Business Cycles and Financial Linkages in the Context of European Integration

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February 2003

Keywords: EMU, European integration, international business cycles

JEL: E32, E44, E42

This paper is preliminary; please do not quote without permission of the authors. This research was supported through a European Community Marie Curie Fellowship (programme "Improving Human Research Potential and the Socio-Economic Knowledge Base" IHP-MCFI-99-1). The first author gratefully acknowledges financial assistance from The Ministerio de Ciencia y Teconología (SEC2002-03375) and from the Conselleria Valenciana de Innovación y Competitividad (CTIDIB/2002/209). The second and third authors gratefully acknowledge financial assistance from the Economic and Social Research Council (UK) under grant number L138251030. This research does not reflect necessarily the views of the funding bodies. The authors also gratefully acknowledge helpful comments from Mike Artis, which contributed to the formulation of this research.

ABSTRACT

We study affiliations for the countries of the European Economic and Monetary Union (EMU) with Germany and the US, considering measures of the business cycle (HP detrended and the quarterly growth in real GDP), short- and long-term nominal interest rates and growth in share prices. By using rolling contemporary and maximum (over a short lead/lag interval) correlations, we document increasing correlations for EMU countries with Germany, with these typically being largest during the 1990s. Relationships with other countries, and especially the US, are also examined. Here we correct the widespread fallacy that the European business cycle was disjoint from the US for most of the 1990s.

1 Introduction

There is an obvious and intense interest within Europe as to the nature of the links between growth in the countries of the European Economic and Monetary Union (EMU). Such growth is often referred to in terms of so-called business cycle movements, and a key issue is the extent to which monetary integration will imply a single, common, business cycle across the countries of the EMU, so that their short-run growth experiences are inextricably linked. If there is to be (ultimately) such a common business cycle, it should be anticipated that the affiliations across European countries will have become progressively stronger over time. Indeed, the commencement of the European Monetary System (EMS) in 1979 marks a particularly important date in this context, and papers have frequently examined relationships for growth across European countries separately for the pre- and post-EMS periods; see, for example, Artis and Zhang (1997, 1999). In these papers, Artis and Zhang find increased integration since 1979 for the member countries of the European Exchange Rate Mechanism, with increased contemporaneous correlation with Germany and lower correlation with the US. In contrast, by sub-dividing both the pre- and post-EMS periods, Inklaar and de Haan (2001) have recently argued that finer sub-periods show different patterns, and that there is no systematic relationship between business cycle affiliations and monetary integration.

It remains an open issue as to the relative importance of different channels through which business cycle links operate. Although bilateral trade links are positively related with business cycle correlations (Frankel and Rose, 1998), there is now broad agreement that such interdependencies through trade have not altered sufficiently over time to explain changing business cycle affiliations (for example, see IMF, 2001). Therefore, recent interest has turned to the role of monetary and financial linkages.

One strand of literature has examined relationships among interest rates, in either the context of the EMS (Artis and Zhang, 1998, Hassapis, Pittis and Promodides, 1999, Karfakis and Moschos, 1990, Katsimbris and Miller, 1993) or in a broader international context (for example, Fujihara and Mougoue, 1996, Laopodis, 2002). Despite ambiguous previous evidence on whether linkages have generally become stronger over time (outside the European context), Laopodis (2002) finds increased international synchronisation of long-term interest rates since 1990. The large literature on international stock market linkages is relatively unambiguous in pointing to the increased importance of these over time.

This paper examines evidence on the changing relationships over time in both business cycle movements and in variables related to monetary and financial linkages. Our focus is on Europe, including countries both inside and outside EMU, but we set this in an international context by including the non-European G7 countries of the US, Canada and Japan. The technique we use is the conventional one of correlation analysis for each country with Germany and with the US, but this correlation analysis is employed on both a rolling basis and also for specific sub-periods related to important economic events in Europe.

For our analysis of changing affiliations, we prefer to use correlation analysis rather than other techniques, such as vector autoregressive (VAR) modelling, so that we do not inadvertently impose restrictions on the data that may not be valid. In particular, the type of series we examine are known to be subject to volatility changes and other structural breaks since the 1970s; van Dijk, Osborn and Sensier (2002) analyse these for the G7 countries and find that some of the important breaks are effectively common across countries. It is

anticipated that rolling correlations and correlations over sub-periods should be relatively robust to such breaks.

We follow others, including Artis and Zhang (1997, 1999), Inklaar and de Haan (2001), and IMF (2001), by examining business cycle affiliations using real output after detrending, in our case by application of the Hodrick-Prescott (HP) filter. Instead of monthly industrial production used in some studies, we prefer quarterly real gross domestic product (GDP), since GDP better reflects the general economy. However, in addition to HP-detrended data, (and in contrast to these earlier studies) we also examine business cycle movements in terms of the quarterly growth rate in GDP. To allow us to comment on lead/lag relationships over time, we follow Artis and Zhang (1997) in examining maximum correlations, as well as contemporaneous correlations.

Our general finding is of increased integration over time for the countries of the EMU with Germany, but with the early years of the 1990s being distinct in terms of the relationship of these countries with the US, possibly due to effects associated with German reunification. Indeed, in contrast to the general view (reflected, for instance in IMF, 2001) that the business cycle in EMU countries became disjoint from that in the US around 1990, we find that the US has led movements in Europe since 1993. The changing business cycle relationships do not appear to be related to corresponding relationships among short-term interest rates, since the EMU countries remain disjoint from the US in their monetary policy through the 1990s. Although they exhibit some different patterns over time, correlations between long-term interest rates have tended to increase. This is especially marked in correlations of long-term interest rates for Germany with other countries, including the non-European G7 ones.

The structure of the paper is as follows. The countries and variables we examine are discussed in Section 2, including the rationale for the sub-periods analysed. We then examine results for affiliations in the business cycle and for monetary/financial variables in Sections 3 and 4 respectively. Conclusions and some further discussion complete the paper in Section 5.

2. Data: Countries, Variables and Sample Periods

We analyse the eight countries of the EMU, namely: Austria (denoted AUT), Belgium (BEL), Finland (FIN), France (FRA), Germany (DEU), Italy (ITA), Netherlands (NDL) and Spain (ESP). Limitations on data availability meant that we do not include all EMU countries, with Greece, Ireland, Luxembourg and Portugal excluded. Other European countries analysed are Sweden (SWE) and the UK (UK), both non-EMU countries of the European Union, and Switzerland (CHE), which is not a member of the European Union. For comparison, we include the non-European G7 countries, namely the US (USA), Canada (CAN) and Japan (JPN). In most cases, we employ real GDP data over the period 1960Q1 to 2002Q1, although the data series for a few countries begin later[1].

As already mentioned, we examine correlations using both the HP detrended series[2] and the quarterly growth rate of GDP (measured as the first difference of the logarithm). It is important to appreciate that these two measures represent different concepts of the business cycle. The HP detrended series relates to the growth cycle, which considers movements above or below an underlying trend. Such detrended output series are frequently taken as

[1] Our criterion for inclusion is that quarterly data are available in the *Main Economic Indicators* database of the OECD from 1980Q1 or earlier.

[2] We use $\lambda = 1{,}600$, which is the conventional value for quarterly data. The HP filter is applied to the series after transformation by taking the logarithm, and the series analysed is the log series less the HP filtered value.

measures of the output gap, as in IMF (2001). Since the "trend" represented by the HP (or similar) filter series is smoothly changing, the detrended series also tends to be relatively smooth. In contrast, the quarterly growth rate in real GDP can be fairly erratic. In terms of the business cycle, this measure relates to the so-called classical business cycle, which examines the underlying direction of change of the economy (so that growth is typically positive in expansion and negative in recession). In general, we anticipate that correlations between HP detrended series will tend to be higher in absolute value than those for quarterly growth rates, due to the noisy nature of the latter. Further, these two measures may reveal different patterns, since there is no simple relationship between output gap and growth rate measures. In this sense, the focus of the literature to date on filtered series may be missing important aspects of the business cycle represented by growth rate affiliations.

We examine nominal short- and long-term interest rates to capture aspects of monetary policy. In addition to these, we have considered the interest rate spread (calculated as the long-rate minus the short-rate), together with the difference between the short-rate for a specific country and the rate of Germany or the US as a measure of integration in monetary policy. However, results are presented only in relation to the nominal short- and long-term interest rate series, since the other transformations yield qualitatively similar results to those of the nominal short-rate. All interest rate series are examined as levels, without any further transformations. Finally, we examine correlations in the quarterly growth rate of stock market prices, calculated as the first difference of the log series.

Some interest rate and share price series are available from later starting dates than for GDP. This applies especially to stock market prices for various countries (though not the principal stock markets) and for interest rate series for Finland and Sweden. Further, due to the

differing time lags in availability, the sample period for the financial series typically finishes in 2002Q3. Full details of all data, including sample periods and sources, are given in Appendix 1.

We follow Artis and Zhang (1997, 1999) and Inklaar and de Haan (2001) in using the commencement of the EMS 1979 as a defining period in European integration, and hence our sub-period analysis uses this date as one point of separation. We then follow Inklaar and de Haan (2001) in examining further sub-divisions. However, their temporal sub-divisions appear to be arbitrary. In order to focus on evolving relations post-EMS, we divide the post-1980 period into 1980Q1-1990Q4 and 1991Q1-2002Q1. Two important events point to a date around the end of 1990 as an appropriate date for splitting the sample. These are the decision taken at an Intergovernmental Conference in December 1990 to introduce a single currency for the European Union and the reunification of Germany in October 1990. However, we also recognise that the period 1991-1992 contains a number of notable events in the European context, which may be reflected in fluctuating cross-country relationships. In particular, the effects of German reunification, the ERM crisis of 1992 and uncertainty around the establishment of EMU in the period around the signing of the Maastricht Treaty in February 1992 may have temporarily altered affiliations in a nontrivial way. To avoid potential temporary instabilities early in the 1990s and to allow for the establishment of the EMU, we also examine separately the sub-period 1993-2002.

3. Business Cycle Affiliations

Figure 1 shows the rolling contemporary correlations for HP detrended GDP of Germany with selected other countries in our sample. The countries included in the upper panel are the major EMU economies of France, Italy and Spain, together with the Netherlands as a small European country. The lower panel of the figure shows the USA, Canada, the UK and Japan. These, and all rolling correlations, are computed using a window of 40 observations (10 years), with the value shown being centred at the mid-point of this window. For convenience, our discussion refers to this mid-point as the date to which the correlation relates.

The correlation with France in Figure 1 shows a time-varying pattern: it increases almost monotonically between 1965 to 1975, then declines to nearly zero around 1985, before starting a new upward trend. Although the correlations with Spain and Italy exhibit different trajectories until the late 1980s, their patterns from this period are similar to each other and to that of France. This might be anticipated in the case of Spain, since it did not join the European Union until 1986 and the ERM until 1989. Relative to these varied patterns, the correlation with Netherlands shows little variation, but a general upward trend is evident. Thus, it seems that the late 1980s onwards may mark an important period in the development of economic integration for these countries, with these correlations with Germany lying between approximately 0.6 to 0.8 in 1997, compared with much wider bands (and generally lower levels) prior to 1985.

