

Monitoring Convergence and Stability: the case of the European Union

Javier Fernández-Macho*, Pilar González, Paz Moral and Jorge Virto

Department of Econometrics and Statistics

and Institute for Public Economics

University of the Basque Country

E48015 BILBAO Spain

19th January 2001

*Corresponding author: etpfemaj@bs.ehu.es. The authors thank the Spanish Ministry of Education and Culture and the University of the Basque Country for their financial support under research grants PB96-1469-C05-01 and UPV-038.321-G55/98 respectively.

Abstract

This paper presents a methodology for the analysis of convergence and stability within the European Union based on the construction of synthetic indices classified both by countries and by criteria. The usefulness of such indices resides in their ability to summarise a large amount of data about different economic variables in different countries, extracting and displaying the relevant information in a comprehensible manner. Thus, the paper analyses the evolution of each country in fulfilling the convergence criteria as laid down in the Treaty on the European Union and the Stability and Growth Pact. Likewise, the paper also presents indices displaying the fulfilment of each criterion for the EU as a whole. The highest degree of synthesis is achieved by a double aggregation of both criteria and countries, giving rise to an overall index of Treaty compliance for the entire EU.

The paper sets out to discuss the convergence and stability criteria and explains the construction of a database to measure their degree of compliance. It also discusses the construction of synthetic indices and their application to the analysis of the fulfilment of convergence and stability criteria in the European Union. As a general result, it is ascertained that in practice EMU was a fact from as early as 1997 onwards. Also, the evolution of each criteria and the problems encountered along the convergence process have been noticed. In more detail, the fifteen EU countries have been classified into four groups according to their present degree of compliance with the criteria, the last group being made up of countries that show certain problems in complying with them.

These techniques are by no means exclusive to the present EU and indeed they could also be used to monitor the degree of convergence of candidate countries in order to ascertain whether they could be joining the EU in the future. Also, once appropriate criteria are defined, they could be used in other contexts such as analysis of integration in other economic and trade areas (NAFTA, Mercosur, ASEAN, ...), regional convergence within a given country, etc.

Key words:

Cohesion Policy,
Convergence,
Economic and Monetary Union,
Economic Indicators,
Economic Integration,
European Union,
Exchange Rate Mechanism II,
International Economic Order,
Stability and Growth Pact,
Synthetic Indices,
Treaty on the European Union.

JEL classification: F02, F15.

1 Introduction

Since the years 1952, with the creation of the European Coal and Steel Community (ECSC), and 1957, which saw the birth of the European Economic Community (EEC), the process of European integration has rarely strayed away from the path leading it towards the present day European Union (EU). Over this almost fifty-year long period, a single market of goods, services, people and capital has gradually been generated. At the same time, new members have continued to join to make up the current union of 15 countries, namely Germany, France, Italy, Netherlands, Belgium, Luxembourg, Ireland, Denmark, the United Kingdom, Greece, Spain, Portugal, Austria, Finland and Sweden, while other potential candidates might be joining in the future. However, the process of European integration does not end with the creation of a single market. The Treaty on the European Union (TEU) agreed at Maastricht on December 1991, represents one of the fundamental moments in the most recent European integration history, with a series of economic and political agreements laying out the future of the Union. On the economic front a time frame was established for the execution of the Economic and Monetary Union (EMU) with a common currency starting from 1999. So, the Treaty backs the majority view that prior to joining the EMU, and in order to guarantee its success, a high degree of sustainable economic convergence is required among its potential members. Thus, it defines the requisites and criteria that determine such convergence, namely stability in prices, exchange rates, long-term interest rates and sound government finances.

The third phase of the Economic and Monetary Union (stage 3 of EMU) began on January 1, 1999, when the Euro became a currency with full rights and the exchange rates between the Euro and the member state currencies became irrevocably fixed. However, not all member states participate fully in this third phase. Denmark and the United Kingdom have a special status in accordance with the appendices of the Treaty, which permitted their non-participation in this third phase from the outset. Greece and Sweden do not have this clause, and are thus obliged to adopt the Euro, which in turn implies that they still have to fulfil the convergence criteria.

An analysis of the evolution of the economic variables related to convergence is therefore necessary for the non-participating countries. The Stability and Growth Pact (SGP) signed

in Amsterdam 1997, indicates that they need to design policies to obtain a high degree of sustainable convergence. Besides, this Pact establishes for the countries participating in the EMU the medium-term objective of budgetary positions close to balance or in surplus to safeguard the credibility of the single monetary authority and to reinforce the conditions for price stability. The SGP itself states: "...lasting convergence of the economic fundamentals is a prerequisite for sustainable exchange rate stability". Therefore, monitoring the performance of the participating members with regard to the variables of interest becomes very important for the EMU and the Euro to function correctly (Artis & Winkler 1998, Buti, Franco & Ongena 1998, Canzoneri, Diba & Cumby 1998).

In the recent literature we can find different contributions, both theoretical and empirical, on the degree of compliance of the convergence and stability objectives in the EU member states, among others, Casario & Dadkhah (1998), Beetsma & Uhlig (1999), Haug, MacKinnon & Michelis (2000). In this article we analyse the convergence and stability process among the countries that make up the European Union along the lines established by the TEU and the SGP, laying special emphasis on the most recent period, through the construction of synthetic indices classified both by countries and by criteria.

The usefulness of such indices resides in their ability to present a summary of situation within the EU. The TEU, and implicitly the SGP, requires that each member state keep certain macroeconomic variables within permissible limits. In this respect, we may then want to monitor along time the degree of compliance with such multiple criteria both for each country individually and for the EU as a whole. Although we might conceivably think of analysing their performance by simply looking at the recent time paths of available data on all of the variables involved, it will soon become clear that we cannot compare objectively the time evolution of variables of a different kind and therefore we must have some way of comparing the relative importance of such movements through time. For instance, if during the last months a given country is improving on criterion A and another country is improving on criterion B, how are we to say which one is doing better? A similar question would arise when trying to compare the performance of some country during two different periods of time. Indeed, if we were improving on all criteria but one that is worsening, on what account could we really say we were actually doing better than last year? In both cases it obviously depends on the relative importance of the time movements of the variables

involved. In other words, the different variables (criteria) must first be reduced to a common measurement so that an index can be constructed. How to do this in an objective manner is by no means obvious, as, in general, there would be a certain degree of arbitrariness in deciding whether a variable is within admissible levels. In our case, however, these admissible levels have already been set by the TEU and we propose to measure the variables in terms relative to these levels. That is to say, the index is constructed as a weighted sum of the variables involved in the criteria whose weights are somehow determined by the respective TEU limits.

In short, rather than studying the fulfilment of each criterion in each country individually (a complex task since the total number of variables to take into account becomes rather high: see the appendix of partial indicators in pages 31 to 40), we analyse the evolution of each country in fulfilling the convergence and stability criteria as a whole (see figures 2 to 6 from page 25 onwards). Likewise, once an agreement has been reached on how to measure criteria compliance for each country, it is possible to construct indices displaying the fulfilment of each criterion for the EU in its entirety (see figure 7 on page 30). They can be useful in order to determine whether some particular criteria are in trouble or not, which, in the future, may help the central authorities to decide whether to initiate policies in order to correct their course. The highest degree of synthesis is achieved by a double aggregation of both criteria and countries, giving rise to an overall index of Treaty compliance for the whole of the EU (see figure 1 on page 17).

The techniques proposed in this paper can also be used to monitor the degree of convergence of candidate countries that may be joining the UE in the future. However, they are by no means exclusive to the European case and indeed they could be applicable in other contexts. For instance once the appropriate criteria have been defined, they could also be used in the analysis of integration in other economic and trade areas, such as the North American Free Trade Area, the Latin American Mercosur or the Southeast Asian area, or for regional convergence analysis within a given country, etc.

In what follows, this paper presents in section 2 the convergence criteria as set up in the TEU and explains the construction of the database relevant to perform this study. Section 3 discusses the construction of synthetic indices by countries and by criteria and their use in the context of convergence and stability analysis. The method proposed is applied in to the

EU section 4 case and section 5 summarises the main results.

2 The convergence and stability criteria

EU member states have to fulfil certain prerequisites established in article 121 of the TEU and later in the Council Regulation No.1466/87 of the SGP. They are meant to guarantee some degree of convergence within the EMU and refer to exchange rates, price stability, long-term interest rates and public finances (government deficit and debt). This section explains the construction of a database for analysing the compliance of such convergence and stability criteria.

exchange rates

With regard to exchange rate developments the Treaty requires

“the observance of the normal fluctuation margins provided for by the exchange-rate mechanism of the European Monetary System, for at least two years, without devaluing against the currency of any other Member State”.

On January 1, 1999, the third phase of the monetary union began (stage 3 of the EMU) and the Euro became a currency with full rights. The exchange rates between the Euro and the currencies of the 11 member states that had accessed the third phase of the EMU became permanently fixed. Obviously all these countries meet the criteria regarding exchange rates. In spite of this, they are included in the analysis in order to study the convergence process. Moreover, the analysis is also of interest for those member states that still do not fully participate in this third phase, namely Denmark, Greece¹ United Kingdom and Sweden. This is so even for the latter two countries (UK and Sweden) that do not actually belong to the new Exchange Rate Mechanism (ERM II) and thus cannot strictly satisfy this requirement.

¹In accordance with the Commission proposal of May 3 2000, Greece has adopted the common currency on January 1 2001.

In order to do this we will analyse the average monthly nominal exchange rate with respect to the Deutsche mark of each EU currency, as well as, for comparison, those of the US, Japan and Switzerland. The sample size is from January 1979 to April 2000.

price stability

One of the main objectives, both in the TEU and in the Stability and Growth Pact, is to obtain a high degree of price stability. This convergence criterion, as set out in the Treaty, stipulates that

“the achievement of a high degree of price stability [...] will be apparent from a rate of inflation which is close to that of, at most, the three best-performing Member States in terms of price stability.”

In practice, this means that the inflation rate of a given Member State must not exceed by more than 1.5% percentage points that of the three best-performing Member States during the year preceding the examination of the situation in that Member State.

The first problem that we encounter is deciding what data to use in order to measure the concept of average inflation rate as laid down in the aforementioned article. The Treaty explicitly mentions that the inflation will be measured using the Consumer Price Index (CPI) taking into account the differences between countries. As monthly CPI data exist for all countries, one of the possibilities is to use monthly inflation figures as an indicator. However, this series has certain inherent disadvantages such as great variability and a strong seasonal component in some countries. Given that the spirit of the Treaty favours sustained behaviour and long-term effects, we based our analysis on the annual inflation rate, i.e. $\Delta_{12} \log CPI_t$, where $\Delta_{12} = (1 - L^{12})$ is the seasonal difference operator and L is the lag operator. The basic data used are monthly Harmonised Indices of Consumer Prices obtained from the *Eurostatistics* bulletins published by Eurostat. They have been complemented for non-EU countries with those published by the OCDE in its series *Main Economic Indicators*. The sample used covers the period from January 1979 to February 2000, with the exception of Finland, where the CPI series begins in January 1981. In the case of Ireland, we must also point out that a monthly series is available from 1997. From January 1979 to the end

of 1996 only quarterly data are available. Therefore, these quarterly CPI data have been distributed monthly using common interpolation techniques.

A second problem relates to the fact that price convergence is assessed in relative terms. Therefore, we need to construct a reference inflation index displaying the evolution of the three countries with the best-behaved prices. This reference will then serve as the benchmark to gauge the performance of each individual country. First, the so-called TAG rate (Trend Annual Growth: Fernández Macho (1990)) of the prices of each EU country has been extracted. This rate is not calculated directly from the CPI series, rather it is obtained as the annual accumulation of underlying monthly growth rates estimated *via* adjustment of an unobserved components model (Harvey 1989). This cyclical signal is more stable than raw annual growth figures and thus reflects the long-term behaviour of the series better. The three countries with the best price behaviour in accordance with this measure (lowest TAG) are shown in table 1. Finally, the reference inflation rate is constructed as the average of the annual inflation rates of the three countries every month.

Inflation deviations for each of the fifteen EU members as well as Switzerland, Japan and the US were then calculated as the difference between their annual inflation rate and the reference inflation index.

long-term interest rates

The convergence criteria of the Treaty establish that

“the durability of convergence achieved by the Member State [...] being reflected in the long-term interest-rate levels”.

In practice, the nominal long-term interest rate must not exceed by more than 2 percentage points at most that of the three best-performing Member States in terms of price stability (that is, the same Member States as in table 1). The period taken into consideration is the year preceding the observation of the situation in the Member State concerned.

