Cyclical behaviour of real wages

in the euro area and OECD countries

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Abstract

Available empirical evidence of real wage cyclicality is not conclusive about the direction nor the degree of cyclical movement of real wages as a response to business cycle fluctuations. In an effort to provide a consistent set of evidence for the euro area and OECD countries we describe the cyclical behaviour of real wages using aggregate data and focusing on different indicators and techniques. Furthermore, filling a gap in the literature on cyclicality of real wages, we assess the impact of labour market institutions on real wage cyclicality. In a first step, we find that a standard investigation of unconditional correlations of filtered real wage and output series misses important information about the dynamics of the series. Therefore, we also adopt a dynamic method proposed in Den Haan (2000) that can account for the dynamic nature of the variables under consideration. Using quarterly aggregate data for the euro area for both the whole economy and manufacturing we find that aggregate real wages in the euro area have been largely a-cyclical since the 1970s. At the same time, it appears that the largest euro area countries, and most OECD countries, have experienced a moderate pro-cyclical real wage behaviour over this time period. These results suggest an important role for cross-country differences and differences depending on the wage variable used and the sectoral coverage of the data. In a second step we observe that wage cyclicality is closely linked with labour market institutions. In particular, countries with a larger extent of the population covered by union contracts have less pro-cyclical movements in real wages.

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1. Introduction

Despite the fact that the empirical debate on the cyclical behaviour of real wages dates back to Keynes (1936), there has not so far been a consensus among economists about the direction or the degree of cyclical movements of real wages. Indeed, the results appear to be sensitive to the particular techniques of the individual studies and the types of data they focus on. Yet, the debate on this issue remains lively, reflecting the central role that real wage movements play in discussions of both theory and policy. In the case of Europe, in particular, the introduction of the euro makes the response of wages to business cycle fluctuations a key issue of analysis for the evaluation of the potential for macroeconomic stabilisation in the euro area.

The cyclical behaviour of wages in the euro area has not been sufficiently investigated so far, despite its relevance for the functioning of the euro area. In addition, not much work has been done on the potential relationships between the reaction of wages to the business cycle and the institutional features of European labour markets, despite their central role with regards to labour market flexibility in Europe. In particular, since most of the available empirical work on the reaction of wages to the business cycle relates to the United States (US), the theoretical and empirical literature concerning real wage cyclicality has so far mainly focussed on labour markets where the role of labour market institutions is small. This focus has thus resulted in a lack of understanding of the role of labour market institutions, more relevant in the European context, in shaping the cyclical behaviour of real wages.

The aim of this paper is to provide a description of the cyclical behaviour of real wages in the euro area and in a sample of OECD countries in the last decades by using aggregate data. At a first stage, we describe the evidence by using different indicators and techniques. At a second stage, we assess if labour market institutions have any impact on cyclical wage behaviour.

The available empirical evidence focusing on the analysis of wage cyclicality using aggregate data can be broadly classified into two categories: static approaches and dynamic approaches.[1]

The first class of contributions analyses the contemporaneous covariance between real wages and a business cycle indicator by looking at the results of simple OLS regressions of a (detrended) real

[1] Another branch of literature looks at wage cyclicality using microeconomic data. This allows controlling for possible composition bias in aggregate time series (Solon, Barky and Parker, 1994). The main disadvantage of microeconometric approaches is the lack of homogeneous data for a large set of countries and long time periods.

wage series and a (detrended) business cycle series.[2] No definite conclusion about the cyclicality of real wages emerges from these studies, mainly because the findings depend on the wage measure adopted, on the deflator, on the detrending technique, on the frequency of the data and, last but not least, on the sample period chosen. A classification of the major differences among some of the studies that belong to this tradition is reported in Table 1 in the Appendix.

Contributions that adopt the dynamic approach, instead, study the relationship between a (typically detrended) wage series and a (typically detrended) business cycle series within a Vector Auto Regression (VAR) approach. This group includes studies that use two-variable VAR models focusing on the dynamic response of real wages to business cycle indicators such as employment or output[3] and contributions that use structural VAR models with several variables and identifying restrictions from a theoretical framework.[4] Only the studies using structural VAR models explicitly account for alternative causes of business cycles. They generally find pro-cyclical real wages in response to shocks to technology and oil prices, and counter-cyclical real wages in response to shocks in labour supply and aggregate demand.[5] Finally, within the class of the macro studies that adopt a dynamic approach a recent branch of literature analyses the behaviour of aggregate real wages over the business cycle using spectral and dynamic correlation analysis.[6] A classification of the major differences among some of the studies that belong to this tradition is reported in Table 2 in Appendix.

The empirical analysis presented here investigates the degree of comovement between real wages and the cycle by using two methodologies. Following the literature, we first calculate unconditional correlations of filtered real wage and output series. The evidence on contemporaneous correlations between the filtered series of real wages and output suggests that there may be some important information about the dynamics that can be lost, particularly because the cyclical wage response is best characterised by lagged or gradual adjustment to the cycle. The second approach we adopt is the method proposed in Den Haan (2000), which can account for the dynamic nature of the

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[2] This group of studies includes Bodkin (1969), Otani (1980), Sumner and Silver (1989), Abraham and Haltiwanger (1995), Basu and Taylor (1999) and Hart and Malley (2000). A related class of papers adopts the static approach to focus on more disaggregated or industry data (e.g. Chirinko (1980), Bils (1987), Swanson, (1999), Hart and Malley (2000)).

[3] See e.g. Neftci (1978), Sargent (1978), Geary and Kennan (1982), Kennan (1988), Mohammadi (2003).

[4] The structural VAR approach is adopted e.g. by Blanchard and Quah (1989), Gamber and Joutz (1993), Mocan and Topyan (1993), Gamber and Jouz (1997), Fleishman (1999), Balmaseda et al. (2000).

[5] See e.g. Fleischman (1999).

[6] See Hart et al. (2001) and Hart et al. (2003).

variables under consideration. We focus on aggregate data for the euro area for the whole economy and for both whole economy and manufacturing for a number of OECD countries.[7]

Some of the issues that we consider are the following: Do real wages follow a predictable pattern over the business cycle?; Has the cyclicality of the wage series been the same in the last decades or is there any structural break in the series?; Is the evidence on wage cyclicality strongly affected by the sectoral coverage of the data used?; and do labour market institutions have an impact on the cyclicality of real wages?

Our findings indicate that aggregate real wages in the euro area have been on the whole largely a-cyclical since the 1970s. At the same time, it appears that the largest euro area countries, and most OECD countries, have experienced a moderate pro-cyclical real wage behaviour over this time period. In general pro-cyclical wage behaviour appears to be somewhat more predominant in the Anglo-Saxon countries versus the continental European countries. For the manufacturing sector the evidence points to significantly different wage adjustment compared to the whole economy as PPI deflated hourly wages in manufacturing exhibit a predominantly counter-cyclical adjustment (with few exceptions). These results suggest an important role for cross-country differences and differences depending on the wage variable used and the sectoral coverage of the data.

Concerning the analysis of the relationship between labour market institutions and the behaviour of real wages over the business cycle, our preliminary evidence suggests that wage cyclicality is closely linked with labour market institutions. The most relevant institutional dimension appears to be the union presence in wage setting. Countries with a larger extent of the population covered by union contracts have less pro-cyclical movements in real wages. There is some evidence that a number of other institutional variables also have a negative association with wage cyclicality.

This paper is organised as follows. In section 2 we describe the data we focus on in our empirical analysis. In section 3 we present empirical evidence about wage cyclicality using unconditional correlation coefficients of filtered series for the euro area and a number of OECD countries. In section 4 we present further evidence about wage cyclicality using a VAR based methodology that presents a more complete picture of the dynamic adjustment of real wages. In section 5 we assess the relationship between measures of wage cyclicality obtained in previous sections and labour

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[7] Comparisons among the cyclical behaviour of aggregate real wages in the OECD countries can be found in Otani (1980), Basu and Taylor (1999), Geary and Kennan (1982), Kennan (1988), Mocan and Topyan (1993), Balmaseda et al. (2000). In a recent paper, Liu (2003) performs on a comparative analysis of real wage cyclicality in a sample of OECD countries focusing instead on micro data.

market institutions. Finally, we summarise the evidence and conclude in section 6 with some suggestions for further research.

2. Data

2.1. Euro area data

For euro area analysis we use euro area data extended backwards using the revised area wide model (AWM) database.[8]. Two measures of real wages are considered: nominal compensation per employee deflated by the GDP deflator and nominal compensation per employee deflated by the HICP. In addition, we consider real GDP as a measure of the business cycle.

All series in logs are shown in Figure 1, together with business cycle peaks and troughs as recently identified by the CEPR business cycle dating committee (dashed lines).[9] These graphs highlight some features of euro area developments that may be relevant for real wage cyclicality. The real GDP series seems to show clear cyclical movements around a simple linear trend. In comparison, the employment series may reflect changing trend behaviour over this time period. Following a period of relatively low employment growth, employment increases strongly after mid 1980s. This period of strong growth is interrupted only by the early 1990s recession. These developments in employment are reflected also in the relatively strong growth in real wages per person until early 1980s, moderated somewhat thereafter. Furthermore, the early 1990s recession was preceded by a short period of relatively strong real wage growth. Overall the two real wage series show similar trend behaviour, suggesting that the two price indexes tend to move together over longer time horizons.[10]

2.2. Country data

For the whole economy country analysis we use a sample of OECD countries including nine euro-area countries (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, and

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[8] Prior to filtering the data we extend data forwards using forecasts to cover the period from 1970q1 to 2005q4. All data are seasonally adjusted.

[9] The CEPR business cycle dating committee defines a recessions as a “significant decline in the level of economic activity, spread across the economy of the euro area, usually visible in two or more consecutive quarters of negative growth in GDP, employment and other measures of aggregate economic activity for the euro area as a whole, and reflecting similar developments in most countries”. The three euro area recessions identified by the Committee are: 1974q3 to 1975q1, 1980q1 to 1982q3 and 1992q1 to 1993q3. Note that the latest slowdown in activity since 2001 is not (yet) considered a recession by the CEPR, but a “prolonged pause in the growth of economic activity”. The last dashed line is at 2001q2. For a detailed description of the Committees findings see www.cepr.org.

Spain), five Anglo-Saxon countries (Australia, Canada, New Zealand, UK and the US) and Japan. The data for euro area countries covers 92% of euro area in terms of employment and 94% in terms of GDP. In the case of industry wages, the sample covers 12 countries: Belgium, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Spain, Sweden, United Kingdom, United States

The data contains three groups of variables: wage and labour cost indicators, price deflators, and business cycle indicators. The first group includes compensation per employee for total economy and hourly wage/earnings for manufacturing or total industry[11]. Wage and labour cost indicators are available from the 1960's to early 2000's depending on the country and the wage variable. Compensation data come from Quarterly National Accounts (consistent with Eurostat ESA95 and OECD), while hourly wages/earnings is taken from the OECD Main Economic Indicators. The price deflators included in the database are the consumer price index (CPI), the GDP deflator and the producer price index for manufacturing (PPI). The business cycle indicators are real GDP and the industrial production index. Given that total compensation of employees is the most problematic series for the total economy in terms of availability, the time sample for the data is mostly determined by this variable. All data series have been seasonally adjusted. For a more detailed description of the data we used see Table 3 in the Appendix.

3. Measuring wage cyclicality 1: contemporaneous correlation

The simplest and most commonly used measure of wage cyclicality is the unconditional correlation coefficient between the cyclical component of real wages and the cycle. This cyclicality measure indicates the strength of the (linear) association between the two series and can be computed only after rendering the series stationary through some type of filtering technique. The advantages of this measure are that it is simple and it does not impose additional assumptions about the relationship between the two variables (such as causality). The main disadvantage is that the chosen filtering procedure has potentially significant effects on the results (see Canova, 1998). The regression counterpart of the contemporaneous correlation coefficient is the coefficient on the cyclical variables from a single equation regression using only contemporaneous values of real wages and

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[10] This result is particularly true for the interval since the mid-1980s, where there has been little net movement in the ratio of the HICP deflator versus the GDP deflator in the euro area (see Gros and Hefeker, 1999).

[11] These data available refers to hourly wage rate in industry in Austria (total industry), Belgium (manufacturing), France (whole economy), Germany (manufacturing) Italy (total industry), Netherlands (manufacturing), while they corresponds to hourly earnings in manufacturing in Canada, Greece, Ireland, New Zealand, Spain (industry excluding construction), and United States. The concept of hourly earnings is somewhat broader than that of hourly wage rate (i.e. negotiated wages) as it also includes in principle bonuses, overtime payment, etc. It is closer to the concept of labour costs. However, in practical terms, quarterly series of hourly earnings are very close to those of hourly wage rate as the information on bonuses and overtime payment is not always available on a quarterly basis.

the cycle. While this approach is often used in the literature, it also has its drawbacks. The drawbacks include possible omitted variable bias due to excluding past values of both dependent and independent variables and endogeneity bias due to possible reverse causality.

The unconditional correlation measure we adopt to analyse the comovement between real wages and the cycle is the contemporaneous correlation between band-pass filtered real wages and output. Alternative measures could have been the correlation between the growth rates of real wages and economic activity or the correlation between the Hodrick-Prescott (HP) filtered cyclical series of real wages and output. However, the BP filtered cycle is preferred as a measure of cyclical movements since, differently from the other two measures, it has the advantage that in addition to the trend it also removes short-frequency noise in the series, thus producing a smoother measure of the cycle.

The BP filter is calculated as a weighted moving average of the original series, where the weights are determined by sample characteristics (data frequency and the chosen periodicity band).[12] For a detailed description of the derivation of the weights, as well as the optimal length of the moving average, see Mills (2003). Briefly, the weights are determined using a frequency domain transformation. Periodicity refers to the length of the fluctuations, which help to separate short-term movements (noise), business cycle movements, and long-term movements (trend).[13] Following standard practice in the business cycle literature, the BP filter we adopt removes fluctuations that are too short (less than 1.5 years = 6 quarters) or too long (less than 8 years = 32 quarters) to be considered as cyclical.[14] For the calculation of the moving average, 12 quarter leads and lags are used. For this reason, the first and last 12 quarters of data are deleted after filtering.

3.1 Euro area results

Figures 2 and 3 show the band-pass BP filtered euro area real wages together with the band-pass filtered cyclical component of GDP. The sample period is from 1973q until 2002q4, which is the available span of data after filtering. The series are shown together with the business cycle peaks and troughs identified by CEPR (see footnote 10). As expected, since the CEPR method of

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[12] See Baxter and King (1999).

[13] An Ox program by Proietti is used to derive weights for quarterly data and this periodicity band, and a weighted moving average filter in STATA (tssmooth_ma) is used to filter data.

[14] The cycle is meant to roughly correspond to the growth cycle, i.e. to deviations from potential growth. The choice of the cycle length are largely based on the literature on the US business cycle and, in particular, on the description of the NBER business cycle dating committee. The results of the CEPR business cycle committee indicate similar business cycle lengths for the euro area. The results concerning cyclicality of real wages are not likely to be sensitive to these choices. However, evaluating robustness will be considered in further work.

identifying cycles is largely based on the concept of classical, as opposed to growth, cycles the band-pass filtered series we calculate show many more cyclical episodes than those identified by the CEPR methodology. However, the CEPR peaks and troughs coincide roughly with the corresponding peaks and troughs of the band-pass filtered cycle.

