to model the MTMs of the core EMU members and analyze how they evolve over time in relation to each other. SVARs are a variant of vector autoregression (VARs), an approach credited to Sims (1980). According to Sims, VARs are an ideal method to simultaneously estimate relationships between variables nested in multiple equations without imposing suffocating a priori assumptions. SVARs are a specific class of VARs that employ long-run and/or short-run restrictions to integrate economic foundations into the exercise.

Stock and Watson (2002) analyze the strengths and weaknesses of VARs. They claim that VARs perform well compared to other approaches in terms of data description because VARs "involve current and lagged values of multiple time series" and thus, "capture co-movements that cannot be detected in univariate or bivariate models." Furthermore, VARs generate informative summary statistics such as Granger-causality tests, impulse response graphs (IRGs), and variance decompositions. This paper makes heavy use of IRGs to illustrate MTMs and how they change in between periods.

IRGs delineate how shocks to one macroeconomic variable propagate through the macroeconomic system by showing how each macroeconomic variable in the VAR model responds to shocks to itself and other macroeconomic variables. By analyzing changes in IRGs of various periods, I can identify converging (diverging) patterns of the MTMs they represent and consequently, substantiate the symmetry (asymmetry) of these

`

MTMs and the increasing aptitude (inaptitude) of a single monetary policy in addressing national objectives.

Taylor (1995) recommends the macroeconomic variables to use for analyzing closed-economy MTMs and explains the rationale behind his selection. His baseline closed-economy model consists of variables representing real activity, inflation and monetary policy, as well as relationships between the variables to model linkages between these three sectors. Real activity is generally represented by a measure of the output gap, unemployment rate or the capacity utilization rate. Inflationary data can be modeled with a GDP deflator such as the annualized percentage changes in consumer price indices or that of producer price indices.

On the other hand, there is a variety of possible contenders to represent the monetary policy reaction function. Taylor (1995) advises the use of nominal, short-term interest rates. Taylor (1995) advocates nominal interest rates over real interest rates because nominal interest rates capture information about rigidities and future expectations of the economy while real rates do not.

He also argues that short-term interest rates such as money-market interest rates are much more indicative of monetary policy than money supply because modern central banks target short-term interest rates instead of money supply. Additionally, interest rates are more readily observable than the quantity of money. Boivin and Giannoni (2002) support the use of short-term interest rates that are set by market forces. The rationale behind their decision is that official interest rates do not necessarily provide full information about market conditions. Monetary authorities set official rates periodically with observation and implementation lags. Thus, the official rates at a certain point in

`

time do not fully describe current market conditions. Market-driven interest rates, such as money market rates, circumvent this problem because they are continuously updated by market forces.

In order to map the influence of the EMU integration process on the currency component of external linkages, Dornbusch et al (1998) recommend that "exchange rate movements should then be separated into an intra-EMU channel and extra-EMU channel (mostly a dollar channel), as only the former will disappear inside EMU." They make this recommendation to address the subsuming of national currencies by the euro in the final stage of EMU integration. The provision of the extra-EMU channel ensures continuous tracking of a given EMU member's external currency linkages. However, even the authors acknowledge the difficulties in separating existing measures of currency exchange rates into extra-EMU and intra-EMU channels.

To model the influence of external capital markets to domestic capital markets, it is important to include a measure of foreign interest rates. This foreign interest rate has to exert a dominant influence over the domestic capital market and consequently, the domestic interest rate. A popular measure to use is the FFR because of the influence the US interest rate has on international capital markets. Depending on the purpose of the research, other important interest rates can be used. Mojon and Peersman (2001) use the German interest rate to model the influence of the Bundesbank on various European capital markets in the pre-EMU period.

There is a substantial amount of literature on MTM convergence among EMU members. The general gist of the arguments presented below is that the interest-rate pass-through mechanism is becoming more homogeneous in the pre-EMU period than the

EMU period. Even though papers weighted towards pre-EMU data favors heterogeneity with respect to the interest rate pass-through and the interest rate channel, more recent studies with more EMU data supplies evidence for homogeneity in these areas. Furthermore, the exchange rate channel is not considered an influential component of the MTM. Last but not least, there is evidence of increasing heterogeneity with respect to inflation. With respect to observed heterogeneity, miscoordination of fiscal polices, and not monetary policy, appears to be the culprit.

One of the earlier studies that use predominantly pre-EMU data is that of Toolsema, Sturm, and Haan (2001). They base their study of interest rate pass-through in the EMU on monthly data from 1980-2000 and they report MTM divergence with respect to the interest rate channel because they find significant and persistent disparities in the interest rate pass-through from the money market rates to the capital market rates among the six EMU countries under observation. Using rolling regressions and error-correction models (ECMs), they find no convergence patterns in the interest rate pass-through mechanisms among different EMU countries because they observe significant and more importantly, persistent differences in each country's ECM parameters throughout the entire sample. The disparity among pass-through mechanisms of different EMU countries implies that shocks to the common monetary policy have different implications for different countries and thus, facilitate heterogeneity in MTMs of EMU countries.

Another study largely based on data from the pre-EMU period is that of Clements et al (2001). Their paper provides evidence that heterogeneity of national interest rate channels in the pre-euro period persists even when heterogeneous monetary policy reaction functions are accounted for. Their study uses a two-block model that captures

`

both the aspect of monetary policy that can be generalized to the entire EMU and the aspect that caters to domestic specifications. They also supply evidence that certain economies identify more with the Bundesbank interest rate than others to further their argument that there is heterogeneity among the MTMs of EMU countries.

Clements et al (2001) also venture into exchange rate channels by comparing output responses to monetary shocks when the exchange rate component is open and when it is closed. They find that the effects of a common monetary shock on national GDPs are slightly muted under flexible exchange rates than under fixed exchange rates for most countries but the disparity is largely insignificant. Thus, they argue that the exchange rate channel is weak. The exchange rate channel operates when monetary policy shocks induce changes in the exchange rate and in turn, the exchange rate motivates fluctuations in output and inflation.

However, studies with more data from the EMU period reports elements of homogeneity with respect to the interest rate pass-through. Angeloni and Ehrmann (2003) find that interest rate pass-through mechanisms in the EMU period are more cohesive even though deviations from the mean do not revert faster. They support their argument by presenting descriptive statistics of impulse responses of lending and deposit rates to money market rates in the pre-euro and post-euro period. They also include non-EMU countries as a control group so that EMU-specific effects can be singled out.

Contrary to the interest rate pass-through convergence, the inflation component provides evidence for heterogeneity. Busetti et al (2006) find that at the national level, inflationary patterns were converging in the pre-EMU period and are currently diverging into clusters in the EMU period. In their paper, they deduce these patterns by obtaining

`

inflation differentials across all possible pairings of EMU economies and then performing tests for convergence and divergence in the pre-euro and post-euro samples respectively. They use unit root tests on these differentials to test for convergence in the period leading up to the implementation of the euro in 1999 and stationarity tests to test for divergence in the post-euro period. They report that there is convergence in the pre-euro period and divergence in the post-euro period. They report that early members of the EMU display strong convergence properties in the pre-euro sample while later entrants, such as Spain, Portugal and Greece, experience persistent inflation differentials with their peers. They also find that the post-euro period is characterized by a clustering of inflation rates into three separate groups. There is a lower inflation group that consists of Germany, France, Belgium, Austria, Finland and a higher inflation group that comprises Spain, Netherlands, Greece, Portugal and Ireland. Italy is situated between these two groups.

It is possible that the observed inflation asymmetry stems from the heterogeneous effect of monetary policy. Hanson, Hurst, and Park (2006) explore how monetary policy promotes asymmetric ramifications in the context of US states. They find that states with lower than average growth experience more severe recessions from monetary policy contractions and enjoy more muted booms from monetary policy expansions compared to other states. This asymmetric experience between states of differing economic performance can be extrapolated to the EMU case. The EMU monetary policy targets aggregate EMU macroeconomic variables and this aggregate data is heavily weighted towards larger EMU economies. Hence, it is possible that the implementation of the common monetary policy is biased against smaller economies that are at different cycles from larger economies and thus, have different objectives.