The first problem that we come up on attempting to study the interest rates convergence criteria is that of gathering data of this variable for all EU countries. The methods used to

Table 1: reference countries with best price performance

COUNTRIES		COUNTRIES		COUNTRIES		COUNTRIES		COUNTRIES	
74.11	D-NL-L	79.11	D-B-NL	84.11	D-L-NL	89.11	D-B-NL	94.11	F-D-B
74.12	D-NL-L	79.12	D-B-NL	84.12	D-L-NL	89.12	D-B-NL	94.12	F-D-B
75.01	D-NL-L	80.01	D-B-L	85.01	D-L-NL	90.01	D-B-NL	95.01	FIN-F-D
75.02	D-NL-L	80.02	D-B-L	85.02	D-L-NL	90.02	D-B-NL	95.02	FIN-F-D
75.03	D-NL-L	80.03	D-B-L	85.03	D-L-NL	90.03	D-DK-NL	95.03	FIN-D-B
75.04	D-NL-L	80.04	D-B-L	85.04	D-L-NL	90.04	D-DK-NL	95.04	FIN-D-B
75.05	D-NL-DK	80.05	D-B-L	85.05	D-L-NL	90.05	D-DK-NL	95.05	FIN-D-B
75.06	D-NL-DK	80.06	D-B-L	85.06	D-L-NL	90.06	D-DK-NL	95.06	FIN-D-B
75.07	D-NL-DK	80.07	D-B-L	85.07	D-L-NL	90.07	D-DK-NL	95.07	FIN-D-B
75.08	D-NL-DK	80.08	D-B-L	85.08	D-L-NL	90.08	D-DK-NL	95.08	FIN-D-B
75.09	D-NL-DK	80.09	D-B-L	85.09	D-L-NL	90.09	D-DK-NL	95.09	FIN-L-B
75.10	D-NL-DK	80.10	D-B-L	85.10	D-L-NL	90.10	D-DK-NL	95.10	FIN-L-B
75.11	D-NL-DK	80.11	D-L-NL	85.11	D-L-NL	90.11	D-DK-IRL	95.11	FIN-L-S
75.12	D-NL-DK	80.12	D-L-NL	85.12	D-L-NL	90.12	D-DK-IRL	95.12	FIN-L-S
76.01	D-NL-DK	81.01	D-L-NL	86.01	D-L-NL	91.01	D-DK-IRL	96.01	FIN-L-S
76.02	D-NL-DK	81.02	D-L-NL	86.02	D-L-NL	91.02	D-DK-IRL	96.02	FIN-L-A
76.03	D-NL-DK	81.03	D-B-NL	86.03	D-L-NL	91.03	D-DK-IRL	96.03	FIN-L-A
76.04	D-NL-DK	81.04	D-B-NL	86.04	D-L-NL	91.04	D-DK-IRL	96.04	FIN-L-A
76.05	D-NL-DK	81.05	D-B-NL	86.05	D-L-NL	91.05	L-DK-IRL	96.05	FIN-L-A
76.06	D-NL-DK	81.06	D-B-NL	86.06	D-L-NL	91.06	L-DK-IRL	96.06	FIN-A-S
76.07	D-NL-B	81.07	D-B-NL	86.07	D-L-NL	91.07	L-DK-B	96.07	FIN-A-S
76.08	D-NL-B	81.08	D-B-NL	86.08	D-L-NL	91.08	L-DK-B	96.08	FIN-A-S
76.09	D-NL-B	81.09	D-B-NL	86.09	D-L-NL	91.09	L-DK-B	96.09	FIN-A-S
76.10	D-NL-B	81.10	D-B-NL	86.10	D-L-NL	91.10	L-DK-B	96.10	FIN-A-S
76.11	D-NL-B	81.11	D-B-NL	86.11	D-L-NL	91.11	L-DK-B	96.11	FIN-A-S
76.12	D-NL-B	81.12	D-B-NL	86.12	D-L-NL	91.12	L-DK-B	96.12	FIN-A-S
77.01	D-NL-B	82.01	D-B-NL	87.01	D-L-NL	92.01	F-DK-B	97.01	FIN-A-S
77.02	D-NL-B	82.02	D-B-NL	87.02	D-L-NL	92.02	F-DK-B	97.02	FIN-A-S
77.03	D-NL-B	82.03	D-B-NL	87.03	D-L-NL	92.03	F-DK-B	97.03	FIN-A-L
77.04	D-NL-B	82.04	D-B-NL	87.04	D-L-NL	92.04	F-DK-B	97.04	FIN-A-F
77.05	D-L-NL	82.05	D-B-NL	87.05	D-L-NL	92.05	F-DK-B	97.05	FIN-A-F
77.06	D-L-NL	82.06	D-UK-NL	87.06	D-L-NL	92.06	F-DK-B	97.06	FIN-A-F
77.07	D-L-NL	82.07	D-UK-NL	87.07	D-L-NL	92.07	F-DK-B	97.07	FIN-A-F
77.10	D-L-NL	82.10	D-UK-NL	87.10	D-L-NL	92.10	F-DK-B	97.08	F-A-B
77.11	D-L-NL	82.11	D-UK-NL	87.11	D-L-NL	92.11	F-DK-B	97.09	F-A-B
77.12	D-L-NL	82.12	D-UK-NL	87.12	D-L-NL	92.12	F-DK-IRL	97.10	F-A-D
78.01	D-L-NL	83.01	D-UK-NL	88.01	D-L-NL	93.01	F-DK-IRL	97.11	F-A-D
78.02	D-L-NL	83.02	D-UK-NL	88.02	D-L-NL	93.02	F-DK-IRL	97.12	F-A-D
78.03	D-L-NL	83.03	D-UK-NL	88.03	D-L-NL	93.03	UK-DK-IRL	98.01	F-A-D
78.04	D-L-NL	83.04	D-UK-NL	88.04	D-B-NL	93.04	UK-DK-IRL	98.02	F-A-D
78.05	D-L-NL	83.05	D-UK-NL	88.05	D-B-NL	93.05	UK-DK-IRL	98.03	F-A-D
78.06	D-L-NL	83.06	D-UK-NL	88.06	D-B-NL	93.06	UK-DK-IRL	98.04	F-A-D
78.07	D-L-NL	83.07	D-UK-NL	88.07	D-B-NL	93.07	UK-DK-IRL	98.05	F-A-D
78.08	D-L-NL	83.08	D-UK-NL	88.08	D-B-NL	93.08	UK-DK-IRL	98.06	F-A-D
78.09	D-L-B	83.09	D-UK-NL	88.09	D-B-NL	93.09	UK-DK-IRL	98.07	F-L-D
78.10	D-L-B	83.10	D-UK-NL	88.10	D-B-NL	93.10	UK-DK-IRL	98.08	F-A-D
78.11	D-L-B	83.11	D-UK-NL	88.11	D-B-NL	93.11	UK-DK-IRL	98.09	F-S-D
78.12	D-L-B	83.12	D-UK-NL	88.12	D-B-NL	93.12	F-DK-IRL	98.10	F-S-D
79.01	D-L-B	84.01	D-UK-NL	89.01	D-B-NL	94.01	F-DK-IRL	98.11	A-D-S
79.02	D-L-B	84.02	D-UK-NL	89.02	D-B-NL	94.02	F-DK-IRL	98.12	A-F-S
79.03	D-L-B	84.03	D-UK-NL	89.03	D-B-NL	94.03	F-DK-IRL	99.01	A-F-S
79.04	D-L-B	84.04	D-UK-NL	89.04	D-B-NL	94.04	F-DK-IRL	99.02	A-F-S
79.05	D-B-NL	84.05	D-UK-NL	89.05	D-B-NL	94.05	F-DK-L	99.03	A-F-S
79.06	D-B-NL	84.06	D-UK-NL	89.06	D-B-NL	94.06	F-DK-L	99.04	A-F-S
79.07	D-B-NL	84.07	D-UK-NL	89.07	D-B-NL	94.07	F-DK-L	99.05	A-F-S
79.08	D-B-NL	84.08	D-UK-NL	89.08	D-B-NL	94.08	F-DK-L	99.06	A-F-S
79.09	D-B-NL	84.09	D-UK-NL	89.09	D-B-NL	94.09	F-DK-L	99.07	A-F-S
79.10	D-B-NL	84.10	D-L-NL	89.10	D-B-NL	94.10	F-D-L	99.08	A-F-S

calculate long-term interest rates differ substantially across the EU. Nevertheless, Eurostat has made a notable effort in order to get a data set as homogeneous as possible.

In *Eurostatistics* data for the fifteen EU countries (including Finland from 1995 onwards) can be found along with data for the USA. Data for Japan and Switzerland were obtained from *Main Economic Indicators*. In the Spanish case we used a database from the Bank of Spain, which currently elaborates a specific series aimed at monitoring the compliance with the convergence criteria. We obtained samples of monthly data from January 1979 to February 2000 for all countries except Portugal and Japan, whose samples start on January 1980, and the countries joining the EU in 1995, whose series are much shorter (Austria as from August 1989 and Sweden and Finland as from July 1984).

In accordance with the Treaty, a series of *reference interest rates* is constructed as an average of the interest rates of the three countries with the best price performance in table 1. The monthly interest rates and reference index are used as the basis for constructing the interest rates deviation for the fifteen EU countries plus Japan, Switzerland and the USA.

public finances

The Treaty of the European Union stipulates that

“the sustainability of the government financial position [...] will be apparent from having achieved a government budgetary position without a deficit that is excessive [...]”.

Within this framework, the Council evaluated compliance with budgetary discipline based on the recommendations drawn up by the Commission. The requisites necessary to enter the single currency referred to two variables, annual government deficit and government debt. The limits required were set out in article 1 of protocol 5: at the end of the preceding financial year, the ratio of the annual government deficit to gross domestic product (GDP) must not exceed 3% and the ratio of gross government debt to GDP must not exceed 60%.

The objective was for public finances to be in a sustainable situation, avoiding excessive public strains. Besides, the benchmark levels cited above were not strict requirements but

rather represented a commitment by governments to maintain policies aimed at achieving them. For example, debt/GDP ratios higher than 60% (interpreted in trend terms) were admitted on the condition that this percentage was seen to be approaching the reference value at a satisfactory rate. As for deficit, levels higher than 3% (interpreted in trend terms) were allowed in cases where the ratio had reduced substantially and continually and is close to 3% or when the excess in comparison to the benchmark was small and was of an exceptional and temporary nature.

Once the third phase of the EMU began, the SGP established a somehow stricter objective for the EU member states: to maintain in the medium-term budgetary positions close to balance or in surplus.

The series that are analysed in this section consist of annual percentages of the government deficit and debt with respect to the GDP. Eurostat provides these figures for the 15 EU countries on the basis of the annual reports provided by each country and in accordance with the definitions established in the Treaty of the European Union, Protocol on the Excessive Procedure and Council Regulations 3605/93 and 475/2000. We have data from 1979 to 1999, the latest year's data being provisional. Thus, the variables of interest in evaluating the government finances are only available yearly, whereas the compliance of the other three criteria (exchange, prices and interests) can be evaluated on a monthly basis. Hence, in order to incorporate government financial performance into a single index, we must disaggregate the annual data into monthly figures.

The problem of temporal disaggregation appears frequently in applied econometrics. Although simple distribution or interpolation is more often than not the only available solution, a more satisfactory procedure is available if we can find an indicator variable that, being closely related to the annual variable of interest, is observed more frequently. Such an indicator will provide information about the intra-annual evolution of the variable of interest (Chow & Lin 1971, Sanz 1981, Ahmed & Rogers 1998).

In the deficit case, a monthly indicator is available from the deficit figures published by the International Monetary Fund in *International Financial Statistics* for ten of the countries (Germany, Belgium, Spain, Finland, France, Italy, Netherlands, Austria, Ireland and United Kingdom). These indicators show a seasonal component that is of no interest to us since the

criteria regarding government finances refer to long-term sustained behaviour. Thus, before applying the Chow-Lin method, the indicator variable was seasonally adjusted by fitting an unobserved component model (Harvey 1989). For the remaining five countries (namely Denmark, Greece, Luxembourg, Portugal and Sweden) no such indicator is available and their annual deficits were simply distributed throughout the year.

As for public debt, an adequate monthly indicator has not been found for any country. Therefore, since it is a stock variable observed at the end of each year, the monthly series were obtained by simple linear interpolation of the observed yearly figures.

Due to the lack of data for Japan we are left with only two countries, the US and Switzerland, for comparison purposes. Their series are calculated with data from *International Financial Statistics*. The US data are monthly, so that, as before, the seasonal component was removed. Swiss deficit figures appear quarterly; so that each seasonally adjusted value has been spread over the corresponding three-month period. Finally, monthly debt ratios for Switzerland were obtained by linear interpolation of annual data.

3 Measuring the compliance of convergence and stability criteria

In order to assess the degree to which the convergence and stability criteria are being complied with, five different economic variables for each of the fifteen countries that make up the EU have to be taken into account. This adds up to a total of 75 different variables, a number that is clearly excessive. The mere visualisation of their graphics (figures 8 to 17) does not facilitate an easy interpretation of the overall situation. It would be useful, therefore, to proceed to construct synthesising measurements that emphasise different aspects of the analysis. Thus, it would be useful to have an aggregated index of the degree of compliance for each country that would include all five criteria. In addition, an aggregated measurement of each criterion for all countries of the EU would also be crucial. Hence, the maximum level of synthesis would be a single index that would summarise the global degree of compliance for the entire EU. This is not dissimilar to what has been done previously in other contexts at the time of obtaining measurements that sum up diverse partial aspects of the same phenomenon in a single quantity. An example would be the construction of price indices

or the construction of indicators of economic activity (Fernández “nobreakspace –” Macho 1991).

3.1 synthetic indices by criteria

In principle, if the variables to be aggregated are comparable to one another (being expressed in the same units) it will not be necessary to standardise the quantities beforehand. Nevertheless, in general, when several homogeneous variables referring to different countries have to be combined, it seems sensible to weigh the quantities used using a measurement of the economic “*weight*” of each country, e.g. through their respective GDPs.

However, our objective in this case does not really consist in obtaining a supranational measurement of each variable; rather it is an attempt to evaluate the degree of compliance of each criterion jointly. In the authors’ opinion, weighting with GDPs would only serve to distort the analysis, as a strong economy (e.g. Germany) would completely dominate the index. Thus in reality, we would be reflecting the degree of compliance of the biggest economy and not of the entire set. In other words, from the point of view of the Treaty the conditions imposed upon Germany and Luxembourg are the same and the results of complying with them (or not) should count as bad (or as good) for the one as for the other. This is reflected in the construction of the index by using equal weightings.

3.2 synthetic indices by countries

In this case, the aim is to construct an index of the degree of compliance of a country made up of heterogeneous quantities. Therefore, it becomes necessary to process each partial indicator so that it is reduced to a common standard making it possible to compare them to each other. Thus for instance, in the construction of indicators of activity, it is usual to standardise each partial indicator using a measure of dispersion to avoid highly fluctuating series from completely dominating the synthetic index.

In the current context, such standardisation would imply a perfectly valid type of index representing the economic “health” of a country using the variables mentioned in the TEU. Nevertheless, the main objective of this paper is not to study the “economic health” in

absolute terms but in relative terms referring to the bands of fluctuation as dictated in the Treaty. Thus, the standardisation used consists of expressing the (absolute) deviations with respect to each criterion in *relative* terms to the size of each of its fluctuation bands.