The patterns of the rolling correlations in the lower panel of Figure 1 stand in contrast to those of the upper panel. With the exception of Japan from around 1987, they all follow the same general pattern in their correlations with Germany, being highest at around 0.7 between

the mid-1970s and mid-1980s. From 1987 until 1995, the USA, Canada and the UK appear disjoint with Germany, with negative contemporaneous correlations indicating that the business cycle movements were out of phase. Thus, Figure 1 captures the "stylised facts" of business cycle relationships within Europe and internationally. Indeed, the pattern of association of Germany with the US is strikingly similar to that shown in IMF (2001), underlying the apparent dissociation of the European and US business cycles during the 1990s.

Following Artis and Zhang (1997), we also analyse lead/lag relationships, showing in Figure 2 for each country the maximum positive correlation with Germany, computed over all leads and lags to a maximum of five quarters[3]. The upper panel appears to tell a clearer story than Figure 1 of increasing integration in relation to Germany for the EMU countries, at least from the mid-1980s onwards. The lower panel, however, gives a different view from Figure 1 of German business cycle affiliations with the US, Canada and the UK, since the correlations in Figure 2 remain positive (and generally around 0.4) throughout the 1980s and 1990s.

Further light on these business cycle affiliations is shed in Figures 3 and 4, which show the corresponding contemporaneous and maximum correlation values, but now expressed in relation to the US. Like Figure 1, the contemporary correlations in Figure 3 indicate a separation of the business cycle of the EMU countries and the US around 1990, although this is more marked for Germany than other countries. This separation does not occur for the UK. However, the separation from the US is less evident in the maximum correlations of Figure 4. Indeed, for much of the 1990s these are around 0.4-0.7, with only Germany being lower than this range for substantial period. These latter results suggest that at least part of the story of

[3] That is, for each (centred) time period t, we compute the correlation of GDP in a country with German GDP for periods $t - 5, \ldots, t, \ldots, t + 5$. Among these 11 correlations, the one with the maximum positive value is shown.

the changing business cycle affiliations may concern changing lead/lag relationships within Europe and between European countries and the international economy, especially the US.

We investigate this further in Table 1, which shows the correlations of HP detrended GDP for Germany and each other country of our sample over the whole sample period and for each of our sub-periods (1960-1979, 1980-1990, 1991-2001 and 1993-2001). The contemporaneous and maximum (over leads and lags of five quarters) correlations are shown, together with the corresponding lead time for Germany. Thus, a lead of, say, -2 for the maximum correlation with Germany implies that the maximum positive correlation occurs with that country leading Germany by two quarters.

The patterns for the EMU countries in the upper part of the table reinforces the comments made above in relation to France, Italy and Spain from Figure 1. It is notable that for these countries, together with the other EMU countries of Belgium, Austria and the Netherlands, the contemporaneous correlations over the shorter period 1993-2001 are largely unchanged from those over 1991-2001. Considering the maximum, rather than contemporaneous, correlations makes little difference for these countries.

In contrast, the contemporaneous correlations for the UK, US and Canada are apparently dominated by large negative relationships over 1991-1992, since when these two years are excluded the evidence disappears that their business cycles are disjoint from that of Germany. Indeed, in terms of the sub-periods analysed, the contemporaneous correlations of Germany with these countries is at their highest during 1993-2001, with that between the UK and Germany being at a level similar to that of all EMU countries. The impact of these two years is also marked in terms of the maximum positive correlations, with each of the US, Canada

and the UK apparently leading Germany by five quarters over 1991-2001, with this lead being reduced to only one or two quarters over the sub-period from 1993.

Table 2 shows corresponding information from the bilateral correlations of HP detrended output with the US. The values here emphasise two things. Firstly, the exclusion of 1991-1992 has a large impact on the correlations with EMU countries (except Finland), again indicating that this period is atypical. Secondly, the US plays an important role in relation to the growth cycle for all European countries, especially since 1993. Indeed, in this period the US output gap has led each European country (both EMU and non-EMU) by one or two quarters, with a maximum correlation of similar magnitude to that for the country with Germany over the same period. The only country substantially disjoint from the US after 1993 is Japan.

To investigate this phenomenon further, Tables 3 and 4 shows the same information as Tables 1 and 2 respectively, but now in relation to the quarterly growth rate. It has already been remarked that these growth rate series are more erratic than HP detrended series, so that the correlations in these latter tables are typically lower. Further, since these series are not smoothed by the HP filter, lead/lag relationships may be clearer when using growth rates.

The general pattern of business cycle affiliations within the EMU remains similar in Table 3 (compared with Table 1). However, the pattern of increased correlation with Germany in the post-ERM period of 1980-1990, compared with 1960-1979, is clearer in Table 3 for the maximum correlation than the contemporaneous one. Whether over 1991-2001 or 1993-2001, the contemporaneous correlation sometimes drops markedly during the 1990s, but this sometimes appears to be result of changing lead/lag relationships. In particular, the important

European countries of France and Italy lead GDP growth in Germany by one quarter, with a stark contrast in the contemporaneous and lag one correlations for Germany with Italy during 1993 to 2001 (0.07 compared with 0.46).

Table 3 tells a very different story to that of HP detrended values (Figures 1 and 2, Table 1) in relation to the strength of business cycle affiliations of Germany with non-EMU countries. In particular, there is less evidence that the German business cycle became disjoint from that of the US in the 1990s, so that exclusion of 1991-1992 makes relatively little difference. Therefore, detrending must play a role in that conclusion of dramatically changing relationships. Further, the contemporaneous correlation of Germany with the US is relatively high at 0.43 over 1993-2001, emphasising the importance of common short-run movements across these major economies.

Finally, Table 4 presents correlations for growth rates in relation to the US. A possibly surprising feature of these results is the role of the US in leading the EMU economies during the 1990s. Far from the widely held view that Germany is the crucial economy for these countries, the implication of these correlations (like those using HP detrended data) is that the US is as important over this period. Indeed, while the maximum correlations over this period with the US are of similar magnitude to those with Germany, the US has a positive lead in relation to these countries, whereas Germany does not. More specifically, based on the growth rate of GDP, the US leads France, Spain, Italy, Belgium, the Netherlands and Finland by between one and four quarters. Thus, and in contrast to the analysis of IMF (2001), it is not surprising that the US recession of 2001 has serious consequences for the countries of Europe.

4. Monetary and Financial Affiliations

There is a large literature on the links between countries that may give rise to the international propagation of shocks. Although one obvious propagation mechanism is trade, it is now established that trade links are not sufficiently strong, and do not act sufficiently quickly, to be able to provide the principal transmission mechanism (IMF, 2001). Therefore, interest has turned to the roles of financial links and monetary policy, with the latter often represented through exchange rate volatility (Artis and Zhang, 1999, Inklaar and de Haan, 2001). Here we provide a comparable analysis to that of Section 3 to examine the potential role of such links. However, rather than measuring monetary policy in terms of the exchange rate, we consider this more directly by using short-term interest rates.

Figures 5 and 6, together with Table 5, compare the contemporaneous correlations in the nominal short-term interest rate. Rolling correlations for selected countries with Germany and the US are shown in Figures 5 and 6 respectively, while Table 5 provides a sub-period analysis. Since we would expect to see common monetary policy in the EMU reflected in contemporaneous quarterly values, we do not consider lead/lag relationships here[4]. Identical sub-periods are used in Table 5 as in the earlier analysis. Although there has been some discussion about the order of integration for interest rates, with Artis and Zhang (1998), Laopodis (2001) and many other authors concluding that nominal rates are $I(1)$, this conclusion is unattractive in the context of the low rates experienced through much of the 1990s. Our view is that interest rates have experienced a number of structural changes over

[4] We also examined the maximum correlations, but generally these were very similar to the contemporaneous ones.

the period (van Dijk *et al*., 2002), and our sub-period analysis at least partially controls for such breaks. Therefore we present correlations for the level of nominal interest rates.

The impact of European integration in terms of the operation of monetary policy is clear from this information. The upper panel of Figure 5 shows a pattern of increasing correlations of Germany with EMU countries, except for the period from the mid-1980s to mid-1990s. Around the mid-1980s, interest rates in Germany become disjoint from those of the US, UK and Canada, with the correlations of Germany with the US remaining negative through the 1990s. The upper panel of Figure 6 shows that this general pattern (though not the continuing negative correlations) in relation to the US is common across EMU countries.

Table 5 reinforces the trend of increasing correlation of interest rates in EMU countries with those of Germany over the sub-periods 1960-1979, 1980-1990 and 1991-2002. Although in general the correlation is similar for 1991-2002 and the shorter sub-period 1993-2002, this is not the case for the UK, but this exception is explained by the change of interest rate policy in that country when it withdrew from the ERM in 1992. In line with the graphical information, Table 5 shows that the reverse of the increased correlations of Germany with other EMU countries is that short-term interest rates in these countries exhibit a break in their relationship with the US around 1990. Indeed, these correlations with the US are predominantly negative over 1993-2002 in Table 5. Interestingly, the non-EMU countries of Sweden and Switzerland exhibit a similar pattern to the EMU countries of the correlation with Germany increasing and that with the US being negative in the 1990s. This is, however, not the case for the UK and Canada.

The patterns of short-term interest rate correlations stand in contrast to the results in Section 3 for business cycle affiliations with Germany and the US. We concluded that the business cycle affiliations of EMU countries with the US were only temporarily disrupted around 1990, with the US leading growth in these countries through much of the 1990s. However, the break for these countries with US short-term interest rates that occurred around 1990 appears to be on-going. Therefore, although both growth and monetary policy within the EMU are more closely related in the 1990s than previously, there seems to be no simple general story concerning the role of monetary policy in the changing business cycle affiliations for European countries.

We anticipate that long-term interest rates will be influenced not only by monetary policy (as operated through short-term interest rates), but also by perceived long-term future economic prospects and by international capital movements. As shown by the rolling correlations for nominal long-term interest rates in selected countries with Germany in Figure 7, there is a clear tendency for these correlations to increase over time, both for EMU and non-EMU countries. However, there are two periods where this tendency is interrupted, namely around the major international recession of the mid-1975 and around the late 1980s-early 1990s. The pattern of increasing correlations in relation to the US is not clearly seen in Figure 8, but this may be partly because some correlations with the US are already close to one at the beginning of the period; see those for France, the Netherlands, the UK and Canada. Indeed, from around 1995, all correlations for long-term interest rates with both Germany and the US in Figures 7 and 8 are around 0.8 or higher. During our sample, no other period evidences a similar apparent convergence of these rates, emphasising the linkages uncovered also by Laopodis (2001).

Table 6 documents these patterns for long-term interest rates in terms of the sub-period analysis for all countries in our sample. The correlations of EMU countries with Germany are particularly strong for the 1990s, irrespective of whether 1991-1992 is included or not. While some EMU countries show a changing affiliation, from a closer association with US than German interest rates pre-ERM to one where the relationship with Germany is stronger after 1990, the general pattern of a close international association for all rates from 1990 onwards is again evident.