The graphs show no consistent cyclical pattern for real wages over the whole time period and the cyclical behaviour appears different both over time and when comparing the two measures of real wages. The overall picture that emerges suggests that, allowing for a lagged adjustment of wages to the cycle, real wages may have been somewhat more pro-cyclical in the 1990s1990s than previously. The difference between the two time periods is most evident when looking at real wages deflated by the GDP deflator. For example, while both real wage measures show a lagged cyclical decline following the early 1990s1990s recession, the most recent cycle can be seen only in the apparent coincident pro-cyclical reaction of the real wage measure deflated by the GDP deflator. In contrast, both real wage measures also show what appears to be a counter-cyclical decline during the cyclical upswing in the late 1980s. While some cyclicality seems present prior to late 1980s, the two measures of real wages give conflicting signals about the direction of cyclicality during this time period. Furthermore, in many cases the possibility of long and variable lags in the reaction of real wages makes it difficult to judge both the direction and magnitude of the true cyclical reaction.

The graphical evidence is confirmed by a correlation analysis presented in Table 4 in Appendix.[15] The contemporaneous correlation between the band-pass filtered series suggest that real wages in the euro area are on average a-cyclical, both if wages are deflated by the GDP deflator and if wages are deflated by the HICP deflator (i.e. the relevant correlation coefficient is not significantly different from zero).[16] However, once wages are allowed to adjust to the cycle with some lags, a positive correlation emerges. Furthermore, the average lag appears to be very large, i.e. the largest correlation suggest that the linear association between real wages and the cycle is at its strongest level at up to 8 lags (two years).[17] Overall, the correlation analysis highlights the importance of

[15] For a similar correlation analysis using BP filtered series (of mainly nominal variables) see King and Watson (1996).

[16] As we pointed out before, the fact that the results using wages deflated by the HICP and wages deflated by the GDP are quite similar is basically due to the fact that the two price indexes tend to move together over longer time horizonts.

[17] As a robustness check, we have compared the results of the band-pass series with the results that emerge using two alternative methods of filtering the data: the (annual) growth rate (i.e. calculated as the four-quarter difference of the log series) and the HP filter. From a simple graphical inspection, it emerges that the growth rate series show trending behaviour that is likely to affect the results. Furthermore, as expected, both the growth rate and the HP filtered cycles show short-term movements that are likely to reflect noise rather than cyclical movements.17 Comparing the growth rate series and the HP filtered series with the band-pass filtered series, it appears that while the real GDP cycles are very similar, the real wage series using the band-pass filter shows a more clear cyclical patterns than the HP filtered and growth rate data, particularly at the beginning of the sample. Correlation analysis reveals that using the band-pass

allowing for a lagged adjustment of wages to economic activity and that dynamic adjustment is very relevant for correctly measuring real wage cyclicality.[18]

3.2 Country results

Results of correlation analysis for a sample of OECD countries are shown in Tables 5-7. Table 5 shows the cross-correlation between GDP and real wages deflated by the GDP deflator. The results in the table show that the contemporaneous correlation between GDP and real wages is mainly pro-cyclical (i.e. positive and significant contemporaneous correlation between GDP and real wages) or a-cyclical (i.e. insignificant contemporaneous correlation). Table 6 shows the cross-correlation between GDP and CPI deflated real wages. With this wage variable, the sample contains more countries where wages are pro-cyclical, and in each country wages are more pro-cyclical than in the case of real wages deflated by the GDP deflator.[19] Hence, the country results seem to suggest that, at least with reference to total economy, aggregate real wages are mainly moderately pro-cyclical. This is true also for the four largest euro are countries (France, Germany, Italy and Spain). Comparing these findings with the euro area results suggests that the result pointing to a-cyclical wage adjustment at the euro area level should be interpreted with some caution.[20] Ranking countries according to the contemporaneous correlation suggests that the pro-cyclical response is strongest in Japan, while it is statistically not different from zero for a number of countries. According to the contemporaneous correlation the US seems to show consistently significant pro-cyclical real wages. In contrast, results for a number of euro area countries vary significantly with the different deflators used and for a number of euro area countries the correlation appears to be statistically insignificant.

The correlation analysis shows that wages do not always respond instantaneously to cyclical movements in output -- on the contrary -- significant lags have been found in the cyclical patterns of wages. This seems to be the case for a number of euro area countries, where a positive correlation emerges on some quarters after the corresponding change in cyclical real GDP. These results

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filtered and HP filtered data the correlations are very similar. In contrast, the contemporaneous correlation using growth rates is positive.

[18] As also pointed out by Abraham and Haltiwanger (1995), the cyclical behaviour of real wages is perhaps captured more appropriately by a dynamic model.

[19] The fact that real wages are more pro-cyclical when deflated with the CPI deflator with respect to the case where they are deflated by the GDP deflator has also been pointed out by Abraham and Haltiwanger (1995).

[20] As a robustness check, we also computed the correlation analysis with the HP filtered series, and the results are consistent with the BP filtered data. In particular, with the HP filtered data, there are more cases where the contemporaneous correlation between wages and GDP is positive and significant. This evidence is also confirmed by the results of Christodoulakis et al. (1995), who analyses the correlation between HP filtered real wages and GDP in European countries. The authors find that, with a couple of exceptions, compensation per employee, when significant, varies pro-cyclically, with its cycle coinciding or lagging the GDP.

suggest that the analysis of the cyclical behaviour of real wages should take into account the dynamic response of wages to output. Note also that the correlations between GDP and the leads of real wages tend to be large and significant. Overall, compared to the results for the euro area (and the largest euro area countries), cyclical real wages in the US seem to react more strongly and also somewhat faster to movements in cyclical real GDP. In contrast, real wage cyclicality in the United Kingdom (UK) seems very similar to that in the largest euro area countries.

Table 7 shows the cross-correlation analysis in manufacturing, where hourly real wages/earnings are used as the wage measure. It appears that for most European countries the results seem to contradict the results for the whole economy: the contemporaneous correlation between wages and GDP is in most cases negative and significant.[21] The only exception is US, where real hourly wages in manufacturing are pro-cyclical, confirming evidence for this country from previous studies. Leaving aside explanations based on the sample dimension (in most cases the sample is the same as for data on total economy), these findings could be explained by the difference in the wage measure, i.e. wages measured in hours instead of per employee. This fact might have special relevance in the case of Europe where employment adjustment costs are significant. Another possible explanation is that there can be an aggregation bias in the results for total economy. Finally, the deflator is also worth mentioning. Examination of manufacturing wages deflated by the CPI or GDP deflator (not reported in the paper) showed considerably more pro-cyclicality than those of PPI deflated wages.

3.3 The role of expansions and recessions

A final set of results using the band-pass filtered series looks at differences in the cyclicality of wages between expansionary and contractionary periods. To assess whether cyclical wage behaviour is asymmetric, i.e. different across the different phases of the business cycle, we divided our sample in periods of expansion and recession according to a statistical definition. Using the band-pass filtered cyclical component of output (real GDP or industrial production, depending on the sample) we first identify turning points country by country in the data. We define recessions as the periods from peak to through and expansions as the periods from through to peak, but limit the number of expansions or recessions to those that occur for at least 6 consecutive quarters in order to

[21] Similar results can be found in Fiorito and Kollintzas (1994), who also use real hourly wages/earnings in manufacturing as wage measure.

leave out very short cycles. Once the different phases of the cycle have been identified, we calculate the contemporaneous correlations of the different wage measures with respect to output.[22]

Tables 8 and 9 present our findings for the whole economy and the manufacturing sector respectively. The results show a great deal of heterogeneity across countries in the response of wages to output in the different phases of the cycle. While there are some countries with similar responses regardless of the cycle phase (e.g. Austria, Germany, US) others present clear asymmetries. This is for instance the case of Denmark, where wages are pro-cyclical in expansions and counter-cyclical in recessions on average.

However, as noted above the contemporaneous correlation may not be a very informative statistic of co-movement, since dynamic responses are not taken into account. Ideally the analysis of the distinction between expansions and recessions would be done in a dynamic framework. This could be done for example by integrating the dynamic analysis proposed by Den Han (2002) with the Markov-switching framework suggested by Ellison et al. (2003).

4. Measuring wage cyclicality 2: VAR based results

An alternative measure of the degree of comovement between two series based on correlation between VAR forecast errors at different horizons is proposed by Den Haan (2000). Contrary to the unconditional correlation coefficient (and its regression counterpart), this measure can take into account the dynamic nature of the variables under consideration by capturing information about the dynamics of the VAR system.[23] The method can accommodate both integrated and stationary variables and thus does not require filtering. Furthermore, an advantage of this method over the standard VAR approach is that it does not require any identification restrictions.[24]

The measure proposed by Den Haan (2000) can be briefly described in the following terms. Consider a VAR model in standard form:

$$X_t = A_0 + \sum_{i=1}^{m} A_i X_{t-i} + v_t$$

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[22] For an analysis of the comovement between series based on business cycle dummy variables see e.g. Harding and Pagan (2002).

[23] An alternative measure of dynamic comovement based on spectral analysis is proposed by Forni et al. (2001). Conceptually this measure is close to the correlation derived from the band-pass filtered series.

[24] The main drawback of standard VAR analysis based on the study of the impulse response functions is indeed that it requires the imposition of identification restrictions in order to recover coefficient estimates of the structural VAR from reduced-form estimates. As a consequence, the results may be sensitive to the identifying restrictions that are imposed

where X_t is an n-vector of random variables that may include both stationary and integrated processes; A_0 is an n-vector of constant terms or a matrix of deterministic coefficients; A_i are n × n matrices of coefficients; v_t is an n-vector of error terms, and m is the total number of lags included. Denote the k-period ahead forecast of variable y by $E_t y_{t+k}$ and its forecast error by $y_{fe,t+k}$. The same applies to variable x. Denote the covariance between $x_{fe,t+k}$ and $y_{fe,t+k}$ by COV(k) and the correlation coefficient between these two variables by CORR(k). One way to construct estimates of these covariance and correlation coefficients is to construct time series for the forecast errors using the difference between subsequent realizations and their forecasts. The constructed time series are then used to generate covariance and correlation coefficients.[25]

In our empirical analysis, the Den Haan methodology is applied by estimating a number of bivariate VAR models with real wages and output.[26] Similarly to the measure of cyclicality based on band–pass filtered data, we focus both on euro area data and a sample of OECD countries. In order to evaluate the role of model specification in determining the outcome we estimate each VAR twice, using both first differences and levels of log level series. The forecast errors are calculated for the levels. Bootstrapped standard errors based on 2500 replications were used to construct 90 percent confidence bands. The lag length in the VAR and the deterministic components were chosen by the Akaike Information Criterion.[27]

4.1. Euro area results

Figures 4-7 show the evidence about the dynamic correlation between real wages and output in the euro area from the method based on VAR forecasts errors for different forecast horizons.[28] We report results on the correlations between forecasts errors using both VAR in levels and VAR in first differences for the two different deflators. The graphs show the mean of the 2500 replications of the calculation and the relevant lower and upper confidence bands.[29]

Overall, these graphs show that real wages appear to be largely a-cyclical in the euro area at all the different business cycle frequencies. The correlation changes sign for the model in levels using the GDP deflator (Figure 4), whereas the correlations remain positive for the model in first differences (Figure 5). However, the confidence bands are large and mostly indicate that the correlation is not

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[25] For details, see Den Haan (2000).

[26] Den Haan (2000) founds no significant difference between the results of bivariate and multivariate VARs for the case of aggregate level correlation estimates.

[27] For recent applications of the Den Haan's methodology, see e.g,. Camacho, Perez-Quiros and Saiz (2004).

[28] The Matlab programs used to calculate this measure were downloaded from the Den Haan's webpage (ftp://weber.ucsd.edu/pub/wdenhaan/comov/).

statistically different from zero. The only exception is the short run correlation in the model in differences for the HICP deflated real wages (Figure 7) that show a significant positive association between the two forecast errors. These results seem to be in line with the findings from the unconditional correlation analysis, which indicates the presence of a contemporaneous correlation between band-pass filtered real wages and output that it is not significantly different from zero.

4.2. Country results

In the analysis of correlations of VAR forecast errors based the Den Haan method we focus on data for 15 countries for the whole economy sample, while for the manufacturing sample we have data 12 countries. GDP is the output variable for the whole economy sample, while industrial production is the output variable for the manufacturing sample. Compensation per employee (deflated by either the GDP deflator or CPI) is the wage variable for whole economy, hourly wages/earnings (deflated by the PPI) is the wage variable for manufacturing. Tables 10-12 show the characteristics of the VAR models that were fit to the data. Note that there is some variation in the number of lags and the deterministic variables included in the model as indicated by the Akaike criterion. Measures of statistical significance at the 10% level have been computed using bootstrapping.

For the whole economy these results point to mostly pro-cyclical real wage adjustment. Two countries, Austria and the United States, show statistically significant pro-cyclical real wage adjustment for all deflators, both in levels and differences and for the different forecast horizons. Results for several other countries, including Canada, France, Germany, Italy, New Zealand and the UK, indicate significant pro-cyclical wage adjustment for a large share of results. Only Spain shows consistently counter-cyclical real wage adjustment for all deflators, both in levels and differences and for the different forecast horizons. This impact is not significant in all cases for the CPI deflated real wage. In addition, wages appear counter-cyclical in some cases for Belgium, Denmark and the Netherlands. However this counter-cyclicality is not systematic, including some occasions where the sign of the cyclicality changes from negative to positive, and only rarely statistically significant. Overall it is worth noting that a number of results are statistically insignificant even if the apparent correlation between the two forecast error series is relatively large, suggesting that the results of the simple VAR model reflect significant uncertainty for a number of countries.[30]

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[29] Note that while this does not have to be the case the mean of the replications coincides closely with the result from the model for the full sample for the euro area.

[30] In a recent study, Den Haan and Sumner use the correlation coefficients of VAR forecast errors at different forecasting horizons and find a positive correlation between real wages and aggregate output (even at high frequencies) for the G7 countries over the period from February 1965 to December 2001.. See Den Haan and Sumner (2002).

Most countries that have a systematic pattern in the direction of change between the short and long run adjustment suggest that real wages become more pro-cyclical as the forecast horizon is extended. Following the reasoning in Den Haan (2000) this pattern could be interpreted as evidence of the dominating impact of different types of shocks in the short and the long run. There is some empirical evidence that the type of shock matters for the cyclicality of real wages. For example, Fleischman (1999) finds that wages tend to be counter-cyclical in response to labour supply and aggregate demand shocks, and pro-cyclical in responses to productivity and oil shocks. This would tend to argue for a model where there may be a short run impact from labour supply and aggregate demand shocks, which however mainly seems to be dominated by shocks that produce pro-cyclical responses to activity, particularly in the long run. The fact that most of the country series we have (but not all) extend to the 1970s suggests that the oil shocks in the 1970s could have a significant impact on the results, possibly explaining some of the pro-cyclicality in wage adjustment as well as some of the country differences. Most notably data for Spain and Belgium, countries that show some counter-cyclical pattern, do not include the 1970s. This suggests that an important aspect for future work is to evaluate the stability of the results over time.

