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February 2009

Two Speed Europe and Business Cycle Synchronization in the European Union: The Effect of the Common Currency

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Abstract

The purpose of this paper is to examine the effectiveness of the policies and procedures towards economic convergence between the countries that participated in the European Exchange Mechanism I and which are now members states of the Eurozone. The question is whether the introduction of the common currency has led to more synchronisation of the business cycles of member states or it has acted as the monetary ground for the creation of a multi-speed Europe that includes economies that bear little resemblance in terms of their basic economic features and figures and especially with respect to the fluctuations in their Gross Domestic Product. The empirical analysis is done through the use of linear regressions, the estimation of the correlation coefficient, and also a proposed sign concordance index (SCI). The results provide evidence that the synchronisation of the cycles seem to become weaker since the adoption of the new currency. Especially for G6, the group of the smaller regional economies, the results are consistent throughout all three methodologies used and for both groups of countries' cycles used as a comparison base, the broad EU15 and the narrow G3.

Keywords: Business Cycle, Synchronisation, Eurozone.

1. Introduction

The European economic and monetary union is a reality since 1999, when eleven of the fifteen members of the then European Union adopted a common currency, the euro. In 2002 the common currency was put in circulation by the European Central Bank (ECB) and substituted the national currencies of the participant countries. Not only after the introduction of the common currency, but also for many years before, there had been a lot of criticism about the effectiveness and the suitability of the adaptation of one single currency from a large and diverse group of national economies. One of the main arguments was that the degree of business cycle synchronization between the member states of the European Union (EU) was not the proper for the formulation of a common currency area.

The main aim of this paper is to shed light on the question of whether the synchronisation of business cycles of the economies participated in ERM I and are currently members of the Eurozone has improved with the introduction of the common currency. In that respect, we use quarterly data for the gross domestic product (GDP) that spans the time period from the first quarter of 1992 to the fourth quarter of 2007. The data were obtained from the Organisation of Economic Cooperation and Development (OECD) database and they pertain to the fourteen countries that participated in ERM I, namely, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, the Netherlands, Portugal Spain, and the United Kingdom, and also the GDP series for the cumulative EU15 GDP and two subgroups of countries the G3 (Germany, France and Italy) and G6 (Spain, Austria, Finland, Greece, The Netherlands and Belgium). The total of seventeen quarterly nominal GDP time series was first transformed in real prices and then to logs. In order to decompose the series of real GDP and extract the cycle component for further empirical analysis, the commonly used Hodrick-Prescott (1997) filter and also a regression decomposition were employed. To test the impact of the introduction of the common currency on business cycle synchronization we then use two subperiods: the one before the adoption and circulation of the common currency (1992:I-2001:IV) and the other after the circulation of the euro (2002:I-2007:IV). The extracted cyclical components that represent the member states' business cycles were then studied through the use of two methodologies, the correlation coefficient and the proposed Sign Concordance Index (SCI).

The decade followed the Great Depression, research on the area of cyclical phenomena started to develop; see Shumpeter (1939) and Haberler (1944). Burns and Mitchell (1946) were the first that used new statistical parameters among which the study of fluctuation time series in a predetermined breadth of frequencies. Later on, many statistical

methods began to be used progressively for the extraction and measurement of the business cycle. One of the prominent methodologies of the era was the use of moving averages among others [see Bry and Boschan (1971)]. More recently, according to Sims (1977), Lahiri and Moore (1991), and Stock and Watson (1993), two main trends in empirical research pertaining to business cycles, prevailed. The first is related to the methodologies employing moving averages, or in other words filters. The second trend corresponds to the complex statistical approaches for the extraction of the cyclical component, where systems of equations dominate the analysis. Currently, the prevailing practice in the literature of business cycles and the means of their extraction from the trend, is the use of filters. Unquestioningly, the export and measurement of the business cycle is a difficult task. Baxter and King (1999) observed that the problem in its core is in fact the same that Burns and Mitchell (1946) faced roughly fifty years ago, the segregation of economic cycle from the long-term trend, seasonal effects and erratic changes.

Several studies on business cycles deal with the degree of synchronisation between the economies of the European Union (EU). Artis and Zhang (1997) and (1999) use the method of correlation coefficient for thecountries that participated in the Exchange Rate Mechanism I (ERM I). Their results show that the business cycles of the countries that participated in ERM I, were better synchronised to the cycle of Germany, after the end of ERM I, providing positive evidence on the shaping of a "unified" European business cycle. Christodoulakis, Dimelis and Kollitzas (1995) focus their study on the initial twelve country members of the European Union up to 1994. They analyze time series of macroeconomic variables from the 1960's and show that there is no dichotomy between the big mainland Europe countries and the small peripheral countries of the Union. They find evidence that the business cycles are similar for the endogenous variables (income and consumption), while this is not the case for the exogenous variables they use (those that are controlled by the government like government spending). In contrast to the results of Artis and Zhang (1997) and (1999), Dickerson et al (1998) do not find enough evidence of synchronisation of economic cycles between the EU12 economies after the operation of ERM I. Using GDP data from 1960 to 1993 on private consumption and investment, they separate the initial twelve members of the European Union into two sub-groups: A core group (Germany, France, Belgium, Luxembourg and Holland) and a group comprised from the remainder countries of the EU. They claim that there exist elements of homogeneity between the economic cycles of the countries included in the core group, something that is not evident for the twelve countries as a whole. Wynne and Koo (2000) examine the cross-correlation of the EU15 and they reject the hypothesis that

there is no correlation of the cyclical component of product for the six founding members of the EU. However, they find lower correlation between the countries that participated in the ERM I later on. They also present empirical evidence in favour of the claim by Frankel and Rose (1998) that countries with developed commercial relations between them present higher cross-correlation of their business cycles. More evidence on the synchronisation of economic cycles in Europe are provided in Inklaar and Haan (2001). They use the same countries as Artis and Zhang (1997) and (1999) but distinguish four sub-periods instead of the two used by Artis and Zhang (1997). They claim that for most countries that participated in the ERM I there is an increase of cross-correlation of cyclical component of product for the period 1971-1979 while for the period 1979-1987 they observe a reduction of cross-correlation. These findings are in contrast to the findings of Artis and Zhang (1997) and (1999).

In general, there are two main reasons for which we find conflicting conclusions in various studies. The first is the methodology employed for the calculation of the cyclical component. Christodoulakis, Dimelis and Kollitzas (1995), Inklaar and Haan (2001) and Dickerson et al. (1998) use the Hodrick-Prescott (1997) filter. Artis and Zhang (1997) use three methods: the one proposed and used by OECD, the Hodrick-Prescott (1997) filter and a linear trend extraction methodology. Finally, Wynne and Koo (2000) employ the filter proposed by Baxter and King (1995). The second source of conflicting results is that there is no consensus on the minimum value of the correlation coefficient that would indicate business cycle synchronization.

Section 2 of this paper discusses the data used, while section 3 describes the three methodologies we employ to assess in section 4 the degree of business cycle synchronization based on the empirical results. Finally, in section 5 we summarize our conclusions.

2. The Data

The data used in this paper are from the OECD data base and they include the economies that participate in the Economic and Monetary Union (EMU) and have adopted the euro as their common currency: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, The Netherlands, Portugal, and Spain. We also included Denmark and United Kingdom as they originally participated in the EU15. Furthermore, we included the time series for three groups of countries, the G3 that comprises the three largest -in terms of GDP- countries that are members of the eurozone: Germany, France and Italy, and the group G6 that includes the rest of the countries that are part of the eurozone and for which enough data are available to produce comparable results: Austria, Belgium, Finland, Greece, The

Netherlands and Spain. Finally, we use the EU15 group that is comprised of the fifteen countries that participated in the EU before the enlargement of May 1, 2004. The data used are seasonally adjusted quarterly GDP figures in current prices that are transformed in real GDP figures using the seasonally adjusted quarterly GDP deflator with base the year 1995. Then the data are transformed into natural logarithms. Thus, the data availability for each country and group is for the period 1992:I-2007:IV with the following exceptions: Belgium (1992:I-2007:III), Greece (1992:I-2006:III), Ireland (1997:I-2007:III), Italy (1992:I-2007:III), Luxembourg (1995:I-2007:III), The Netherlands (1992:I-2007:III) and Portugal (1995:I-2007:III). For the (G3) the data are for the period 1992:I-2007:III while for G6 the data are for 1992:I-2006:III. For comparison reasons, in the empirical part of the paper we divide the sample data in two sub-groups before and after the introduction of the new common currency, the euro, in 2002:I.

3. The Methodology

In this paper the cycle component is extracted through the use of the Hodrick-Prescott filter (HP)[1]. The HP filter is commonly used in the area of Real Business Cycles[2]. It produces a smooth non-linear trend which is affected more from the long-term fluctuations rather than the short-term ones. The adaptation of the filter sensitivity in long-term fluctuations is achieved through the use of the factor λ which takes certain numbers depending on the data frequency. The filter's contribution is to distinguish an observed shock into a component that causes permanent effects and a component that has provisional effects on the economy. Through the use of the HP filter the main object is the extraction of the trend, τ_t, from a time series y_t so as to isolate the cyclical component c_t via the process of minimising the fluctuations of variable y_t around its long lasting trend τ_t. The minimisation of the variable τ_t is calculated as follows:

$$\min_{\tau_t} \sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2 \qquad (1)$$

[1] Hodrick, R., and E.P. Prescott (1997), "Postwar Business Cycles: An Empirical Investigation," Journal of Money, Credit, and Banking.

[2] Cogley, T. and J.M. Nason., (1995), Effects of the Hodrick-Prescott Filter on Trend and Difference Stationary Time Series: Implications for Business Cycle Research, Journal of Economic Dynamics and Control, p. 254.

where y_t is the initial time series and τ_t is the long-term trend and t = 1, 2, …, T. The term $\sum_{t=1}^{T}(y_t - \tau_t)^2$ measures the adaptation (fitness) of the time series while the term $\lambda\sum_{t=2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$ measures the degree of smoothness of the trend. The minimisation of equation (1) contributes to the extraction of the trend τ_t from the time series y_t with the cyclical component c_t being determined from the time series residuals. The factor λ measures the degree of smoothness of the calculated trend. When $\lambda = 0$ the trend component is equal to the variable y_t. As λ increases, the trend component becomes increasingly linear. For quarterly data, Hodrick and Prescott (1997) proposed the use of $\lambda = 1600$.