In short, the method consists in calculating the *relative* excess (or want) of each criteria with respect to the maximum limit of the band allowed by the Treaty in order to construct the index through averaging the aforesaid relative deviations. This *average* index can become biased if there exists a high deviation in just one of the criteria. To avoid this a *robust* index is also constructed as a trimmed average, eliminating the maximum and minimum values of each month. Note, however, that by construction both indices balance the non-compliance in one criterion with a good performance in another. The Treaty is actually stricter than this, as a country is deemed non-compliant if it goes over the limits of anyone of the bands, even if it is comfortably complying with the rest. The *strict* index is therefore made equal to the maximum relative deviation, month by month.

Table 2 summarises the construction of these synthetic indices. By construction, the value of a synthetic index shows the degree of deviation with respect to the objective of convergence. Thus, if a country, at a given time, just complies with each criterion (exchange deviations = $\pm 2.25\%$, inflation deviations = 1.5% , long-term interest rates deviations = 2% , deficit ratios = 3% and debt ratios = 60%) then all its synthetic indices would be equal to zero at that point. On the other hand, if a country complied with all the criteria strictly to the letter (exchange deviations = inflation deviations = long-term interest rates deviations = deficit = debt = 0) then it would show a value of -1 in all indices. Therefore, more realistically, when a country shows indices going below zero we say that the country complies with the requirements during such period. Conversely, when an index is above zero it means that the Treaty is being somehow violated. In other words, a value of 0 means that a country just complies at the limits of the corresponding bands, a value of 1 indicates that a country has a 100% non-compliance, a value of 0.5, of a 50% , a value of 2, of 200% , etc. In contrast, negative values would show compliance (average, strict, etc.) indicating the corresponding degree of free movement in terms of the maximum deviation allowed.

Table 2: Construction of synthetic indices

average	robust	strict
$\frac{\sum_{i=1}^5 x_i}{5}$	$\frac{\sum_{i=1}^5 x_i - \max\{x_i\} - \min\{x_i\}}{3}$	$\max\{x_i\}$

where

$$\text{Exchange rates: } x_1 = \frac{\left| \left(\frac{\text{exchange rates with respect to the DM}}{\text{ERM central parity}} \right) - 1 \right|}{0.0225} - 1$$

$$\text{Inflation: } x_2 = \frac{\text{inflation deviations (in \% from average of 3 best countries in prices)}}{1.5} - 1$$

$$\text{Interest rates: } x_3 = \frac{\text{long-term interest rates deviations (in \% from average of 3 best countries in prices)}}{2} - 1$$

$$\text{Deficit: } x_4 = \frac{\text{monthly deficit (in \% of GDP)}}{3} - 1$$

$$\text{Debt: } x_5 = \frac{\text{monthly debt (in \% of GDP)}}{60} - 1$$

4 Convergence and Stability in the EU

In this section we will take up the ideas expressed above in the construction of synthetic indices of convergence and stability in the EU, starting out from partial indicators obtained for each country and criteria (see figures 8 to 17 in the appendix).

Figure 1 shows, for the EU, the index of overall compliance with the criteria. As can be observed, already at the end of 1992 the EU as a whole showed an optimum degree of compliance, although the difficult period between 1993 and 1996 would end up threatening the attainment of the objectives. Nevertheless, 1996 became a critical year for the future of the EU with the candidates opting for compliance with the criteria in a clear and determined manner, and by mid-1996 they had succeeded. As from 1997 onwards (see end of figure) it could be said that the EMU was a fact in practice, since the member countries were fulfilling their obligations.

Also, figure 1 shows the joint evolution of the EU as compared to some other important OECD countries (Switzerland, the United States and Japan). Obviously, these countries do not have to comply with the criteria, so that the narrowing of the differences between series clearly appreciable over time in the figure must be a reflection of the global convergence phenomenon that the industrial economies have been undergoing during the last twenty years.

Figures 2 to 6 show synthetic indices as constructed for each EU country, as well as for some key OECD countries (the latter for comparison purposes). Table 3 summarises the main conclusions derived from their observation. Overall, we can divide the countries into four groups. In first place, five countries (Luxembourg, France, Finland, Germany and Austria) that over the last two years, on average, have been complying with the criteria better than the EU as a whole and whose strict compliance (measured as the criteria with the worst value for each month) is good. Secondly, three other countries, Netherlands, Spain and Denmark, whose behaviour during the last two years is similar to the EU as a whole and in addition, do not display any problem with regards to any of the criteria (public variables included). In third place, Belgium, Portugal and Sweden show similar behaviour although they have some problems with some financial variables. In the last group are the four remaining countries (Ireland, UK, Italy and Greece) that show a worse compliance than

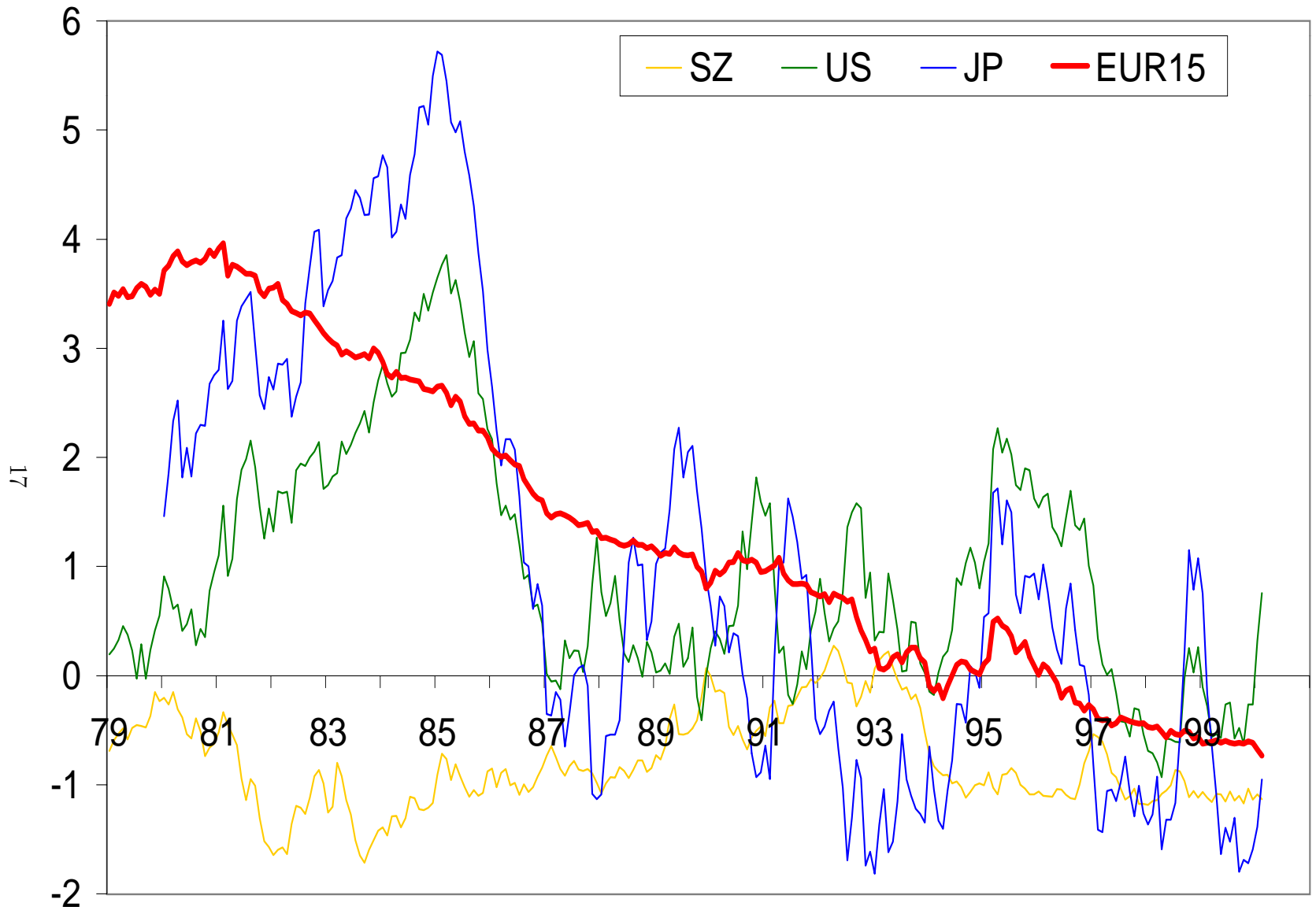


Figure 1: EU overall index: EUR15 vs. others

the EU as a whole and have additional problems with some of the criteria (usually debt and/or exchange rate). The last line of table 3 refers to Switzerland, a country that would have no problems in joining the group of countries at the head of the EU, should it wish to do so.

Figure 7 displays the evolution of the compliance of the EU as a whole with each of the stability criteria through the corresponding synthetic index. In all of them, the phenomenon of convergence can be clearly seen in all variables, with the exception of Public Debt.

exchange rates

In *exchange rates*, the synthetic indices of each country are simply the normalisation of the difference in value of the series with respect to the central exchange rate.

The central exchange rate with respect to the Deutsche Mark for the 11 member states participating in the third phase of the EMU from the outset is the one corresponding to the fixed exchange rates established by the European Central Bank on December 31st, 1998. Consequently, only fixed exchange rates are to be found after this date for these countries. Of the member states that are not taking full part in the third stage of the EMU, only Denmark and Greece are participating in the new Exchange Rate Mechanism (ERM II) and in principle, only these two have a central parity with the Euro with which it is possible to calculate synthetic indices in order to analyse the fulfilment of the criterion. Given that there is no central parity for the currencies of United Kingdom, Sweden and the other non-EU countries, their exchange rates as in January 1998 have been used.

Figures 8 and 9 in the appendix show, for each EU country, the quantity

$$\left(\frac{\text{exchange rate with the DM}}{\text{ERM central parity}} \right) - 1$$

that measures the distance from the central parity, taking the Deutsche Mark as the reference currency. A value of zero indicates that the currency exchange rate coincides with the central exchange rate. A positive value (negative) indicates the magnitude, in relative terms, of the devaluation (revaluation) of the currency with respect to the central exchange rate. Therefore, values of the x_1 index in table 2 greater than zero indicate that the currency has deviated in more than 2.25%, and will be outside the band proposed by the EMS control

Table 3: EU countries: synthetic indices

country	comparison with EUR15 <i>(last two years)</i>	average	robust	strict
Germany	better	fine		not bad
Austria	better	fine	except for	not bad
Denmark	same (worsening at the end)	fine (90→)	Luxembourg	not bad
Luxembourg	better	fine	(prices)	fine
Netherlands	same	fine	and UK	not bad (debt)
France	better	fine (except 95)	(exchange)	fine (98→)
Finland	better	fine (95→)	at present	fine (97→)
Belgium	better	fine (94→)	the signal	too bad (debt)
Portugal	same (getting better at the end)	fine (96→)	is always	bad (except 97)
Spain	same	fine (97→)	robust,	not bad (97→)
United Kingdom	worse	bad (except 97)	not so in	bad (exchange)
Ireland	worse	fine (98→)	historical	too bad (→97 exchange) bad (98)
Italy	worse	fine (98→)	years of the	too bad (public finances)
Sweden	same	bad (→95) not bad (96→)	convergence	bad (debt & exchange)
Greece	worse (OK at the end; great effort)	bad (but outstanding improvement)	period	too bad
EUR 15	—	fine (97→)	(see figures)	not bad (97→)
Switzerland	better	fine		fine (98→)

average: average fulfilment of the Treaty (one criterion may compensate other). **robust:** relative fulfilment of the Treaty (maximum and minimum values are discarded). **strict:** strict fulfilment of Treaty (only maximum values count). **Note:** the value of the synthetic indicator signals the degree of deviation from the fulfilment of the Treaty: a hypothetical country just fulfilling each criteria (at the border of the allowance) would have a synthetic indicator with a zero value. Thus a value of 1 would mean that such country (on average, etc) fails the Treaty by 100%, a value of 0.5, would mean failing by 50%, a value of 2, by 200%, etc. On the other hand, negative values would show fulfilment, providing a measure of free movement.

mechanism. Thus it is very easy to observe whether, in accordance with the Treaty, the exchange criterion is fulfilled (within the band) or not (outside) during any given period.

Figure 7 allows us to appreciate the convergence in the different exchange rates that has historically taken place in steps, alternating long periods of stability with short periods of turbulence. After the creation of the EMS in 1979, the first negative period took place at the beginning of the 1980's marking one of the oil crises. The second period of instability occurred in the years 1985 and 1986, when multiple realignments took place. Year 1987 marked a long period of stability known as the "new EMS". In more recent years, the problems with this criterion had begun with several monetary crises during the years 1992 and 1993, climaxing in the monetary storms of October 93. As from the end of 1995 however, this trend changed abruptly when it became clear that it was probable that a large number of EU countries would be able to meet the criteria related to, at least, inflation and interest rates. As already mentioned in Fernández Macho, González, Díaz-Emparanza, Virto, Moral & Caminero (1997), the compliance with this criterion depends to a large extent on the confidence about the final outcome of the EMU, i.e. the period from the last quarter of 1995 onwards. On the contrary, only the most "stable" currencies resist crises concerning the credibility of the European project, such as those of 92 or 94. The final evolution of the synthetic index thus indicates the growing expectations of a large number of countries joining the EMU.

Looking at the two years previous to the convergence evaluation of spring of 1998, we can observe that Germany (by definition), Austria, Belgium-Luxembourg, Denmark, Spain and Netherlands comply strictly with the criteria, not leaving the bands at any point between 1996 and 1998. France (96.02) and Portugal (97.01) only go over once. Finland went over thrice (96.03, 96.02 and 97.07) and Italy in the first seven of the 8 months at the beginning of the sample period. These countries can be said to have complied with the exchange rate criterion, as they rarely go over the limits, and when they do, it only happens during the first months of 1996. At the other end of the line are Ireland, United Kingdom, Sweden and Greece, that do not comply on 22, 23, 23 and 24 occasions respectively, of the 28 possible in all.

Of the currencies incorporating into the Euro at the outset, only Ireland had serious problems with this criterion. This behaviour, as already discussed in Fernández Macho et

al. (1997), can be explained on account of its important trade relations with the UK (for a more detailed explanation look at Fernández Macho & Roca Castro (1997)).