For the manufacturing sector the evidence from the correlations of VAR forecast errors points to significantly different wage adjustment compared to the whole economy. The PPI deflated hourly wages point to predominantly counter-cyclical wage adjustment, with few exceptions. The counter-cyclical response is statistically significant for both models for Belgium, Ireland and Italy. In addition France, Finland, Spain and Sweden show a clear counter-cyclical response, whereas hourly wages in manufacturing appear largely pro-cyclical in Germany, Japan and the United States. It is notable that compared to the results for the whole economy a number of differences in the data definition can in principle explain this result (sector, wage variables and deflator). Again comparing the results for the manufacturing sector when other deflators are used (not shown) suggests that deflator has a significant influence on the results.

Finally, there is no clear pattern in the results in levels versus results in first differences. The differences seem isolated to a few countries such as the Netherlands, where results sometimes changes sign when the models is estimated using levels rather than differences. Beyond the fact that quadratic trends are in some cases needed for the level models, there does not appear to be any real reasons to choose one or the other method to deal with the long run.

4.3. Identifying common sources of wage cyclicality using factor analysis

The measures just described are meant to systematize and quantify the differences between countries in real wage cyclicality. Given the variety of measures presented, which depend on the wage variable used, the price deflator and the forecast horizon, an important question arises: do we observe consistent differences across countries? If so, are these differences consistent across methods? Do we observe consistent patterns within countries across different forecast horizons?

A simple answer to this first set of questions can be obtained by factor analysing all the measures of real wage cyclicality. Factor analysis is a statistical procedure that begins with the assumption that the observed measures share one or more common unobserved determinants (factors) and provides a way of estimating a model relating the underlying determinant(s) to the observed data.

The first result of the factor analysis is an assessment of how many dimensions it takes to produce a reasonable summary of the common variance (Johnson and Wichern, 1998). There are a number of methods for doing this. Maximum likelihood factor analysis allows one to test the statistical significance of the contribution of each factor to determining the common variance between the variables. A drawback to relying on this method alone is that it is possible for a factor to be statistically significant, but to reflect commonality between as few as two observed variables. Thus ML could identify the presence of a factor that only reflected the similarity of as few as two similar measures. This would not be informative of the number of factors related to a large number of dissimilar measures.

An alternative is to consider whether there are one or more factors that explain the bulk of the observed common variance. The first step of any factor analysis is to compute the eigenvalues of the principal components decomposition of the correlation matrix of the observed variables. The magnitude of these eigenvalues is another indicator of the dimensionality of the shared variance between the observed variables. The largest eigenvalue divided by the number of variables included in the analysis can be interpreted as the percent of variance that would be explained by the first principal component of the data. The second largest can be interpreted as the fraction that would be explained by the second principal component and so on. If there is one component that explains a very large fraction of the variance, and the others all explain only relatively small and similar shares, this is an indication that there is a single source of common variation. If there are two factors that explain large, and not too dissimilar, shares of the variance this is taken as an indication that there are two sources of common variance. In some cases this method can indicate the presence of three or more sources. A scree plot (which orders the eigenvalues in a decreasing scale) is useful in making such judgments (Johnson and Wichern, 1998, p475).

If the factor analysis suggests that one dimension is adequate to describe the bulk of the common variance between the measures of the same concept the next questions to be addressed are whether the measures all have the appropriate relationship with the underlying concept and how well each one reflects that concept. The factor loadings represent an estimate of the correlation of each variable with the hypothetical underlying causes of the common variation. If there is a single dominant factor then the measures' loadings on that factor can be thought of as a measure of the reliability with which they represent the underlying concept.

We have 18 measures of real wage cyclicality based on the results using the VAR based approach to measuring wage cyclicality. These measures include correlations of forecast errors at three different horizons: the short-run (six quarters), the medium-run (16 quarters or four years) and the long-run (32 quarters or 8 years) from models in levels and in first differences. We pool these measures to perform principal components factor analysis. The results of the factor analysis are presented in Table 13. The analysis of the eigenvalues clearly suggested two important dimensions of common variance. The first factor explains 66 per cent of the variance and can be interpreted as a country effect of real wage cyclicality. All indicators of wage cyclicality have large and positive loadings on this factor, suggesting the coherence of all measures, regardless the definition of the wage variable and the forecast horizon in determining the importance of cross-country differences in wage cyclicality.

The second factor explains 25 per cent of the variance. According to the loadings of the variables, a clear distinction arises between wage cyclicality when wages are measured hourly and in industry and wage cyclicality measured as compensation per employee for the whole economy. Wage cyclicality in the industrial sector presents always high and positive loadings for this factor, while measures of wage cyclicality for the whole economy typically present high negative correlations (especially those related to CPI deflated wages). This highlights the importance of the wage measure and sectoral coverage used for the analysis. Unfortunately, at this stage we are not able to disentangle between both sources of variation. In a next stage we will construct measures of compensation per employee for the industrial sector to be able to determine if differences of wage cyclicality measures are due to the sectoral coverage of the data or the definition of the wage variable used.

Finally, it is worth noting that we do not find consistent patterns over time in the data. Consequently, we can conclude that the main sources of variation in wage cyclicality are country and data specific, and do not relate to the forecast horizon considered.

5. Investigating the relationship between wage cyclicality and labour market institutions

We perform our assessment of the role of labour market institutions on wage cyclicality by focusing on our sample of OECD countries. In this way, we exploit all the available information arising from the differences in labour market across countries.

Our procedure is based on a two-stage approach. The first stage consists in a country by country estimate of a measure of the correlation between output and real wages at the different business cycle frequencies (i.e. the measures derived above following the Den Haan's methodology), while the second stage consists in the estimate of the degree of correlation between this measure and the labour market institutions variables. The presence of a significant correlation between the labour market institutions variables and our different measures of wage cyclicality will be an indicator of the presence of a significant role of labour market institutions on real wage cyclicality.

This section presents a first attempt to relate differences across countries in the relationship between wages and GDP along the business cycle with labour market institutions. Rather than testing fully-fledged theoretical hypotheses, we follow a fact-finding approach that should serve as input for the development of a coherent theoretical framework in a future stage of this research project.

The institutional variables included in the analysis come from a variety of sources. Since the focus of the analysis is on cross-country comparisons, we have taken averages of the institutional indicators for the periods covered in our dataset. We consider a large set of institutional variables:

- Unionization. Union density and union coverage reflect partial aspects of union bargaining power in the labour market. Depending on the set of norms and regulations governing the labour market, there are large differences within countries between the coverage of wages negotiated by unions and the extent of unionisation (as measured by the number of union members in the total labour force). Well-known examples are those of France and Spain where collective agreements cover more than three quarters of the labour force but less than 15 per cent of workers belong to a union. For this reason, the indicator of union coverage is probably a better indicator of the impact of unions in wage negotiations in the case of cross-country comparisons.

The main source for union density is Nickell and Nunziata (2001) for all countries except Ireland and New Zealand. Data for New Zealand have been obtained from OECD (1997) and for Ireland from Holden and Wulfsberg (2004). Union coverage data for all countries with the exception of New Zealand, Spain and Ireland come from Golden and Wallerstein (2002). Coverage for New Zealand and Spain is reported in OECD (1997) and for Ireland in Holden and Wulfsberg (2004).

- Wage-setting institutions. The degree of centralization and the extent of co-ordination between parties in wage-setting negotiations have proved to be important determinants of labour market performance. We consider an indicator of wage bargaining level developed by Golden and Wallerstein (2002). This indicator is a categorical variable taking values 1 to 5 according to an increasing scale in the wage bargaining level. Alternatively, we consider an indicator of wage setting co-ordination developed by Nickell and Nunziata (2001) which ranks countries in a scale from 1 to 3 according to an increasing scale in the co-ordination of unions and employers associations in the wage setting negotiations.
- Employment Protection. This indicator ranges between 0 and 2 increasing with the strictness of employment protection legislation. Source: Nickell and Nunziata (2001).
- Unemployment Benefits. This indicator reports the first year of unemployment benefits, averaged over family types of recipients, since in many countries benefits are distributed according to family composition. The benefits are a percentage of average earnings before tax. Source: OECD database
- Tax Wedge: wedge between the real (monetary) labour cost faced by the firms and the consumption wage received by the employees normalized by GDP. Source: Nickell and Nunziata (2001)

We present bivariate correlations of each of the summary measures of wage cyclicality and the set of institutional variables described above. In the context of the determination of cross-country differences of unemployment, Van Ours and Belot (2001) place important emphasis on the role of interactions between different institutional structures. We follow this approach here, and also discuss bivariate correlations between wage cyclicality measures and selected interactions between these different labour market institutions.

Table 14 presents bivariate correlations between labour market institutions and wage cyclicality in the industrial sector. The most important driving factor of cross-country differences in wage cyclicality is union coverage, which presents a strong and statistically significant negative association with the response of wages to output movements. Thus, countries with a larger extent of the population covered by unionised contracts present less pro-cyclical movements of real wages. This result holds regardless of the forecast horizon and modelling choice. The second aspect worth noting is the negative association between all institutional variables and the cyclicality of industrial wages. However, this association is not significant at the 5 per cent level in most cases, with the exception of the Bargaining level (centralization in the tables) and the Tax wedge for the short run when the model is run in first differences. Some of the interaction terms are statistically significant, but their significance is probably driven by the role of union coverage in the interaction. Figure 14 illustrates some of these correlations. It is clear from the picture that the reported correlations are not due to the presence of outliers in the sample. However, one should bear in mind that the data was available for different sample periods in each country. Most importantly, data for the 1970s was missing for some of the countries that present the strongest counter-cyclical real wages.

Table 15 replicates the same exercise for the whole economy when wages are deflated by the GDP deflator and Table 16 presents the correlations for CPI deflated wages. In accordance with our previous results, all correlations with institutional variables present a negative sign. However, union coverage becomes non-significant in most of the specifications. The variable that presents stronger negative associations is unemployment benefits, which is statistically significant in 10 out of 12 of the presented specifications. This is consistent with the view that more generous unemployment benefits reduce the sensitivity to fundamentals in the economy by insulating a portion of the labour force from business cycle conditions. Figures 15 and 16 illustrate some of these correlations for the short run and the model in first differences. As in the previous case, no specific outliers seem to be driving the reported associations in the case of GDP deflated wages. For CPI deflated wages the correlations are somewhat weaker and to some extent more driven by the presence of Spain and The Netherlands, the only two countries with clear counter-cyclical wages in the this sample.

Factor analysis has proved to be quite useful in disentangling common patterns within our complex set of measures. The exercise presented in the previous section can be extended to include the set of labour market institutions in the database. In line with our previous results, we divide the sample between measures for the whole economy and measures for industry. In order to avoid excessive multicollinearity we exclude from the analysis the interaction terms between institutions. Thus, we include into each factorization the following labour market indicators: union coverage, union density, EPL, unemployment benefits, tax wedge, wage bargaining level and wage setting co-ordination. On top of those variables, we include two dummy variables: one for continental European countries and another for Anglo-Saxon economies.

The results of the factor analysis are presented in Table 16. The results for both sub-samples suggest a single important dimension of common variance. In the whole economy data, that factor explains 57 per cent of the total standardised variation in the measures. The next most important factor explains only 14 per cent of the variance and a plot of the eigenvalues clearly shows that there is only one meaningful common factor. All cyclicality measures load positively on that factor while all institutional measures have negative loadings. This is clearly consistent with the bivariate correlations presented above. Benefits replacement rate, wage setting co-ordination, the bargaining level and union coverage are the institutional measures more strongly related with the factor. Interestingly, the Anglo-Saxon dummy presents a positive loading while the dummy for Continental Europe is negatively related to the factor, corroborating the observation that wages are more pro-cyclical in Anglo-Saxon countries.

The results in the industrial sector are very similar. There is clearly a single factor that explains 58 per cent of the variance. All institutional variables have strong negative loadings with this factor (the weaker case is wage-setting co-ordination) while measures of cyclicality in the industrial sector present a strong positive loading. As suggested by the bivariate analysis, the strongest negative association with underlying cyclicality in this case comes from union coverage.

6. Conclusions

The literature on business cycle characteristics in the euro area and OECD countries remains somewhat inconclusive about the cyclical adjustment of real wages over the business cycle. This is partly due to the heterogeneity in data characteristics (such as deflators, sectoral coverage etc.), time periods and methods used in the various investigations of wage cyclicality. Furthermore, very little is known about the role of institutions in shaping cyclical adjustment in real wages.

We contribute to this literature by presenting consistent cross-country evidence of real wage cyclicality for the euro area and a number of OECD countries since the 1970s. We present evidence using a number of methods and measures attempting to draw robust conclusions from a large set of results. In addition to a comprehensive description of real wage cyclicality in these countries we have also investigated the role of labour market institutions in shaping real wage cyclicality.

We have used two main methods to investigate the cyclical response of real wages. First, we have calculated unconditional correlations of band-pass filtered real wage and output series. Second, following the method proposed in Den Haan (2000) we have estimated correlations between forecast error series from a VAR model at different forecast horizons. The latter method is likely to better capture dynamic adjustment in real wages over the business cycle. The correlations have been calculated using aggregate data for the euro area for the whole economy and for both whole economy and manufacturing for a number of OECD countries. Finally, various robustness checks were performed, including analysis using different deflators and filters.

Our findings indicate that aggregate real wages in the euro area have been on the whole largely a-cyclical since the 1970s. At the same time, it appears that the largest euro area countries, and most OECD countries, have experienced a moderate pro-cyclical real wage behaviour over this time period. Spain appears to be one of the notable exceptions to this result with counter-cyclical wage responses dominating. In general pro-cyclical wage behaviour appears to be somewhat stronger in the Anglo-Saxon countries versus the continental European countries. Results for most countries that have a systematic pattern in the direction of change between the short and long run adjustment suggest that real wages become more pro-cyclical as the forecast horizon is extended. For the manufacturing sector the evidence points to significantly different wage adjustment compared to the whole economy as PPI deflated hourly wages in manufacturing point to predominantly counter-cyclical wage adjustment (with few exceptions). Results using factor analysis across a wide set of measures confirm that there are important country effects in the data. These results also point out the important difference in patterns for the whole economy and the manufacturing sector.

Concerning the analysis of the relationship between labour market institutions and the behaviour of real wages over the business cycle, our preliminary evidence suggests that wage cyclicality is closely linked with labour market institutions. The most relevant institutional dimension appears to be the union presence in wage setting as measured by union coverage. Countries with a larger extent of the population covered by union contracts have less pro-cyclical movements in real wages. There is some evidence that a number of other institutional variables, such as the bargaining level, the tax wedge and unemployment benefits, also have a negative association with wage cyclicality. Factor analysis of the role of institutions suggests that the institutional impact is robust to differences in measurement and sectoral coverage of the data.

The current set of results could be extended in various dimensions. First, band-pass results could be calculated for different periodicity bands to obtain short run and long run correlations, an approach that is closely linked to the VAR based methodology already applied here. Second, even if significant amount of effort has been put already at evaluating robustness of the results, some additional robustness analysis could be envisaged, using alternative measures of the cycle and presenting results using other deflators for the manufacturing sector. Third, the investigation of the behaviour of real wages in expansions and recessions requires further study, by also allowing for asymmetric effects of institutions in the different phases of the business cycle. Finally, the theoretical motivation of the relationship between real wage cyclicality and labour market institutions would benefit from a more structured conceptual background, perhaps in the form of a theoretical model that could capture some of the empirical results.