Finally, we turn to the quarterly growth in stock market prices in Table 7, where broadly similar patterns are obtained as for long-term interest rates. In particular, there is a general pattern of increasing correlation over time for movements of other stock markets in Europe with that of Germany (note especially France, Italy and the UK), while correlations with the US are more constant over time. Interestingly, the international association of stock market prices in Table 7 is not as strong as that of long-term interest rates in Table 6.

5. Discussion and Conclusions

This paper has examined business cycle affiliations and financial linkages for EMU and non-EMU countries. Although the conventional technique of correlation analysis is used, we believe that our results have thrown new light on these issues.

In terms of business cycle affiliations, we illustrate the increasing relationship between Germany and other countries of the EMU, with this increase being particularly notable for the output gap (measured by HP detrended GDP) since around 1985. It is, however, perhaps

surprising that the analysis using maximum correlations implies that the major economies of France and Italy have led Germany during the 1990s, with this being the case whether the output gap or quarterly growth rates are used to capture the business cycle.

Monetary and financial affiliations within the EMU have also strengthened over time. However, the differing temporal patterns in the relationships for the business cycle and short-term interest rates of these countries with the US in the period subsequent to 1990 implies that monetary policy, as measured by short-term interest rates, cannot explain the general international patterns of business cycle affiliations. However, the strengthening of linkages among international markets, seen in correlations of long-term interest rates and growth in stock market prices, is particularly notable for the EMU countries in relation to Germany and may provide part of the story.

One important finding of this paper is that the widespread belief that Europe became disjoint from the US in the early 1990s is incorrect, and is based on an undue reliance on contemporary correlations obtained from detrended output data. If either lead/lag relationships are considered and allowed to change over time or quarterly growth rate data are used, then this discontinuity effectively disappears. Indeed, we find that the business cycle relationship between European countries and the US is particularly strong by post-war standards during the 1990s, with the US economy leading growth in European countries by one to five quarters.

One theme of our analysis has been the relationship between Germany and the US, since Germany is often considered to be the economic leader within the EMU. Our conclusions in this respect are effectively summarised by Figure 9, where we examine rolling correlations

for the business cycle (HP detrended GDP) in the top panel, short-term and long-term interest rates in remaining panels. In each panel, we show the contemporary correlation and the maximum positive correlation (over leads and lags of five quarters, as above). In addition, we show the lead time for the maximum correlation, with the lead time scaled by division by 10 and expressed in relation to Germany. For example, a lead of –0.1 implies a one quarter lag for Germany (a lead for the US).

The top panel of Figure 9 indicates that the US has generally led the output gap of Germany by one quarter, with the maximum and contemporary correlations being very close until the late-1980s. For a time, the business cycles in the two countries are then out of phase in terms of the contemporary correlations, but the dynamics of the relationship also appear to change, with the US attaining a longer lead of five quarters for the maximum correlation. Short-term interest rates are highly (and generally increasingly) correlated until the clear break in the mid-1980s, a similar time to the break in the output gap relationship. It is also notable that the US consistently leads German interest rates by one quarter until this period, when (as with the output gap), the lead increases to five quarters. Finally, the story of long-term interest rates is similar to the short-term ones, but now with a marked break around 1975 and a resumption of the general upward trend in the correlation by 1995.

The approximate concurrence of the break in the business cycle relationship with those occurring for both interest rate series, again indicates a potentially important role for monetary and financial factors in understanding business cycle affiliations.

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Appendix 1: Data

All the data are quarterly and comes from the OECD and IMF databases. We attempted to use comparable series for each country, but in some cases, to obtain longer samples, different sources were used.

GDP: for all the countries (except Italy and Germany) come from the Main Economic Indicators database of the OECD. Concretely our measure of GDP is . GDP volume index sa (the code typically is country_NAGVVO01_IXOBSA)

For Germany the series GDP(PAN BD from 1991) CONA. Datastream code BDGDP…D. The series comes from the OECD national Accounts and was corrected to take into account the jump in 1991, due to German reunification.

For Italy, a GDP volume index from the IMF is used (13699BVRZF…) the series was corrected in 1970 and 1966 for a jump and an outlier respectively.

Share price: they come from the OECD. Share prices: All Shares index/Index publication base. The code is Country_SPASTTO1_IXOB

Short rate: We primarily use data from the IMF (line 60) but Switzerland comes from the OECD. Line 60B corresponds to money market rate, and line 60C corresponds to treasury bill rate.

Long rate: Usually we use the government bond yield from the IFS (line 61; Government bond yield: long term). In order to maximise the sample some series come from the OECD

Details of interest rate series are below.

	Short rate	Long rate
DEU	IMF line 60B (13460B..ZF...)	IMF line 61 (13461...ZF...)
FRA	IMF line 60C (13260C..ZF...)	OECD (FRA_IRLTOT02_ST)
ITA	IMF line 60B (13660B..ZF...)	IMF line 61 (13661...ZF...)
ESP	IMF line 60B (18460B..ZF...)	IMF line 61 (18461...ZF...)
NLD	IMF line 60B (13860B..ZF...)	IMF line 61 (13861...ZF...)
BEL	IMF line 60C (12460C..ZF...)	OECD (BEL_IRLTGV01_ST)
AUT	IMF line 60B (12260B..ZF...)	OECD (AUT_IRLTPB02_ST)
FIN	IMF line 60B (17260B..ZF...)	OECD (FIN_IRLTGV02_ST)
USA	IMF line 60B (11160B..ZF...)	OECD (USA_IRLTGV13_ST)
CAN	IMF line 60C (15660C..ZF...)	IMF line 61(15661...ZF...)
UK	IMF line 60C (11260C..ZF...)	OECD (GBR_IRLTGV02_ST)
JPN	IMF line 60B (15860B..ZF...)	IMF line 61 (15861...ZF...)
CHE	OECD (CHE_IRSTCM01_ST)	OECD (CHE_IRLTGV08_ST)
SWE	IMF line 60C (14460C..ZF...)	OECD (SWE_IRLTGV02_ST)

The samples periods for our data are:

	GDP	Short rate	Long rate	Share prices
DEU	60:1- 02:2	60:1- 02:3	60:1- 02:3	60:1- 02:2
FRA	60:1- 02:1	70:1- 02:3	60:1- 02:3	60:1- 02:2
ITA	60:1- 01:4	71:1- 02:3	60:1- 02:3	75:1- 02:2
ESP	70:1 -02:1	74:1- 02:3	78:2- 02:3	85:1- 02:2
NLD	60:1- 02:1	60:1- 98:4	60:1- 02:3	83:1- 02:2
BEL	80:1- 02:1	60:1- 02:3	60:1- 02:3	85:2- 02:2
AUT	64:1- 02:1	67:1- 98:4	65:1- 02:3	68:1- 02:2
FIN	75:1- 02:1	78:1- 02:3	88:1- 02:2	87:1- 02:2
USA	60:1- 02:1	60:1- 02:3	60:1- 02:3	64:3- 02:2
CAN	60:1- 02:1	60:1- 02:3	60:1- 02:3	60:1- 02:2
UK	60:1- 02:2	60:1- 02:2	60:1- 02:3	60:1- 02:2
JPN	60:1- 02:1	60:1- 02:3	66:4- 02:2	60:1- 02:2
CHE	60:1- 02:1	72:1- 02:3	60:1- 02:3	60:1- 02:2
SWE	80:1- 02:1	63:1- 02:3	87:1- 02:3	60:1- 02:2

Table 1: Correlation of GDP with respect to Germany. (HP filtered)

		Whole Smpl	[60:1 - 79:4]	[80:1 - 90:4]	[91:1 - 02:4]	[93:1 - 02:4]
DEU	Cont. corr.	1.00	1.00	1.00	1.00	1.00
	Max. corr.	1.00	1.00	1.00	1.00	1.00
	Lead/lag	0	0	0	0	0
FRA	Cont. corr.	0.56	0.61	0.30	0.79	0.79
	Max. corr.	0.56	0.61	0.55	0.79	0.79
	Lead/lag	0	0	-4	0	0
ITA	Cont. corr.	0.27	0.16	0.56	0.67	0.63
	Max. corr.	0.27	0.16	0.56	0.67	0.65
	Lead/lag	0	0	0	0	1
ESP	Cont. corr.	0.36	0.23	0.21	0.78	0.64
	Max. corr.	0.36	0.35	0.46	0.81	0.66
	Lead/lag	0	2	-5	-1	-1
NLD	Cont. corr.	0.50	0.40	0.70	0.69	0.57
	Max. corr.	0.50	0.40	0.74	0.73	0.60
	Lead/lag	0	0	-1	-1	-1
BEL	Cont. corr.	0.66	-	0.56	0.81	0.83
	Max. corr.	0.66	-	0.56	0.81	0.83
	Lead/lag	0	-	0	0	0
AUT	Cont. corr.	0.62	0.60	0.58	0.73	0.61
	Max. corr.	0.62	0.66	0.58	0.73	0.61
	Lead/lag	0	2	0	0	0
FIN	Cont. corr.	0.10	-0.27	0.26	0.27	0.62
	Max. corr.	0.26	0.54	0.48	0.54	0.71
	Lead/lag	-4	5	-3	-5	-1
USA	Cont. corr.	0.33	0.36	0.47	-0.05	0.57
	Max. corr.	0.41	0.43	0.56	0.31	0.68
	Lead/lag	-1	-1	-2	-5	-2
CAN	Cont. corr.	0.26	0.33	0.40	-0.02	0.67
	Max. corr.	0.27	0.38	0.47	0.36	0.79
	Lead/lag	-1	1	-1	-5	-2
UK	Cont. corr.	0.36	0.54	0.11	-0.09	0.61
	Max. corr.	0.39	0.54	0.53	0.37	0.64
	Lead/lag	-1	0	-5	-5	-1
JPN	Cont. corr.	0.48	0.48	0.47	0.50	0.27
	Max. corr.	0.49	0.48	0.57	0.53	0.30
	Lead/lag	-1	0	-1	-1	-1
CHE	Cont. corr.	0.59	0.56	0.75	0.75	0.69
	Max. corr.	0.60	0.61	0.75	0.77	0.69
	Lead/lag	1	3	0	-1	0
SWE	Cont. corr.	0.53	-	0.52	0.62	0.68
	Max. corr.	0.56	-	0.52	0.69	0.69
	Lead/lag	-1	-	0	-1	-1

For each variable the first row contains the contemporary correlation; the second row the maximum (positive) correlation for a window of five leads and five lags. The number in the third row shows, for the maximum correlation, the lead(lag) of Germany if the value is positive(negative).