At present, the national currencies of the majority of EU countries have given up their place in the exchange markets in favour of the Euro, so that this stability criterion is of little relevance on its own except, of course, for those EU countries outside the Euro zone and for other countries that are candidates for an eventual enlargement of the EU. Of the currencies not joining the EMU, the only one that complies with the criteria is the Danish Krone, which has traditionally been pegged to the DM as it is practically now to the Euro.

price stability

As a whole, Europe was far from convergence as regards *inflation* levels throughout the eighties. At the start of the 1990s when the convergence criteria were established, the difference between the synthetic index and the benchmark inflation rate was quite significant. As from 1992 onwards, the differences started to narrow but with many relapses that can be explained by the particular behaviour of some countries (see figures 10–11 in the Appendix). The European synthetic index in the period 92–94 shows the rate of decline lessening in comparison to the reference index, which implies that there were countries within the EU that were not being able to adjust their prices at the desired speed, basically located in Southern Europe: Greece, Italy, Portugal and Spain. As from 1994 onwards, the synthetic index was at the outer limits of the compliance band although with some specific problems. An example is the year 1995, where there are relapses in the rates in some important countries e.g. Italy. As from the year 1997, the very strong decline of the European synthetic index is a reflection of the final effort made by some countries, mostly in the South. During the last few years of the race towards integration Spain, Italy and Portugal managed to reduce their inflation deviations in excess of 2 percentage points, finally complying with the criteria.

During the last two years, the behaviour of this synthetic index has been good, particularly during 1998. By the end of the sample, that is the beginning of 2000; the average compliance is situated at around an inflation deviation of 0.8%–0.7%, which is far from the limit of 1.5%. Nevertheless, it should also be noted that there has been an upward turn of this synthetic index from mid-1999 onwards, due to inflationary strains that have lately

appeared all over Europe and that have badly affected the inflation performance in some countries, specially Denmark, Ireland, Netherlands, Portugal and Spain.

long-term interest rates

Figure 7 shows how in historical times the *long term interest rates* has been experimenting a slow reduction of the differences between European countries, entering the compliance zone from as early as 1989. Although at present these deviations are very slight in the Euro zone, obviously due to the implementation by the European Central Bank of one of its first competencies, this was already practically true from as early as the beginning of 1998.

public finances

As regards the government finance variables, the historical *deficit* has shown cyclical fluctuations of certain magnitude. Only the nearing of the deadline for the implementation of the convergence criteria imposed by the TEU led, one way or another, to the joint average compliance showing an important improvement in 1996 and achieving levels well below 3% (there are certain exceptions such as Luxembourg, which has traditionally presented a budget surplus). More specifically, it can be observed that only three countries clearly comply with the criteria in 1995 but this number rose to twelve in 1997. Over the past two years the objective of deficit reduction has been maintained and the European index in 1999 stood at -0.05% , close to the Stability and Growth Pact main objective of budgetary balance. That same year saw all EU countries displaying deficit levels below 3% of GDP. In addition, other countries such as the USA share this decreasing deficit trend.

Public debt is by far the criteria displaying the worst behaviour. In fact, it is the only one that gradually gets worse over time both in the EU and the USA, indeed along similar paths (figure 17 in the appendix). Figure 7 shows how during the period 1979–1997 the European index fluctuates around a growing trend with two distinctive phases of rapid debt growth. The first, and longer, occurs during the early 80s where the joint average public debt grew swiftly from 35% to 60% in the year 1986. It did so in all EU countries except for Luxembourg and, perhaps, Finland (figures 16–17). From then on debt figures went on rising in some countries but started to go down in others like Ireland, United Kingdom and

Sweden, so that the average debt remained stable at the 60% until 1992.

During the period encompassing 1992–93, public debt again grew quickly in most of the EU, except for Ireland and Netherlands. Average debt jump to 75%, the figure at which it remained until 1997. This point signals the beginning of the current downward trend, which continues at the end of the available sample. Debt reduction during the last three years is the greatest experienced since 1979. Nevertheless, at 65% it remains above the desired 60% level.

Although at present practically all countries display a declining debt/GDP ratio, provisional data for 1999 places eight countries above the 60% limit. The level of non-compliance can be divided into two categories: five countries, namely Germany, Spain, the Netherlands, Austria and Sweden, are very near the required limit i.e. between 60% to 65% whereas three other countries (Belgium, Italy and Greece) easily surpass the 100% mark.

5 Conclusions

The evolution of each EU country in fulfilling the convergence criteria as laid down in the TEU and the stability pact has been analysed in this paper by means of the construction of suitable synthetic indices.

Analysing the synthetic indices by criteria (see figure 7) we note that the relevant economic variables observe in general a good behaviour during the last years securing a full compliance with the Stability and Growth Pact stipulations. However, a number of member states are suffering inflationary strains. Besides, the four EU countries that are not yet full participants in the EMU show exchange rates against the Euro far from the stability requirements.

More specifically, the 11 member states participating in the third phase of the EMU from the outset present a healthy economic situation. Long-term interest rates show slight deviations from the TEU reference, as it could be expected within a monetary union (figures 12 to 13).

Moreover, public finances generally show a good behaviour, with most countries close to the medium-term objective of budgetary balance. The majority also improve on debt terms,

perhaps with the exception of Italy (figures 14 to 17).

On the negative side, we can observe a general upward trend in prices, with countries like the Netherlands, Ireland, Luxembourg, Portugal and Spain showing inflation figures well above the EU average (figures 7, 10 and 11), which may put in danger the price stability objective.

With respect to Greece, we observe that it fulfils the conditions required for the adoption of the common currency. Indeed, it became a full member of EMU as from January 1, 2001. This notwithstanding, Greece exhibits in general a behaviour beneath the EU average, although it shows a substantial progression towards convergence. In particular, the exchange rate against the Euro has only got within the permissible bands in the last few months of the sample.

The member states that do not participate in the third phase of the EMU, namely Denmark, United Kingdom and Sweden, display a situation that is even better than that of the participating countries, except for the lack of stability of their exchange rates. Their interest rates and public finance figures behave in a similar manner as to the rest of the member states, and only Denmark shows problems with its prices. On the other hand, while the British Pound and the Swedish Krone are quite unstable with respect to the Euro, the Danish Krone is well within the permissible bands (figures 8 and 9). In summary, we may conclude that these countries should not have great difficulties in joining the EMU should they so desire. Actually, once they would express their will to become members of the EMU, their currencies would in due course stabilize against the Euro (as it happened to the Greek Drachma) thus fulfilling the requirements for entering the third phase of EMU.