7. References

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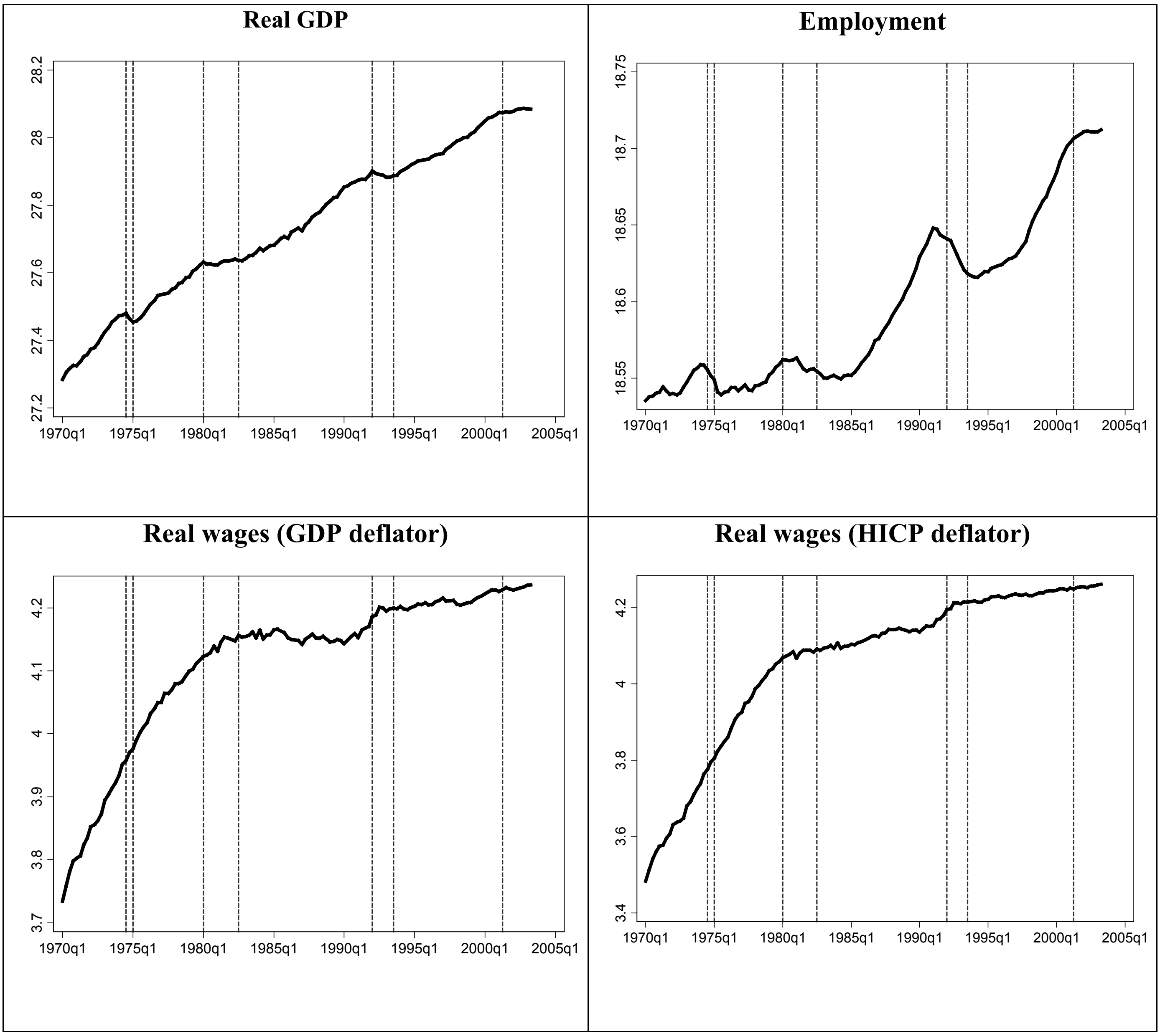
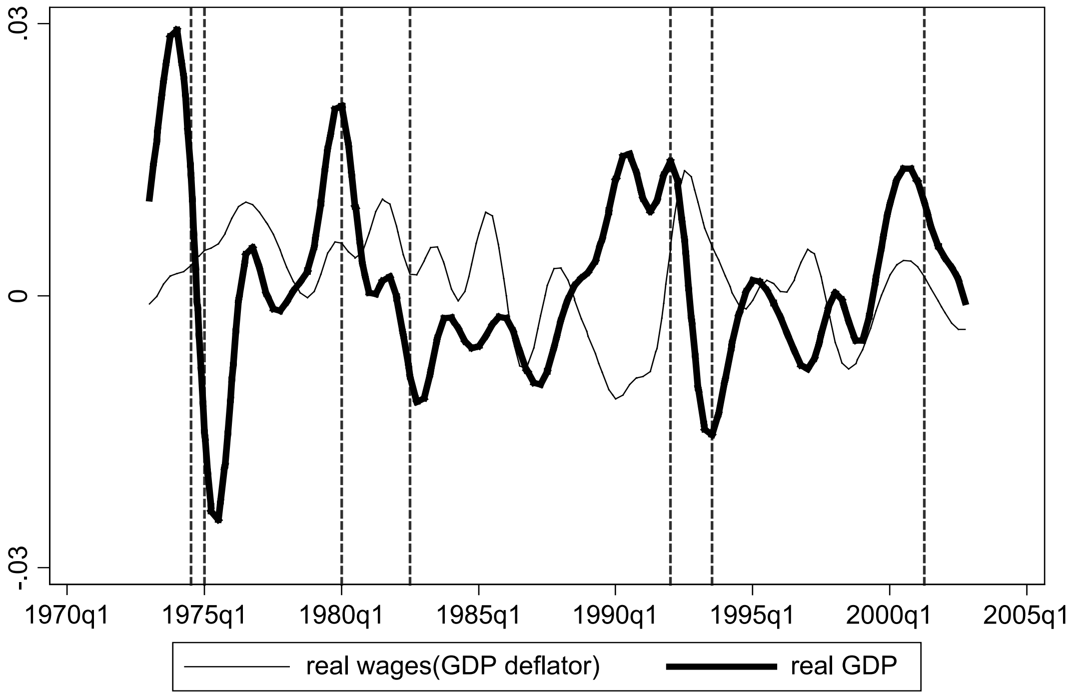
Appendix: Figures and tables

Figure 1. Euro area variables



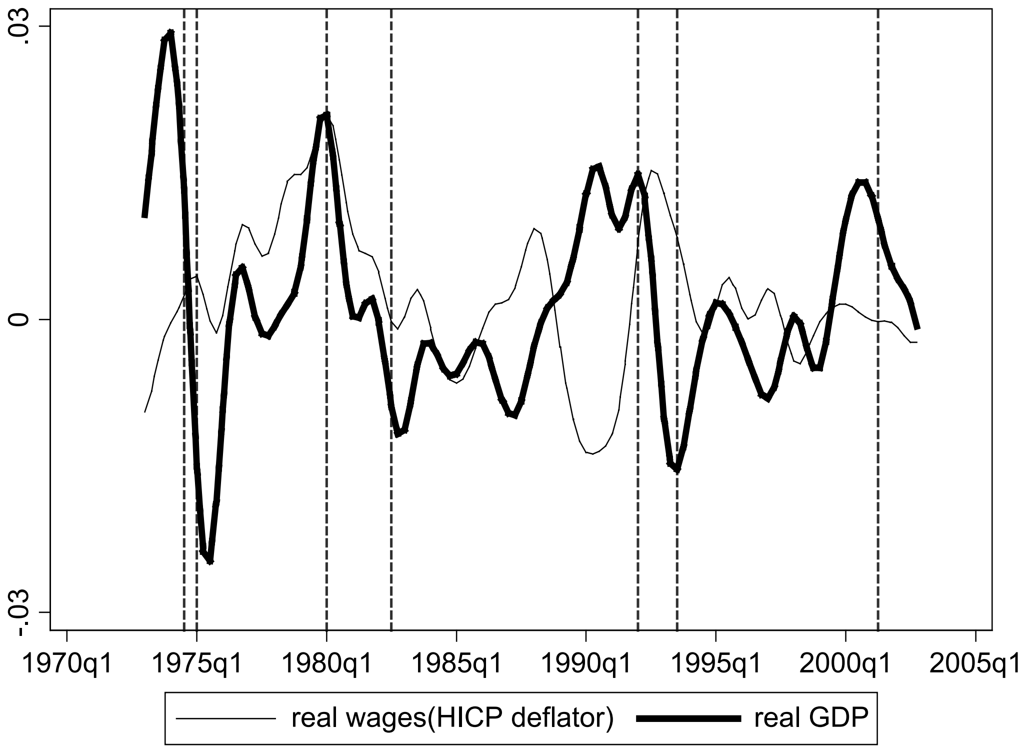
Note: Dashed lines are business cycle peaks and troughs identified by the CEPR.

Figure 2. Band-Pass filtered real wages (GDP deflated) and GDP in the euro area



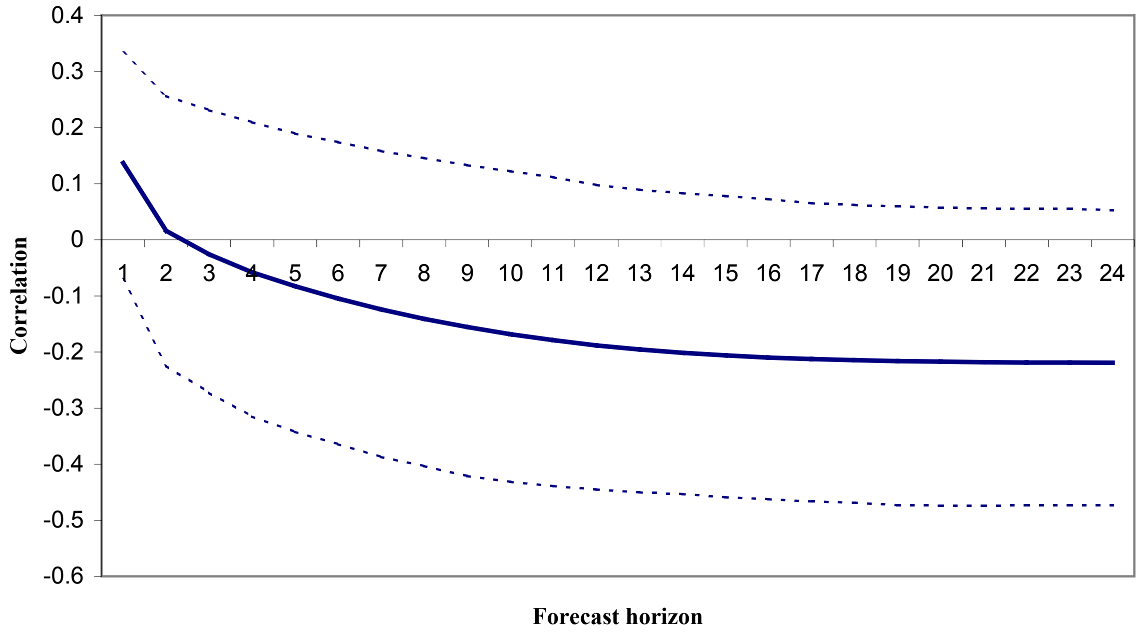
Note: Dashed lines are business cycle peaks and troughts identified by the CEPR.

Figure 3. Band-Pass filtered real wages (HICP deflated) and GDP in the euro area



Note: Dashed lines are business cycle peaks and troughts identified by the CEPR.

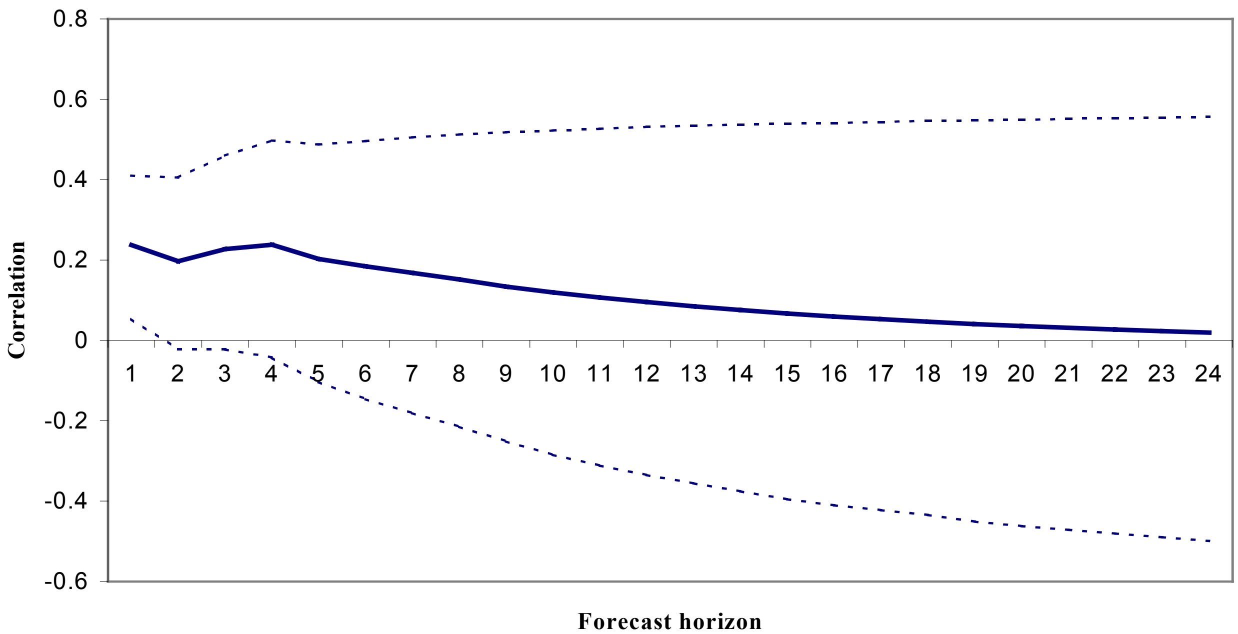
Figure 4. Euro area: mean correlation between forecast errors of GDP and real wages deflated by the GDP deflator (VAR model in levels)



Notes:

