ASYMMETRIES IN THE EURO AREA ECONOMIES: OBSTACLE FOR EUROPEAN CENTRAL BANK EFFICIENCY?

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I dedicate this dissertation to my parents, Dr. Donald and Lucille Batista who supported and encouraged me as I pursued and completed my PhD, as well as throughout my entire life.

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Part I: Introduction

The euro area, which consists of the twelve European countries that have recently joined together to form a common monetary union, represents more than 15% of global GDP and 20% of world exports. Thus, the economic impact of this union is resonating worldwide. Both the successes and failures of the European Central Bank (ECB) will affect not only members of the euro area, but also the global economy in general. While the creation of the ECB and its currency, the euro, has brought greater prosperity to the euro area economies, its long-term efficiency and stability will depend on the efficacy of the ECB in addressing some critical obstacles to its success.

In this paper, I propose to evaluate the efficiency of the European Central Bank in maintaining an unbiased monetary policy with a goal of price stability, and to assess the reaction of the national economies to economic shocks. To do so, I will test the efficiency of the monetary policy tool used by the ECB and evaluate its national transmission. Specifically, I will pose and resolve four questions. First, has the implementation of a common monetary policy significantly changed the monetary policy previously practiced by the national economies? Second, are the member countries adhering to the policy guidelines put forth by the ECB, and are they better off under such circumstances? Third, are the costs and benefits of the common monetary equally distributed to all euro area economies? That is, is the ECB biased? And fourth, are the national economies synchronized enough to thwart any potential asymmetric shocks from rendering the ECB policy inefficient.

The organization of this paper is as follows. In Part II, I review the literature on the costs and benefits of a common monetary policy in Europe. Specifically, I will incorporate a discussion of the challenges that the ECB faces due to the diverse structures of the national economies of the euro area, and the potential risks associated with shocks affecting the national economies asymmetrically. This section also highlights the role of synchronized national business cycles in the stability of the area. Part III discusses the policy of the ECB and how it goes about achieving its goal of price stability. This will include a discussion of the Taylor Rule, which is a monetary policy tool used by the ECB. It will also include a discussion of the data. In Part IV, I determine the efficiency of the ECB in achieving its goal by estimating the Taylor Rule and then testing to make certain that the Taylor Rule used by each individual country before the implementation of the euro is structurally different. I will also extract the target inflation rate for each country. Part V provides an estimation of the Taylor Rule for the euro area aggregate. Part VI uses impulse responses to show how various shocks are transmitted across economies. I expect that if the shocks are easily transmitted, then the countries will experience similar business cycles, which will have positive implications for the ECB policy. Finally, Part VII offers a summary of all results and findings of the paper.

To perform the above analysis, all 12 euro area economies will be tested. These countries include; Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. My work contributes to the literature in that it applies the results of other works to the particular and unique circumstances of the euro area. For example, a body of literature exists on business cycle synchronization

and asymmetric shocks. Literature exists on the Taylor Rule for *some* individual European countries. However, no one has used the Taylor Rule to empirically test these implications for asymmetries, and the efficiency of the ECB using all euro area countries.

PART II: Literature Review

Costs and Benefits of the Euro

The inception of the euro and its complementary common monetary policy is providing the participating countries with tremendous economic benefits, while contributing to regional stability. These countries were forced to comply with convergence criteria such as low inflation and interest rates, and minimal budget deficits, thus transferring the stability culture of some European states to the entire euro area.

In *The Euro, The European Central Bank, and the International Monetary System,* Dominick Salvatore highlights the benefits of the euro and the common monetary policy in Europe. He points out that a common currency implies that prices are all posted in the euro in all euro area countries. This serves to facilitate price comparisons within the euro area countries. Any inflationary tendencies in a country will no longer be able to be masked by currency differentials. Consumers will thus seek to purchase any bundle of goods where they could be acquired at the lowest cost. This will eventually increase cross-border competition and greater prosperity throughout the area as a whole.

Price stability and a common currency also impose greater economic discipline. The Stability and Growth Pact, which accompanied the introduction of the euro in January 1999 created new rules for economic policy. One of these rules prohibits excessive deficits by the member states. Specifically, they must be less than 3% of national GDP. Economic discipline is particularly relevant for countries such as Greece, Italy, and Portugal that experienced significant inflationary pressures in the past. For example,

Portugal, which experienced inflation of over 10% in 1998, succeeded in reducing the rate dramatically to less than 4% by 1996 to be included in the euro area. Greece, which had an inflation rate of 15% in 1988 managed to reduce it to 5% by 1996. It is doubtful that these countries would have been as successful in reducing inflation had the euro area incentive not existed. Once part of the euro area the strict adherence of the ECB to price stability forces the member states to maintain low inflation rates.

Barry Eichengreen in *European Monetary Unification* confirms the notion put forth by Salvatore that a common currency facilitates trade and eliminates the transaction costs previously associated with currency conversion. In 2001, the European Commission proposed a regulation based on the principle that cross-border transactions should not cost any more than domestic transactions. As a result, by July 1, 2003, anyone withdrawing euros from a cash machine anywhere in the euro area will not pay more than they would for a withdrawal in their country of origin. In addition, the cost of a cross-border transfer will be the same as the cost of domestic transfers of the euro by July 2003.

The euro and common monetary policy also offer significant benefits at the supranational level. For example, as the euro is increasingly used as an international currency, the ECB will collect more seigniorage, and as a result be able to increase spending. As outlined above, monetary unification will render Europe more competitive, more prosperous, and consequently more stable. However, the economic stability of Europe is not free from challenges.

In *The Euro: Expectations and Performance,* Salvatore points out the main challenge to ECB efficiency. A common monetary policy can only achieve prosperity and stability for the entire euro area if the policy is more appropriate and responsive than the previous national monetary policy. For the ECB to implement an effective policy that is appropriate for all of the national economies, the business cycles of the countries must be synchronized. If they are not, then any economic shocks to the area, such as the oil crises of the 1970s or even September 11th, will affect the economies asymmetrically as will the reaction of the ECB. Prior to the creation of the common monetary policy, the national central bank would have been able to stabilize the economy through monetary policy or through the exchange rate. Now, the European Central Bank can only respond to the aggregate effects that the shock may impose on the euro area as a whole. This raises questions about the ECB's ability to stabilize the national economies in the face of a shock.

Without control of monetary policy or the exchange rate, fiscal policy and labor mobility would be able to help stabilize a depressed national economy. However the potential for these two tools is limited in Europe. While the Stability and Growth Pact helps impose beneficial economic discipline on the national economies, it also hinders the reliance on fiscal policy by the member states. For example, the Pact prohibits bail-outs of national government deficits, as well as the financing of these deficits.

Salvatore (2002) and Eichengreen (1990) refer to the reduced scope for fiscal policy as a stabilization tool for the national economies. National economies are typically free to

increase public spending or reduce taxes. However due to factor mobility, the fiscal options that could be employed unilaterally are limited. This is because government spending must be equal to present value of taxes plus present value of seigniorage. With EMU, they cannot control seigniorage. Government borrowing today is limited by the taxes that can be raised tomorrow. With free movement of labor and capital and goods, if people expect that taxes will be raised, they can leave or capital will flow out of the country. Fiscal policy is usually more politically motivated and thus cannot be relied upon as much as monetary policy to stabilize the economy. Also, one country's fiscal policy affects the next so fiscal policies are essentially regional and not national in scope.

In other common monetary zones, such as the US, if one region is in recession while another is not, flexible wages and the movement of labor away from pockets of unemployment towards where it is needed helps to stabilize both areas. However, in Europe, the labor market has historically been extremely rigid, further exacerbating the challenge of the ECB. Despite the EU provision for free movement of labor, as well as goods and services, in practice labor generally encounters obstacles when seeking employment in another member state. For example, a Greek doctor will encounter language, cultural, and social obstacles to practicing medicine if he or she were to relocate to Germany. Not to mention that European real estate markets are sometimes controlled by the government, which typically seeks to provide housing for its nationals before expatriates, even if they are fellow EU citizens. Under such circumstances, the Greek doctor will be forced to live under sub-optimal conditions and might be forced to find another, less productive career.

Maurice Obstfeld, in *Europe's Gamble* shows how in the presence of labor rigidities, readjustment or stabilization after an asymmetric shock is more difficult. Under such circumstances, currency alignments are useful tools. The implications are that it could be costly for euro area states to surrender control of their currencies, and that unless social policy is revised in Europe, the euro area states will be vulnerable to asymmetric shocks. Thus, the efficiency of the ECB is of critical importance if the euro area, including all of its members is to remain a stable and prosperous player in the global economy. If business cycles are synchronized, then the inadequacies of the labor and real estate market will not be as highlighted. Thus it is worth discussing the state of the literature on synchronization.

On Business Cycle Synchronization and Specialization

Synchronization of national business cycles will be critical if the euro area is to prove resilient to shocks. Specifically, ECB reactions to a shock will be less likely to damage one nation while attempting to stabilize another if the shock affects all countries in the same way. That is, the greater the degree of business cycle correlation, the lesser the likelihood and destructiveness of asymmetric shocks. There are two primary schools of thought on this issue. The first school incorporates the works of Krugman (1993), Kenan (1969), Eichengreen (1992), and Mundell (1961) who contend (on a theoretical basis) that closer trade ties would result in countries becoming more specialized in the goods in which they have the comparative advantage. This would cause the business cycles to be less symmetric as they would become more susceptible to shocks that affect

only their specific industry. They specify that greater specialization results if the trade is mostly inter-industry. According to this theory, ECB reactions to a shock might not be most efficient.

Alternatively, the other school, whose point is captured by the work of Frankel and Rose in *The Endogeneity of the Optimum Currency Area* (1996), and Rose and Engel in *Currency Unions and International Integration* (2002) claims that tighter integration will synchronize business cycles and reduce the negative effects of asymmetric shocks. Under these circumstances, a common monetary policy is desirable. Frankel and Rose (1996) empirically test their claim and discover that countries with more integrated trade tend to experience correlation between their respective business cycles. This correlation implies that these countries would be less susceptible to asymmetric shocks, leading to the expectation that the actions of the ECB in response to a shock would be the appropriate action for all euro area nations. They specify that their conclusion is based on the assumption that cross-country, rather than cross-industry shocks are more prevalent. This would be the case if trade is mostly intra-industry, instead of inter-industry.

Frankel and Rose use panel trade and business cycle data for 20 industrialized countries for 30 years. In doing so, they attempt to provide some intuition for the relationship between trade integration and business cycles. They compute the cross-country covariance of output and the covariance of country-specific shocks, and then assert that the degree of business cycle synchronization depends on how these two covariances

change with increased trade integration. They go on to measure bilateral trade intensity and bilateral correlations of real economic activity. They then estimate a regression of trade intensity on economic activity correlations. They developed 16 variations of this regression representing the four different ways in which economic activity can be measured, as well as the three different weights that could be applied depending on the export-import ratio in the country. This test finds a strong relationship between the degree of trade intensity and cross-country bilateral correlation of business cycles.

Rose and Engel (2002) build on the work of Frankel and Rose by adding that currency unions in general are more inclined to trade more but they are not more specialized than non-currency unions of comparable size. Specifically, they find that trade between members of a currency union is higher than trade between non-currency union countries by a factor of three. They also find that business cycles are systematically more highly correlated between members of currency unions, particularly as the level of integration increases. To determine the degree of specialization, they compute the Herfindahl index (the sum of squared shares of the individual goods) for each country. At first they find that currency union members are more specialized but once they control for the small-country currency union sample that they used, they conclude that the currency union effect on specialization is economically and statistically insignificant. They also show that the volatility of real exchange rates is lower for currency union countries than non-currency union countries. Thus, they paint a desirable picture for a euro area that has the potential reap all of the benefits of the euro with minimal costs.

In *Comparisons of Business Cycles in the EC: Idiosyncracies and Regularities (1995), Christodoulakis, Dimelis, and Kollintzas* also found that that many European Union countries experience similar macro variable performance. This implies that their business cycles are correlated. This supports the notion that ECB policy will be effective but does not comment on whether or not the business cycles have become more correlated as a result of the formation of the common monetary policy.

In 1993, in *Shocking Aspects of European Monetary Integration*, Bayoumi and Eichengreen demonstrated the different effects on prices and output of demand verses supply shocks. Unlike demand shocks, supply shocks result in permanent changes in output. In addition positive demand shocks raise prices, while positive supply shocks reduce them. Their results lead them to believe that there is a core of countries whose shocks are correlated and a periphery that does not exhibit correlation.

In *Monetary Policies in the Presence of Asymmetries*, Paul De Grauwe highlights the challenge faced by the ECB when the member countries have either asymmetric national shock transmission mechanisms or face different shocks. Using a two country model, he shows that while euro area policy-makers take decisions on behalf of the euro area as a whole, they often weigh the effects of the policies on their home country more heavily than the others. The only way that contradiction between minimizing the national loss functions and minimizing the euro area loss function could be prevented is if the national economies are symmetric. Under such an ideal situation, advancing the good of the euro area is synonymous with advancing the good of each individual economy. To determine

how likely it will be for the euro area to realize such an ideal situation, de Grauwe optimizes the Phillips curves for each country and then tests to see if their residuals are correlated. This has implications for synchronization of the national business cycles. He then assesses the effectiveness of the ECB in responding to asymmetric shocks under the different degrees of business cycle correlation. He finds that as the degree of asymmetry increases, the effectiveness of stabilization of output and unemployment is reduced. De Grauwe also articulates that the ECB has declared that in order to find its optimal policy rule, national macroeconomic data should be first aggregated into euro-wide averages. Then this average will be used to determine the overall loss function and hence ECB policy. However, de Grauwe discovers that a more efficient method would be for each nation to minimize its respective loss function and then aggregate these loss functions.

PART III

ECB Policy

The European Central Bank has clearly, comprehensively, and transparently outlined its mission as the monetary authority for the euro area. It has highlighted medium term price stability as its primary objective, and thus monetary policy will be used as a means to this end. Specifically, the ECB has committed the euro area to a less than 2% year-on-year increase. By maintaining price stability in the medium term, the ECB acknowledges that non-monetary shocks such as tax changes or variations in international commodity prices could cause short-term price volatility that cannot be controlled by monetary policy. By not responding to such temporary fluctuations and continuing to focus on the medium-term, the ECB will avoid creating uncertainty in the economy, thereby maintaining credibility, which is a critical component for a successful monetary policy. Since inflation itself is very difficult to control, the Central Bank must have tools that could be used to address the causes of inflation. The ECB has thus created a role for money. Thus, the ECB can respond to inflationary pressures by increasing or decreasing the rate of money growth, which will impact inflation. Alternatively, the interest rate could be a useful tool for monetary policy. Historically, many of the euro area countries, as well as others, have relied on the interest rate as the monetary policy tool (Clarida, Gali, Gerter 1998 see below). Thus, I will test to see if the interest rate rule known as the Taylor Rule is being applied by the ECB.

The Model

In 1993, John Taylor proposed a simple interest rate rule that is currently known as the Taylor Rule. This rule implies that the interest rate is a function of its lag, inflation and output as such:

$$i_t = \rho_1 i_{t-1} + (1-\rho_1) i_t^* + \varepsilon_t \quad (1)$$

$$\text{and,} \quad i_t^* = i_s + \beta_\pi \underset{t}{\mathrm{E}} \pi_{t+1} + \beta_y y_t \quad (2)$$

Where i_t is the current nominal interest rate, i_s is the long-run equilibrium nominal rate of interest, π_{t+1} is the deviation of next period's inflation from its target rate, and y_t is the deviation of output from its potential. $ß_\pi$ and $ß_y$ represent the weights placed on maintaining the equilibrium value of π_{t+1} and y_t respectively. The monetary authority manipulates these weights or coefficients in such a way so as to affect the interest rate according to the plan. For example, if the value of $ß_\pi$ is greater than 1, and if inflation rises by 1%, the nominal interest rate will rise by more than 1%, causing the real interest rate to also increase. Alternatively, if the value of $ß_\pi$ is less than 1%, and if inflation rises by 1%, the nominal interest will rise by less than inflation, which will cause the real interest rate to decrease. Thus, the Central Bank could engineer either a contraction or an expansion by adjusting the weights on inflation. A similar argument can be made for the weight on output. The monetary authorities also seek to smooth interest rates. Thus, the actual interest rate is a function of the desired target rate as well as lags of the actual interest rate. This smoothing behavior is captured the parameter ρ. For example, if ρ is 0.5, then the monetary authorities will move the actual rate one-half towards the rate

suggested by the Taylor Rule, while the other 0.5 will be on maintaining the rate from the previous period or periods.

In *The ECB and the Taylor Rule,* Taylor recommends raising the interest rate by 1.5 percentage points for each 1 percentage point increase in inflation. This will result in a rise in real interest rates that would help slowdown the economy, thereby reducing inflation. He also recommends reducing the interest rate by 0.5 percentage points for each percentage point decline in real GDP below its natural rate. This would serve to ease the recession and maintain price stability.

In *Discretion Versus Policy Rules in Practice*, Taylor showed that during the 15 years prior, the Talyor Rule correctly captured the behavior of the United States Federal Reserve Bank in setting interest rates. Clarida, Gali, and Gertler (1998) in *Monetary Policy Rules in Practice: Some International Evidence* also confirm that the US follows a Taylor Rule, but they added that Japan, England, France, Germany, and Italy also follow some form of the Taylor Rule in setting interest rates.

The Data

To estimate the Taylor Rule for all euro area countries, the equivalent of the United States federal funds rate is used for each respective country. However, in some cases, where data availability did not permit use of the federal funds rate, another measure of the interest rate is substituted, provided that it exhibits a high degree of correlation with

the federal funds rate. All data was taken from the International Financial Statistics of the International Monetary Fund.

The deviation of output from its potential is represented by the "output gap." This is calculated by regressing industrial production on a quadratic time trend. The residuals are then used as the gap. The source for this data is the International Financial Statistics of the International Monetary Fund.

Inflation is the percent change in consumer prices per year, where the base year is 1995. The source for this data is the International Financial Statistics of the International Monetary Fund.

Finally, the 3 Spot Price Index is included to capture any forward-looking expectations of the monetary authorities. For example, the central bank might foresee a rise in inflation and thus adjust the interest in response, prior to the actual rise.

For all variables and for most countries data is collected from 1974Q1 to 2002Q2, based on availability of the data. Since a concern of this paper is to comment on the effectiveness of the ECB's monetary policy as compared to the previous national policies, it is necessary to impose a structural break in the data. The definitive movement towards a common monetary policy in Europe was implemented in the Maastricht Treaty of 1991. After this point the countries began to prepare their economies for the union in three stages, culminating with complete unification of policy and currency. As a result, it

can be assumed that this point represents a departure from the national policies previously practiced. However, since most European countries experienced a severe currency crisis shortly thereafter, the post-Maastricht period is considered to begin instead with 1993Q4.

The table below summarizes some interest rate characteristics, and quantity of the data used for this study:

Country	**Period Used (depends on data availability)**	**Interest Rate Used**	**Correlation w/Fed Funds Rate (if different)**
Austria	1974Q1-2000Q3	Government Bond Yield 10yr	.718
Belgium	1974Q1-2000Q4	Treasury Paper	.849449
Finland	1978Q1-2002Q3	Average Cost of CB Debt	N/A
France	1974Q1-2001Q4	Treasury Bill 3 Month	.99637
Germany	1974Q1-2002Q3	Call Money Rate	N/A
Greece	1975Q4-2001Q4	Treasury Bill 12 Month	.755803
Ireland	1978Q2-2002Q3	1 Month Fixed Rate	N/A
Italy	1974Q1-2001Q1	Money Market Rate	N/A
Luxembourg	1974Q1-1999Q1	Government Bond Yield	.952491
Netherlands	1980Q1-2001Q4	Lending Rate	.993439
Portugal	1976Q1-2000Q1	Lending Rate	.909585
Spain	1974Q1-2002Q3	Call Money Rate	N/A
Euro area	1994Q1-2002Q3	Inter-Bank Rate 3 Month	N/A

On Stationarity of the Variables

This paper treats the variables of the Taylor Rule (the interest rate, inflation, and the output gap) as stationary for two reasons. First, the ADF tests that reflect a unit root in the variables have low power. Second, theory suggests that since these variables are targeted by the monetary authorities as implied by the Taylor Rule, they should inherently be stationary. To support the assumption of stationarity, I regressed time, the lag of the variable, and the first difference of lags 1, 2, 3, and 4 on the first difference of

the variable. If the parameter on the lag is negative, then I can conclude that there is no unit root and that the variables are stationary. The logic behind this test is as follows. Consider the following series:

$$y_t = \rho y_{t-1} + \varepsilon_t \qquad (3)$$

Taking the first difference:

$$y_t - y_{t-1} = (\rho - 1) y_{t-1} + \varepsilon_t \qquad (4)$$

If (3) has a unit root (ρ=1) and is therefore nonstationary, after taking the first difference then (ρ-1) equals 0 and (4) is stationary. If (3) does not have a unit root, ρ must be less than 1. If so, then (ρ-1) must be negative. In addition, since a unit root in (4) would cause (ρ-1) to completely drop out of (4), a significant estimate if this coefficient is also indicative of stationarity.

The results suggest stationarity, as the table below reveals. Specifically, all of the estimates are negative and most of these coefficients are significant. In addition, past empirical tests of the Taylor Rule, such as that of Clarida, Gali, and Gertler treat the variables of the Taylor Rule as stationary. As such, I proceed to treat them as stationary as well, so as not to undermine the assumption of the Taylor Rule.

Results of Regression Test for Stationarity

	Interest Rate			Inflation			Output Gap		
Country	**Estimate**	**T-stat**	**P-value**	**Estimate**	**T-stat**	**P-value**	**Estimate**	**T-stat**	**P-value**
Austria	-0.11948	-3.28	.0015	-0.09242	-3.12	.0024	-0.3719	-2.99	.0035
Belgium	-0.13910	-3.68	.0004	-0.08791	-4.62	<.0001	-0.35259	-2.87	.005
Finland	-0.20579	-3.44	.0009	-0.11236	-2.54	.013	-0.06672	-2.13	.0364
France	-0.11980	-2.87	.0050	-0.02497	-1.51	.1342	-0.13	-2.71	.008
Germany	-0.07589	-3.04	.003	-0.12035	-3.26	.0015	-0.15965	-1.16	.2505
Greece	-0.09308	-3.19	.0019	-0.07655	-3.87	.0002	-0.04656	-.72	.4733
Ireland	-0.35229	-3.73	.0003	-0.06186	-2.44	.0162	-0.22287	-3.30	.0013
Italy	-0.10717	-2.38	.0194	-0.02866	-1.50	.1366	-0.16503	-3.14	.0022
Luxembourg	-0.09172	-3.00	.0035	-0.06769	-2.94	.0042	-0.17616	-2.83	.0058
Netherlands	-0.09204	-2.53	.0136	-0.11419	-2.90	.0049	-0.27887	-2.73	.0079
Portugal	-0.05441	-2.20	.0303	-0.04368	-.95	.3464	-0.23702	-3.39	.0011
Spain	-0.40596	-3.87	.0002	-0.01884	-.86	.3921	-0.12457	-2.64	.0095

For the above test, a dummy variable is inserted where the structural break is expected to occur (1993Q4). Results are based on the assumption of the break. However, in the absence of the dummy variable, the coefficients all remain negative. Only a few cases (those marked in bold and italics) exhibited insignificance, however the coefficients are still negative.

Lag Selection

The smoothing component of the Taylor Rule implies that past periods interest rates are considered by the monetary authorities when setting the actual rate. To determine the most efficient amount of lags of the interest to incorporate into the model, the Akaike Information Criteria is compared for the inclusion of lags one through three for both the pre-Maastricht and post-Maastricht periods for all twelve countries. The results are summarized in the chart below, where the smallest AIC values are marked in bold and italics. These values represent the quantity of lags that is optimal to include in the model.

Pre-Maastricht

Country	*1 Lag*	*2 Lags*	*3 Lags*
Austria	***-11.41293***	-10.51087772	-11.17675
Belgium	***-9.702914215***	-9.25136	-8.7935358
Finland	***-8.645225***	-8.34770166	-6.3155963
France	***-9.210437***	-9.107467	-9.1535
Germany	***-10.126727***	-10.07125967	-9.989786748
Greece	***-10.11604959***	-9.49406	-9.350567274
Ireland	-6.952487	-7.223102	***-7.2788337****
Italy	***-8.4119298***	-8.288549	-7.95503
Luxembourg	***-11.22534075***	-11.1172279	-11.25398074
Netherlands	-9.672680357	***-9.79079***	-9.746869
Portugal	-8.82091025	***-8.912666676***	-8.552288011
Spain	***-6.283698328***	-5.945870128	-5.961691573

*For Ireland, the AIC was calculated for lag 4, which produced a larger value.

Post-Maastricht

Country	*1 Lag*	*2 Lags*	*3 Lags*
Austria	***-10.86961***	-10.48229721	-10.048
Belgium	***-11.31181664***	-11.01761529	-11.08024
Finland	***-9.989567378***	-9.83944891	-9.72693849
France	***-10.09171014***	-9.720977	-9.5305164
Germany	-11.09530588	-12.0679697	***-12.0744***
Greece	-10.22524153	***-11.08428196***	-10.4059852
Ireland	***-9.73007***	-9.6838	-9.656320
Italy	***-10.30033843***	-10.13505831	-9.310159
Luxembourg	-12.42638231	***-12.43292621***	-11.51179679
Netherlands	-9.993495833	***-10.00494707***	-9.831591071
Portugal	-10.01788699	***-10.22547089***	-9.580520339
Spain	***-6.283698328***	-5.945870128	-5.961691573

Based on the above results, I will proceed to estimate a customized Taylor Rule, for each country both pre and post Maastricht.

Part IV: Estimation of the Taylor Rule for the National Economies

Estimation

To determine if the European Central Bank's policy has impacted the national economies, I will recover the parameter estimates of the model. A change in the estimates and their corresponding levels of significance from the pre-Maastricht period to the post-Maastricht period, indicates that the ECB policy is in fact different from the national policies practiced prior to the implementation of the common monetary policy. Formal tests for structural change confirm or disprove any changes in the parameter estimates.

To estimate the parameters of the model, I employ iterated generalized method of moments (ITGMM). In doing so, I can account for the simultaneous equations bias inherent in the model. In addition, I will be able to extract the target inflation. The instruments used vary slightly by country depending on how many lags are included in each country's model. In general the instruments include, at least two periods of lagged inflation, industrial production, and the interest rate, and the first difference of the spot commodity price index. The model to be estimated is derived as follows.

Recalling the Taylor Rule,

$$i_t = \rho_1 i_{t-1} + (1-\rho_1) i_t^* + \varepsilon_t \qquad (1)$$

$$\text{and,} \qquad i_t^* = i_s + \beta_\pi \underset{t}{\mathrm{E}} \pi_{t+1} + \beta_y y_t \qquad (2)$$

Defining i_s as $(1-\rho_1)(r+\bar{\pi})$ (5)

Substituting (2) into (1);

$$i_t = i_s + (1 - \rho_1)\left[\beta_\pi \, E_t \pi_{t+1} + \beta_y yt\right] + \rho_1 i_{t-1} + \varepsilon_t \tag{6}$$

where,

$$\beta_\pi E_t \pi_{t+1} = \beta_\pi \pi_{t+1} + \beta_\pi \left(E_t \pi_{t+1} - \pi_{t+1}\right) \tag{7}$$

plugging into (6),

$$i_t = i_s + (1-\rho_1)\beta_\pi \pi_{t+1} + (1-\rho_1)\beta_\pi \left(E_t \pi_{t+1} - \pi_{t+1}\right) + (1-\rho_1)\beta_y y_t + \rho_1 i_{t-1} + \varepsilon_t \tag{8}$$

$$i_t - i_s - (1-\rho_1)\beta_\pi \pi_{t+1} - (1-\rho_1)\beta_y y_t - \rho_1 i_{t-1} = -(1-\rho_1)\beta_\pi \left(\pi_{t+1} - E_t \pi_{t+1}\right) + \varepsilon_t \tag{9}$$

where,

$$-(1-\rho_1)\beta_\pi \left(\pi_{t+1} - E_t \pi_{t+1}\right) + \varepsilon_t \equiv e_{t+1} \tag{10}$$

thus,

$$i_t - i_s - (1-\rho_1)\beta_\pi \pi_{t+1} - (1-\rho_1)\beta_y y_t - \rho_1 i_{t-1} = e_{t+1} \tag{11}$$

The equation to be fitted using ITGMM is:

$$i_t = i_s + (1-\rho_1)\beta_\pi \pi_{t+1} + (1-\rho_1)\beta_y y_t + \rho_1 i_{t-1} + e_{t+1} \tag{12}$$

Here, $E(e_{t+1} X_t) = 0$, where X_t is the set of instruments. That is, the expected value of any unanticipated inflation is 0 because it cannot be forecasted. As a result, it cannot be correlated with any information known at time t. It is thus orthogonal to the selected instruments. This creates the moment conditions required for GMM.

The weight matrix used is the inverse of the information matrix. This matrix is the most efficient in that it gives the greatest weight to the moments with the lowest variance.

Before reporting the estimates, some proof that the model is well specified for each country is useful. For a properly specified model, the "Objective * N" value must be below the critical chi square level, which varies depending on the degrees of freedom. These results are summarized below, where the critical value is indicated in parentheses.

Objective*N

Country	Pre-Period Obn*N (Critical Value)	Post-Period Obn*N (Critical Value)	Entire Dataset Obn*N (Critical Value)
Austria	4.6358 (7.82)	2.7515 (9.49)	8.4503 (16.92)
Belgium	2.8597 (7.82)	4.703 (9.49)	8.0689 (16.92)
Finland	4.3212 (7.82)	3.0647 (7.82)	11.1555 (16.92)
France	4.5334 (7.82)	2.5381 (7.82)	7.9268 (16.92)
Germany	2.5878 (7.82)	2.3777 (11.07)	9.5495 (16.92)
Greece	0.8998 (7.82)	3.5324 (12.59)	3.9 (16.92)
Ireland	3.6621 (11.07)	7.4089 (7.82)	7.1981 (16.92)
Italy	5.1726 (9.49)	4.1018 (9.49)	10.1859 (16.92)
Luxembourg	3.7617 (9.49)	2.3402 (9.49)	10.8603 (16.92)
Netherlands	3.7369 (11.07)	4.2808 (11.07)	7.3754 (16.92)
Portugal	2.1716 (9.49)	1.8 (11.07)	5.1573 (16.92)
Spain	1.6771 (7.82)	5.7272 (9.49)	5.5583 (16.92)

As is evident from the above table, in all cases, the Taylor Rule appears to be capturing the behavior of the monetary authorities. Thus, recovering the parameter estimates for each model is appropriate. They are summarized below.

Parameter Estimates

Austria Pre				***Austria Post***			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.012566	4.50	<.0001	**Constant (a0)**	0.013603	3.44	0.0026
Inflation (a1)	0.60401	7.50	<.0001	**Inflation (a1)**	1.109389	5.28	<.0001
Ind.Prod.(b1)	0.241709	4.29	<.0001	**Ind.Prod.(b1)**	-0.01278	-0.40	0.6961
Lag Interest (c1)	0.772878	18.94	<.0001	**Lag Interest (c1)**	0.561503	4.74	<.0001

Belgium Pre				***Belgium Post***			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.00599	1.37	0.1747	**Constant (a0)**	0.00656	1.90	0.0730
Inflation (a1)	0.190332	0.47	0.6403	**Inflation (a1)**	1.082546	2.95	0.0083
Ind.Prod.(b1)	0.561485	0.92	0.3612	**Ind.Prod.(b1)**	-0.03166	-0.63	0.5337
Lag Interest (c1)	0.926612	21.18	<.0001	**Lag Interest (c1)**	0.650243	6.06	<.0001

Finland Pre				*Finland Post*			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.012143	1.35	0.1840	**Constant (a0)**	-0.00201	-0.64	0.5299
Inflation (a1)	0.434863	0.99	0.3253	**Inflation (a1)**	2.963453	2.62	0.0138
Ind.Prod.(b1)	0.023476	0.10	0.9183	**Ind.Prod.(b1)**	-0.29807	-2.31	0.0282
Lag Interest (c1)	0.866237	12.41	<.0001	**Lag Interest (c1)**	0.790713	8.15	<.0001

France Pre				*France Post*			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.018202	4.31	<.0001	**Constant (a0)**	0.002357	0.88	0.3866
Inflation (a1)	0.14137	1.02	0.3106	**Inflation (a1)**	2.220398	2.79	0.0098
Ind.Prod.(b1)	0.509529	4.19	<.0001	**Ind.Prod.(b1)**	0.266858	1.26	0.2203
Lag Interest (c1)	0.789284	16.26	<.0001	**Lag Interest (c1)**	0.786692	7.59	<.0001

Germany Pre				*Germany Post*			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.005781	3.04	0.0034	**Constant (a0)**	0.010824	2.91	0.0086
Inflation (a1)	0.472287	1.74	0.0855	**Inflation (a1)***	0.63045	2.58	0.0178
Ind.Prod.(b1)	0.814436	4.04	0.0001	**Ind.Prod.(b1)**	0.097647	1.49	0.1527
Lag Interest (c1)	0.867211	23.72	<.0001	**Lag Interest (c1)**	0.889593	2.18	0.0412
				Lag Interest (c2)	-0.10548	-0.19	0.8502
				Lag Interest (c3)	-0.20665	-0.66	0.5139

*When lags two and three of the interest rate are eliminated the estimate for inflation becomes 1.24 with a t-value of 2.93 and p-value of 0.0067.

Greece Pre				*Greece Post*			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	-0.00107	-0.28	0.7781	**Constant (a0)**	0.012587	4.99	0.0001
Inflation (a1)	0.396465	1.24	0.2210	**Inflation (a1)**	0.160012	2.01	0.0602
Ind.Prod.(b1)	0.658152	0.75	0.4538	**Ind.Prod.(b1)**	0.093314	2.84	0.0108
Lag Interest (c1)	0.928599	14.56	<.0001	**Lag Interest (c1)**	1.194269	5.61	<.0001
				Lag Interest (c2)	-0.6386	-3.26	0.0044

Italy Pre				*Italy Post*			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.004144	.50	0.6219	**Constant (a0)**	-0.00475	-2.82	0.0100
Inflation (a1)	0.160745	0.21	0.8377	**Inflation (a1)**	2.55854	10.43	<.0001
Ind.Prod.(b1)	2.057883	0.45	0.6526	**Ind.Prod.(b1)**	-0.01722	-0.07	0.9475
Lag Interest (c1)	0.957674	11.99	<.0001	**Lag Interest (c1)**	0.743064	18.25	<.0001

Lux. Pre				*Lux. Post*			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.001238	0.39	0.6954	**Constant (a0)**	0.011659	4.78	0.0010
Inflation (a1)	1.251193	1.14	0.2573	**Inflation (a1)**	0.426519	2.29	0.0478
Ind.Prod.(b1)	0.138815	0.74	0.4599	**Ind.Prod.(b1)**	0.064931	1.11	0.2960
Lag Interest (c1)	0.953365	25.63	<.0001	**Lag Interest (c1)**	1.89471	4.49	0.0015
				Lag Interest (c2)	-1.12908	-2.88	0.0182

Nether. Pre				*Nether. Post*			
	Estimate	**T-Value**	**P-Value**		**Estimate**	**T-Value**	**P-Value**
Constant (a0)	0.020747	1.73	0.0908	**Constant (a0)**	0.013594	9.30	<.0001
Inflation (a1)	0.245086	0.80	0.4255	**Inflation (a1)**	0.426165	5.03	<.0001
Ind.Prod.(b1)	0.624472	4.83	<.0001	**Ind.Prod.(b1)**	0.559881	9.48	<.0001
Lag Interest (c1)	1.118831	2.79	0.0079	**Lag Interest (c1)**	0.951547	10.16	<.0001
Lag Interest (c2)	-0.33312	-1.16	0.2535	**Lag Interest (c2)**	-0.32313	-5.07	<.0001

The parameter estimates reveal that, in some cases, the inflation-targeting ECB is in fact meeting its primary objective of minimizing inflation in the national economies. Some results also indicate that the countries that were targeting industrial production prior to the common monetary policy are no longer doing so. This latter result is also in accordance with the ECB policy of not targeting output. Out of the twelve countries tested, nine demonstrated a significant inflation parameter estimate (with or without the optimal value of the estimate), the elimination of the significance of the output gap estimate in the post-period, or both.

Structural Change in the Taylor Rule

A dummy variable test is performed in order to determine if the Taylor Rule practiced by the ECB is statistically different from the Taylor Rule practiced by the national monetary authorities prior to Maastricht. This entails inserting a dummy variable into the model for the post-Maastricht period. Specifically, a zero is inserted for all periods up until and including 1993Q3. Thereafter a one is inserted. This dummy variable then multiplies all variables in the model so as to produce different parameter estimates for each variable for the two distinct periods. The dummy variable augmented model becomes:

$$i_t = i_s + di_s + (1-\rho_1 - d\rho_2)\beta_{\pi 1}\pi_{t+1} + (1-\rho_1 - d\rho_2)\beta_{\pi 2}d\pi_{t+1} + (1-\rho_1 - d\rho_2)\beta_{y1}y_t + (1-\rho_1 - d\rho_2)\beta_{y2}dy_t + \rho_1 i_{t-1} + \rho_2 di_{t-1} \quad (13)$$

where *d* represents the dummy variable. A Wald test then indicates if the parameter estimates for the variables that are multiplying the dummy are significantly different from the non-dummy parameter estimates. Since the dummy variable is zero prior to 1993Q3, this test will essentially indicate if the pre-Maastricht parameter estimates are different from the post-Maastricht estimates. For this test, the null hypothesis is that there is no change between the two periods. The dummy variable test and Wald test was performed for each country. The model above, which includes only one lag of the interest rate was used for all of the countries that required only 1 lag both pre and post-Maastricht based on the AIC criteria (see above). If the lag length differed between periods, then the AIC was re-calculated using the entire set of observations. The quantity of lags that produced the smallest AIC value was the quantity of lags added to the model above. Ultimately, only Greece, the Netherlands, and Portugal required two lags. The other countries all required only one lag. The two lag model is:

$$i_t = i_s + di_s + (1-\rho_1 - d\rho_2 - \rho_3 - d\rho_4)\beta_{\pi 1}\pi_{t+1} + (1-\rho_1 - d\rho_2 - \rho_3 - d\rho_4)\beta_{\pi 2}d\pi_{t+1} + (1-\rho_1 - d\rho_2 - \rho_3 - d\rho_4)\beta_{y1}y_t + (1-\rho_1 - d\rho_2 - \rho_3 - d\rho_4)\beta_{y2}dy_t + \rho_1 i_{t-1} + \rho_2 di_{t-1} + \rho_3 i_{t-2} + \rho_4 di_{t-4} \quad (14)$$

The results of the Wald test are summarized in the table below.

Model Wald Test

Country	*Statistic*	*Pr>ChiSquare*
Austria	55.16	<.0001
Belgium	21.19	0.0003
Finland	34.09	<.0001
France	18.42	0.0010
Germany	16.81	0.0021
Greece	***2.56***	***0.6343***
Ireland	79.61	<.0001
Italy	58.89	<.0001
Luxembourg	***2.03***	***0.7312***
Netherlands	47.58	<.0001
Portugal	***5.29***	***0.2586***
Spain	32.66	<.0001

From the above, it is evident that the only countries that do not reflect a structural change in the model are Greece, Luxembourg, and Portugal.

Structural Change in the Individual Variables of the Model

The above Wald test reveals that in most cases, the model previously employed by the national monetary authorities has experienced a change. However, this test does not demonstrate which variables of the model are causing the change. It is necessary to perform variable structural change tests in order to determine the cause of the break in the model.

Country	*Variable*	*Statistic*	*Pr>ChiSquare*
Austria	*Constant*	26.72	<.0001
	Inflation	10.46	0.0012
	Output gap	12.19	0.0005
	Lagged interest	2.24	0.1349
Belgium	*Constant*	0.00	0.9862
	Inflation	0.38	0.5386
	Output gap	0.57	0.4518
	Lagged interest	11.02	0.0009
Finland	*Constant*	4.15	0.0417
	Inflation	6.76	0.0093
	Output gap	2.61	0.1064
	Lagged interest	1.84	0.1744
France	*Constant*	8.10	0.0044
	Inflation	13.15	0.0003
	Output gap	4.92	0.0266
	Lagged interest	2.87	0.0901
Germany	*Constant*	0.76	0.3831
	Inflation	0.02	0.9010
	Output gap	5.98	0.0145
	Lagged interest	10.61	0.0011
Greece	*Constant*	0.01	0.9106
	Inflation	0.41	0.5199
	Output gap	0.37	0.5428
	Lagged interest	0.64	0.4240
Ireland	*Constant*	0.94	0.3312
	Inflation	0.15	0.6996
	Output gap	1.15	0.2843
	Lagged interest	34.98	<.0001
Italy	*Constant*	1.37	0.2416
	Inflation	4.68	0.0305
	Output gap	0.21	0.6500
	Lagged interest	7.28	0.0070
Luxembourg	*Constant*	0.17	0.6801
	Inflation	0.8	0.7834
	Output gap	0.3	0.8558
	Lagged interest	0.84	0.3608
Netherlands	*Constant*	0.15	0.6974
	Inflation	0.84	0.3593
	Output gap	2.50	0.1138
	Lagged interest	0.00	0.9444
Portugal	*Constant*	1.54	0.2152
	Inflation	3.15	0.0758
	Output gap	0.40	0.5281
	Lagged interest	0.77	0.3807
Spain	*Constant*	4.27	0.0387
	Inflation	0.01	0.9084
	Output gap	9.39	0.0022
	Lagged interest	10.73	0.0011

The above results of the test for variable structural change illustrate that for Austria, France, and Finland, both inflation and output experienced a break. For France, Germany, and Spain, only output structurally changed, while for Italy and Portugal only inflation changed. This test supports neither a structural change in inflation nor output for Belgium, Greece, Luxembourg, and Ireland.

Overall Analysis

In terms of significance of the estimates, the above tests reveal that in nine out of twelve cases, inflation is a significant contributor to interest rate adjustments in the post-Maastricht period.

Regarding the economic theory that motivates the Taylor Rule, not only is the significance of the estimate relevant, but also its value. As noted above, in *The ECB and the Taylor Rule,* Taylor recommends that the interest rate be raised by 1.5 percentage points for each 1 percentage point increase in inflation. This will result in a rise in real interest rates that would help slowdown the economy, thereby reducing inflation. He also recommends reducing the interest rate by 0.5 percentage points for each percentage point decline in real GDP below its natural rate. This would serve to ease the recession and maintain price stability. However, this recipe must be refined for a European Central Bank that does not target output.

The values of the parameter estimates for six countries support the recommendation of the Taylor Rule to raise the interest rate by more than 1 in the face of a one unit inflation

shock. Three countries, Finland, France, and Italy, are targeting inflation more aggressively than the Taylor Rule recommends. Ten out of the twelve countries tested positive for structural change in the Taylor Rule around the time that the common monetary policy regulations were being implemented. All countries for both the pre and post period seek to smooth interest rates. This is evidenced by the significance of the lagged interest rate coefficient in all tests. However, for inflation and industrial production, the results vary.

The estimates reveal that *Austria* had been targeting both inflation and industrial production in the pre period. However, in the post period it is only targeting inflation. The model test for structural change reflects a break around the time of the common monetary policy. The variable tests for structural change indicate a change in inflation, as well as industrial production.

For Austria, the estimate for inflation increased from 0.60401 to 1.109556 (both periods significant). The estimate for industrial production was significant at 0.241709 in the pre period and then became insignificant.

The estimates indicate that *Belgium* targeted neither inflation nor industrial production in the pre period, while in the post period, inflation became significant with an estimate of 1.08. The model test for structural change reflects a break in the model, but this break is not confirmed by the variable tests for change.

For pre Maastricht *Finland*, according to the parameter estimates, neither inflation nor industrial production played a role in interest rate changes. However, in the post period Finland is targeting inflation, with an estimate of 2.96. The model test for structural change confirms the break. The variable tests for change reflect a break in inflation, as well as a break in industrial production at the 10% level.

For pre Maastricht, *France,* industrial production was of relevance in setting the actual interest rate. In the post period, industrial production becomes irrelevant while inflation becomes relevant with an estimate of 2.22. This change in inflation and industrial production is confirmed by the variable tests for structural change, as well as by the model test for structural change.

German parameter estimates depict that Germany considered industrial production (with an estimate of 0.814212) when determining the actual interest rate in the pre period, while in the post period this emphasis shifted to inflation but with an estimate of only 0.630451. According to these results Germany raises the interest rate by only 0.630451 in response to an inflation shock, which implies that the real rate is actually falling. Although inflation has become significant, the German response is not aggressive enough. However, when the second and third lags of the interest rate are removed from the model, the estimate for inflation becomes 1.24, which is more in accordance with both the Taylor Rule and Germany's typically aggressive stance against inflation. The test for model structural change is positive. The variable tests reveal a break in industrial production but not inflation.

For *Greece,* both inflation and industrial production became significant in the post period compared to the pre period. However, the value of the estimate for inflation (0.16) is not even close what Taylor recommends. Both the model tests and variable tests for structural change do not support a break.

Italy's estimates indicate that in the pre period, neither inflation nor industrial production played any role in interest rate changes. However post Maastricht inflation, with an estimate of 2.56 not only became significant but it also surpasses the recommendation of the Taylor Rule theory. The model test for a structural break reflects a change in the model, and according to the variable tests for structural change, this break is attributable to inflation.

Luxembourg showed a shift in the emphasis on inflation. In the pre period, only the lagged interest rate mattered, while in the post period, inflation became significant. However, the value of the estimate for inflation (0.427) is not at par with what Taylor recommends in order to prevent a falling real interest rate. The model test for structural change reflects a break in the model, but this break is not confirmed by the variable tests for change.

For the *Netherlands,* industrial production was significant in the pre period and remained significant in the post period. Inflation became significant from the pre to the post period, although the estimate of 0.426 is not aggressive enough. The estimate for

industrial production is 0.559878, which corresponds with the theory of the Taylor Rule but not with the policy of the ECB. The model test for a break reveals a change, but the variable tests show a change only in industrial production.

Portugal, *Spain*, and *Ireland* did not produce any significant results in either period. However, for all three countries the model tests for structural change indicate a break. For the variable tests for change, Portugal shows a break in inflation, Spain shows a change in industrial production, and Ireland does not show a change in either.

Target Inflation

By reorganizing the model, the target inflation rate can be extracted for each country for both the pre and post period.

The equation being estimated is,

$$i_t = i_s + (1-\rho_1)\beta_\pi \pi_{t+1} + (1-\rho_1)\beta_y y_t + \rho_1 i_{t-1} + e_{t+1} \qquad (15)$$

where i_s, the long-run equilibrium nominal interest rate is defined as $(1-\rho_1)(r+\overline{\pi})$ and r is the average real interest rate calculated from the data (the nominal interest rate minus inflation).

And,

$$(1-\rho_1)\beta_\pi \pi_{t+1} = (1-\rho_1)\beta_\pi \pi_{t+1} - (1-\rho_1)\beta_\pi \overline{\pi} \qquad (16)$$

(15) becomes,

$$i_t = (1-\rho_1)(r+\overline{\pi}) + (1-\rho_1)\beta_\pi \overline{\pi} + (1-\rho_1)\beta_\pi \pi_{t+1} + (1-\rho_1)\beta_y y_t + \rho_1 i_{t-1} + e_{t+1}$$

Defining,

$$(1-\rho_1)(r+\overline{\pi})+(1-\rho_1)\beta_\pi\overline{\pi}\equiv C \qquad (17)$$

Where C is the constant given by the SAS output. Solving for $\overline{\pi}$ yields,

$$\overline{\pi}=(C-(1-\rho_1)r)/(1-\rho_1)(1-\beta_\pi) \qquad (18)$$

After solving (17) for all of the countries, the results are summarized below.