Appendix: Partial Indicators

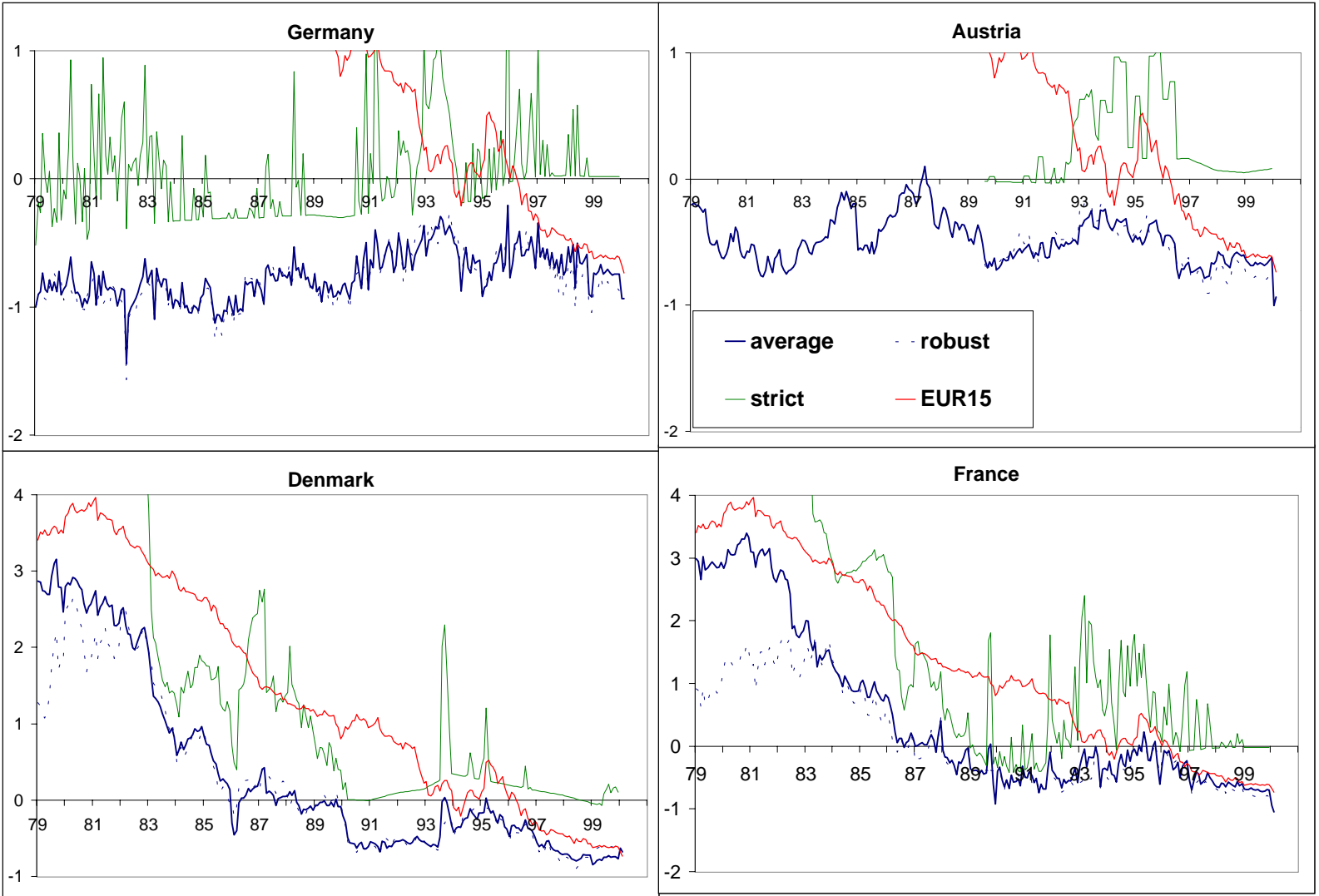


Figure 2: EU countries: Synthetic indices 1

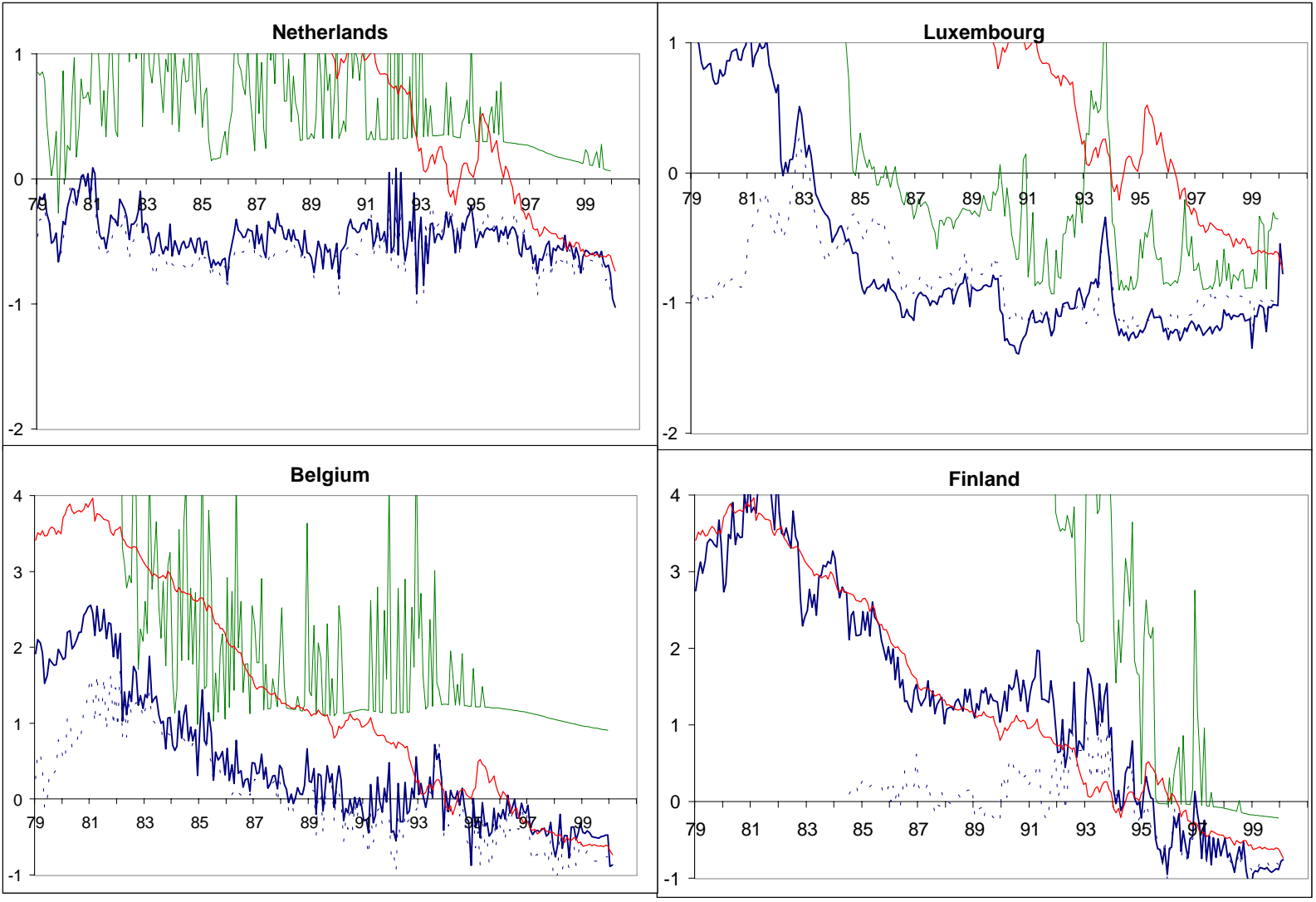


Figure 3: EU countries: Synthetic indices 2

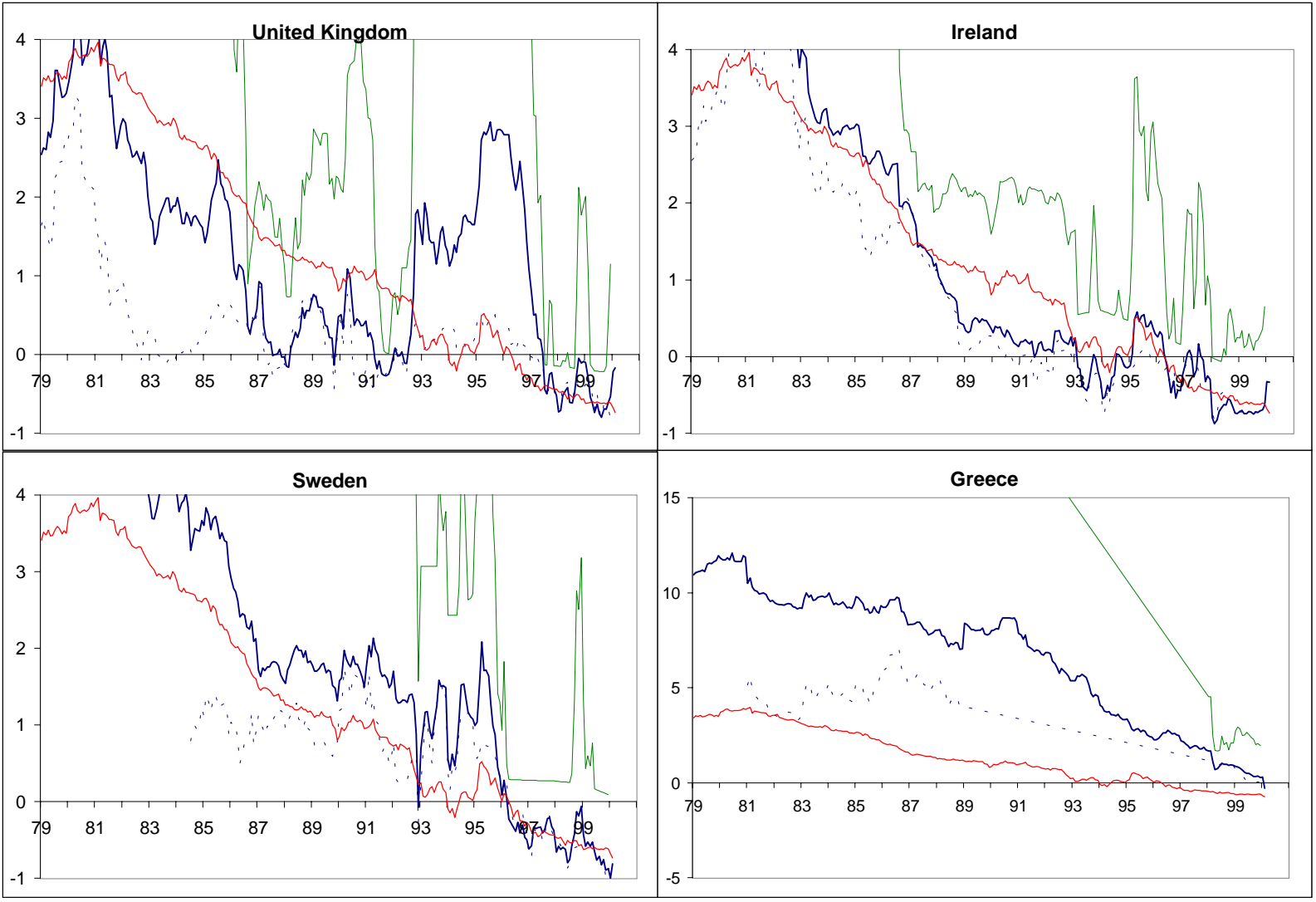


Figure 4: EU countries: Synthetic indices 3

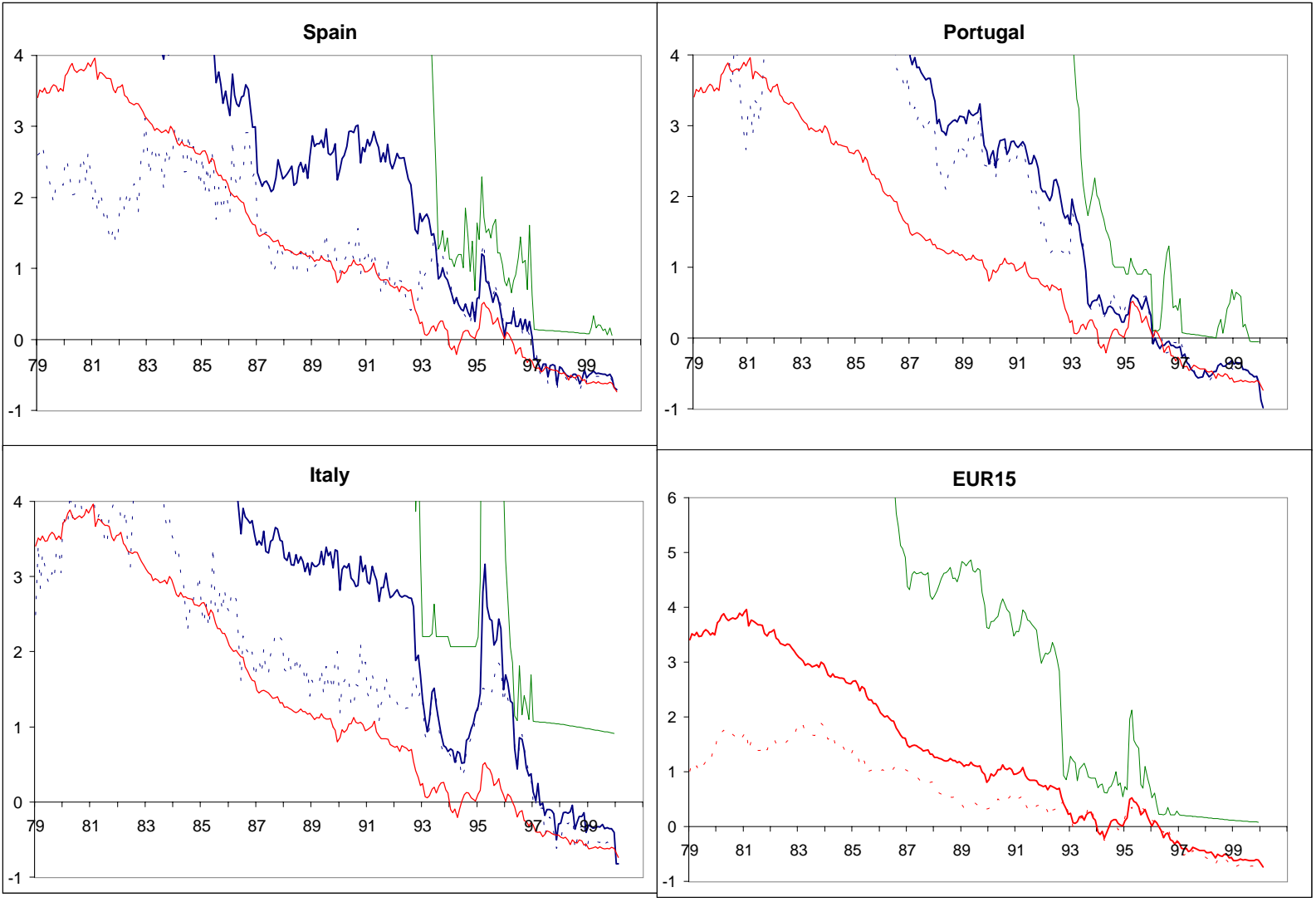


Figure 5: EU countries: Synthetic indices 4

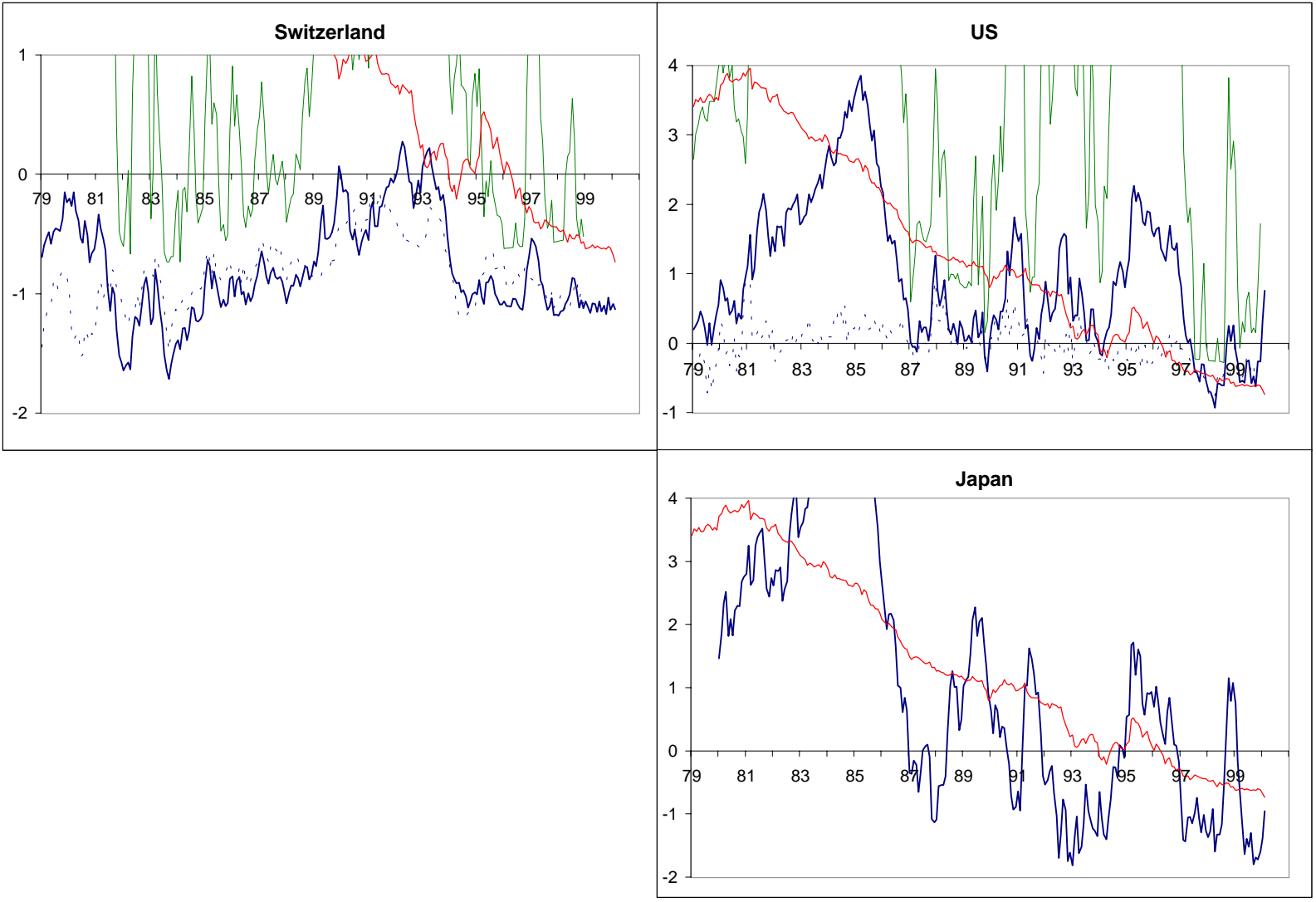


Figure 6: Other countries: Synthetic indices 5

Figure 7: Europe: synthetic indices by criteria

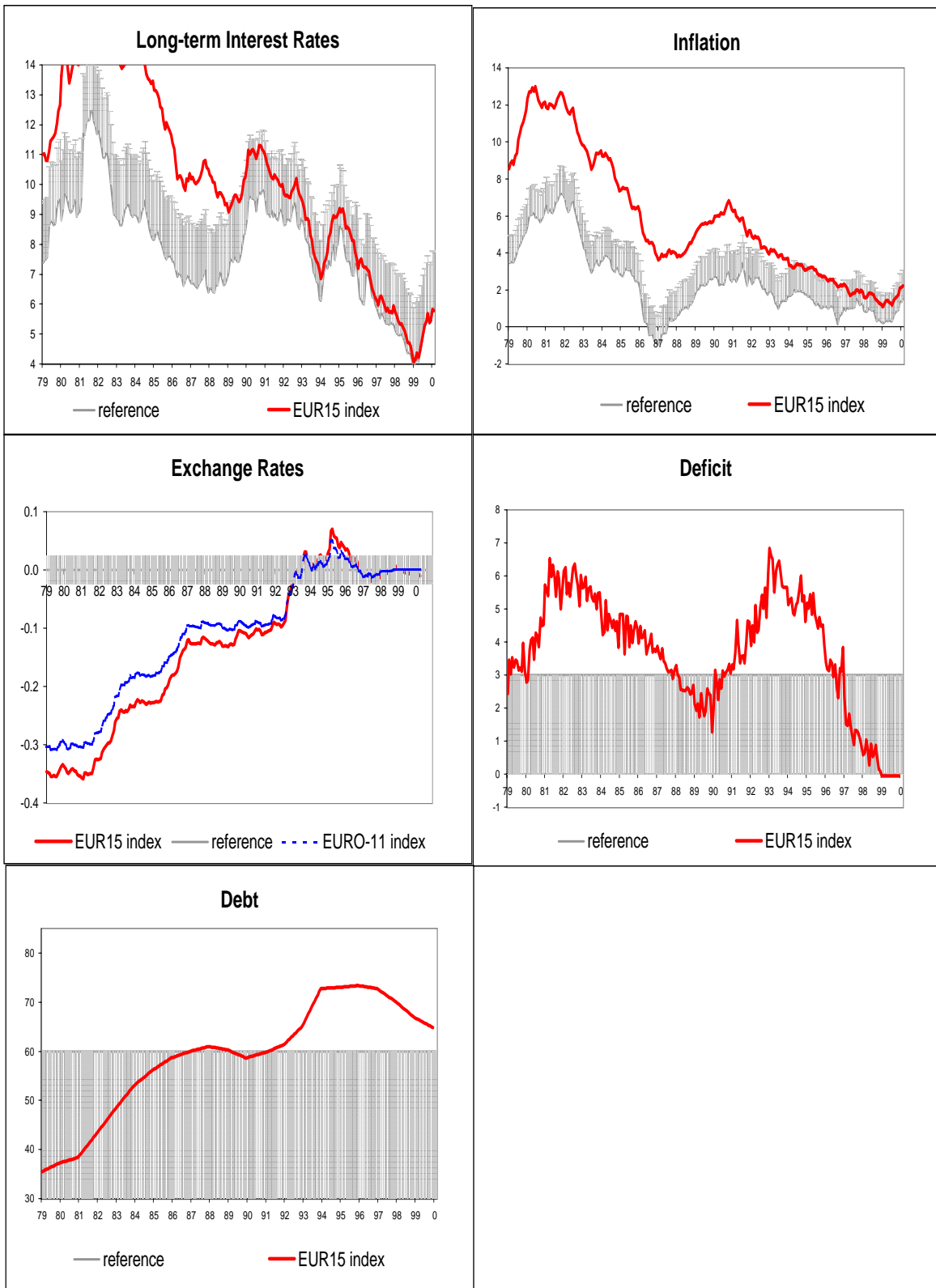


Figure 8: Exchange Rates 1

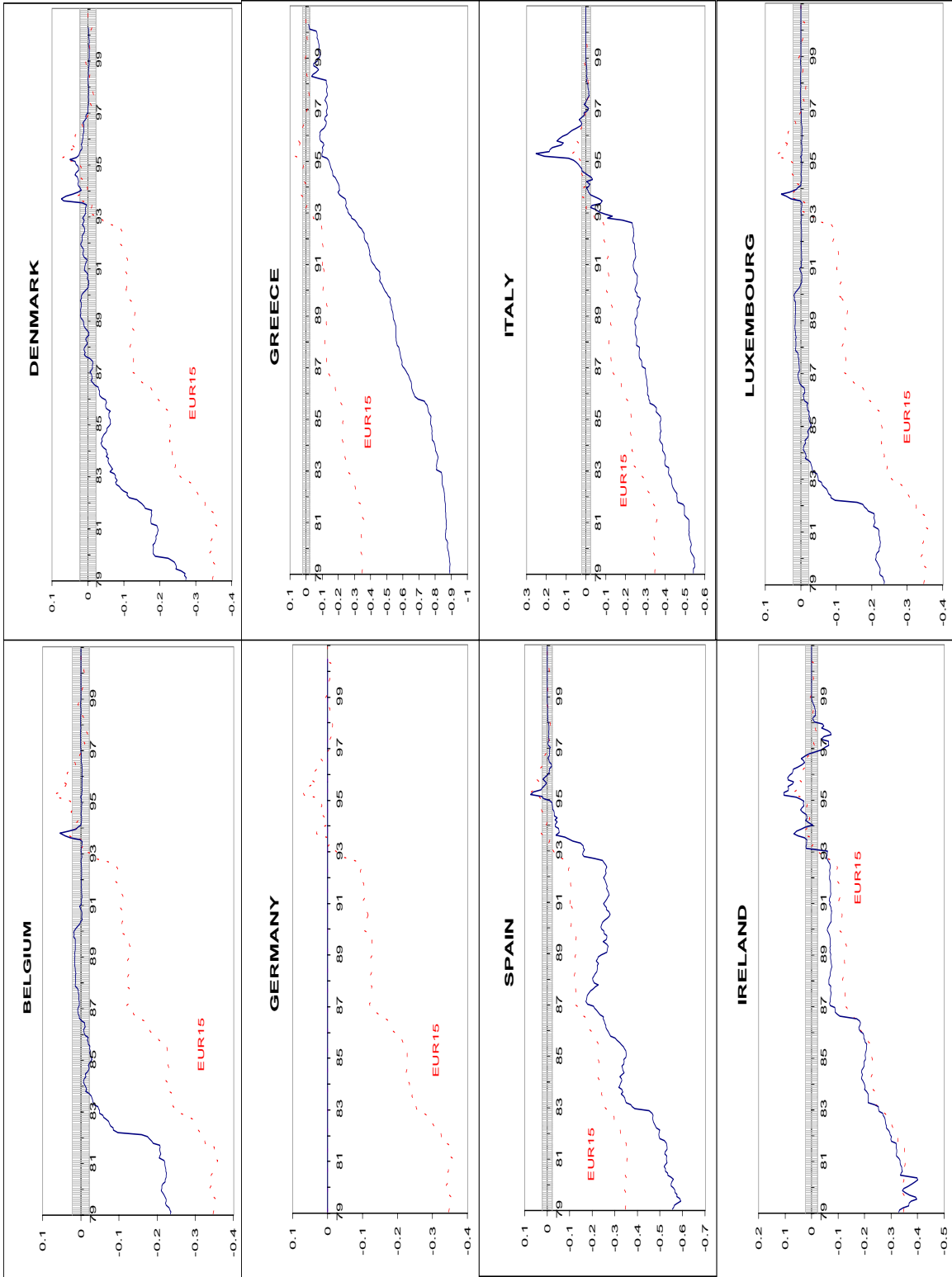


Figure 9: Exchange Rates 2

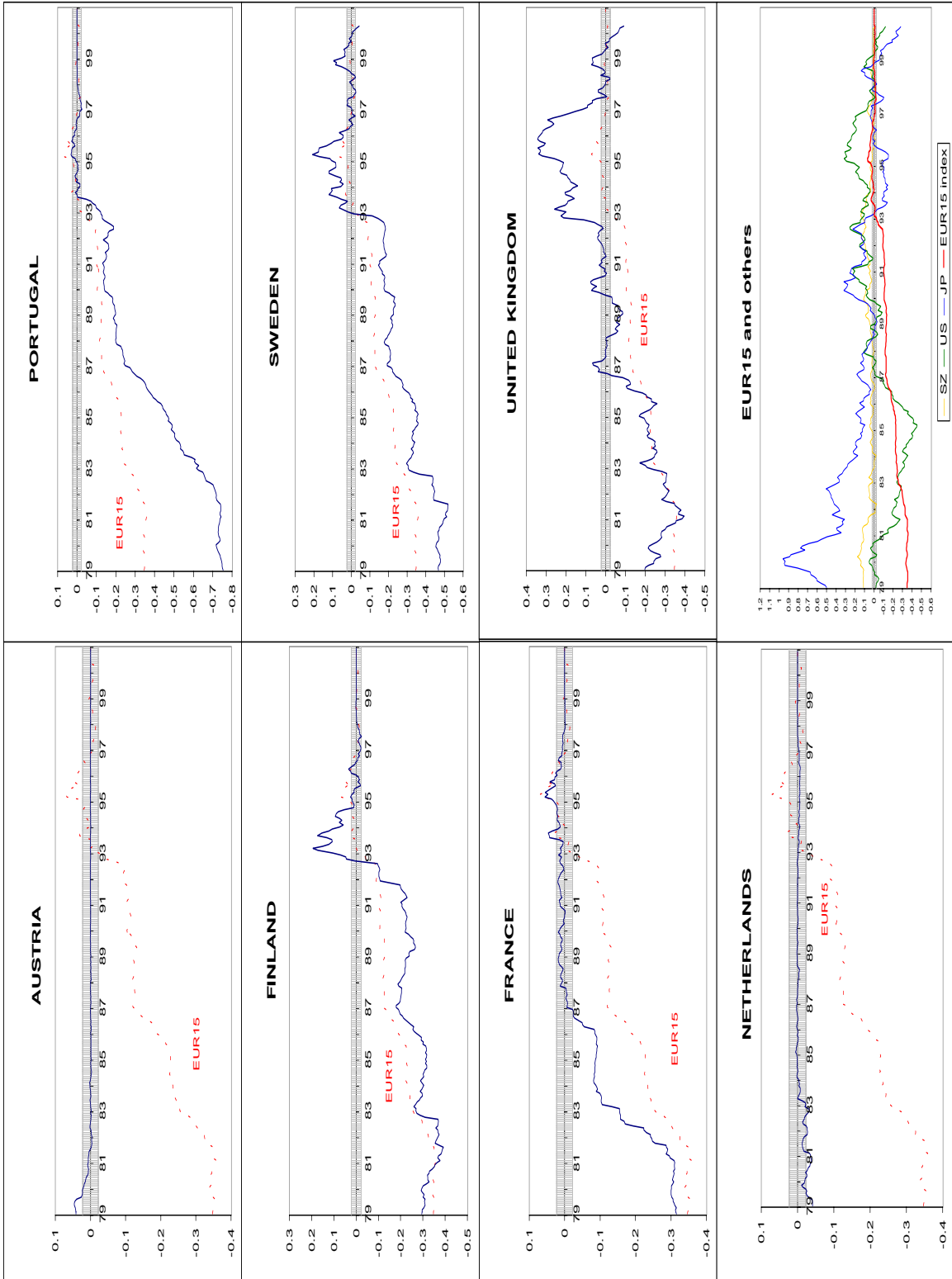


Figure 10: Inflation 1

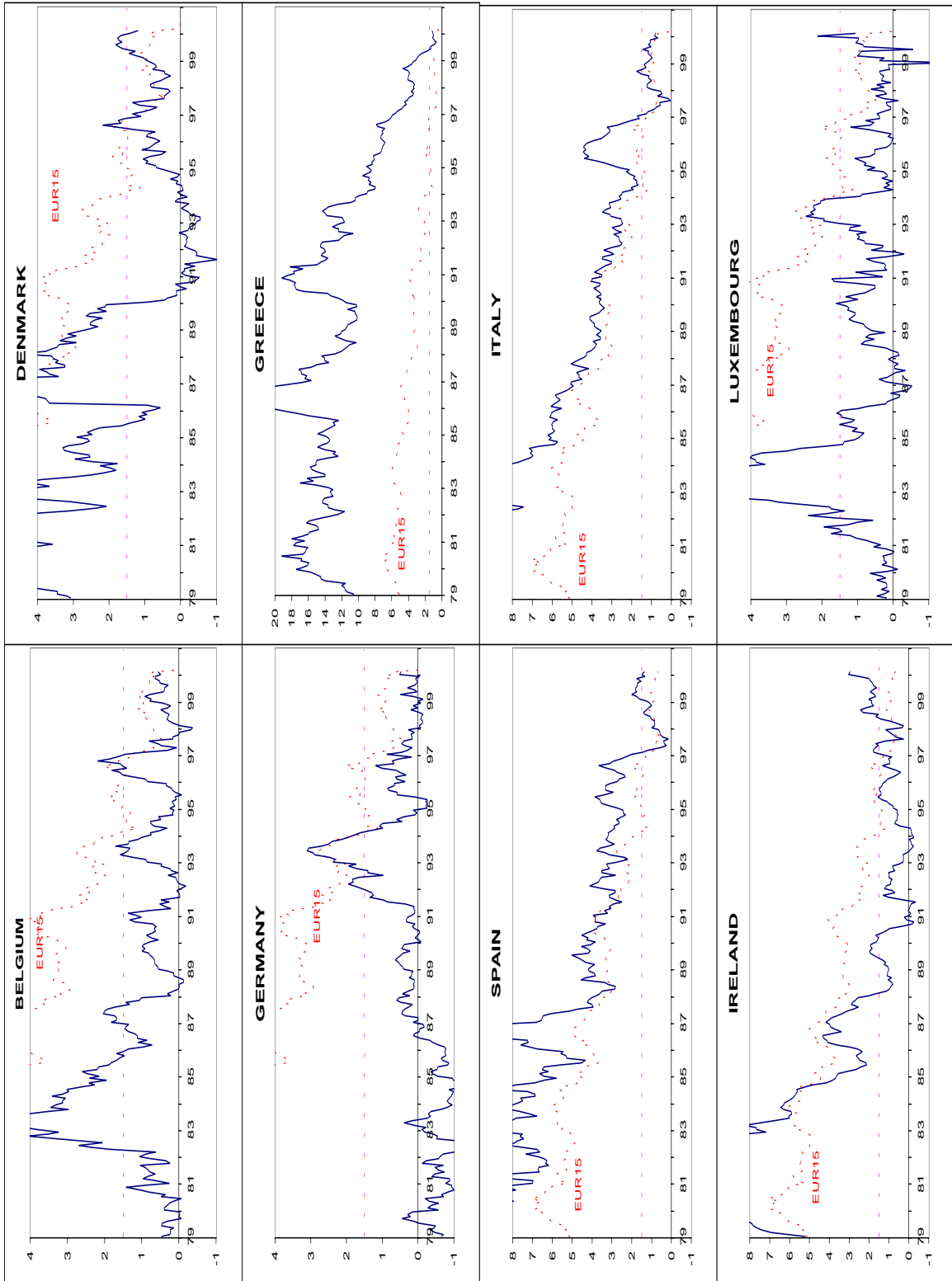


Figure 11: Inflation 2

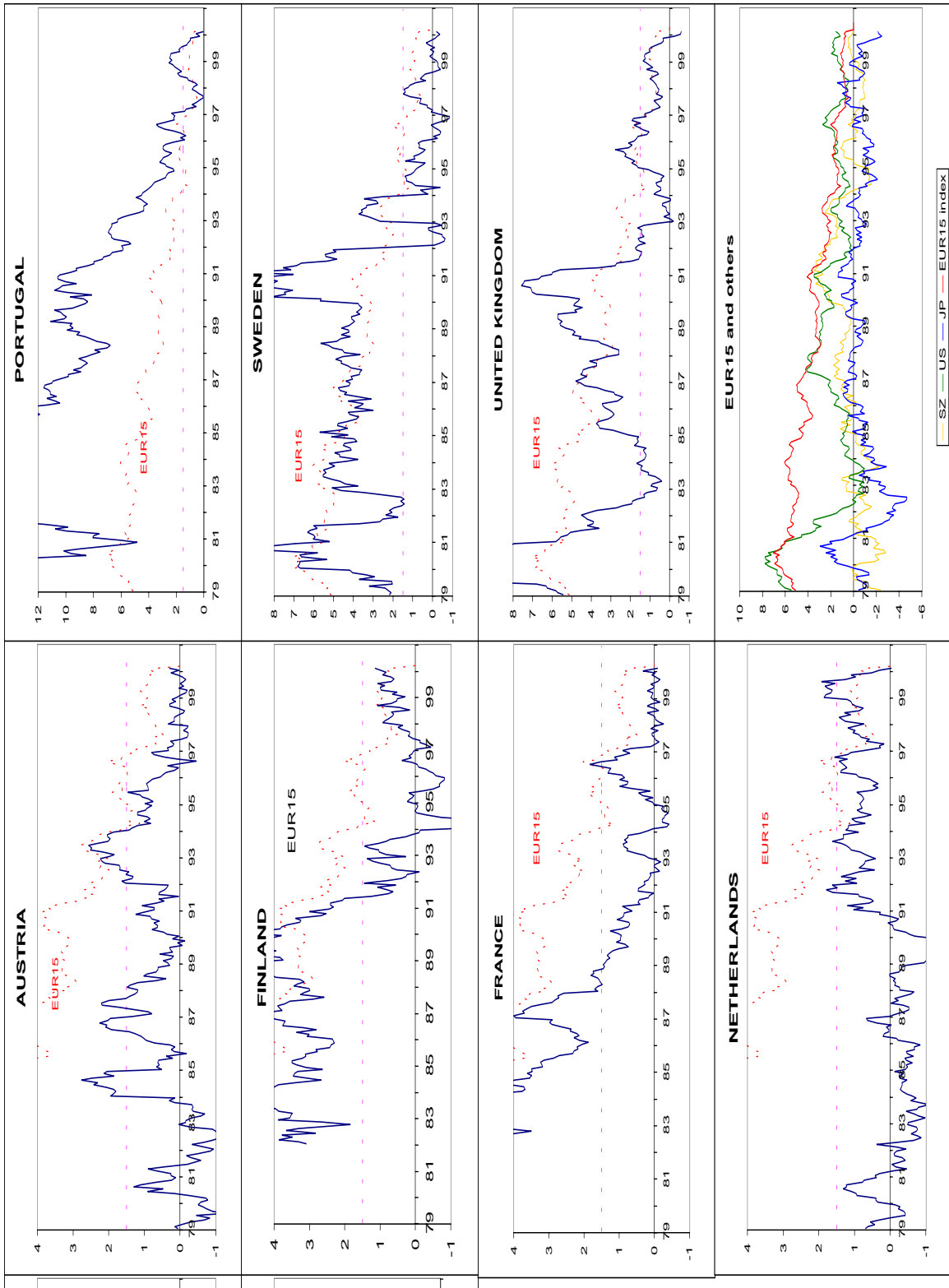


Figure 12: Long-Term Interest Rates 1