Table 2: Correlation of GDP with respect to US. (HP filtered)

		Whole Smpl	[60:1 - 79:4]	[80:1 - 90:4]	[91:1 - 02:4]	[93:1 - 02:4]
DEU	Cont. corr.	0.33	0.36	0.47	-0.05	0.57
	Max. corr.	0.41	0.44	0.48	0.16	0.71
	Lead/lag	1	1	1	5	2
FRA	Cont. corr.	0.34	0.51	0.09	0.2	0.62
	Max. corr.	0.37	0.52	0.19	0.33	0.85
	Lead/lag	1	1	5	2	2
ITA	Cont. corr.	0.27	0.23	0.51	-0.02	0.31
	Max. corr.	0.42	0.43	0.62	0.41	0.5
	Lead/lag	3	4	2	5	2
ESP	Cont. corr.	0.28	0.47	0.19	0.02	0.64
	Max. corr.	0.39	0.66	0.31	0.39	0.75
	Lead/lag	2	2	-3	5	2
NLD	Cont. corr.	0.34	0.2	0.66	0.29	0.8
	Max. corr.	0.38	0.26	0.69	0.33	0.82
	Lead/lag	1	2	1	1	1
BEL	Cont. corr.	0.33	-	0.43	0.24	0.69
	Max. corr.	0.38	-	0.52	0.25	0.72
	Lead/lag	1	-	1	2	1
AUT	Cont. corr.	0.15	0.24	0.03	0.06	0.59
	Max. corr.	0.2	0.35	0.09	0.08	0.62
	Lead/lag	1	1	-4	1	1
FIN	Cont. corr.	0.16	-0.51	0.31	0.63	0.72
	Max. corr.	0.37	0.53	0.36	0.74	0.8
	Lead/lag	3	5	2	1	1
USA	Cont. corr.	1.00	1.00	1.00	1.00	1.00
	Max. corr.	1.00	1.00	1.00	1.00	1.00
	Lead/lag	0	0	0	0	0
CAN	Cont. corr.	0.76	0.72	0.87	0.81	0.79
	Max. corr.	0.76	0.73	0.87	0.82	0.79
	Lead/lag	0	1	0	1	0
UK	Cont. corr.	0.59	0.63	0.5	0.6	0.55
	Max. corr.	0.59	0.63	0.56	0.67	0.61
	Lead/lag	0	0	-3	1	1
JPN	Cont. corr.	0.21	0.28	0.21	-0.13	0.19
	Max. corr.	0.23	0.28	0.41	0.05	0.21
	Lead/lag	2	0	4	5	1
CHE	Cont. corr.	0.2	0.12	0.45	0.14	0.59
	Max. corr.	0.42	0.34	0.67	0.42	0.78
	Lead/lag	2	3	2	4	2
SWE	Cont. corr.	0.46	-	0.66	0.25	0.53
	Max. corr.	0.51	-	0.66	0.49	0.67
	Lead/lag	2	-	2	5	2

For each variable the first row contains the contemporary correlation; the second row the maximum (positive) correlation for a window of five leads and five lags. The number in the third row shows, for the maximum correlation, the lead(lag) of US if the value is positive(negative).

Table 3: Correlation of GDP with respect to Germany. (Growth rate)

		Whole Smpl	[60:1 - 79:4]	[80:1 - 90:4]	[91:1 - 02:4]	[93:1 - 02:4]
DEU	Cont. corr.	1.00	1.00	1.00	1.00	1.00
	Max. corr.	1.00	1.00	1.00	1.00	1.00
	Lead/lag	0	0	0	0	0
FRA	Cont. corr.	0.44	0.40	0.47	0.36	0.33
	Max. corr.	0.44	0.40	0.47	0.36	0.47
	Lead/lag	0	0	0	0	-1
ITA	Cont. corr.	0.26	0.18	0.40	0.18	0.07
	Max. corr.	0.26	0.18	0.40	0.30	0.46
	Lead/lag	0	0	0	-1	-1
ESP	Cont. corr.	0.21	0.14	0.14	0.37	0.36
	Max. corr.	0.21	0.19	0.27	0.37	0.36
	Lead/lag	0	1	-5	0	0
NLD	Cont. corr.	0.22	0.20	0.11	0.43	0.33
	Max. corr.	0.22	0.20	0.38	0.43	0.33
	Lead/lag	0	0	-1	0	0
BEL	Cont. corr.	0.41	-	0.36	0.53	0.47
	Max. corr.	0.41	-	0.39	0.53	0.47
	Lead/lag	0	-	-3	0	0
AUT	Cont. corr.	0.35	0.20	0.60	0.39	0.48
	Max. corr.	0.35	0.20	0.60	0.39	0.48
	Lead/lag	0	0	0	0	0
FIN	Cont. corr.	0.06	-0.02	0.04	0.16	0.12
	Max. corr.	0.11	0.49	0.08	0.26	0.47
	Lead/lag	2	5	-3	1	-1
USA	Cont. corr.	0.10	-0.01	0.26	0.30	0.43
	Max. corr.	0.24	0.29	0.26	0.30	0.43
	Lead/lag	-1	-1	0	0	0
CAN	Cont. corr.	0.16	0.14	0.08	0.16	0.36
	Max. corr.	0.17	0.14	0.17	0.36	0.40
	Lead/lag	1	0	-1	-2	-2
UK	Cont. corr.	0.29	0.31	0.24	0.17	0.14
	Max. corr.	0.29	0.31	0.24	0.24	0.34
	Lead/lag	0	0	0	-1	-1
JPN	Cont. corr.	0.24	0.23	0.05	0.01	-0.08
	Max. corr.	0.25	0.23	0.37	0.20	0.27
	Lead/lag	-4	0	-4	5	5
CHE	Cont. corr.	0.33	0.31	0.34	0.29	0.24
	Max. corr.	0.33	0.31	0.34	0.37	0.35
	Lead/lag	0	0	0	-1	-1
SWE	Cont. corr.	0.21	-	0.14	0.37	0.43
	Max. corr.	0.21	-	0.21	0.40	0.43
	Lead/lag	0	-	-5	-1	0

For each variable the first row contains the contemporary correlation; the second row the maximum (positive) correlation for a window of five leads and five lags. The number in the third row shows, for the maximum correlation, the lead(lag) of Germany if the value is positive(negative).

Table 4: Correlation of GDP with respect to US. (Growth rate)

		Whole Smpl	[60:1 - 79:4]	[80:1 - 90:4]	[91:1 - 02:4]	[93:1 - 02:4]
DEU	Cont. corr.	0.10	-0.01	0.26	0.30	0.43
	Max. corr.	0.24	0.29	0.26	0.30	0.43
	Lead/lag	1	1	0	0	0
FRA	Cont. corr.	0.22	0.19	0.19	0.25	0.30
	Max. corr.	0.25	0.27	0.29	0.35	0.47
	Lead/lag	1	1	3	2	2
ITA	Cont. corr.	0.20	0.15	0.41	-0.05	0.12
	Max. corr.	0.25	0.24	0.41	0.34	0.32
	Lead/lag	2	2	0	4	4
ESP	Cont. corr.	0.11	0.16	0.02	0.23	0.17
	Max. corr.	0.20	0.31	0.22	0.56	0.39
	Lead/lag	3	1	-3	5	5
NLD	Cont. corr.	0.17	0.10	0.25	0.34	0.38
	Max. corr.	0.20	0.23	0.35	0.34	0.46
	Lead/lag	2	2	1	0	1
BEL	Cont. corr.	0.25	-	0.17	0.39	0.55
	Max. corr.	0.29	-	0.38	0.39	0.55
	Lead/lag	2	-	2	0	0
AUT	Cont. corr.	0.06	0.03	0.07	0.01	0.10
	Max. corr.	0.13	0.22	0.22	0.24	0.37
	Lead/lag	1	1	-4	-1	-1
FIN	Cont. corr.	0.12	-0.20	0.18	0.34	0.24
	Max. corr.	0.34	0.55	0.23	0.46	0.49
	Lead/lag	2	2	-4	1	1
USA	Cont. corr.	1.00	1.00	1.00	1.00	1.00
	Max. corr.	1.00	1.00	1.00	1.00	1.00
	Lead/lag	0	0	0	0	0
CAN	Cont. corr.	0.51	0.39	0.69	0.58	0.54
	Max. corr.	0.51	0.39	0.69	0.58	0.54
	Lead/lag	0	0	0	0	0
UK	Cont. corr.	0.23	0.16	0.38	0.35	0.32
	Max. corr.	0.23	0.20	0.38	0.43	0.33
	Lead/lag	0	-3	0	1	-1
JPN	Cont. corr.	0.15	0.17	0.23	-0.11	-0.07
	Max. corr.	0.15	0.18	0.31	0.30	0.29
	Lead/lag	0	2	5	5	-1
CHE	Cont. corr.	0.13	0.07	0.36	0.33	0.29
	Max. corr.	0.23	0.20	0.60	0.41	0.40
	Lead/lag	2	5	2	4	4
SWE	Cont. corr.	0.35	-	0.41	0.22	0.38
	Max. corr.	0.35	-	0.41	0.28	0.44
	Lead/lag	0	-	0	4	1

For each variable the first row contains the contemporary correlation; the second row the maximum (positive) correlation for a window of five leads and five lags. The number in the third row shows, for the maximum correlation, the lead(lag) of US if the value is positive(negative).

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Table 5: Contemporary correlations of Short-term Interest Rate (Levels).

		Whole Smpl	[60:1 - 79:4]	[80:1 - 90:4]	[91:1 - 02:4]	[93:1 - 02:4]
DEU	Cont. corr. (with DEU)	1.00	1.00	1.00	1.00	1.00
	Cont. corr. (with USA)	0.59	0.63	0.84	-0.20	-0.31
FRA	Cont. corr. (with DEU)	0.72	0.52	0.78	0.96	0.92
	Cont. corr. (with USA)	0.73	0.69	0.80	-0.17	-0.23
ITA	Cont. corr. (with DEU)	0.48	-0.13	0.62	0.81	0.61
	Cont. corr. (with USA)	0.66	0.29	0.73	0.01	0.10
ESP	Cont. corr. (with DEU)	0.40	-0.25	0.31	0.89	0.81
	Cont. corr. (with USA)	0.50	0.23	0.29	-0.08	-0.11
NLD	Cont. corr. (with DEU)	0.75	0.55	0.95	1.00	0.99
	Cont. corr. (with USA)	0.63	0.74	0.77	-0.46	-0.83
BEL	Cont. corr. (with DEU)	0.66	0.36	0.79	0.98	0.96
	Cont. corr. (with USA)	0.71	0.73	0.79	-0.20	-0.32
AUT	Cont. corr. (with DEU)	0.78	0.40	0.96	1.00	1.00
	Cont. corr. (with USA)	0.51	0.40	0.80	-0.46	-0.84
FIN	Cont. corr. (with DEU)	0.57	-0.08	0.06	0.96	0.95
	Cont. corr. (with USA)	0.51	-0.34	0.02	-0.08	-0.18
USA	Cont. corr. (with DEU)	0.59	0.63	0.84	-0.20	-0.31
	Cont. corr. (with USA)	1.00	1.00	1.00	1.00	1.00
CAN	Cont. corr. (with DEU)	0.56	0.23	0.91	0.66	0.36
	Cont. corr. (with USA)	0.87	0.79	0.89	0.43	0.53
UK	Cont. corr. (with DEU)	0.58	0.43	0.71	0.66	-0.17
	Cont. corr. (with USA)	0.77	0.77	0.46	0.35	0.76
JPN	Cont. corr. (with DEU)	0.30	0.13	0.71	0.90	0.87
	Cont. corr. (with USA)	0.22	-0.07	0.58	-0.01	-0.26
CHE	Cont. corr. (with DEU)	0.66	0.61	0.41	0.97	0.93
	Cont. corr. (with USA)	0.26	0.59	0.16	-0.04	-0.11
SWE	Cont. corr. (with DEU)	0.49	0.05	0.39	0.89	0.71
	Cont. corr. (with USA)	0.51	0.26	0.30	-0.09	-0.07