`

Cicarelli and Rebucci (2002) provide mixed evidence for the homogeneous impact of monetary policy. They study the convergence of core EMU (Germany, France, Italy, and Spain) economies' individual output responses to monetary policy shocks. In their model, they employ time-varying parameters and allow for interdependence between countries observed. They report that the magnitude of the cumulative impact of monetary policy shocks is homogeneous even though the timing of these impacts is different. This homogeneous impact implies monetary success. However, they also find the differences in timing of impacts to be persistent in both pre-euro and post-euro samples even though the parameters of MTMs were changing. This persistent temporal difference undermines the argument for monetary success.

Böwer and Guillemineau (2006) offer evidence that monetary policy is successful for the entire EMU population. A defining property of unsuccessful monetary policy is that instead of minimizing welfare losses from inflation and output gap fluctuations for all EMU members, monetary policy impacts EMU members asymmetrically and aggravates cyclical disparities between their economies. Böwer and Guillemineau (2006) find that the implementation of the EMU intensified business cycle synchronization among EMU members and consequently, improved the aptitude of monetary policy in addressing national economic objectives.

Boivin and Giannoni (2002, 2006) provide a method to measure monetary success that can be applied to the IRGs generated in this paper. They argue that insignificant output and inflation responses to monetary innovations are characteristic of a successful monetary policy. Their analysis of post-1980 US monetary policy finds that impulse responses of output and inflation to monetary policy shocks are quantitatively

`

insignificant. However, they claim that this observation stems from the effectiveness of monetary policy in reacting to output and inflation variations instead of from its impotency in influencing output and inflation. They argue that monetary policy shocks motivate lower output and inflation responses when monetary policy tracks inflation and output gap fluctuations more effectively.

Since there is insufficient evidence that monetary policy is responsible for promoting heterogeneity, it is likely that fiscal policies may be the culprit. The heterogeneous effects of fiscal policy can be traced to differences in the fiscal transmission mechanism and/or differences in the fiscal behavior of the EMU members. There is little to no research on the effects of fiscal policy on EMU members. Theoretically, the Stability and Growth Pact (SGP) is supposed to regulate fiscal policies among EMU members. However, Buti and van den Noord (2004) point to electoral budget cycles and a weak enforcement system as primary reasons behind fiscal miscoordination between EMU members. Instead of adhering to a fiscal policy that promotes convergence and optimizes EMU-wide objectives, certain members pursue discretion to maximize individual objectives. They point to the persistent deficits generated by Portugal, Germany and France as evidence for deviations from the SGP and for heterogeneous fiscal policy reaction functions. They argue that even though the EMU benefits from influential automatic stabilizers, such as large tax and welfare mechanisms, that allow for relatively high degree of cycle-smoothing, members continue to pursue fiscal activism.

Eichengreen (2006) reinforces this notion of fiscal failure and monetary success in the EMU. Eichengreen notes that the common currency and the single monetary policy

`

has served EMU members well by providing more stability and encouraging the integration of European financial markets. At the same time, he argues that current fiscal practices among EMU members are insufficient to counterbalance the inevitable rigidities of using a single currency and monetary policy for a variety of economies. Eichengreen criticizes current EMU fiscal restrictions as arbitrary and counterproductive. He makes the case for more discretion but also greater rigor in analyzing public debt sustainability. Current fiscal restrictions encourage heterogeneous levels of monetary and fiscal coordination among EMU members and thus, may be responsible sustaining or even aggravating the divergences in MTM evolution among EMU members.

In my paper, I find evidence for greater homogeneity in the case of the interest rate pass-through. This finding opposes the results of Toolsema et al (2001). However, my results with respect to interest rate pass-through are similar to Angeloni and Ehrmann (2003) and I trace the increasing homogeneity of the interest rate pass-through to the increasing dominance of the EMU-wide interest rate in EMU members' MTMs.

My results with respect to the interest rate channel agree with Cicarelli and Rebucci (2002) and run contrary to the findings of Clements et al (2001). Like Cicarelli and Rebucci (2002), I find that the cumulative impacts of EMU members' output responses to monetary policy innovations are relatively homogeneous. However, the confidence bands around the IRGs prevent me from offering my opinion on their argument about the timing of the effects of monetary policy shocks. On the other hand, my IRGs verify the weak exchange rate channel observed by Clements et al (2001). Additionally, I show that the exchange rate component of MTMs exhibit convergence.

`

My findings with respect to inflation largely agree with that of Busetti et al (2006). Both of us observe how Spain's MTM exhibits a significantly different inflation component compared to that of Germany, France and Italy. However, I do not have sufficient evidence to support the assertion of Busetti et al (2006) that Italy's experience with inflation is diverging from that of France and Germany.

In this paper, I find insignificant responses of output and inflation to monetary shocks for the core EMU members. According to Boivin and Giannoni (2002, 2006), this finding represents evidence for monetary success for the core EMU members and thus, monetary policy is not a likely source for the observed inflation asymmetry. This argument for monetary success echoes the findings of Böwer and Guillemineau (2006).

It is important to note that the majority of studies discussed above work with quarterly data while my report is based on monthly data. Thus, disparities between our findings may stem from this difference in choice of the temporal units of observation. It is also important to note that most of the publications discussed below have only been able to include relatively fewer years of the EMU period in their analysis. Thus, sample choice may be another factor that explains discrepancies between my findings and theirs. Furthermore, some of the models discussed below involve making a priori assumptions about the type of relationships that EMU members share with each other. A popular example is to establish the primacy of German interest rates over other members in the pre-EMU period. In this paper, I try to build a generalizable model so that the differences between countries show up in the results rather than in the assumptions and specifications.

`

II. Model

In this paper, I model the closed-economy component with output gap, inflation and short-term domestic money market rates. These variables measure real activity, price level movements and interest rate movements respectively. To extend this closed-economy model to an open-economy model, I need to include variables that model external linkages, such as foreign interest rates that have a strong influence on the domestic economy and important national currency exchange rates. For example, Kim and Roubini (2000) use the Federal Funds Rate (FFR) and the nominal exchange rate with respect to the US dollar to capture external linkages in their study of MTMs of industrialized countries.

Additionally, I use real effective exchange rates (REERs) to provide a continuous measure of an EMU member's external currency linkages. A country's REER is constructed by comparing the price levels, trading volumes and nominal exchange rates of that country and its trading partners.[1] Under the relatively fixed nominal exchange rate arrangements of the EMS and the common currency of the EMU, the nominal exchange rates between EMU members are very rigid and do not accurately represent external linkages because they are artificially managed. On the other hand, the REER responds to more than just nominal exchange rate fluctuations; it also reflects movements in domestic

[1] The REER of a given country is constructed from its real exchange rate (RER) with respect to its trading partners. The RER is defined as RER = e(P/P*). e is the nominal exchange rate (e = foreign currency/domestic currency), P is domestic price level and P* is the foreign price level.
The REER is indexed to a base year (by) and thus, the REER of a given country for the current year (cy) is defined as $REER_i^{cy} = \sum_{i=1}^{n} w_i \, (RER_i^{cy}) / (RER_i^{by})$, where n is the number of trading partners the given country has, w_i is the proportion of trade volume between the given country and country i to total trade volume of the given country and RER_i is the real exchange rate between the given country and country i.

`

inflation, foreign inflation and trading patterns. Thus, the REER provides a less rigid measure of external linkages that more accurately represents external linkages.