Country	Inflation Target Pre Period	Inflation Target Post Period
Austria	0.0067287	0.0005236
Belgium	0.035066	0.000313
Finland	0.019373	0.068796
France	0.05038	0.021922
Germany	0.007761	0.001584
Greece	0.062567	0.042029
Ireland	0.04081	0.06436
Italy	0.061658	0.085167
Luxembourg	0.000318	0.005093
Netherlands	0.014704	0.001527
Portugal	0.012224	4.490384
Spain	0.161679	2.086274

The above results reveal that only France has an inflation target near 2%, which is the goal of the ECB. The other countries' targets are either far above or far below the 2% target. These results could be tainted for two reasons. First, the central banks might have been acting to minimize a loss function that seeks to maintain output above its natural rate. If so, they would be operating on an alternative Taylor Rule in the form of:

$$i_t^* = i_s + \beta_\pi \underset{t}{\mathrm{E}}\pi_{t+1} + \beta_y(y_t - \{y_N + k\}) \qquad (18)$$

Where y_N is the natural rate of output and k is a constant representing the amount by which output exceeds the natural rate. Such an augmented Taylor Rule would cause the constant to be a different value. This would alter the value of the constant produced by the model. Second, the estimate of the average real rate might not be completely accurate due to the inconsistent behavior of the real rate during the period of estimation (1973-

present). In 1996, Rene Garcia and Pierre Peron showed that the United States real interest rate generally hovered just below 0 for most of the 1970s, jumped to a relatively higher rate in the 1980s before dropping again to a somewhat lower rate in the 1990s. A Markov Switching Model best captures this non-stationary behavior. Graphs of the real interest rate for each euro area country (Appendix 1) reveal that the real interest rate in Europe may have followed a similar pattern as that of the US. The general pattern, which exhibits three different trends may not be captured be the conventional method of calculating the real interest rate.

Part V: Estimation of the Taylor Rule for the Euro Area

Estimation

The analyses of part IV pertained primarily to the behavior of the national economies within the euro area. The implication is that most euro area countries are following a Taylor Rule by adjusting their national interest rates more aggressively in response to changes in inflation in the post-Maastricht period as compared to the pre-Maastricht period. In addition, countries that were historically targeting output have mostly ceased such behavior in favor of a lower inflation rate. Since this behavior is assumed to be a result of the common monetary policy set forth by the ECB, it is worth determining if the ECB is also following a Taylor Rule and aggressively targeting inflation as it asserts.

Using GMM to extract the model parameters for the ECB Taylor Rule, the results are:

	Estimate	**T-Stat**	**P-Value**
Constant	0.007599	1.92	0.0788
Inflation	1.235637	5.13	0.0003
Output	0.020494	1.96	0.0730
Lagged Interest Rate	0.362948	3.24	0.0071

The objective*N for this model is 1.6503 with a critical value of 7.82. Thus, the Taylor Rule accurately captures adjustments to the interest rate. In addition, the ECB appears to be adhering to its objectives of combating inflation while not targeting output. Specifically, if inflation rises by 1% than the nominal interest rate will rise by 1.23%, which implies that the real interest rate is also rising.

Target Inflation Rate

To determine if the ECB is maintaining its 2% inflation goal, the target inflation is calculated as it was calculated above for the national targets. This calculation produces a target of 1.7944%, which is only slightly lower than the 2% target. The implication is that the ECB is diligent in its efforts to fight inflation in a region that has historically been plagued by high inflation.

Is the ECB Biased?

Inflation Weights

The ECB strives toward an inflation rate of 2% for the entire euro area, which comprises the respective inflation rates of each country. If the ECB is transparent and it is reporting its inflation rate accurately, the euro area inflation should represent a properly weighted average of the national inflation rates. The ratio of the national GDP to the overall euro area GDP provides a logical weight to be placed on each country. If the ECB is weighing each country's inflation by its contribution to the area's GDP, then the coefficients produced from a regression of the euro area inflation on all national inflations should be statistically equal to the GDP ratio. An F-test reports if the difference between these two values is 0, which is the null hypothesis. This test yielded an F-statistic of 6.44 and a P-value of 0.0101. As a result, the null must be rejected and it appears as though the ECB is not placing the appropriate weights on the national inflation rates when calculating the euro area inflation.

Interest Rate Weights

The analysis explained above regarding the weights on the individual countries inflation rates was applied to the interest rate as predicted by the Taylor Rule, as well as the actual interest rate. The predicted interest rate was calculated for each country by solving the Taylor Rule using the parameter estimates produced by GMM. These interest rates were then regressed on the euro area 3 month inter-bank lending rate. Using the same GDP weights as above, an F-test was again performed to determine if the ECB is properly weighing the interest rates of each country when setting its interest rate. The test yielded an F-statistic of 45.71 with a P-value of $<.0001$. Rejection of the null implies that the ECB is not placing the appropriate weights on the national predicted interest rates when calculating the euro area interest rate.

The above two tests provide evidence that the ECB might be unjustly favoring certain countries over others. That is, it is placing a greater emphasis on certain countries than the respective national GDP ratios suggest.

For comparison, the interest rate regression is re-calculated using the actual national interest rates instead of those predicted by the Taylor Rule. The F-test yielded a statistic of 1.17 and a P-value of 0.4216. For this test, the null cannot be rejected. This indicates that the weight placed on each country's actual interest rate by the ECB is in accordance with that country's contribution to the overall GDP. This implies that the ECB is not biased when the actual interest rate is used instead of the rate predicted by the Taylor Rule.

Part VI: Business Cycle Synchronization

The above sections demonstrated how the Taylor Rule functions, the degree to which the euro area economies are adhering to the rule, and whether or not they are better off having joined the monetary union. However, it does not address the synchronization of the national business cycles, which is critical if the response of the ECB (via the Taylor Rule) is to be appropriate for all member states. To comment on this issue, the variables of the Taylor Rule are used to construct various vector autoregressive (VAR) models, whereby each variable in a given model is a function of its own lag as well as the lag of the other variables in the system, and a noise term. The VAR essentially represents the reduced form of a structural system of simultaneous equations. In the reduced form, the noise term could be a linear combination of shocks to some or all of the variables in the system. Since the shocks to each variable occur independently of each other, when the noise term changes one does not know which variable is causing the change. As such, the VAR assumes that all variables are endogenous.

Impulse response functions, which are generated from a VAR, reveal the impact of a one-time shock to a variable on the other variables in the VAR. They set all variables to their starting value of zero and then shock the system to determine how each variable reacts to a shock to one of the others.

Impulse response functions will be the primary means of unveiling any potential correlation among the variables. However, before proceeding with these functions, a simple cross-country correlation of the output gap is worth identifying.

Post Maastricht

	AU	*BE*	*FIN*	*FRA*	*GER*	*GRE*	*IRE*	*ITA*	*NETH*	*SPA*	*LUX*	*PORT*
AU	1.00											
BE	0.45	1.00										
FIN	0.93	0.47	1.00									
FRA	0.90	0.35	0.92	1.00								
GER	0.86	0.38	0.88	0.89	1.00							
GRE	0.76	0.43	0.85	0.74	0.70	1.00						
IRE	0.55	0.34	0.65	0.46	0.61	0.49	1.00					
ITA	0.32	0.23	0.47	0.40	0.39	0.40	0.56	1.00				
NETH	-0.32	-0.13	-0.17	-0.26	-0.33	-0.20	0.10	0.49	1.00			
SPA	0.89	0.46	0.93	0.90	0.79	0.78	0.52	0.58	-0.06	1.00		
LUX	0.38	0.12	0.28	0.42	0.32	0.19	0.08	0.13	-0.15	0.32	1.00	
PORT	0.38	0.07	0.41	0.41	0.12	0.46	0.07	0.30	0.25	0.50	0.17	1.00

Pre Maastricht

	AU	*BE*	*FIN*	*FRA*	*GER*	*GRE*	*IRE*	*ITA*	*NETH*	*SPA*	*LUX*	*PORT*
AU	1.00											
BE	0.35	1.00										
FIN	0.21	0.07	1.00									
FRA	0.33	0.74	0.14	1.00								
GER	0.31	0.81	-0.19	0.75	1.00							
GRE	0.19	0.25	0.35	0.61	0.32	1.00						
IRE	0.29	0.40	0.52	0.63	0.28	0.73	1.00					
ITA	0.26	0.66	0.26	0.86	0.68	0.57	0.55	1.00				
NETH	0.25	0.62	-0.25	0.50	0.77	0.14	0.15	0.51	1.00			
SPA	0.32	0.70	0.34	0.70	0.62	0.55	0.63	0.67	0.39	1.00		
LUX	0.12	0.66	-0.08	0.20	0.56	-0.28	-0.05	0.27	0.58	0.37	1.00	
PORT	0.15	-0.07	0.12	0.23	-0.13	0.15	0.32	0.03	-0.20	-0.04	-0.38	1.00

Overall, the cross-country correlation chart is inconclusive as to whether or not the economies output gaps have become more synchronized. In some cases, the correlation has become greater in the post period, while in others it has diminished. The impulse response functions are expected to clarify this discrepancy.

Output Gap Impulse Response Functions

I will first employ the impulse response functions to demonstrate the effect of a one-time shock to the output gap for each euro area country on the others. The extent to which the economies experience similar fluctuations has implications for the degree of business cycle synchronization. The VAR for this model is as such:

$$y_{1t} = y_{1t-1} + y_{2t-1} + y_{3t-1} + \ldots + y_{12t-1}$$
$$y_{2t} = y_{1t-1} + y_{2t-1} + y_{3t-1} + \ldots + y_{12t-1}$$
$$\text{M}$$
$$y_{12t} = y_{1t-1} + y_{2t-1} + y_{3t-1} + \ldots + y_{12t-1}$$

Where y is the output gap and subscripts 1 through 12 represent each euro area country.

The full set of functions is labeled 1 through 12 for each shocked country and then A through L for each response for both the Post Maastricht period and the Pre Maastricht period. These can be found in Appendix 2.

Post Maastricht Period

Overall, these graphs suggest that a shock to any country is not transmitted uniformly or with the same strength to the other economies. The larger economies, such as France, Germany, and Italy seem to respond only to few shocks to other economies. For example, the French output gap increases in response to a shock to the output gap for 8 out of the 12 countries. However for the remaining four (Belgium, Ireland, Italy, and the Netherlands), the French output gap instead declined (1-12D). The German output gap

exhibits similar unpredictable behavior. In response to the Austrian, Finnish, French, German, Greek, and Irish shocks, the German output gap increases, however for Belgium, Italy, Luxembourg, the Netherlands, Portugal, and Spain it declines or barely reacts at all (1-12E). The Italian output gap only increases in response to a shock to Italy, Greece, Ireland, Luxembourg, the Netherlands, and Portugal. For all of the other countries, it declines in the face of output gap shocks (1-12H).

France and Germany appear to be the most synchronized in terms of the transmission of output gap shocks. Each country responds positively to a shock to the output gap of the other (4E and 5D). In addition, as pointed out above, the list of countries that they positively react to is mostly the same (Austria, Finland, France, Germany, and Greece). Italy does not display behavior similar to that of France and Germany, since it does not respond positively to a shock to neither France nor Germany. In addition, neither France nor Germany responds to Italy.

Aside from France and Germany, any other evident responses are not reciprocal and thus cannot constitute a relationship. For example, Italy responds positively to a shock to Ireland (7H). However, Ireland exhibits a negative reaction to an Italian shock (8G). Finland greatly reacts to Ireland (7C), while Ireland barely reacts at all to Finland (3G). Also, Austria, Finland, France, Germany, Greece, the Netherlands, and Spain respond to a shock to Austria, while Austria only responds to itself and Portugal (1A and 11A).

Spain has the least success in transmitting their shocks to the other countries, resulting in a reaction only in 3 countries (France, Netherlands, and Spain), while Austria, Finland, and Germany, have the most success by each affecting 7 countries. Also worth noting is that Belgium, France, the Netherlands, and Spain are affected by the largest amount of countries. Spain is affected by 9 and the remaining three are affected by 8.

Pre Maastricht Period

Compared to the post Maastricht period, the pre Maastricht period impulse response functions France responded to 9 out of the 12 countries; however Germany was not one of these countries (1-12D). Germany also positively responded to a shock to 9 other countries output gap (1-12E). Italy responded to a shock to 5 other countries, of which France, but not Germany is included (1-12H).

Austria and Italy have the most success in transmitting their shocks to other countries, resulting in a reaction in 9 and 7 countries respectively, while Greece is the least successful, affecting only 3 countries. France, Germany, and Spain are affected by the largest amount of countries. Spain is affected by 11, while France and Germany are affected by 10.

From the above results, it cannot be concluded that the business cycles of the national economies have become more or less synchronized. The only conclusion that can be drawn is that the business cycles of France and Germany may have become more correlated, and more consistent. Otherwise, there is no evidence to suggest that increased

integration resulting from the implementation of the common monetary policy has resulted in more correlation of the national business cycles. As a result, the national economies could be susceptible to asymmetric shocks that cannot be accommodated by any supranational action of the ECB.

Inflation Impulse Response Functions

The inflation impulse response functions reveal the extent to which an inflationary shock to one country is transmitted to another. They will thus have implications for the degree of business cycle synchronization among the euro area countries. In addition, the functions show if inflation has been better controlled since the inception of the common monetary policy.

Impulse response functions were produced from the following VAR for both the pre and post Maastricht period.

$$\pi_{1t} = \pi_{1t-1} + \pi_{2t-1} + \pi_{3t-1} + \ldots + \pi_{12t-1}$$
$$\pi_{2t} = \pi_{1t-1} + \pi_{2t-1} + \pi_{3t-1} + \ldots + \pi_{12t-1}$$
M
$$\pi_{12t} = \pi_{1t-1} + \pi_{2t-1} + \pi_{3t-1} + \ldots + \pi_{12t-1}$$

Where π is the output gap and subscripts 1 through 12 represent each euro area country. The full set of functions is labeled 1 through 12 for each shocked country and then A through L for each response for both the Post Maastricht period and the Pre Maastricht period. These can be found in Appendix 3.

A comparison of the pre and post period effects of an inflation shock to a given country on its respective economy illustrates the efficacy of the ECB in maintaining its monetary policy goal of price stability. In fact, 7 out of the 12 countries provide evidence in favor of greater price stability in the post period. Specifically, Finland, France, Italy and the Netherlands portrayed permanently elevated inflation following an inflationary shock in the pre period. However, in the post period the same shock resulted in a rise followed by an immediate return to the target (pre and post 3C, 4D, 8H, 10J). Austria, Luxembourg, and Portugal exhibit slightly different behavior than the above group in that the pre period inflation is not permanent. That is it eventually returns to the target, but only after a long period (one to two years) of inflationary pressure. In the post period, inflation returns to its target more rapidly (1A, 9I, 11K). The remaining five countries (Belgium, Germany, Greece, Ireland, and Spain) do not portray any noteworthy difference in their behavior from the pre period to the post period (2B, 5E, 6F, 7G,12L).

An analysis of the cross country effects of an inflation shock reveals how readily shocks are transmitted across borders. To begin this analysis, France and Germany are first considered since the output gap impulse response functions above revealed a relationship between the two. Graphs 4E and 5D for the pre and post periods depict that an inflationary shock to France or Germany results in a similar reaction. Specifically, a shock to France caused German inflation to increase slightly in the pre period and decline in the post period. The same shock to Germany caused French inflation to also rise in the pre period and decline in the post before returning to the target. A possible explanation for the inverse relationship in the post period is that the ECB could be responding to the

rise in inflation in either country by raising the interest rates. If the actions of the ECB are rapid, then the inflation in the other country could be responding to the change in the interest rate instead of the inflation shock.

The Italian response to French and German inflation shocks varies slightly (pre and post 4H and 5H). In the pre period, the shocks caused Italian inflation to also increase in the pre period and remain elevated. However, in the post period, unlike the reaction of France and Germany, Italian inflation increases before returning to target. The Netherlands and Greece respond to a German shock by increasing permanently in the pre period, while in the post period it also increases but returns rapidly to the target. No other countries demonstrate a noteworthy reaction to the French inflationary shock.

A shock to Italian inflation caused French inflation to rise in the pre period and remain elevated, while declining in the post period before returning to the target (pre and post 8D). German inflation also rose in the pre period and remained elevated, but did not respond at all in the post period to the Italian inflation shock (pre and post 8E). Also worth noting is that Luxembourg and the Netherlands react the same to the Italian shock as did France and Germany (pre and post 8I and 8J).

When Austria experiences an inflationary shock, in the pre period Finland, France, Germany, Greece, Italy, the Netherlands, and Portugal all suffer from elevated inflation either permanently or for at least 5 quarters (Portugal). However, in the post period all of the above listed countries except for Finland depict either declining inflation (France,

Germany, Italy, the Netherlands, and Portugal) or a rise followed by an immediate return to the target (Greece). This implies that an inflation shock was readily transmitted to, and maintained in other countries prior to the formation of the common monetary policy, however thereafter inflationary trends are immediately addressed by the ECB to prevent them from spreading abroad (pre and post 1C,1D, 1E, 1F, 1H, 1J, 1K).

The effects of a Belgian inflation shock on Austria, France, Germany, and Greece reveal a similar pattern of transmission in the pre period, while in the post period, inflation is controlled (pre and post 2A, 2D, 2E, 2F). Likewise, a Finnish shock causes the same reaction in France, Germany, and Italy (pre and post 3D, 3E, 3H); a Greek shock has similar results in France, Luxembourg, and the Netherlands (pre and post 6D, 6I, 6J); as does an Irish shock in France, Italy, and the Netherlands (pre and post 7D, 7H, 7J). A shock to Luxembourg results in the same pattern in Finland, France, Greece, and Luxembourg (pre and post 9C, 9D, 9F, 9I); and Finland, France, Greece, and Italy behave similarly in the face of a Dutch shock (pre and post 10C, 10D, 10F, 10H). Finland, Italy, and Luxembourg also show inflationary tendencies in the pre period, while in the post period inflation is quickly dampened after a Portuguese inflation shock (pre and post 11C, 11H, 11I). Finally, a Spanish inflation shock has the same result in Italy, the Netherlands, and Portugal (pre and post 12H, 12J, 12K). In response to the Spanish shock, Finland demonstrates a gradual return to the target, however in the pre period inflation does not return at all (pre and post 12C).

Overall, the above analyzed impulse response functions reveal that inflation is better controlled in the post period than in the pre period. This implies that the ECB is effective in maintaining price stability by preventing spiraling national inflation. They also reveal that while shocks are still transmitted abroad, which implies some degree of business cycle correlation, they are quickly muted.

Interest Rate Impulse Response Functions

The interest rate impulse response functions are constructed only for the pre Maastricht period. In the post period, the national economies are all implementing a common interest rate as dictated by the ECB. The pre period functions reveal the extent to which the countries were affecting each other's national interest rates prior to the implementation of the common rate.

Impulse response functions were produced from the following VAR for the pre Maastricht period.

$$
\begin{aligned}
i_{1t} &= i_{1t-1} + i_{2t-1} + i_{3t-1} + \ldots + i_{12t-1} \\
i_{2t} &= i_{1t-1} + i_{2t-1} + i_{3t-1} + \ldots + i_{12t-1} \\
&\text{M} \\
i_{12t} &= i_{1t-1} + i_{2t-1} + i_{3t-1} + \ldots + i_{12t-1}
\end{aligned}
$$

Where i is the interest rate and subscripts 1 through 12 represent each euro area country. The full set of functions is labeled 1 through 12 for each shocked country and then A through L for each response for pre Maastricht period. These can be found in Appendix 4.

Most notably, a shock to the Austria national interest rate resulted in a mentionable interest rate rise (0.2 or more) in only Belgium (1B). A shock to the Belgian rate produced a jump in the French and Italian rate, as well as the Greek and Spanish rate with a lag (2D, 2H, 2F, 2L). A shock to Finland yielded a rise in Belgium, France, the Netherlands, Portugal, and Spain (3B, 3D, 3J, 3K, 3L). A French shock caused a rise of the interest rate in Austria, Belgium, Greece, Italy, and Spain (4A, 4B, 4F, 4H, 4L), while the German shock positively affected Belgium, Greece, Portugal, and Spain (5B, 5F, 5K, 5L). The Greek shock caused a temporary rise in France (6D), and a lagged positive response Belgium, Portugal, and Spain (6B, 6K, 6L). A shock to the Irish interest rate seems to be the most pervasive, having produced an almost one unit rise in the Finnish rate (7C), an almost 1.5 unit rise in Italy (7H), a 2 unit rise in Luxembourg's rate (7I), and a notable rise in the rate in Germany (7E), France (with a lag) (7D), and the Netherlands (7J). The Italian shock was only transmitted to Austria and France (8A, 8D), and Belgium and Spain with a lag (8B, 8L). A shock to Luxembourg's rate only caused a notable rise in Belgium (with a lag) and France (9B, 9D), while the same shock to the Netherlands resulted in a rise in Belgium and Greece (10B, 10F). A rise in the Portuguese rate resulted in a rise in the rate in Belgium, Finland, and Spain (11B, 11C, 11L), while a shock to Spain caused a rise in Belgium, Italy, and Luxembourg (12B, 12H, 12I).

Of all of the countries, Belgium, Spain, and France were the most receptive to interest rate shocks, having been affected by 10, 7, and 6 other countries shocks. The least

receptive countries were Ireland and Germany, having been affected by 0 and 1 shocks. The Irish shock affected the greatest amount of economies and the Austrian affected the least amount, having caused a rise in the rate in 6 and 1 other countries respectively.

Overall, the impulse response graphs for the pre Maastricht interest rate illustrate that some shocks were transmitted across borders, but not all. In addition, the magnitudes of the cross border transmissions, when they occur, are typically weak with the exception of the Irish interest rate shock. Thus, it cannot be concluded that the pre Maastricht interest rates of the euro area economies were synchronized. The formation of the common monetary policy and its inherent common interest rate has since forced the synchronization of these national rates.

Part VII: Conclusion

The above analysis reveals that the European Central Bank follows a Taylor Rule when setting interest rates. The Taylor Rule allows for interest rates to be adjusted for both inflation and output, however the ECB explicitly states that it will adjust interest rates only in response to inflation. This implies that the coefficient on the output gap variable in the Taylor Rule for the ECB should not be significant, while the coefficient on inflation should be significant and valued over one. The results outlined in Part IV for the post Maastricht period overwhelmingly show that the Taylor Rule for the euro area economies emphasizes inflation while practically eliminating the role for output in setting interest rates. A comparison of the post period results to the pre period results reveals that in the pre period, many of the countries were following a Taylor Rule that either emphasized output more than inflation, or maintained a weight on inflation that was less than one. The latter rule would produce the undesirable effect of a decline in the real interest rate when a rise in the rate is the appropriate response to an inflation shock. Together the pre and post estimation of the Taylor Rule reveal that the ECB has been efficient in curbing inflation in countries that typically experienced high inflation in the past.

The tests revealed that a Taylor Rule accurately captured the behavior of the monetary authorities for both the pre and post period (despite the inefficiency of the pre period), however the coefficients on the variables varied drastically across the two periods. Most of the tests for structural change support the notion that the Taylor Rule followed in the pre period is not the same Taylor Rule followed in the post period.

The estimation of the Taylor Rule revealed that the ECB is targeting inflation according to plan. When the target inflation was calculated from the model, the rate of 1.79% demonstrates the ECB's commitment to its policy objective of maintaining inflation at or below 2%. In addition, the estimation of the Taylor Rule for the euro area as a whole yielded coefficients of 1.23 and 0.02 on inflation and output respectively. Thus, the goals of the national economies (as revealed by the national Taylor Rule estimations) and the goals of the aggregate coincide.

The above conclusions paint a positive picture for the euro area and the success of the ECB. However, the impulse response functions of Part IV imply that this success might not be sustainable. Particularly the output gap functions highlight that shocks are not necessarily transmitted from one euro area country to another, with the exception of France and Germany which demonstrated a reciprocal relationship. As such, a significant degree of synchronization of the euro area business cycles is not obvious. The implication is that in the absence of business cycle correlations, the national economies are susceptible to asymmetric shocks to which the ECB might not provide the most appropriate or adequately aggressive response. If one country experienced a positive shock while another was hit by a negative shock, the effects of the shocks on national inflation and output could neutralize each other, thereby maintaining the status quo for the aggregate of the euro area. Under such circumstances, the ECB would not respond, and thus not accommodate the needs of the individual economies. In addition, since output is not targeted by the ECB, even if an output gap shock to one country is

permanently transmitted to another, one cannot expect that the ECB would respond to bring the spiraling output back under control.

Likewise, the inflation impulse response functions do not necessarily reveal that shocks are readily transmitted anymore in the post Maastricht period than in the pre period. Although no correlation conclusions can be drawn from these functions, they do overwhelmingly suggest that if inflation shocks are transmitted, they are immediately corrected for more so in the post period. This further highlights the ECBs commitment to maintaining its policy goal of price stability.

Overall, this paper suggests that the ECB fulfills its obligations and commitments by adhering to a Taylor Rule, which has been proven to be more efficient than the Taylor Rules followed by the national economies prior to the implementation of the common monetary policy. However, it does not infer that the business cycles of the national economies have become more synchronized upon creation of the ECB, nor does it conclude that they are synchronized enough to thwart any potential asymmetric shocks. The implication is that despite the efficiency and effectiveness of the ECB, the euro area should seek to revise its rigid labor market and real estate laws so that the region as a whole is more capable of national stabilization in the event of an asymmetric shock.

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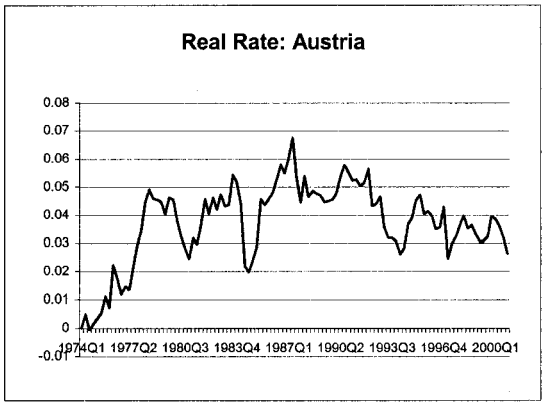
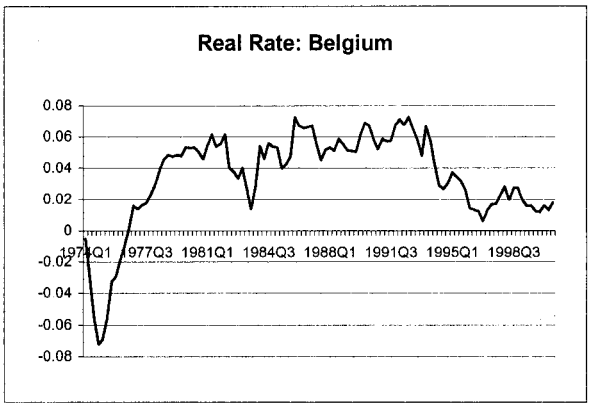
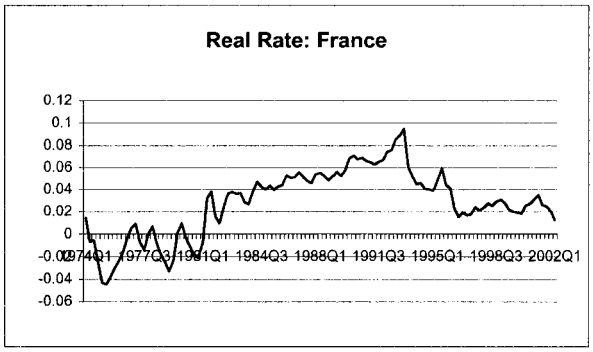
Appendix 1: Graphs of National Real Interest Rates

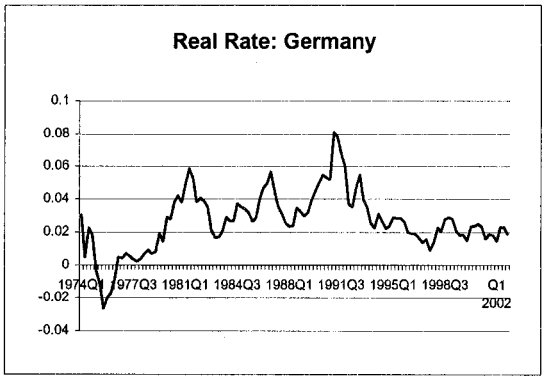
Appendix 1

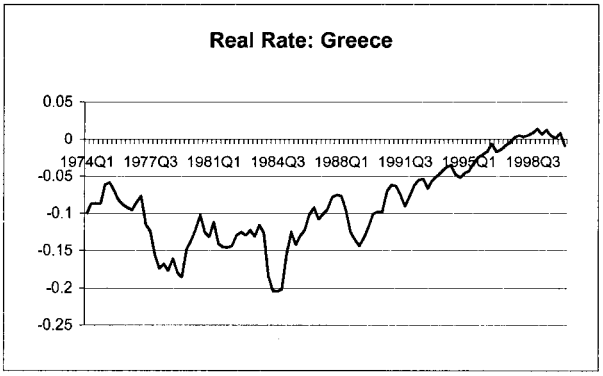

Real Rate: Austria
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.0
1974Q1 1977Q2 1980Q3 1983Q4 1987Q1 1990Q2 1993Q3 1996Q4 2000Q1


Real Rate: Belgium
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
1974Q1 1977Q3 1981Q1 1984Q3 1988Q1 1991Q3 1995Q1 1998Q3

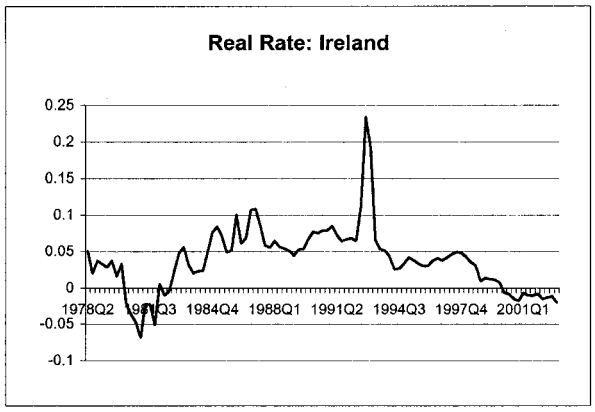

Real Rate: Finland
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.04
1978Q1 1981Q1 1984Q1 1987Q1 1990Q1 1993Q1 1996Q1 1999Q1 2002Q1

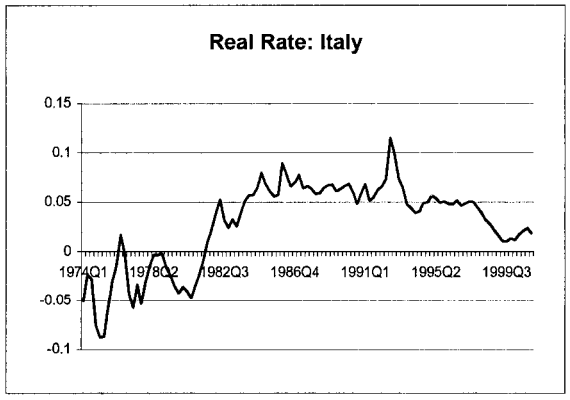

Real Rate: France
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.04
-0.06
1974Q1 1977Q3 1981Q1 1984Q3 1988Q1 1991Q3 1995Q1 1998Q3 2002Q1

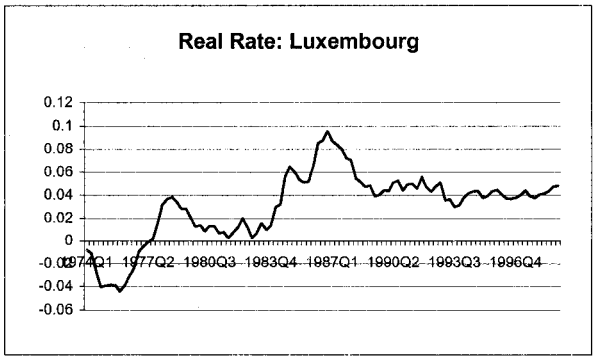

Real Rate: Germany
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
1974Q1 1977Q3 1981Q1 1984Q3 1988Q1 1991Q3 1995Q1 1998Q3 Q1
2002

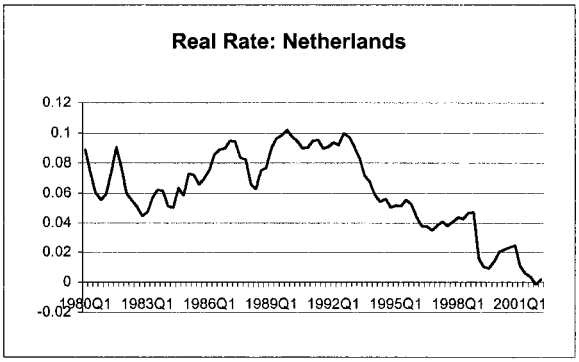

Real Rate: Greece
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
1974Q1 1977Q3 1981Q1 1984Q3 1988Q1 1991Q3 1995Q1 1998Q3

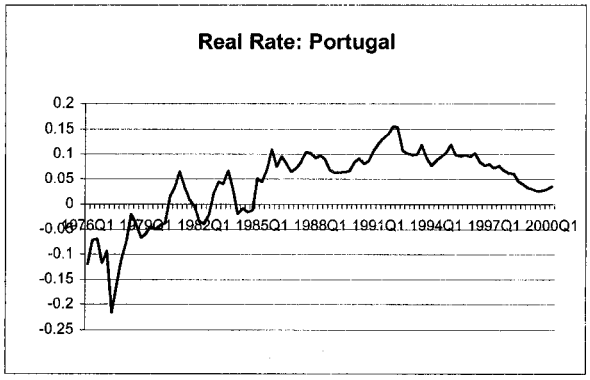
Appendix 1 Continued

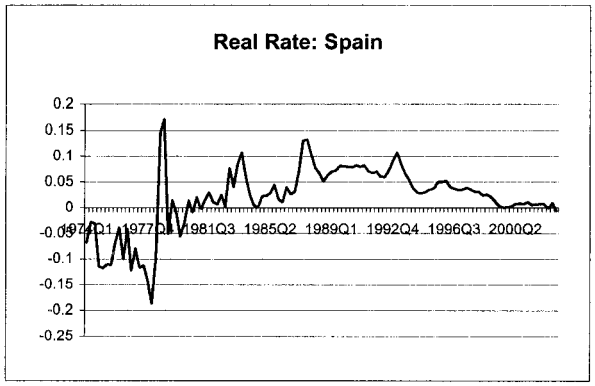








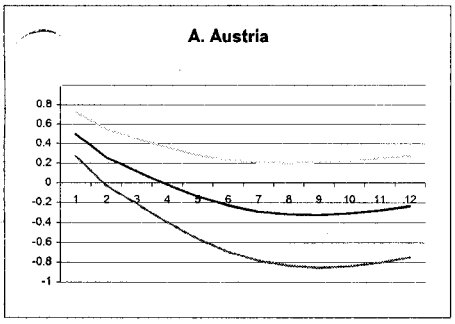


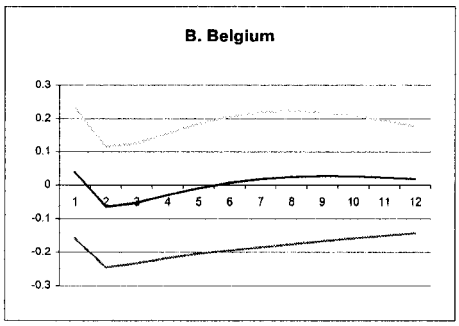


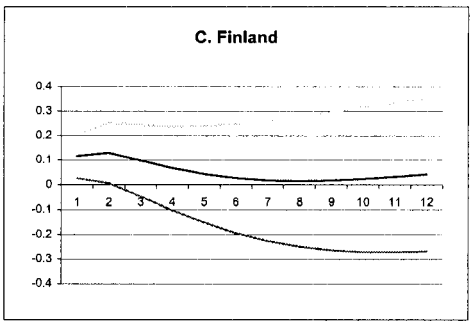
Appendix 2: Output Gap Impulse Response Functions Pre and Post Maastricht

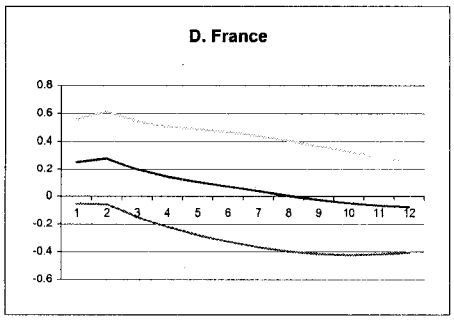
Pre Maastricht

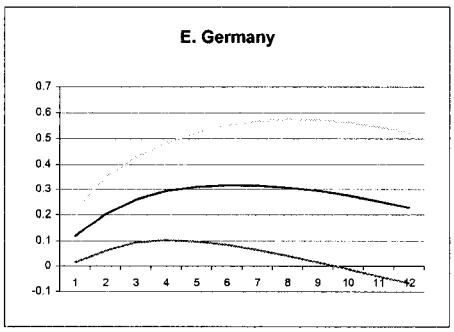
1. Shock to Austrian Output Gap on National Output Gaps

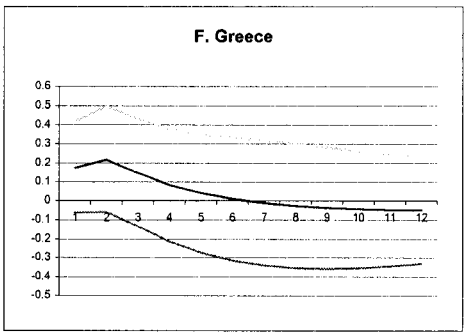


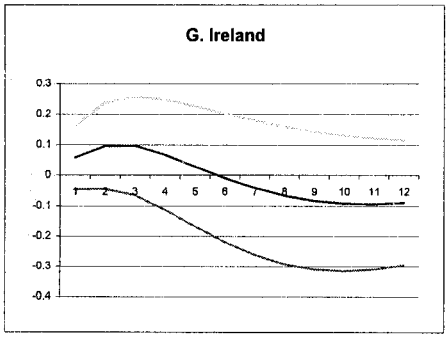


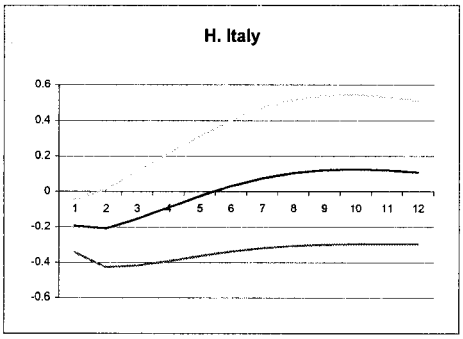


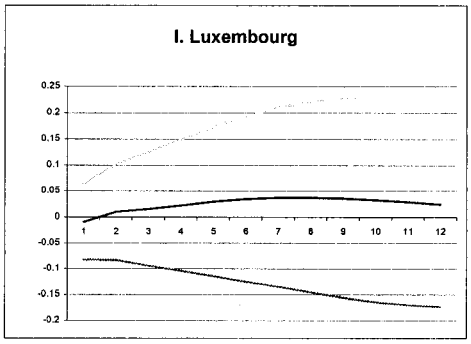


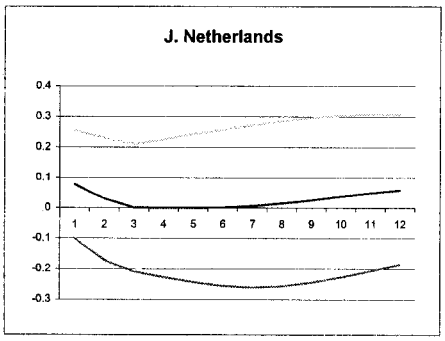


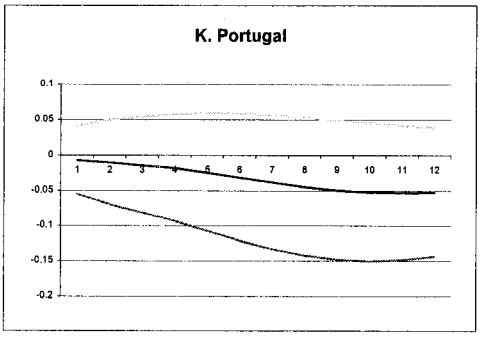


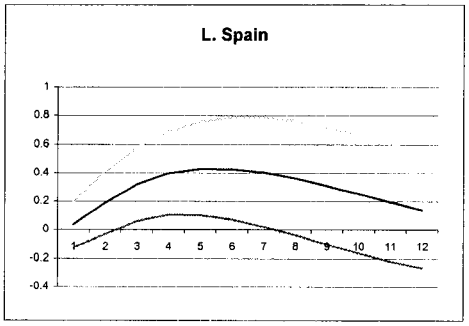






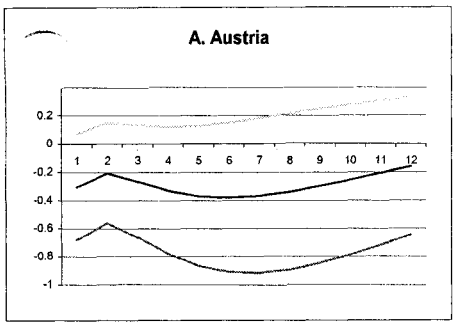


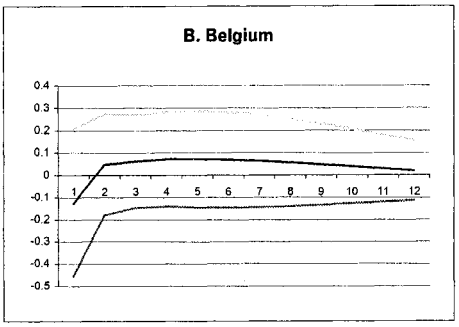


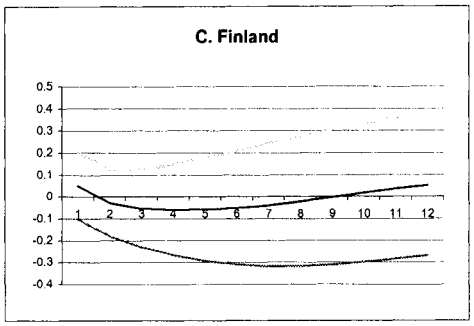


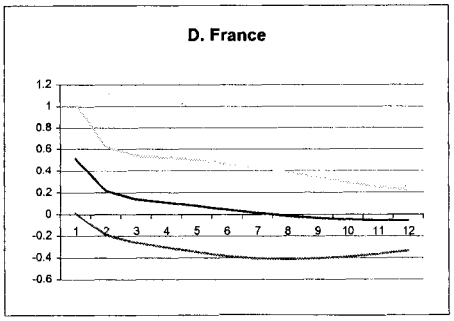
Pre Maastricht

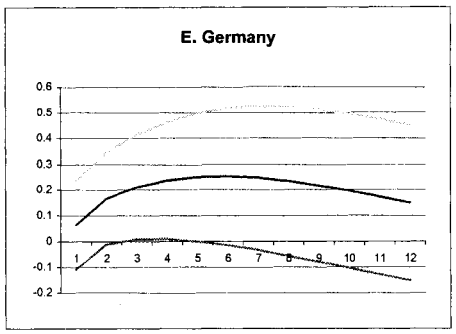
2. Shock to Belgian Output Gap on National Output Gaps

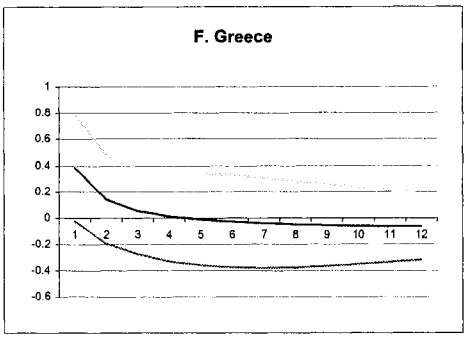


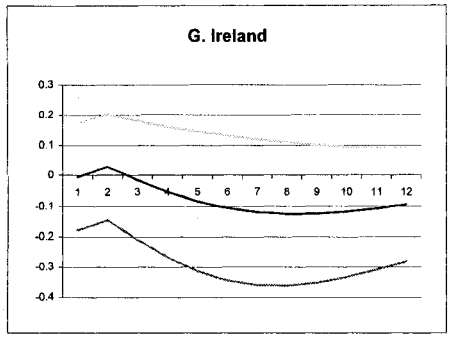


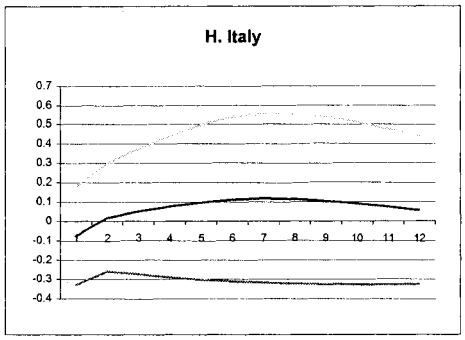


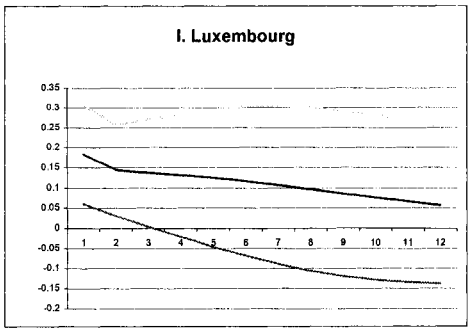


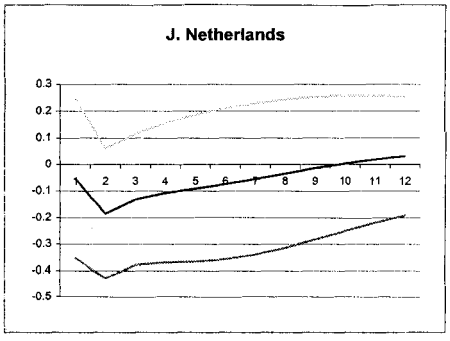


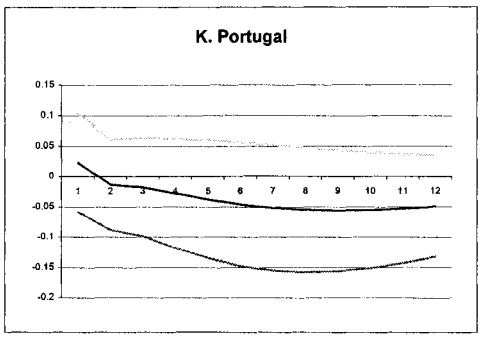


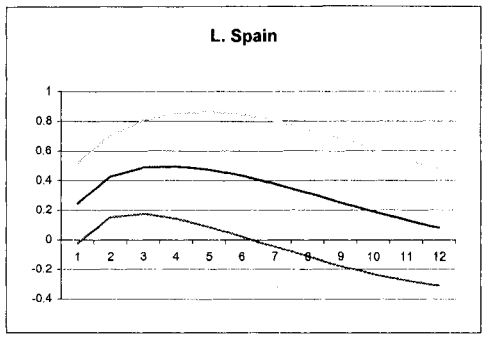






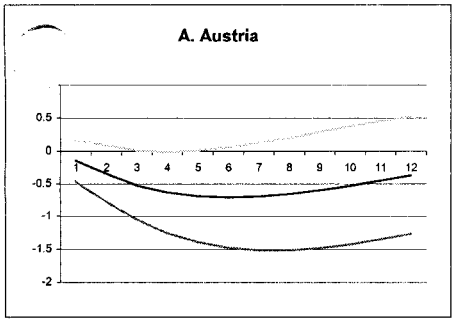


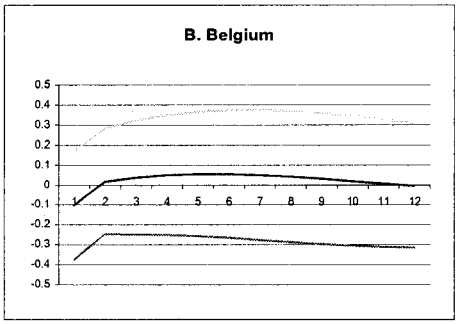


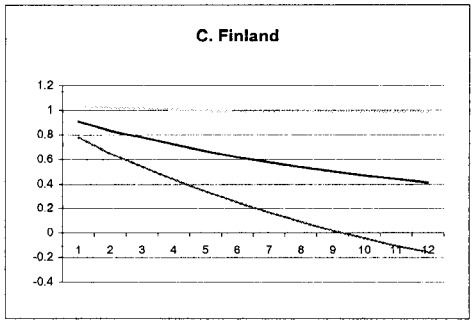


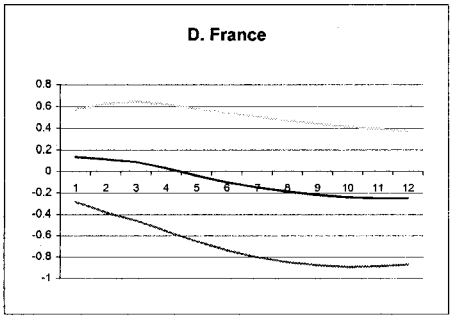
Pre Maastricht

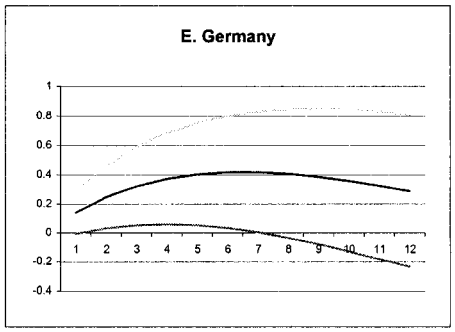
3. Shock to Finnish Output Gap on National Output Gaps