1. The correlation at 16 steps ahead is –0.22
2. The model has two lags and includes a linear and a quadratic trend.

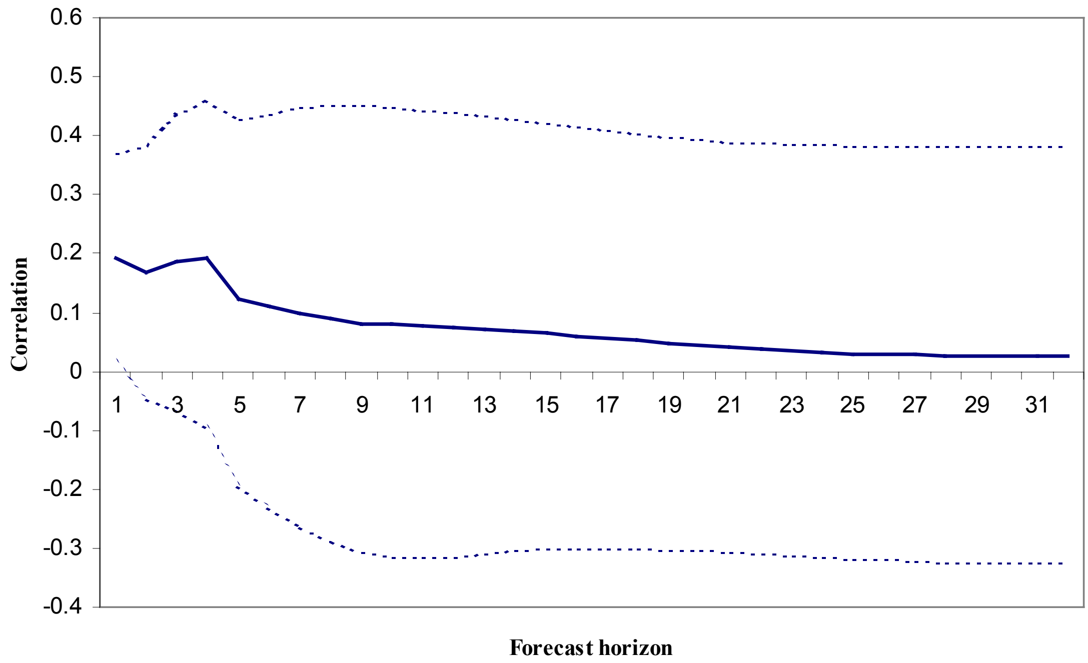
Figure 5. Euro area: mean correlation between forecast errors of GDP and real wages deflated by the GDP deflator (VAR model in first differences)



Notes:

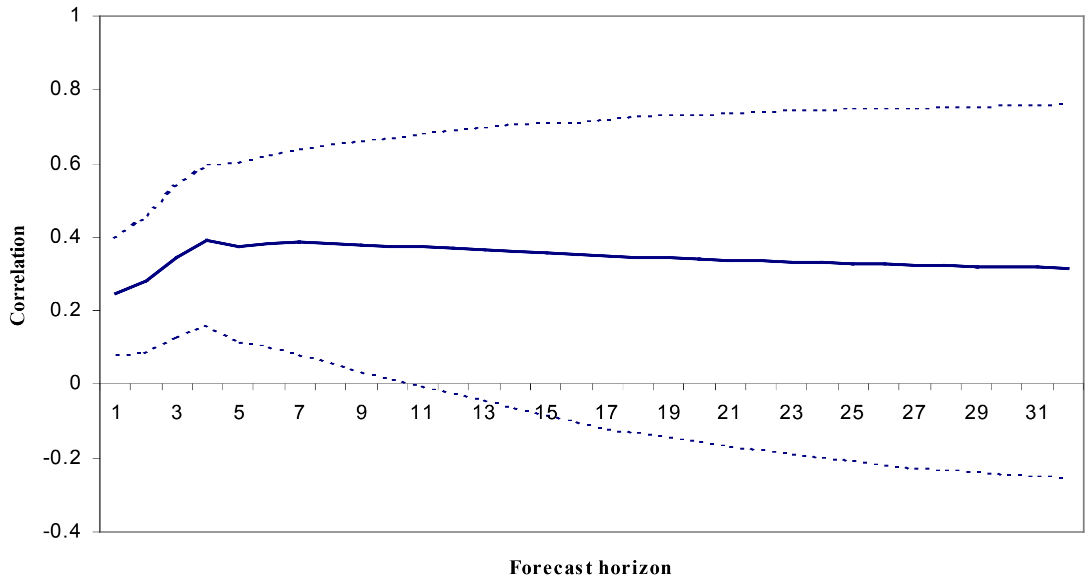
1. The correlation at 16 steps ahead is 0.03
2. The model has 4 lags and includes a constant.

Figure 6. Euro area: mean correlation between forecast errors of GDP and real wages deflated by the HICP (VAR model in levels)



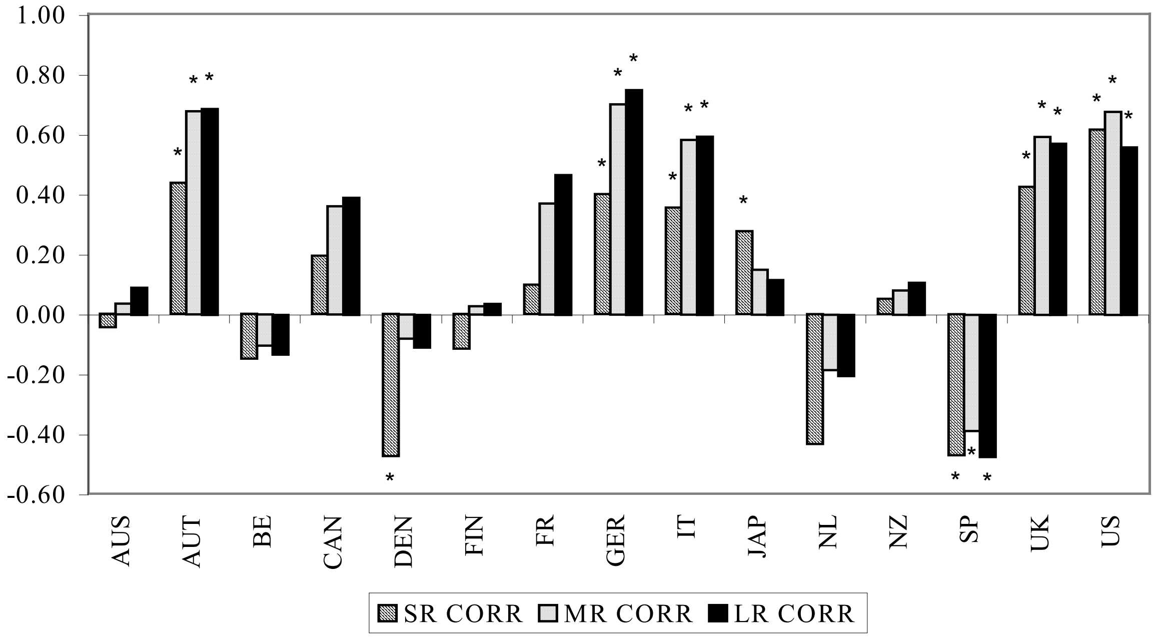
Notes:
1. The correlation at 16 steps ahead is 0.07
2. The model has 5 lags and includes a constant and linear and quadratic trend.

Figure 7. Euro area: mean correlation between forecast errors of GDP and real wages deflated by the HICP (VAR model in differences)



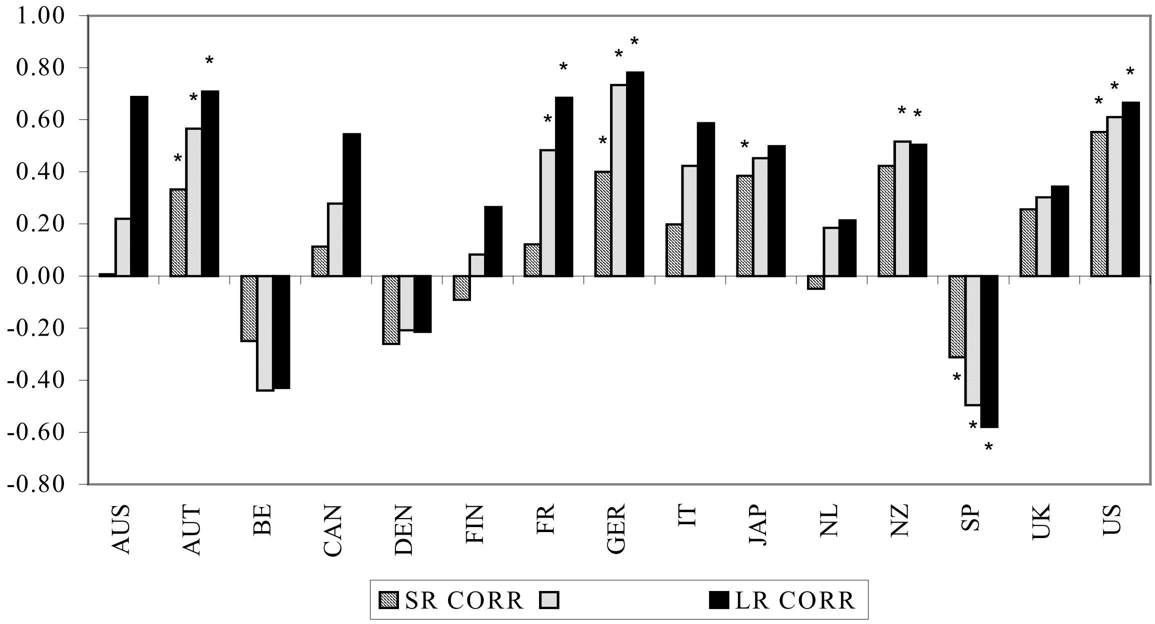
Notes:
1. The correlation at 16 steps ahead is 0.37
2. The model has 4 lags and includes a constant.

Figure 8. Correlation between forecast errors of GDP and real wages deflated by the GDP deflator in a sample of OECD countries (VAR model in levels)



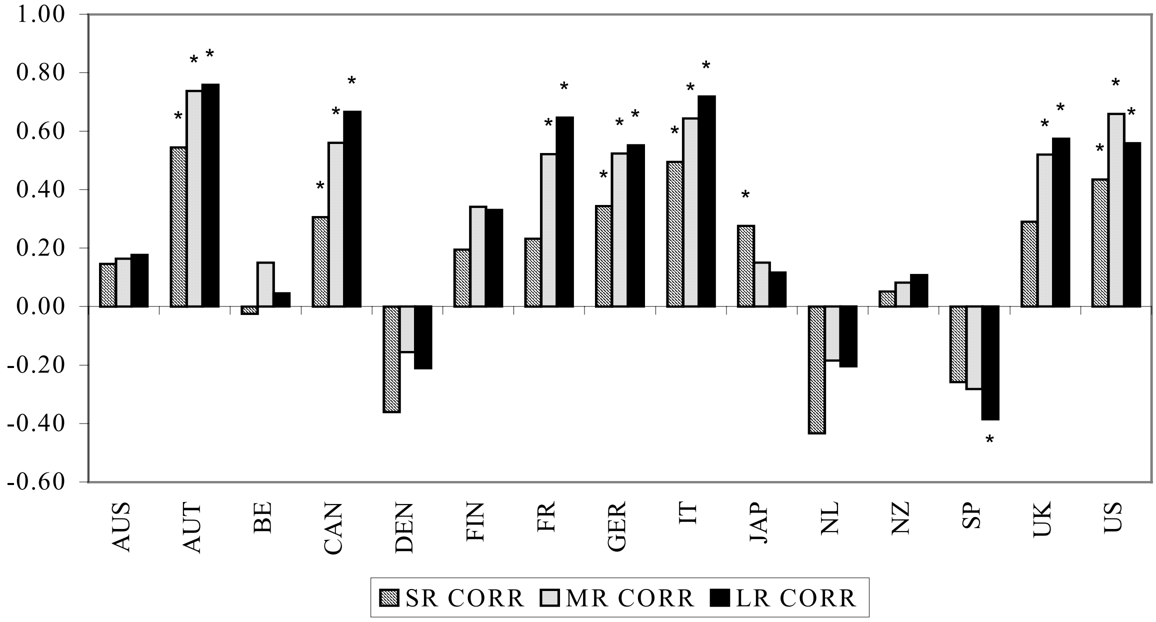
Note:
1. Stars indicate significance at the 10% level.
2. SR CORR (short-run correlation) = correlation at 1.5 years; MR CORR (medium run correlation) = correlation at 4 years; LR CORR (long-run correlation) = correlation at 8 years.

Figure 9. Correlation between forecast errors of GDP and real wages deflated by the GDP deflator in a sample of OECD countries (VAR model in first differences)



Note:
1. Stars indicate significance at the 10% level.
2. SR CORR (short-run correlation) = correlation at 1.5 years; MR CORR (medium run correlation) = correlation at 4 years; LR CORR (long-run correlation) = correlation at 8 years.

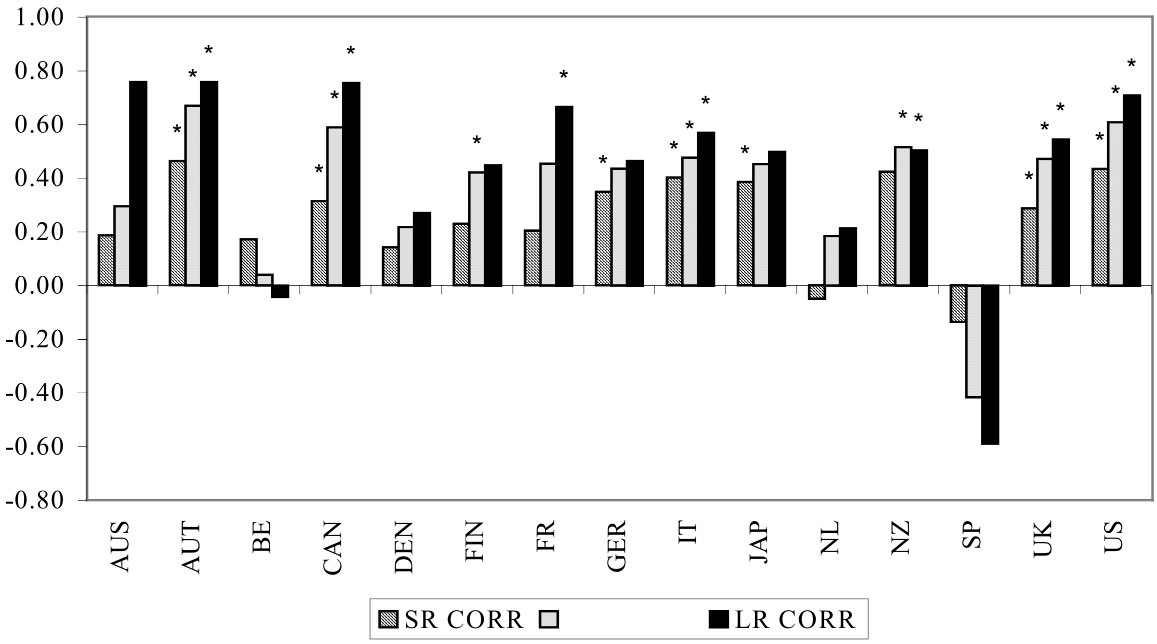
Figure 10. Correlation between forecast errors of GDP and real wages deflated by the CPI deflator in a sample of OECD countries (VAR model in levels)



Note:

1. Stars indicate significance at the 10% level.
2. SR CORR (short-run correlation) = correlation at 1.5 years; MR CORR (medium run correlation) = correlation at 4 years; LR CORR (long-run correlation) = correlation at 8 years.