The first method employed to examine the degree of synchronisation of economic cycles is the linear regression. We regress the extracted cyclical component from the time series of the logarithms of the seasonally adjusted real GDP of each country against the cyclical component of EU15:

$$c_{it} = \alpha + \beta c_{EU15t} + \sum_{i=1}^{j}\gamma_i c_{i(t-i)} + \varepsilon_t, \qquad (2)$$

and the cyclical component of the group G3:

$$c_{it} = \alpha + \beta c_{G3t} + \sum_{i=1}^{j}\gamma_i c_{i(t-i)} + \varepsilon_t, \qquad (3)$$

Where c_{it} represents the cyclical component of the studied countries, and c_{EU15t} and c_{G3t} are the cyclical components for the EU15 and the G3 groups respectively. In equations (2) and (3), the optimal value of j is selected such that ε_t is not serially correlated according to the Q(20) test statistic of Ljung-Box (1978)[3]. In Tables 1 and 2, we produce results for sixteen regressions for each equation. Results are been reported not only for the period 1992:I-2007:IV but also for two separate sub-periods: the period before the introduction of the common currency, the euro, from 1992:I to 2001:IV and the period after the circulation of the common currency from 2002:I to 2007:IV. This is done in an effort to assess whether the introduction of the new currency had any positive impact towards synchronization of the

[3] Ljung, G. M. and G. E. P. Box (1978), On a measure of lack of fit in time series models, Biometrika.

business cycles for the EU countries, in terms of a higher β coefficient in the second sub-sample.

The next methodology employed is that of the correlation coefficient. The method focuses on the cross-correlation which is a pure number (in the notion that it is not influenced by units of measurement) and is used for the comparison of the degree of linear co-movement between different series. The correlation coefficient of two time series time X_t and Y_t is calculated as follows:

$$\rho_{XY} = \frac{\sigma_{XY}}{\sigma_X \sigma_Y} \quad \text{where } -1 \le \rho_{XY} \le 1, \qquad (4)$$

where, σ_X and σ_Y are the series' standard deviations and σ_{XY} is the their covariance. The correlation coefficient ρ_{XY} measures the degree of linear dependence between variables X and Y. We calculate the correlation coefficient for all countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal Spain, The Netherlands, United Kingdom) and groups of countries (G3, G6, EU15) with respect to G3 and EU15. As previously, we divide the data and report the results for two sub-periods: The period before the introduction of the common currency, the euro (1992:I to 2001:IV) and the period after the adoption and circulation of the common currency (2002:I to 2007:IV). The higher the correlation coefficient in the period after the circulation of the euro in comparison with the previous period, the better the synchronization of the business cycles for the EU countries.

The third methodology we employ in testing the degree of business cycle synchronization is the proposed Sign Concordance Index (SCI). With the SCI, the sign of the cyclical component time series for each country and group of countries is used as a measure of the concordance of the cycles and synchronization. When for a specific quarter one country's or group of countries' cycle has the same sign, positive or negative, with the compared group of countries' cycle either EU15 or G3, this means that, for that quarter, they are both above or below the long term trend of their real GDP. Thus, their cycles are in concordance. Pairs of countries that show a high percentage of concordance in their cycles are said to have a high degree of business cycle synchronization.

$$SCI_{ig} = \frac{\sum_{j=1}^{n} k_j}{n} \qquad k_j = \begin{cases} 1 \text{ for } \text{sign}(c_{it}) = \text{sign}(c_{gt}) \\ 0 \text{ for } \text{sign}(c_{it}) \neq \text{sign}(c_{gt}) \end{cases} \qquad (4)$$

where SCI_{ig} is the concordance index of country or group of countries i with the group of countries g, c_{it} is the cyclical component at time t for the country or group of countries i, c_{gt} is the cyclical component at time t for the group of countries g, where $g = [EU15, G3]$ and n is the common sample size between the country or group of countries i and the group of countries g. Thus, $0 \leq SCI_{ig} \leq 1$, and it can be expressed as a percentage of the instances of coincidence of business cycles between country or group of countries i and the group of countries g. Again, we produce results for the two sub-samples 1992:I-2001:IV before the introduction of the new currency, and 2002:I-2007:IV after the euro was adopted within the eurozone. A higher concordance index in the second sub-sample period for a country or group of countries with respect to either EU15 or G3 is interpreted as a higher degree of synchronization of the two business cycles, providing evidence that the introduction of the euro was successful.

4. Empirical Results

Using the regression methodology as described in the previous section and the EU15 as the independent variable, we get the results presented in Table 1. For the period covering the entire sample 1992:I-2007:IV we observe that with the exception of Austria, all cycles are positively related to the EU15 cycle. Belgium and Denmark demonstrate the best degree of synchronization with β = 1,03 and 0,91 respectively, despite the fact that Denmark does not participate in the monetary union. From the group of the large economies, Germany and Italy present relatively high sensitivity (β=0,58 and β=0,57 respectively) with EU15 cycle while the G3 as whole has a high degree of synchronization with the EU15 cycle (β=0,75). Spain, also presents a relatively high degree of comovement with EU15 cycle (β =0,68). Ireland with β = 1.65 and Luxembourg with β = 1.86 show a very high sensitivity to the EU15 output fluctuations. The Netherlands, Portugal and Finland present medium to low degrees of sensitivity with β = 0.44, 0.34 and 0.28 respectively. The U.K. does not seem to be influenced by the EU15 output fluctuations (β=0,142). Finally, for Austria, France, Greece and the G6, the estimated coefficient is not statistically different from zero, implying no sensitivity to EU15. Analyzing the results from the sub-periods, we see that Austria, France, Ireland, Luxemburg and the Netherlands are more sensitive to the EU15 cycle before the circulation of the euro (1992:I-2001:IV). For the group of smaller economies, G6, we find that β is reduced from 1.653 to 0.664. On the other hand, the coefficient for G3 seems to be strengthened since

the circulation of the euro from 0,924 to 1,404 while Germany shows an over sensitivity in the second sub-sample as β increases from 0.798 to 2.040.

Using the G3 now as the independent variable in the regressions, and the entire sample, we find that, in general, all countries and groups of countries show a positive relation to the G3 cycle as before, with the exception of Austria and Greece where the estimated coefficients are not statistically significant. The three large economies Germany, France and Italy show as expected a high degree of synchronization with β = 1.08, 0.89 and 0.68 respectively. From the regional economies, Denmark shows high synchronization as β = 0.90, while Belgium and Spain are far below with β = 0.59 and 0.48 respectively. The Netherlands, Portugal and the U.K. follow with β = 0.40, 0.29 and 0.10 respectively. The group of regional countries G6 has a very low coefficient β = 0.20. In the two sub-periods (1992:I-2001:IV and 2002:I-2007:IV) the estimated β's with G3 as the independent variable as shown in Table 2. For Germany there is a strong positive –as expected- relationship in both periods. France, Italy[4], Luxembourg and the Netherlands all show overshooting behaviour to the G3 cycle during the first sub-sample that is reduced however significantly after the introduction of the euro. It is important to see that G6, the group of small regional countries, shows a significant decrease in the degree of synchronization of its cycle to the one from G3 after the introduction of the euro. The respective coefficient drops from an implied high cycle synchronization of 0.95 to 0.66 in the euro era. The estimated coefficients are not statistically significant for Finland, Greece and Italy for the first sub-sample and for Greece, Portugal, the U.K. and G6 in the second sub-sample. The only cases for which synchronization improves after the introduction of the euro are Denmark and Finland with β = 0.84 and 0.21[5] in the first sub-sample and 1.01 and 1.30 in the second respectively. Ireland from a highly significant β = 1.56 in the era before the euro reduces to 0.92 that is significant only at the 5% and not the 1% significance level. Finally, the cycle of the U.K. with its independent monetary policy seems to follow a completely different course as its coefficient β from a highly significant value of 0.70 becomes not statistically significant from zero after the establishment of the Eurozone.

The results of the calculation of the correlation coefficients are presented in Table 3 and 4 and they are also depicted in Figures 13 and 14, using again EU15 and G3 as the base for the calculation. In column two we present the correlation coefficients for the entire

[4] For Italy the estimated coefficient is only statistically significant at the 10% confidence level so results must be interpreted with caution.

[5] Not statistically significant with probability = 0.64.

sample, while in columns three and four we report the correlation coefficients for the two sub-samples before and after the introduction of the euro. In general, the correlation coefficients provide strong evidence that the business cycles of the studied countries and groups of countries became less synchronized with the cycle of the EU15 and the G3 group after the introduction of the euro in 2002. More specifically, in Table 3, where EU15 is the base for the calculation, only the cycles of Luxemburg and Portugal appear more synchronized with the cycle of EU15 after the introduction of the common currency. All other countries' and groups of countries' cycles became less synchronized with EU15 in the euro era. The results are almost identical when the base group for comparison of the individual countries' and groups of countries' cycles is G3, the group of the three largest economies in the EU. Now the only country that appears to have a higher correlation coefficient in the second sub-sample, after the introduction of the euro, is Portugal. All other cycles are less synchronized in the common currency era.

The last methodology we employ to access the degree of cycle synchronization is the proposed sign concordance index as it was described in section 3. The results are presented in Tables 5 and 6 and also in Figures 15 and 16. Here, the results are quantitatively different from the ones we obtained with the use of the regression and the correlation coefficients. More countries appear to have an improved cycle synchronization with both the EU15 and G3. The cycles of Greece, Ireland, Luxemburg, Spain, the U.K. and G6 are less synchronized with the cycle of EU15 after the introduction of the euro. When G3 is the base for the comparison, cycle synchronization worsens for Belgium, France, Greece, Luxemburg, Spain, the U.K. and G6 in the second sun-sample. Although the results using the SCI provide, in general, less evidence of no synchronization of the cycles, we must still note that when EU15 is the base cycle, six of the sixteen cycle series appear less synchronized and when the G3 is used as the base cycle the number is increases to seven. What is more important is that even with the SCI, the cycle of G6, the group of the six smaller regional economies, appears less synchronized in the second sub-sample, after the introduction of the euro, casting serious doubt on the effectiveness of monetary policy in such a diverse group of countries.