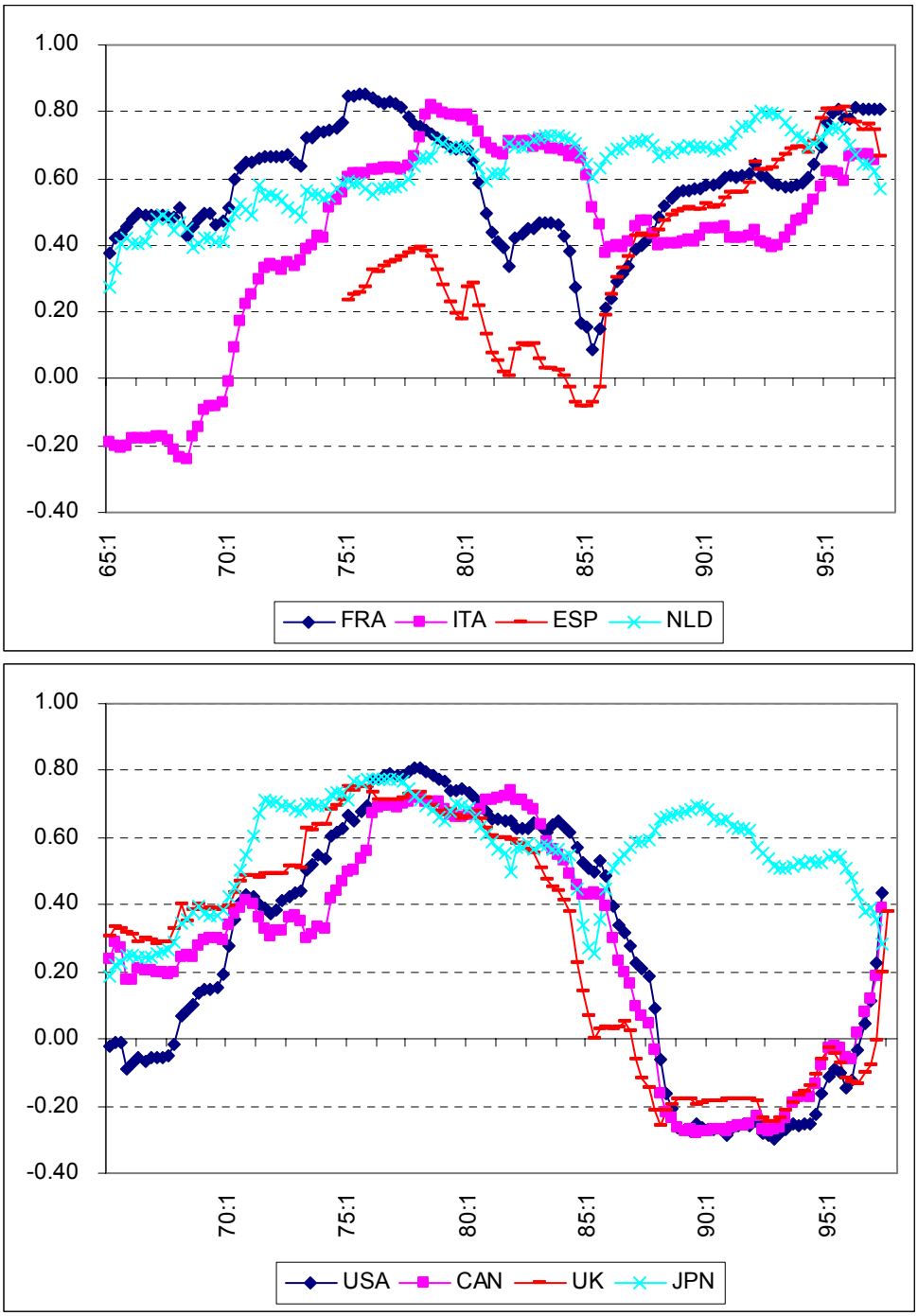
Table 6: Contemporary correlations of Long-term Interest Rate (Levels).

		Whole Smpl	[60:1 - 79:4]	[80:1 - 90:4]	[91:1 - 02:4]	[93:1 - 02:4]
DEU	Cont. corr. (with DEU)	1.00	1.00	1.00	1.00	1.00
	Cont. corr. (with USA)	0.45	0.39	0.73	0.88	0.80
FRA	Cont. corr. (with DEU)	0.68	0.48	0.77	0.96	0.90
	Cont. corr. (with USA)	0.88	0.94	0.90	0.87	0.77
ITA	Cont. corr. (with DEU)	0.56	0.15	0.78	0.90	0.92
	Cont. corr. (with USA)	0.86	0.87	0.86	0.81	0.74
ESP	Cont. corr. (with DEU)	0.85	0.84	0.72	0.93	0.94
	Cont. corr. (with USA)	0.87	0.93	0.73	0.83	0.73
NLD	Cont. corr. (with DEU)	0.81	0.68	0.96	0.98	0.97
	Cont. corr. (with USA)	0.76	0.89	0.78	0.92	0.87
BEL	Cont. corr. (with DEU)	0.68	0.44	0.81	0.99	0.99
	Cont. corr. (with USA)	0.90	0.94	0.90	0.89	0.81
AUT	Cont. corr. (with DEU)	0.86	0.40	0.92	0.99	0.98
	Cont. corr. (with USA)	0.54	0.64	0.75	0.84	0.72
FIN	Cont. corr. (with DEU)	0.94	-	0.95	0.97	0.97
	Cont. corr. (with USA)	0.88	-	-0.35	0.87	0.80
USA	Cont. corr. (with DEU)	0.45	0.39	0.73	0.88	0.80
	Cont. corr. (with USA)	1.00	1.00	1.00	1.00	1.00
CAN	Cont. corr. (with DEU)	0.58	0.42	0.84	0.94	0.94
	Cont. corr. (with USA)	0.97	0.98	0.94	0.92	0.85
UK	Cont. corr. (with DEU)	0.71	0.51	0.88	0.93	0.87
	Cont. corr. (with USA)	0.75	0.89	0.74	0.92	0.87
JPN	Cont. corr. (with DEU)	0.83	0.64	0.87	0.94	0.85
	Cont. corr. (with USA)	0.38	0.26	0.71	0.86	0.72
CHE	Cont. corr. (with DEU)	0.80	0.86	0.66	0.98	0.97
	Cont. corr. (with USA)	0.34	0.42	0.14	0.84	0.77
SWE	Cont. corr. (with DEU)	0.83	-	0.78	0.91	0.94
	Cont. corr. (with USA)	0.91	-	-0.01	0.86	0.81

Table 7: Contemporary correlations of Share prices (Growth rate).

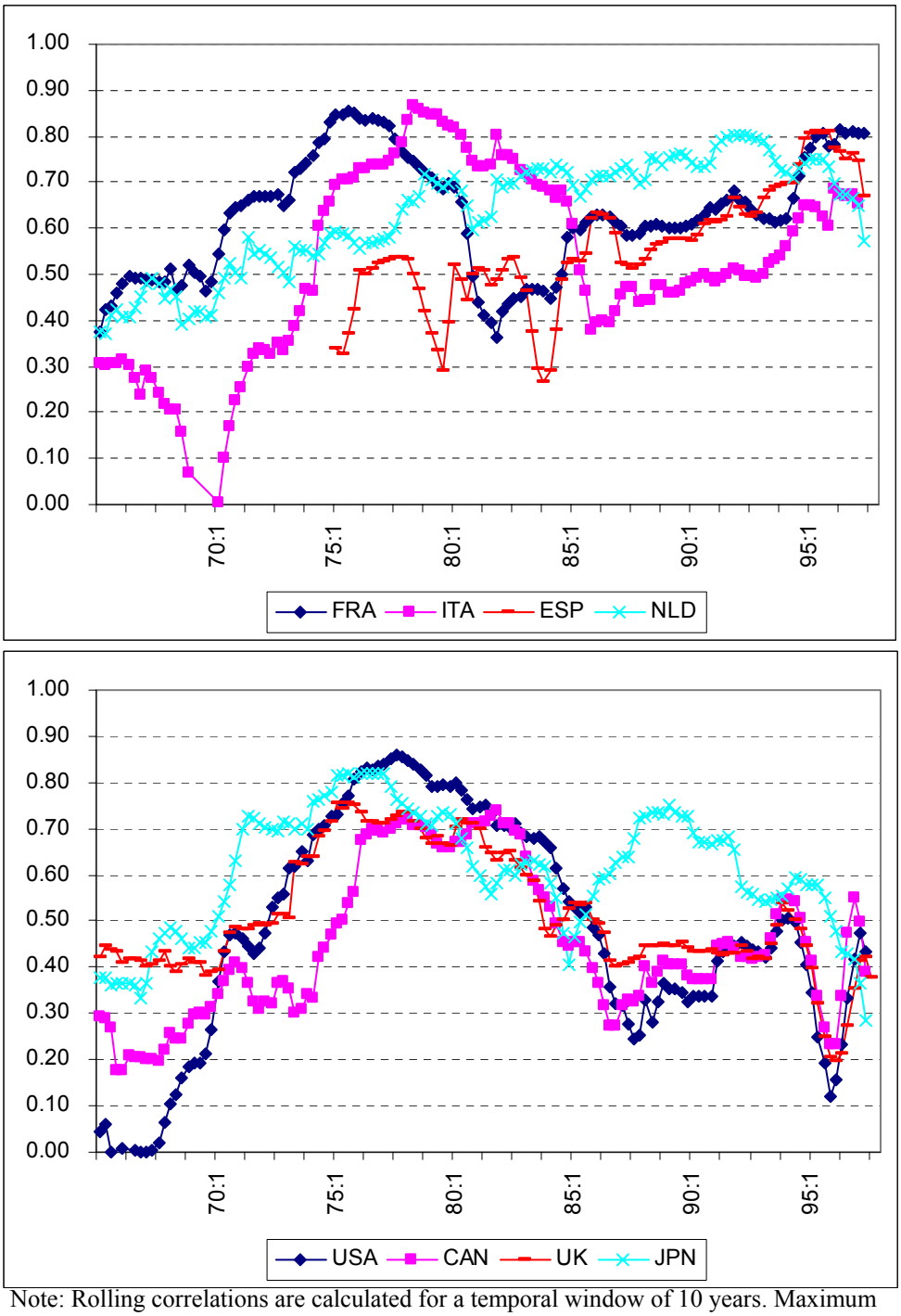
		Whole Smpl	[60:1 - 79:4]	[80:1 - 90:4]	[91:1 - 02:4]	[93:1 - 02:4]
DEU	Cont. corr. (with DEU)	1.00	1.00	1.00	1.00	1.00
	Cont. corr. (with USA)	0.51	0.49	0.55	0.51	0.55
FRA	Cont. corr. (with DEU)	0.62	0.45	0.61	0.88	0.87
	Cont. corr. (with USA)	0.55	0.46	0.62	0.59	0.62
ITA	Cont. corr. (with DEU)	0.56	0.12	0.46	0.78	0.79
	Cont. corr. (with USA)	0.44	0.33	0.47	0.44	0.48
ESP	Cont. corr. (with DEU)	0.61	-	0.36	0.86	0.86
	Cont. corr. (with USA)	0.68	-	0.74	0.61	0.65
NLD	Cont. corr. (with DEU)	0.81	-	0.72	0.91	0.90
	Cont. corr. (with USA)	0.73	-	0.77	0.70	0.74
BEL	Cont. corr. (with DEU)	0.61	-	0.64	0.58	0.53
	Cont. corr. (with USA)	0.72	-	0.84	0.58	0.59
AUT	Cont. corr. (with DEU)	0.57	0.13	0.62	0.68	0.63
	Cont. corr. (with USA)	0.23	0.14	0.23	0.41	0.45
FIN	Cont. corr. (with DEU)	0.63	-	0.36	0.75	0.77
	Cont. corr. (with USA)	0.33	-	0.31	0.35	0.40
USA	Cont. corr. (with DEU)	0.51	0.49	0.55	0.51	0.55
	Cont. corr. (with USA)	1.00	1.00	1.00	1.00	1.00
CAN	Cont. corr. (with DEU)	0.43	0.35	0.44	0.56	0.59
	Cont. corr. (with USA)	0.78	0.79	0.89	0.62	0.62
UK	Cont. corr. (with DEU)	0.48	0.43	0.54	0.69	0.77
	Cont. corr. (with USA)	0.67	0.65	0.76	0.71	0.80
JPN	Cont. corr. (with DEU)	0.27	0.29	0.23	0.30	0.35
	Cont. corr. (with USA)	0.35	0.48	0.45	0.17	0.13
CHE	Cont. corr. (with DEU)	0.73	0.67	0.85	0.74	0.73
	Cont. corr. (with USA)	0.69	0.66	0.72	0.69	0.72
SWE	Cont. corr. (with DEU)	0.58	0.42	0.54	0.77	0.82
	Cont. corr. (with USA)	0.50	0.41	0.58	0.53	0.55