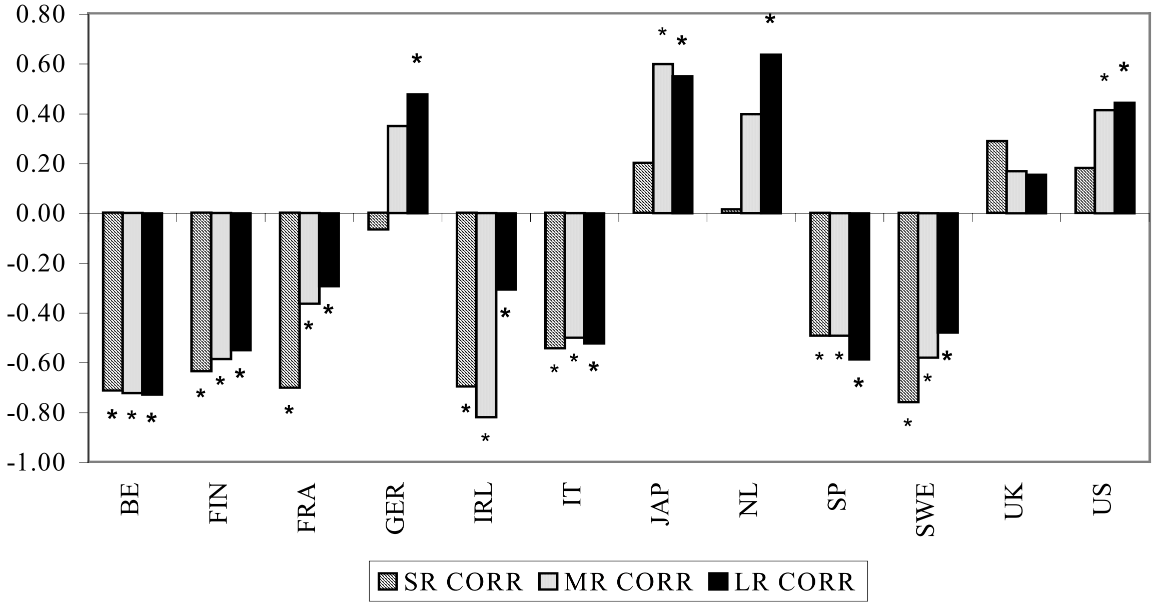
Figure 11. Correlation between forecast errors of GDP and real wages deflated by the CPI deflator in a sample of OECD countries (VAR model in differences)



Note:

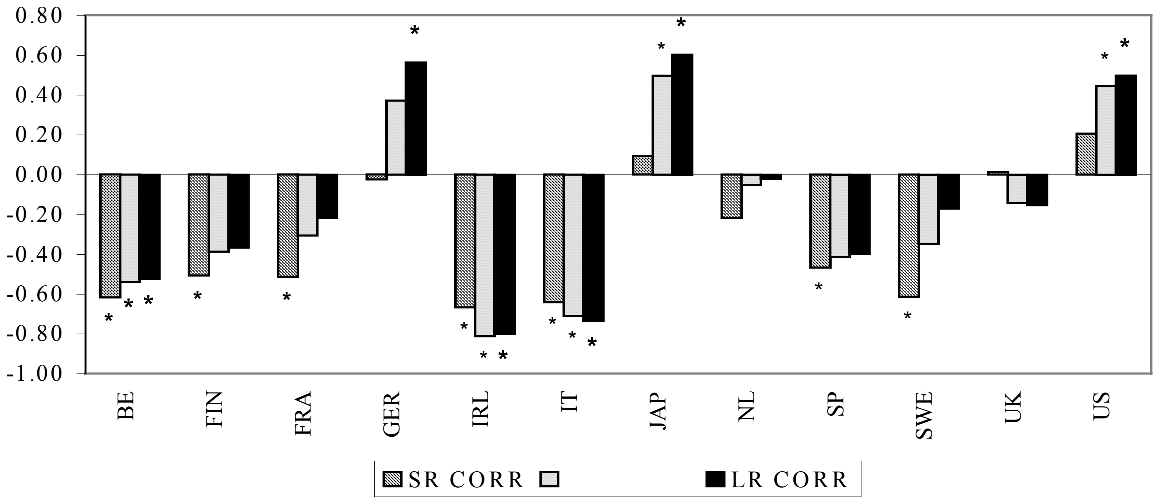
1. Stars indicate significance at the 10% level.
2. SR CORR (short-run correlation) = correlation at 1.5 years; MR CORR (medium run correlation) = correlation at 4 years; LR CORR (long-run correlation) = correlation at 8 years.

Figure 12. Correlation between forecast errors of industrial production and manufacturing hourly real wages deflated by the PPI deflator in a sample of OECD countries (VAR model in levels)



Note:
1. Stars indicate significance at the 10% level.
2. SR CORR (short-run correlation) = correlation at 1.5 years; MR CORR (medium run correlation) = correlation at 4 years; LR CORR (long-run correlation) = correlation at 8 years.

Figure 13. Correlation between forecast errors of industrial production and manufacturing hourly real wages deflated by the PPI deflator in a sample of OECD countries (VAR model in differences)



Note:
1. Stars indicate significance at the 10% level.
2. SR CORR (short-run correlation) = correlation at 1.5 years; MR CORR (medium run correlation) = correlation at 4 years; LR CORR (long-run correlation) = correlation at 8 years.

Figure 14. Institutions and Wage Cyclically in Industry.

Model in First Differences. Short Run

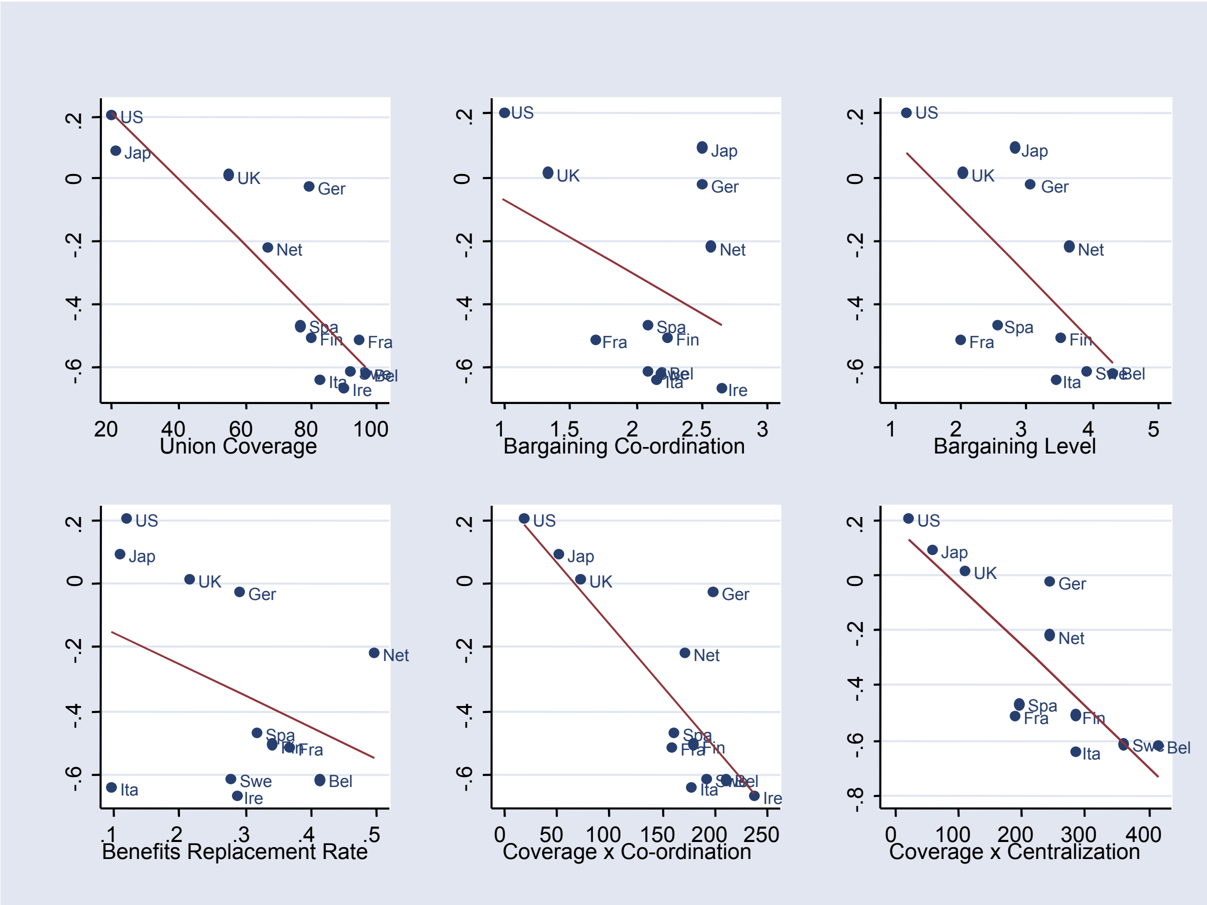


Figure 15. Institutions and Wage Cyclically. Whole Economy. GDP Deflated Wages

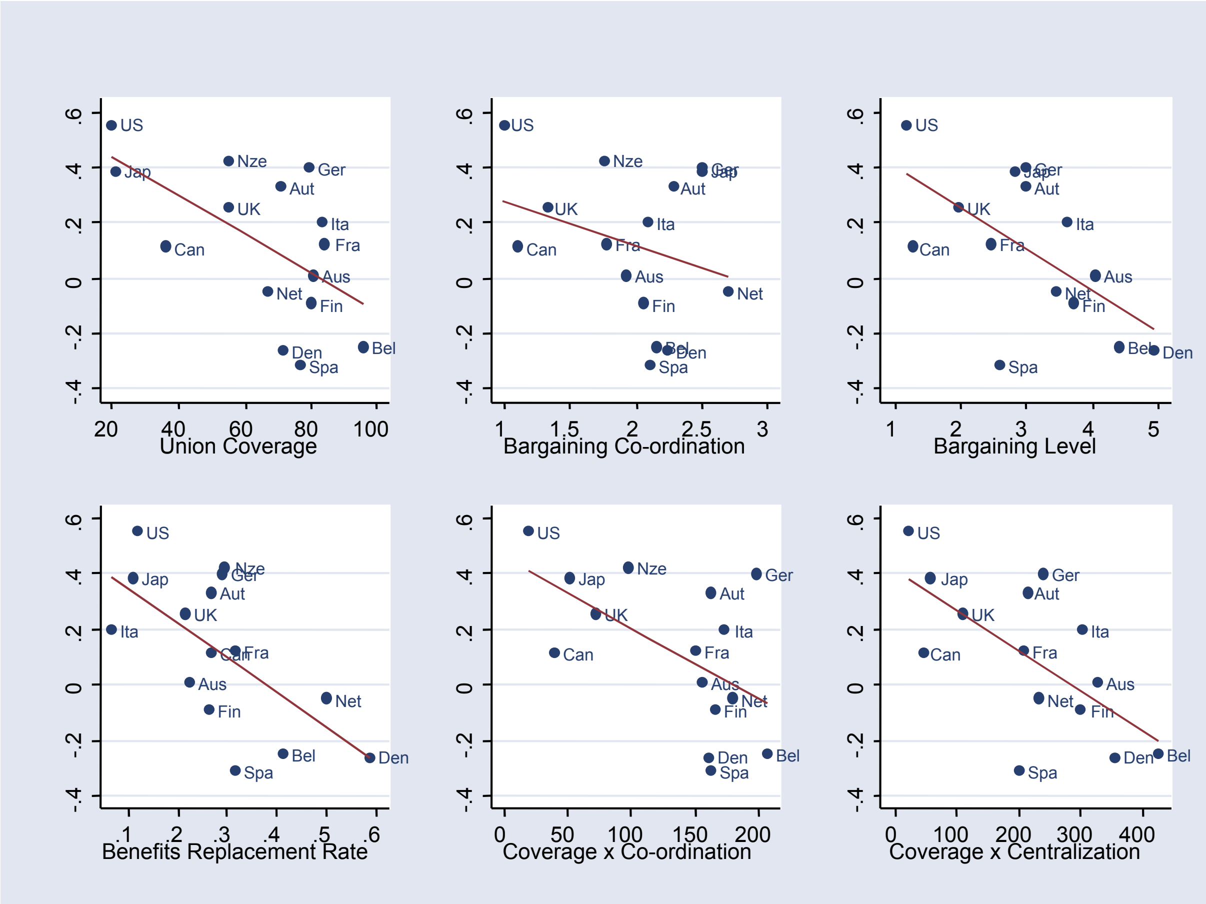


Figure 16. Institutions and Wage Cyclically. Whole Economy. CPI Deflated Wages

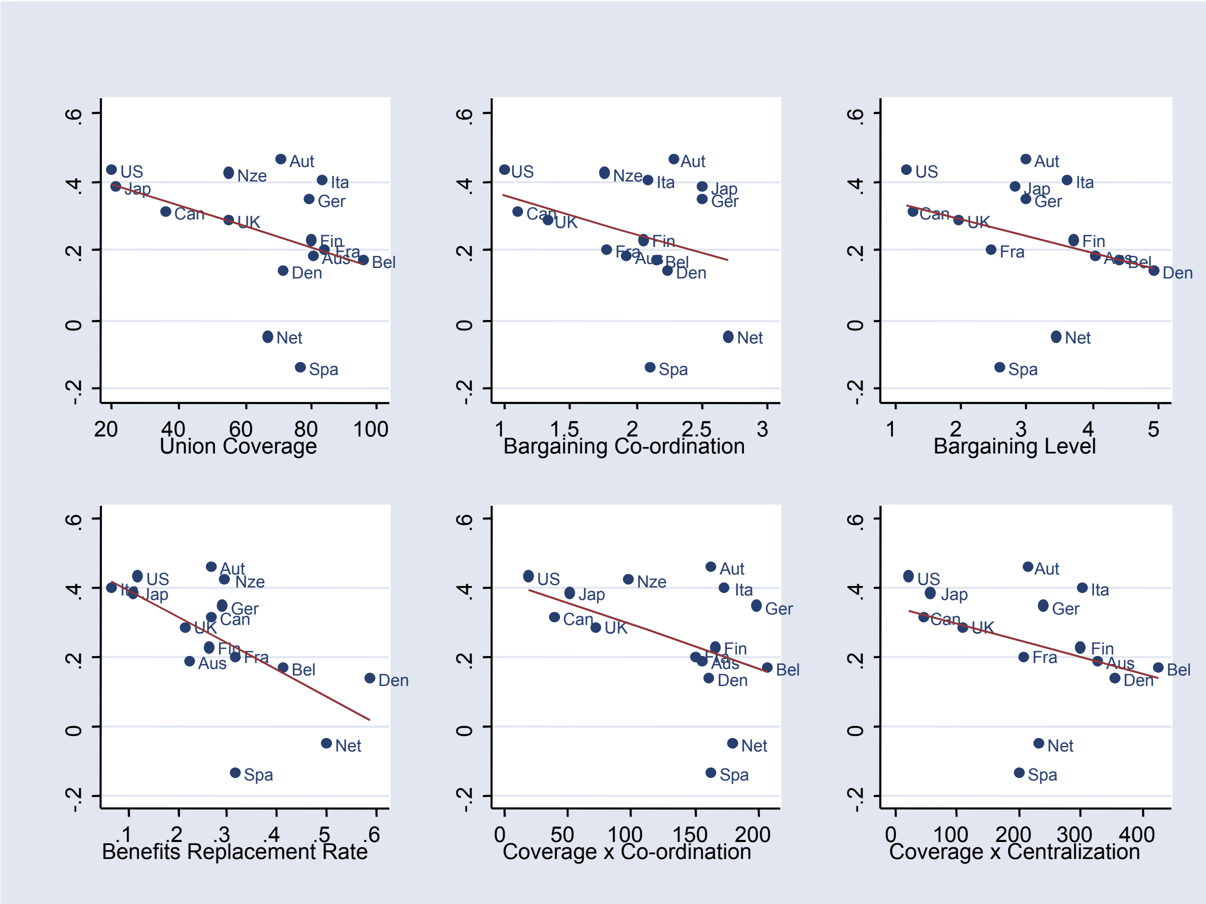


Table 1. Macro studies (*static* approach): some examples of the differences between the approaches adopted and the conclusions reached

Authors	Detrending technique	Real wage variable	Cyclical variable	Frequency of the data	Sample period	Coverage of the wage series	Countries studied	Conclusions on the cyclicality of real wages
Bodkin (1969)	Linear trend	Average hourly earnings index CPI deflator	Unemployment rate	Annual (pre-war) Quarterly (post-war)	1900-65 (USA) 1921-65 (Canada)	Manufacturing Whole economy	USA Canada	Real wages do not exhibit a consistent pattern over the business cycle.
Otani (1980)	Growth rates	Average hourly earnings PPI deflator	Index of industrial production	Annual	1952-1975	Manufacturing	14 OECD countries	Counter-cyclical.
Sumner and Silver (1989)	Growth rates	Average hourly earnings PPI deflator	Employment	Annual	Various sample periods.	Manufacturing	USA	Either pro-cyclical or counter-cyclical depending on the period chosen.
Abraham and Haltiwanger (1995)	Linear trend Growth rates HP filter	Average hourly earnings PPI deflator CPI deflator	Index of industrial production Employment	Quarterly	1949:1-1993:1	Manufacturing Private (non-agricultural) sector	USA	Either pro-cyclical or counter-cyclical depending on the detrending technique, deflator used, business cycle indicator.
Basu and Taylor (1999)	BP filter	Real wages (historical) real wage database)	Output	Annual	1870-late 90s	Total economy	13 OECD countries	Pro-cyclical or counter-cyclical depending on the sample period chosen (exchange rate regimes).