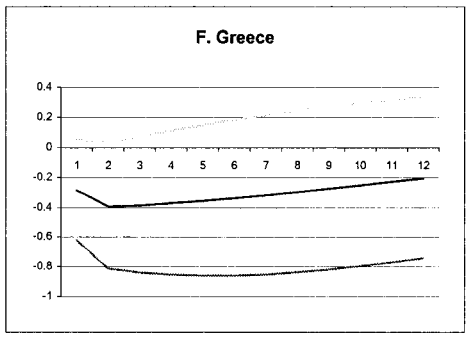


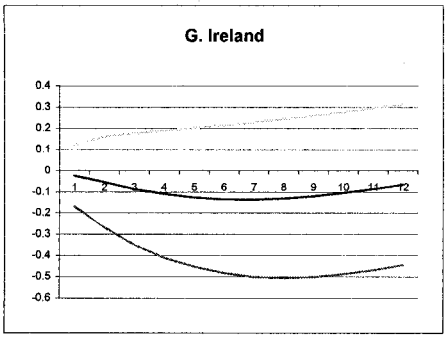


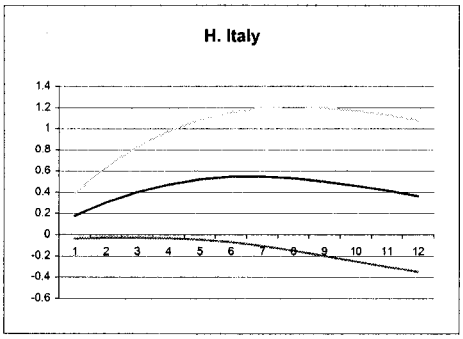


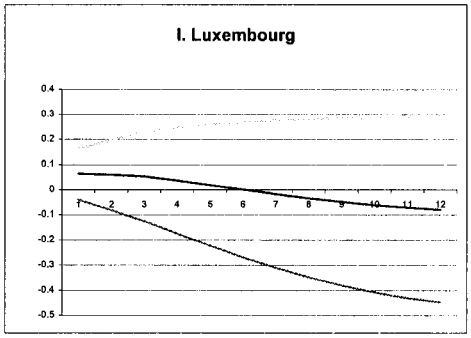


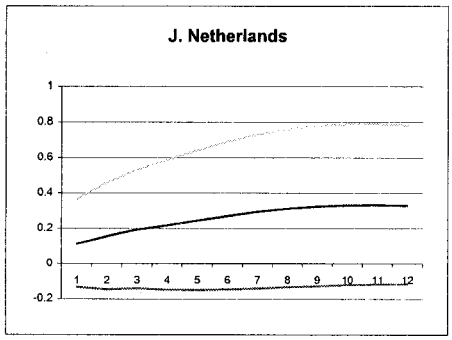


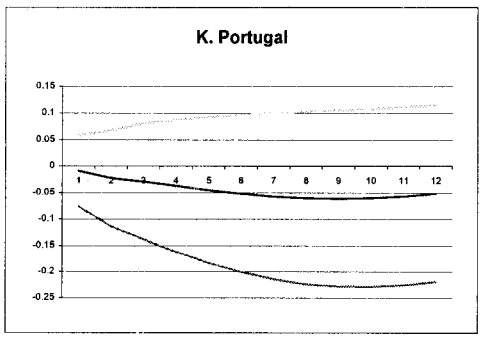


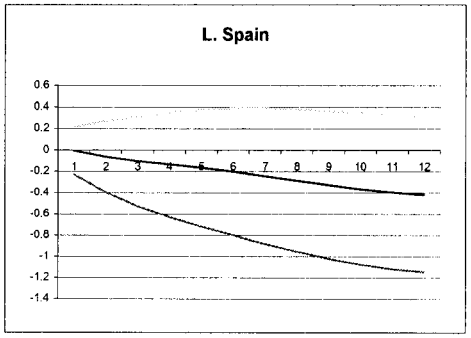






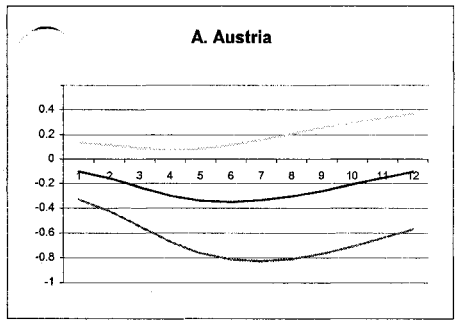


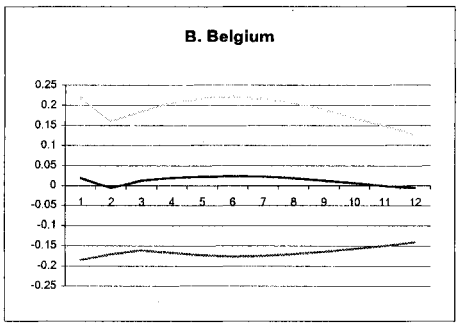


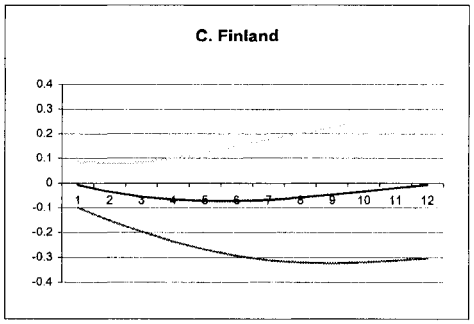


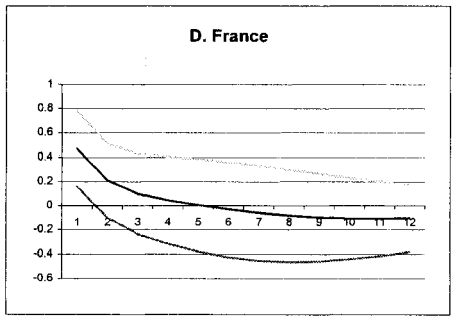
Pre Maastricht

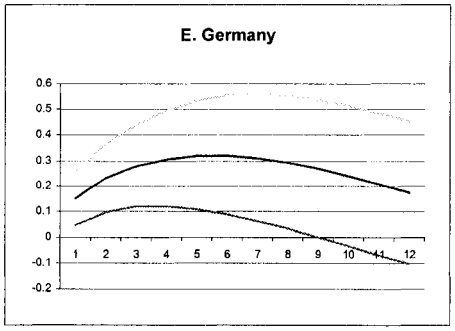
4. Shock to French Output Gap on National Output Gaps

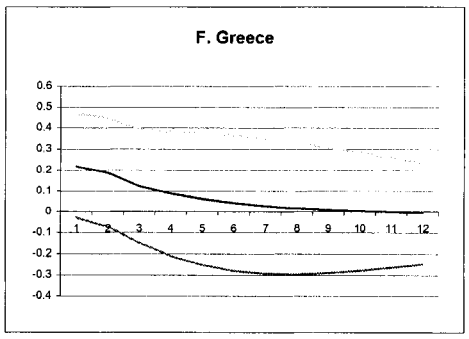


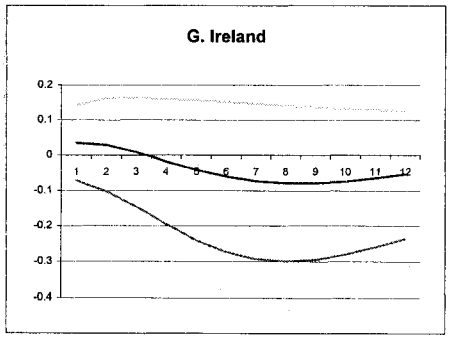


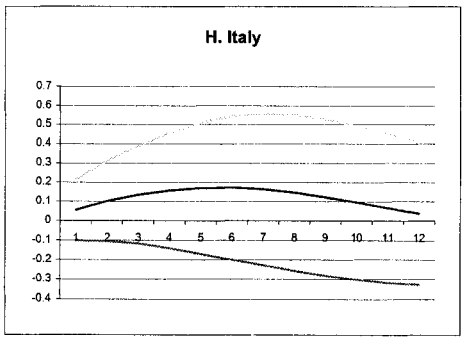


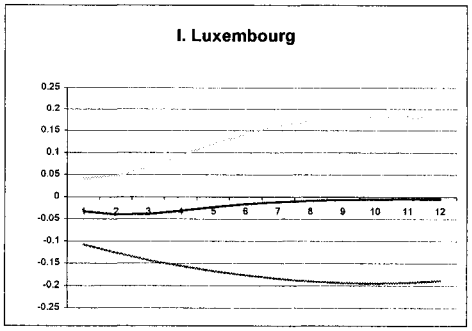


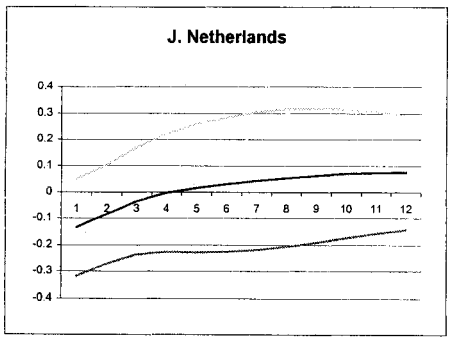


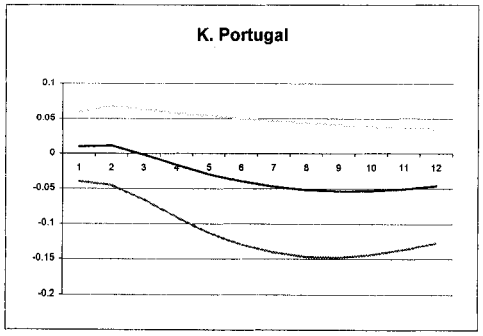


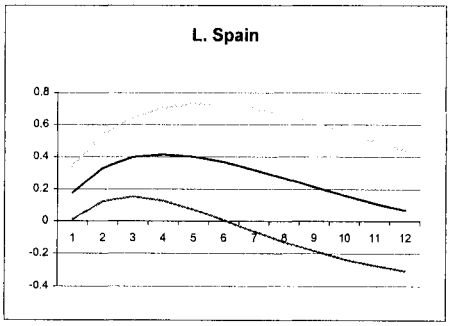






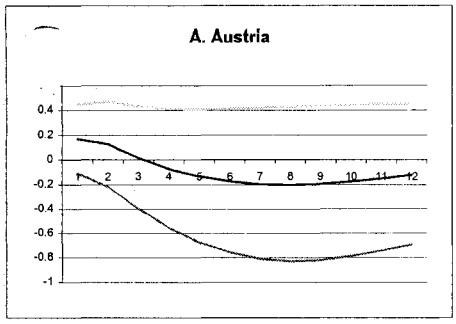


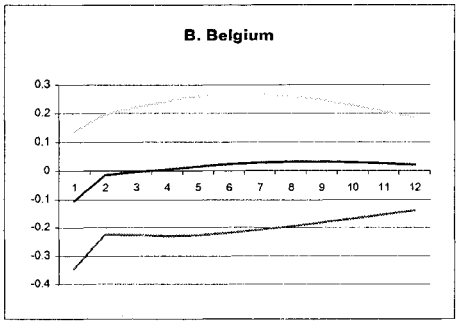


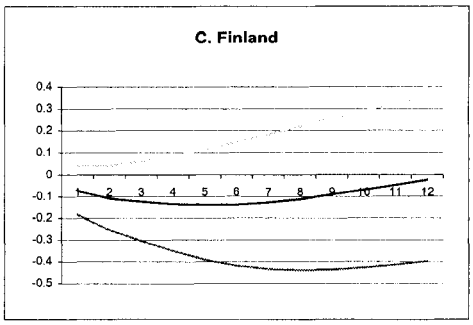


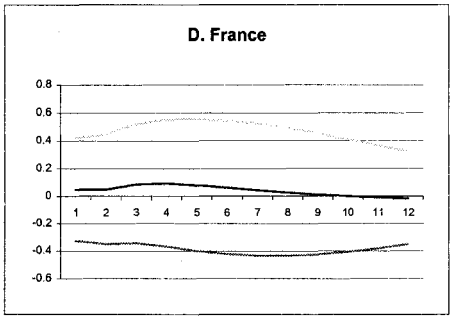
Pre Maastricht

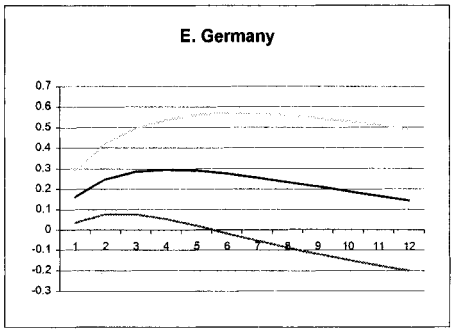
5. Shock to German Output Gap on National Output Gaps

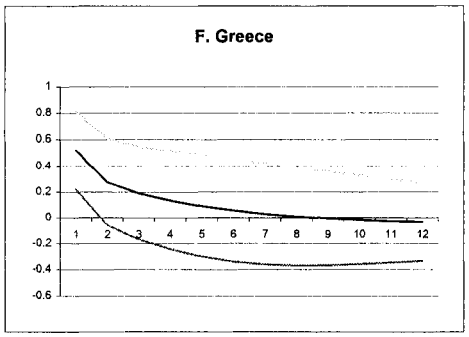


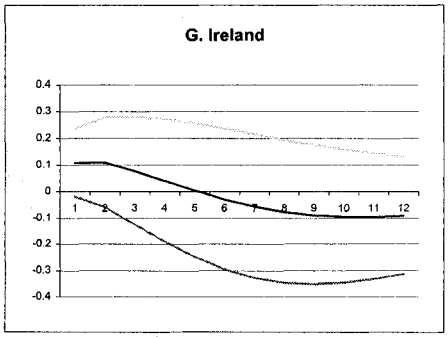


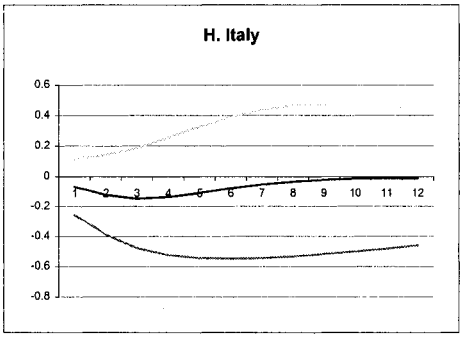


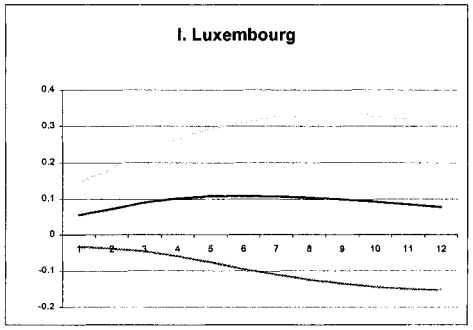


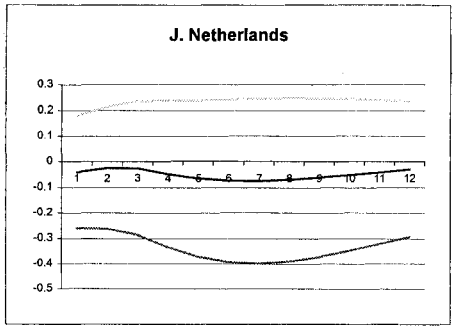


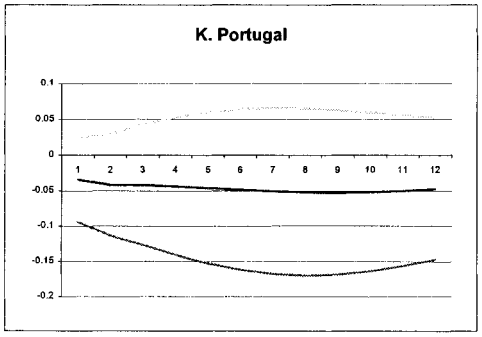


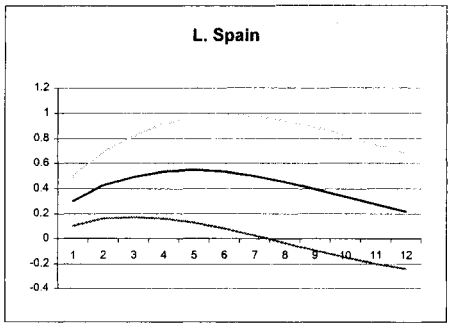






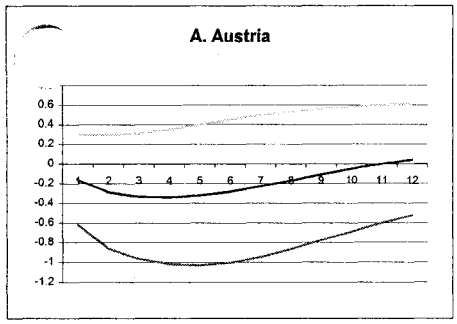


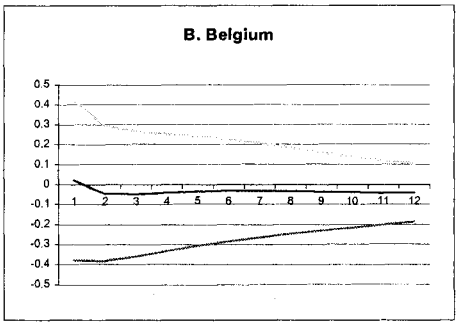


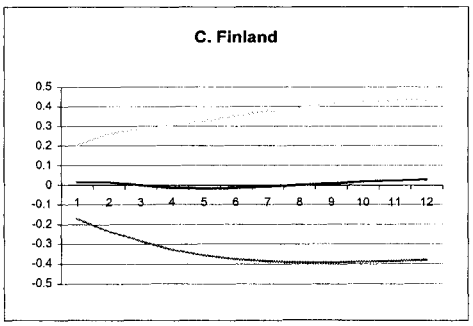


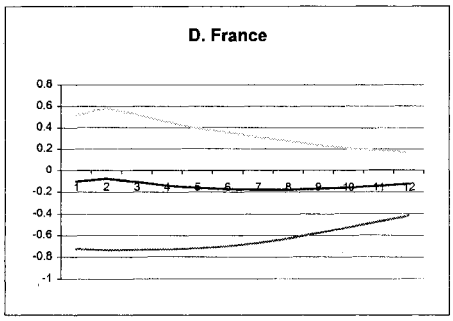
Pre Maastricht

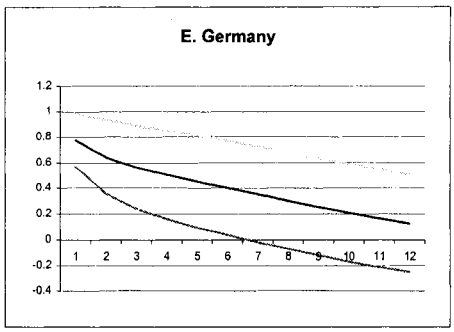
6. Shock to Greek Output Gap on National Output Gaps

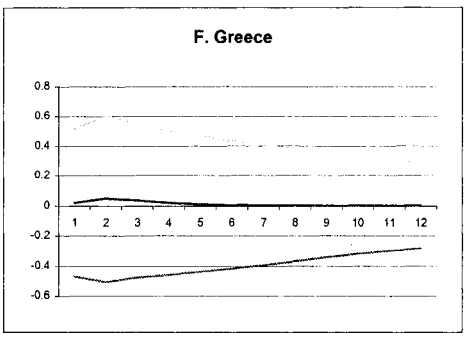


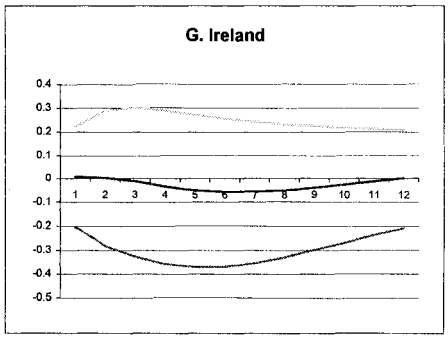


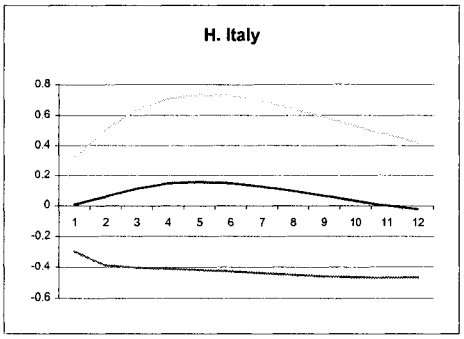


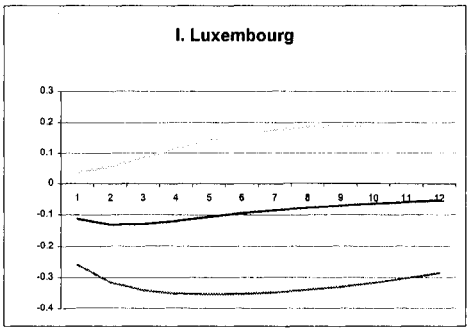


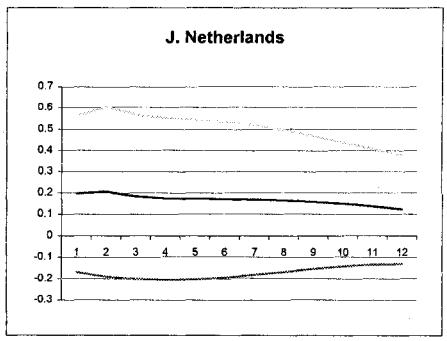


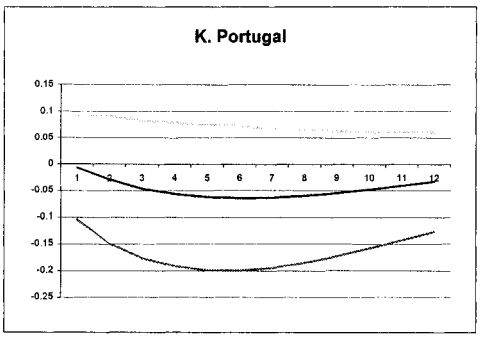


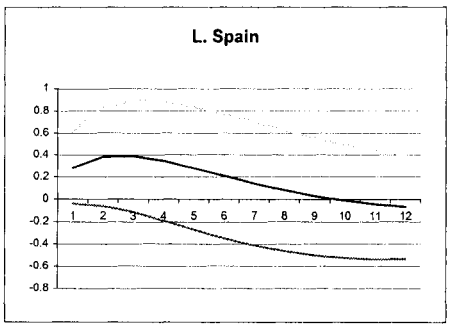






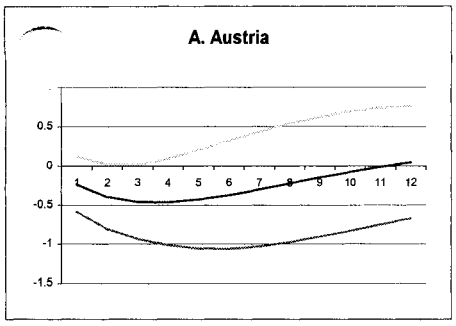


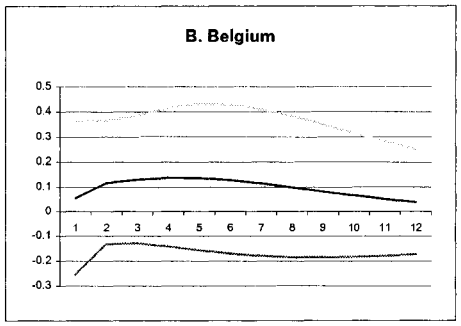


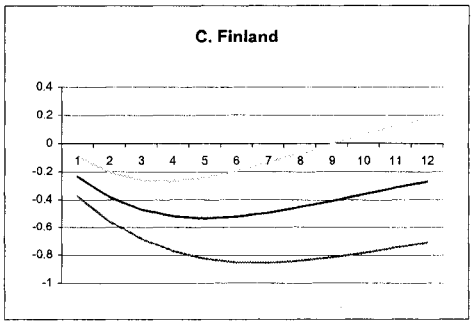


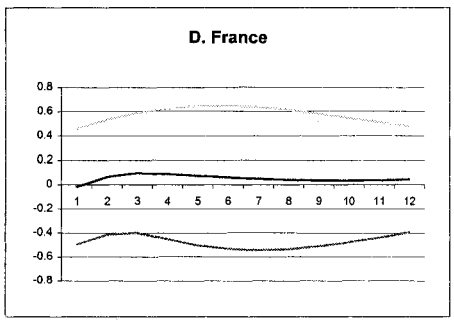
Pre Maastricht

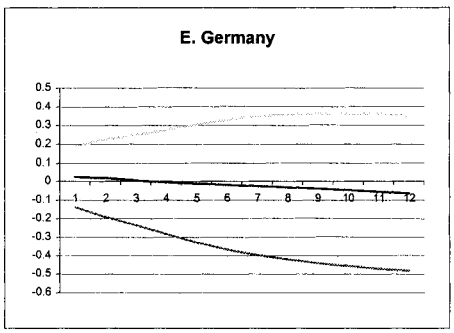
7. Shock to Irish Output Gap on National Output Gaps

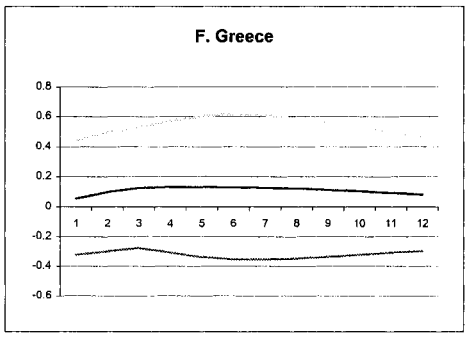


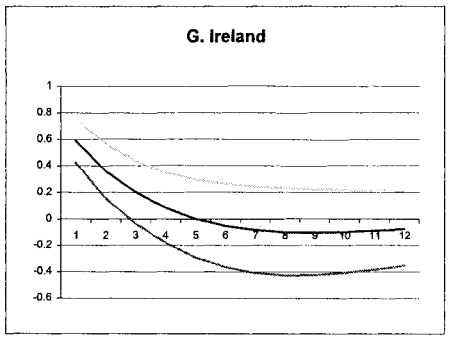


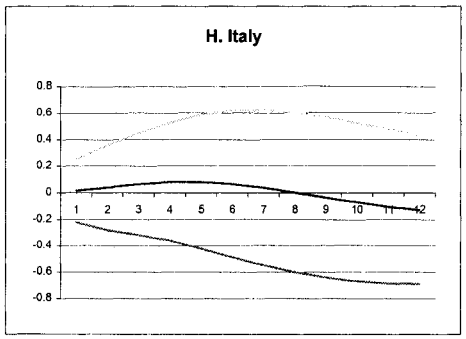


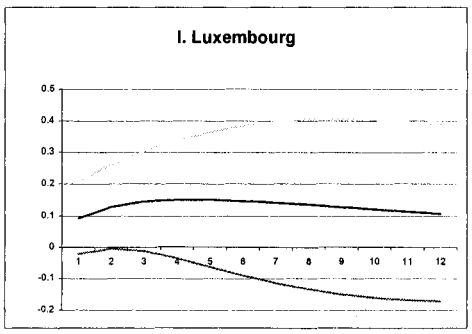


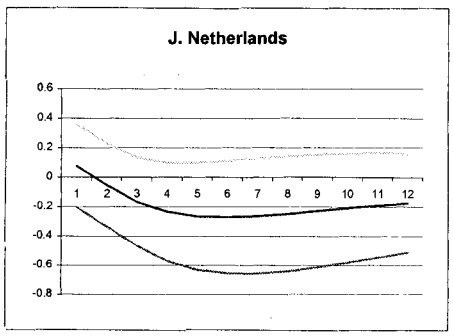


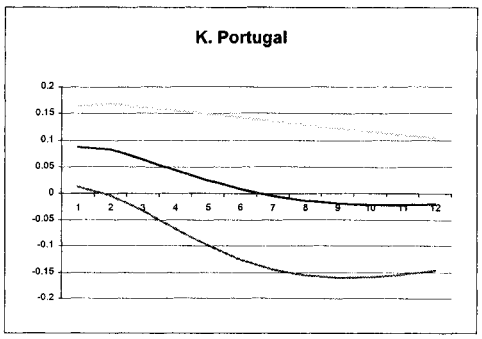


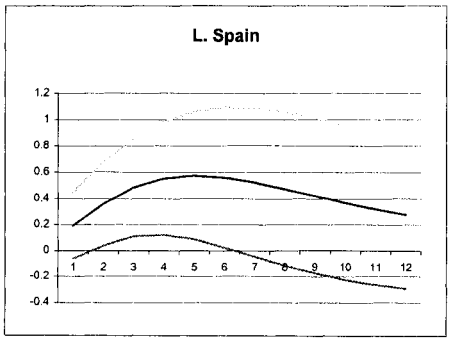






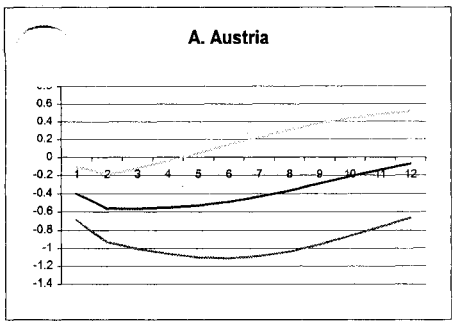


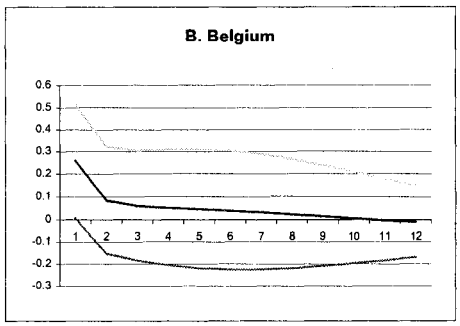


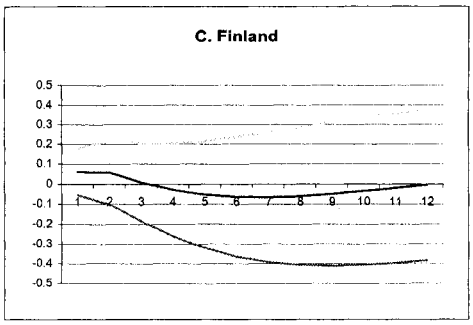


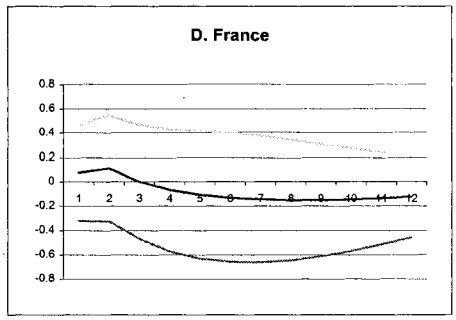
Pre Maastricht

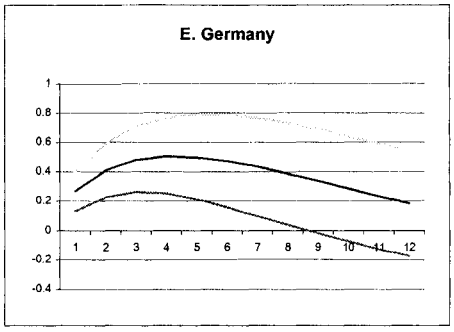
8. Shock to Italian Output Gap on National Output Gaps

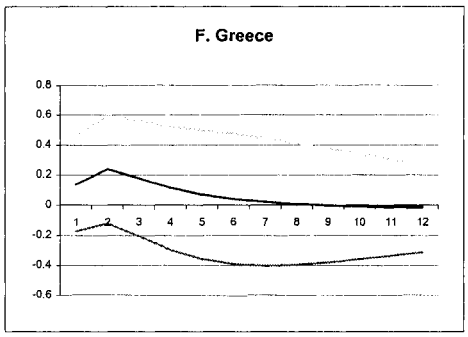


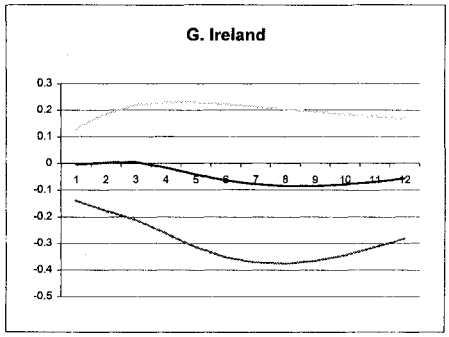


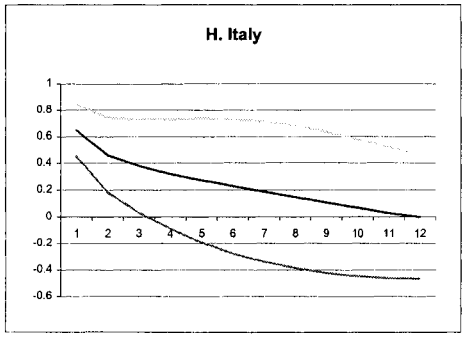


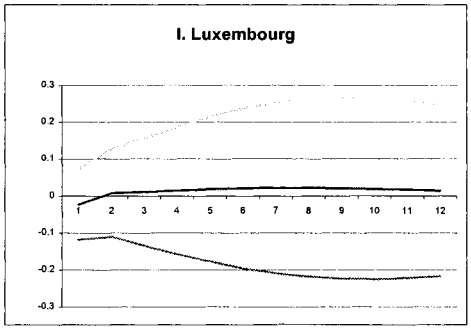


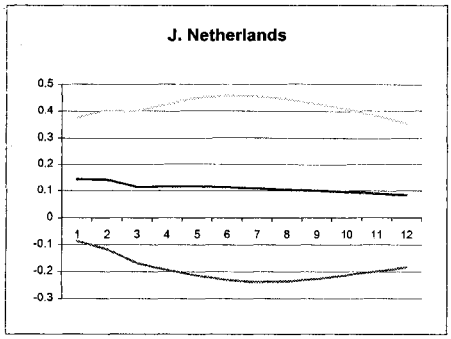


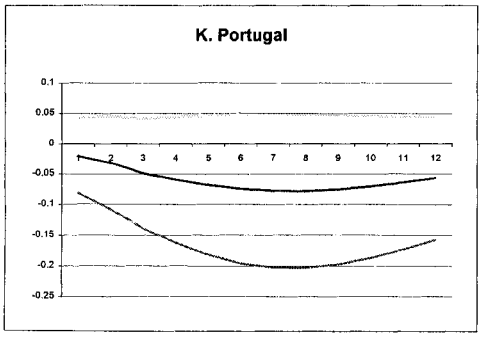


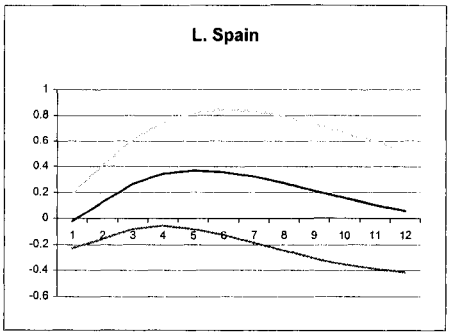






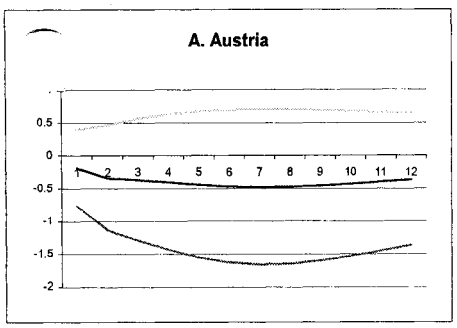


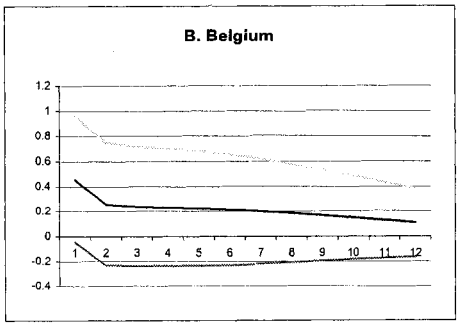


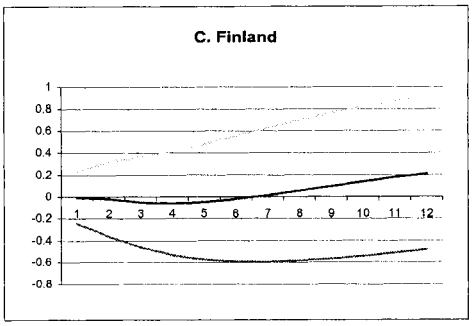


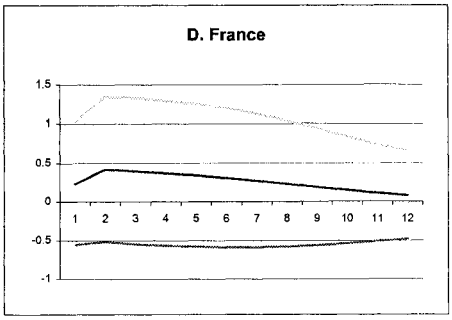
Pre Maastricht

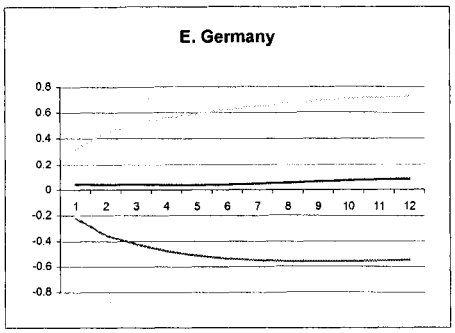
9. Shock to Luxembourg Output Gap on National Output Gaps

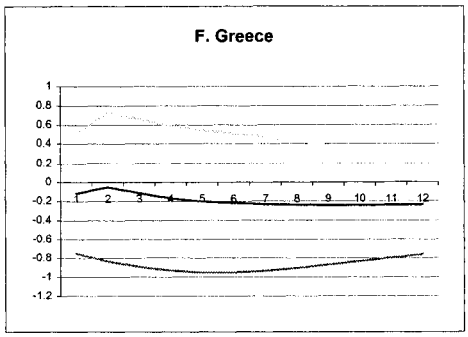


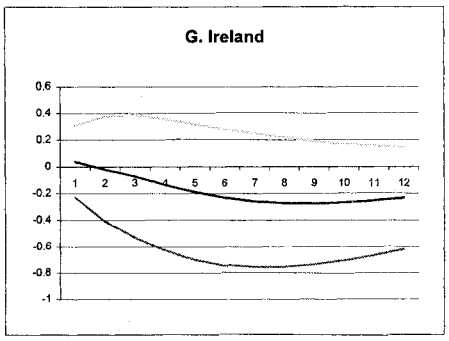


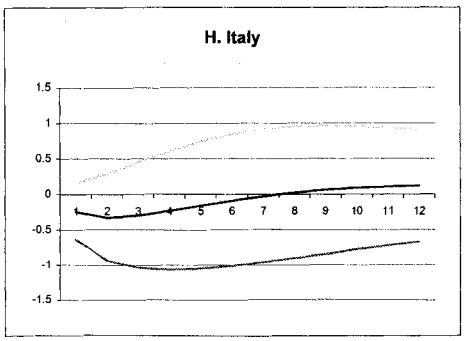


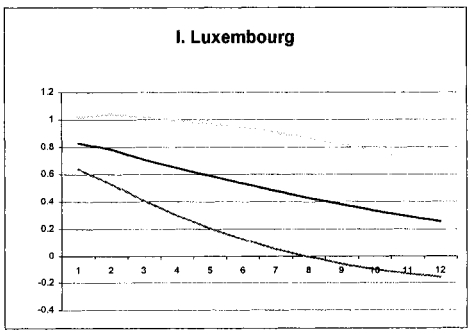


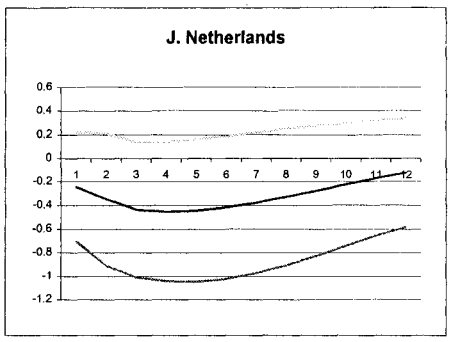


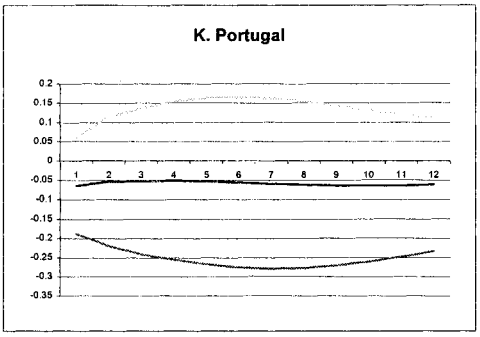


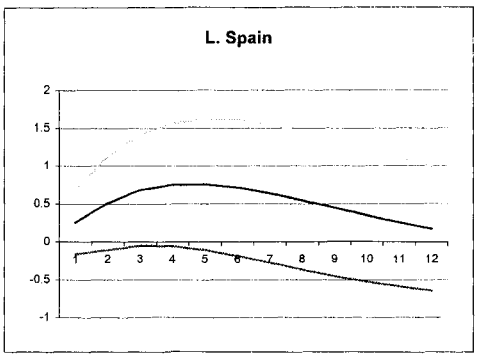






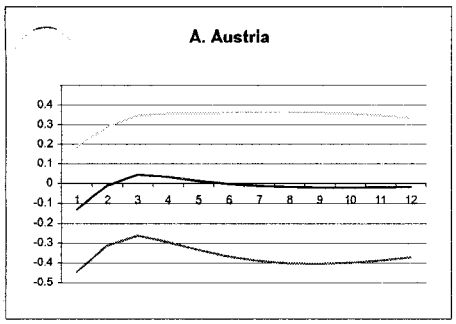


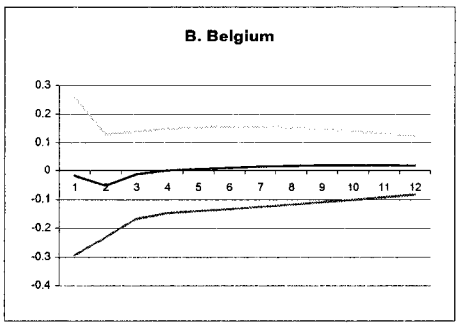


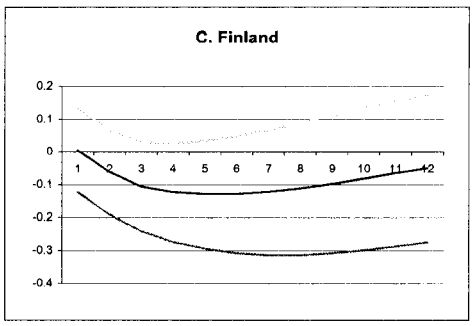


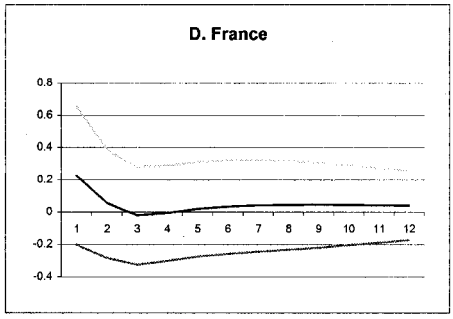
Pre Maastricht

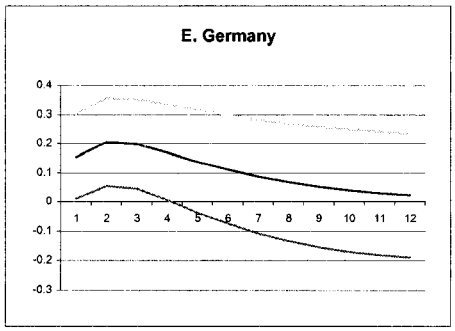
10. Shock to Dutch Output Gap on National Output Gaps

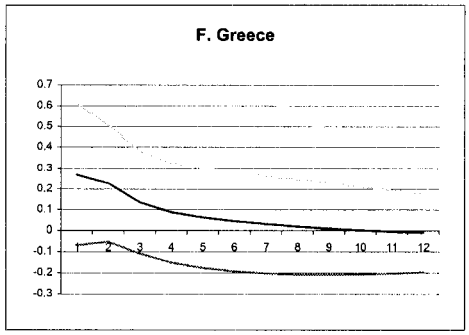


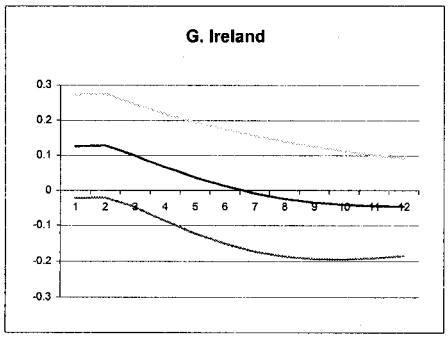


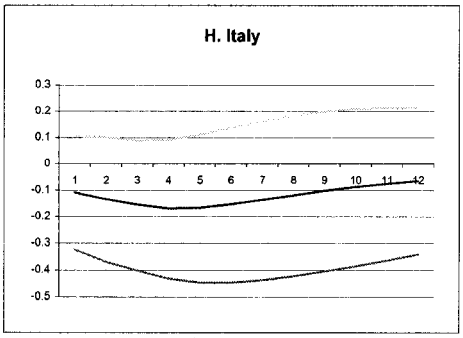


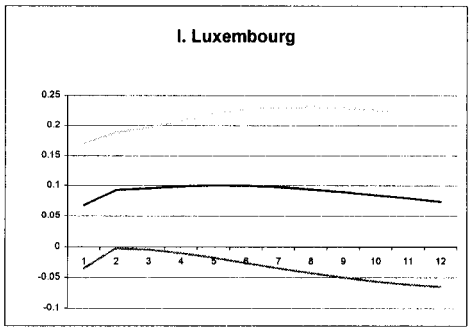


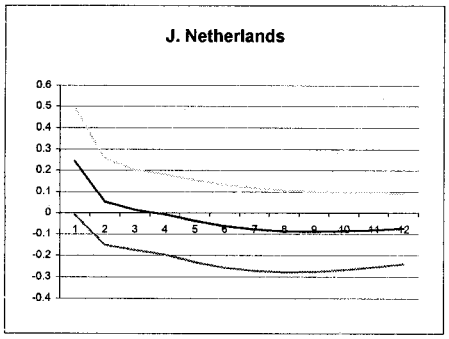


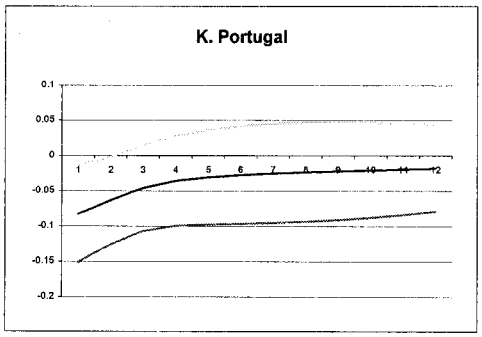


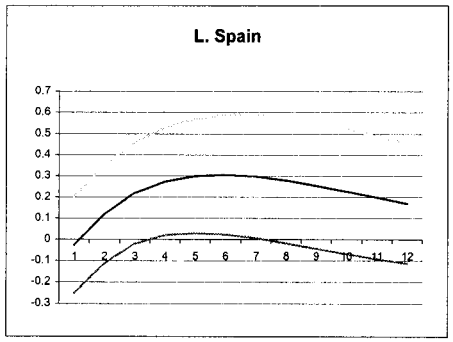






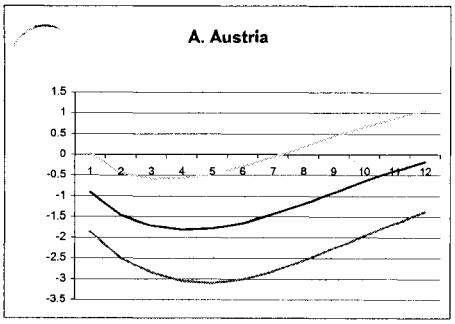


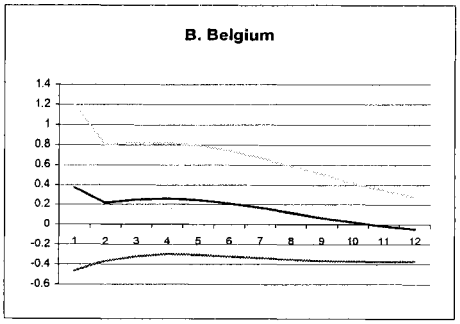


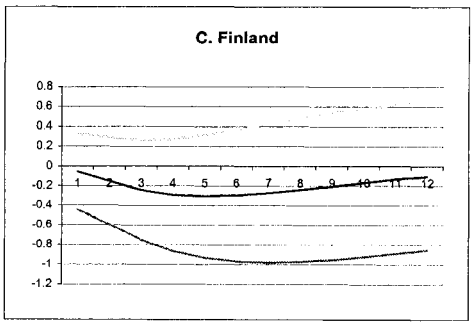


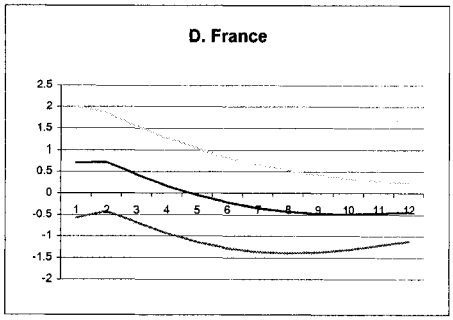
Pre Maastricht

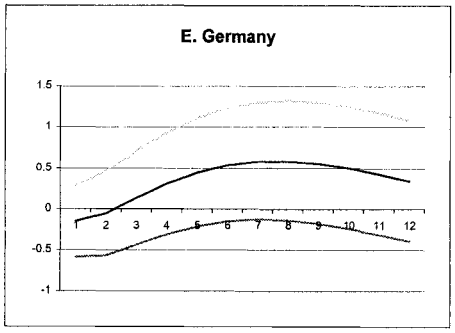
11. Shock to Portuguese Output Gap on National Output Gaps