5. Conclusion

The empirical results seem to support the view of many economists and policymakers that the synchronisation of the business cycles of the individual national economies within the European Union became weaker after the introduction of the common currency in the eurozone. The methods that were employed in order to examine the degree of business cycle

synchronization provide strong evidence that the European common currency did not live as yet to the expectations of a homogenous synchronised European economic cycle contributing to the vision and goal of a strong economic and political union. Especially for G6, the group of the smaller regional economies, the results are consistent throughout all three methodologies used, regression, correlation coefficients and the proposed sign concordance index, and for both groups of countries' cycles used as a comparison base, the broad EU15 and the narrow G3. This provides empirical evidence in favour of the view that the EU is becoming a group of countries that follow two or more speeds of development in terms of their basic economic features and figures and especially with respect to the fluctuations in their GDP. The introduction of the euro in such a diverse group of countries does not seem to have a positive effect yet on the diminishing of such differences as it was expected. On one hand, monetary policy in such diverse business cycle conditions will not be efficient for the European Union as a whole when individual countries' cycles are not synchronized. Baring in mind, on the other hand, that the group of the three largest economies, G3, produces almost 60% of the EU GDP, monetary policy focusing on G3 economic conditions and requirements will even be destabilizing for the small regional economies when, as it appears in this paper, their cycles are not synchronized with G3. The weakening of the degree of synchronization of business cycles of the so-called regional or peripheral economies, with the EU15 and the three big economies raises scepticism about the capability of the first to continue their participation in the monetary union following the same economic pace as the big economies.

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Table 1: Regressions Results with EU15 as the independent variable

	1992:I-2007:IV			1992:I-2001:IV			2002:I-2007:IV		
Country	adj. R^2	Coeff. β	Prob.	adj. R^2	Coeff. β	Prob.	adj. R^2	Coeff. β	Prob.
Austria	0.94	-0.02	0.75	0.49	2.06	0.01	0.73	1.24	0.00
Belgium	0.85	1.03	0.00	0.84	1.51	0.00	0.60	0.93	0.00
Denmark	0.42	0.91	0.00	0.44	0.79	0.00	0.40	1.61	0.00
Finland	0.76	0.28	0.03	0.43	1.90	0.02	0.71	1.43	0.00
France	0.82	0.16	0.11	0.68	2.17	0.00	0.57	0.53	0.07
Germany	0.78	0.59	0.00	0.69	0.80	0.00	0.90	2.04	0.00
Greece	0.21	0.29	0.11	-	-	-	-	-	-
Ireland	0.41	1.65	0.00	0.59	2.00	0.00	0.12	1.23	0.06
Italy	0.86	0.57	0.00	0.89	1.03	0.02	0.79	0.82	0.01
Luxemburg	0.54	1.86	0.00	0.48	2.16	0.00	0.51	2.12	0.00
Netherlands	0.79	0.44	0.01	0.53	2.41	0.00	0.83	1.68	0.00
Portugal	0.62	0.35	0.04	-0.04	1.19	0.18	0.56	1.47	0.00
Spain	0.84	0.68	0.00	0.81	1.14	0.00	0.68	0.53	0.00
U.K.	0.74	0.14	0.01	0.61	0.66	0.00	-0.00	-0.34	0.49
G3	0.93	0.75	0.00	0.88	0.92	0.00	0.96	1.40	0.00
G6	0.85	0.07	0.58	0.64	1.65	0.00	0.55	0.66	0.37
EU15	-	-	-	-	-	-	-	-	-

Table 2: Regressions Results with G3 as the independent variable

	1992:I-2007:IV			1992:I-2001:IV			2002:I-2007:IV		
Country	adj. R^2	Coeff. β	Prob.	adj. R^2	Coeff. β	Prob.	adj. R^2	Coeff. β	Prob.
Austria	0.94	0.00	0.99	0.52	1.06	0.03	0.56	0.85	0.02
Belgium	0.71	0.59	0.00	0.74	1.50	0.00	0.48	0.79	0.01
Denmark	0.42	0.90	0.00	0.45	0.84	0.00	0.28	1.01	0.01
Finland	0.75	0.22	0.08	0.81	0.21	0.64	0.64	1.30	0.00
France	0.83	0.25	0.01	0.78	1.26	0.00	0.44	0.65	0.01
Germany	0.90	1.08	0.00	0.90	1.20	0.00	0.96	1.33	0.00
Greece	0.19	0.20	0.25	0.08	-0.74	0.26	0.23	0.75	0.44
Ireland	0.41	1.30	0.00	0.55	1.56	0.00	0.15	0.92	0.04
Italy	0.77	0.68	0.00	0.55	1.43	0.06	0.84	0.86	0.00
Luxemburg	0.51	1.30	0.00	0.39	1.66	0.00	0.45	1.40	0.00
Netherlands	0.78	0.30	0.01	0.60	1.59	0.00	0.72	1.11	0.00
Portugal	0.62	0.29	0.04	0.32	0.63	0.00	0.43	0.89	0.06
Spain	0.75	0.48	0.00	0.69	0.68	0.00	0.71	0.39	0.00
U.K.	0.73	0.10	0.04	0.63	0.70	0.00	-0.10	-0.14	0.71
G3	-	-	-	-	-	-	-	-	-
G6	0.82	0.20	0.04	0.71	0.95	0.01	0.50	0.66	0.12
EU15	0.91	0.80	0.00	0.90	0.84	0.00	0.94	0.80	0.00

Table 3: Correlation Coefficients with EU15

	1992:I-2007:IV	1992:I-2001:IV	2002:I-2007:IV
Country	ρ_{xy}	ρ_{xy}	ρ_{xy}
Austria	0.82	0.77	0.66
Belgium	0.84	0.82	0.60
Denmark	0.67	0.64	0.60
Finland	0.75	0.71	0.64
France	0.90	0.91	0.78
Germany	0.93	0.96	0.82
Greece	0.04	0.10	0.00
Ireland	0.69	0.78	0.43
Italy	0.87	0.88	0.79
Luxemburg	0.68	0.66	0.66
Netherlands	0.90	0.91	0.87
Portugal	0.71	0.61	0.79
Spain	0.91	0.92	0.66
U.K.	0.71	0.91	0.08
G3	0.98	0.99	0.93
G6	0.89	0.94	0.55
EU15	-	-	-

Table 4: Correlation Coefficients with G3

	1992:I-2007:IV	1992:I-2001:IV	2002:I-2007:IV
Country	ρ_{xy}	ρ_{xy}	ρ_{xy}
Austria	0.75	0.72	0.51
Belgium	0.77	0.78	0.43
Denmark	0.62	0.62	0.45
Finland	0.70	0.68	0.54
France	0.86	0.89	0.60
Germany	0.97	0.98	0.96
Greece	0.01	0.06	0.00
Ireland	0.69	0.76	0.51
Italy	0.91	0.91	0.88
Luxemburg	0.66	0.63	0.59
Netherlands	0.86	0.89	0.74
Portugal	0.69	0.61	0.69
Spain	0.88	0.89	0.71
U.K.	0.62	0.86	-0.11
G3	-	-	-
G6	0.82	0.90	0.35
EU15	0.98	0.99	0.93

Table 5: Sign Concordance Index with EU15

Country	1992:I-2007:IV SCI*ig*	1992:I-2001:IV SCI*ig*	2002:I-2007:IV SCI*ig*
Austria	0.81	0.78	0.88
Belgium	0.79	0.78	0.83
Denmark	0.73	0.68	0.83
Finland	0.73	0.65	0.88
France	0.86	0.85	0.88
Germany	0.91	0.88	0.96
Greece	0.52	0.55	0.44
Ireland	0.72	0.75	0.70
Italy	0.83	0.80	0.87
Luxemburg	0.82	0.83	0.78
Netherlands	0.84	0.80	0.91
Portugal	0.73	0.68	0.78
Spain	0.89	0.90	0.88
U.K.	0.70	0.78	0.58
G3	0.94	0.93	0.96
G6	0.79	0.85	0.67
EU15	-	-	-

Table 6: Sign Concordance Index with G3

Country	1992:I-2007:IV SCI*ig*	1992:I-2001:IV SCI*ig*	2002:I-2007:IV SCI*ig*
Austria	0.81	0.80	0.83
Belgium	0.79	0.80	0.78
Denmark	0.76	0.75	0.78
Finland	0.70	0.63	0.83
France	0.86	0.88	0.83
Germany	0.97	0.95	1.00
Greece	0.48	0.53	0.39
Ireland	0.72	0.70	0.74
Italy	0.83	0.78	0.91
Luxemburg	0.80	0.86	0.74
Netherlands	0.81	0.78	0.87
Portugal	0.71	0.68	0.74
Spain	0.86	0.88	0.83
U.K.	0.67	0.75	0.52
G3	-	-	-
G6	0.76	0.83	0.61
EU15	0.94	0.93	0.96

Figure 1. Real GDP and Trend (HP filter): Austria, Belgium, Denmark.