Table 2. Macro studies (*dynamic* approach): some examples of the differences between the approaches adopted and the conclusions reached

Authors	Detrending technique	VAR	Real wage variable	Cyclical variable	Frequency of the data	Sample period	Coverage of the wage series	Countries studied	Conclusions on the cyclicality of real wages
Nefcti (1978)	Linear detrending	Distrib. lags	Straight-time wage index CPI deflated	Straight-time hours	Quarterly	1948:1-1972:4	Manufacturing	USA	Counter-cyclical.
Geary and Kennan (1982)		VAR	Average hourly earnings WPI deflated	Employment	Annual	1955-1978	Manufacturing	12 OECD countr.	Real wages and employment are independent.
Abraham and Haltiwanger (1995)	HP filter	Struct. VAR	Average hourly earnings PPI deflated	Employment in manufact	Quarterly	1949:1-1993:1	Manufacturing	USA	Pro-cyclical or counter-cyclical according to the different combination of demand and supply shocks and labour demand and labour supply elasticities
Fleischman (1999)	Linear trend	Struct. VAR	Nominal hourly compensation Implicit price deflator	Real gross domestic product (GDP)	Quarterly	1955:4-1998:4	Business sector (nonfarm)	USA	Real wages are pro-cyclical in response to supply shocks but are counter-cyclical in response to aggregate demand shocks.
Balmaseda et al. (2000)		Struct. VAR	Real labour cost GDP deflator	Output GDP deflator	Annual	1950-1996	Total economy	16 OECD countr.	In all countries except the US real wages respond counter-cyclically (in the short run) to aggregate demand shocks.

Table 3. OECD countries data. Sample Coverages.

	Whole Economy		Industry/Manufacturing	
	First observation	Last observation	First observation	Last observation
Australia	1964Q1	2003Q2		
Austria	1965Q3	2003Q2		
Belgium	1980Q1	2003Q2	1980Q1	2003Q1
Canada	1961Q1	2003Q2		
Denmark	1977Q1	2003Q2		
Finland	1960Q1	2003Q2	1975Q1	2003Q2
France	1964Q1	2003Q2	1984Q3	2003Q2
Germany	1970Q1	2003Q2	1960Q2	2003Q2
Ireland			1975Q3	2003Q2
Italy	1960Q1	2003Q2	1981Q1	2003Q2
Japan	1965Q1	2003Q2	1960Q1	2003Q2
Netherlands	1977Q1	2003Q2	1971Q1	2003Q2
New Zealand	1970Q1	2003Q2		
Spain	1980Q1	2003Q2	1981Q1	2003Q2
Sweden			1982Q1	2003Q2
United Kingdom	1960Q1	2003Q2	1963Q1	2003Q2
United States	1960Q1	2003Q2	1960Q1	2003Q2

Note: Total compensation has been backcasted in the cases of France, Germany and Japan using the previous National Account system in order to extend the series. Sources: Quarterly National Accounts and OECD Main Economic Indicators.

Table 4. Cross-correlation of GDP and real wages in the euro area

	Correlation of GDP_t with																
	W_{t-8}	W_{t-7}	W_{t-6}	W_{t-5}	W_{t-4}	W_{t-3}	W_{t-2}	W_{t-1}	W_t	W_{t+1}	W_{t+2}	W_{t+3}	W_{t+4}	W_{t+5}	W_{t+6}	W_{t+7}	W_{t+8}
GDP defl.	**-0.241**	**-0.349**	**-0.432**	**-0.461**	**-0.372**	**-0.372**	**-0.293**	**-0.216**	-0.154	-0.109	-0.069	-0.022	0.042	0.121	**0.200**	**0.266**	**0.312**
HICP defl.	0.112	0.043	-0.051	-0.142	**-0.200**	**-0.210**	-0.171	-0.100	-0.021	0.048	0.085	0.093	0.086	0.082	0.091	0.112	0.136

Notes:

1. All data are band-pass filtered. Wages are compensation per employee. The first row shows the correlation between GDP and wages deflated by the GDP deflator while the second rows shows the correlation between GDP and wages deflated by the HICP deflator. In bold are the coefficients which are significant at the 5% confidence level.
2. "GDP defl." indicates the series of real wages deflated by the GDP deflator and "HICP defl." indicates the series of real wages deflated by the HICP deflator.

Table 5. Cross-correlation of GDP and real wages (GDP deflator) in a sample of OECD countries

Whole economy

	Correlation of GDP_t with																
	W_{t-8}	W_{t-7}	W_{t-6}	W_{t-5}	W_{t-4}	W_{t-3}	W_{t-2}	W_{t-1}	W_t	W_{t+1}	W_{t+2}	W_{t+3}	W_{t+4}	W_{t+5}	W_{t+6}	W_{t+7}	W_{t+8}
Australia	**-0.206**	**-0.295**	**-0.362**	**-0.405**	**-0.407**	**-0.356**	**-0.243**	-0.082	0.091	**0.232**	**0.305**	**0.304**	**0.249**	**0.174**	0.105	0.053	0.012
Austria	-0.078	-0.031	0.040	**0.131**	**0.233**	**0.325**	**0.387**	0.404	**0.372**	**0.275**	0.185	0.137	0.133	0.146	0.145	0.110	0.050
Belgium	**-0.773**	**-0.678**	**-0.512**	**-0.323**	-0.161	-0.053	0.001	0.021	0.032	0.058	0.113	0.193	**0.290**	**0.396**	**0.503**	**0.600**	0.674
Canada	**0.189**	0.140	0.094	0.055	0.023	0.006	0.007	0.030	0.064	0.084	0.085	0.055	-0.001	-0.065	-0.114	-0.128	-0.093
Finland	**-0.408**	**-0.473**	**-0.494**	**-0.458**	**-0.366**	**-0.232**	-0.079	0.074	**0.215**	**0.318**	**0.413**	**0.502**	**0.574**	**0.615**	**0.613**	**0.562**	**0.464**
France	-0.107	-0.160	**-0.217**	**-0.241**	**-0.199**	-0.093	0.048	0.187	**0.291**	**0.366**	**0.387**	**0.385**	**0.392**	**0.427**	**0.480**	**0.525**	**0.539**
Germany	-0.119	**-0.268**	**-0.393**	**-0.458**	**-0.435**	**-0.326**	-0.162	0.019	0.181	**0.295**	**0.363**	**0.395**	**0.400**	**0.383**	**0.339**	**0.273**	**0.202**
Italy	**-0.508**	**-0.459**	**-0.243**	0.070	**0.355**	**0.536**	**0.576**	**0.465**	**0.255**	0.060	-0.058	-0.072	-0.001	0.107	**0.210**	**0.282**	**0.317**
Japan	0.026	0.139	**0.256**	**0.372**	**0.491**	**0.623**	**0.742**	**0.786**	**0.742**	**0.636**	**0.491**	**0.331**	0.174	0.027	-0.105	-0.212	**-0.277**
Netherlands	**-0.605**	**-0.682**	**-0.726**	**-0.724**	**-0.659**	**-0.518**	**-0.324**	-0.129	0.032	0.121	0.238	**0.384**	**0.541**	**0.665**	**0.715**	**0.686**	**0.605**
Spain	**-0.415**	**-0.444**	**-0.456**	**-0.435**	**-0.384**	**-0.316**	**-0.248**	-0.184	-0.120	-0.049	0.046	0.161	**0.285**	**0.413**	**0.542**	**0.656**	**0.739**
UK	**-0.315**	**-0.400**	**-0.450**	**-0.455**	**-0.405**	**-0.303**	**-0.169**	-0.033	0.081	**0.168**	**0.245**	**0.330**	**0.418**	**0 .488**	**0.505**	**0.451**	**0.337**
US	-0.165	-0.077	0.029	0.149	**0.277**	**0.403**	**0.502**	**0.548**	**0.519**	**0.409**	**0.249**	0.075	-0.080	**-0.194**	**-0.258**	**-0.275**	**-0.256**

Note: All data are band-pass filtered. Wages are compensation per employee. In bold are the coefficients, which are significant at the 5% confidence level. Due to time constraints this table is based on a previous version of the database.

Table 6. Cross-correlation of GDP and real wages (CPI deflator) in a sample of OECD countries

- Whole economy -

	Correlation of GDP_t with																
	W_{t-8}	W_{t-7}	W_{t-6}	W_{t-5}	W_{t-4}	W_{t-3}	W_{t-2}	W_{t-1}	W_t	W_{t+1}	W_{t+2}	W_{t+3}	W_{t+4}	W_{t+5}	W_{t+6}	W_{t+7}	W_{t+8}
Australia	**-0.309**	**-0.330**	**-0.319**	**-0.284**	**-0.228**	-0.146	-0.033	0.104	**0.236**	**0.325**	**0.334**	**0.254**	0.110	-0.045	-0.160	**-0.204**	**-0.179**
Austria	-0.029	0.043	0.134	**0.233**	**0.324**	**0.388**	**0.412**	**0.391**	**0.332**	**0.231**	0.134	0.060	0.010	-0.029	-0.072	-0.121	-0.163
Belgium	**-0.495**	**-0.402**	-0.259	-0.109	0.006	0.063	0.066	0.039	0.012	0.028	0.081	0.159	0.245	**0.334**	**0.422**	**0.508**	**0.581**
Canada	-0.067	-0.069	-0.058	-0.029	0.022	0.096	**0.186**	**0.283**	**0.365**	**0.400**	**0.384**	**0.312**	**0.197**	0.072	-0.028	-0.074	-0.057
Finland	**-0.227**	-0.188	-0.115	-0.007	0.129	**0.275**	**0.415**	**0.535**	**0.629**	**0.692**	**0.733**	**0.735**	**0.686**	**0.584**	**0.433**	**0.247**	0.050
France	0.123	0.100	0.086	0.102	0.156	**0.232**	**0.305**	**0.350**	**0.349**	**0.316**	**0.248**	0.183	0.152	0.169	**0.225**	**0.294**	**0.346**
Germany	-0.184	**-0.242**	**-0.282**	**-0.297**	**-0.272**	**-0.194**	-0.064	0.102	**0.276**	**0.426**	**0.531**	**0.577**	**0.569**	**0.517**	**0.435**	**0.333**	**0.226**
Italy	**-0.436**	**-0.445**	**-0.306**	-0.041	**0.258**	**0.515**	**0.672**	**0.684**	**0.548**	**0.330**	0.127	-0.001	-0.032	0.025	0.132	**0.240**	**0.318**
Japan	0.117	**0.250**	**0.377**	**0.499**	**0.614**	**0.715**	**0.788**	**0.804**	**0.751**	**0.639**	**0.492**	**0.328**	0.164	0.014	-0.118	-0.225	**-0.296**
Netherlands	**-0.661**	**-0.657**	**-0.627**	**-0.584**	**-0.525**	**-0.439**	-0.312	-0.143	0.047	0.196	**0.345**	**0.491**	**0.625**	**0.733**	**0.797**	**0.812**	**0.786**
Spain	**-0.382**	**-0.424**	**-0.470**	**-0.489**	**-0.457**	**-0.371**	**-0.247**	-0.111	0.020	0.139	**0.256**	**0.366**	**0.462**	**0.536**	**0.586**	**0.614**	**0.620**
UK	**-0.294**	**-0.348**	**-0.372**	**-0.361**	**-0.312**	**-0.231**	-0.136	-0.048	0.020	0.071	0.135	**0.233**	**0.360**	**0.478**	**0.540**	**0.514**	**0.406**
US	0.083	**0.207**	**0.337**	**0.463**	**0.575**	**0.653**	**0.678**	**0.633**	**0.515**	**0.331**	0.116	-0.092	**-0.265**	**-0.385**	**-0.449**	**-0.466**	**-0.446**

Note: All data are band-pass filtered. Wages are compensation per employee. In bold are the coefficients which are significant at the 5% confidence level. Due to time constraints this table is based on a previous version of the database.

Table 7. Manufacturing: Cross-correlation of industrial production and hourly wages (PPI deflator) in selected OECD countries

	Correlation of industrial production$_t$ with																
	W_{t-8}	W_{t-7}	W_{t-6}	W_{t-5}	W_{t-4}	W_{t-3}	W_{t-2}	W_{t-1}	W_t	W_{t+1}	W_{t+2}	W_{t+3}	W_{t+4}	W_{t+5}	W_{t+6}	W_{t+7}	W_{t+8}
Belgium	**0.379**	**0.312**	0.194	0.038	-0.140	**-0.321**	**-0.480**	**-0.586**	**-0.614**	**-0.568**	**-0.475**	**-0.363**	-0.249	-0.135	-0.018	0.102	0.214
France	-0.134	-0.110	-0.113	-0.153	-0.228	**-0.331**	**-0.442**	**-0.541**	**-0.602**	**-0.608**	**-0.527**	**-0.357**	-0.115	0.160	**0.414**	**0.602**	**0.700**
Germany	0.048	0.037	0.059	0.093	0.107	0.077	0.008	-0.075	-0.134	-0.169	-0.125	-0.017	0.117	**0.233**	**0.293**	**0.277**	0.193
Italy	0.038	-0.015	-0.059	-0.109	-0.171	**-0.244**	**-0.322**	**-0.399**	**-0.461**	**-0.488**	**-0.458**	**-0.370**	**-0.240**	-0.088	0.064	0.195	**0.290**
Japan	**0.220**	**0.338**	**0.435**	**0.492**	**0.494**	**0.434**	**0.320**	**0.174**	0.025	-0.100	**-0.181**	**-0.206**	**-0.180**	-0.117	-0.035	0.045	0.103
Netherlands	**0.716**	**0.547**	0.322	0.074	-0.146	-0.317	**-0.454**	**-0.566**	**-0.642**	**-0.660**	**-0.630**	**-0.565**	**-0.480**	**-0.384**	-0.271	-0.130	0.046
Spain	0.111	0.101	0.086	0.058	0.005	-0.076	-0.179	**-0.282**	**-0.356**	**-0.369**	**-0.321**	-0.222	-0.094	0.034	0.154	**0.256**	**0.337**
US	**0.216**	**0.356**	**0.475**	**0.561**	**0.608**	**0.607**	**0.556**	**0.454**	**0.307**	0.137	-0.048	**-0.227**	**-0.382**	**-0.494**	**-0.554**	**-0.558**	**-0.513**

Notes: All data are band-pass filtered. In bold are the coefficients that are significant at the 5% confidence level. The sample for Belgium is 1984q1-1998q4, for France 1984q3-2000q1, for Germany 1973q1-2000q1, for Italy 1981q1-1999q4, for Japan 1963q3-1998q3, for Netherlands 1990q1-1999q4, for Spain 1983q1-2000q1 and for US 1963q2-2000q1. The sample for each country refers to the period for which data are available *after* the variables were filtered (i.e. after cutting the first three and the last three years of the dataset). Due to time constraints this table is based on a previous version of the database.