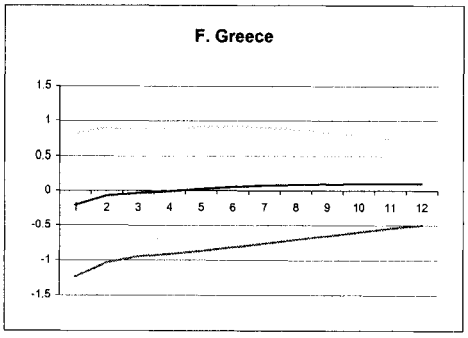


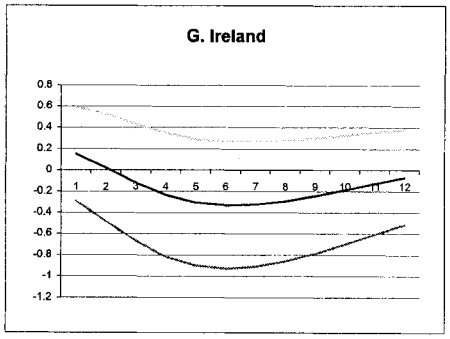


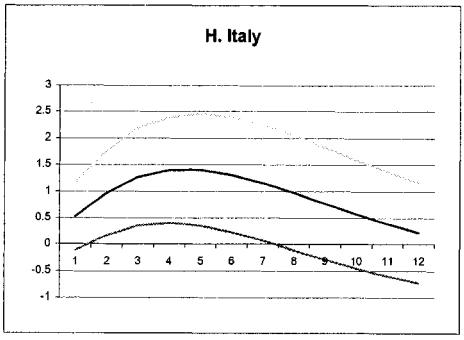


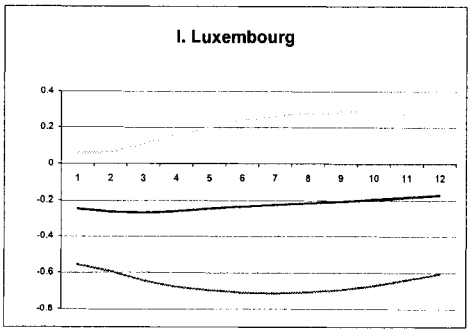


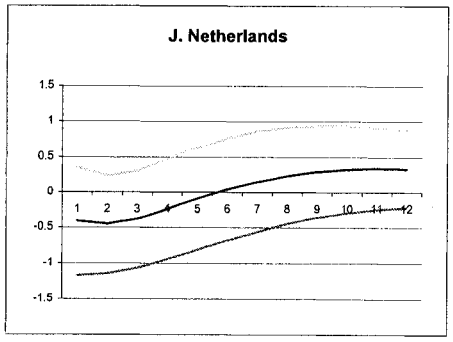


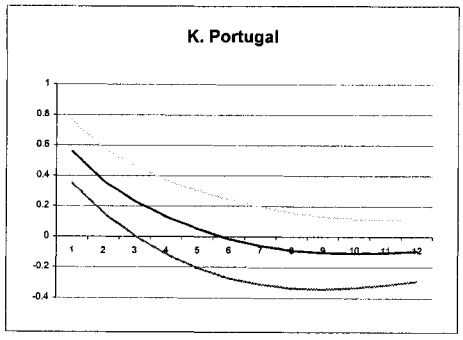


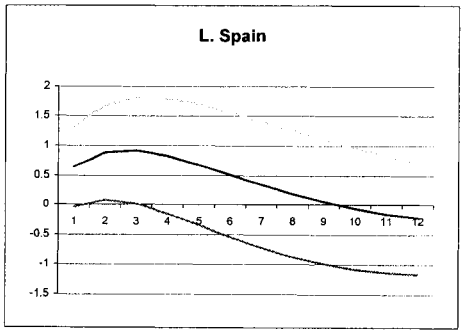






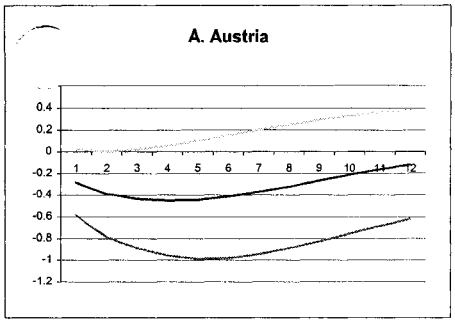


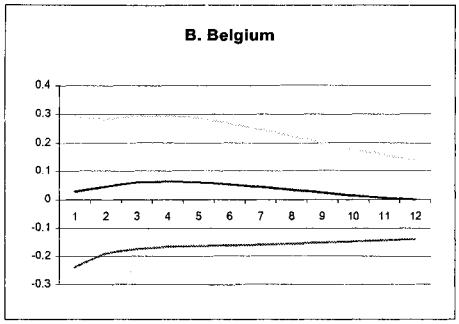


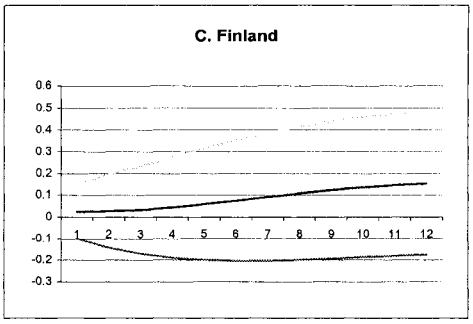


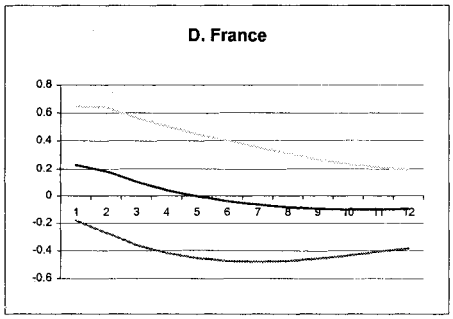
Pre Maastricht

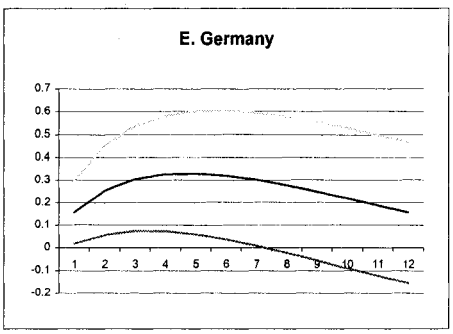
12. Shock to Spanish Output Gap on National Output Gaps

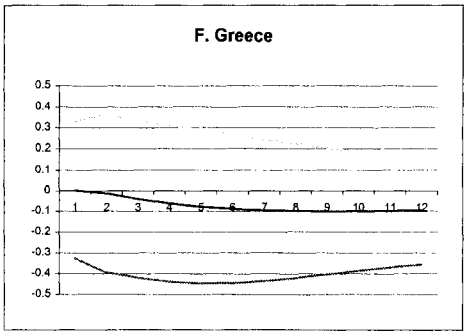


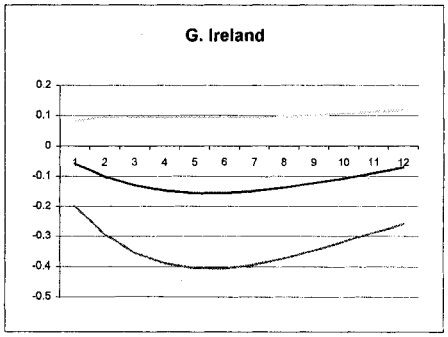


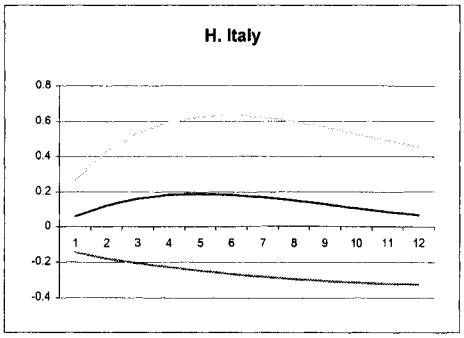


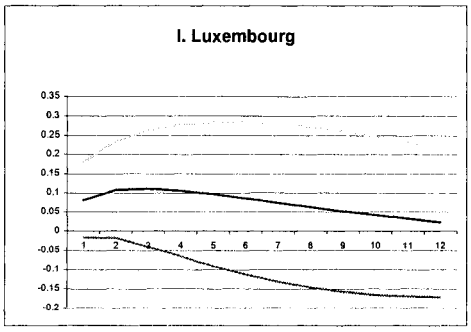


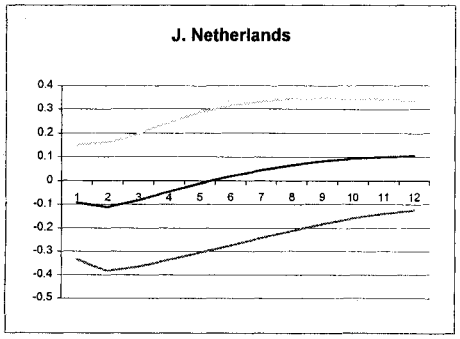


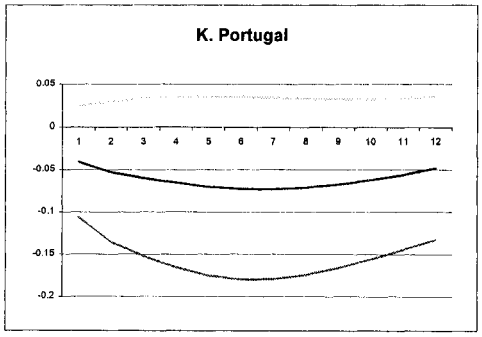


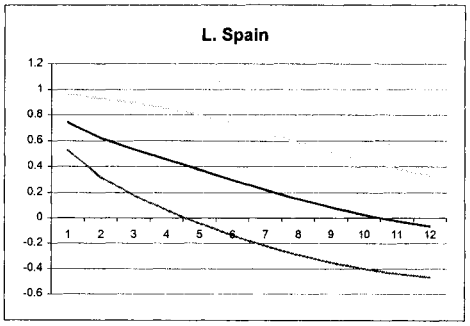






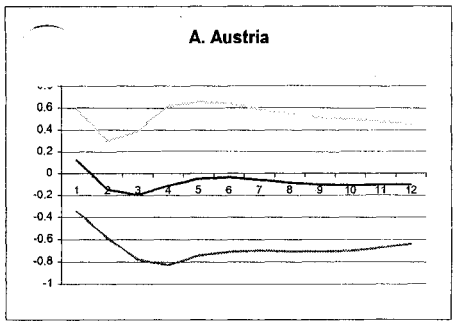


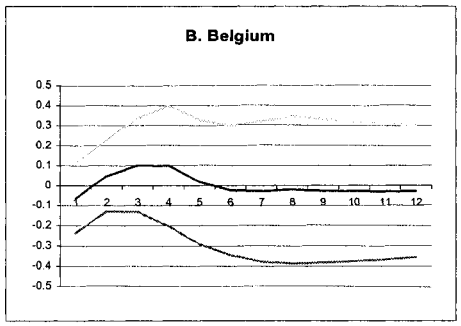


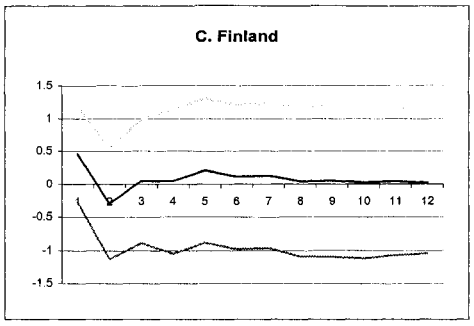


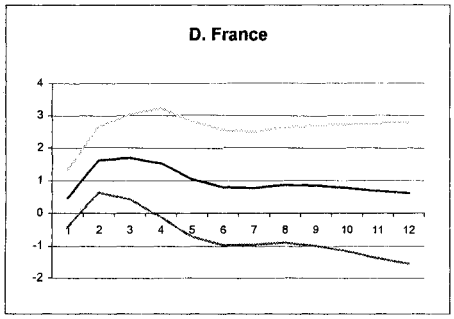
Post Maastricht

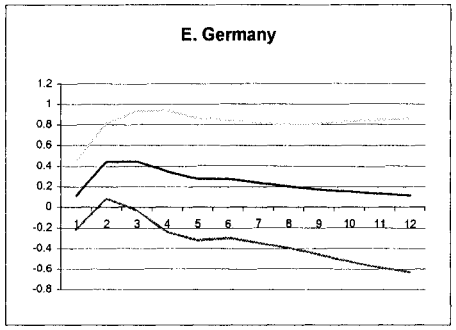
1. Shock to Austrian Output Gap on National Output Gaps

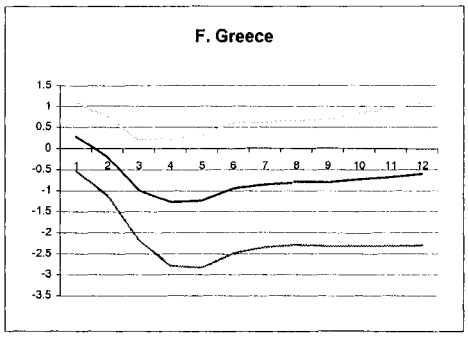


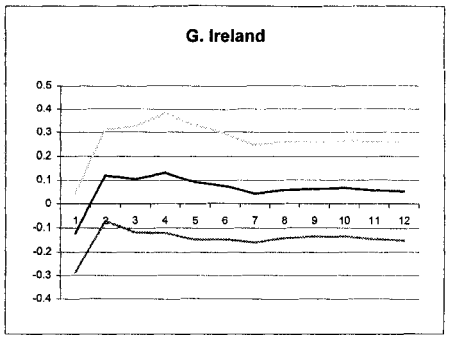


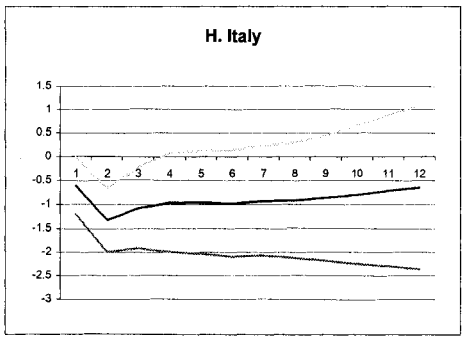


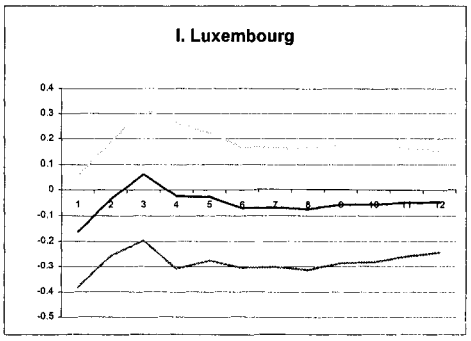


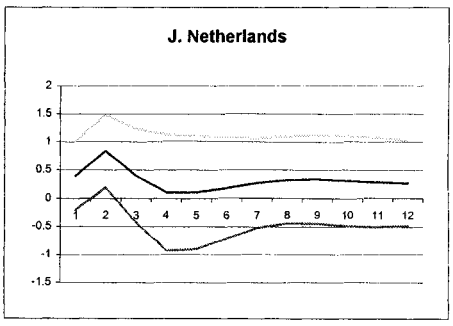


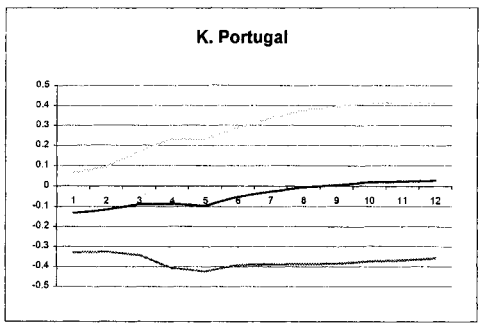


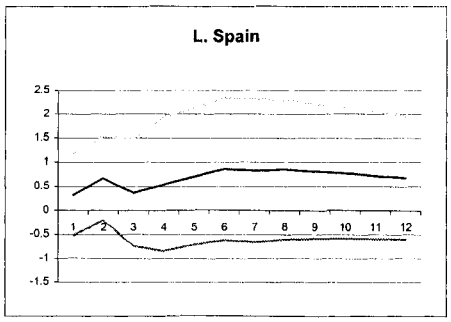






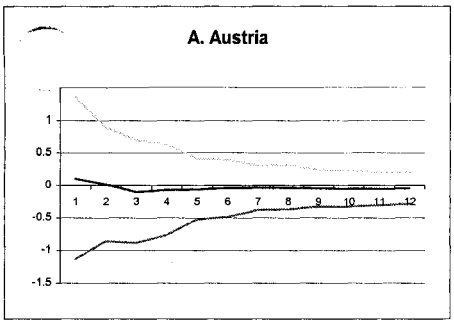


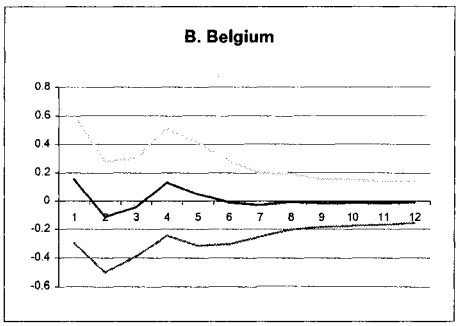


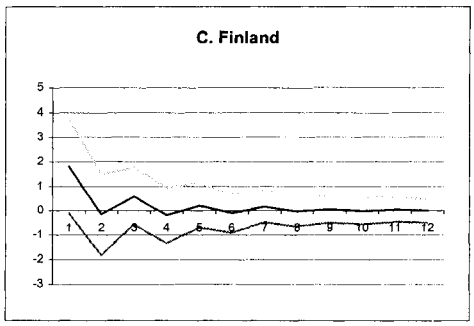


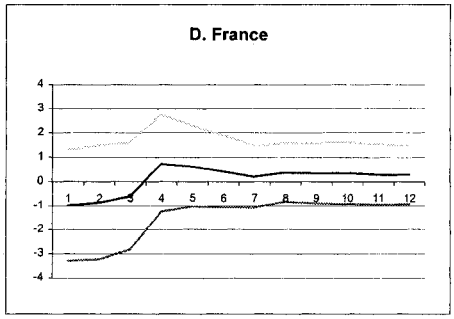
Post Maastricht

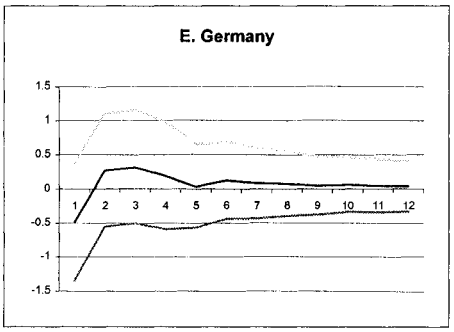
2. Shock to Belgian Output Gap on National Output Gaps

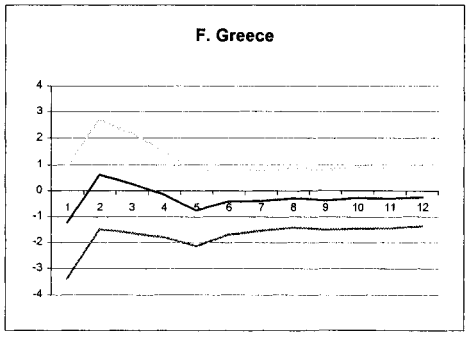


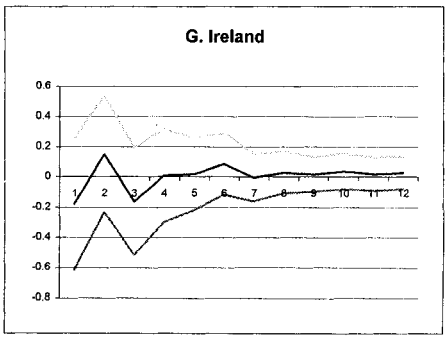


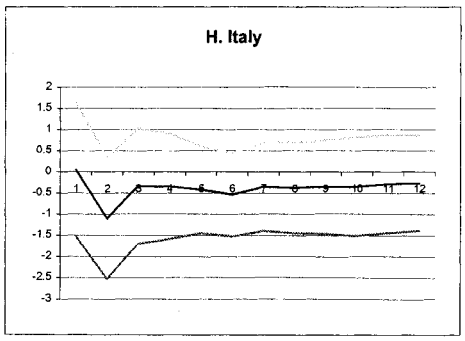


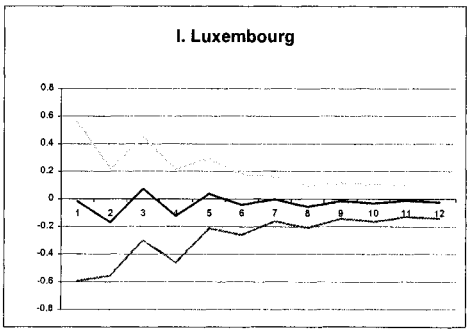


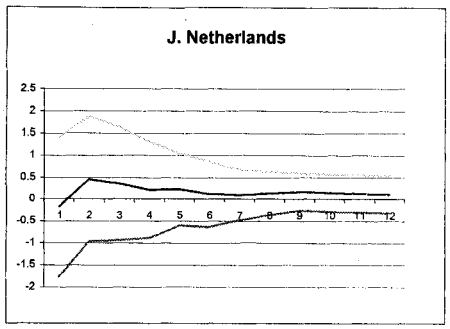


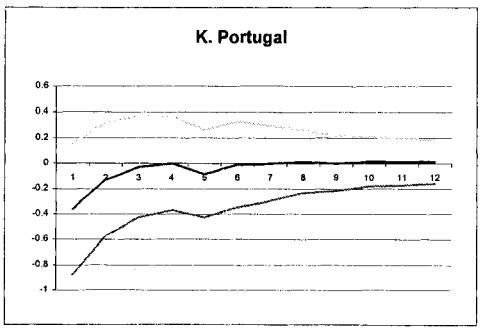


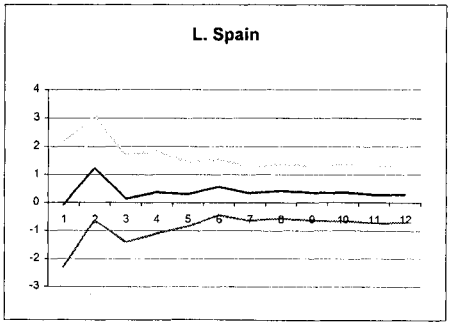






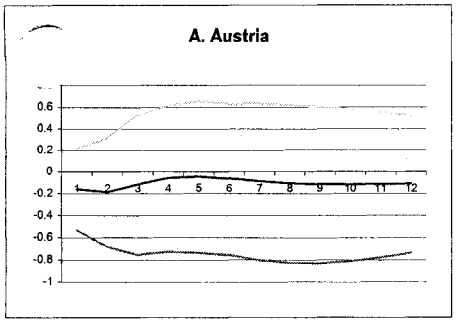


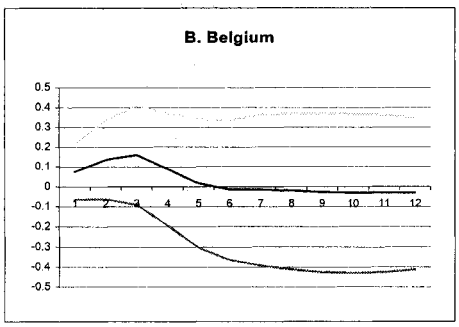


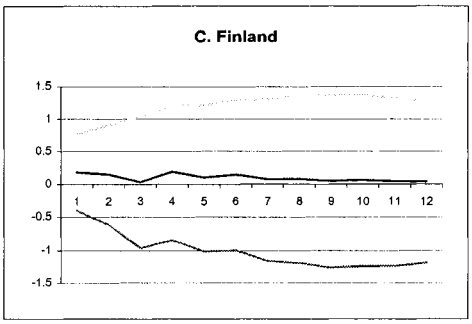


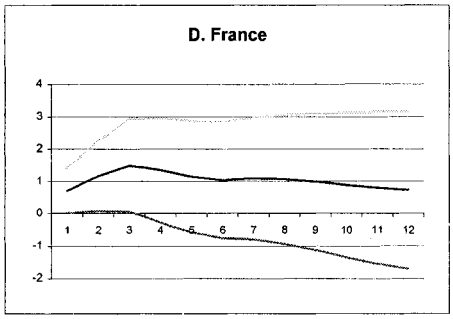
Post Maastricht

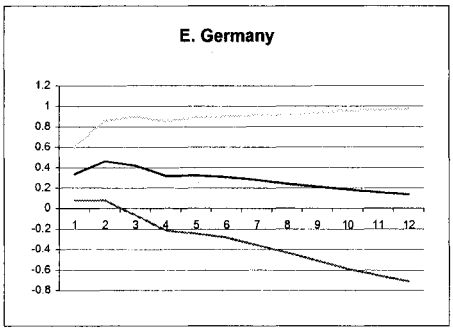
3. Shock to Finnish Output Gap on National Output Gaps

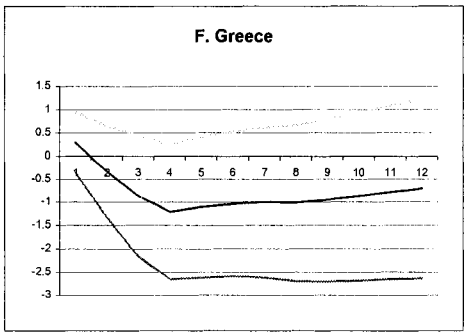


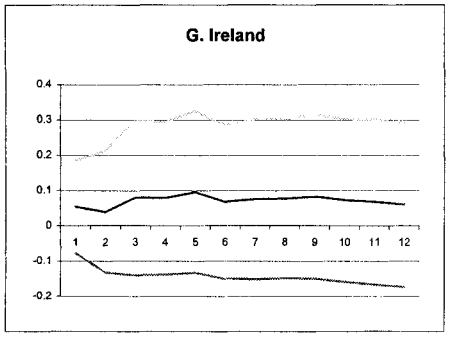


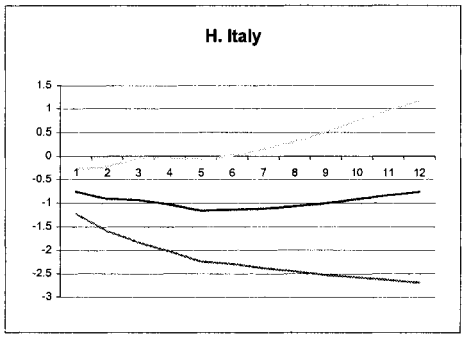


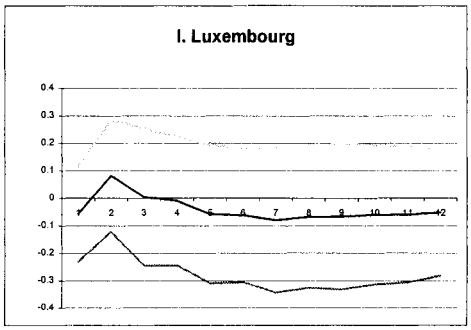


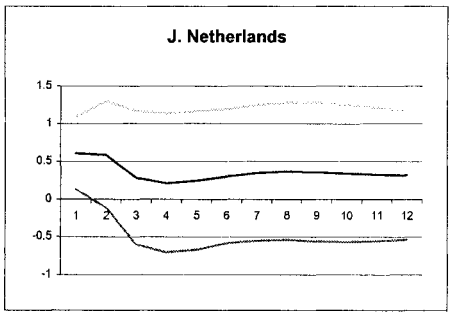


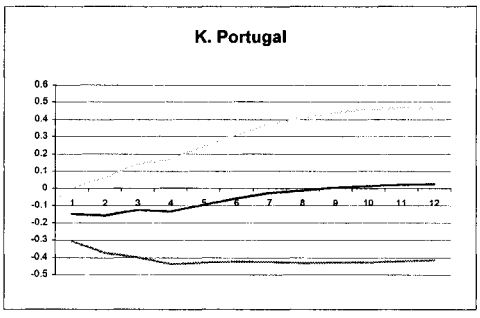


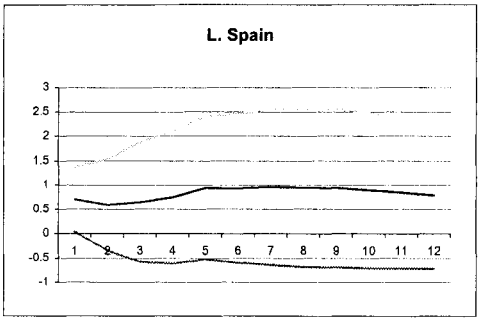






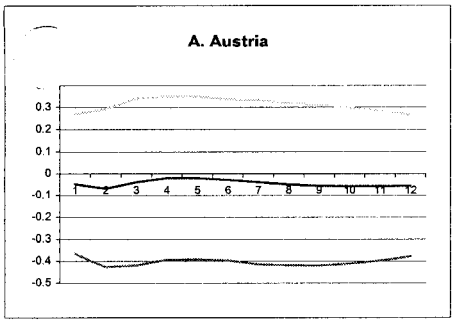


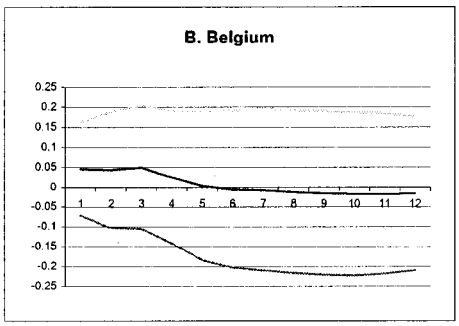


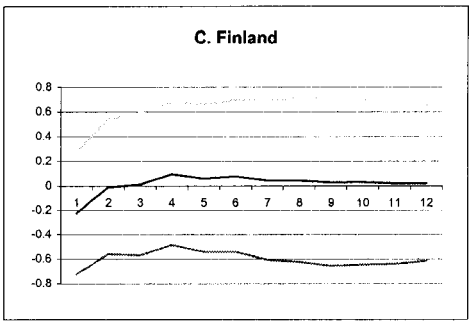


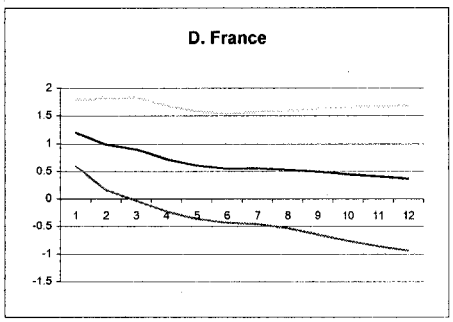
Post Maastricht

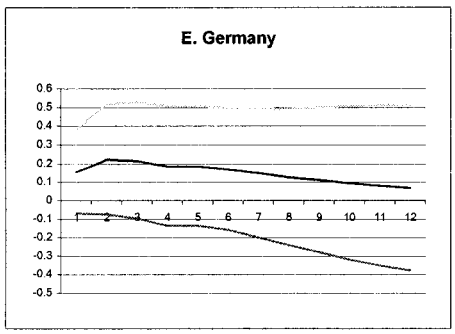
4. Shock to French Output Gap on National Output Gaps

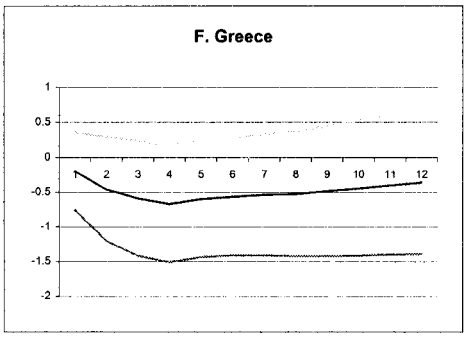


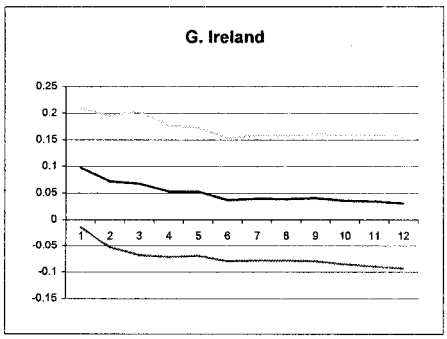


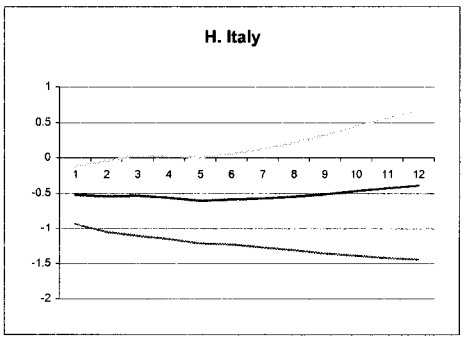


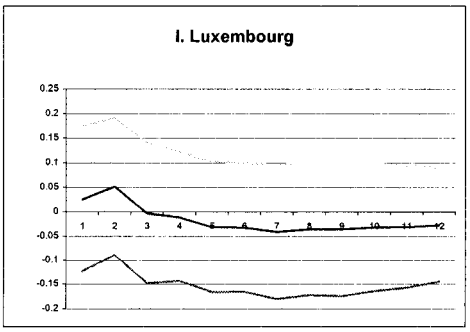


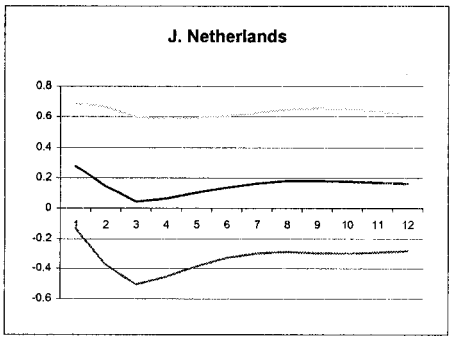


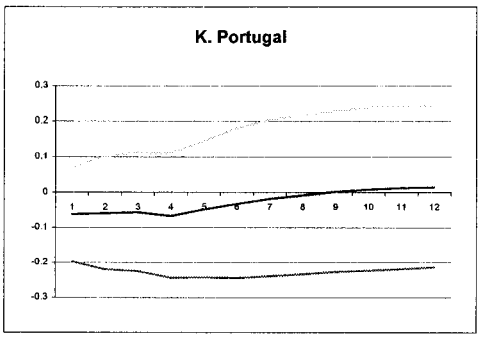


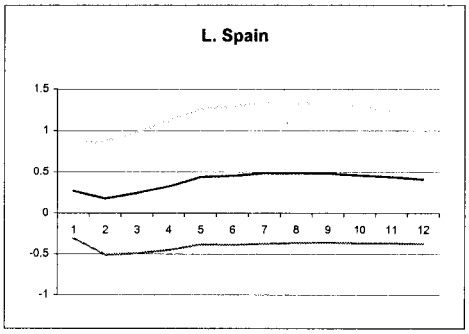






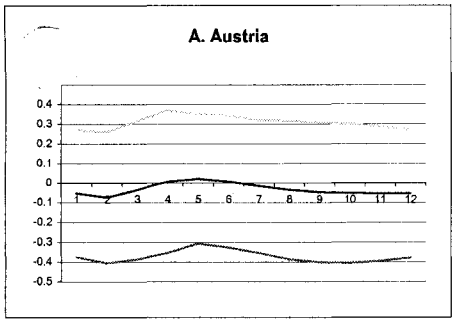


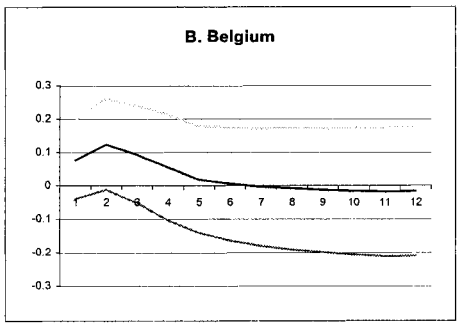


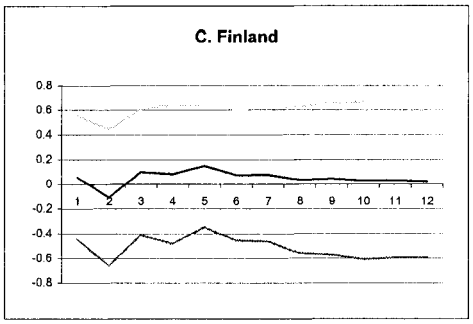


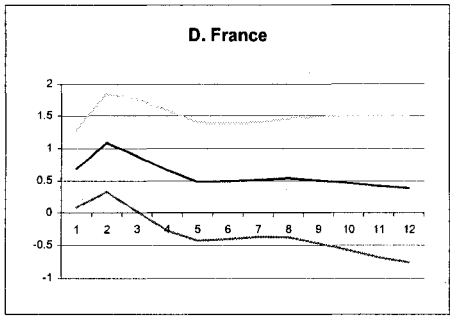
Post Maastricht

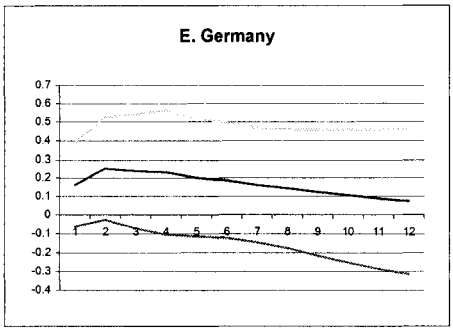
5. Shock to German Output Gap on National Output Gaps

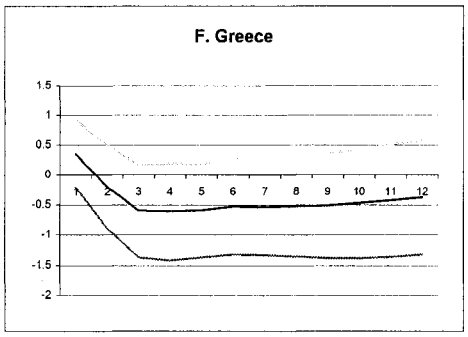


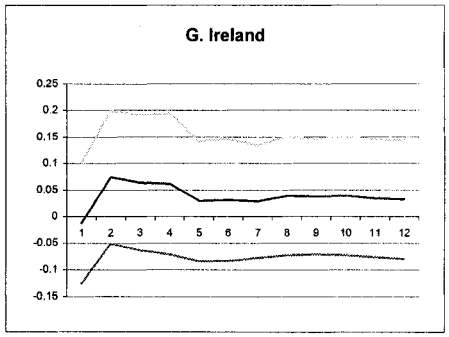


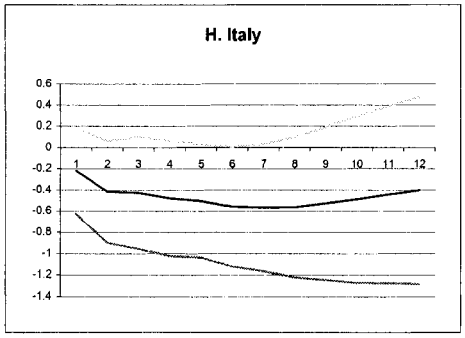


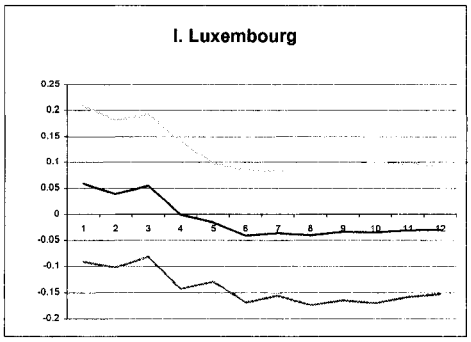


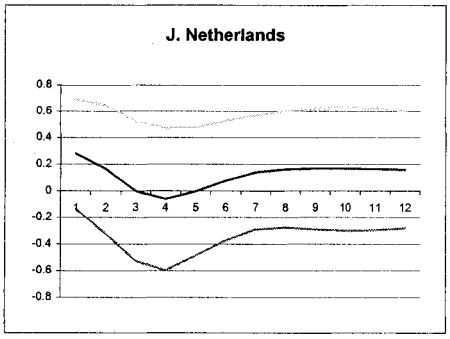


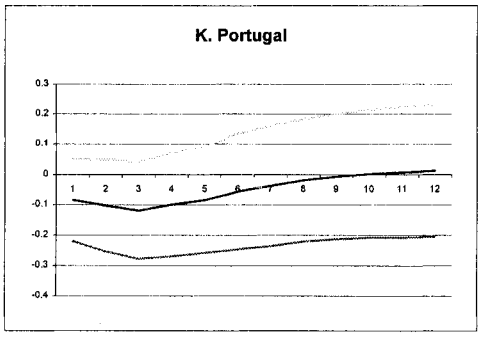


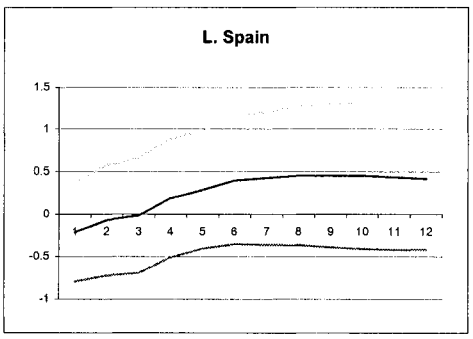






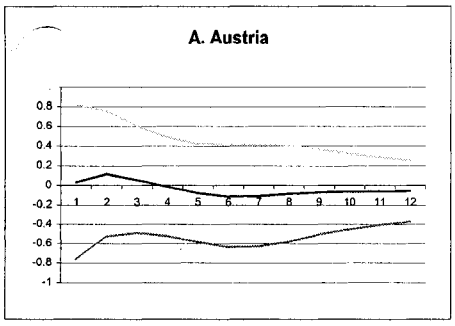


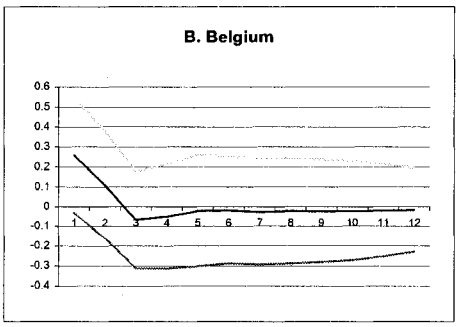


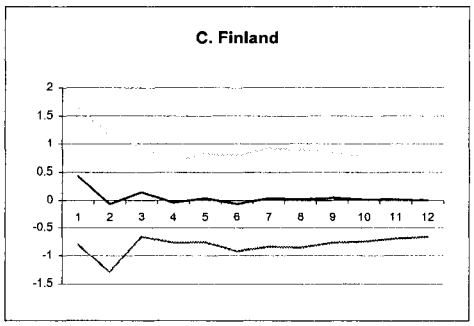


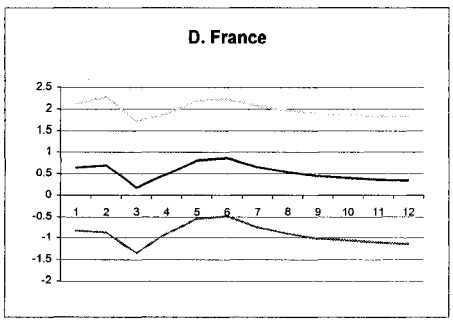
Post Maastricht

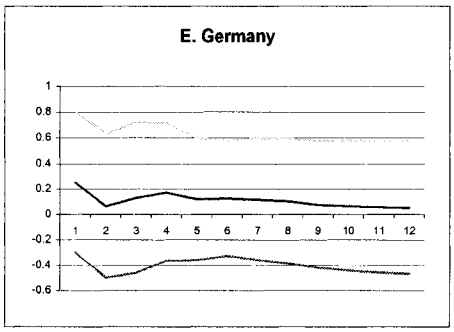
6. Shock to Greek Output Gap on National Output Gaps