I use the EMU-wide interest rate because it provides continuity throughout both the pre-EMU and EMU period and because it is required to examine how the EMU-wide interest rate passes to national interest rates. The Bundesbank has been the dominant force behind interest rate movements in Europe in the pre-EMU period but in the EMU period, the decision to set interest rates lies in the hands of the European Central Bank (ECB). Eurostat provides a continuous measure of the EMU-wide interest rate that is constructed by weighting and aggregating pre-EMU national interest rates and appending it to ECB rates in the EMU period. Thus, Eurostat's EMU-wide interest rate provides a continuous foreign, but European, interest rate. Its identity as an European interest rate also allows exploration into the interest rate pass-through mechanism that demonstrates how well national capital markets are integrated into the EMU capital market. A rapid and complete pass-through of shocks from the EMU-wide interest rate to that of domestic interest rates intimates that the observed domestic capital market is synchronized and integrated into the general EMU capital market, vice versa.

I specify my preliminary SVAR model as:

$$\mathbf{Y_t} = A(L).\ \mathbf{Y_t} + \mathbf{e_t}$$

where $\mathbf{Y_t} = [\, i_t^{EMU}, \chi_t, \pi_t, i_t, \Delta r_t \,]$` in order of decreasing exogeneity or increasing endogeneity , A(L) is a matrix of weights on current and lagged values of $\mathbf{Y_t}$ and $\mathbf{e_t}$ represents the error terms.

i_t^{EMU} is the EMU-wide short-term interest rate. χ_t is the monthly output gap derived by applying a Hodrick-Prescott filter with the smoothing parameter at 14400 on

`

the monthly data of seasonally-adjusted industrial production, π_t is the annualized monthly inflation rate, i_t is the monthly short-term money-market interest rate and r_t is the first difference of the real effective exchange rate.[2]

In the SVAR, I use the following short-run restriction:

$$\mathbf{e_t} = \mathbf{\Omega} \,.\, \mathbf{u_t}$$

Where $\mathbf{e_t} = [\mathbf{e}_{i_t^{EMU}}, \mathbf{e}_{x_t}, \mathbf{e}_{\pi_t}, \mathbf{e}_{i_t}, \mathbf{e}_{\Delta r_t}]'$, $\mathbf{\Omega}$ is a lower triangular matrix and $\mathbf{u_t} = [\mathbf{u}_{i_t^{EMU}}, \mathbf{u}_{x_t}, \mathbf{u}_{\pi_t}, \mathbf{u}_{i_t}, \mathbf{u}_{\Delta r_t}]'$. The **e**'s represent error terms of the relationships in the model and the **u**'s represent structural shocks.

Each country's model is estimated for two sub-samples of monthly data: the pre-EMU period, 1991M01 to 1997M12, and the EMU period, 2000M01 to 2006M09. I selected the beginning of the sample size to minimize the impact of shifts due to German Reunification. Also, the Eurostat data on the monthly EMU-wide interest rate starts at this point and it provides me with a consistent and continuous source for and measure of EMU-wide interest rates.[3] I omit observations for years 1998 and 1999 to account for the adjustment period to the Euro and to the ECB's single monetary policy. I believe their omission will better portray changes in the MTM correlated with the introduction of the

[2] All the data, except i_t^{EMU} and i_t for France, was obtained from the International Financial Statistics website (www.imfstatistics.org). I obtained i_t for France from short-term commercial paper rate from the Banque de France website and I acquired i_t^{EMU} from the Eurostat website (www.europa.eu.int/comm/eurostat/).

[3] I could construct a measure of EMU-wide interest rates that stretch further back than the one provided by Eurostat. To do so, I could assign appropriate weights to existing data on important interest rates in the EMU and aggregate them in the time period before the Eurostat dataset starts. However, this course of action may cause continuity errors that create artificial shifts in the data and undermine the integrity of the research effort. Thus, I choose to stick with the Eurostat data.

single currency and the common monetary policy. My choice for the endpoint of the dataset is based on availability.

In total, there are eight models; two for each country, spanning the two time periods noted above. For each country, I compare the IRGs from both time periods to extract information about how their MTM changed. To gauge shifts in MTM convergence, I derive patterns of change across core members by comparing their respective MTM evolutions.

Stationary tests on the variables entered into the model return mixed results and thus, I cannot reject the possibility of spurious relationships in the model. However, I persist on entering certain variables at levels for two reasons. Firstly, certain macroeconomic variables are known to have cyclical components that fluctuate around a stationary component. The relatively short time period considered in this project may not provide sufficient time for cycles to resolve and thus, may be responsible for exaggerating the cyclical component and obscuring the stationary aspect. Secondly, Sims (1992) advises against rendering non-stationary variables stationary because if the variables turn out to be cointegrated, the model may be misspecified. For my model, I enter output gap, inflation, EMU interest rates and domestic interest rates at levels and the REER at first differences. The choice for REER to be at first differences is to complement inflation because part of REER is derived from comparing price levels and inflation is a representation of first differences of price levels. As a robustness check against spurious relationships, I estimate another model by entering the first-difference of all variables into the original model. I find the resulting IRGs to be qualitatively similar

`

and thus, this exercise substantiates my choice of using variables at levels even if they are non-stationary.

I use the Akaike Information Criterion (AIC) to specify the lag order of each model. The AIC selects the appropriate amount of lags based on the marginal improvement in information that each lag order brings to the model. It penalizes the inclusion of each lag order and thus, lag orders that do not bring a significant amount of improvement to the model do not score well and are not recommended for use. Due to the small sample size that is available to me, I follow the AIC's recommendation up to four lags to preserve degrees of freedom.

Table 1

Test results for heteroskedasticity and autocorrelation

	White X	White	LM_1	LM_2	LM_3	LM_4
DE (pre-EMU)	0.2621	0.2085	0.3212	0.0346**	0.5899	0.191
DE (EMU)	0.0333**	0.000***	0.068*	0.4965	0.1839	0.1981
ES (pre-EMU)	0.003***	0.0018***	0.4198	0.0314**	0.2303	0.2314
ES (EMU)	NA	0.0065***	0.3059	0.1179	0.2908	0.384
FR (pre-EMU)	NA	0.2239	0.6453	0.1009	0.9703	0.5618
FR (EMU)	0.3444	0.0504*	0.0508*	0.0103**	0.8296	0.3812
IT (pre-EMU)	0.0001***	0.0002***	0.489	0.0018***	0.0278**	0.9734
IT (EMU)	0.0939*	0.1145	0.0054***	0.0842*	0.0608*	0.7814

DE – Germany
ES – Spain
FR – France
IT - Italy

* - statistically significant at the 90% confidence level
** - statistically significant at the 95% confidence level
*** - statistically significant at the 99% confidence level

Tests for heteroskedasticity and autocorrelation on the models indicate the prevalence of these problems in the model. Due to software limitations, I am unable to correct these problems without undermining the VAR approach. **Table 1** underlines the severity of each issue among the models. It shows the results of the White heteroskedasticity test with cross terms (White X) and without (White). It also provides results for LM serial autocorrelation test for lag order 1 (LM_1), 2 (LM_2), 3 (LM_3)

`

and 4 (LM_4). The existence of heteroskedasticity and autocorrelation affects the size of the confidence bands surrounding the IRGs. However, large confidence bands are a constant issue in the VAR literature. Even though the large bands are detrimental to the statistical significance of my findings, I believe that the IRGs still provide useful and important information about the MTMs.

III. Discussion of Results

My results show that there are converging features for the interest rate component and the exchange rate component of MTMs across core EMU members. However, I find increasing heterogeneity in the inflation component. Convergent (divergent) features represent evidence for increasing symmetry (asymmetry) among the MTMs of the core members and testify towards the increasing aptitude (inaptitude) of the single monetary policy. Results indicate monetary success and hence, the observed heterogeneity may stem from national fiscal policy miscoordination instead of monetary failure.