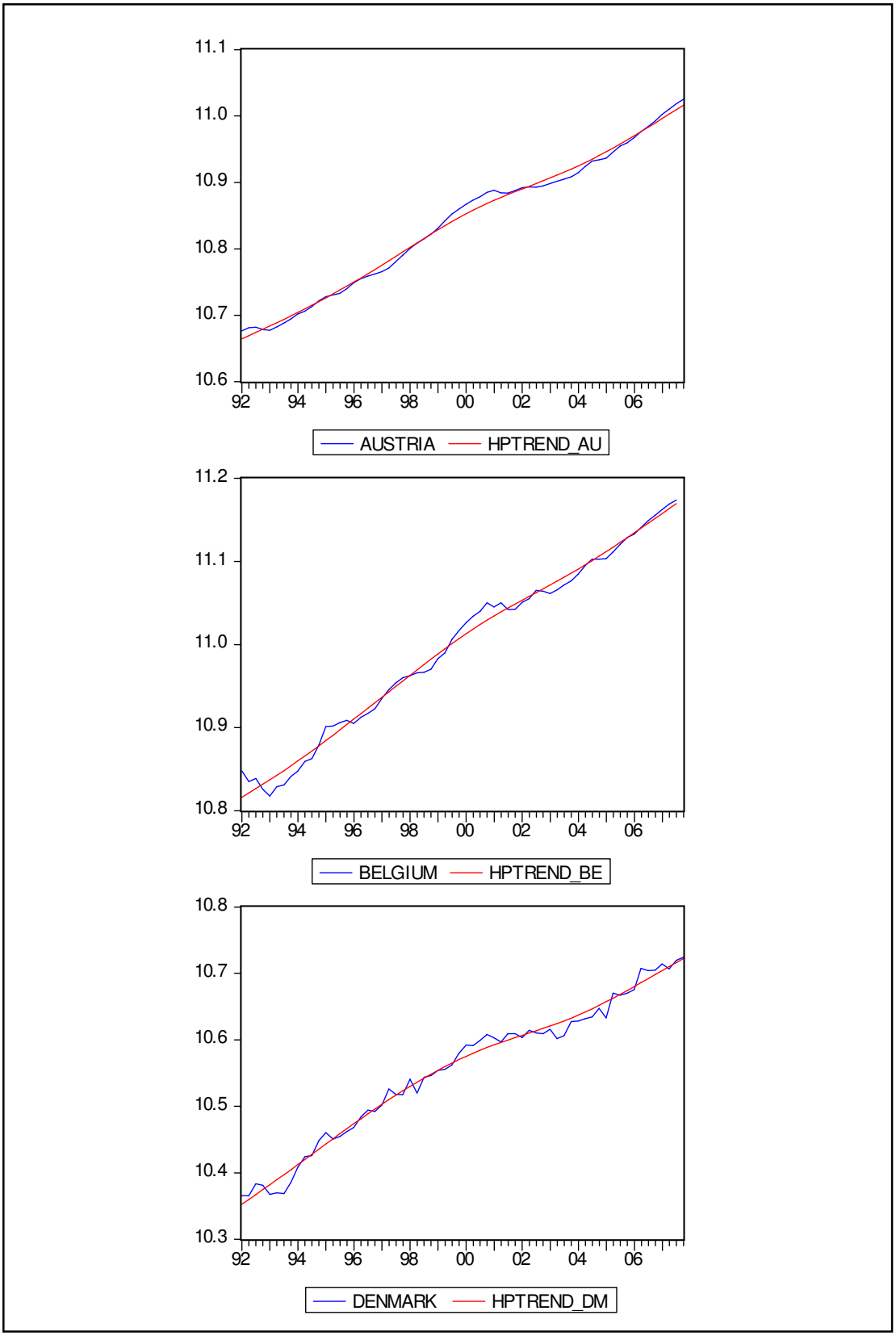

Figure 2. Real GDP and Trend (HP filter): Finland, France, Germany.

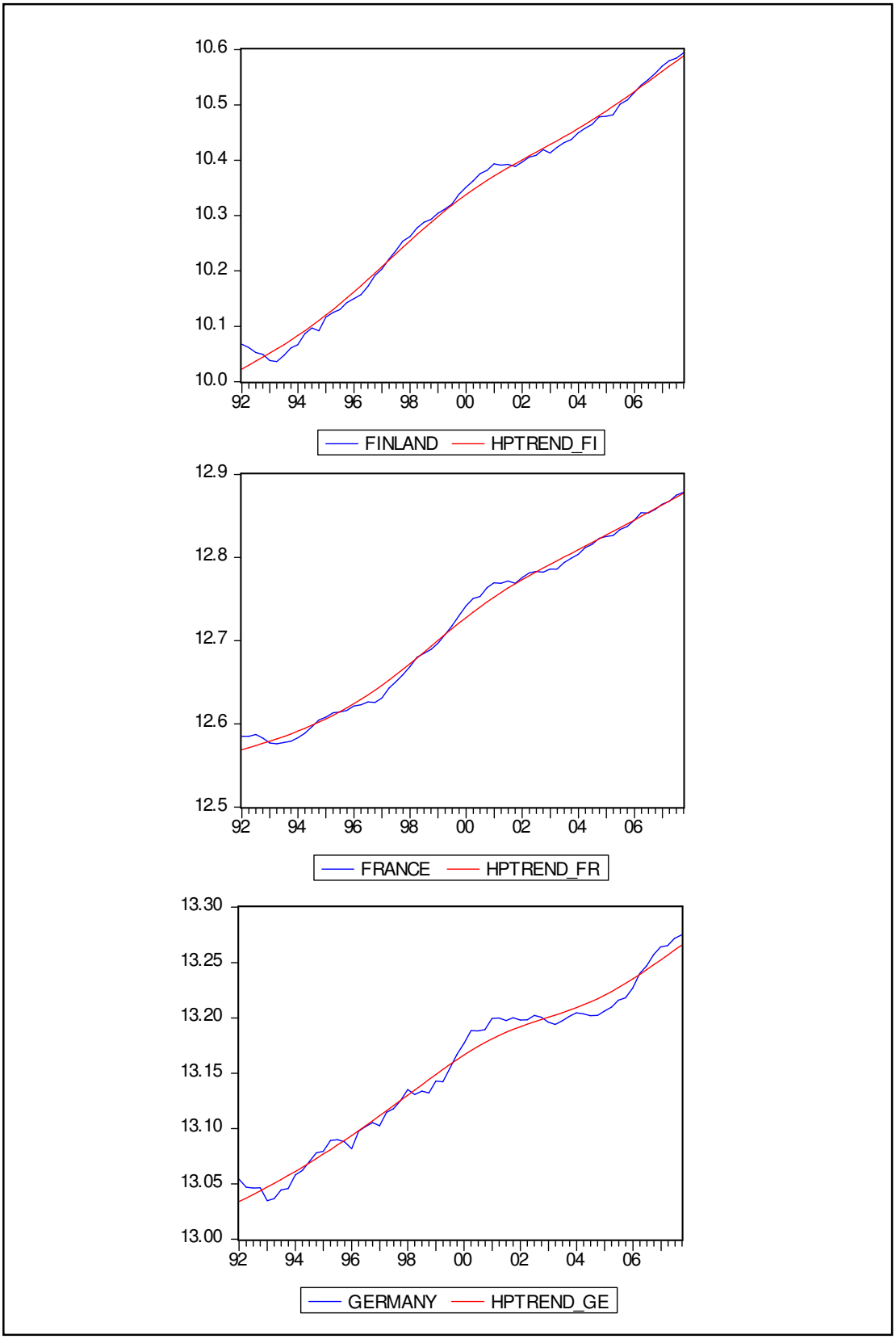

Figure 3. Real GDP and Trend (HP filter): Greece, Ireland, Italy.

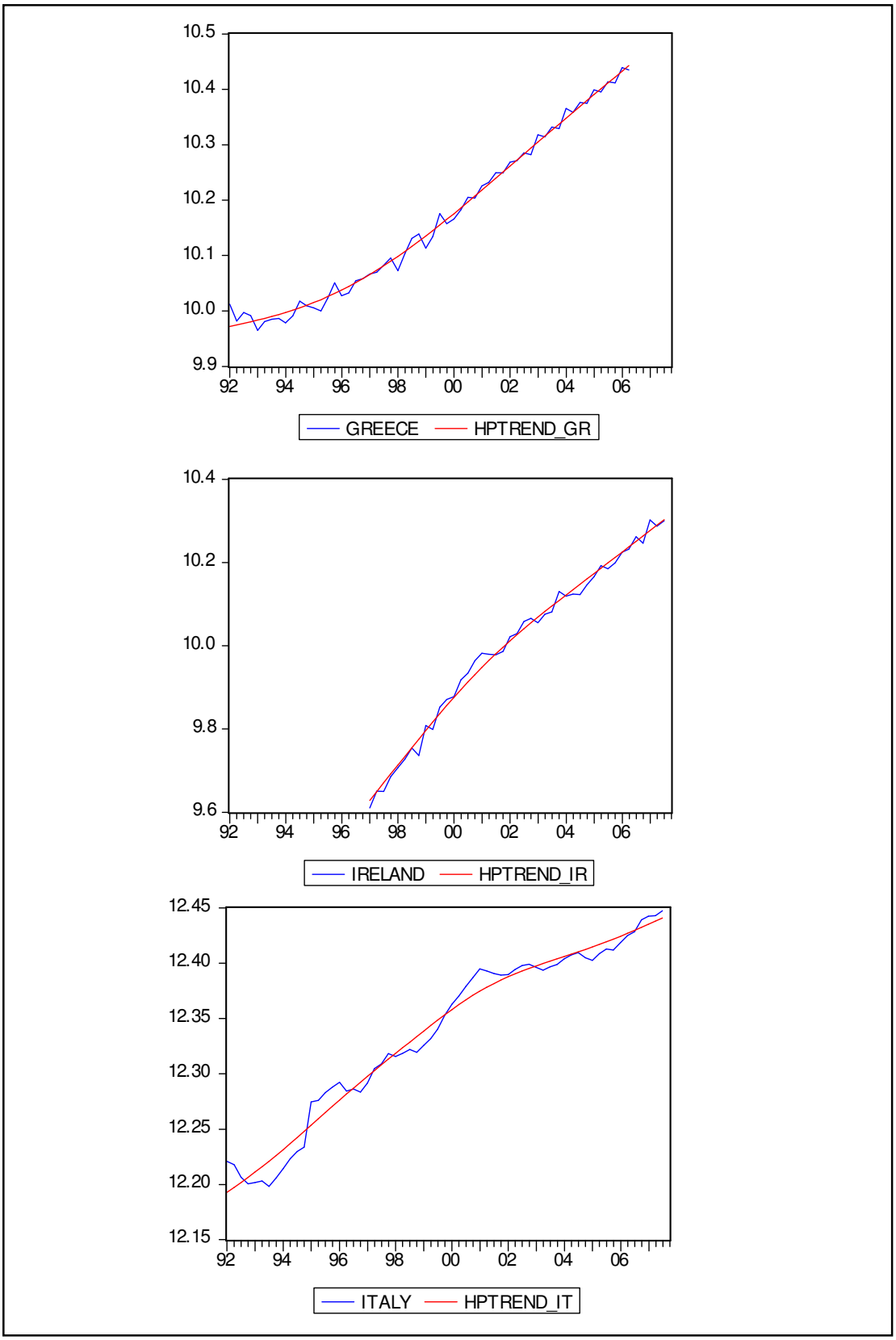

Figure 4. Real GDP and Trend (HP filter): Luxemburg, The Netherlands, Portugal.