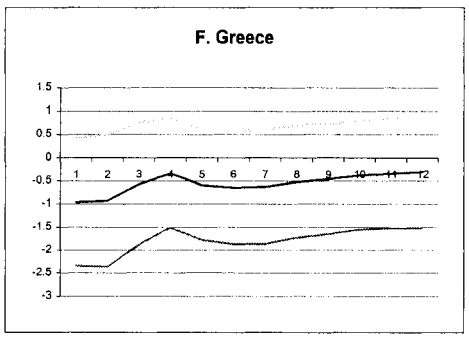


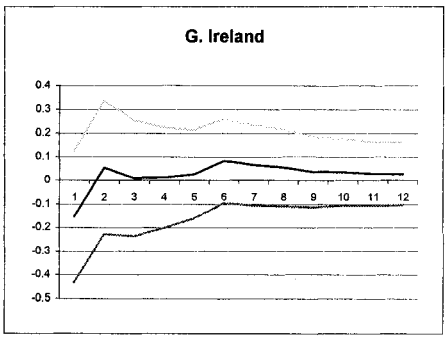


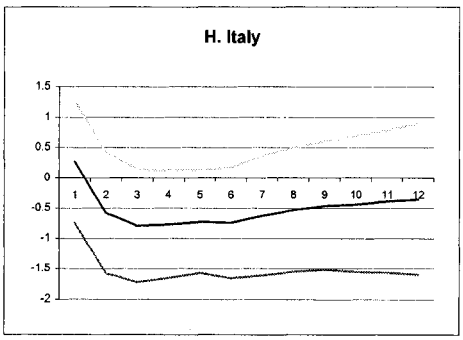


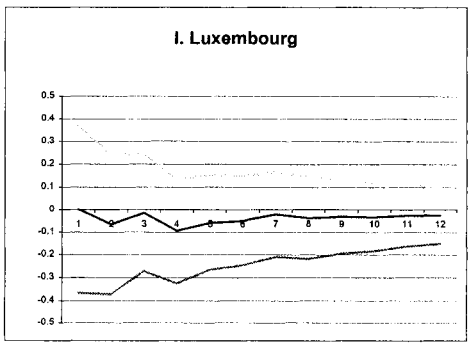


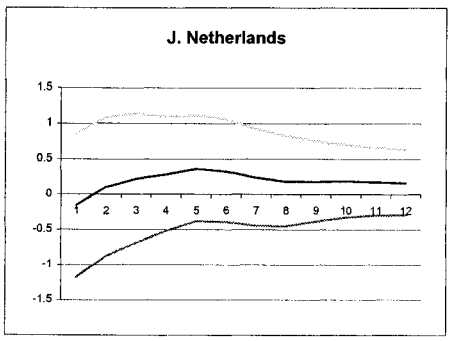


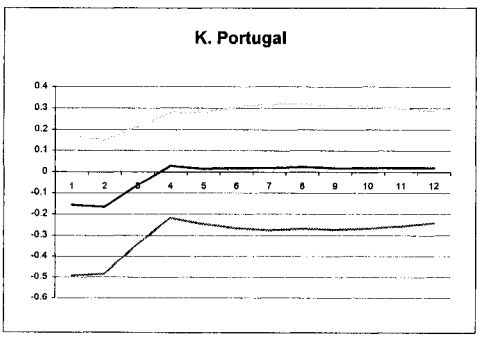


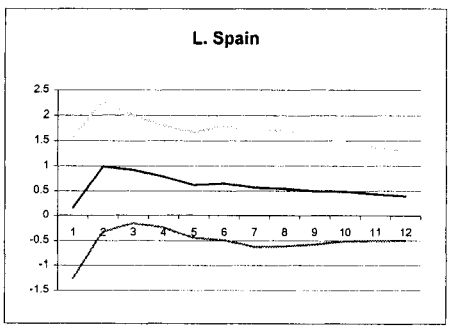






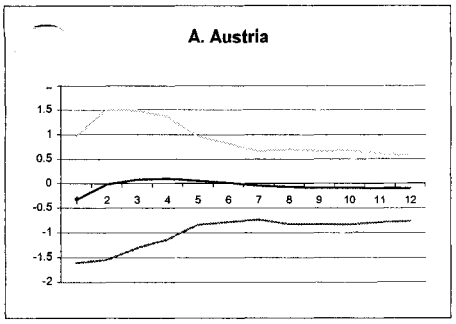


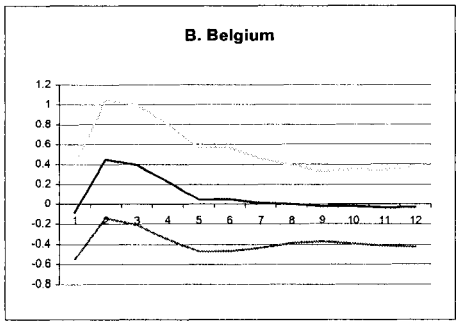


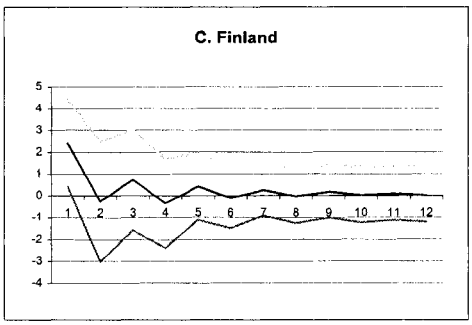


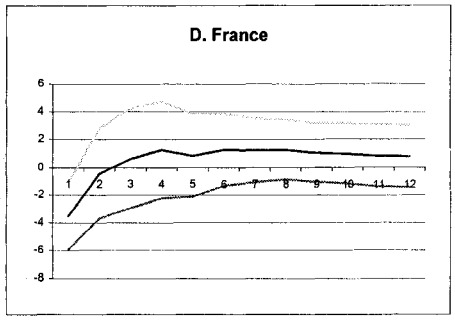
Post Maastricht

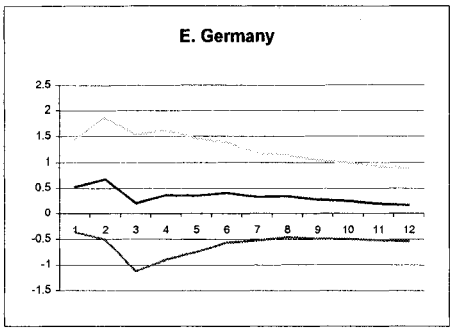
7. Shock to Irish Output Gap on National Output Gaps

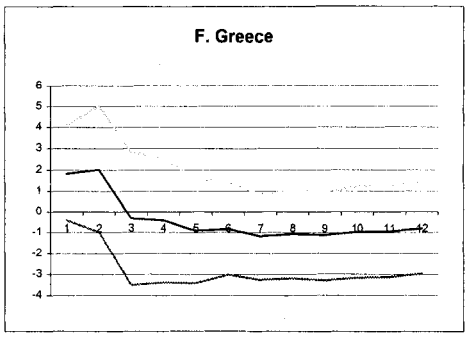


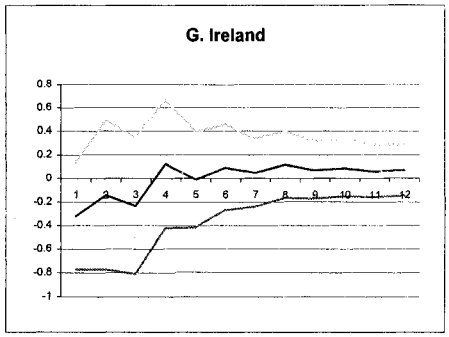


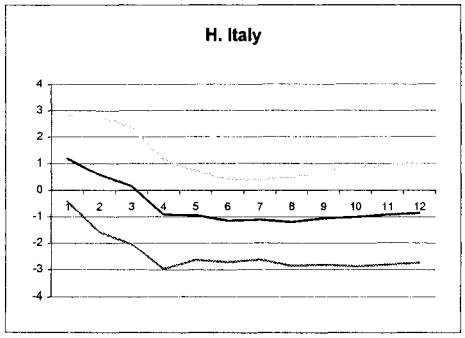


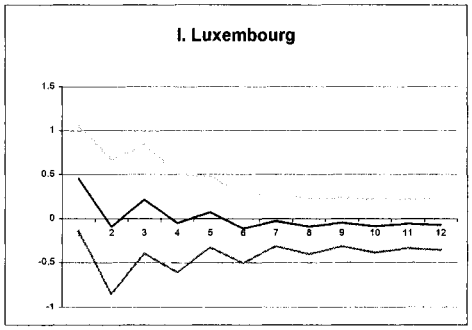


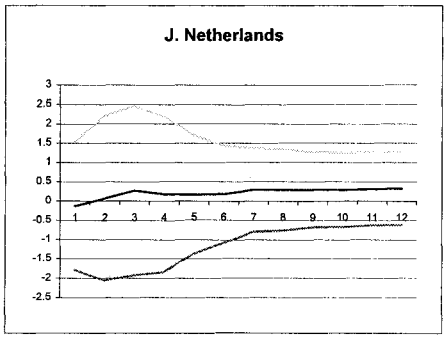


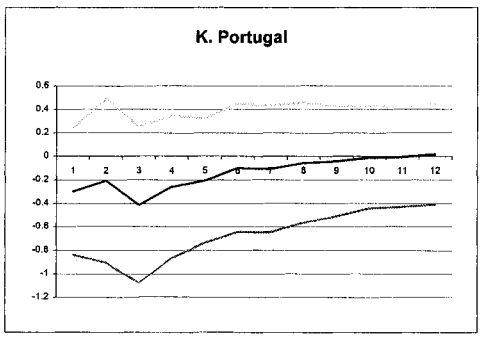


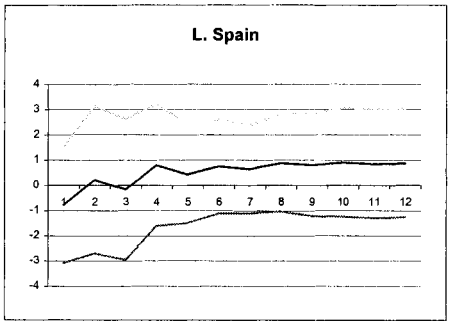






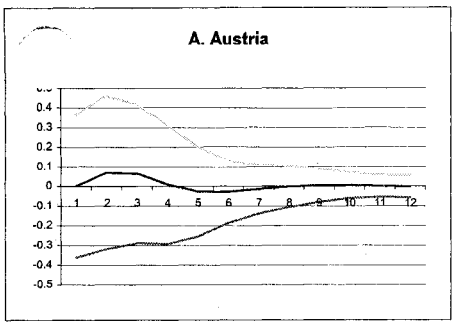


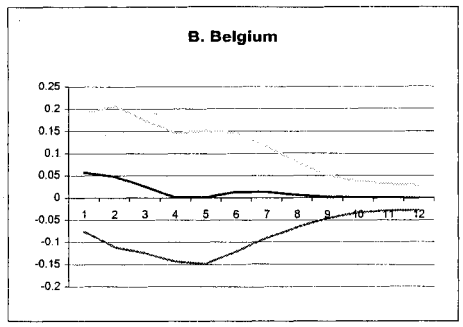


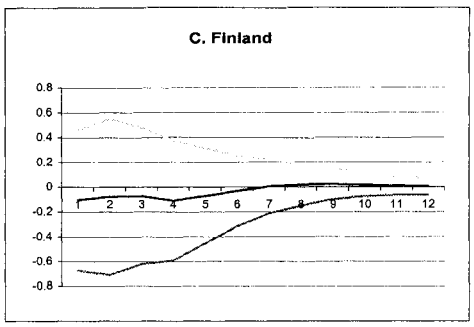


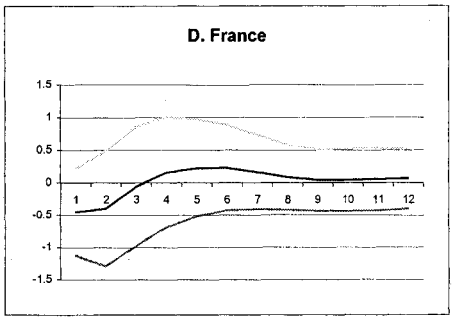
Post Maastricht

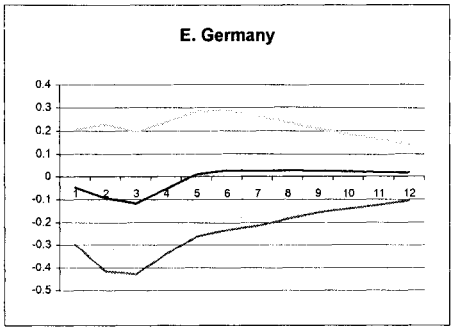
8. Shock to Italian Output Gap on National Output Gaps

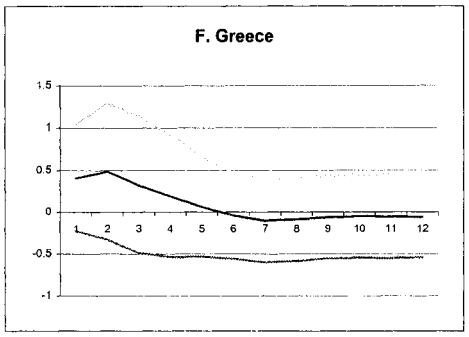


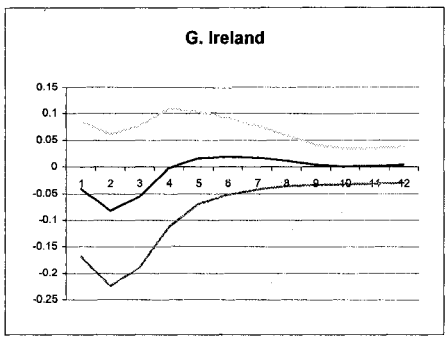


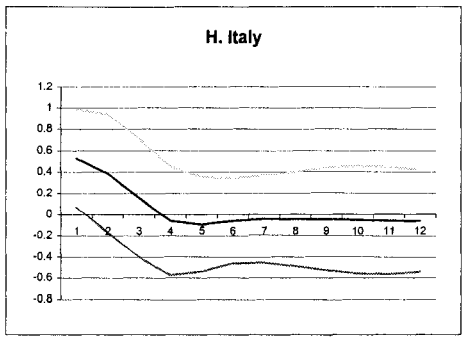


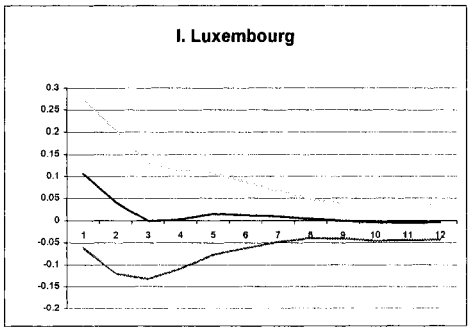


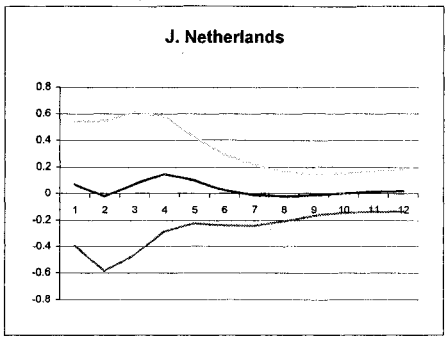


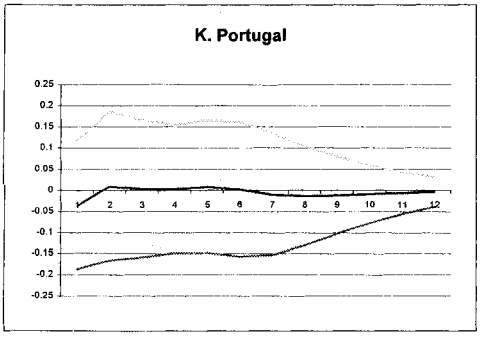


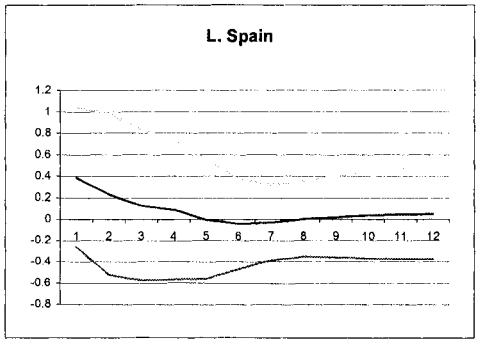






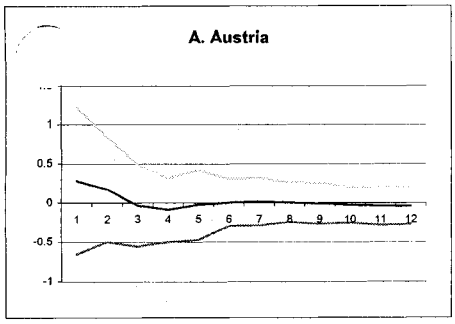


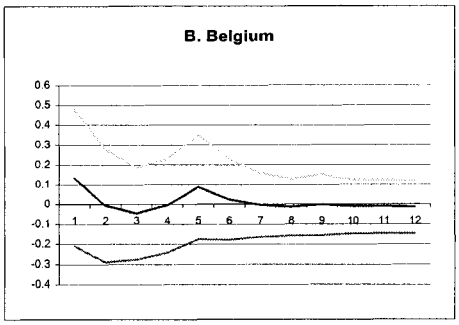


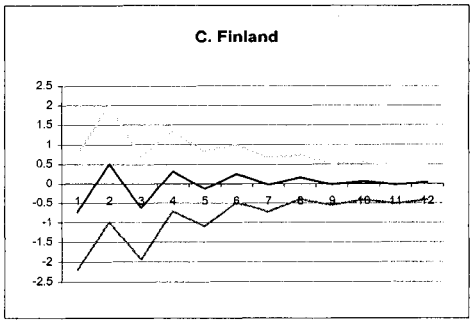


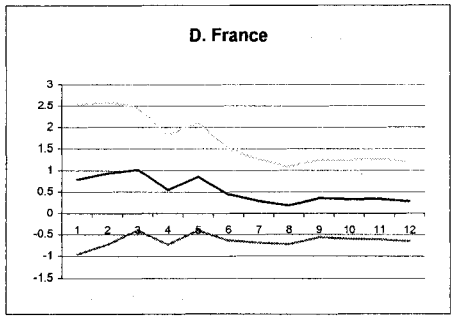
Post Maastricht

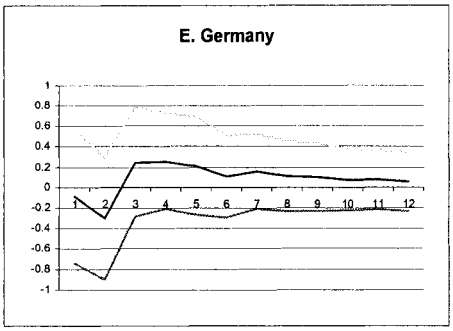
9. Shock to Luxembourg Output Gap on National Output Gaps

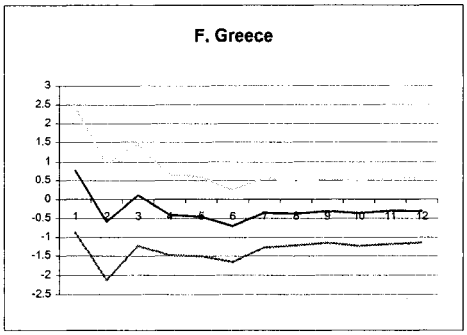


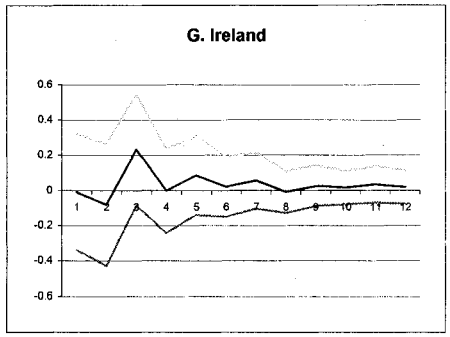


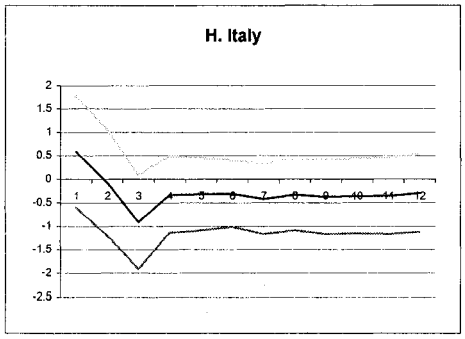


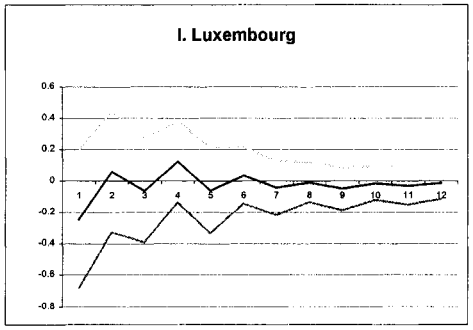


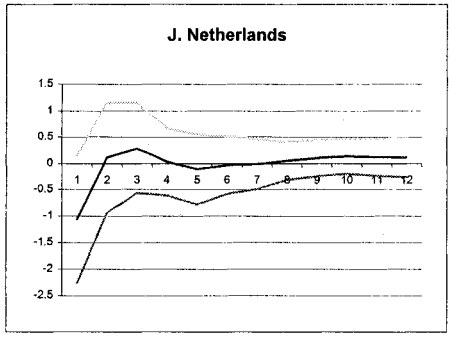


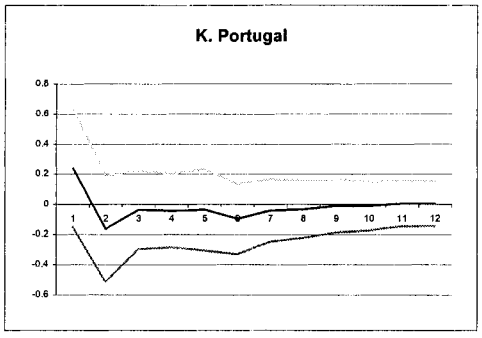


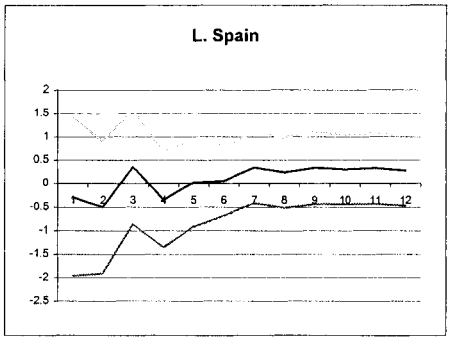






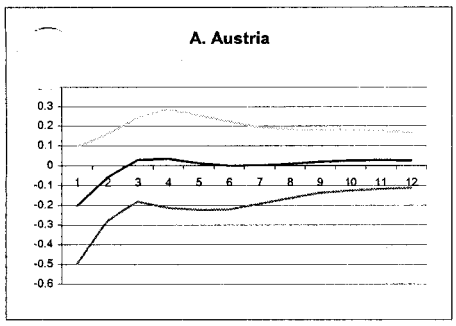


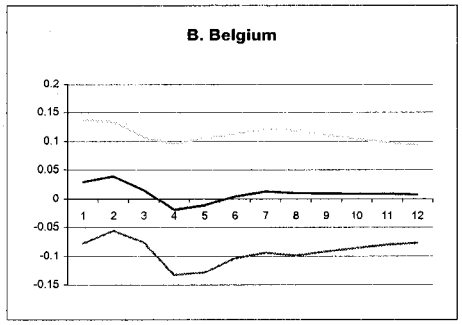


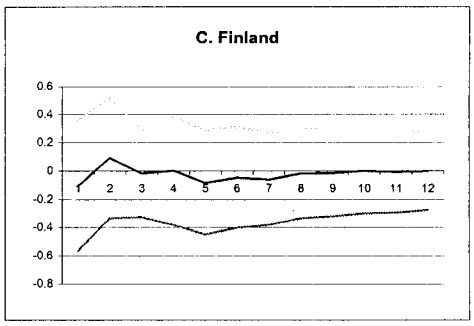


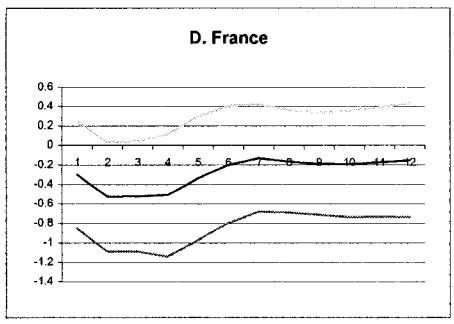
Post Maastricht

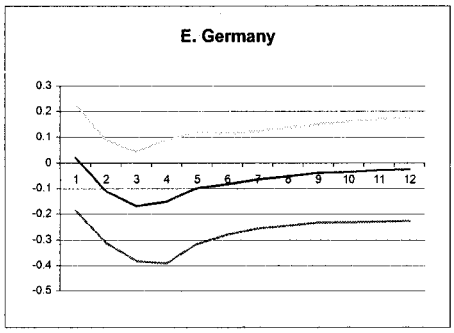
10. Shock to Dutch Output Gap on National Output Gaps

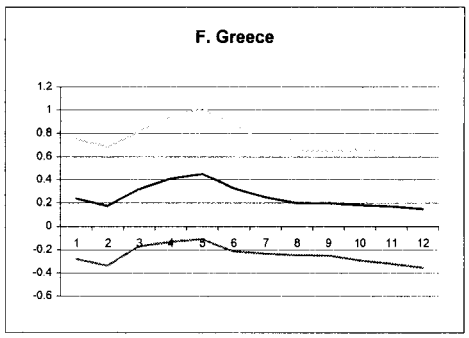


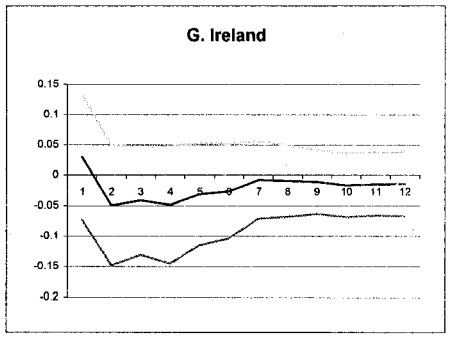


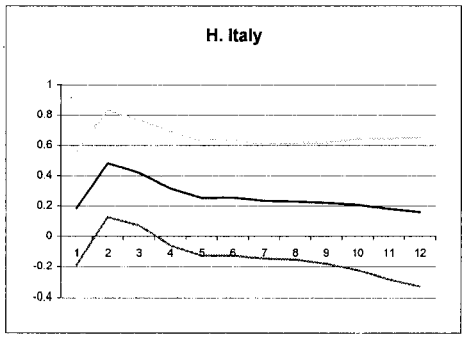


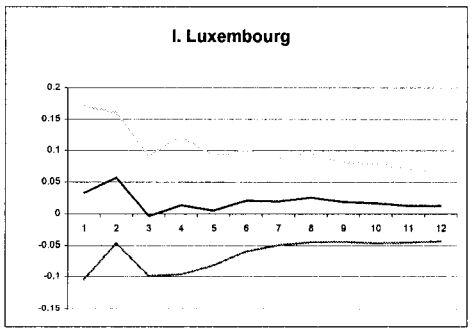


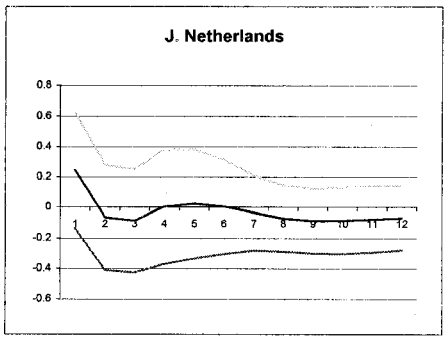


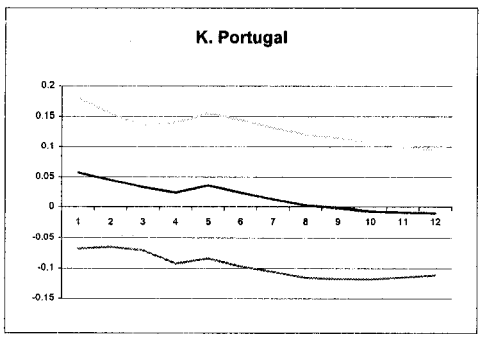


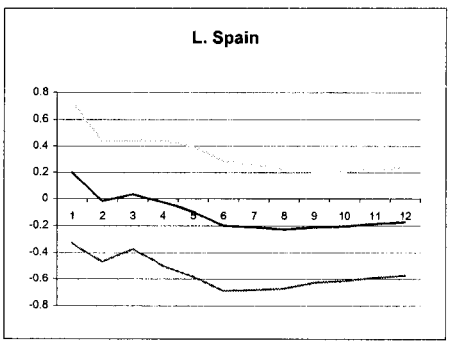






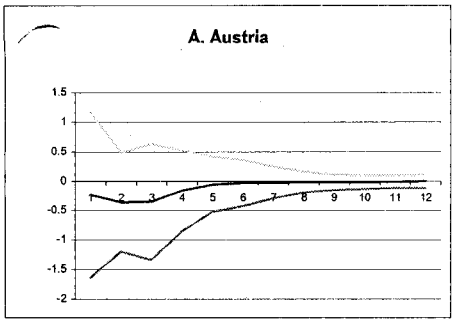


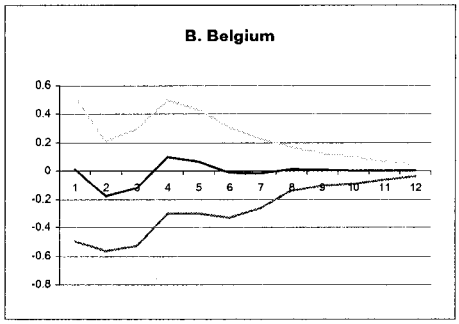


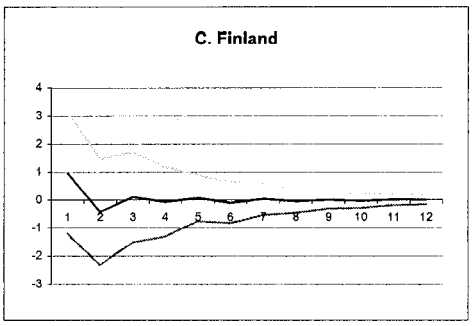


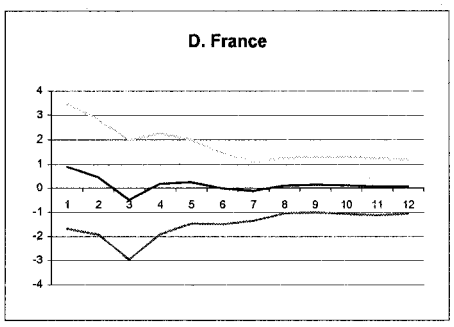
Post Maastricht

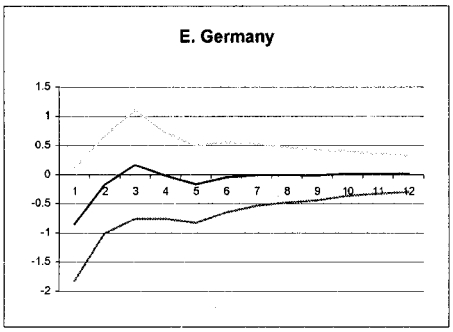
11. Shock to Portuguese Output Gap on National Output Gaps

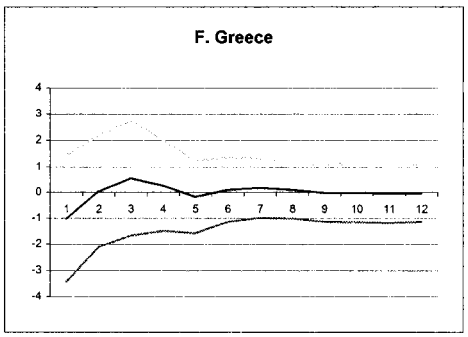


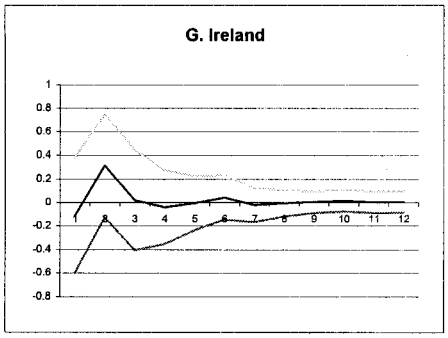


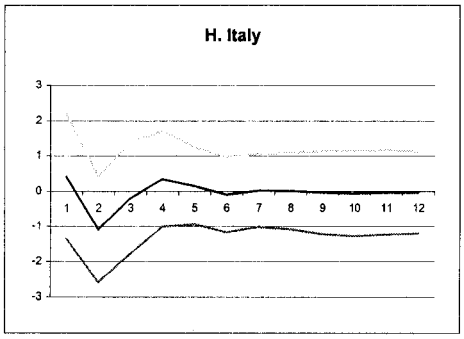


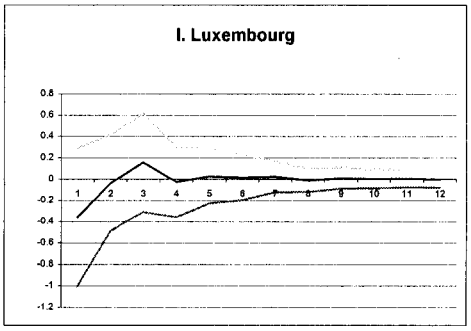


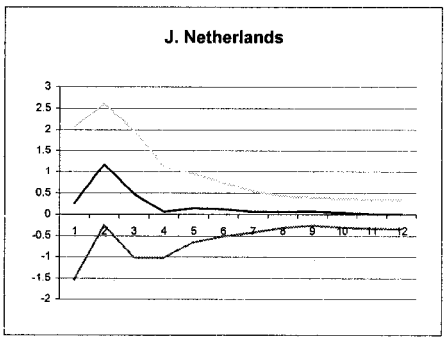


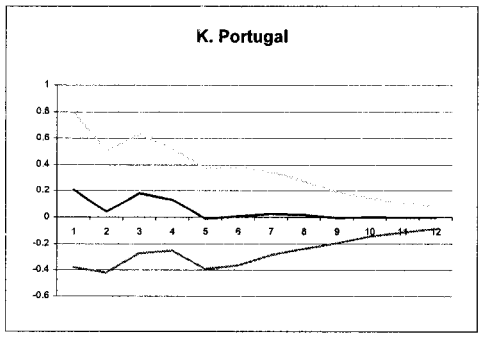


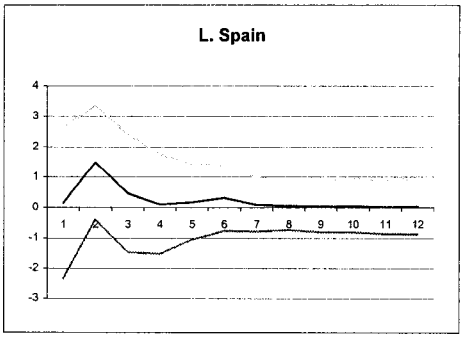






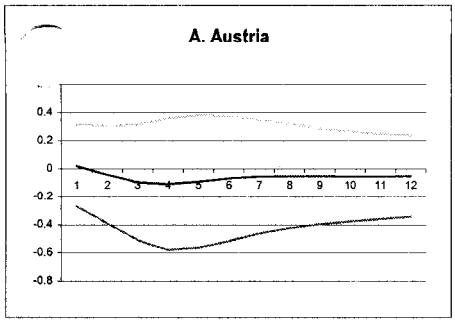


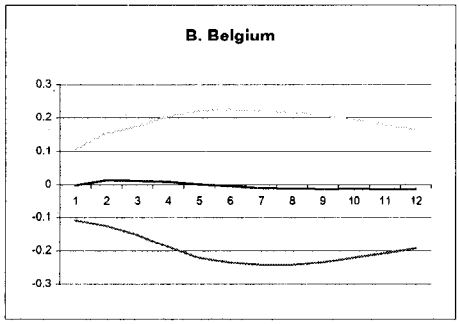


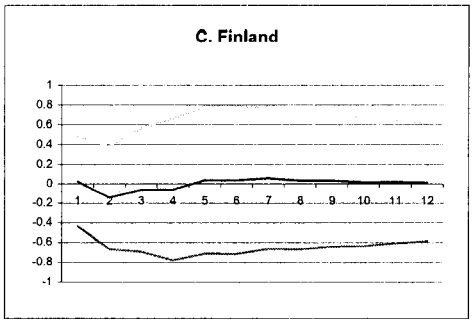


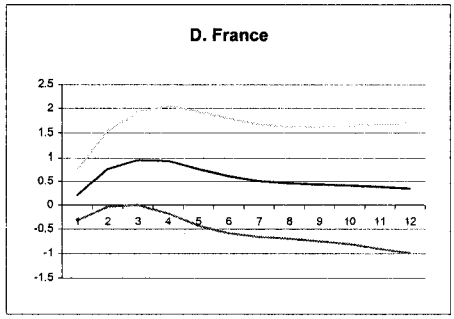
Post Maastricht

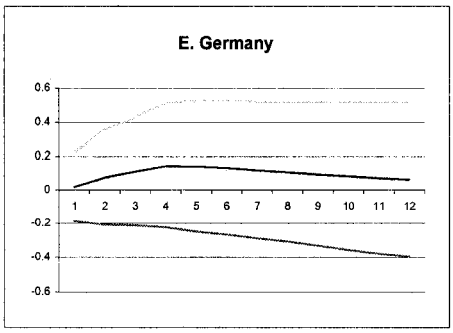
12. Shock to Spanish Output Gap on National Output Gaps

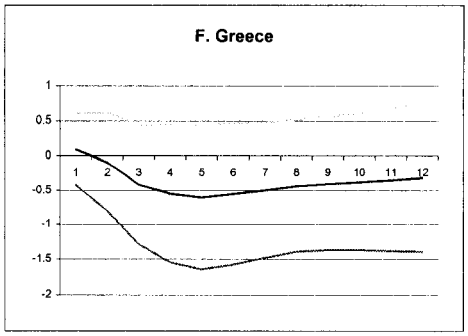


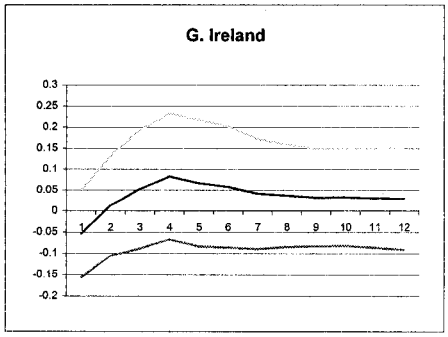


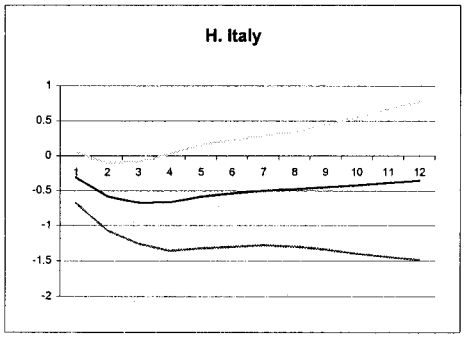


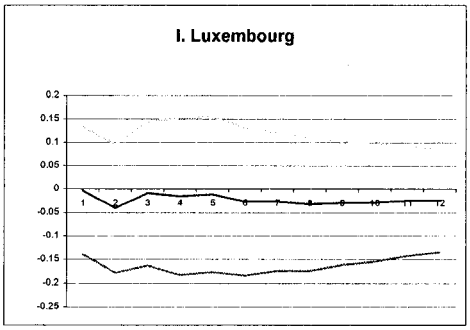


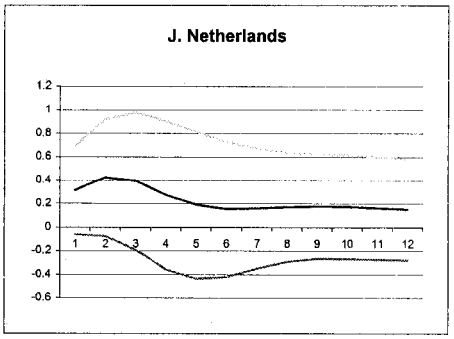


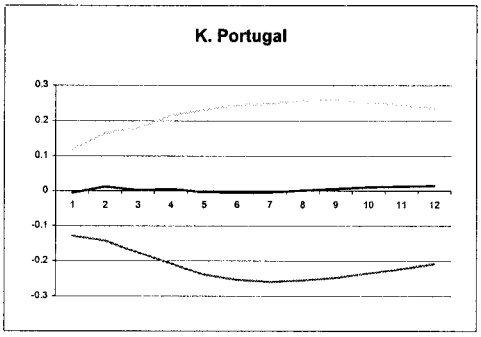


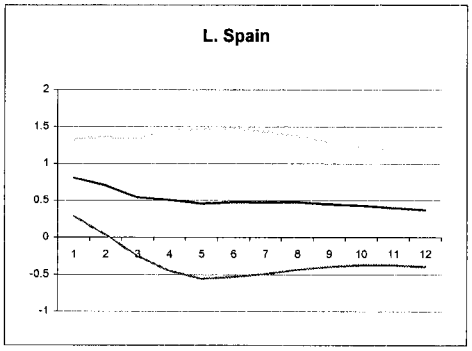








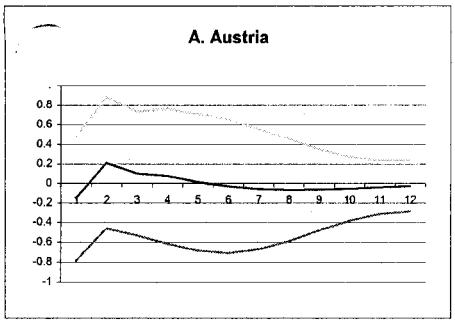


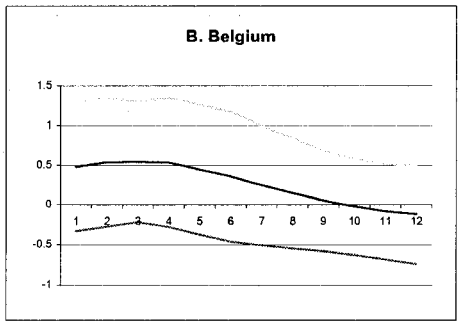


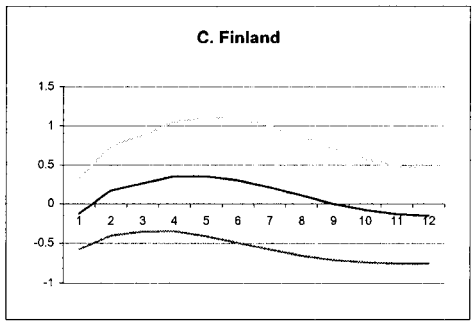
Appendix 3: Inflation Impulse Response Functions Pre and Post Maastricht

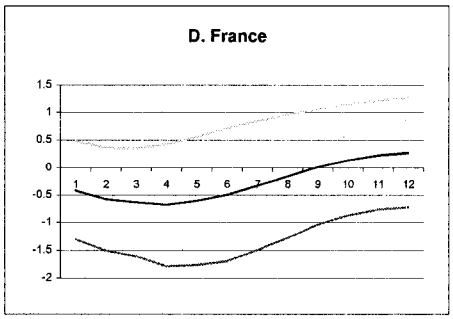
Post Maastricht

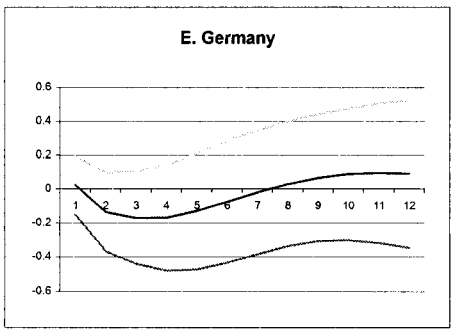
1. Shock to Austrian Inflation on National Inflations

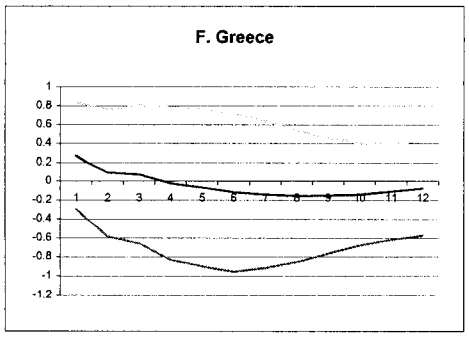


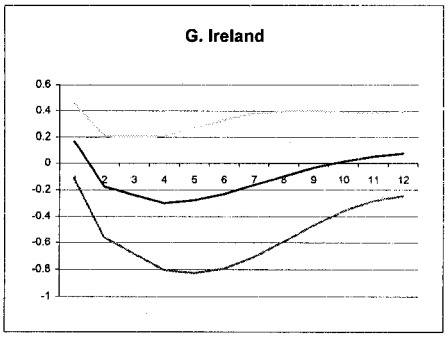


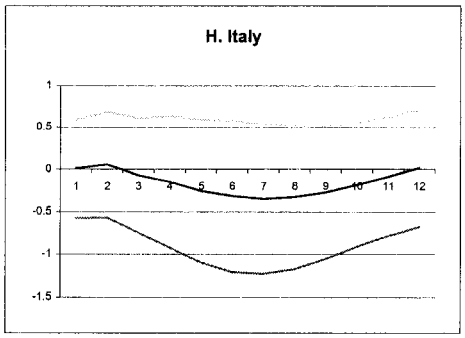


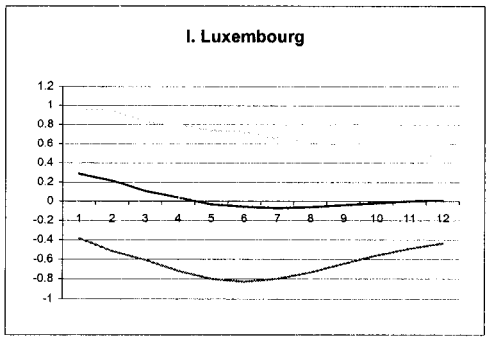


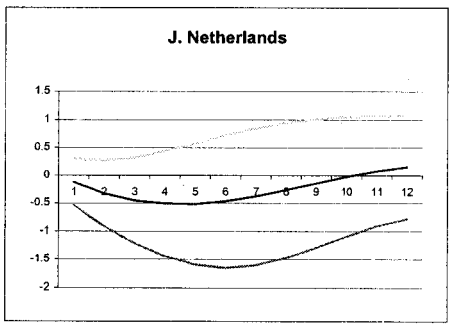


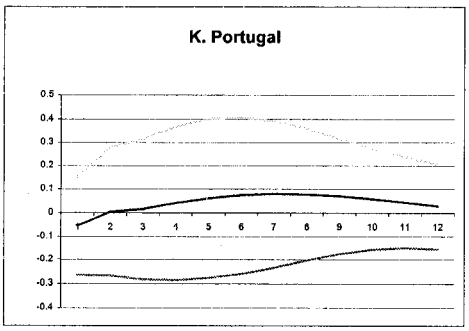


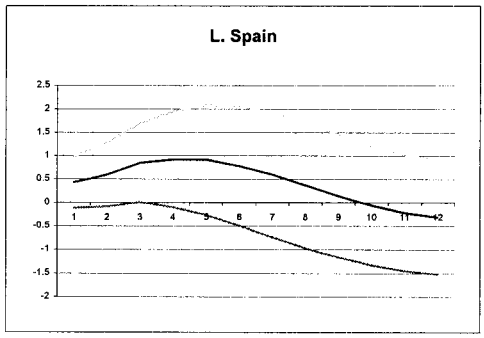






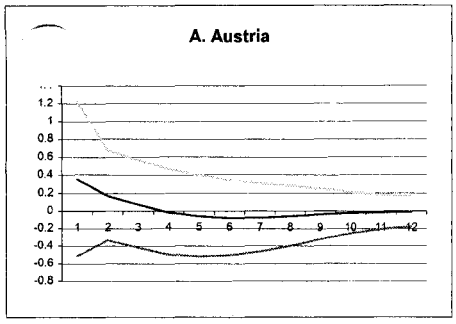


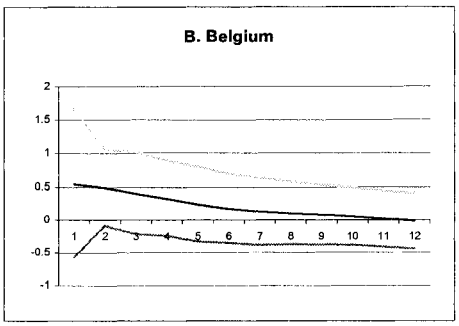


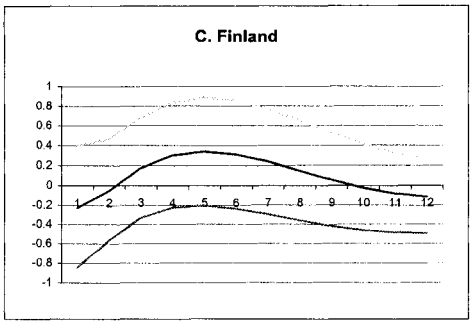


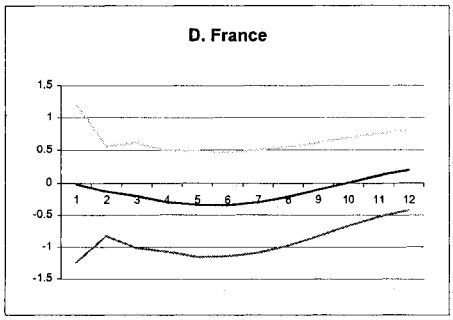
Post Maastricht

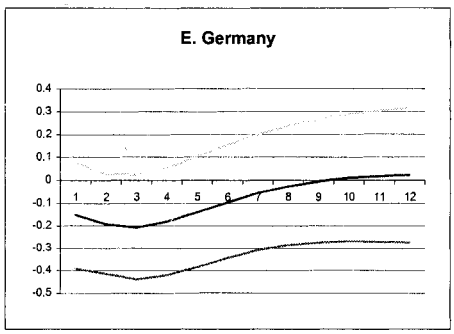
2. Shock to Belgian Inflation on National Inflations