I find homogeneous features with respect to the interest rate pass-through mechanism of EMU-wide interest rates to domestic interest rates. **Graph 1** shows how domestic short-term money market rates become more responsive to the EMU-wide interest rate shocks compared to domestic interest rate shocks for all models when one goes from the pre-EMU period (’91-’97) to the EMU period (’00-’06). Additionally, there are no noticeable changes for INT responses to other variables. The general pattern of increasing pass-through of EMU-wide rates to the domestic money market rate underlines the increasing homogeneity and symmetry of this channel for the core EMU members.

`

I also estimate pass-through equations based on Kaufmann and Scharler (2006). Kaufmann and Scharler (2006) analyze financial systems and estimate a pass-through equation to measure the influence of deposit rates on lending rates. In this paper, I modify their pass-through equations to gauge the influence of the EMU-wide interest rate on individual members' domestic interest rates and verify observations from IRGs about interest rate pass-through.

My version of their equation is:

$$i_t = ß_0 i_t^{EMU} + ß_1 i_{t-1}$$

The intuition behind the equation is that the current domestic interest rate depends on the current EMU-wide interest rate and the lagged domestic interest rate. By examining the evolution of the coefficients of the independent variables, $ß_0$ and $ß_1$, I will be able to determine changes in the significance and influence of the respective independent variables.

I specify the equation at levels for the four EMU economies based on data from the pre-EMU period and the EMU period. **Table 2** illustrates a pattern of increasing dominance of EMU-wide rates in the interest rate channel that is similar to **Graph 1**. These results substantiate the EMU rates as the dominant force in homogenizing and promoting symmetry in the interest rate component of EMU MTMs. Interestingly, the general pattern of change between the pre-EMU and the EMU period becomes more difficult to discern when I enter the variables at first differences or at greater lags. One possible explanation for this is that crucial information is lost when the data is considered at first differences instead of levels. Furthermore, the marginal cost of including

`

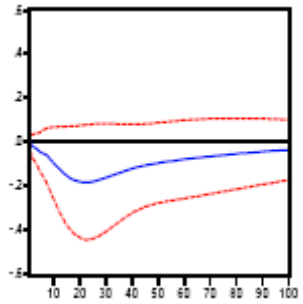
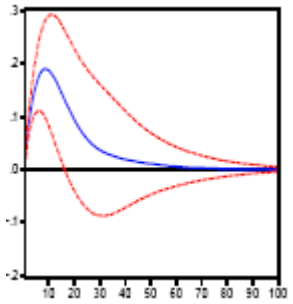
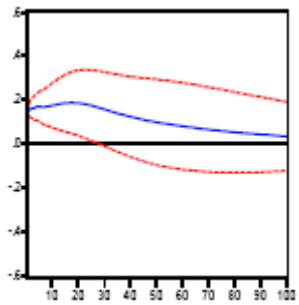
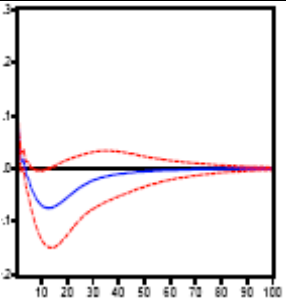
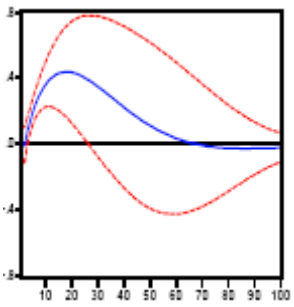
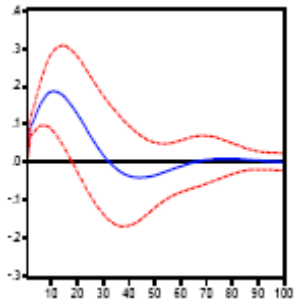
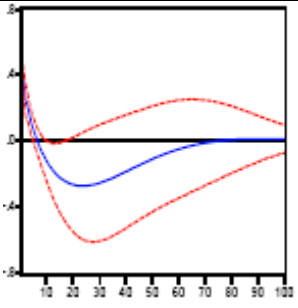
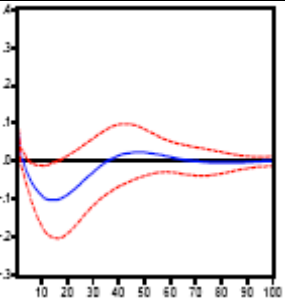
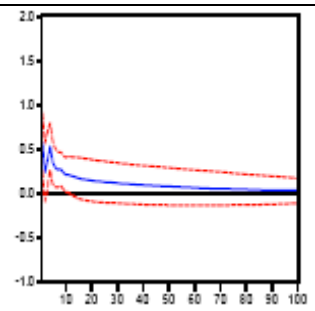
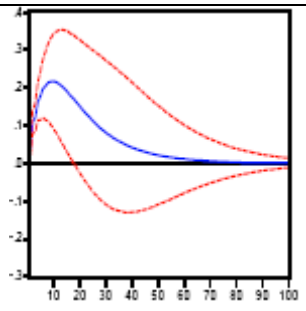
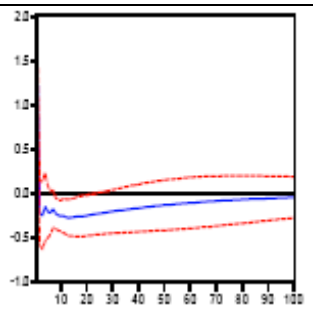
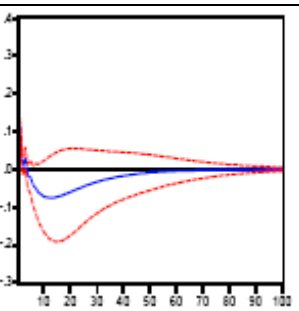
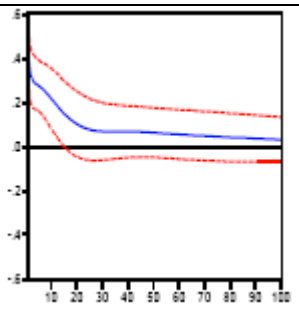
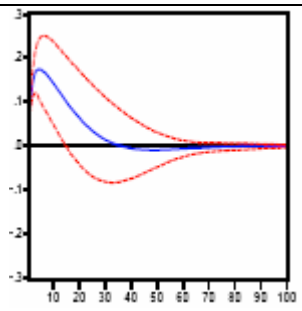
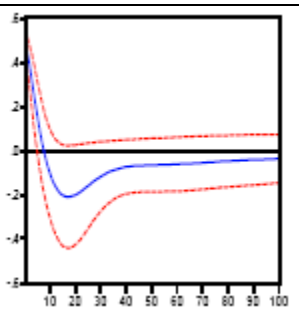
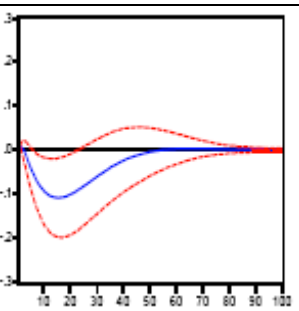
additional lags, such as decreasing the statistical significance of lags in the baseline model, exceeds the marginal benefits from the increase in information that they provide.

Table 2 shows how the larger core economies, Germany and France, are isolated from EMU-wide interest rates in the pre-EMU period but with the implementation of the EMU, the EMU-wide interest rate significantly influences the domestic interest rate. The smaller economies, Italy and Spain, experience a significant pass-through from EMU-wide interest rates in both periods and the pass-through of EMU-wide interest rate is stronger in the EMU period than the pre-EMU period. From **Table 2**, it also appears that the pass-through became considerably stronger in Italy compared to Spain. In the EMU period, the EMU-wide interest rate becomes the dominant force in Italy while the lagged domestic interest rate maintains an equal influence in comparison to the EMU-wide interest rate in Spain.

Chart 1 tracks the movement of domestic short-term interest rates among core EMU members as well as that of the EMU-wide interest rate. It provides further evidence that the domestic money market rates for EMU members have converged in the aftermath of the introduction of the euro and ECB interest rates on 1st January 1999. The results from these exercises verify the findings of Angeloni and Ehrmann (2003) that the pass-through mechanism is converging for all EMU members at the monthly level.