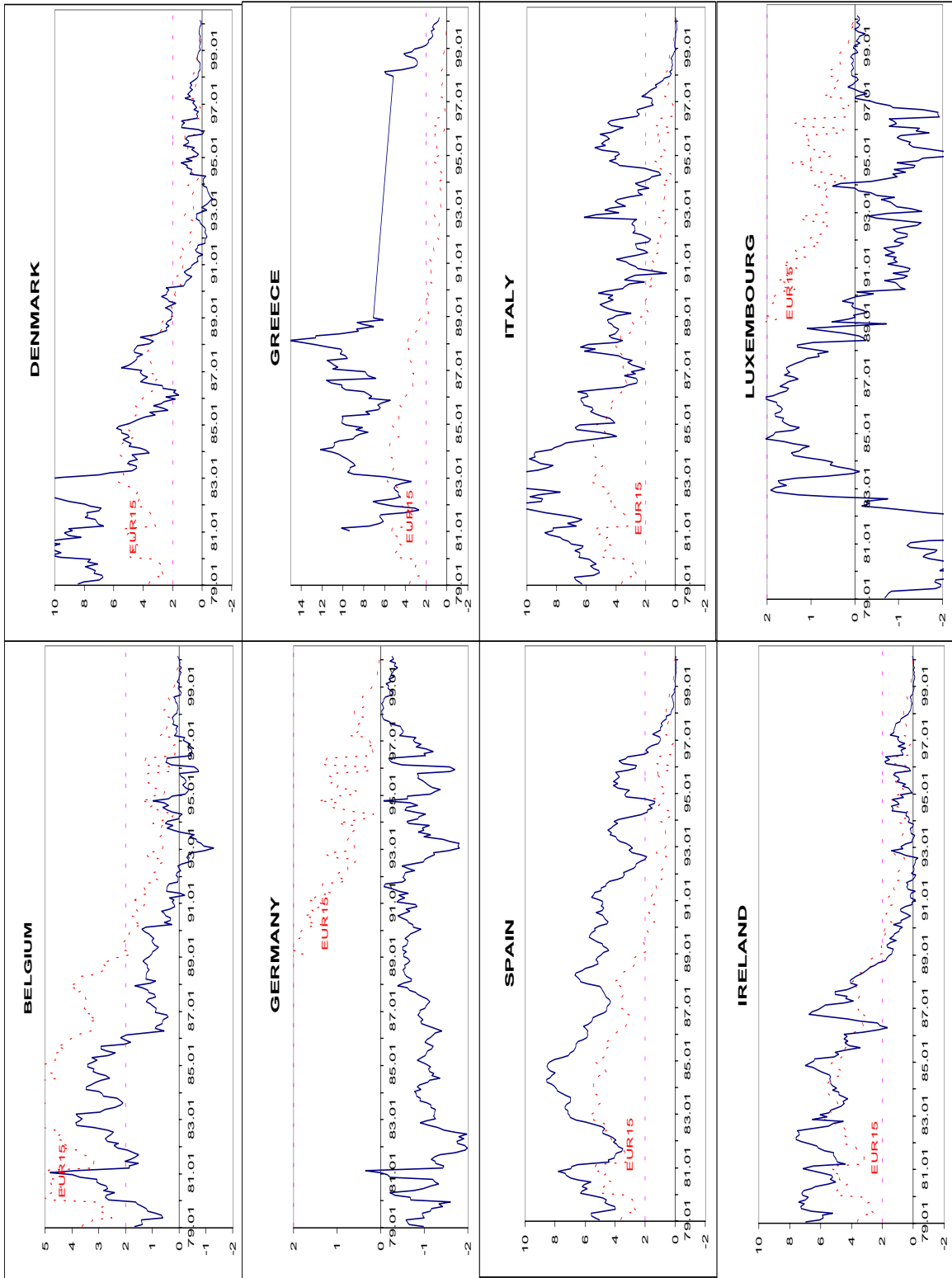


Figure 13: Long-Term Interest Rates 2

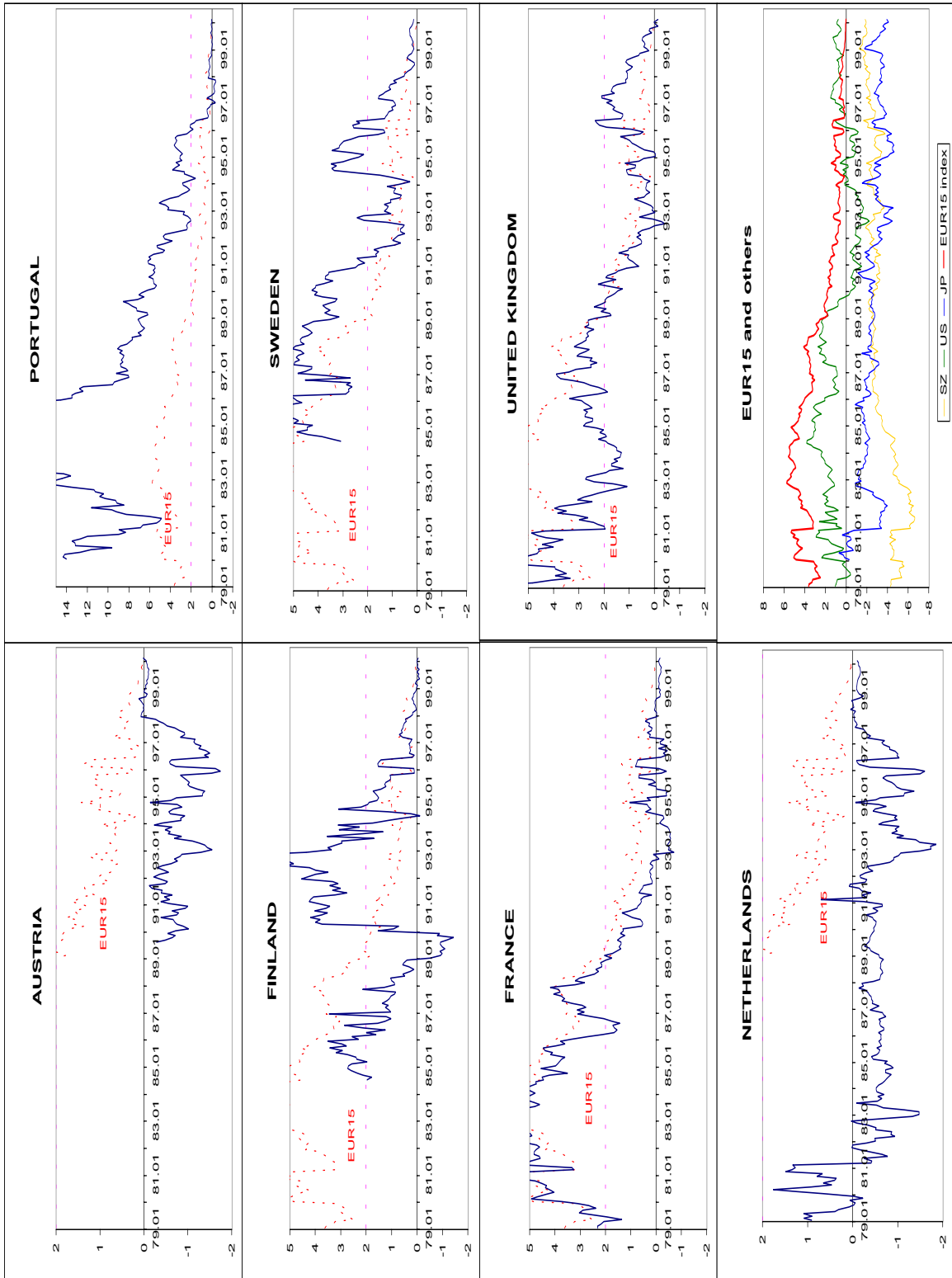


Figure 14: Public Deficit 1

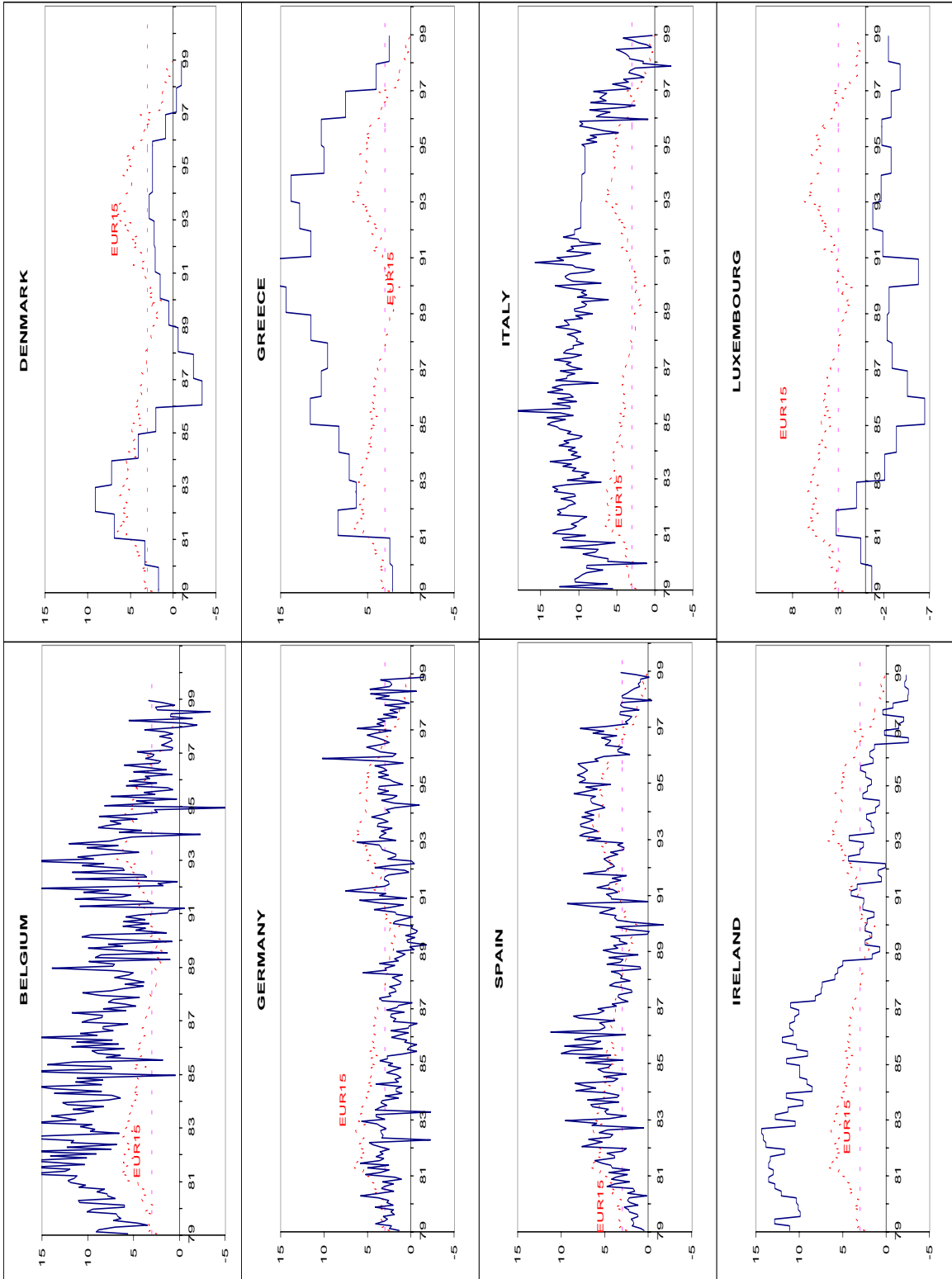


Figure 15: Public Deficit 2

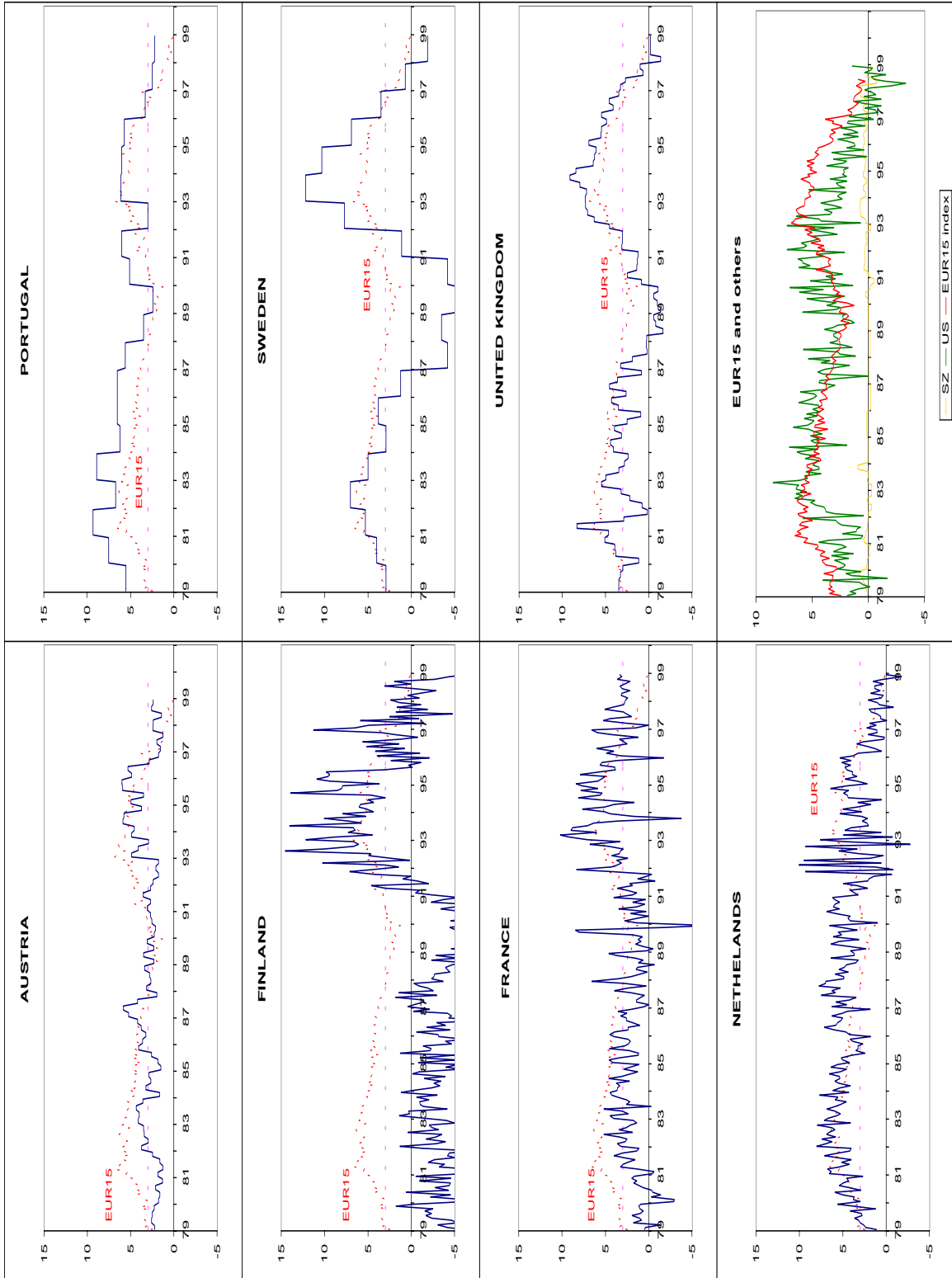


Figure 16: Public Debt 1

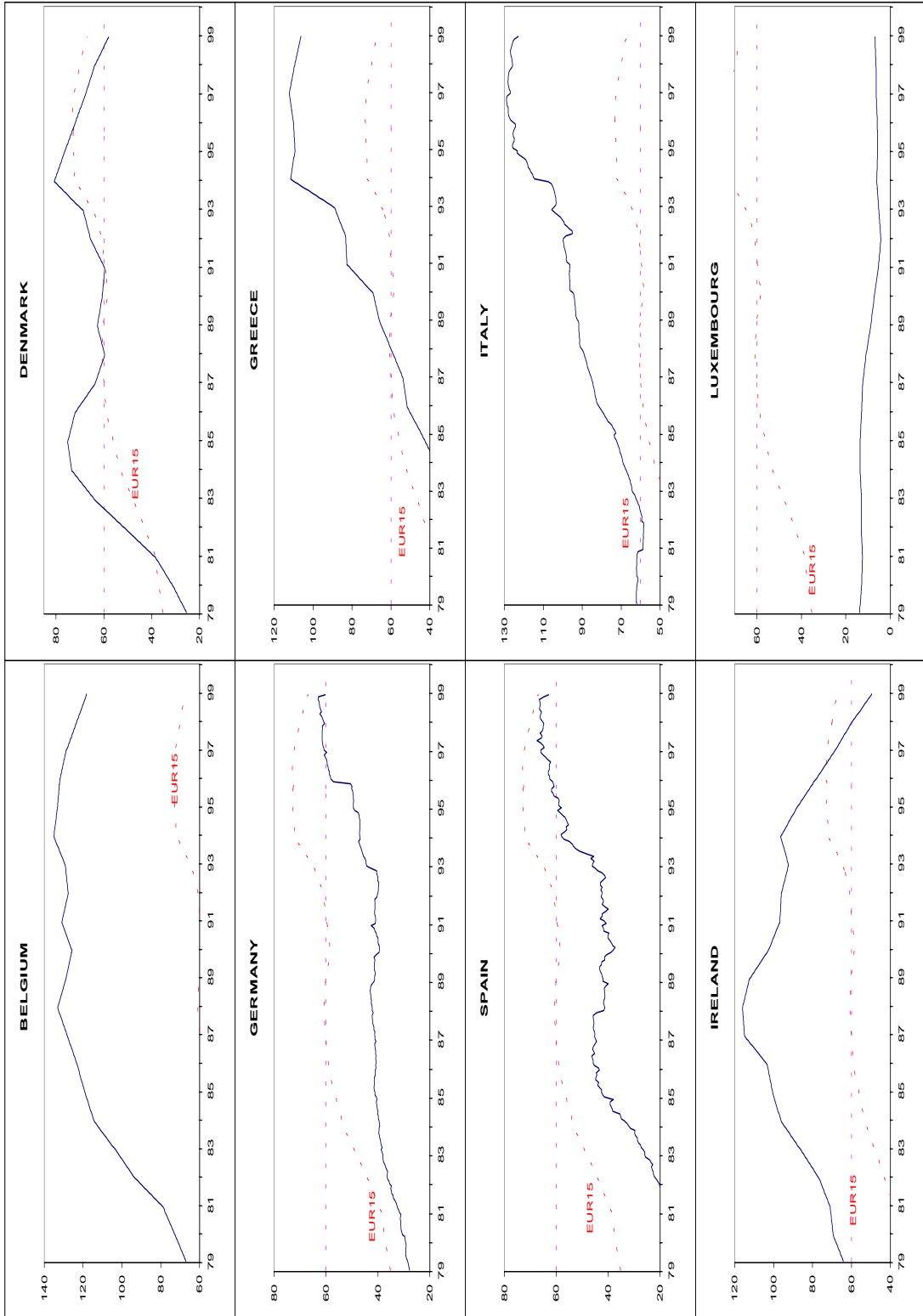
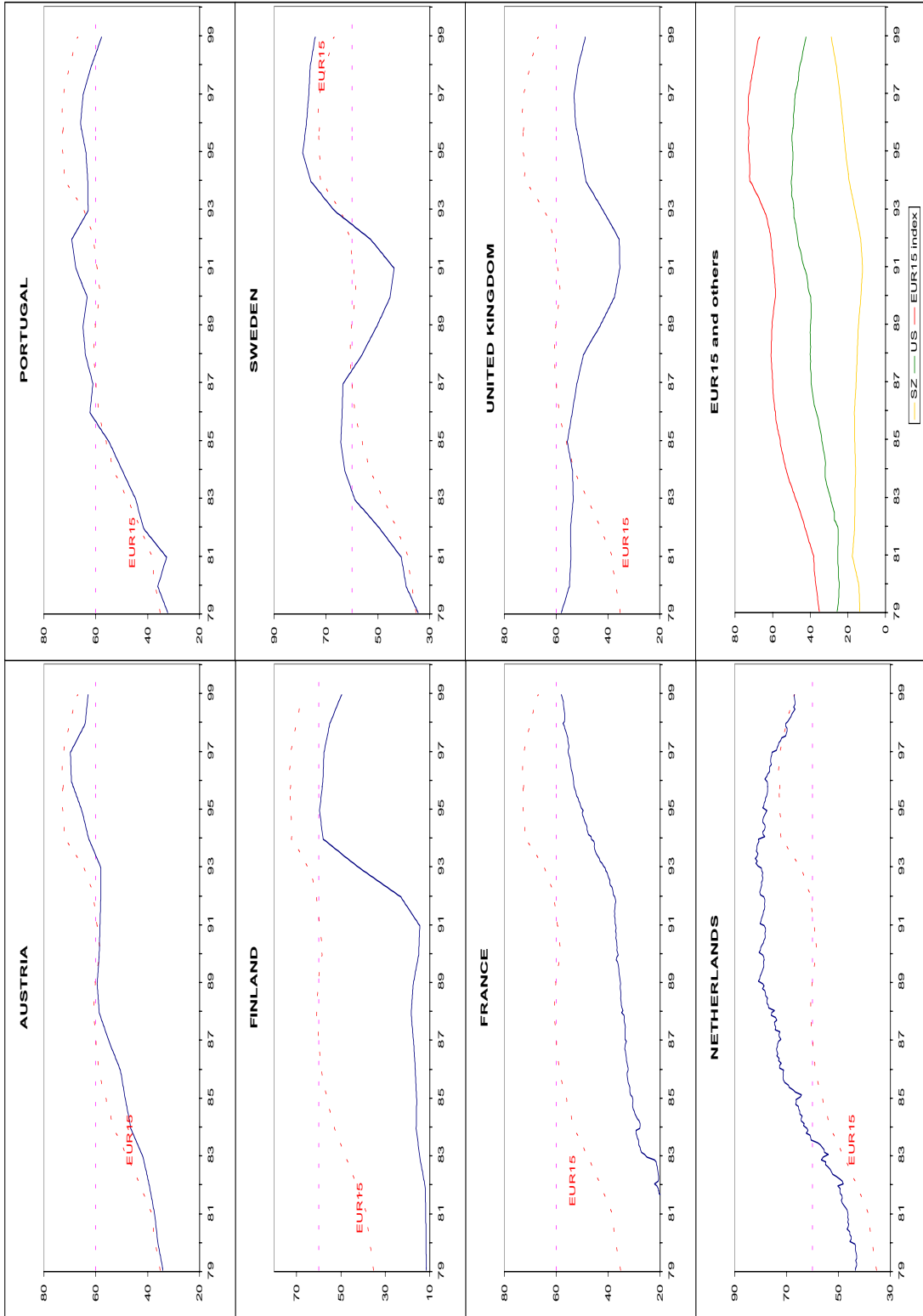


Figure 17: Public Debt 2



References

- Ahmed, S. & Rogers, J. (1998), Best linear unbiased disaggregation of annual GDP to quarterly figures: the case of Malaysia, **Journal of Forecasting** 17, 527–537.
- Artis, M. & Winkler, B. (1998), The stability pact: safeguarding the credibility of the European Central Bank, **National Institute Economic Review** 0(163), 87–98.
- Beetsma, R. & Uhlig, H. (1999), An analysis of the stability and growth pact, **The Economic Journal** 109, 546–571.