Table 8. The Cyclicality of Wages in Expansions and Recessions

	Whole Economy. GDP Defl Wages		Whole Economy. CPI Defl Wages	
Country	*Booms*	*Recessions*	*Booms*	*Recessions*
Australia	-0.0904	-0.2866	0.1077	-0.0873
Austria	0.1544	0.1966	0.4592*	0.1009
Belgium	-0.3876*	0.1030	-0.1138	-0.0545
Canada	0.0260	-0.3054*	0.2996*	-0.0036
Denmark	0.1286	-0.1197	0.4003*	-0.4737*
Finland	0.1932	-0.0992	0.5231*	0.2497
France	-0.2189	0.0962	-0.0092	0.1247
Germany	0.5247*	0.4888*	0.5136*	0.2751*
Italy	0.0237	-0.1593	0.3464*	0.0516
Japan	-0.0432	0.4110*	0.3512*	0.5037*
Netherlands	-0.2560	-0.0983	-0.3998*	-0.0474
New Zealand	-0.0130	0.4968*	-0.0470	0.3531*
Spain	-0.6559*	-0.0678	-0.6524*	0.1022
United Kingdom	-0.0431	-0.0746	0.1563	-0.0754
United States	0.4433*	0.5874*	0.5191*	0.5778*

Table 9. The Cyclicality of Wages in Expansions and Recessions. Industry

Country	*Booms*	*Recessions*
Belgium	-0.6294*	-0.7346*
Finland	-0.3448*	-0.6104*
France	-0.7830*	-0.4767*
Germany	-0.0332	-0.2277
Ireland	-0.5157*	-0.3702*
Italy	-0.6998*	-0.5152*
Japan	0.2379	-0.1774
Netherlands	-0.3642*	-0.3512*
Spain	-0.3350	-0.6841*
Sweden	-0.4807*	-0.6955*
United Kingdom	-0.1153	-0.1142
United States	0.4650*	0.1025

Table 10. Model specification: whole economy (GDP deflated wages)

	Levels				Differences			
	Lags	Constant	Linear trend	Quadratic trend	Lags	Constant	Linear trend	**N**
Australia	11	Yes	Yes	Yes	9	Yes	No	155
Austria	12	Yes	Yes	Yes	12	Yes	Yes	151
Belgium	8	Yes	Yes	Yes	8	Yes	No	81
Canada	9	Yes	Yes	No	12	Yes	No	167
Denmark	11	Yes	Yes	Yes	10	Yes	Yes	93
Finland	11	Yes	Yes	Yes	10	Yes	Yes	171
France	12	Yes	Yes	No	11	Yes	No	155
Germany	9	Yes	Yes	Yes	8	Yes	Yes	131
Italy	12	Yes	Yes	Yes	11	Yes	Yes	171
Japan	6	Yes	Yes	Yes	5	Yes	No	83
Netherlands	9	Yes	Yes	Yes	9	Yes	No	171
New Zealand	10	Yes	Yes	Yes	12	Yes	No	171
Spain	7	Yes	Yes	Yes	6	Yes	Yes	136
UK	12	Yes	Yes	Yes	11	Yes	Yes	95
US	11	Yes	Yes	Yes	12	Yes	No	131

Table 11. Model specification: whole economy (CPI deflated wages)

	Levels				Differences			
	Lags	Constant	Linear trend	Quadratic trend	Lags	Constant	Linear trend	**N**
Australia	11	Yes	Yes	No	12	Yes	No	155
Austria	12	Yes	Yes	Yes	8	Yes	Yes	151
Belgium	8	Yes	Yes	Yes	10	Yes	No	81
Canada	10	Yes	Yes	Yes	12	Yes	No	167
Denmark	12	Yes	Yes	Yes	10	Yes	No	93
Finland	10	Yes	Yes	Yes	9	Yes	Yes	171
France	9	Yes	Yes	Yes	4	Yes	No	155
Germany	4	Yes	Yes	Yes	12	Yes	Yes	131
Italy	12	Yes	Yes	No	8	Yes	Yes	171
Japan	8	Yes	Yes	Yes	8	Yes	No	83
Netherlands	9	Yes	Yes	Yes	8	Yes	No	171
New Zealand	10	Yes	Yes	Yes	7	Yes	No	171
Spain	7	Yes	Yes	Yes	6	Yes	Yes	136
UK	12	Yes	Yes	Yes	12	Yes	Yes	95
US	11	Yes	Yes	Yes	11	Yes	No	131

Table 12. Model specification: manufacturing (PPI deflated hourly wages)

	Levels				Differences			
	Lags	Constant	Linear trend	Quadratic trend	Lags	Constant	Linear trend	**N**
Belgium	10	Yes	Yes	Yes	6	Yes	No	94
Finland	6	Yes	Yes	Yes	6	Yes	No	114
France	10	Yes	Yes	Yes	6	Yes	No	76
Germany	9	Yes	Yes	Yes	8	Yes	No	174
Ireland	9	Yes	Yes	No	10	Yes	No	112
Italy	10	Yes	Yes	Yes	7	Yes	Yes	90
Japan	11	Yes	Yes	Yes	10	Yes	Yes	174
Netherlands	7	Yes	No	No	6	Yes	No	130
Spain	12	Yes	Yes	Yes	6	Yes	Yes	90
SWE	12	Yes	Yes	Yes	12	Yes	No	86
UK	12	Yes	Yes	Yes	9	Yes	No	162
US	10	Yes	Yes	No	10	Yes	No	174

Table 13. Factor analysis

Variance Explained			**0.66**	**0.25**
Sector	*Forecast horizon*	*Specification*		
Whole Economy (GDP)	Short Run	Levels	0.93	-0.20
Whole Economy (GDP)	Medium Run	Levels	0.91	-0.30
Whole Economy (GDP)	Long Run	Levels	0.90	-0.35
Whole Economy (GDP)	Short Run	First Diff	0.98	0.14
Whole Economy (GDP)	Medium Run	First Diff	0.94	0.02
Whole Economy (GDP)	Long Run	First Diff	0.91	-0.11
Whole Economy (CPI)	Short Run	Levels	0.80	-0.49
Whole Economy (CPI)	Medium Run	Levels	0.80	-0.57
Whole Economy (CPI)	Long Run	Levels	0.79	-0.60
Whole Economy (CPI)	Short Run	First Diff	0.87	-0.30
Whole Economy (CPI)	Medium Run	First Diff	0.91	-0.22
Whole Economy (CPI)	Long Run	First Diff	0.89	-0.24
Industry	Short Run	Levels	0.59	0.70
Industry	Medium Run	Levels	0.64	0.76
Industry	Long Run	Levels	0.62	0.75
Industry	Short Run	First Diff	0.68	0.68
Industry	Medium Run	First Diff	0.64	0.71
Industry	Long Run	First Diff	0.64	0.69

Table 14. Institutions and Wage Cyclically. Hourly Wages PPI Deflated. Industry

	Model in Levels			Model in First Differences		
	Short	Medium	Long	Short	Medium	Long
Union Density	-0.40	-0.47	-0.42	-0.42	-0.38	-0.34
Union Coverage	**-0.85**	**-0.80**	**-0.71**	**-0.87**	**-0.77**	**-0.71**
Centralization	-0.53	-0.47	-0.40	**-0.63**	-0.49	-0.43
Co-ordination	-0.29	-0.18	-0.04	-0.38	-0.22	-0.18
EPL	-0.47	-0.27	-0.37	-0.49	-0.24	-0.19
Benefits Replacement Rate	-0.36	-0.27	-0.17	-0.38	-0.29	-0.26
Tax Wedge	**-0.62**	-0.44	-0.47	**-0.62**	-0.43	-0.37
Coverage x EPL	**-0.74**	**-0.58**	**-0.64**	**-0.73**	-0.52	-0.46
Density x EPL	-0.54	-0.46	-0.49	-0.54	-0.34	-0.27
Coverage x Centralization	**-0.78**	**-0.74**	**-0.66**	**-0.83**	**-0.71**	**-0.63**
Density x Centralization	-0.54	-0.56	-0.49	-0.55	-0.44	-0.38
Coverage x Co-ordination	**-0.78**	**-0.71**	-0.56	**-0.82**	**-0.70**	**-0.64**
Density x Co-ordination	-0.50	-0.51	-0.41	-0.52	-0.43	-0.37
Coverage x U. Benefits	**-0.63**	-0.53	-0.43	**-0.61**	-0.48	-0.44
Density x U. Benefits	-0.48	-0.50	-0.41	-0.48	-0.40	-0.36

Note: The table presents bivariate correlations between institutional variables and wage cyclicality measures, which differ depending on the specification (levels vs. first differences) and forecast horizon (short, medium and long run). Numbers in bold indicate that the correlation is significant at the 5 per cent level. Number of observations=12 in all cases except for centralization where information for Ireland is missing.

Table 15. Institutions and Wage Cyclically. Compensation per Employee. CPI Deflator. Whole Economy

	Model in Levels			Model in First Differences		
	Short	Medium	Long	Short	Medium	Long
Union Density	-0.11	-0.05	-0.06	0.09	0.10	0.08
Union Coverage	-0.25	-0.16	-0.13	-0.41	-0.43	-0.34
Centralization	-0.47	-0.50	-0.49	-0.31	-0.37	-0.29
Co-ordination	-0.39	-0.46	-0.45	-0.32	-0.36	-0.37
EPL	-0.19	-0.28	-0.27	-0.30	-0.47	**-0.54**
Benefits Replacement Rate	**-0.81**	**-0.62**	**-0.59**	**-0.61**	-0.44	-0.43
Tax Wedge	-0.29	-0.09	-0.10	-0.30	-0.26	-0.38
Coverage x EPL	-0.18	-0.16	-0.16	-0.36	-0.50	**-0.54**
Density x EPL	-0.11	-0.11	-0.13	-0.01	-0.13	-0.22
Coverage x Centralization	-0.39	-0.35	-0.34	-0.34	-0.41	-0.33
Density x Centralization	-0.35	-0.31	-0.32	-0.09	-0.12	-0.11
Coverage x Co-ordination	-0.34	-0.28	-0.26	-0.44	-0.46	-0.41
Density x Co-ordination	-0.24	-0.20	-0.22	-0.02	-0.04	-0.06
Coverage x U. Benefits	**-0.73**	**-0.56**	**-0.55**	**-0.63**	**-0.55**	-0.51
Density x U. Benefits	**-0.54**	-0.40	-0.41	-0.25	-0.19	-0.19

Note: The table presents bivariate correlations between institutional variables and wage cyclicality measures, which differ depending on the specification (levels vs. first differences) and forecast horizon (short, medium and long run). Numbers in bold indicate that the correlation is significant at the 5 per cent level. Number of observations is 15 in all cases except for centralization where information for New Zealand is missing.

Table 16. Institutions and Wage Cyclically. Compensation per Employee. GDP Deflator. Whole Economy

	Model in Levels			Model in First Differences		
	Short	Medium	Long	Short	Medium	Long
Union Density	-0.22	-0.10	-0.08	-0.36	-0.31	-0.24
Union Coverage	-0.44	-0.26	-0.19	**-0.60**	-0.40	-0.31
Centralization	**-0.59**	-0.50	-0.45	**-0.60**	-0.47	-0.40
Co-ordination	-0.44	-0.37	-0.34	-0.30	-0.17	-0.22
EPL	-0.32	-0.28	-0.25	-0.32	-0.24	-0.31
Benefits Replacement Rate	**-0.76**	**-0.57**	**-0.54**	**-0.64**	**-0.53**	**-0.56**
Tax Wedge	-0.33	-0.10	-0.09	-0.42	-0.29	-0.38
Coverage x EPL	-0.34	-0.22	-0.19	-0.46	-0.34	-0.36
Density x EPL	-0.28	-0.17	-0.15	-0.39	-0.30	-0.31
Coverage x Centralization	**-0.54**	-0.42	-0.36	**-0.66**	-0.50	-0.41
Density x Centralization	-0.45	-0.33	-0.30	-0.52	-0.44	-0.38
Coverage x Co-ordination	-0.49	-0.31	-0.25	**-0.56**	-0.37	-0.33
Density x Co-ordination	-0.35	-0.21	-0.19	-0.42	-0.32	-0.29
Coverage x U. Benefits	**-0.75**	**-0.56**	**-0.52**	**-0.73**	**-0.61**	**-0.61**
Density x U. Benefits	**-0.55**	-0.36	-0.35	**-0.55**	-0.49	-0.49

Note: The table presents bivariate correlations between institutional variables and wage cyclicality measures, which differ depending on the specification (levels vs. first differences) and forecast horizon (short, medium and long run). Numbers in bold indicate that the correlation is significant at the 5 per cent level. Number of observations is 15 in all cases except for centralization where information for New Zealand is missing.

Table 17. Institutions and Wage Cyclicality. Factor Analysis

Industry		Whole Economy	
Variance Explained	0.58	Variance Explained	0.57
Industry		*Whole Economy (CPI def)*	
Short run levels	0.93	Short run levels	0.91
Medium run levels	0.90	Medium run levels	0.91
Long run levels	0.84	Long run levels	0.90
Short run first diff.	0.98	Short run first diff.	0.89
Medium run first diff.	0.89	Medium run first diff.	0.90
Long run first diff.	0.83	Long run first diff.	0.85
		Whole Economy (GDP def)	
		Short run levels	0.95
		Medium run levels	0.92
		Long run levels	0.91
		Short run first diff.	0.91
		Medium run first diff.	0.87
		Long run first diff.	0.86
Institutions		Institutions	
Union Coverage	-0.92	Union Coverage	-0.51
Union Density	-0.41	Union Density	-0.18
EPL	-0.70	EPL	-0.46
Benefits Replacement Rate	-0.51	Benefits Replacement Rate	-0.71
Tax Wedge	-0.90	Tax Wedge	-0.43
Centralization	-0.70	Centralization	-0.63
Co-ordination	-0.37	Co-ordination	-0.52
Continental Europe	-0.50	Continental Europe	-0.43
Anglo-Saxon	0.61	Anglo-Saxon	0.38