`

Graph 1

	Domestic interest rate response to EMU-wide interest rate shocks		Domestic interest rate response to domestic interest rate shocks	
	Pre-EMU	EMU	Pre-EMU	EMU
DE				
ES				
FR				
IT				

The red lines represent the confidence bands based on a 95% confidence level.

Table 2

Statistics of pass-through coefficients

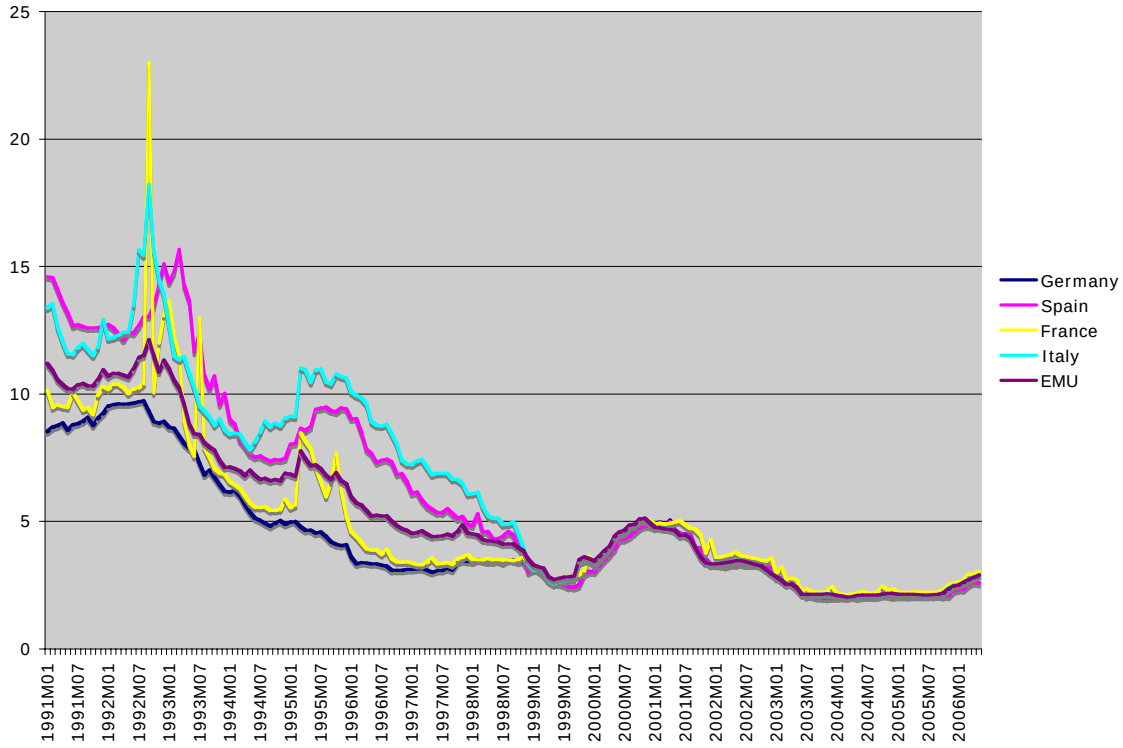
	$ß_0$	$ß_1$
DE (pre-EMU)	-0.00852(-0.3668)	1.001512***(32.2231)
DE (EMU)	0.431506***(11.2499)	0.552663***(13.6354)
ES (pre-EMU)	0.239927***(5.0263)	0.800435***(21.3266)
ES (EMU)	0.43897***(11.2219)	0.543977***(13.1519)
FR (pre-EMU)	-0.01326(-0.0909)	1.004703***(6.0754)
FR (EMU)	0.272746***(2.8266)	0.740217***(8.1876)
IT (pre-EMU)	0.110283**(2.34627)	0.913363***(27.9213)
IT (EMU)	0.860659***(28.4647)	0.135282***(4.5033)

DE – Germany
ES – Spain
FR – France
IT – Italy

* - statistically significant at the 10% significance level
** - statistically significant at the 5% significance level
*** - statistically significant at the 1% significance level
t-statistics in parentheses

Chart 1

Evolution of domestic short-run interest rates



`

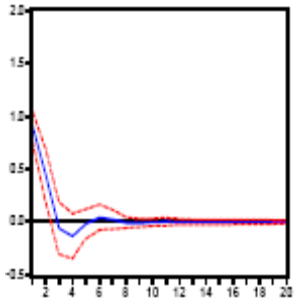
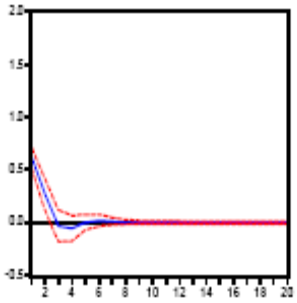
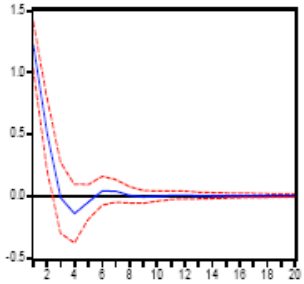
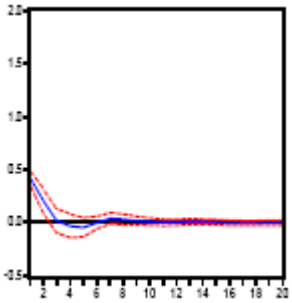
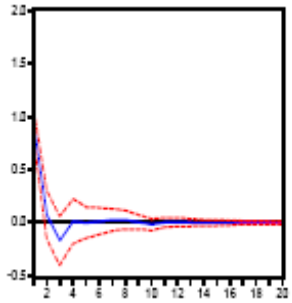
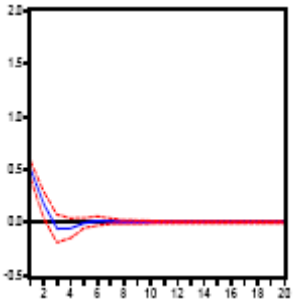
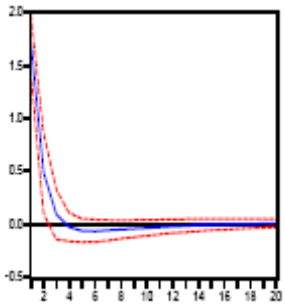
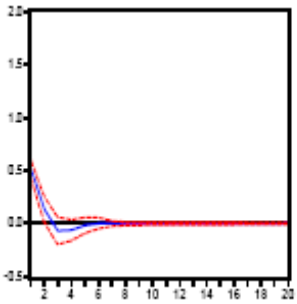
Another convergent feature among the MTMs lies in the exchange rate component. **Graph 2** demonstrates that the immediate response of the first difference of REER to shocks to itself becomes more muted in the EMU period compared to during the pre-EMU period for all EMU core members. Furthermore, the differences between the immediate responses of core EMU members are smaller in the EMU period than during the pre-EMU period. Additionally, **Graph 3** shows how the response of Δr_t to the EMU-wide interest rate shocks is becoming more homogeneous for all core EMU members in the EMU period.

Furthermore, the responses of output and inflation to r are insignificant, as are the exchange rate response to monetary policy shocks for all EMU core economies in both the pre-EMU and EMU period. This provides evidence for a weak exchange rate channel in the spirit of Clements et al (2001). There appears to be no significant changes in the influence of the exchange rate channel between the two time periods. This can be attributed to the existence of rigid exchange rate agreements in the EMS that are comparable to the euro arrangement under the EMU.

Moreover, **Graph 4** demonstrates how inflation response to shocks to itself remains relatively the same for DE, FR and IT from the pre-EMU period to the EMU period. However, inflation becomes more volatile for ES.