Figure 1: Contemporary rolling correlation of GDP (HP detrended) with respect to Germany.



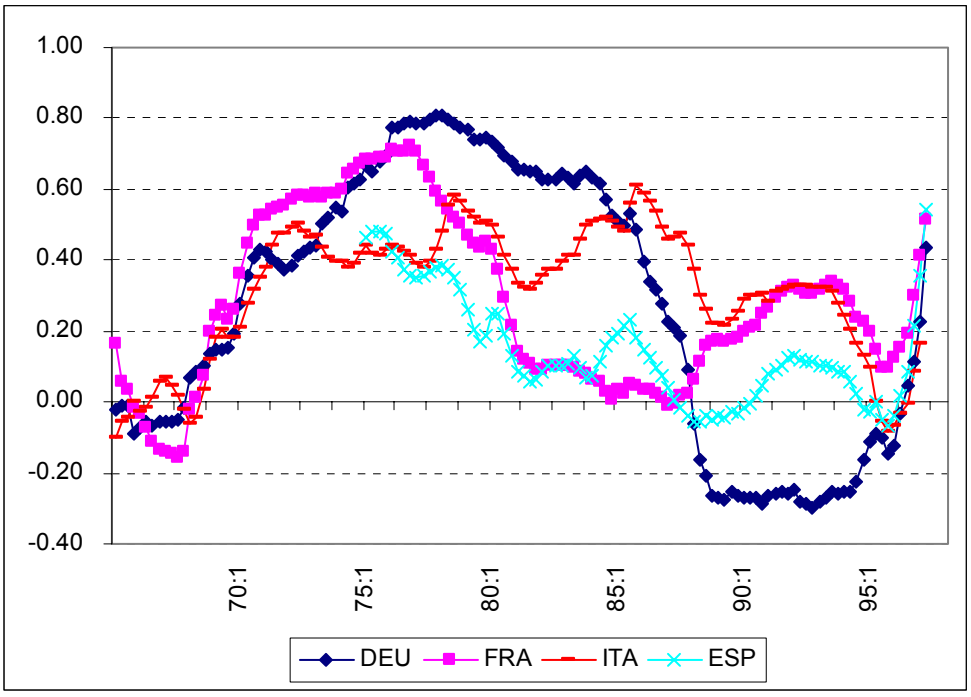
Note: Rolling correlations are calculated for a temporal window of 10 years

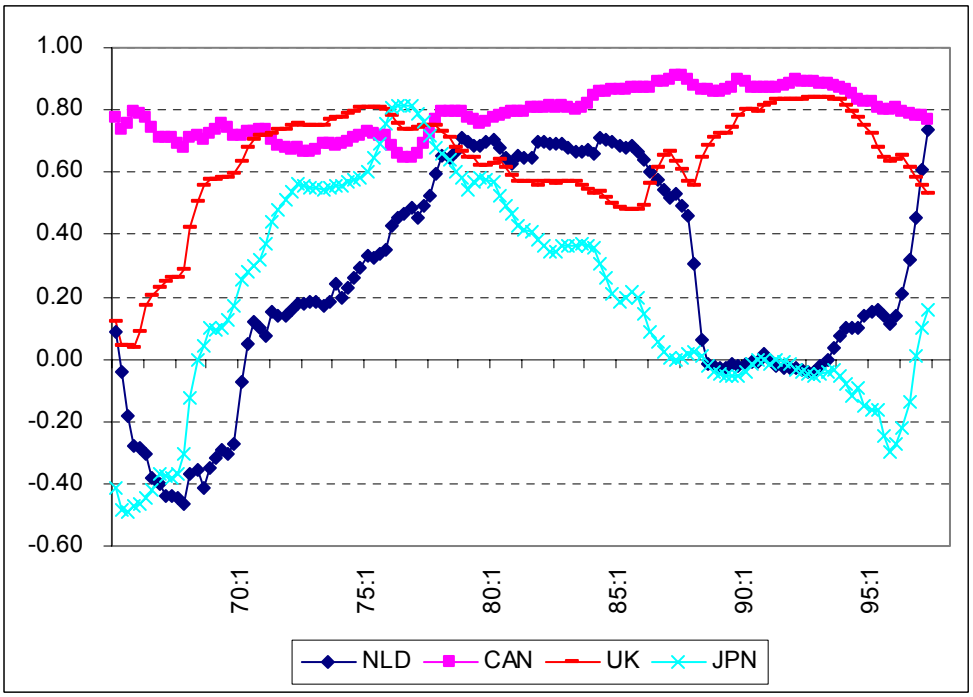
Figure 2: Maximum positive rolling correlation of GDP (HP detrended) with respect to Germany.



Note: Rolling correlations are calculated for a temporal window of 10 years. Maximum correlation is computed over a range of five leads and five lags.

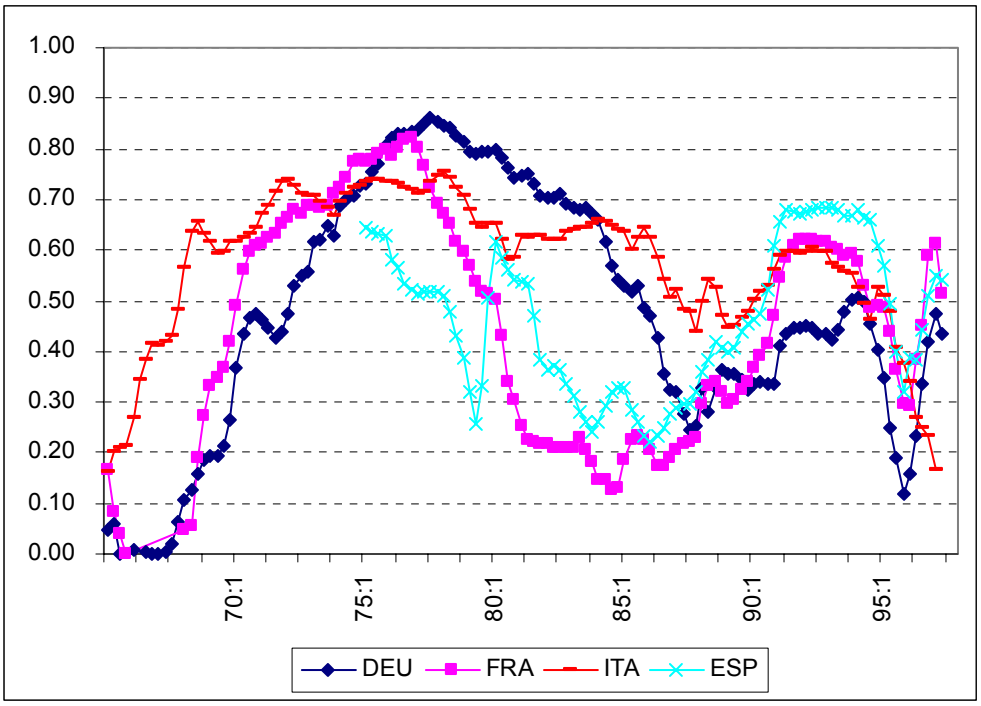
Figure 3: Contemporary rolling correlation of GDP (HP detrended) with respect to US.

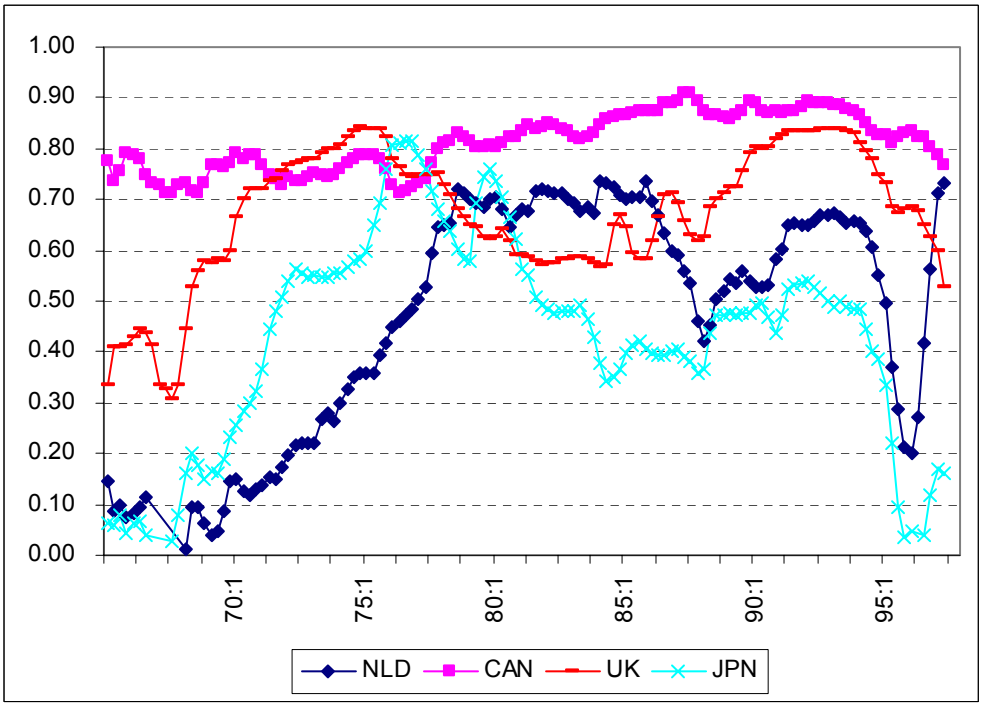




Note: Rolling correlations are calculated for a temporal window of 10 years.