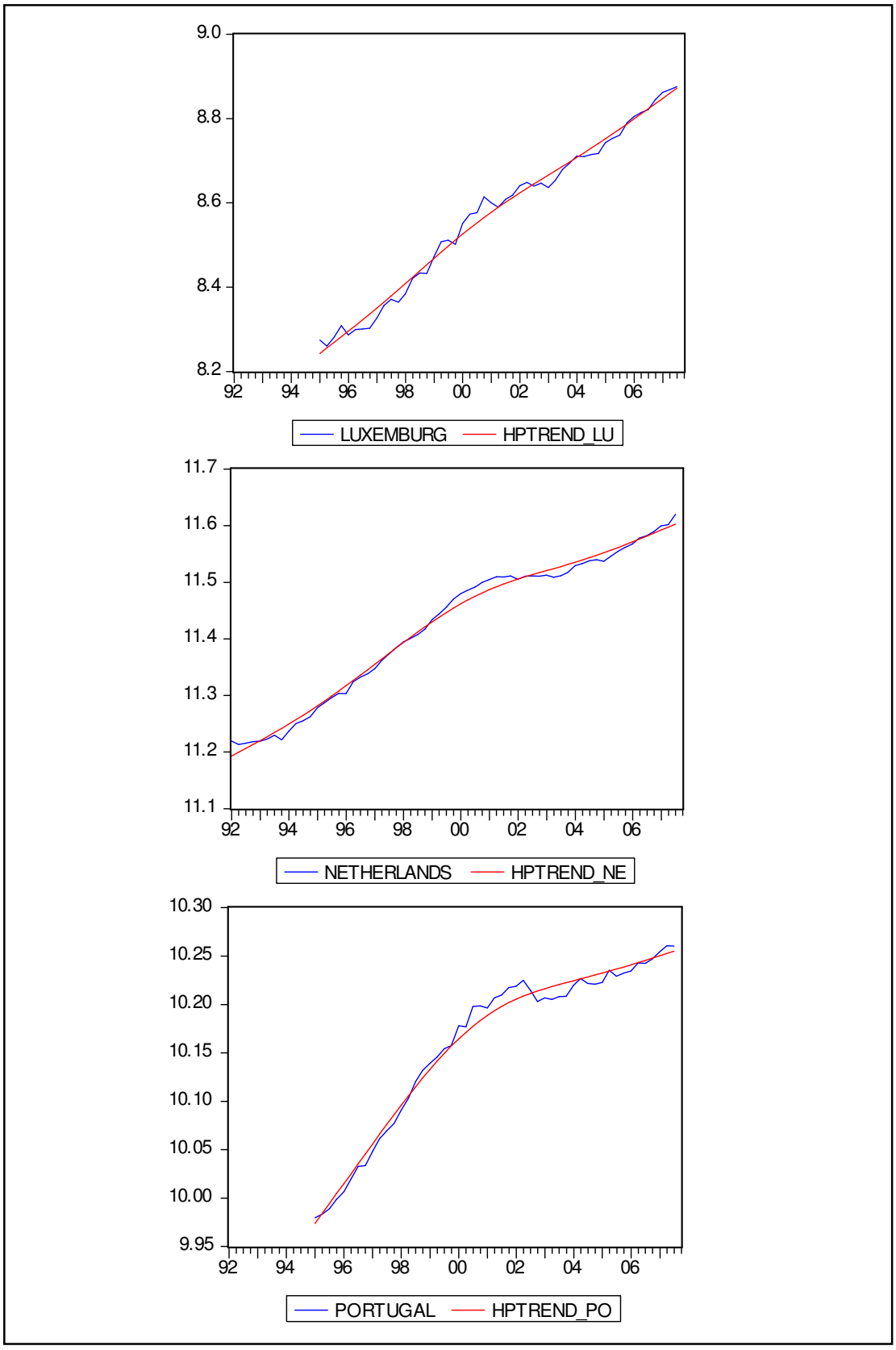

Figure 5. Real GDP and Trend (HP filter): Spain, United Kingdom (UK), G3.

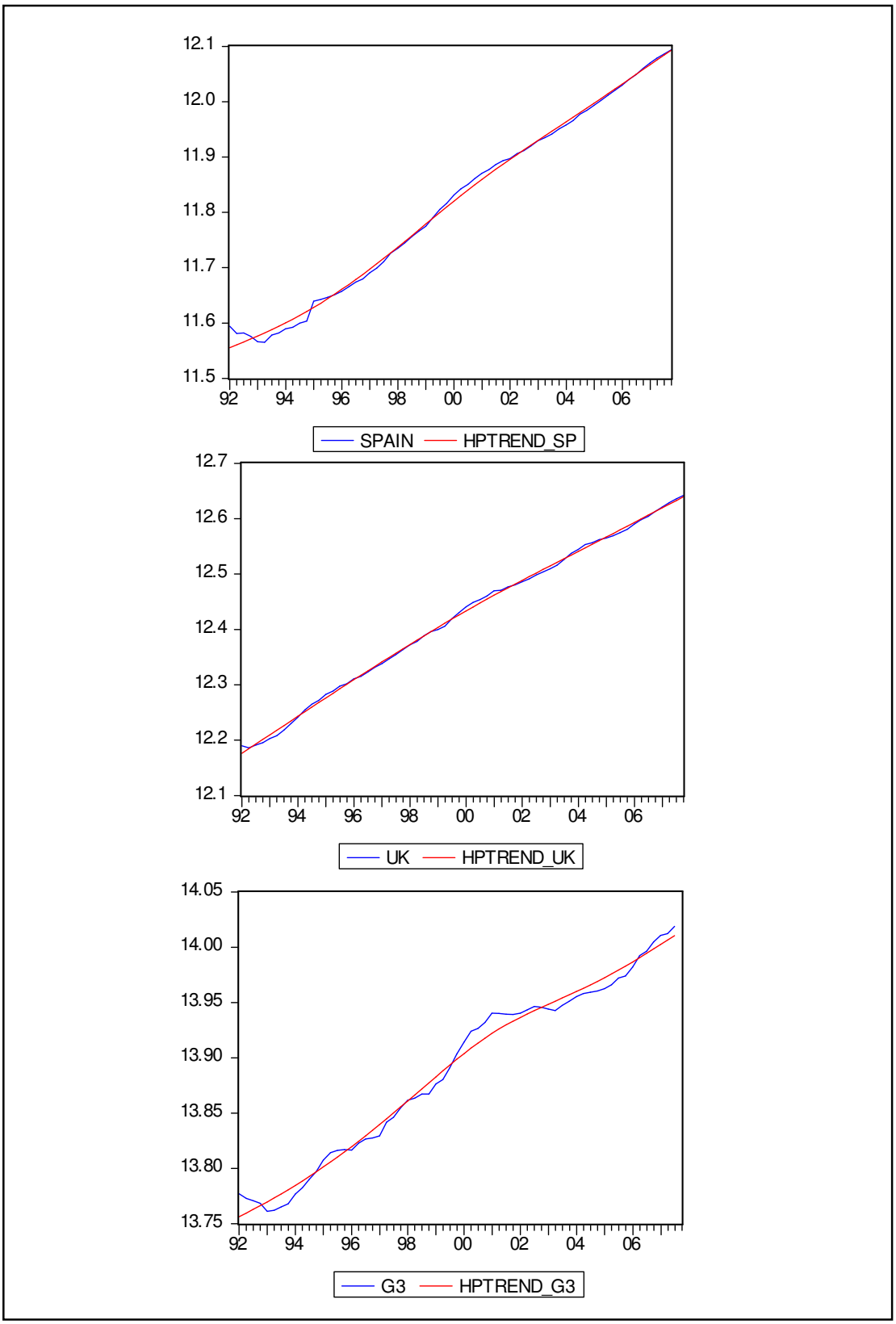

Figure 6. Real GDP and Trend (HP filter): G6, EU15.

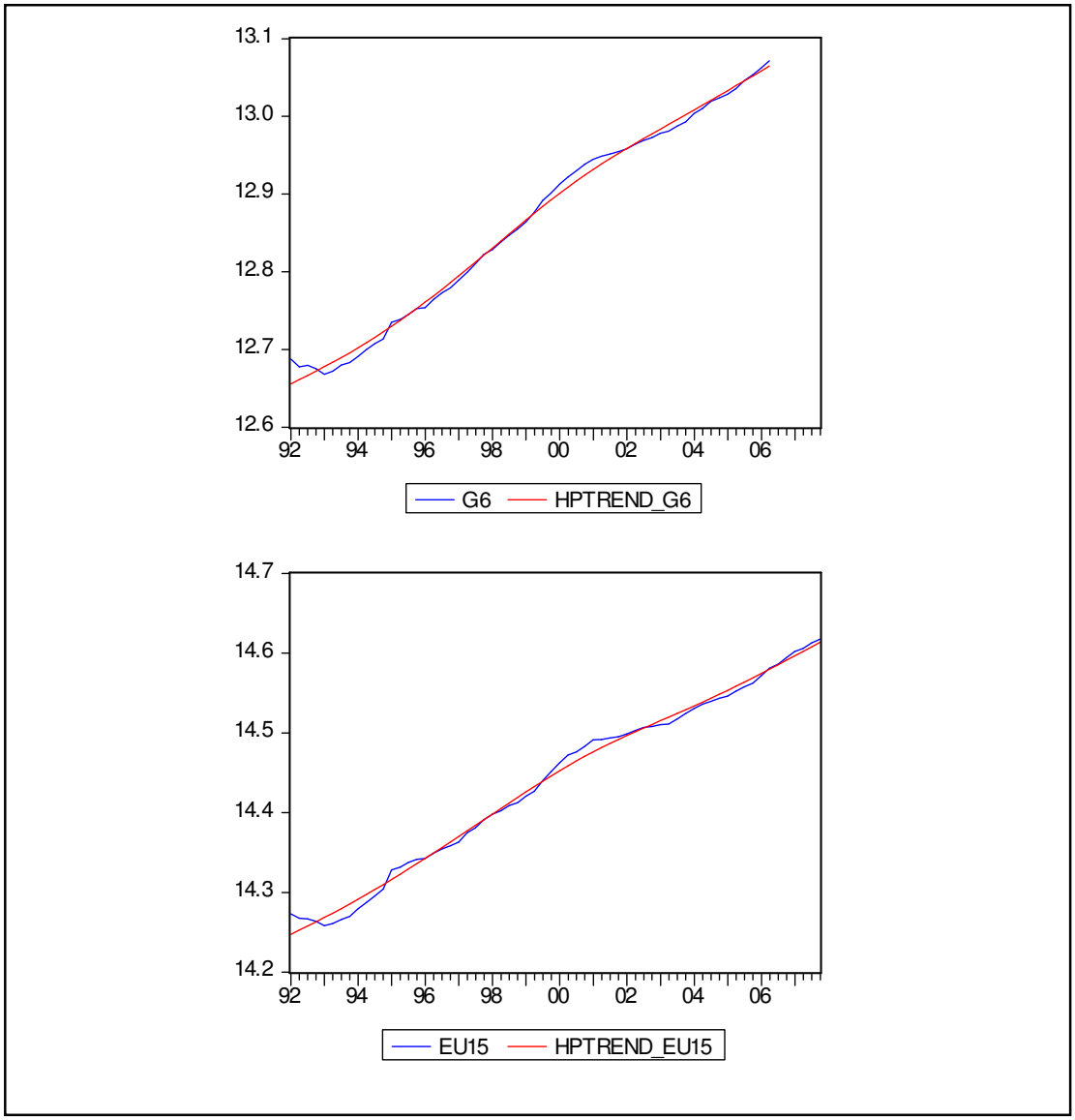

Figure 7. Business Cycles (HP): Austria, Belgium, Denmark.