`

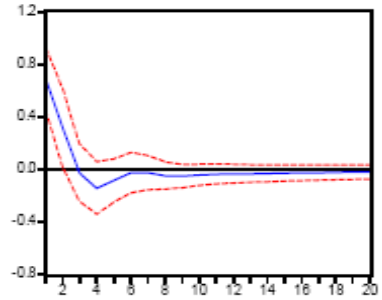
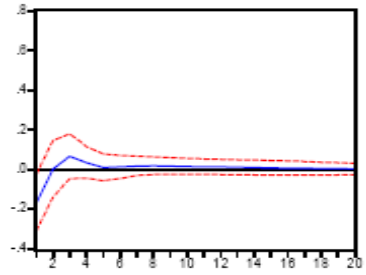
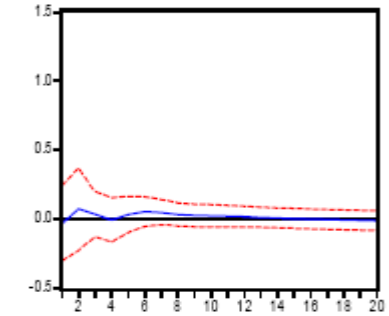
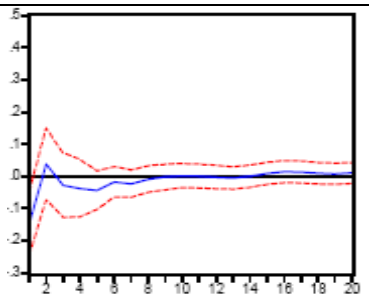
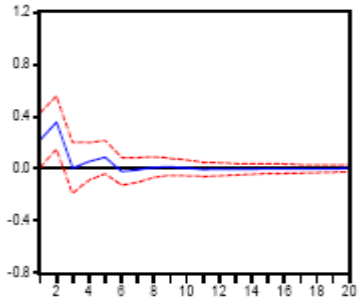
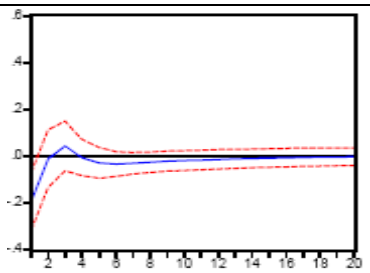
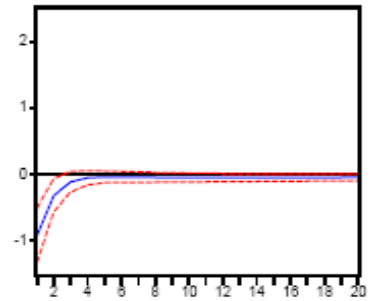
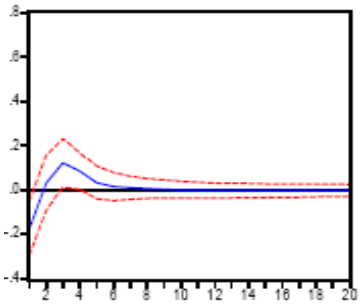
Graph 2

Δr_t response to shocks to Δr_t		
	Pre-EMU	EMU
DE		
ES		
FR		
IT		

The red lines represent the confidence bands based on a 95% confidence level.

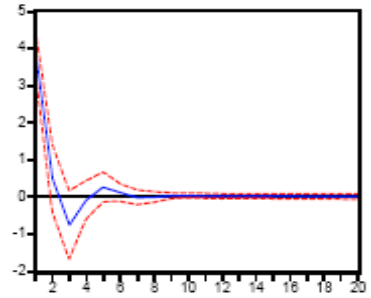
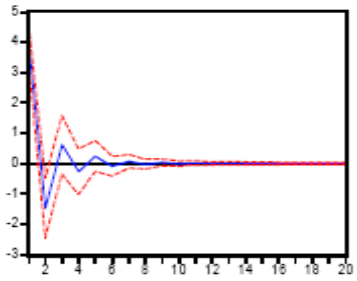
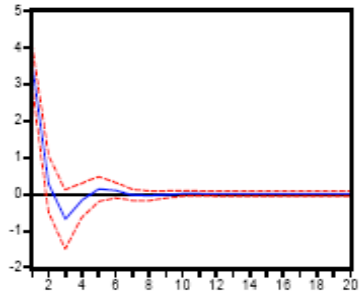
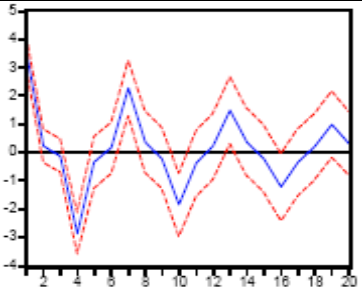
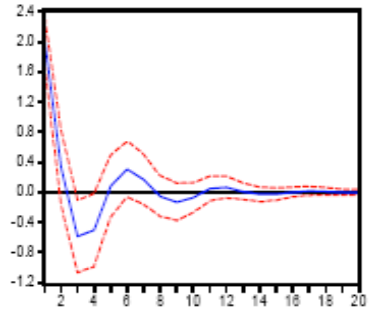
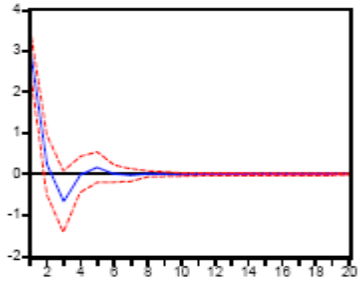
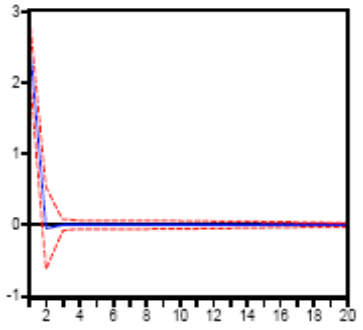
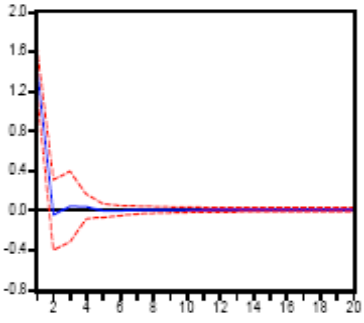
`

Graph 3

Δr_t response to EMU-wide interest rate shocks		
	Pre-EMU	EMU
DE		
ES		
FR		
IT		

The red lines represent the confidence bands based on a 95% confidence level.

Graph 4

Inflation response to shocks to inflation		
	Pre-EMU	EMU
DE		
ES		
FR		
IT		

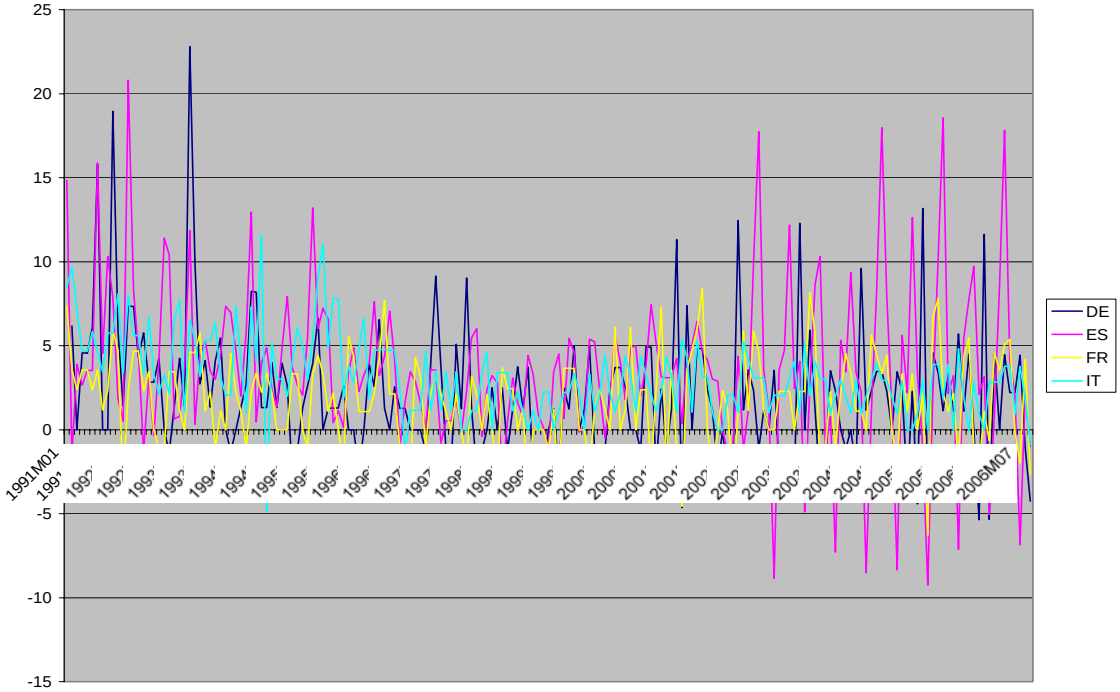
The red lines represent the confidence bands based on a 95% confidence level.
Note: When the period is set to 100, the inflation response for Spain during the EMU period converges to 0 in an oscillatory manner