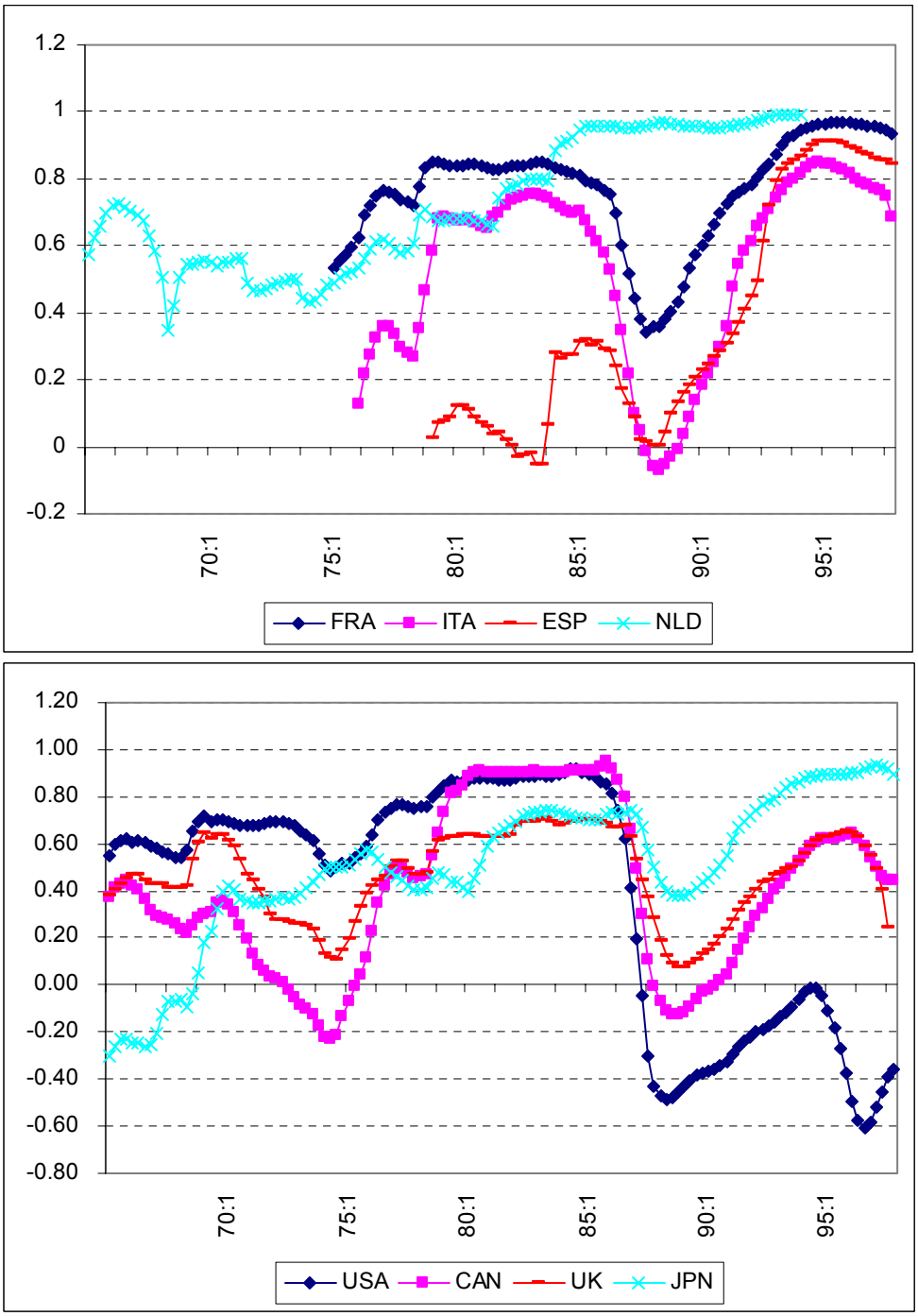
Figure 4: Maximum positive rolling correlation of GDP (HP detrended) with respect to US.





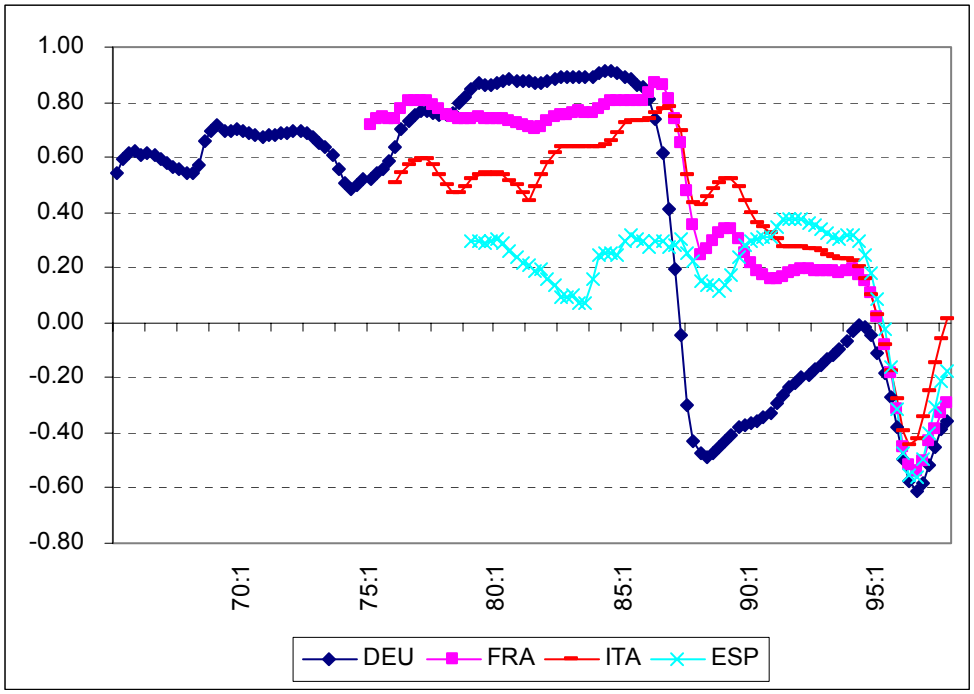
Note: Rolling correlations are calculated for a temporal window of 10 years. Maximum correlation is computed over a range of five leads and five lags.

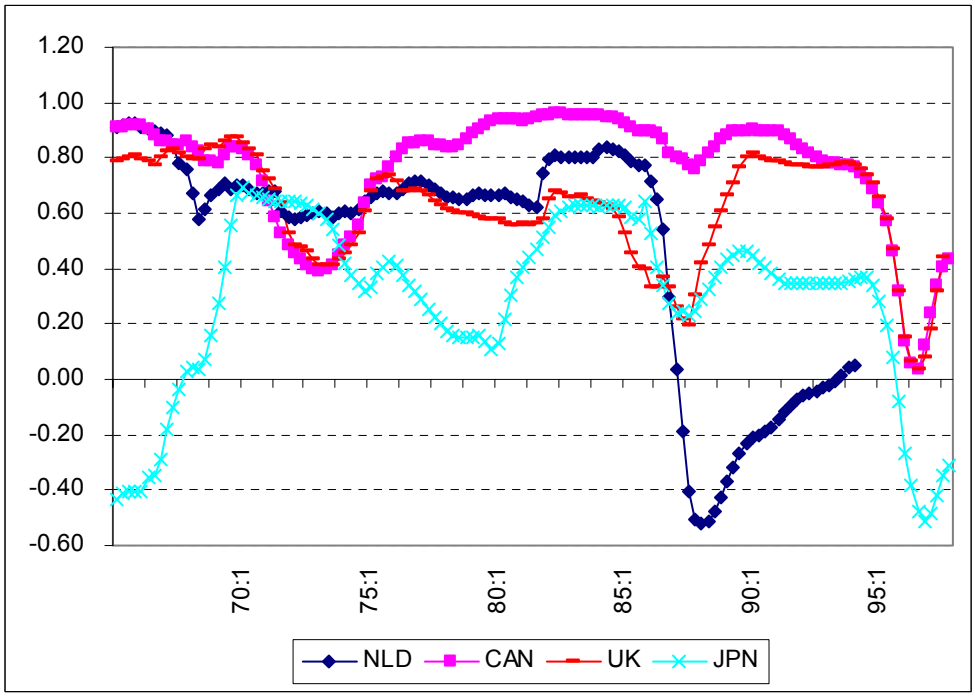
Figure 5: Contemporary rolling correlation of Short-term interest rate (Levels) with respect to Germany.



Note: Rolling correlations are calculated for a temporal window of 10 years.