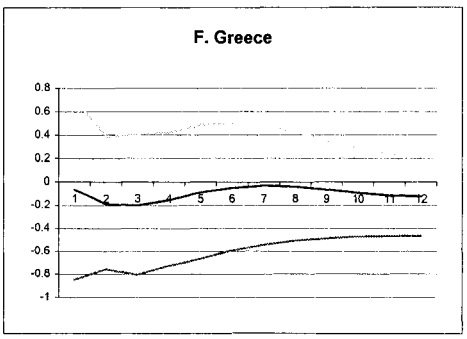


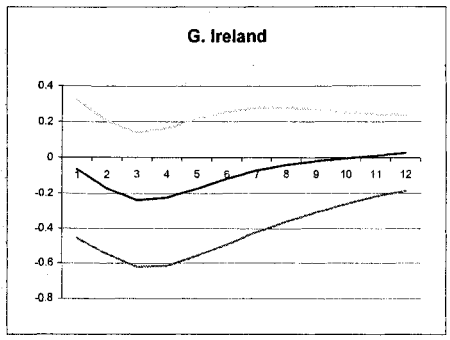


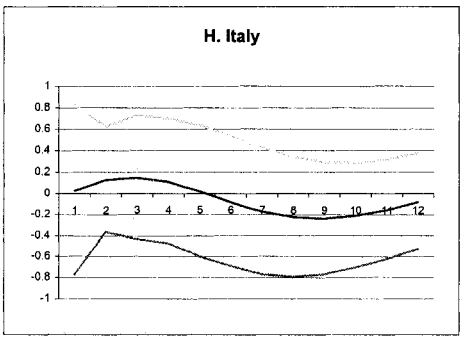


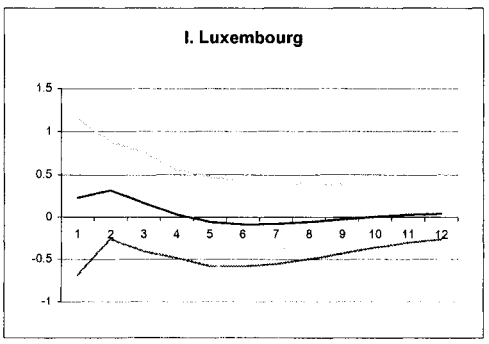


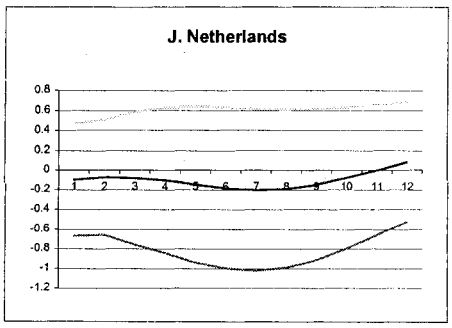


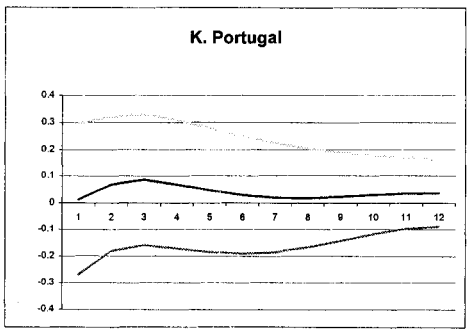


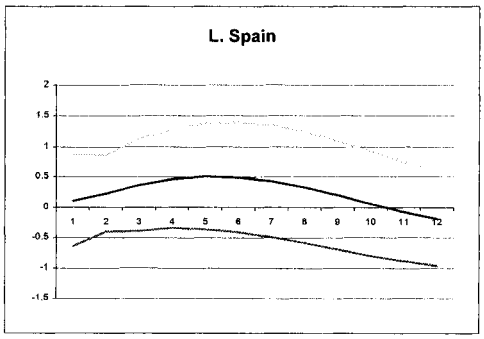






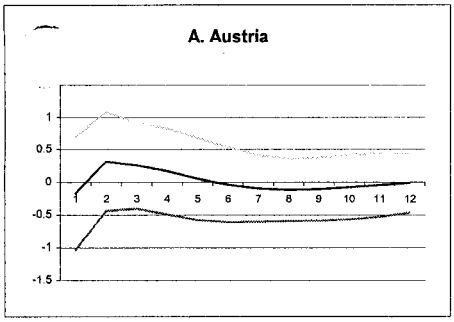


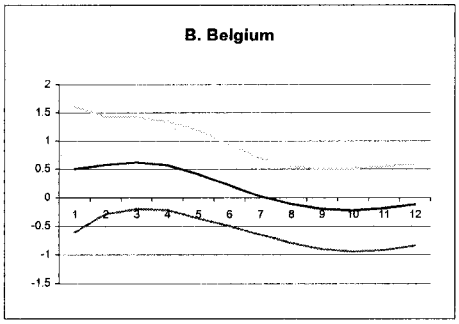


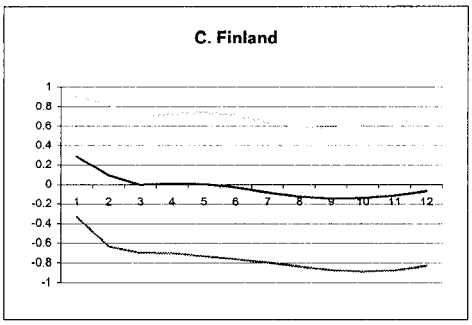


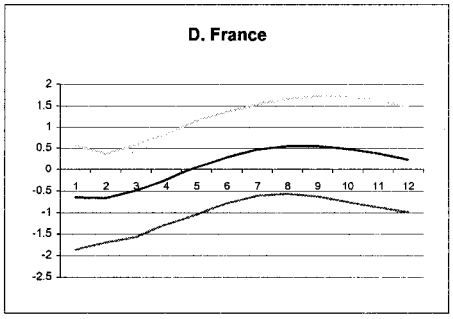
Post Maastricht

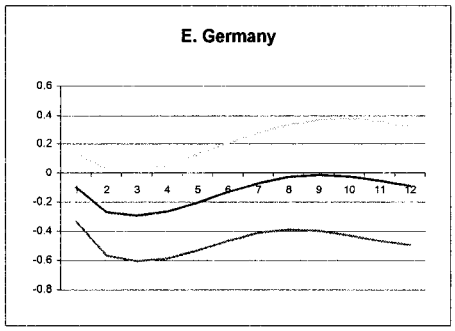
3. Shock to Finnish Inflation on National Inflations

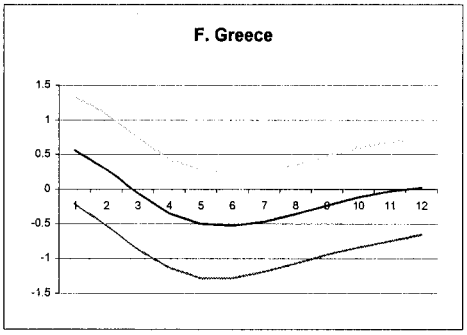


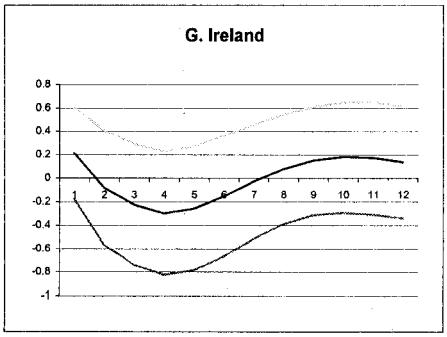


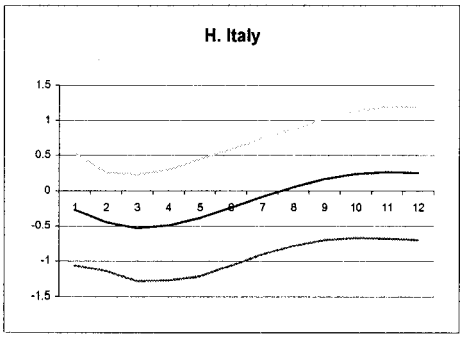


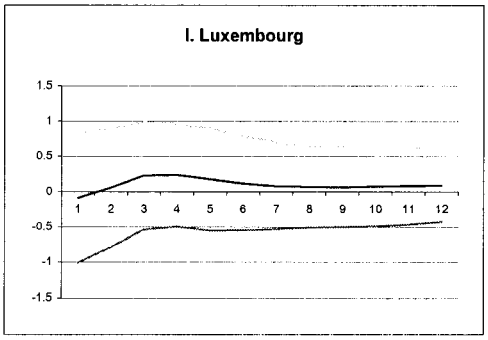


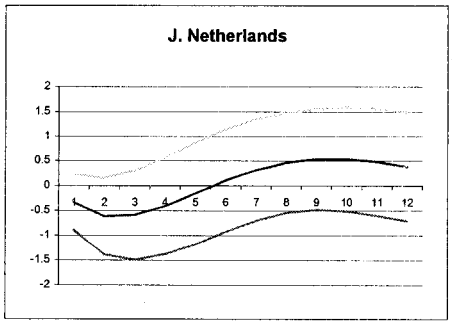


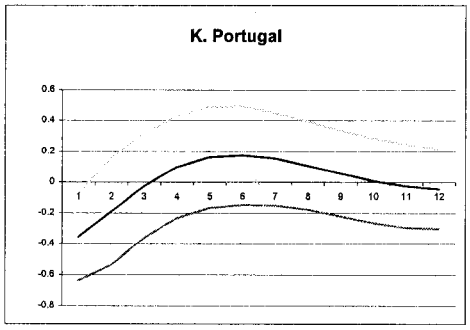


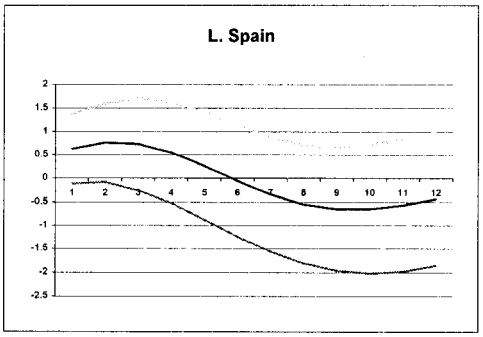






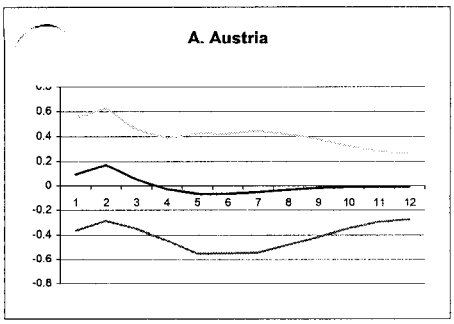


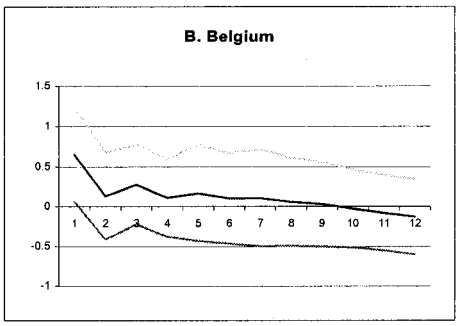


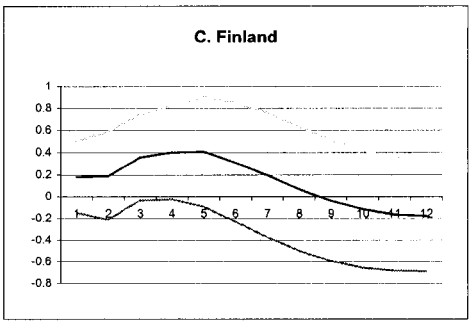


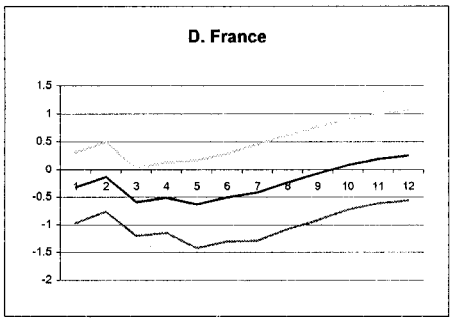
Post Maastricht

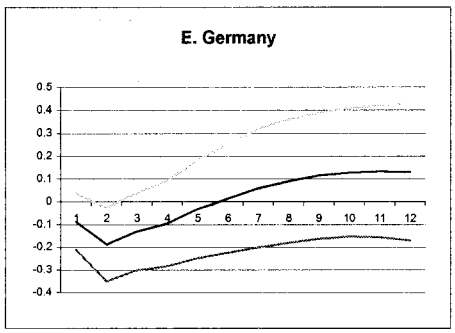
4. Shock to French Inflation on National Inflations

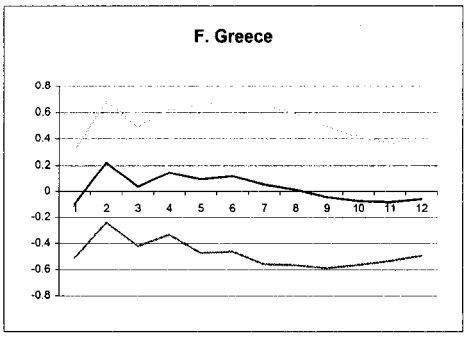


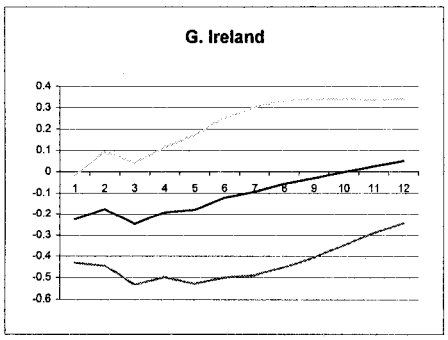


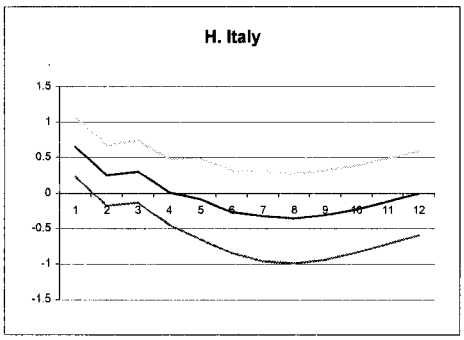


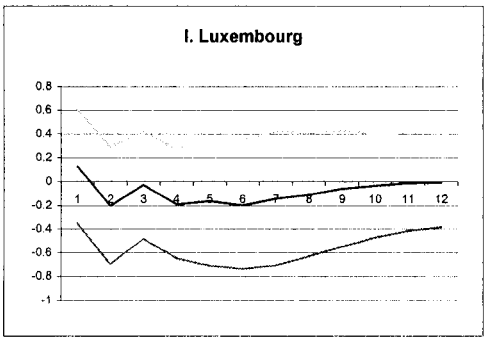


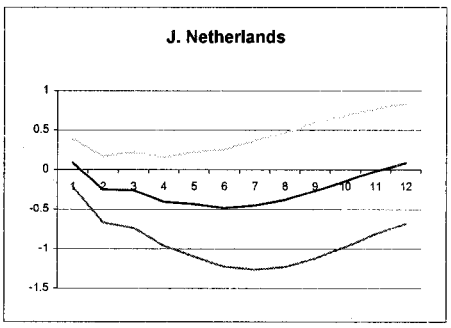


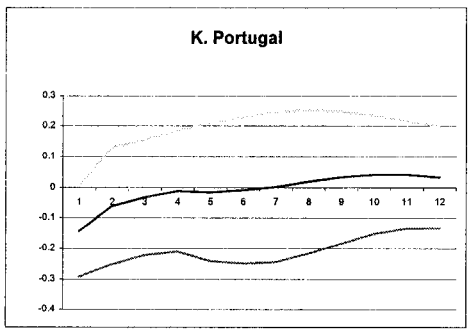


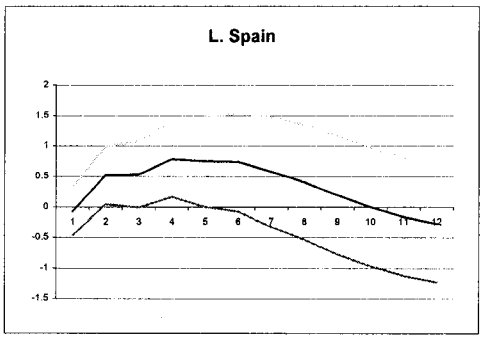






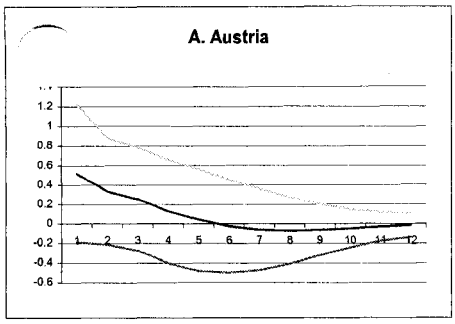


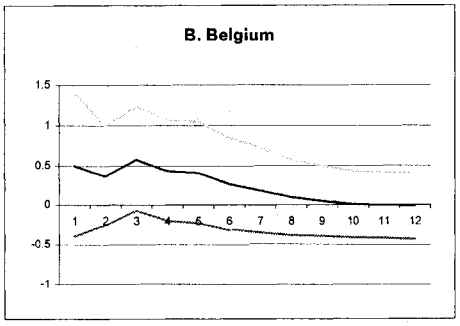


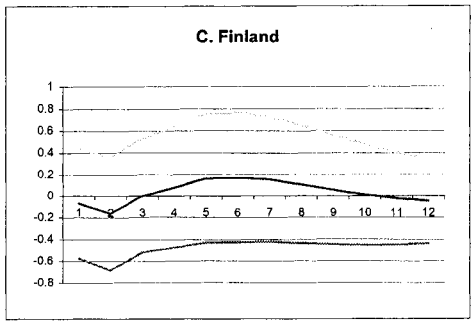


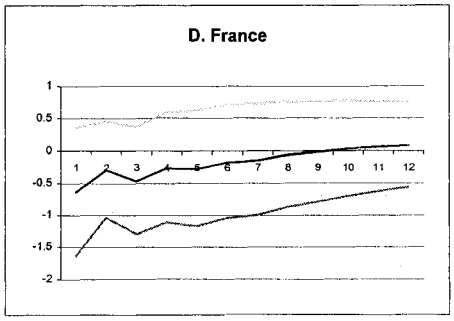
Post Maastricht

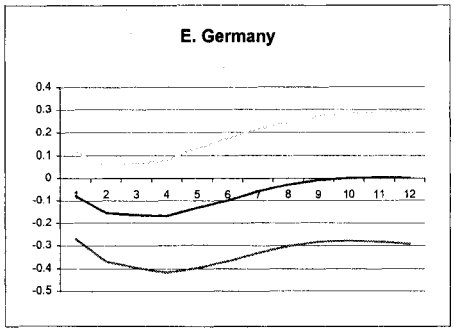
5. Shock to German Inflation on National Inflations

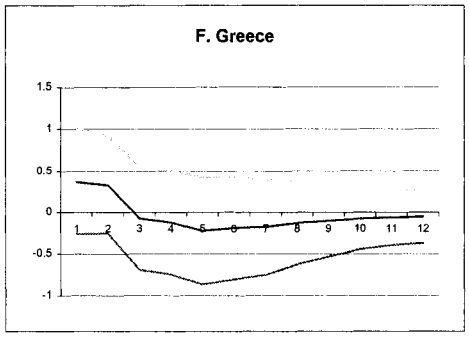


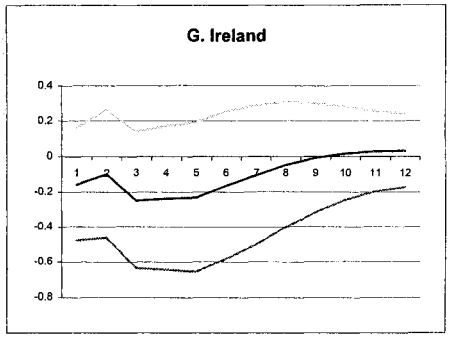


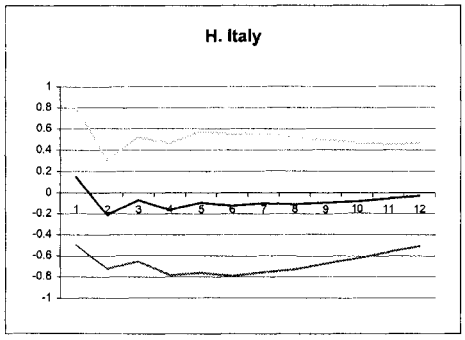


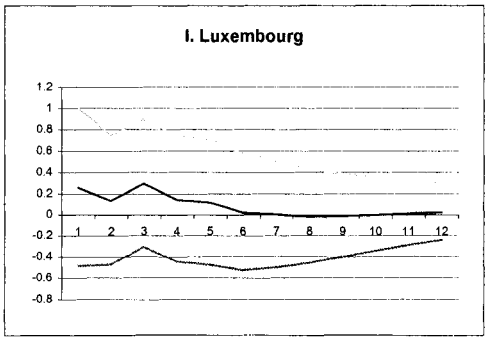


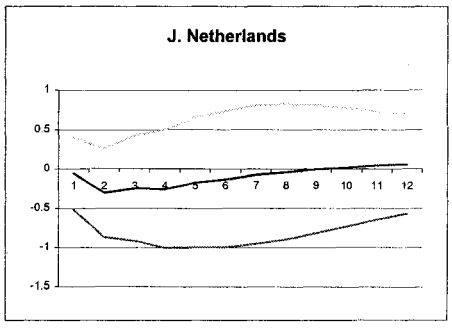


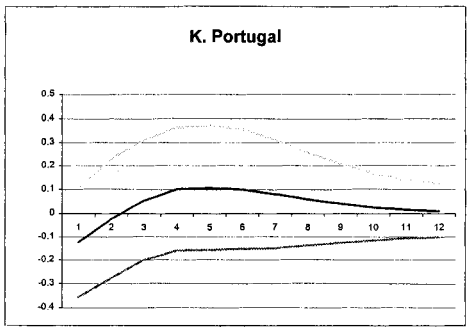


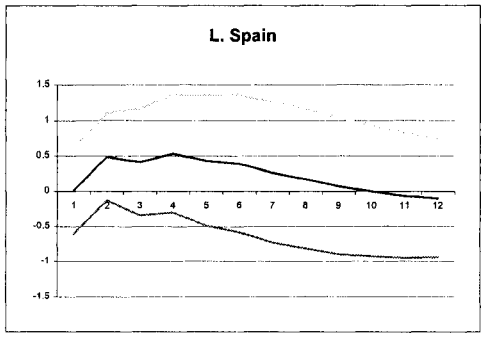






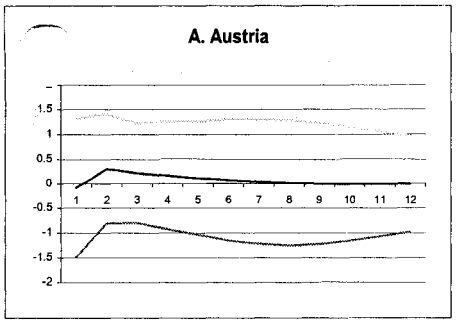


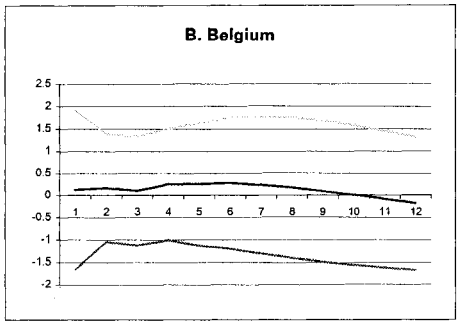


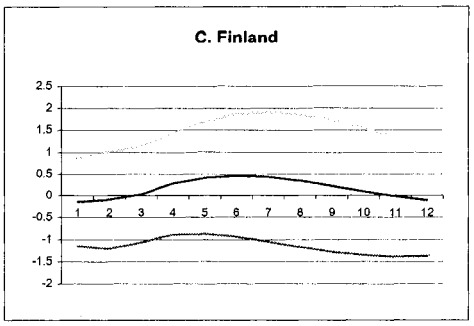


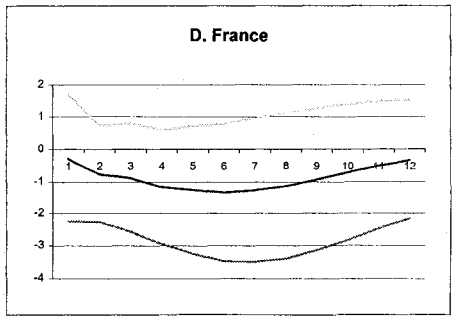
Post Maastricht

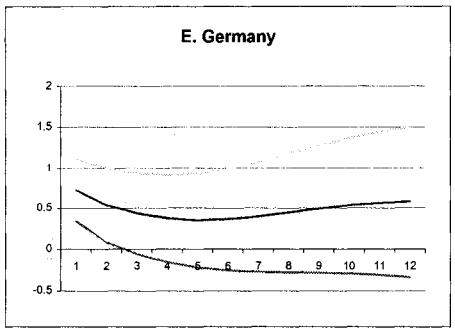
6. Shock to Greek Inflation on National Inflations

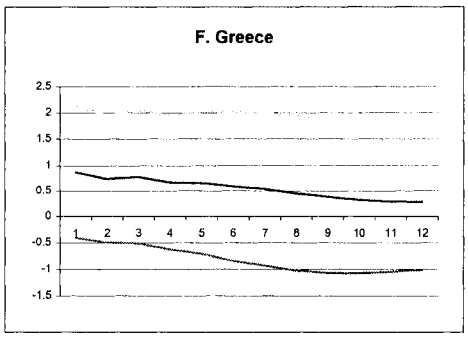


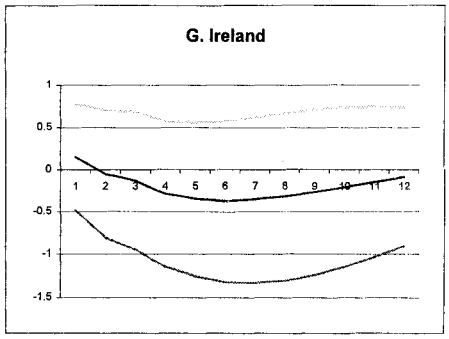


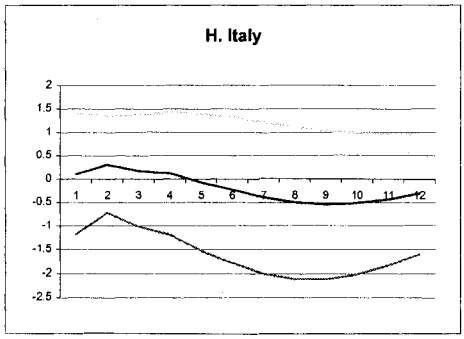


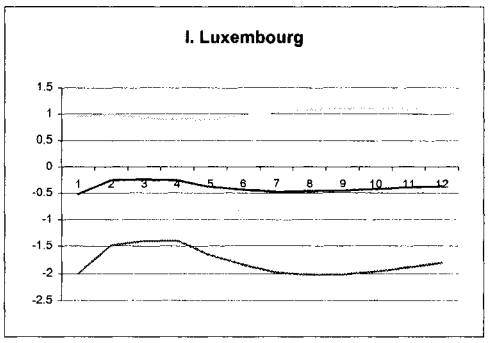


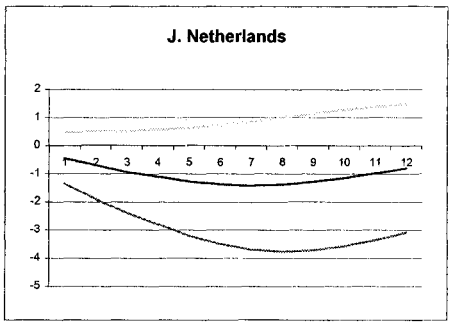


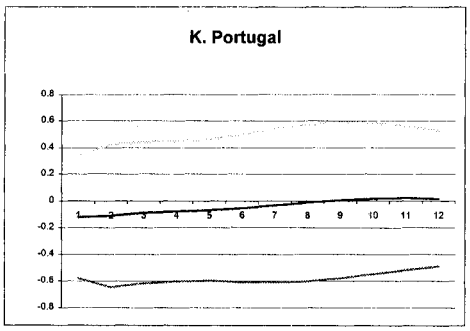


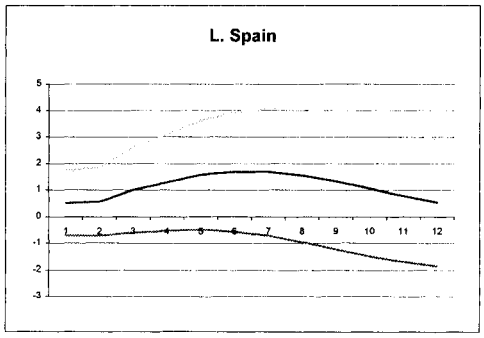






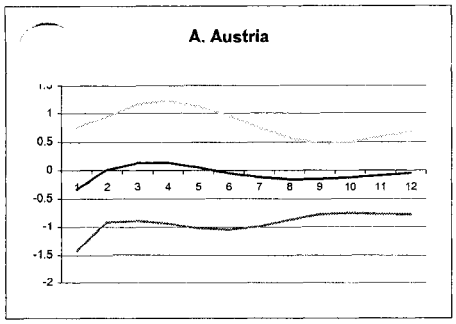


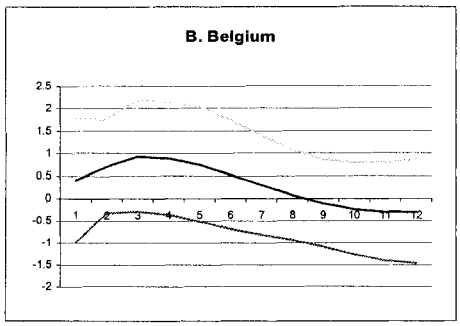


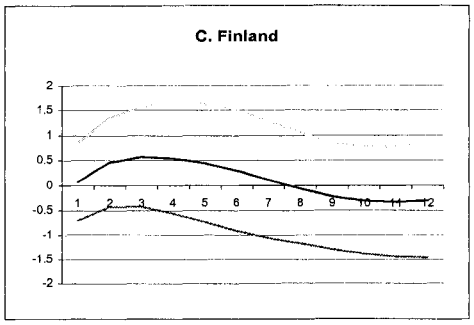


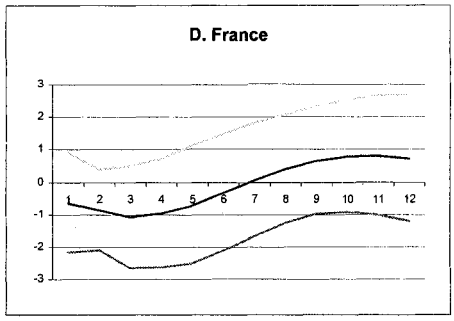
Post Maastricht

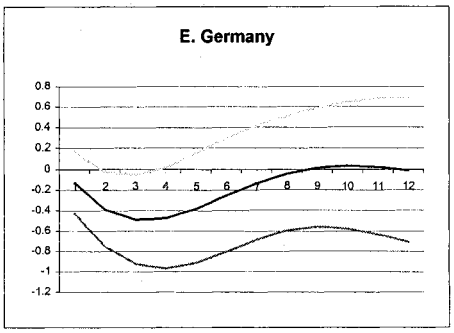
7. Shock to Irish Inflation on National Inflations

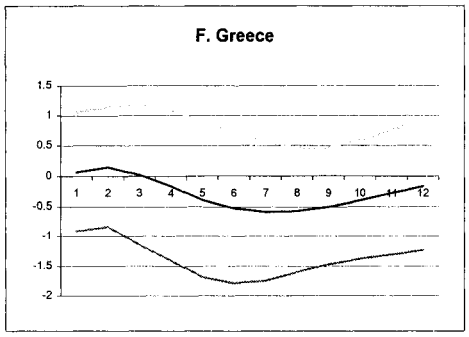


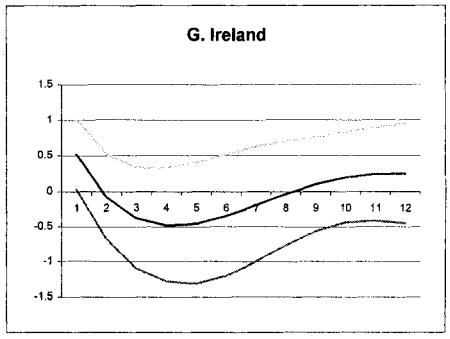


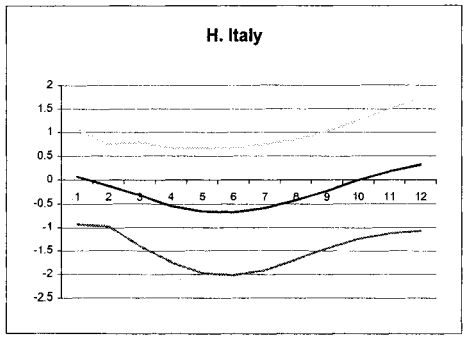


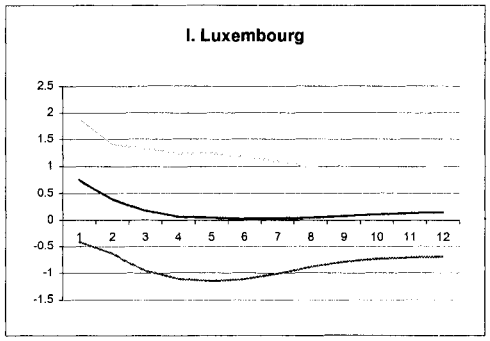


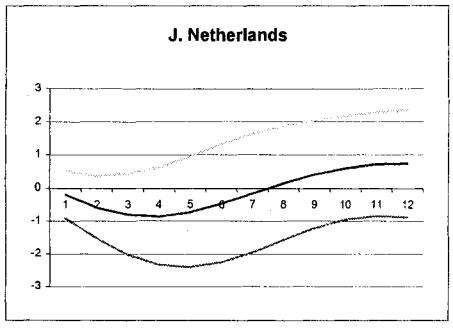


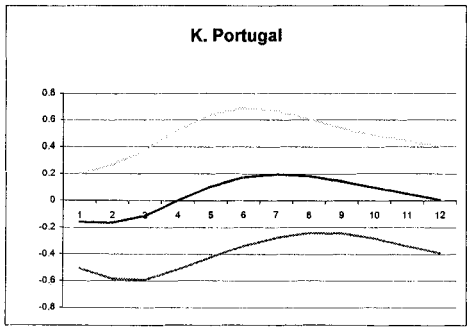


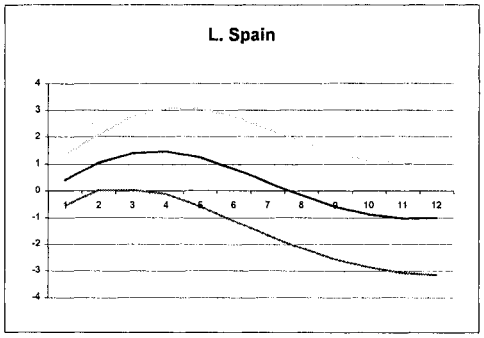






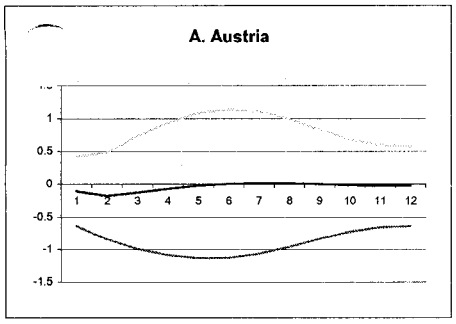


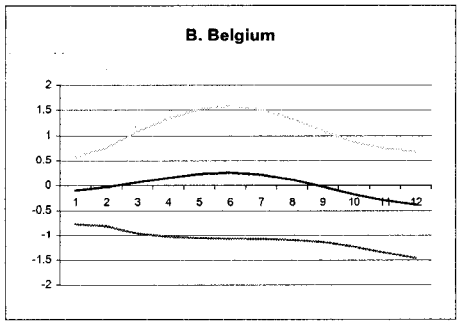


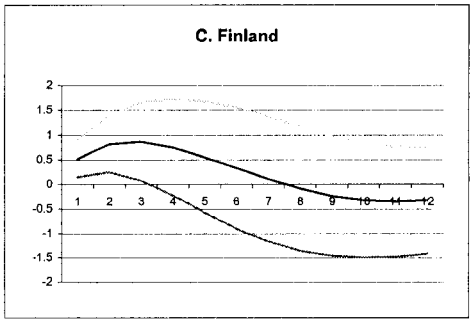


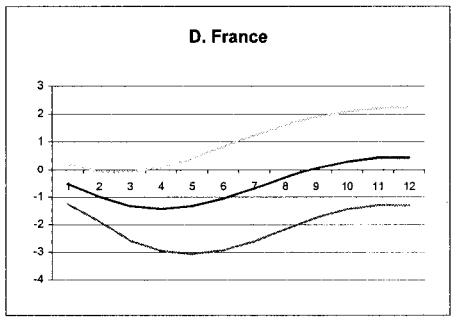
Post Maastricht

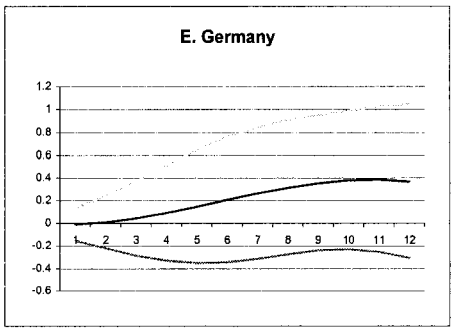
8. Shock to Italian Inflation on National Inflations

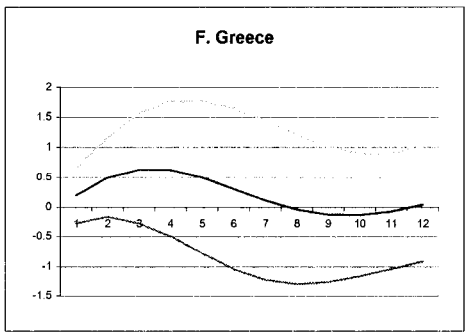


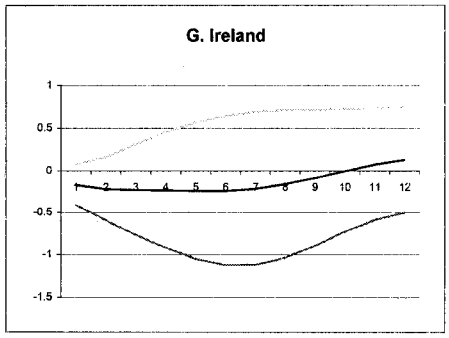


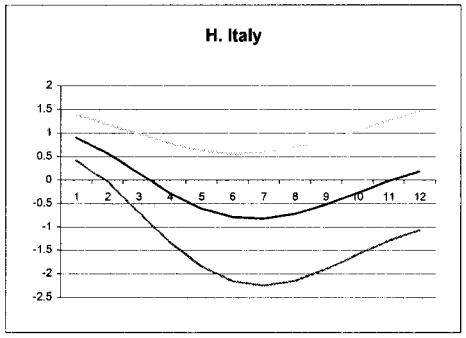


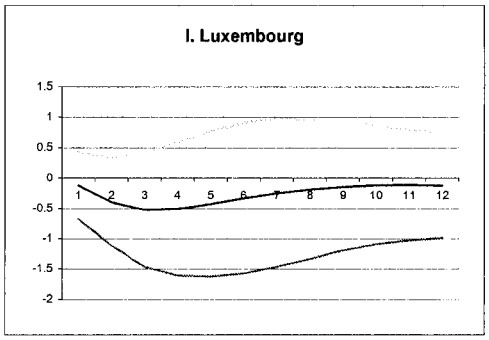


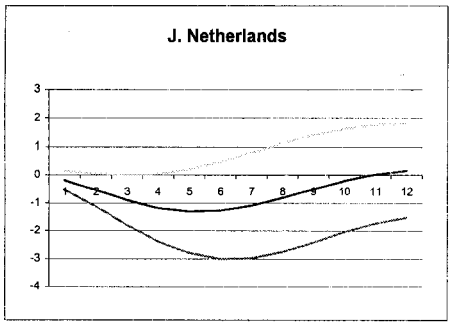


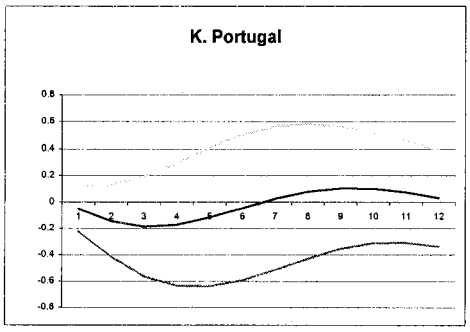


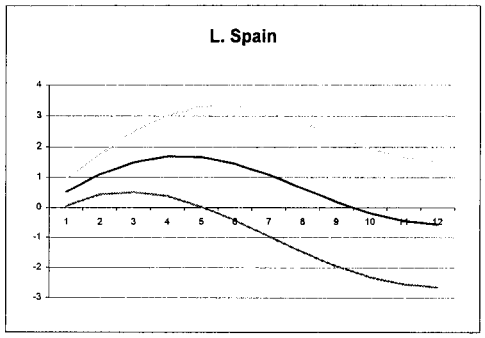






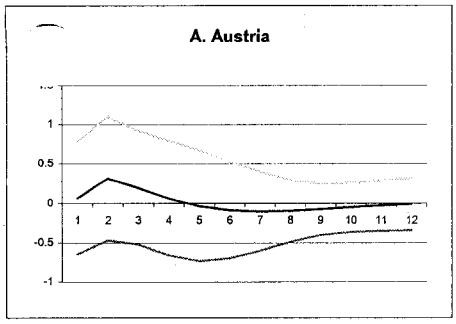


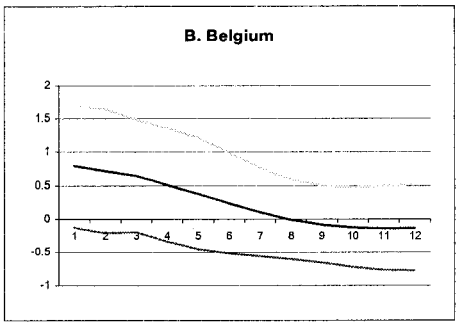


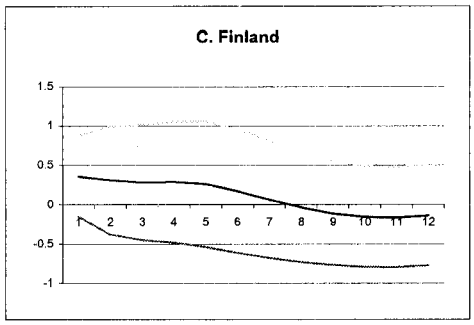


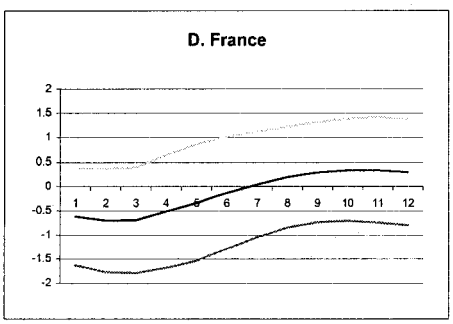
Post Maastricht

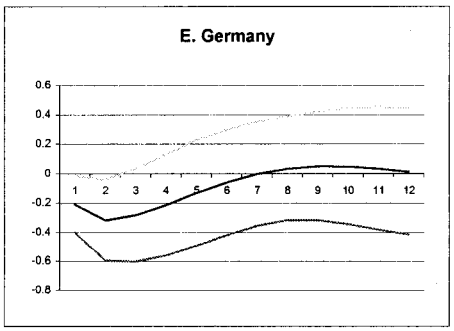
9. Shock to Luxembourg Inflation on National Inflations

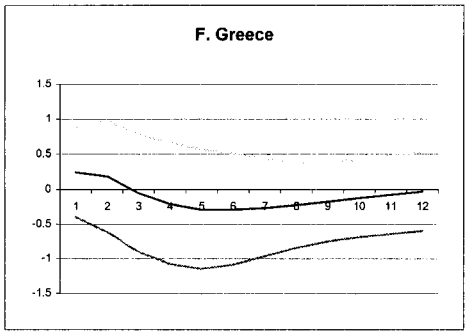


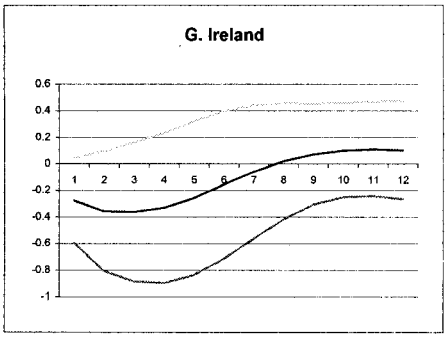


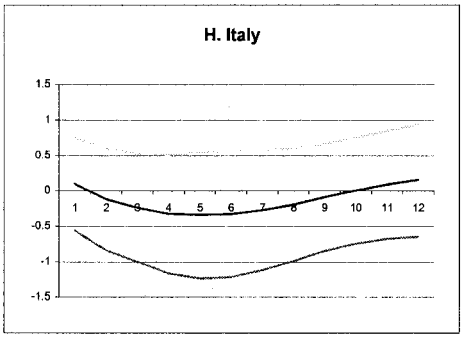


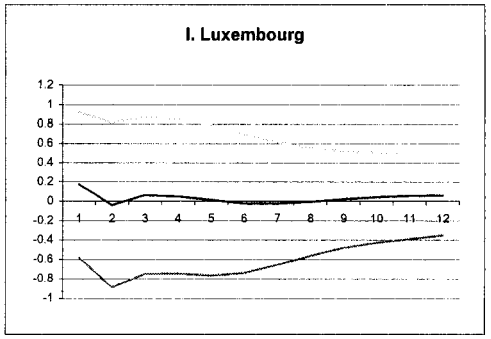


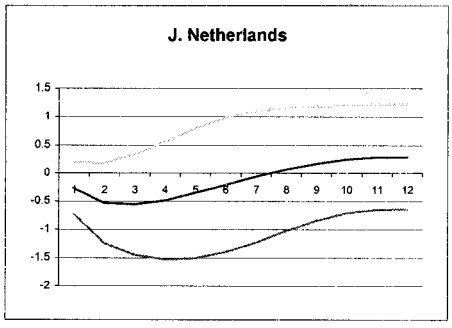


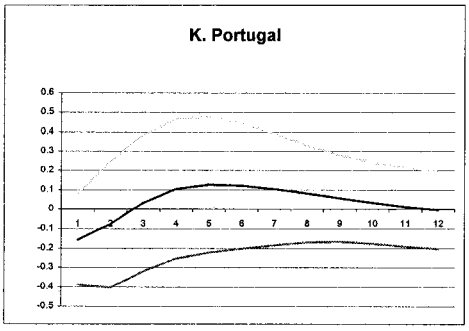


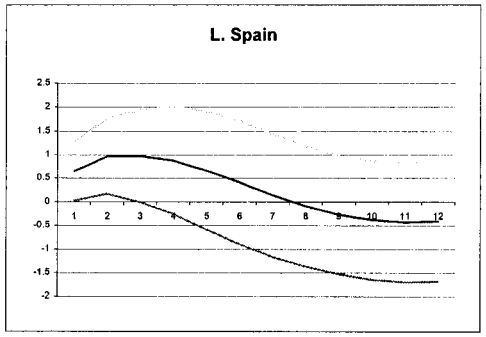






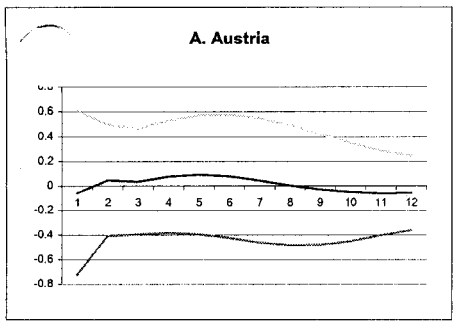


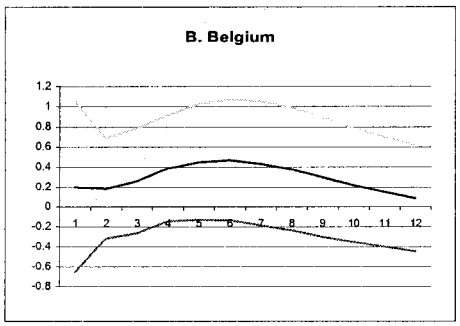


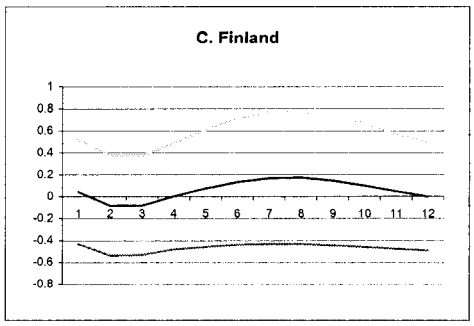


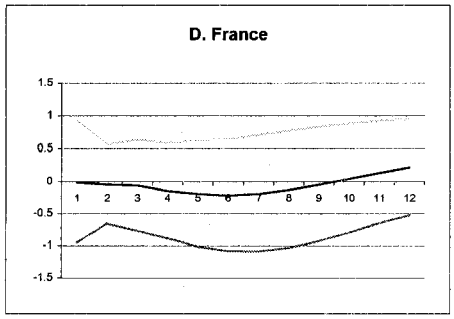
Post Maastricht

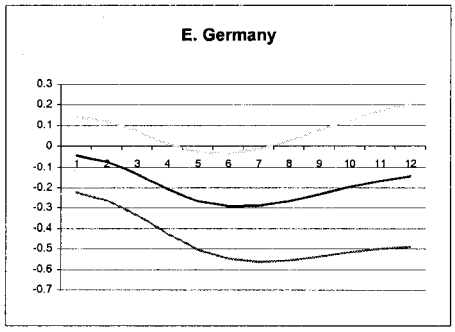
10. Shock to Dutch Inflation on National Inflations