`

Chart 2 tracks the evolution of inflation among the core EMU members from January 1991 to September 2006. It shows how Spain is considerably more volatile than its core EMU peers when it comes to inflation fluctuation in the EMU period. In the pre-EMU period, Spain's inflation volatility is relatively similar to that of DE and IT. This observation provides evidence that Spain is suffering more than its peers in coming under the EMU. These results on inflation tie in with the findings of Busetti et al (2006). Like Busetti et al (2006), I find that Spain's experience with inflation differs from that of Italy, Germany and France, who have relatively similar experiences with inflation. Unlike Busetti et al (2006), I do not find sufficient evidence to corroborate the argument of Busetti et al (2006) that Italy's experiences with inflation is different from that of France and Germany.

Chart 2

Inflation rates for 1991-2006



`

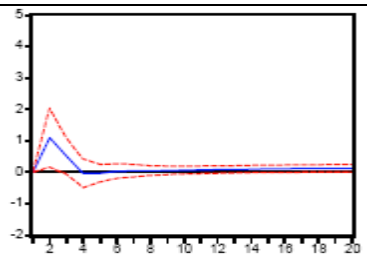
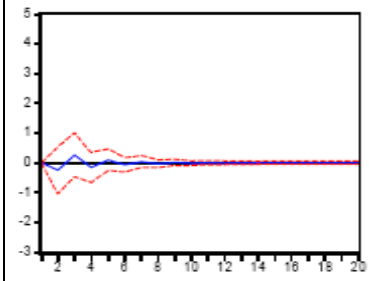
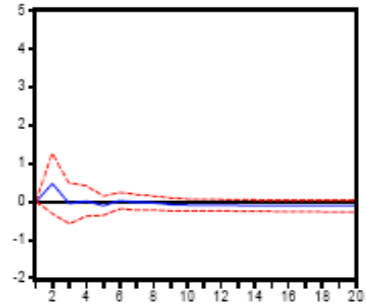
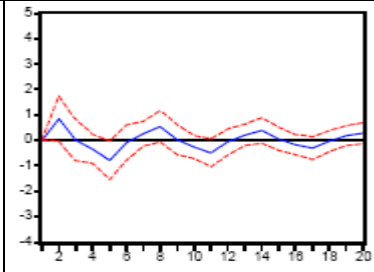
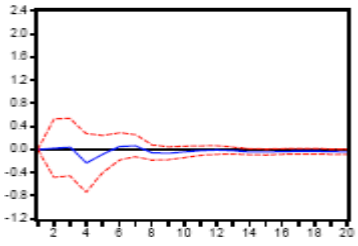
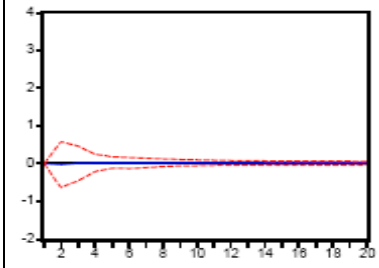
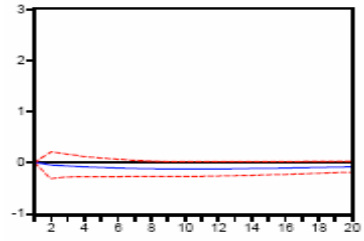
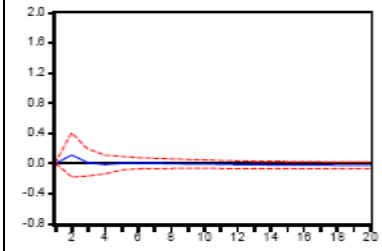
One possible explanation is that business cycles in Spain are more out of step with the general EMU business cycle compared to its core EMU peers. As a result, Spain's experience with inflation takes on a very different track compared to other core EMU members when all members are subjected to a common monetary policy that is based on general EMU objectives. If this argument is true, then it should be reflected in a greater output and inflation response to monetary policy shocks in the EMU period for Spain compared to that in the pre-EMU period. **Graph 5** maps the responses of inflation gap to monetary shocks. Even though, the Spain's response changes in direction across the two periods, non-response is still a possibility for both periods when one considers the confidence bands. **Graph 6** describes the response of output gap to monetary policy shocks in both EMU and pre-EMU periods for all core EMU members. All the responses in **Graph 6** are insignificant.

Graphs 5 & 6 demonstrate the insignificant responses of inflation and output, respectively, to monetary policy shocks. While some may interpret this as monetary policy impotency, Boivin and Giannoni (2002) argue that the insignificant responses stem from the success of the systematic behavior of monetary policy in minimizing the variability of output and inflation. As the systematic component of monetary policy anticipates output and inflation fluctuations better, monetary policy shocks are less likely to cause substantial output and inflation fluctuations. Thus, the insignificant responses in **Graphs 5 & 6** provide evidence for monetary success among core EMU members and in the context of core EMU members, substantiate the assertions of Böwer and Guillemineau (2006) that the common monetary policy has been successful. In the

`

absence for monetary failure, fiscal miscoordination emerges as the likely candidate for observed inflation heterogeneity.

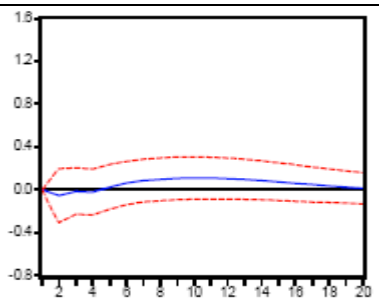
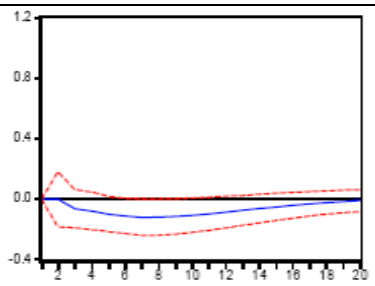
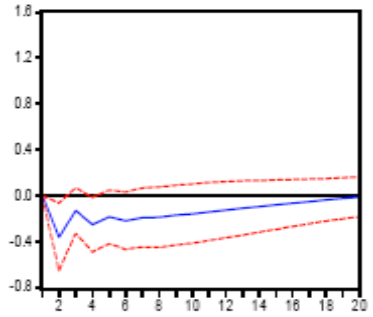
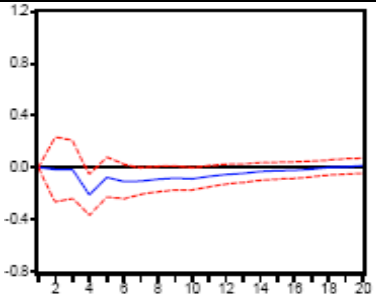
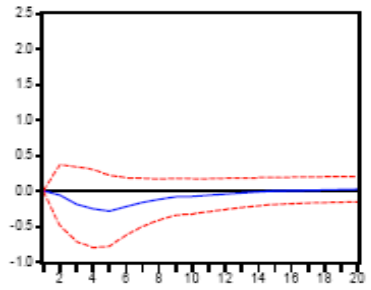
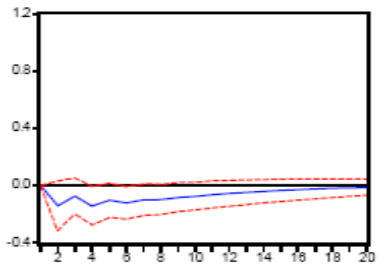
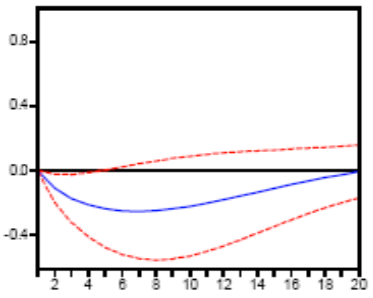
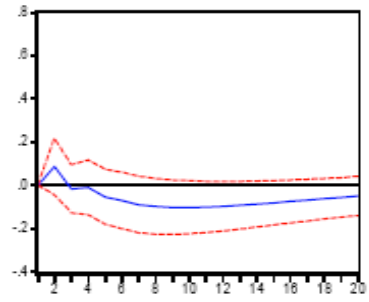
Graph 5