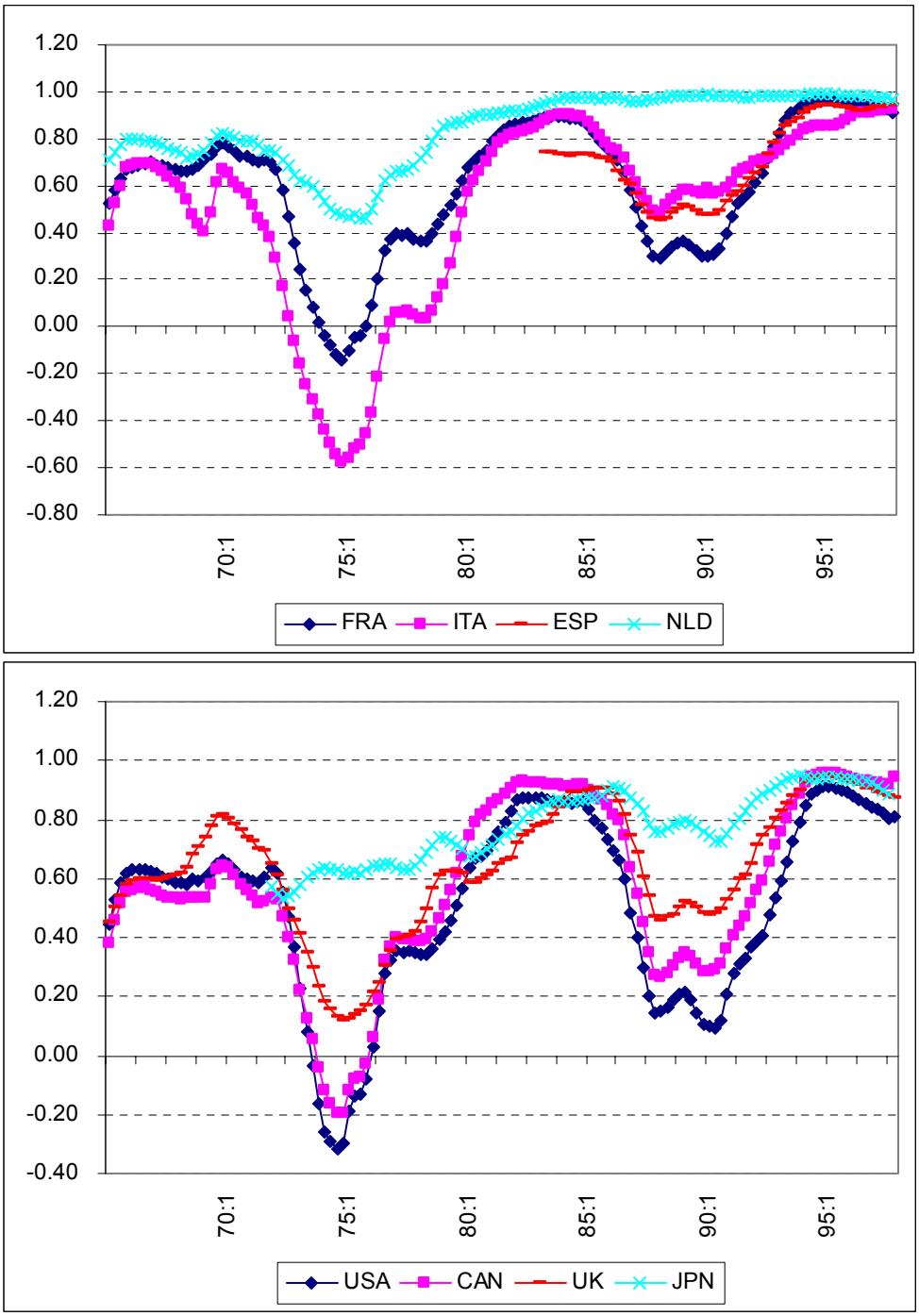
Figure 6: Contemporary rolling correlation of Short-term interest rate (Levels) with respect to US.





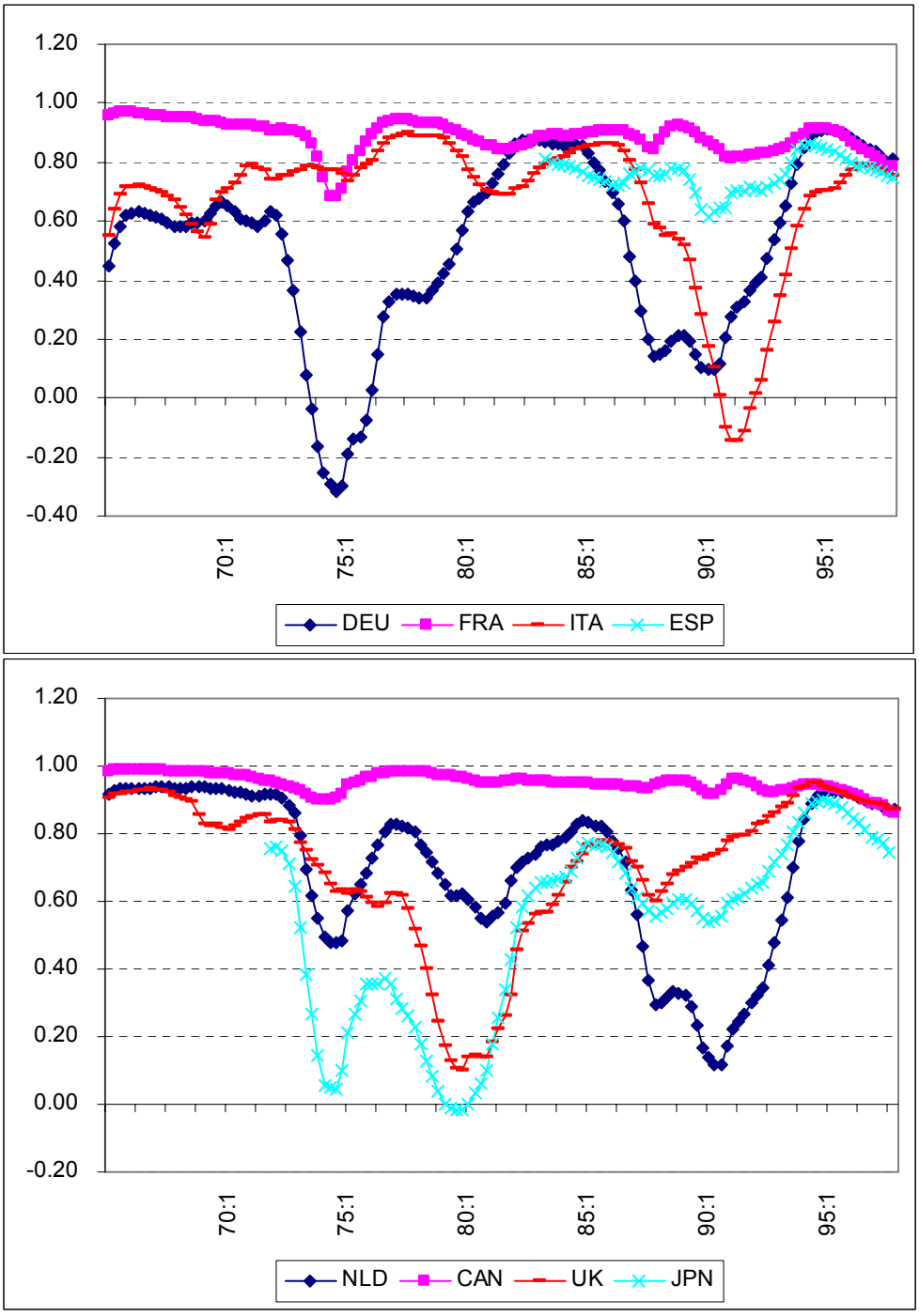
Note: Rolling correlations are calculated for a temporal window of 10 years.

Figure 7: Contemporary rolling correlation of Long-term interest rate (Levels) with respect to Germany.



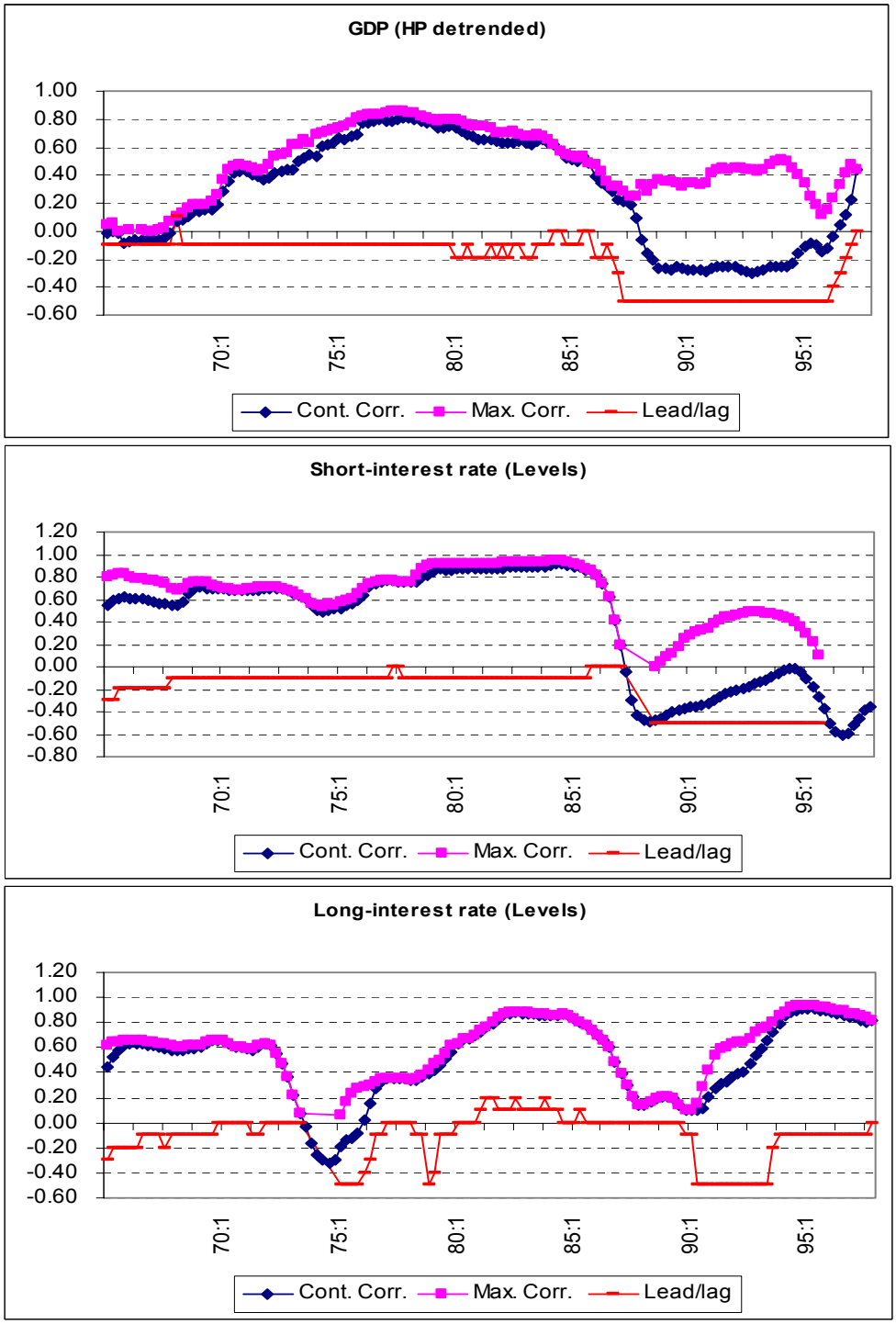
Note: Rolling correlations are calculated for a temporal window of 10 years. Maximum correlation is computed over a range of five leads and five lags.

Figure 8: Contemporary rolling correlation of Long-term interest rate (Levels) with respect to US.



Note: Rolling correlations are calculated for a temporal window of 10 years. Maximum correlation is computed over a range of five leads and five lags.

Figure 9: Rolling contemporary and maximum correlations and lead/lag for the maximum with respect to Germany.



Notes: Rolling correlations are calculated for a temporal window of 10 years. Maximum correlation is computed over a range of five leads and five lags. The leads/lags are divided by 10, for presentation purposes, to make the values of this variable comparable to the values of the correlations.