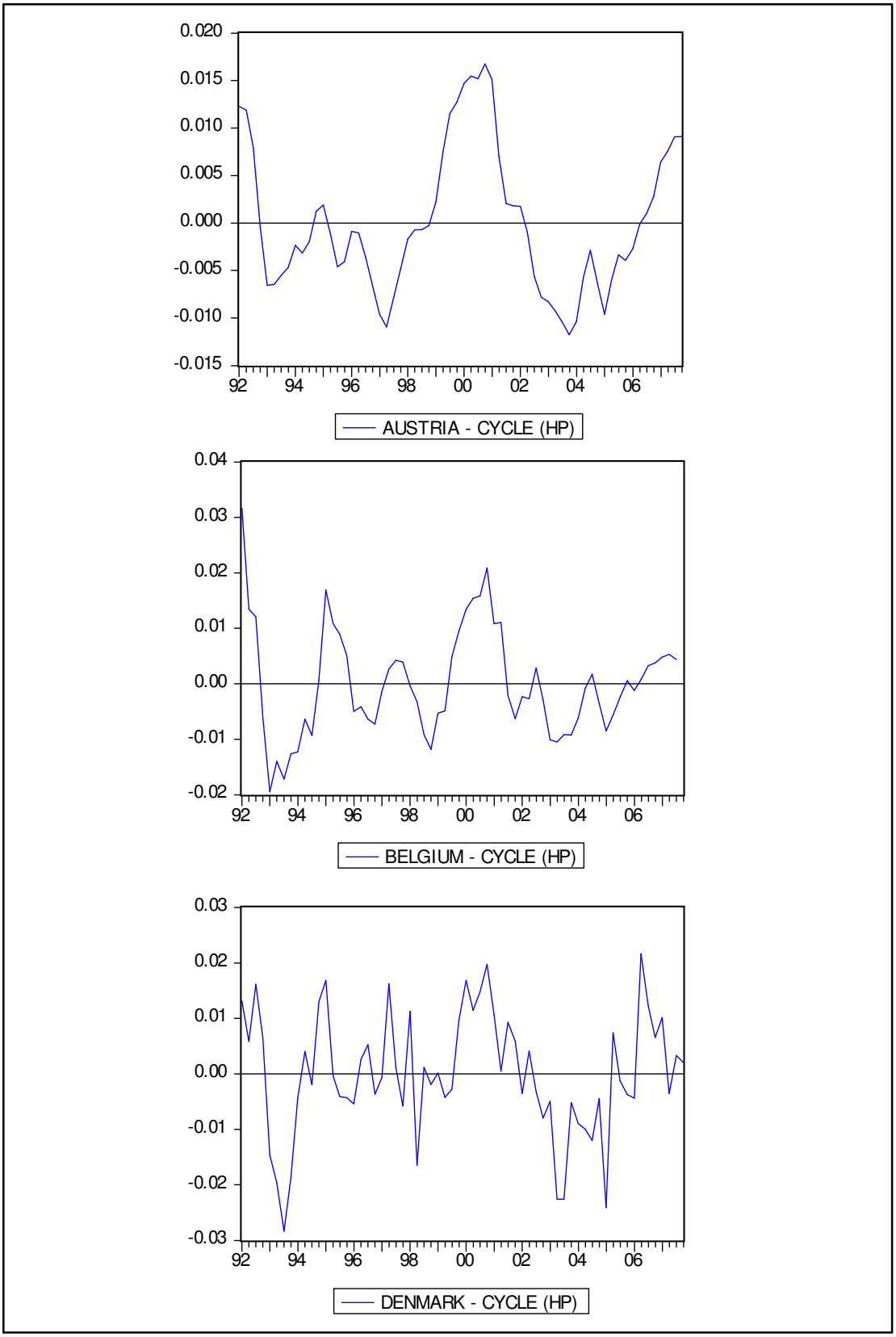

Figure 8. Business Cycles (HP): Finland, France, Germany.

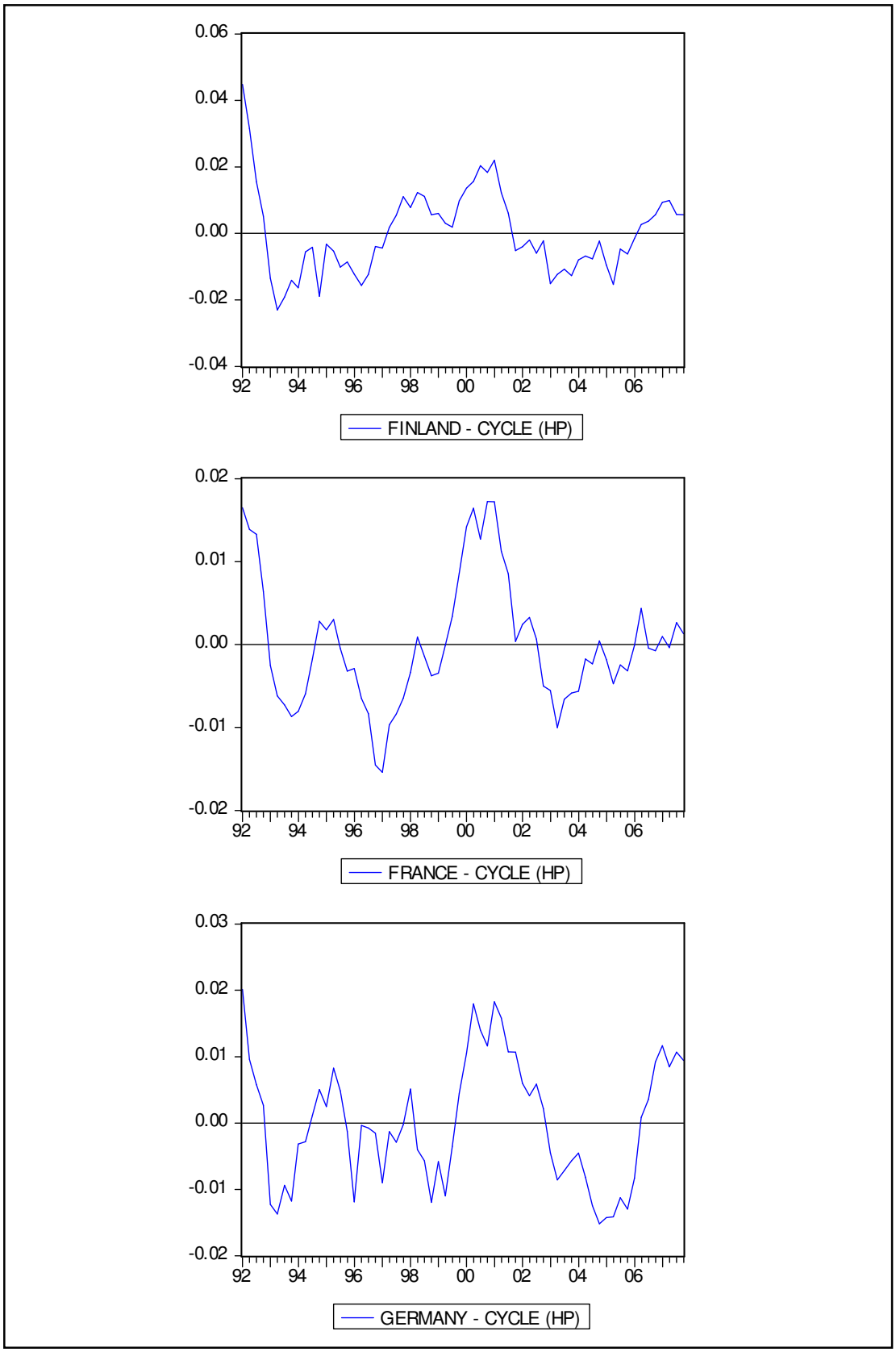

Figure 9. Business Cycles (HP): Greece, Ireland, Italy.

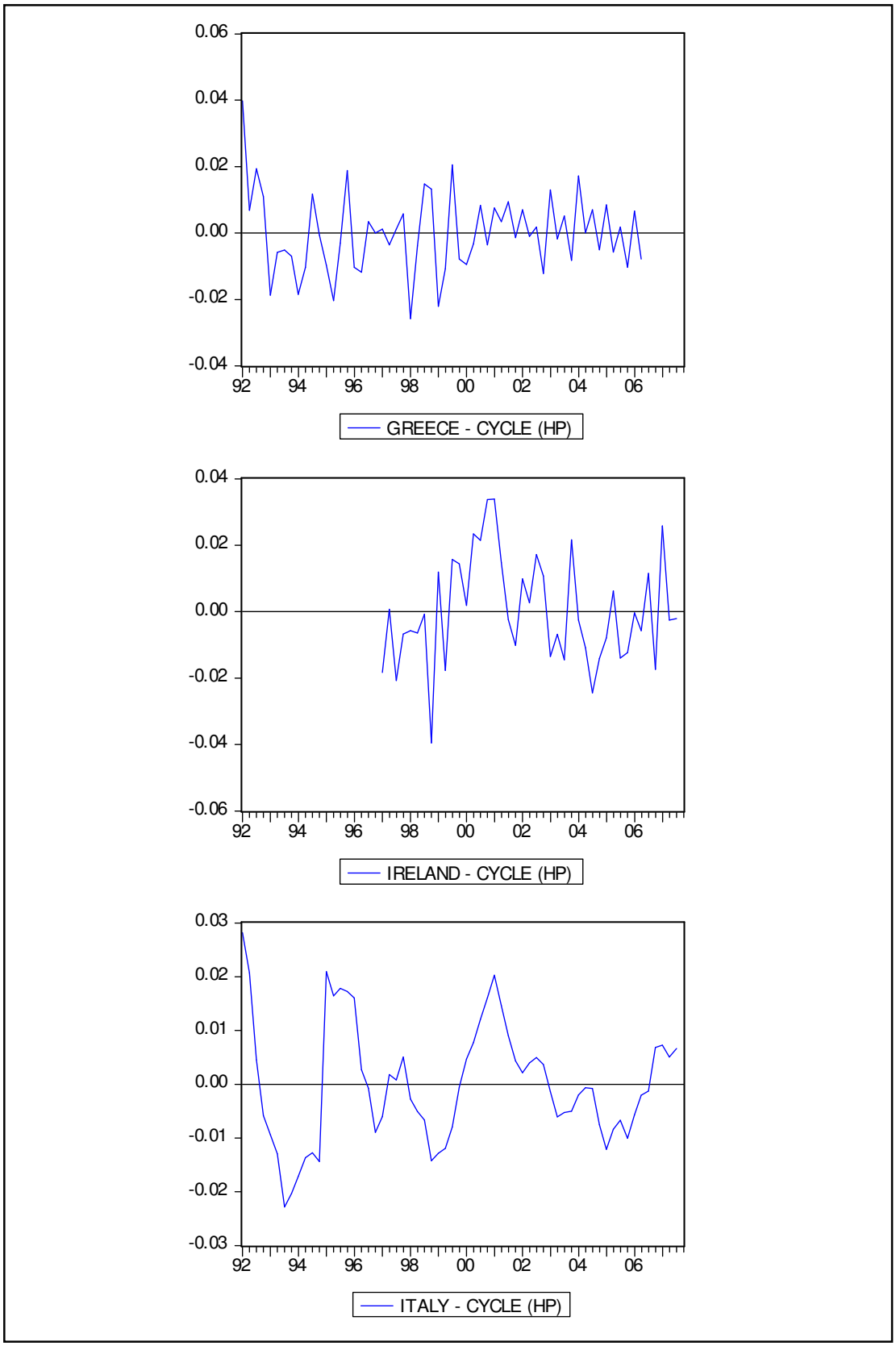

Figure 10. Business Cycles (HP): Luxemburg, The Netherlands, Portugal.