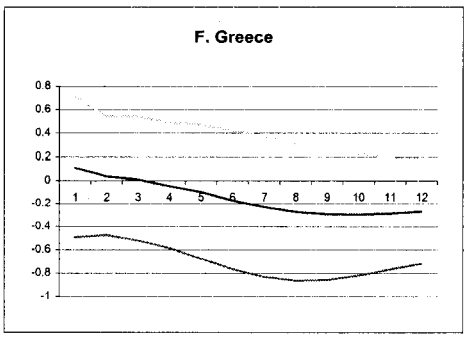


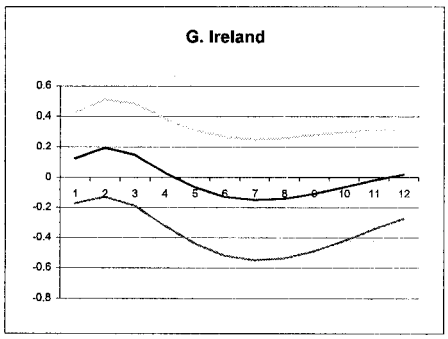


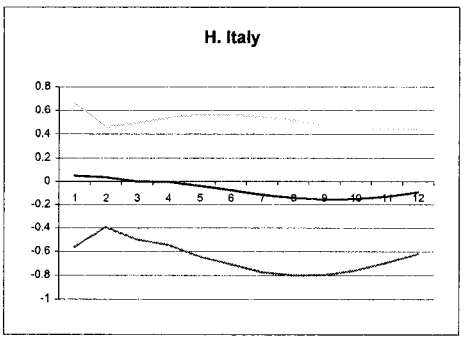


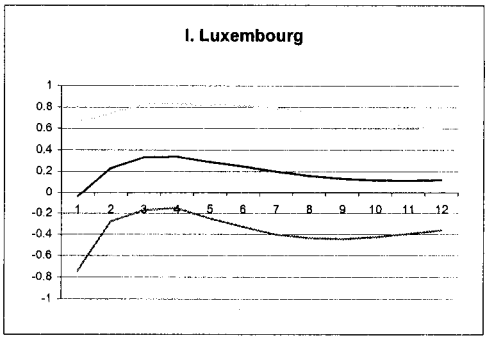


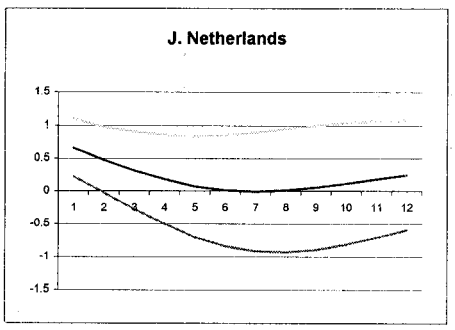


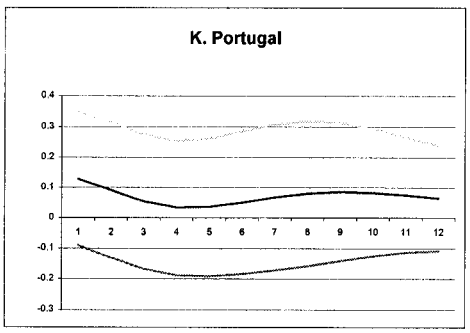


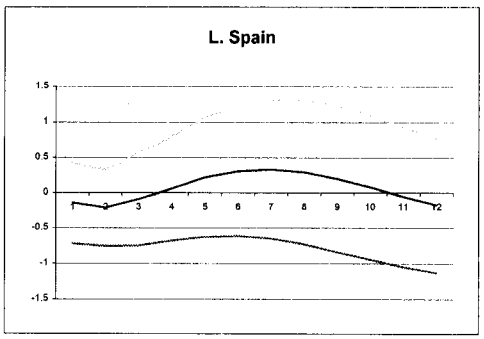






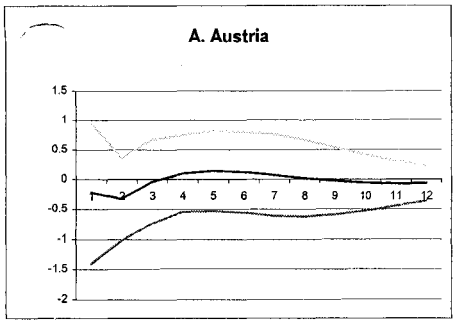


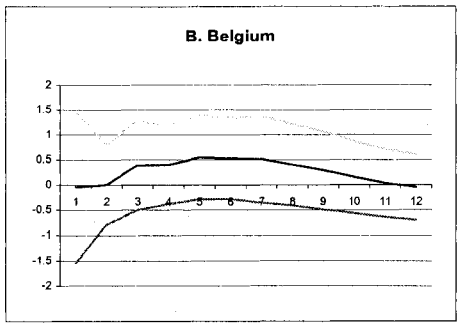


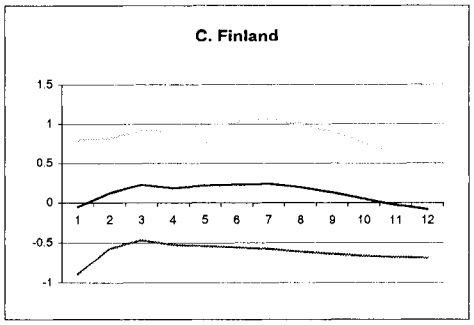


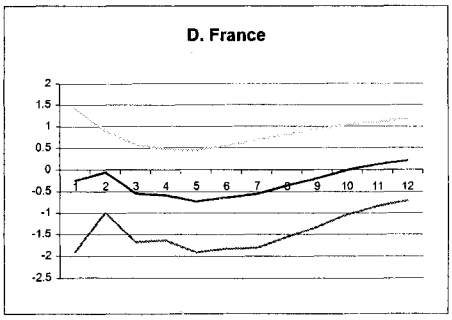
Post Maastricht

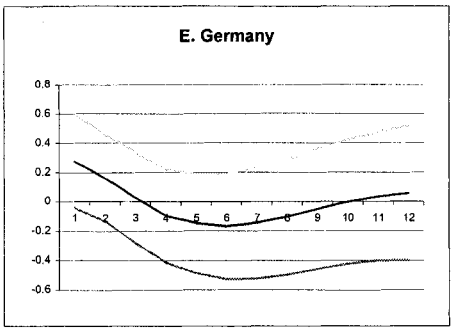
11. Shock to Portuguese Inflation on National Inflations

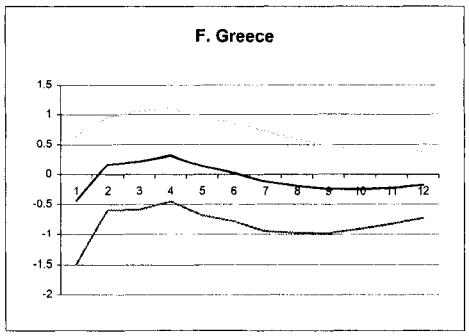


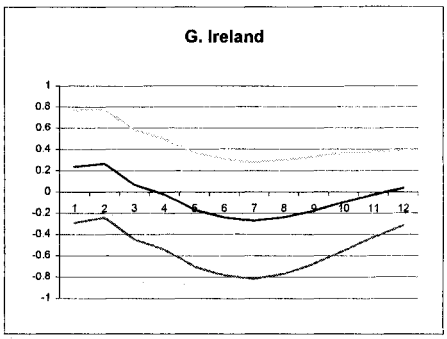


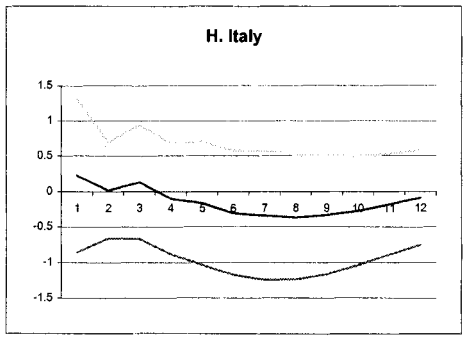


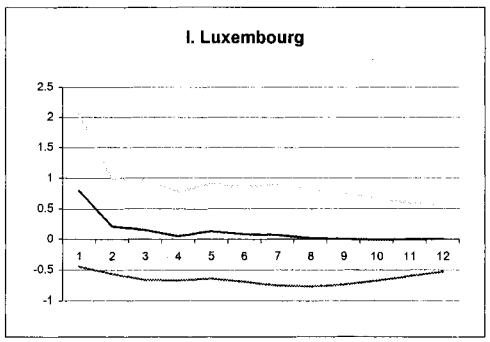


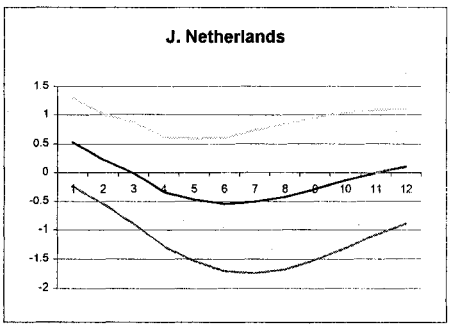


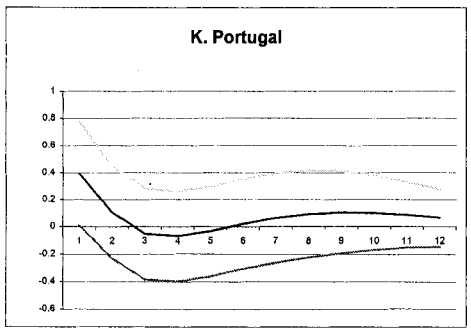


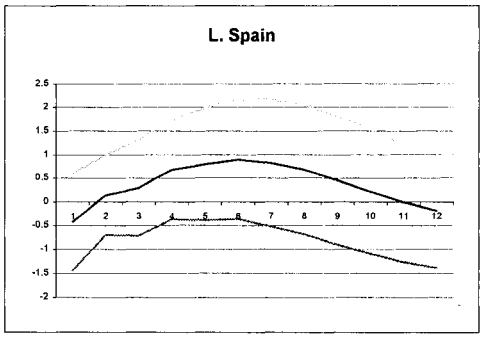






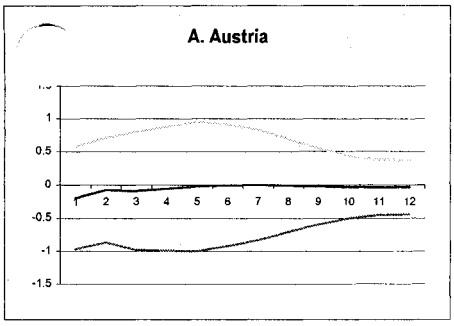


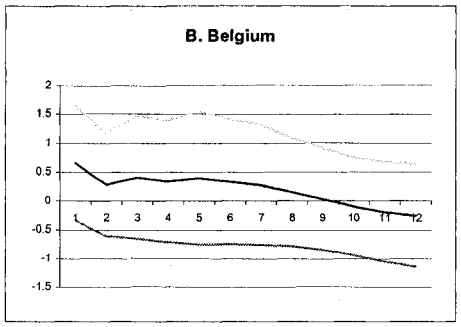


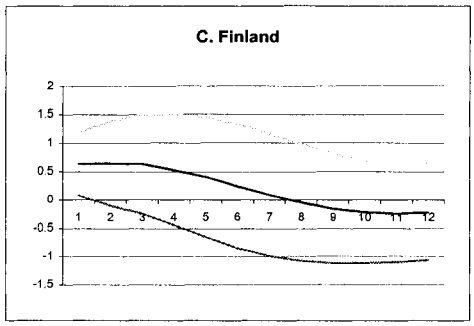


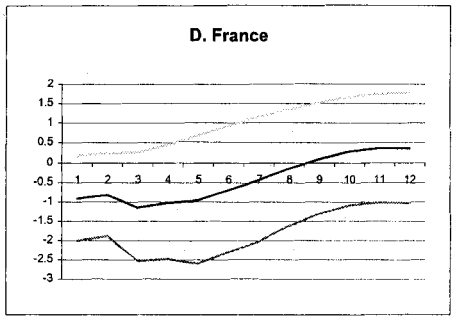
Post Maastricht

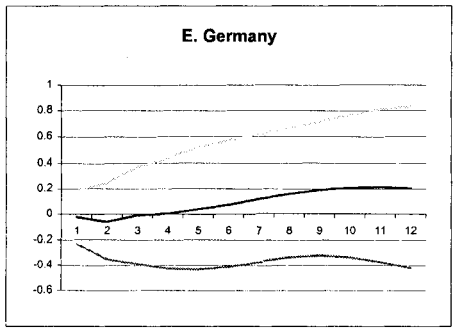
12. Shock to Spanish Inflation on National Inflations

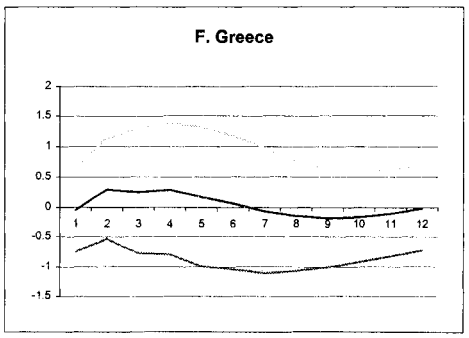


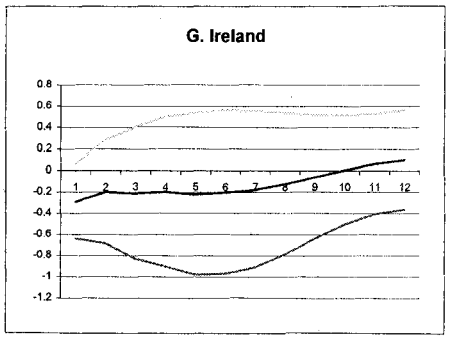


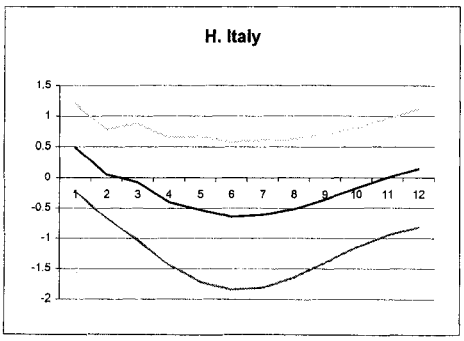


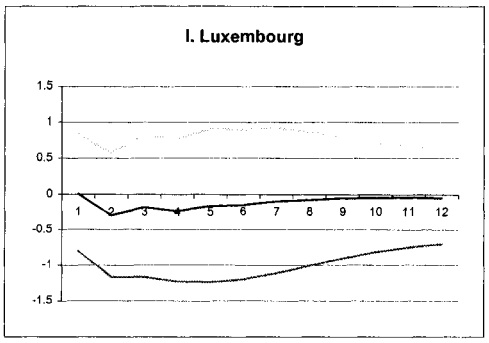


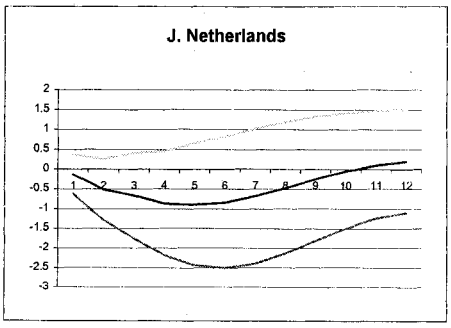


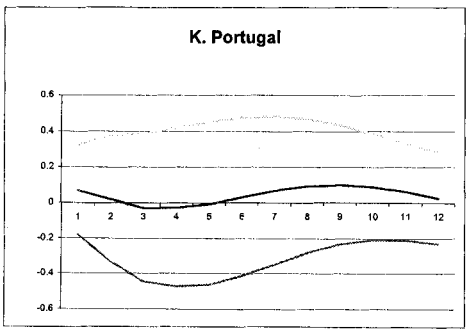


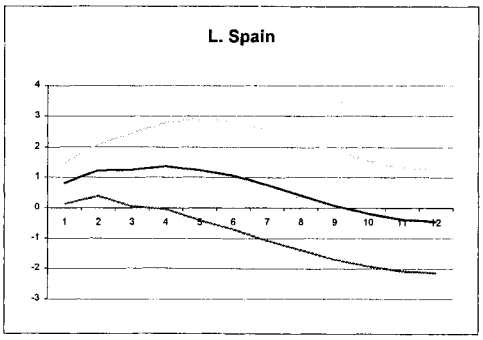






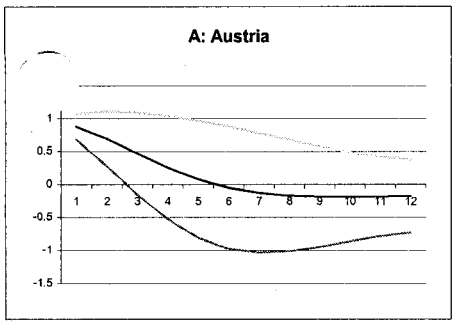


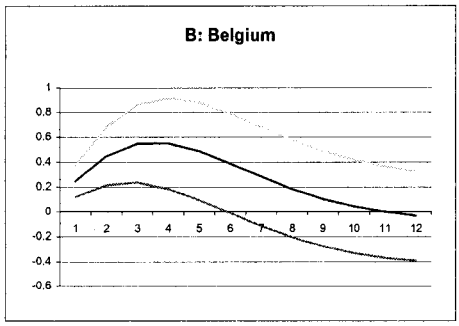


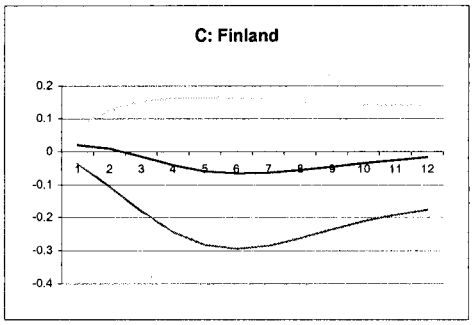


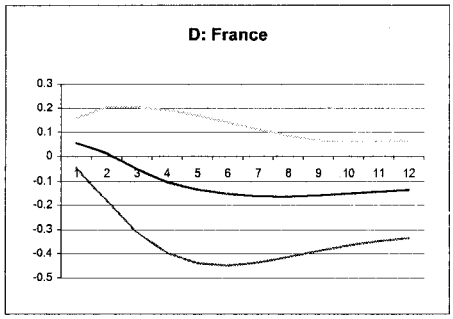
Appendix 4: Interest Rate Impulse Response Functions
Pre Maastricht Only

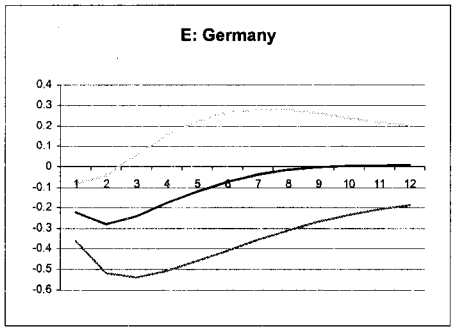
Pre-Maastricht
1: Shock to Austrian Interest Rate on National Interest Rates

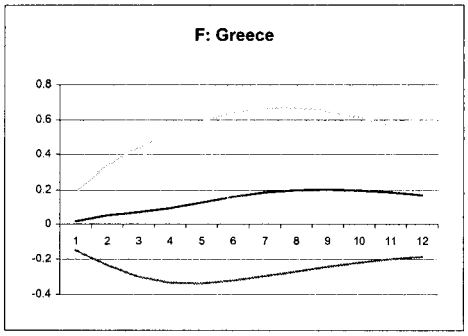


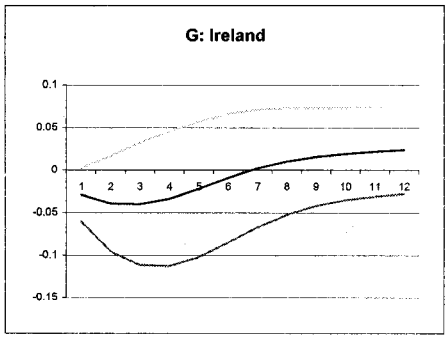


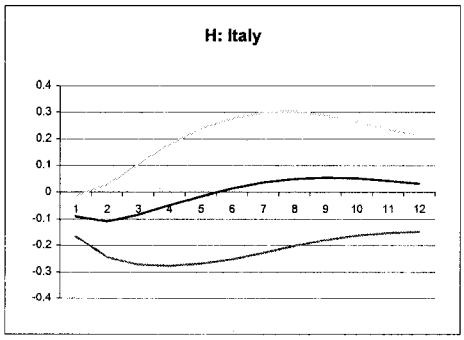


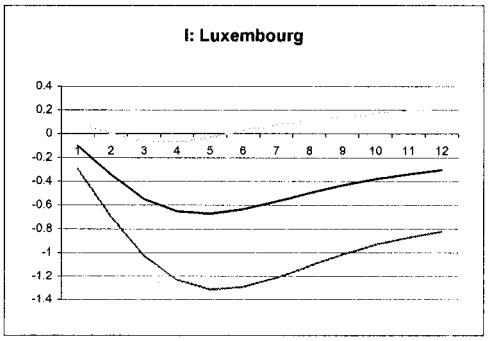


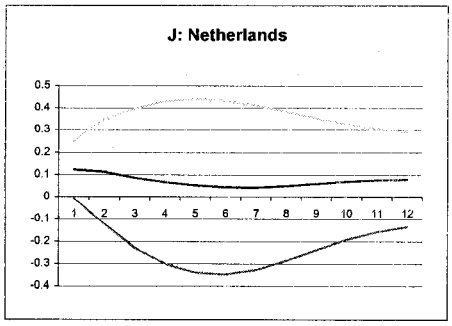


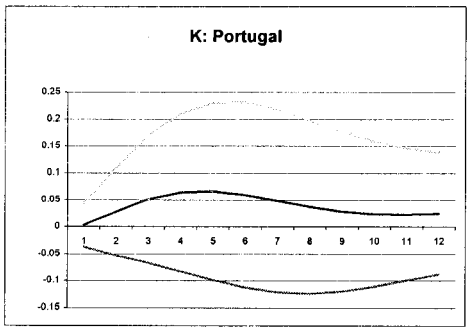


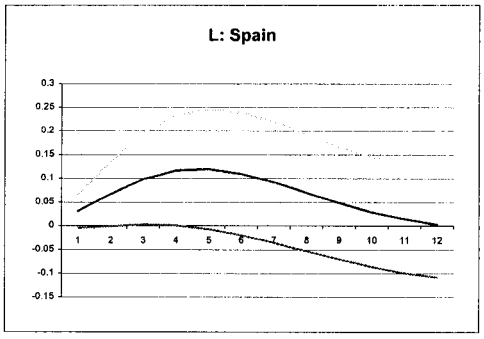




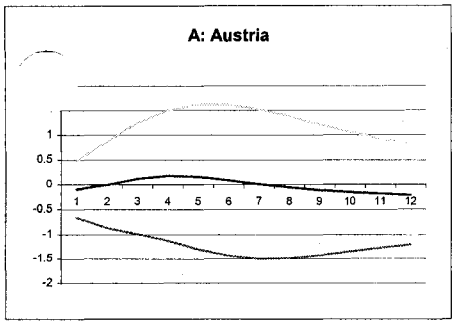


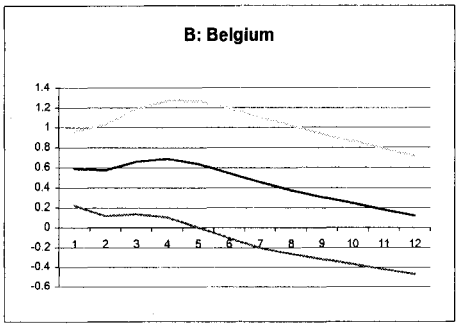


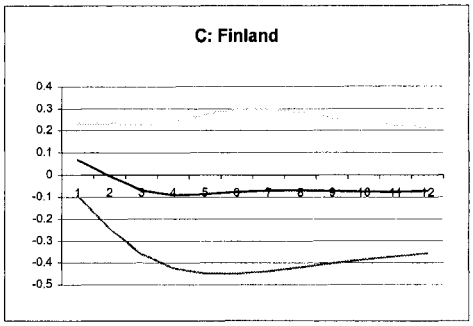


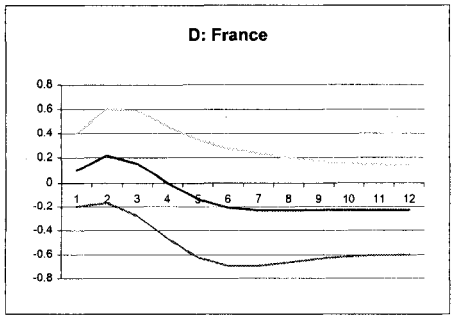


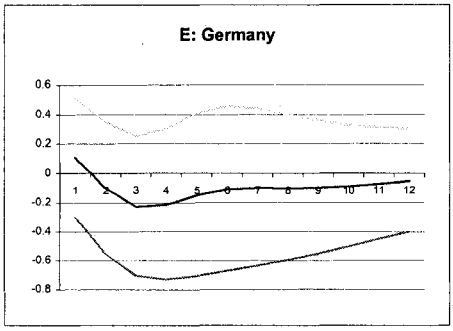
Pre-Maastricht
2: Shock to Belgian Interest Rate on National Interest Rates

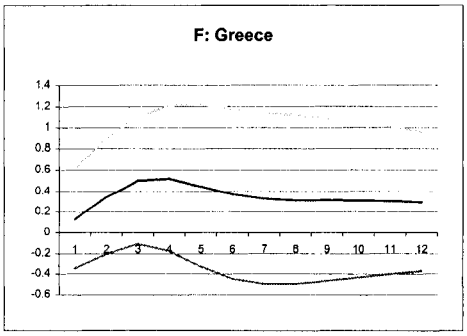


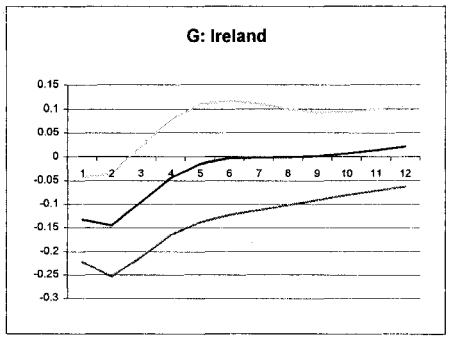


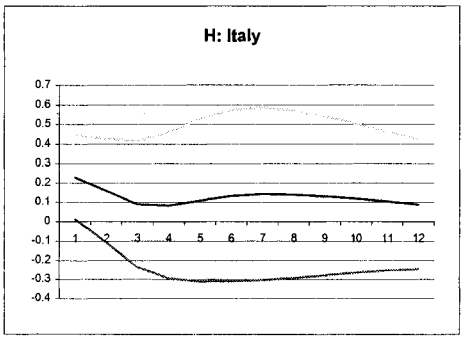


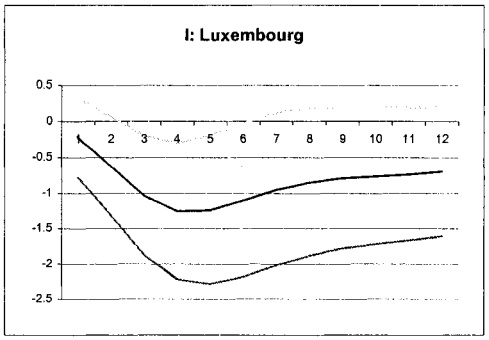


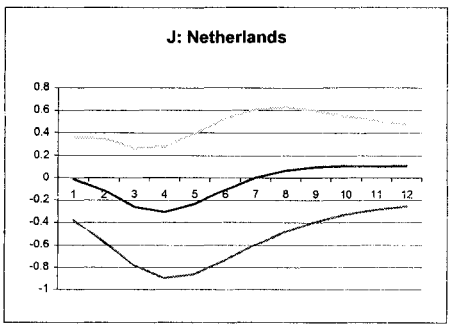


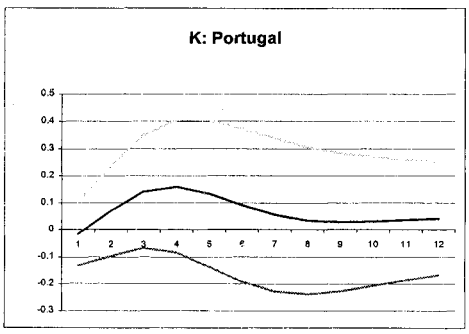


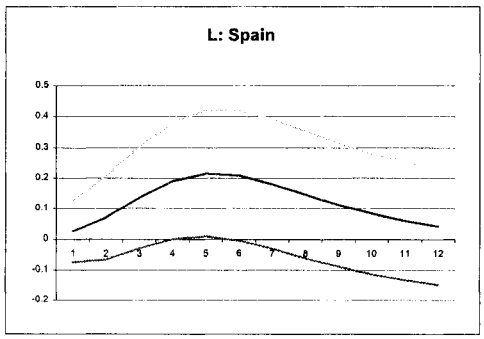




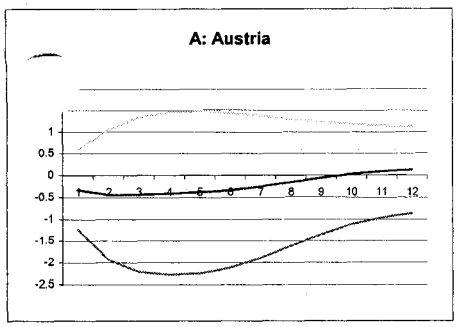


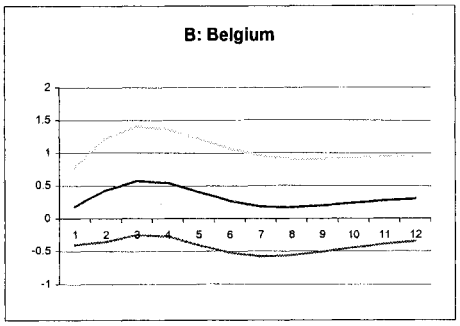


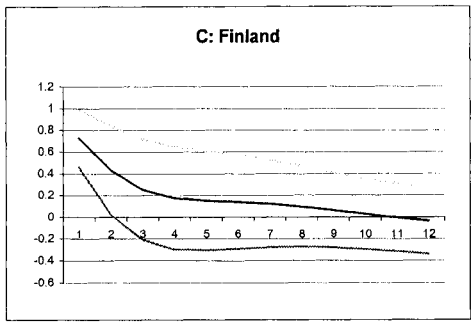


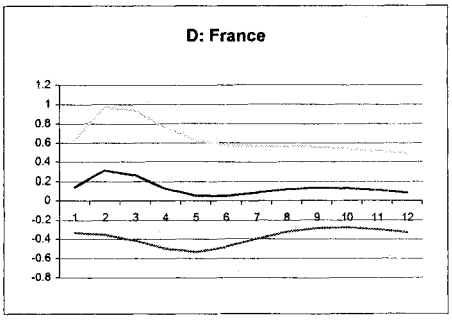


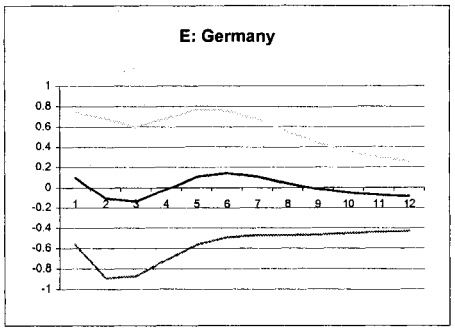
Pre-Maastricht
3: Shock to Finnish Interest Rate on National Interest Rates

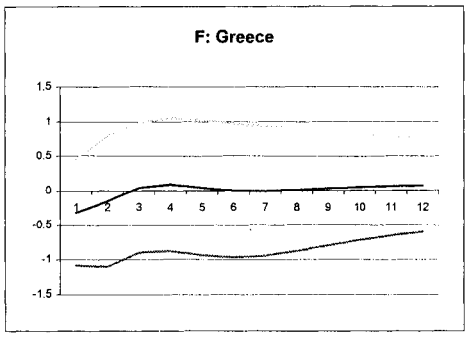


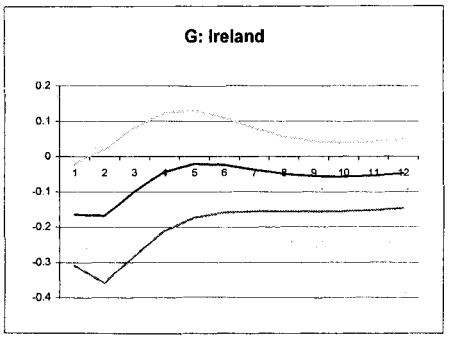


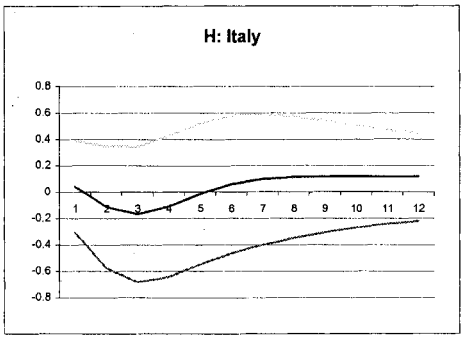


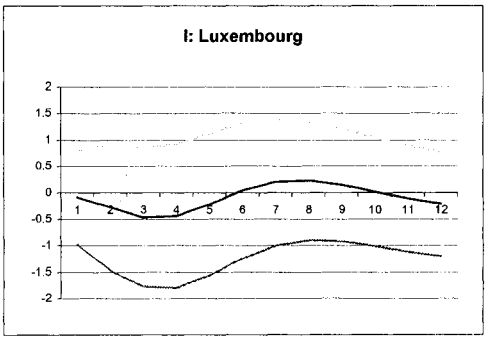


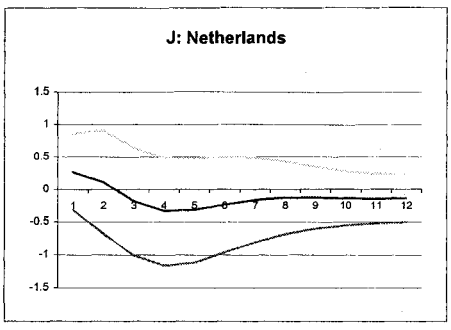


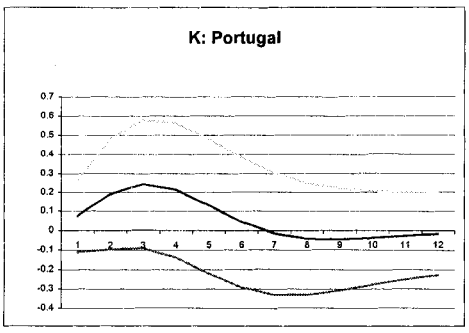


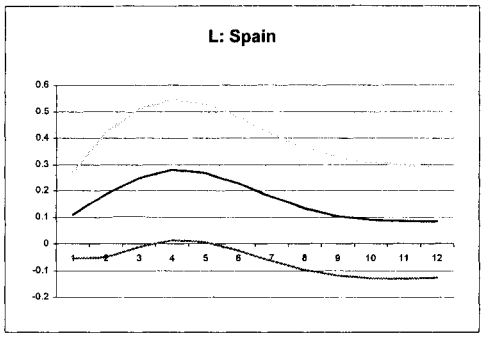




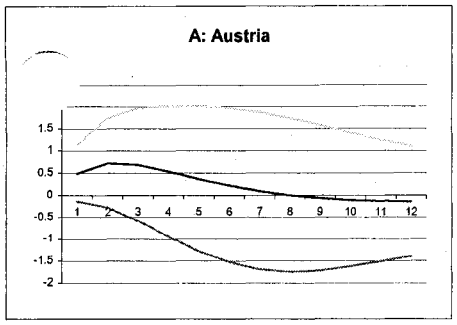


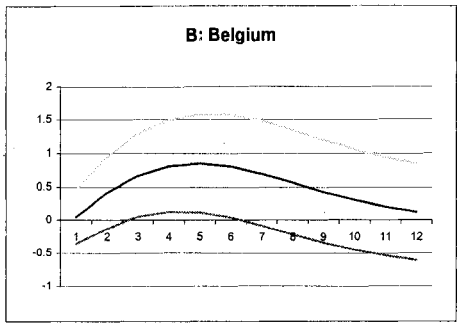


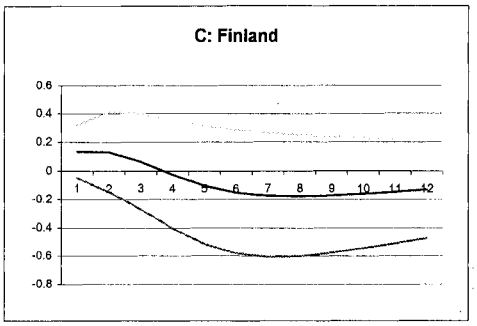


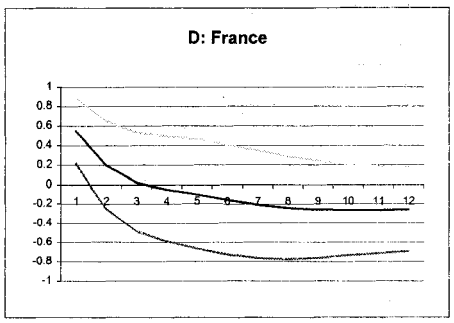


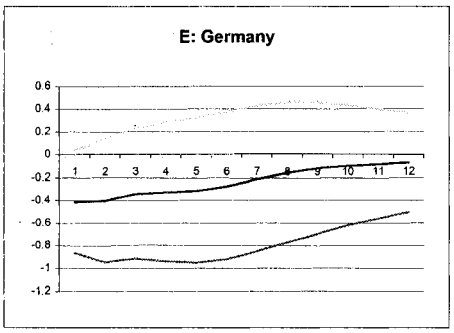
Pre-Maastricht
4: Shock to French Interest Rate on National Interest Rates

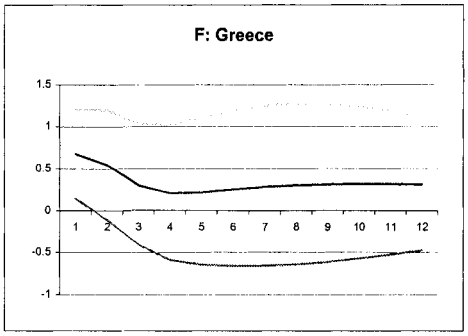


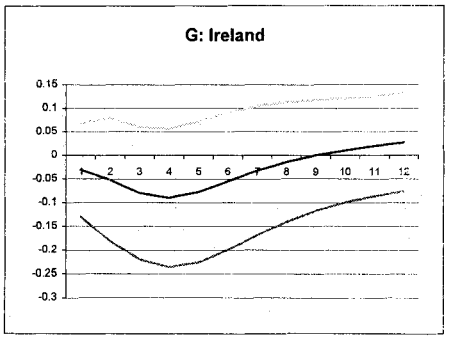


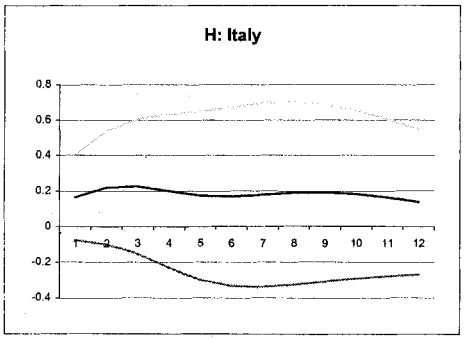


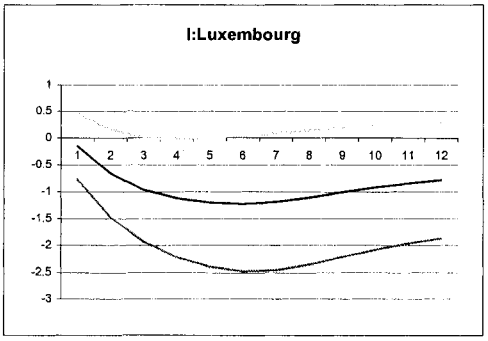


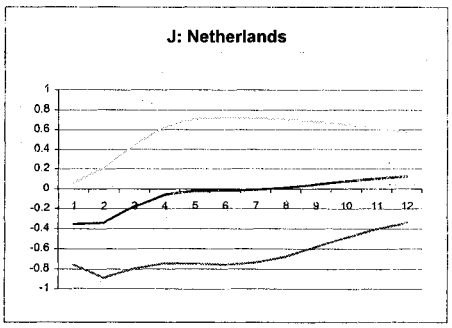


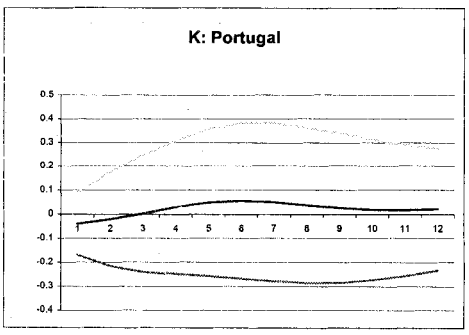


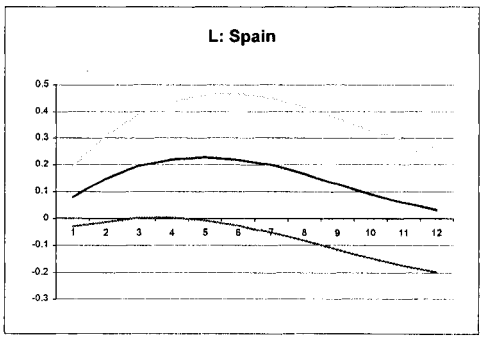




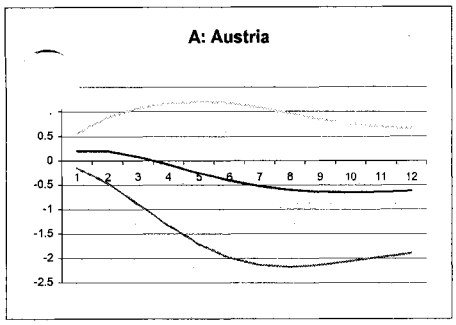


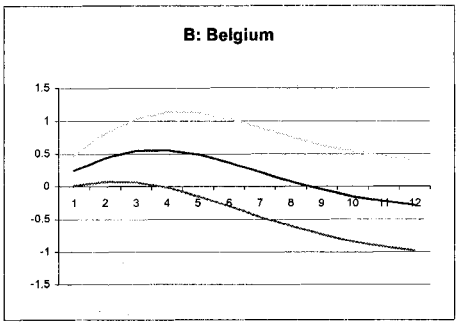


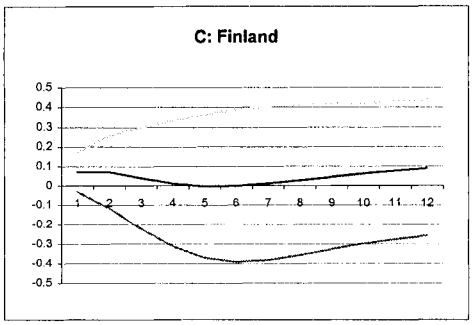


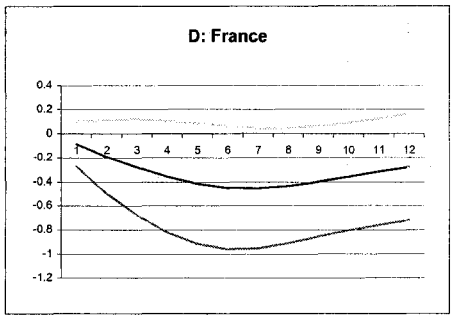


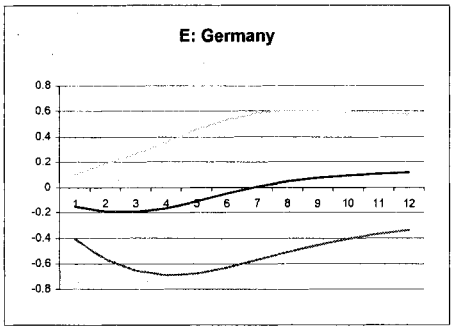
Pre-Maastricht
5: Shock to German Interest Rate on National Interest Rates