Inflation response to domestic interest rate shocks		
	Pre-EMU	EMU
DE		
ES		
FR		
IT		

The red lines represent the confidence bands based on a 95% confidence level.

`

Graph 6

Output gap response to domestic interest rate shocks		
	Pre-EMU	EMU
DE		
ES		
FR		
IT		

The red lines represent the confidence bands based on a 95% confidence level.

`

IV. Future research

Increasing the sample size appears to be a fairly straightforward approach to improve this research. To do so, one can lengthen the time frame under consideration. Lengthening the time period makes it more likely for cycles to complete and thus, prevents the misspecification of cyclical behavior as linear trends and of stationary trends as non-stationary trends. Furthermore, the findings of this paper are limited to the core EMU members. By including non-core EMU members in the research project, its results can be extended to a larger proportion of the EMU population.

However, there are many exogenous shocks in the history of the EMU and the EMS, such as the exchange rate speculations during 1994 and the German Reunification in 1990-1991. The complexity of the research project increases significantly when one has to account for these exogenous shocks in the model. Similarly, inclusion of more EMU members for analysis makes comparing and contrasting IRGs a more taxing exercise. Last but not least, data availability may prove to be a problem when one tries to expand the period and/or the number of EMU members under observation.

Another area of improvement for this paper is to account for the fiscal policy component, especially since this may be an important explanatory variable for the inflation heterogeneity that this paper finds. However, it may be difficult to devise a fiscal policy reaction function considering the ambiguous application of SGP. Furthermore, the EU regional policy poses conundrums for modeling the effects of supranational fiscal policy because EU regional policy allows for wealth transfers from one EMU member to another and its effects are not reflected in national fiscal indicators.

`

Aside from accounting for the fiscal policy, future research should also work harder to detail the exact role of monetary policy. Specifically, future efforts can examine whether my finding of monetary failure stems from good policy and/or good fortune. This paper provides evidence that monetary policy has been relatively successful in the pre-EMU and EMU periods but its results may stem from a period of mild economic shocks rather than a period of prudent monetary policy. It is possible that with more sophisticated techniques, such as that of Boivin and Giannoni (2006), one can separate the roles that policy and environment have in instigating shocks and in influencing their propagation in the economy.

V. Conclusion

In this paper, I find that there is evidence for convergence in the exchange rate and interest rate components of the MTMs of core EMU members in the aftermath of the implementation of the common currency and the single monetary policy. However, the inflation components exhibit divergence. Convergence patterns intimate increasing aptitude with respect to the single monetary policy while the increasing heterogeneity of inflation components represent a factor that may eventually undermine the effectiveness of the common monetary policy in addressing national objectives. Insignificant responses of output and inflation to monetary policy shocks suggest the single monetary policy is currently successful for core EMU members. Thus, the single monetary policy is an unlikely source for the observed heterogeneity and the culprit may be national fiscal policy miscoordination among the core EMU members.

`

Bibliography

Angeloni, Ignazio and Michael Ehrmann "Monetary Policy Transmission in the Euro Area: Any Changes after EMU?" *ECB Working Paper No. 240*

Boivin, Jean and Marc Giannoni (May, 2002) "Assessing Changes in the Monetary Transmission Mechanism: A VAR Approach" *FRBNY Policy Review May 2002*

Boivin, Jean and Marc Giannoni (2006) "Has MP become more effective?" *Review of Economics and Statistics (August 2006)*

Böwer, Uwe and Catherine Guillemineau (2006), "Determinants of Business Cycle Synchronization across Euro Area Countries" *ECB Working Paper Series No. 587*

Busetti, Fabio, Lorenzo Forni, Andrew Harvey and Fabrizio Venditti (2006) "Inflation Convergence and Divergence within the European Union" *ECB Working Paper Series No. 574*

Buti, Marco and Paul van den Noord (2004) "Fiscal Policy in the EMU: Rules, Discretion and Political Incentives," *European Commission Economic Papers No. 206*

Cicarelli, Matteo and Alessandro Rebucci (March 2002) "The Transmission Mechanism of European Monetary Policy: Is There Heterogeneity? Is it Changing over Time?" *IMF Working Papers WP/02/54*

Clements, Benedict, Zonon G. Kontolemis and Joaquim Levy (2001) "Monetary Policy under EMU: Differences in the Transmission Mechanism?" *IMF Working Papers WP/01/102*

Dornbusch, Rudi, Carlo Favero, Francesco Giavazzi, Hans Genberg and Andrew K. Rose (1998) "Immediate Challenges for the European Central Bank" *Economic Policy, Vol. 13, No. 26, EMU (Apr. 1998), pp 15-64*

Eichengreen, Barry (2005) "Europe, the Euro and the ECB: Monetary Success, Fiscal Failure" *Journal of Policy Modeling (2005)*

Hanson, Michael, Erik Hurst, and Ki Young Park (2006) "Does Monetary Policy Help Least Those Who Need It Most" *Wesleyan Economics Working Papers No: 2006-06*

Kaufmann, Sylvia and Johann Scharler (2006) "Financial Systems and the Cost Channel Transmission of Monetary Policy Shocks" *Oesterreichische Nationalbank Working Paper 116*

Kim, Soyoung and Nouriel Roubini (2000) "Exchange Rate Anomalies in the Industrial Countries: A Solution with a Structural VAR approach" *JME, 45(3), 561-586.*

`

Mojon, Benoit and Gert Peersman (2001) “A VAR Description of the Effects of Monetary Policy in the Individual Countries of the Euro Area” *ECB Working Paper Series Working Paper no. 92*

Mundell, Robert A. (Nov 1963) “Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates” *The Canadian Journal of Economics and Political Science Vol. 29, No. 4*

Sims, Christopher (1980) “Macroeconomics and Reality” *Econometrica (1980) vol.48*

Sims, Christopher (1992) “Interpreting the Macroeconomic Time Series Facts: The Effects of Monetary Policy” *European Economic Review*, vol. 36, 975-1000

Stock, James and Mark Watson (2001) “Vector Autoregressions” *JEP*, 15(4), 101-115

Taylor, John B. (Autumn, 1995) “The Monetary Transmission Mechanism: An Empirical Framework” *The Journal of Economic Perspectives Vol. 9, No. 4 pp 11-26*

Toolsema, Linda A., Jan-Egbert Sturm and Jakob de Haan (Apr 2001) “Convergence of Monetary Transmission in EMU New Evidence” *CESinfo Working Paper No. 465*

`