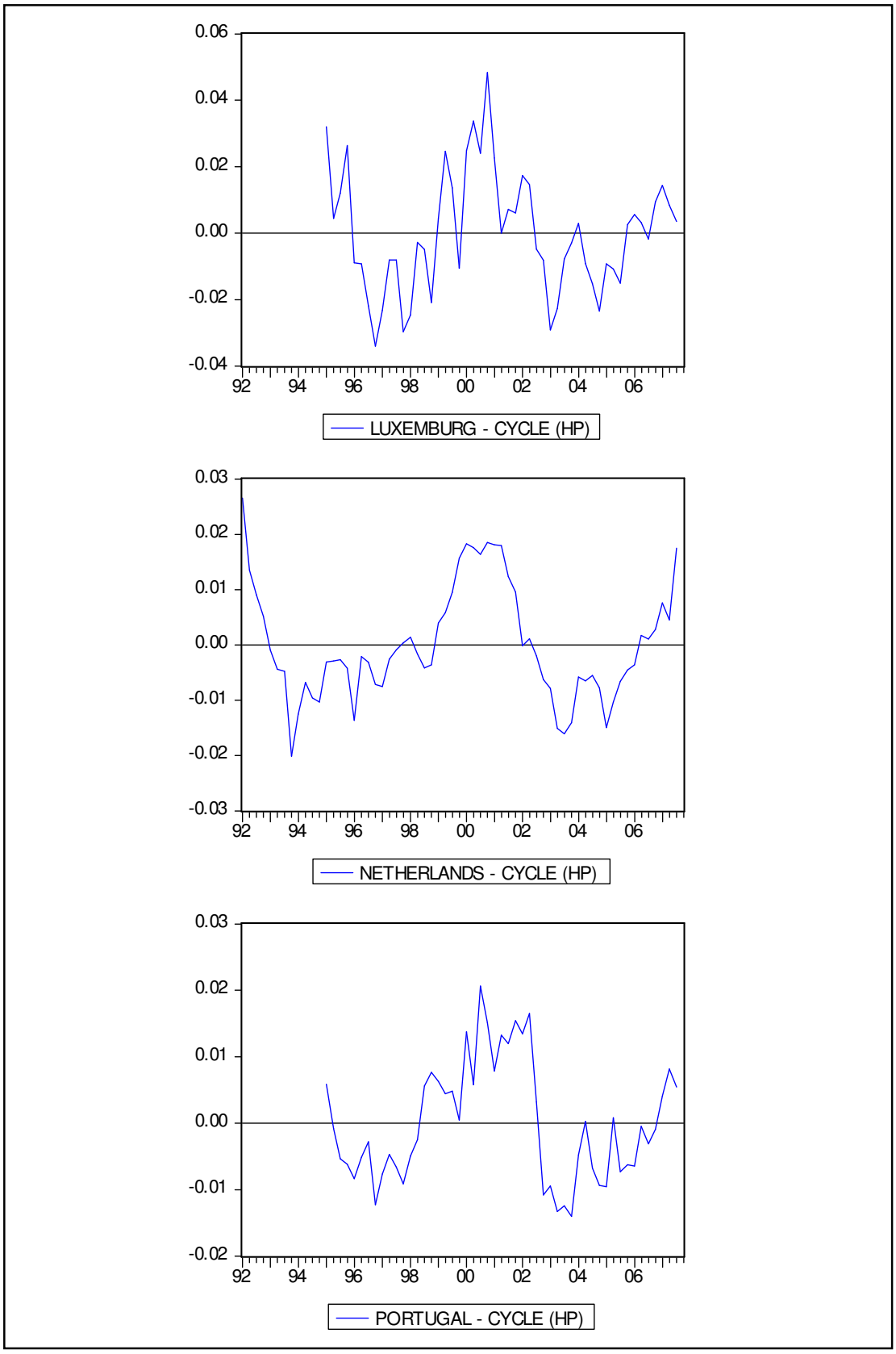

Figure 11. Business Cycles (HP): Spain, United Kingdom (UK), G3.

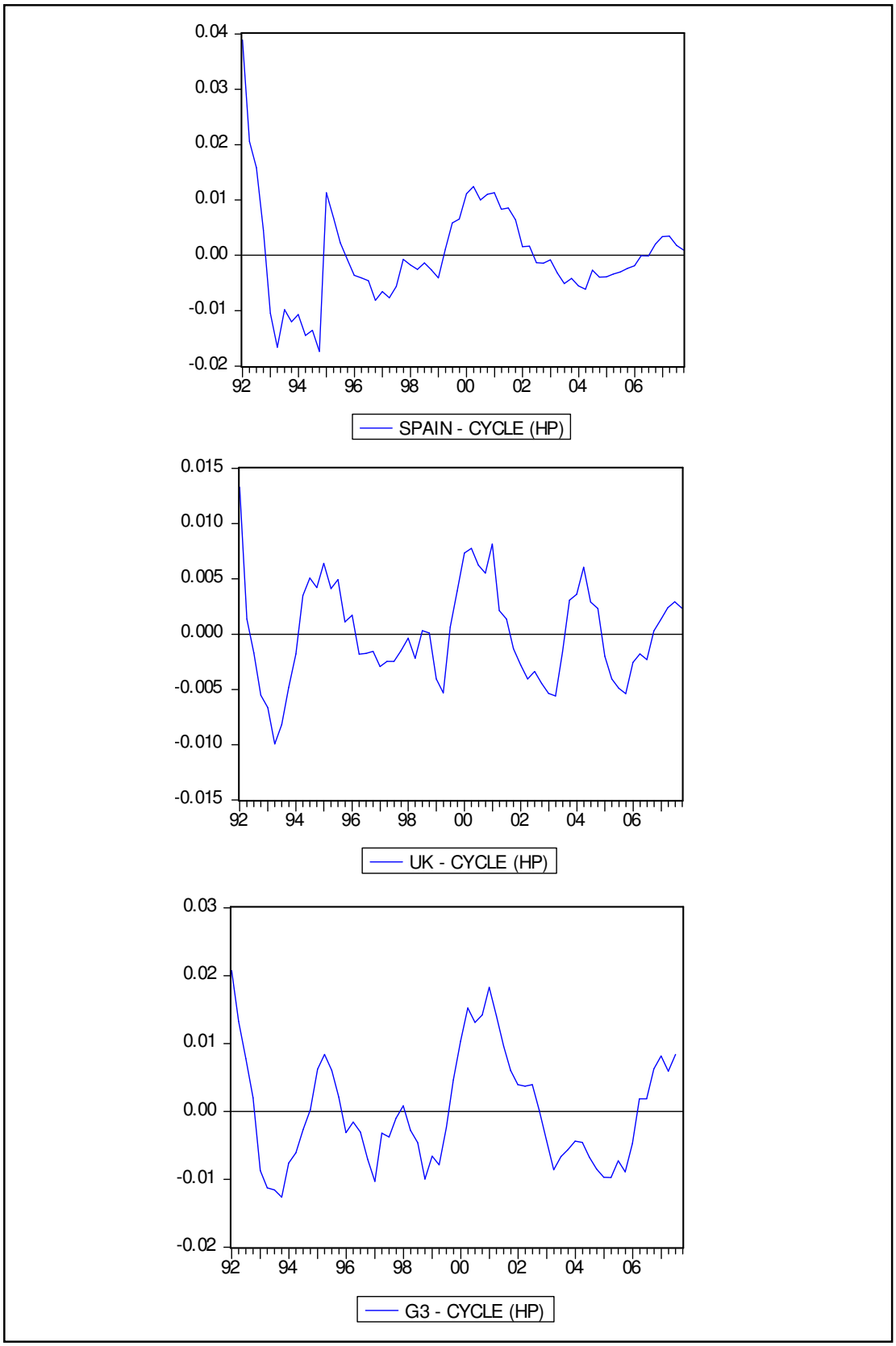

Figure 12. Business Cycles (HP): G6, EU15, G3-G6.