- Buti, M., Franco, D. & Ongena, H. (1998), Fiscal discipline and flexibility in EMU: the implementation of the stability and growth pact, **Oxford Review of Economic Policy** 14, 81–97.
- Canzoneri, M., Diba, B. & Cumby, R. (1998), Fiscal discipline and exchange rate regimes, **CEPR Discussion Papers** 1899, CEPR.
- Casario, M. & Dadkhah, K. (1998), An evaluation of progress towards European Monetary Union using fuzzy analysis, **Journal of Policy Modeling** 20, 741–765.
- Chow, G. & Lin, A. (1971), Best linear unbiased interpolation, distribution and extrapolation of time series by related series, **The Review of Economics and Statistics** 53, 372–375.
- Fernández Macho, F. J. (1990), Estimation and testing of a multivariate exponential smoothing model, **Journal of Time Series Analysis** 11, 89–105.
- Fernández Macho, F. J. (1991), Indicadores sintéticos de aceleraciones y desaceleraciones en la actividad económica, **Revista Española de Economía** 8(1), 125–156.
- Fernández Macho, F. J. & Roca Castro, M. J. (1997), Testing for convergence: The Punt-Sterling relationship in the context of the EMS, **BILTOKI DT 97.1b**, University of the Basque Country.
- Fernández Macho, J., González, P., Díaz-Empananza, I., Virto, J., Moral, M. P. & Caminero, E. (1997), **Cointegración y Convergencia en la Unión Europea**, University of the Basque Country Press.

- Harvey, A. C. (1989), **Forecasting, Structural Time Series Models and the Kalman Filter**, Cambridge University Press.
- Haug, A., MacKinnon, J. & Michelis, L. (2000), European Monetary Union: a cointegration analysis, **Journal of International Money and Finance** 19, 419–432.
- Sanz, R. (1981), Métodos de desagregación temporal de series temporales, **Estudios Económicos** 22, Servicio de Estudios del Banco de España.