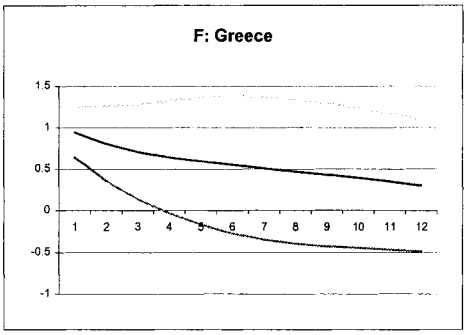


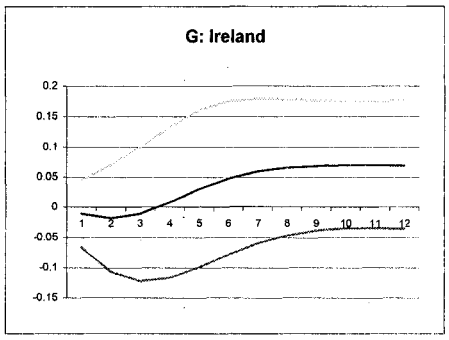


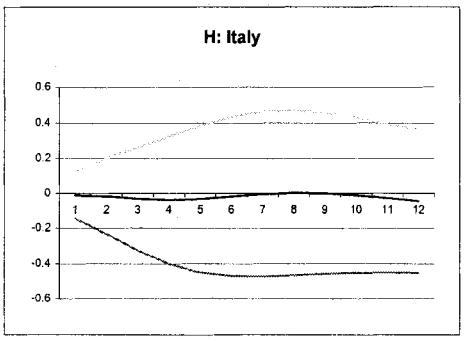


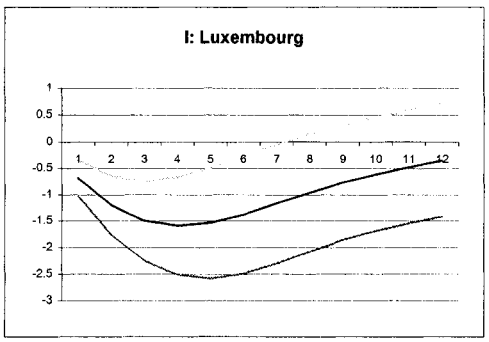


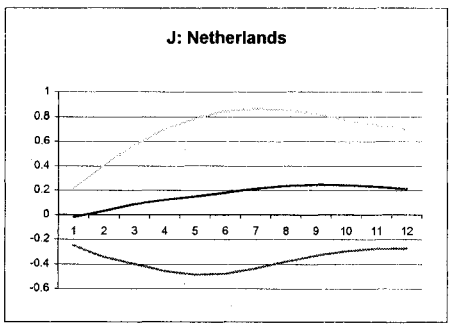


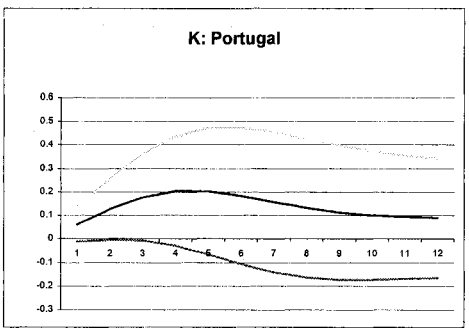


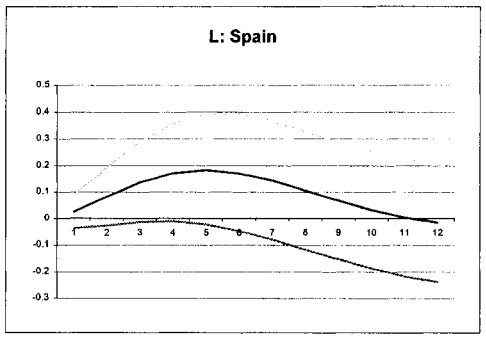




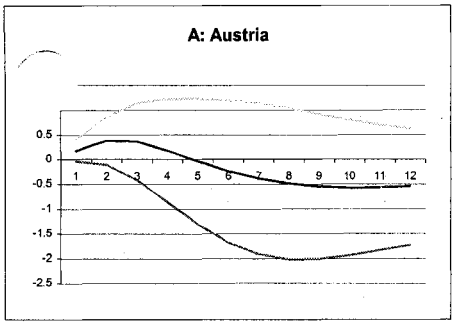


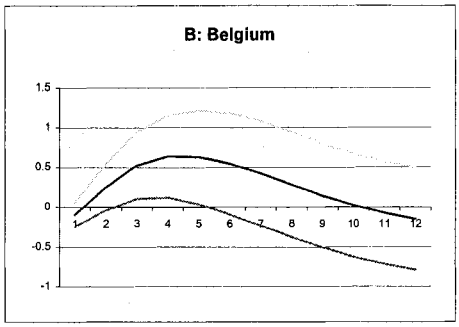


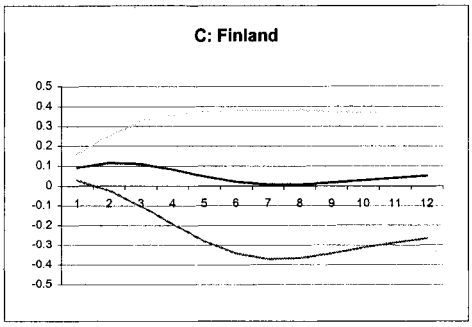


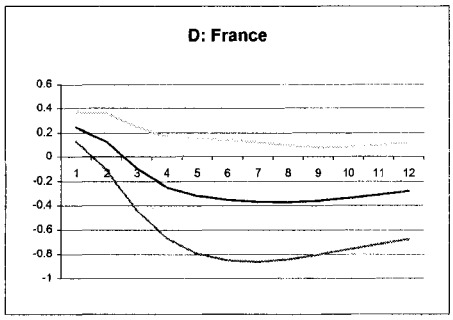


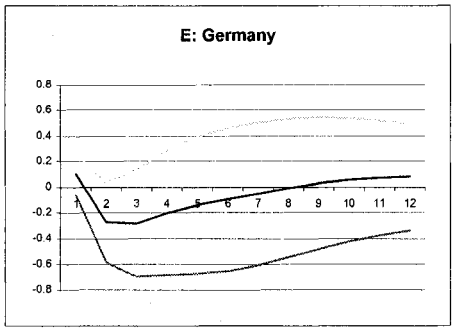
Pre-Maastricht
6: Shock to Greek Interest Rate on National Interest Rates

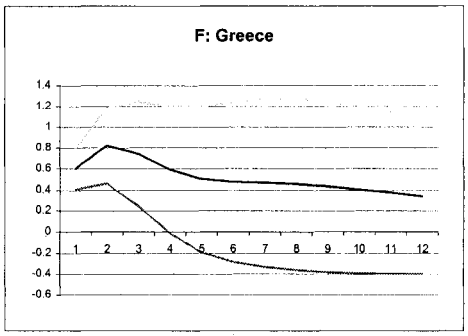


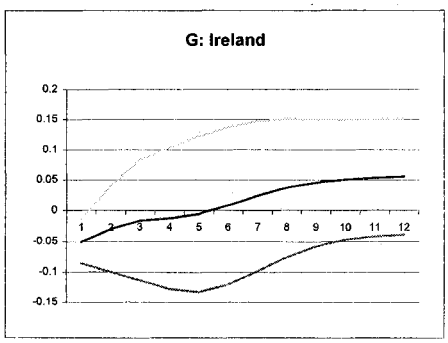


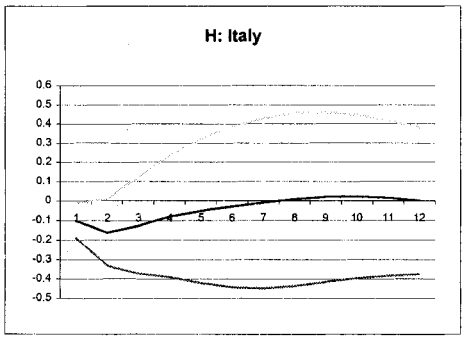


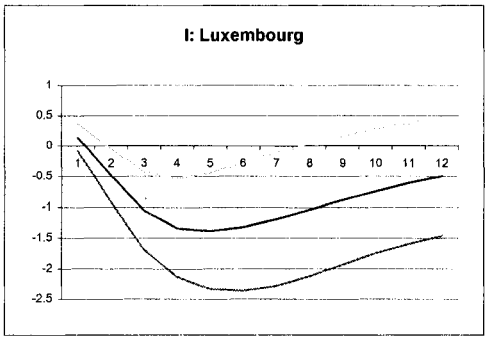


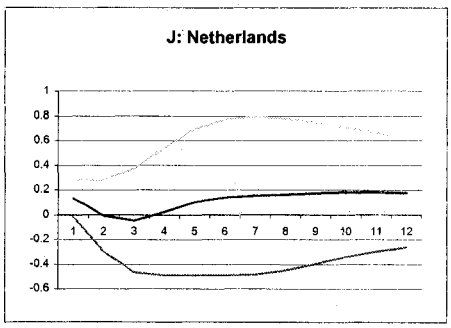


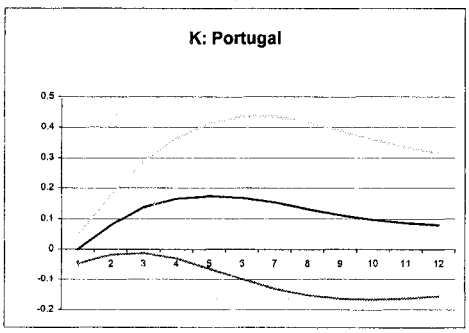


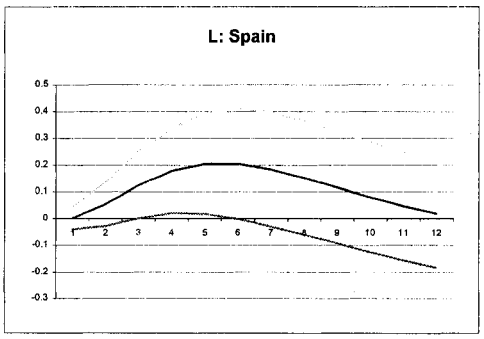




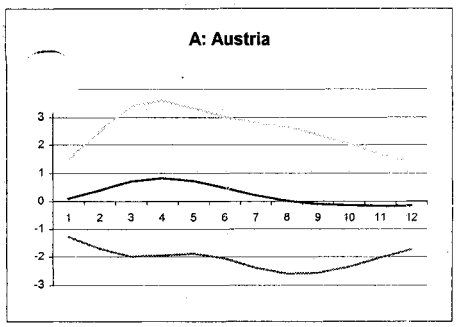


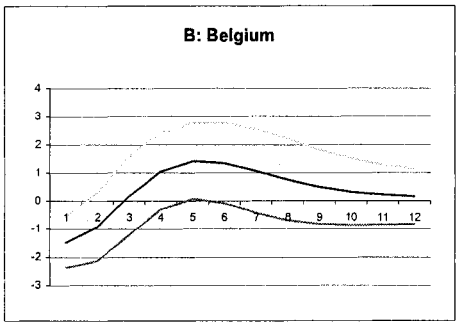


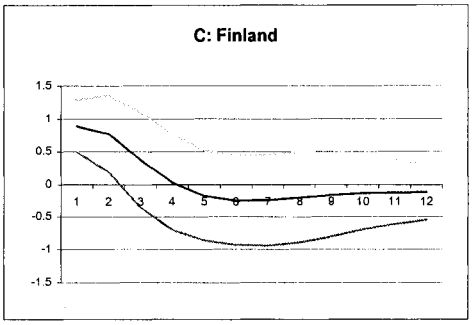


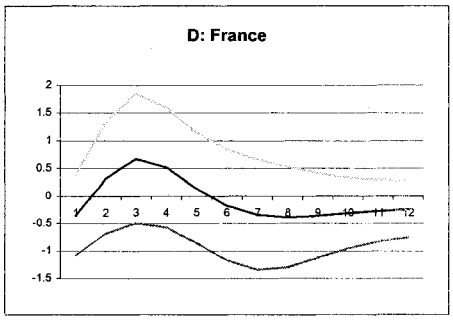


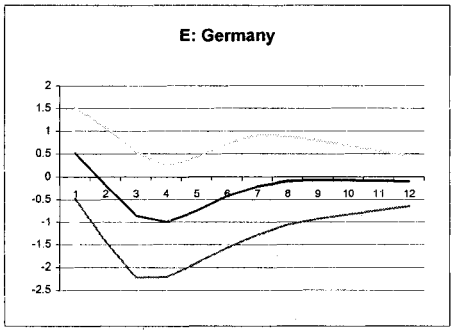
Pre-Maastricht
7: Shock to Irish Interest Rate on National Interest Rates

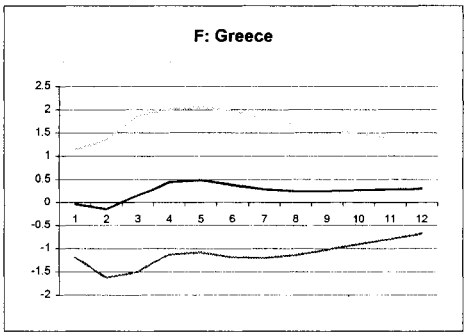


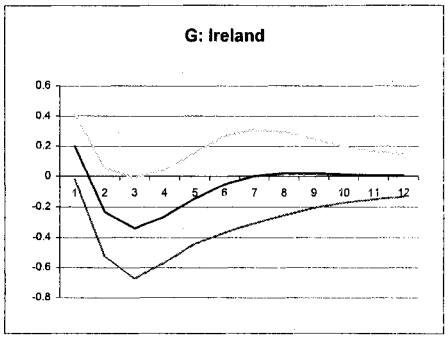


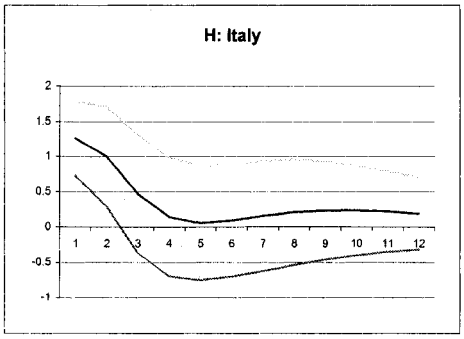


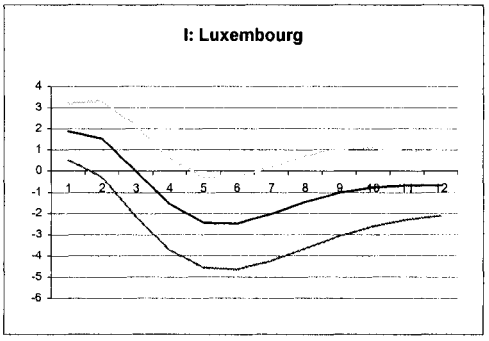


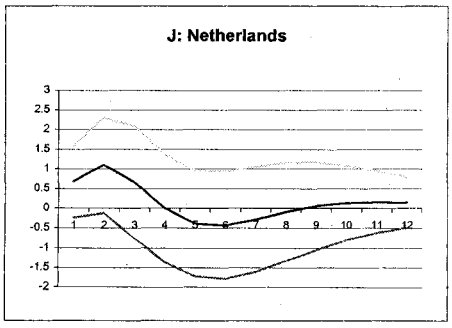


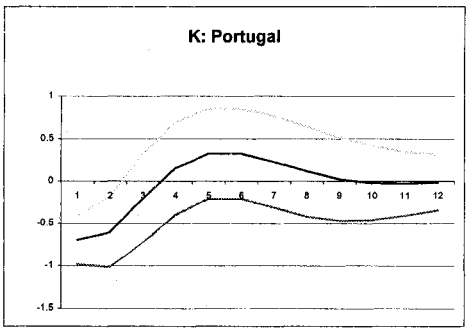


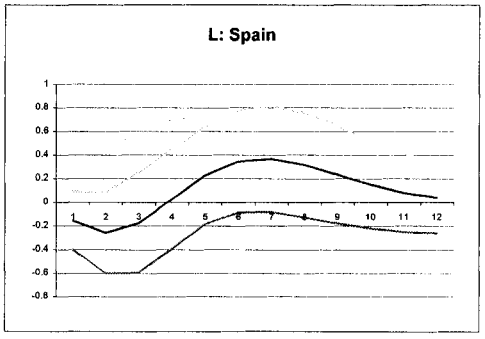




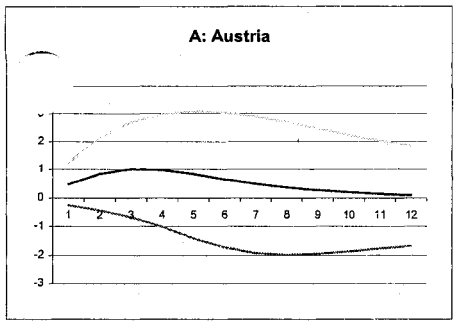


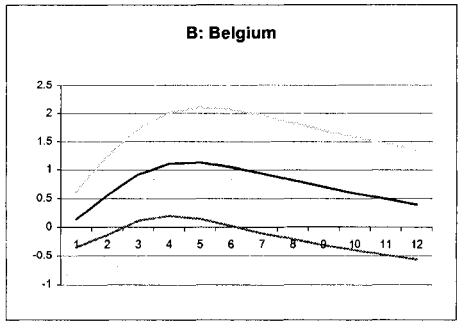


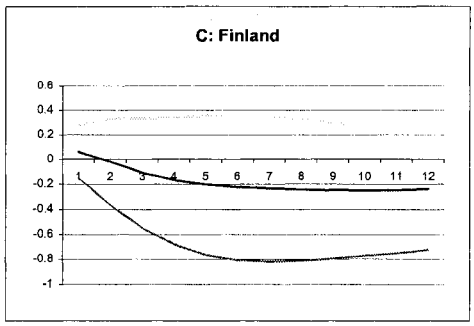


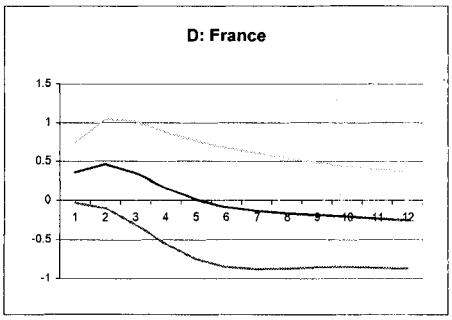


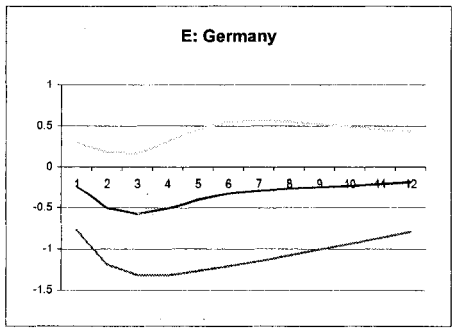
Pre-Maastricht
8: Shock to Italian Interest Rate on National Interest Rates

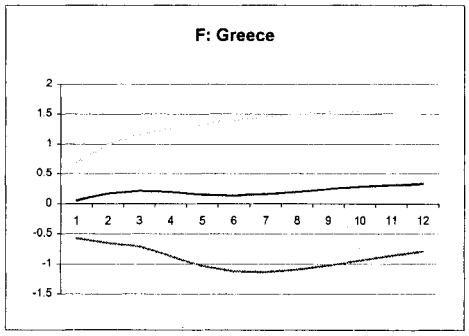


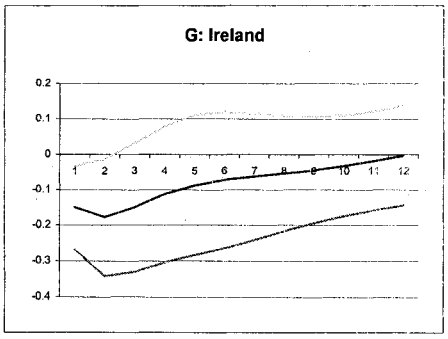


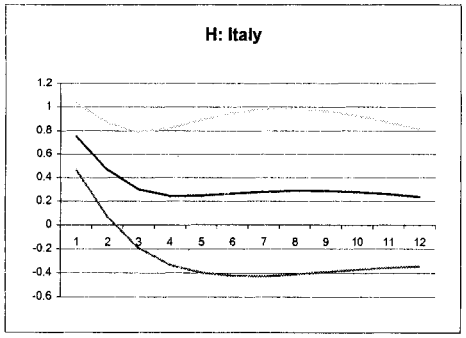


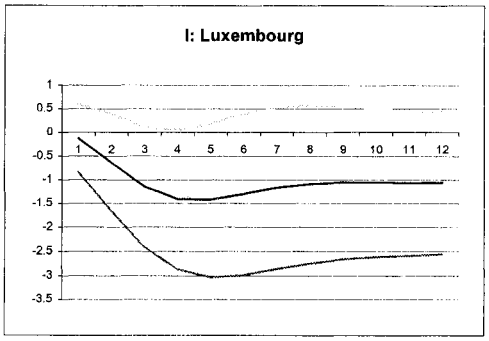


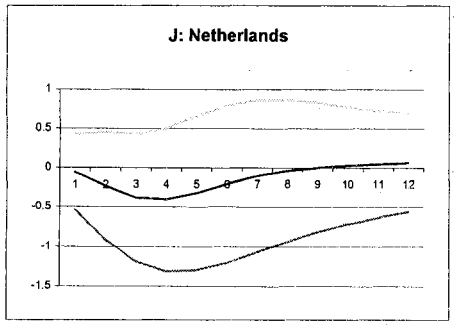


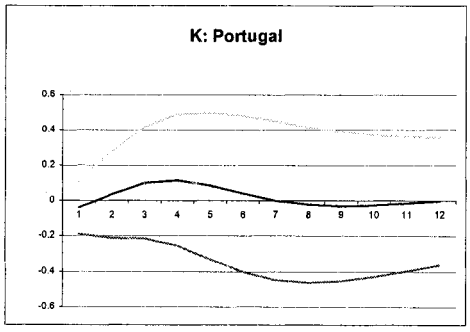


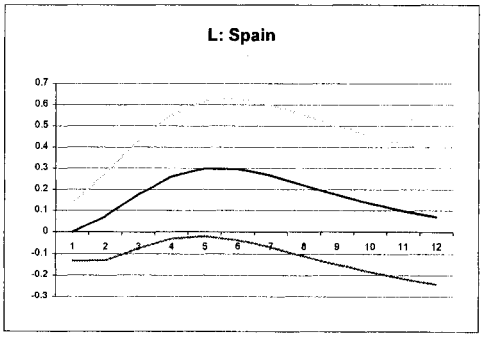




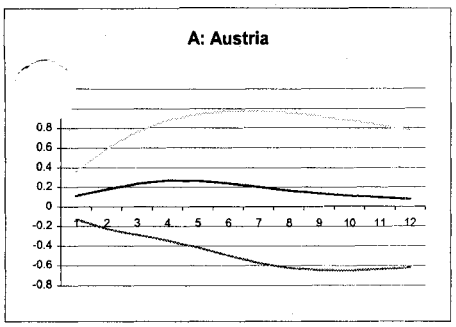


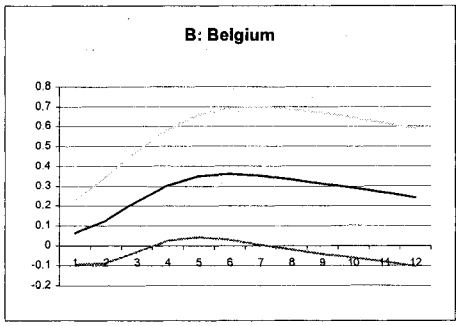


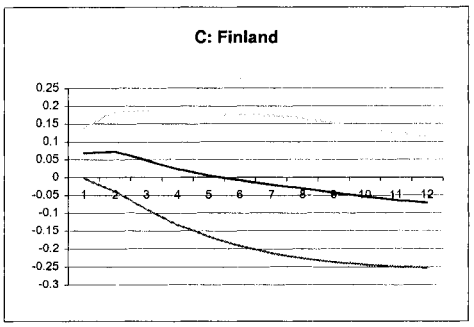


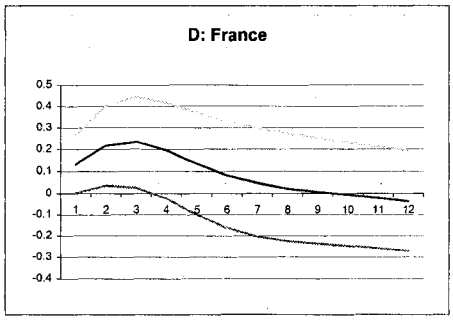


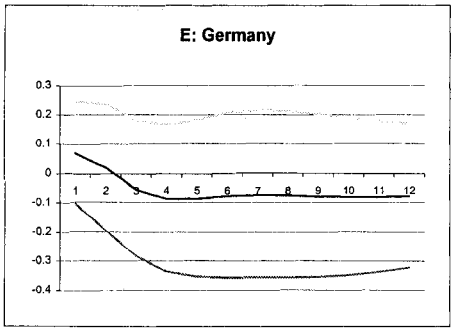
Pre-Maastricht
9: Shock to Luxembourg Interest Rate on National Interest Rates

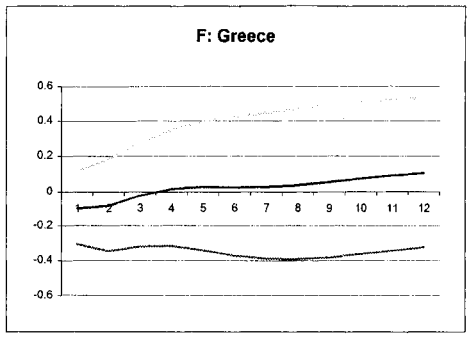


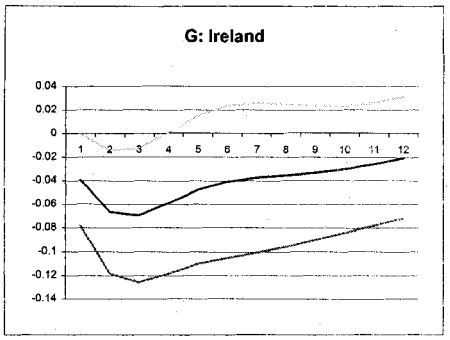


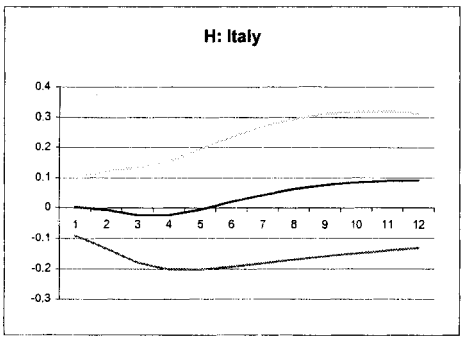


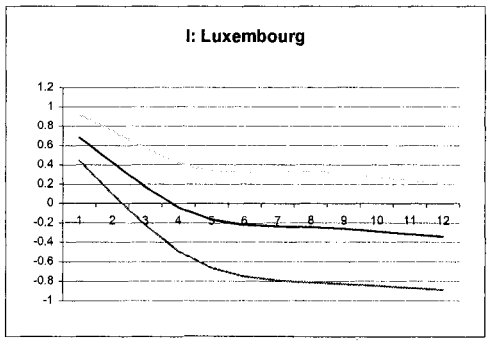


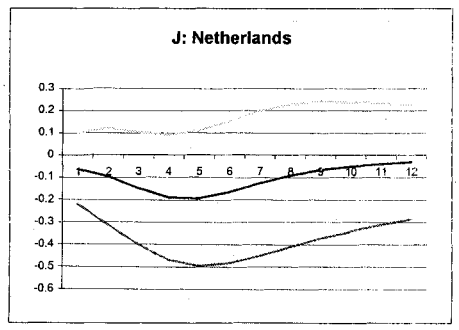


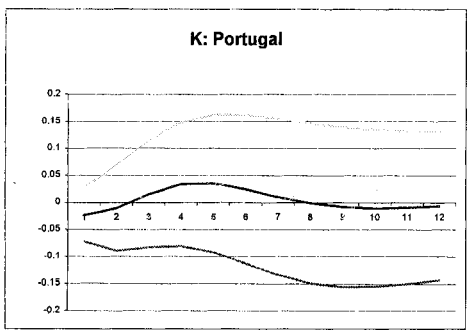


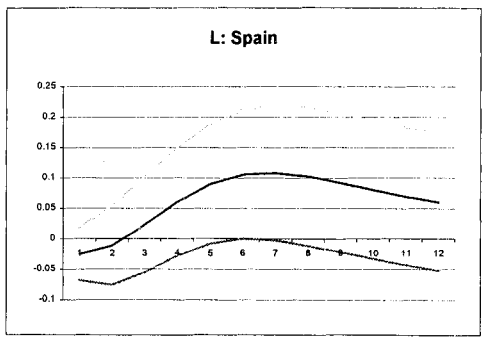




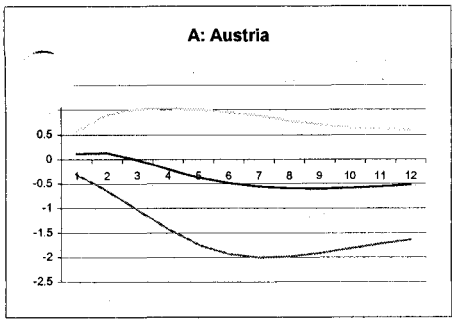


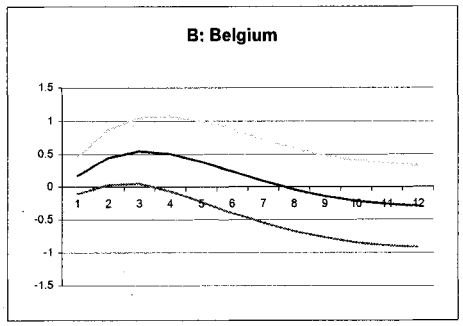


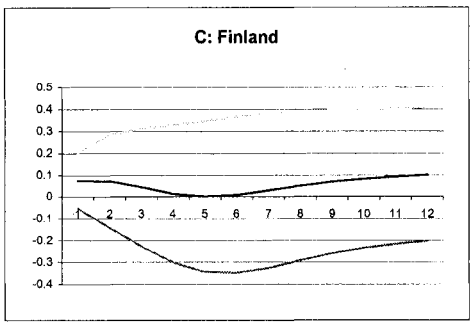


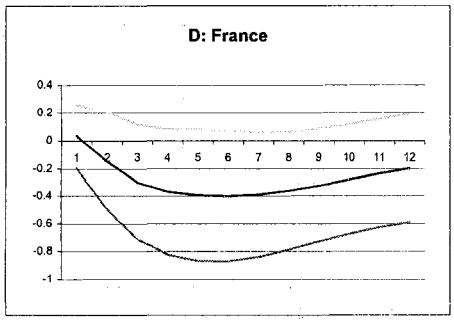


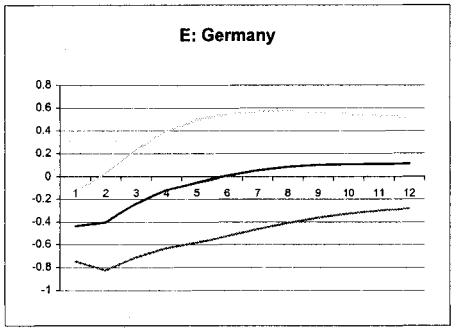
Pre-Maastricht
10: Shock to Dutch Interest Rate on National Interest Rates

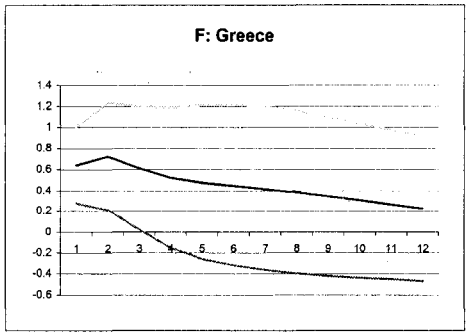


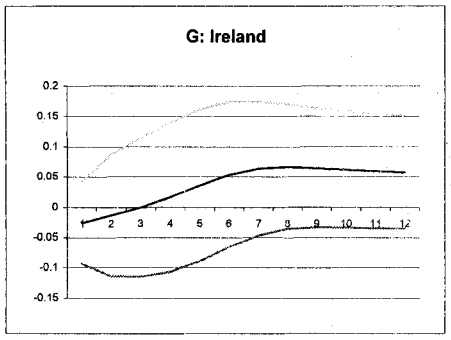


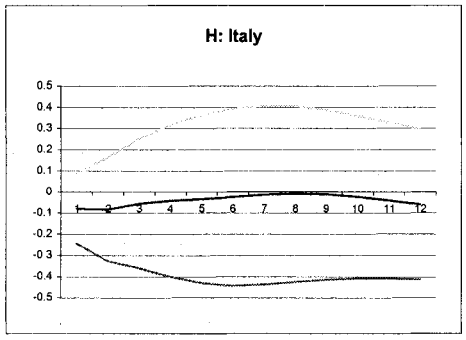


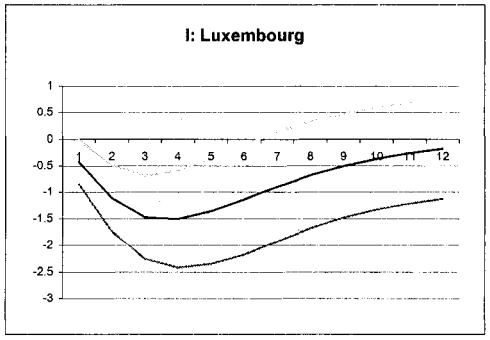


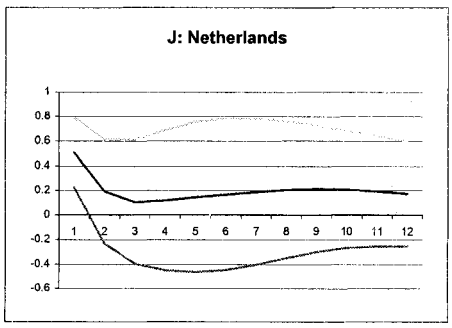


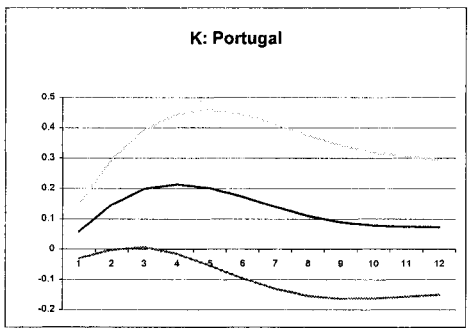


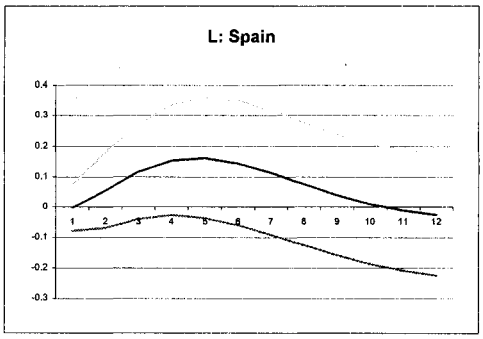




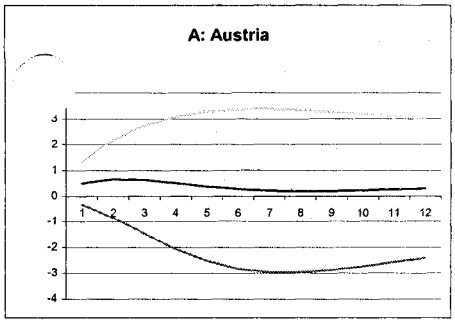


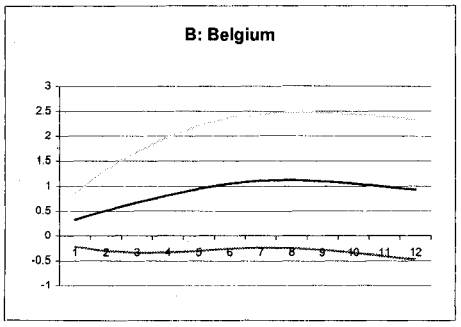


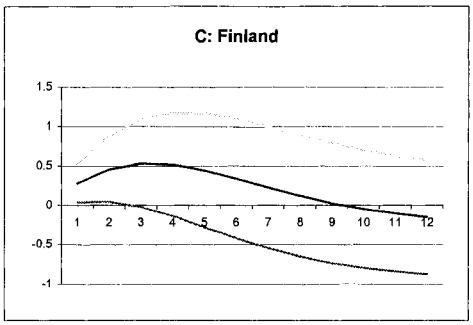


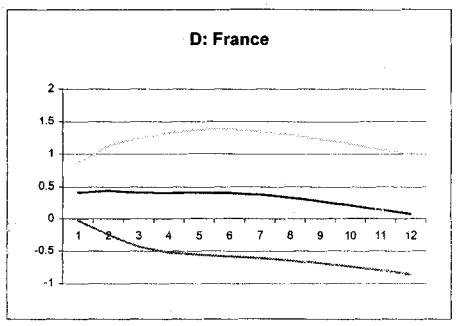


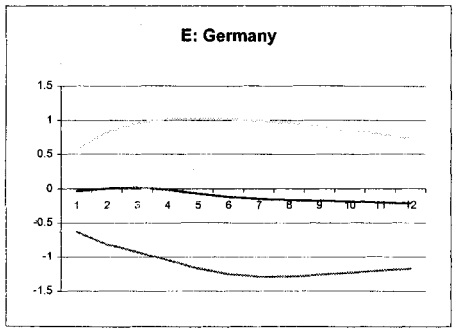
Pre-Maastricht
11: Shock to Portuguese Interest Rate on National Interest Rates

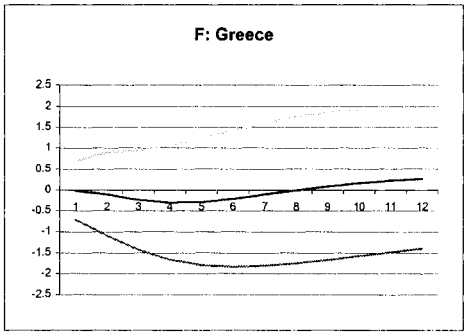


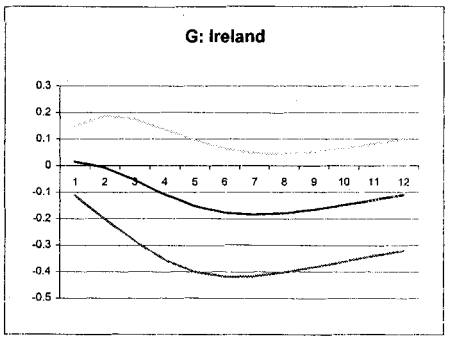


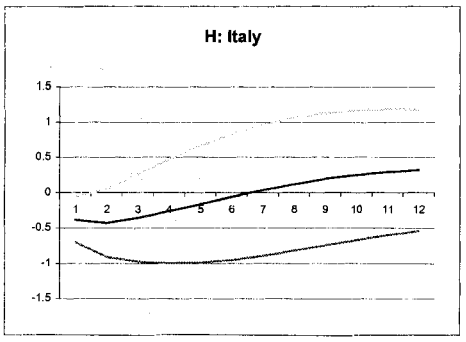


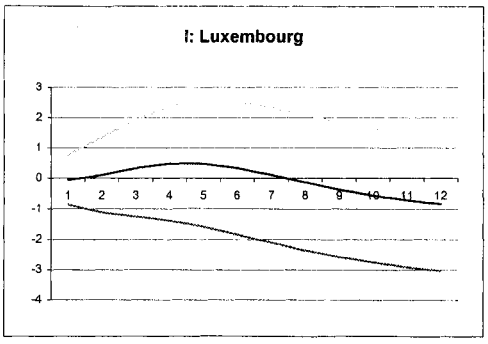


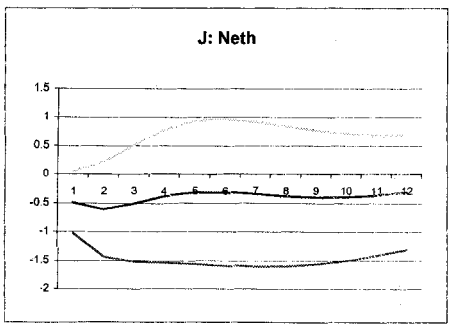


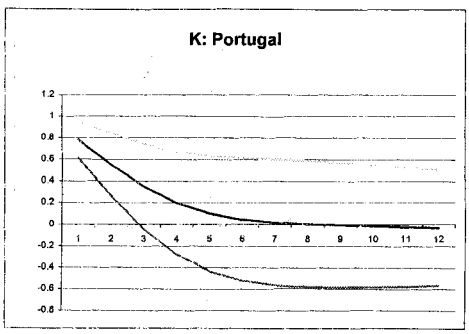


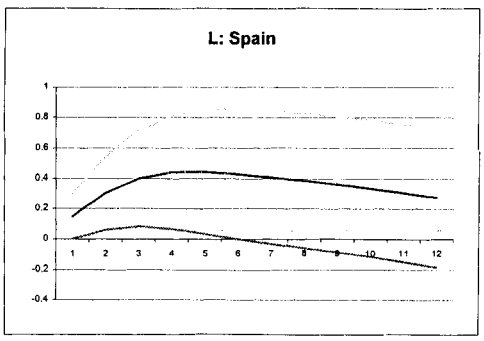




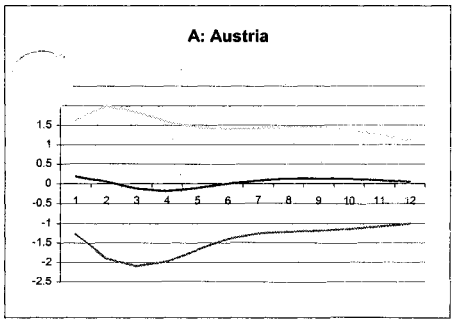


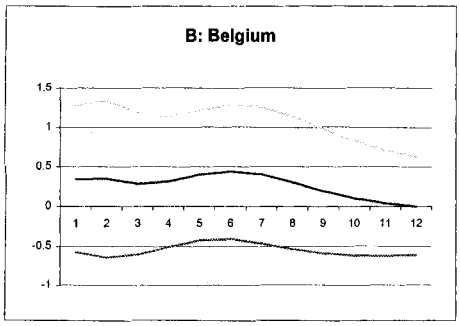


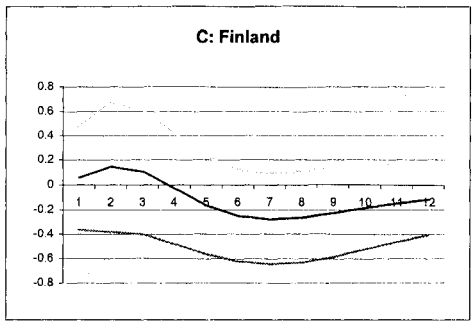


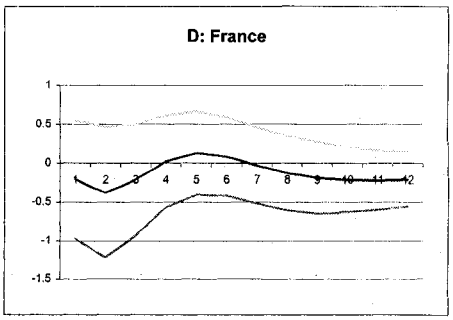


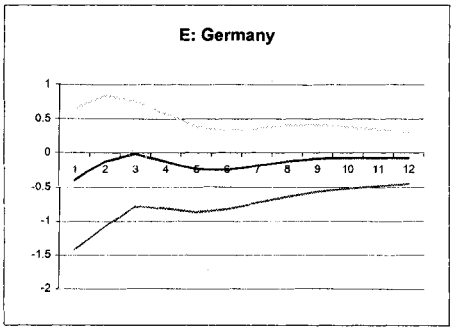
Pre-Maastricht
12: Shock to Spanish Interest Rate on National Interest Rates

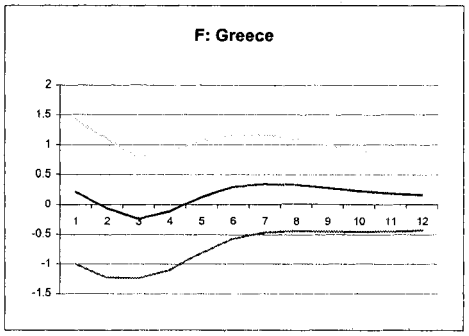


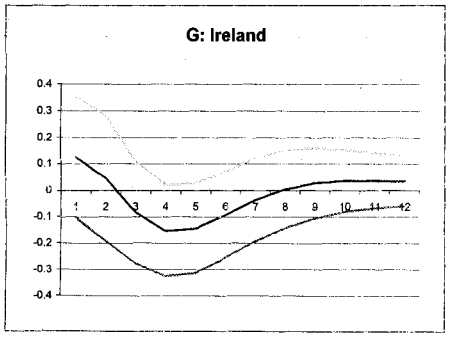


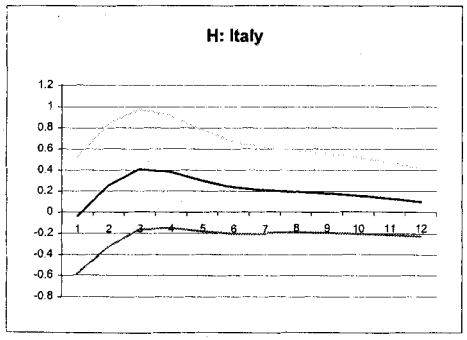


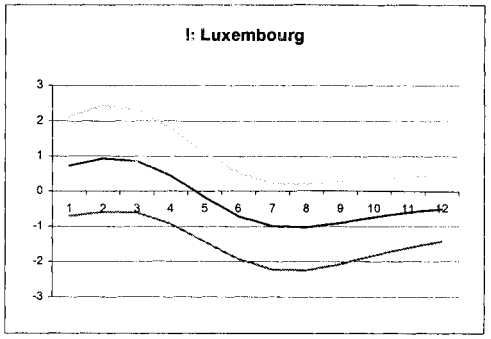


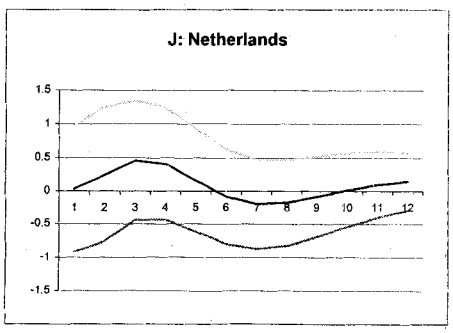


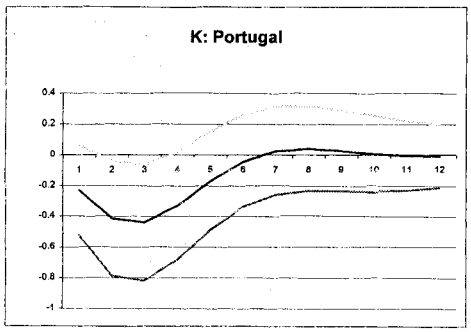


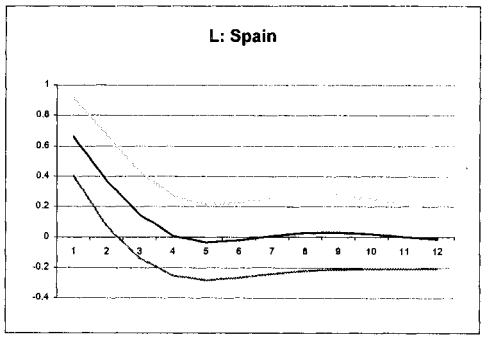












Geralynn Batista

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Asymmetries In The Euro Area Economies: Obstacle For European Central Bank Efficiency?

Dissertation directed by Dominick Salvatore, PhD

Both the successes and failures of the European Central Bank (ECB) will affect not only members of the euro zone, but also the global economy in general. While the creation of the ECB and the euro has brought greater prosperity to the euro area economies, its long-term efficiency and stability will depend on the efficacy of the ECB in addressing some critical obstacles to its success. This paper evaluates the efficiency of the European Central Bank in maintaining an unbiased monetary policy with a goal of price stability, and assesses the reaction of the national economies to economic shocks. To do so, it tests the efficiency of the monetary policy tool used by the ECB and evaluates its national transmission. Specifically, four questions are posed and resolved. First, has the implementation of a common monetary policy significantly changed the monetary policy previously in practice? Second, are the member countries adhering to the policy guidelines of the ECB, and are they better off ? Third, are the costs and benefits of the common monetary equally distributed to all euro area economies? That is, is the ECB biased? And fourth, are the national economies synchronized enough to thwart any potential asymmetric shocks from rendering the ECB policy inefficient.

VITA

Geralynn Batista, daughter of Donald and Lucille Batista, was born on April 23, 1973, in Bronxville, New York. After graduating in 1991 from the Ursuline School in New Rochelle, she entered American University. In 1995, she received the Bachelor of Science degree in International Relations.

She then went on to pursue a Master of Arts degree in International Relations, which she received in 1998 from American University. Thereafter, she worked for the International Plant Genetic Resources Institute in Rome, Italy, and then at the World Bank in Washington D.C. She entered the PhD program in Economics at Fordham University in 2000 as a Presidential Fellow. She was also awarded the Dissertation Research Grant in 2003. She worked toward her doctoral degree under the mentorship of Dr. Dominick Salvatore. In August 2003, she joined the Capital Markets Associate Program at Lehman Brothers in New York.