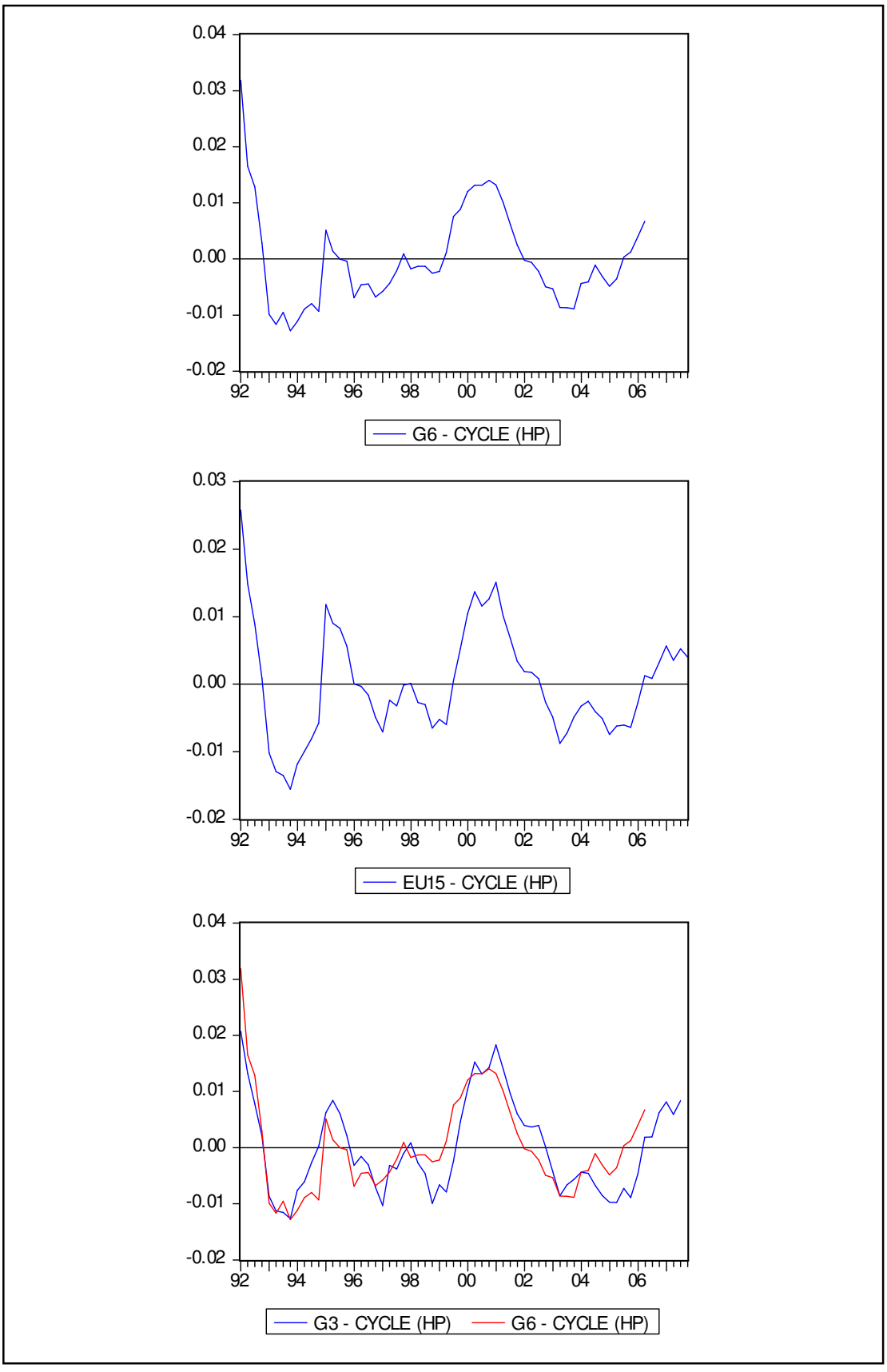

Figure 13. Correlation Coefficients Before the Introduction of the Euro

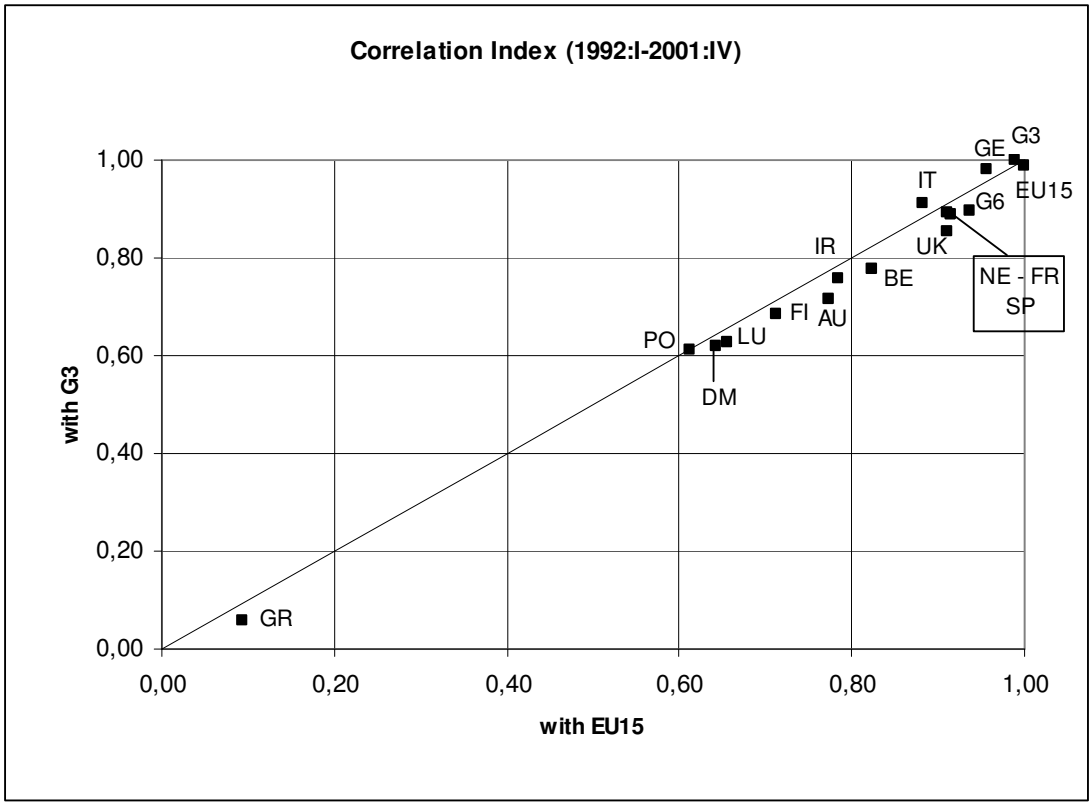

Figure 14. Correlation Coefficients After the Introduction of the Euro

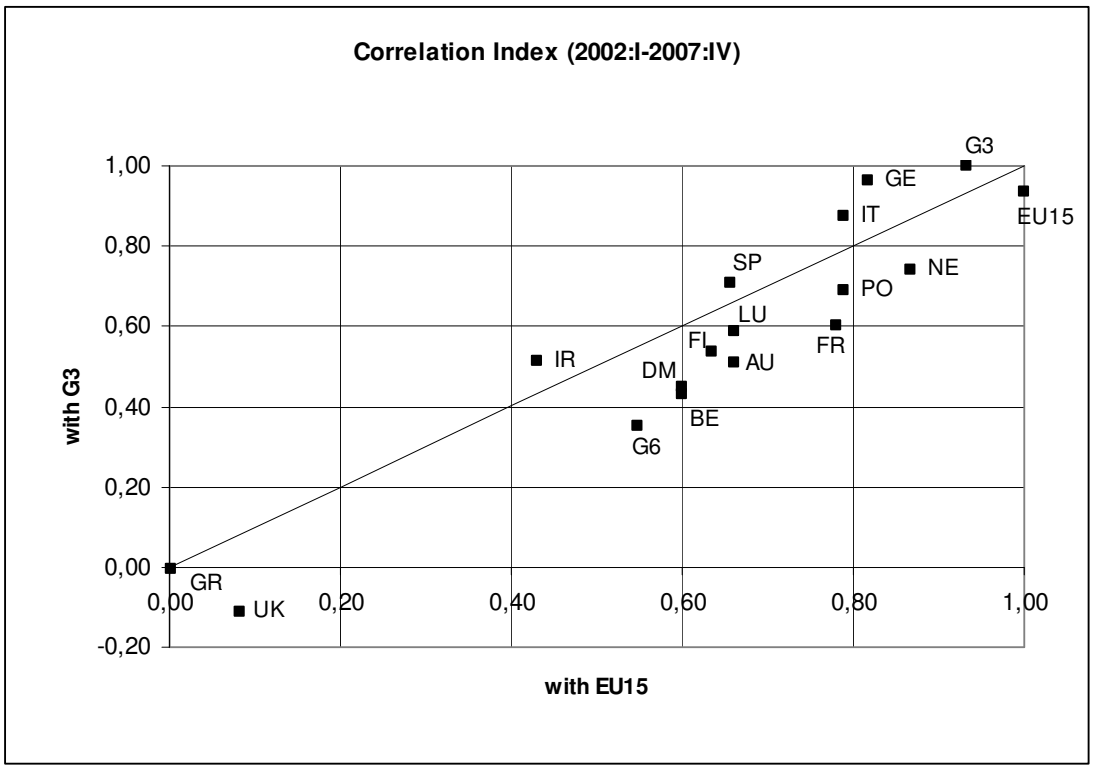

Figure 15. Sign Concordance Indices Before the Introduction of the Euro

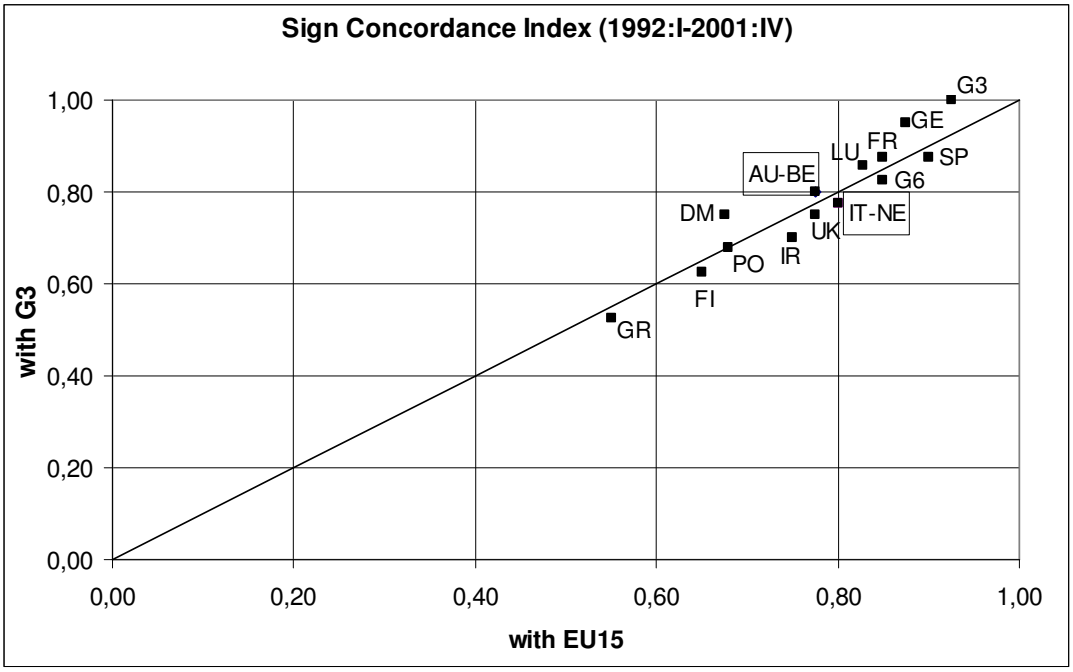

Figure 16. Sign Concordance Indices After the Introduction of the Euro