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In 2011 all ECB publications feature a motif taken from the €100 banknote.

NOTE: This Working Paper should not be reported as representing the views of the European Central Bank (ECB). The views expressed are those of the authors and do not necessarily reflect those of the ECB.

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CONTENTS

Abstract

A small labour market model for the six largest euro area countries (Germany, France, Italy, Spain, the Netherlands, Belgium) is estimated in a state-space framework. The model entails, in the long run, four driving forces: a trend labour force component, a trend labour productivity component, a long-run inflation rate and a trend hours worked component. The short run dynamics is governed by a VAR model including six shocks. The state-space framework is convenient for the decomposition of endogenous variables in trends and cycles, for shock decomposition, for incorporating external judgement, and for running conditional projections. The forecast performance of the model is rather satisfactory.

The model is used to carry out a policy experiment with the objective of investigating whether euro area countries differ in the labour market adjustment to a reduction in labour costs. Results suggest that, following the 2008-09 recession, moderate wage growth would significantly help delivering a more job-intense recovery.

Key words: Labor market; Forecasting, Kalman filter
J.E.L. Classification: C51, C53, E17, J21.

Non technical summary

This paper presents a new macro tool for monitoring and forecasting labour market developments across the six largest euro area countries, namely Germany, France, Italy, Spain, the Netherlands and Belgium.

The model consists of a set of labour market equations (labour force, labour demand, wage curve, production function, relative prices, hours worked) which are jointly estimated, thereby providing a consistent pull of estimates for labour market quantities and prices. In particular, the model is able to distinguish between intensive (hours worked per person) and the extensive (persons employed) margins.

The model presents a number of features which in our view makes it appealing in comparison with similar studies. First, the same specification is estimated for all countries, which allows for a straightforward cross-country comparison of the different reactions to shocks. Second, the estimation technique used allows to jointly estimate the long and short run dynamics, where both the trend and the cyclical component have theoretical underpinning. Therefore, there is no need to detrend data before estimation. Third, on the data front, the paper makes use of recently available hours worked series at a quarterly frequency compatible with national accounts.

While the model is primarily empirical, the long run restrictions are consistent with a frictionless economy where a Cobb-Douglas production function is used to derive the desired level of employment by firms. On the labour supply side, the long-run wage curve is consistent with a bargaining model where the real consumption wage depends on productivity and on the prevailing labour market conditions, which are captured by the rate of unemployment. The estimated model is cast in a state-space framework, which is very convenient for the decomposition of endogenous variables in trends and cycles, for the shock decomposition, for incorporating external judgments and for running conditional projections.

Recursive point forecasts show that in all countries the model can track rather well the short term dynamics of almost all variables. The forecasting properties of the estimated model can be considered satisfactory as they generally improve on first and second order VAR models and random walk processes.

Focusing on developments during the past 10 years, the paper shows that labour market adjustments differ substantially across euro area countries in terms of contribution of the long-term driving forces and short-term shocks to key labour market developments. Interestingly, the model's reading of the 2009 crisis is that it has mainly affected the cyclical part of labour market development while trend developments have not been affected by the crisis. The only exception across countries is Spain, were a clear downward movement in trend employment and an upward movement in trend hours worked can be observed.

Finally, the model is used to assess the employment impact of a reduction in the nominal hourly wage rate. The results of this policy experiment suggest that in an environment characterized by significant labour hoarding, achieving moderate wage growth significantly helps delivering a more job-intense recovery. In other words, wage moderation appears important for labour demand to fully benefit from a boost in output. The simulations also show that countries tend to differ in their adjustment of hours worked versus job creation in response to a nominal wage cut, most likely in relation to the different institutional settings. In Spain, wage moderation appears particularly beneficial for preventing further employment losses after the sharp labour shedding witnessed in 2009. By contrast, in France, Italy and Belgium a lower nominal wage rate triggers a higher response of hours worked rather than jobs. In Germany and the Netherlands both margins of adjustment are equally positively affected by a nominal wage reduction.

1 Introduction

The main objective of this paper is to illustrate some key features of the euro area labour markets. For this purpose a small labour market model for the six largest euro area countries – Germany, France, Italy, Spain, the Netherlands and Belgium – is estimated in a state-space framework. The model consists of a set of labour market equations (labour force, labour demand, wage curve, production function, relative prices, hours worked) which are jointly estimated.

On the quantity side the model distinguishes between the intensive (hours worked per persons) and the extensive (persons employed) margins. On the price side it distinguishes between GDP and consumer price deflators. The model entails long-run dynamics and short-run fluctuations. The long-run dynamics is derived from strong theoretical restrictions which determine the pattern of trends (labour force, labour productivity, inflation rate and hours worked). The short-run fluctuations are driven by a homoscedastic vector autoregressive process.

In addition, the model presents a number of features which in our view makes it appealing in comparison with similar studies. First, the same specification is estimated for all countries, which allows for a straightforward cross-country comparison of the different reactions to shocks. Second, the estimation technique used allows to jointly estimate the long and short run dynamics, where both the trend and the cyclical component have theoretical underpinnings. Therefore, there is no need of detrending data by purely statistical methods prior the model estimation [1] . Third, on the data front, the paper makes use of recently available hours worked series at a quarterly frequency compatible with national accounts.

While the model is primarily empirical, the long run restrictions are consistent with a frictionless economy where a Cobb-Douglas production function is used to derive the desired level of employment by firms. On the labour supply side, the long-run wage curve is consistent with a bargaining model where the real consumption wage depends on productivity and on the prevailing labour market conditions, which are captured by the rate of unemployment.

The model is cast in a state-space framework, which is very convenient for the decomposition of endogenous variables in trends and cycles, for the shock decomposition, for incorporating external judgments and for running conditional projections.

[1] Canova and Ferroni (2009), who adopted a non-structural approach to detrending using a parsimonious econometric specification, recently confirmed by simulations that an incorrect specification of trends distorts the estimation of parameters of the cyclical part of macroeconomic models.

Focusing on developments during the past 10 years, this paper shows how the euro area countries differ in terms of contribution of the long-term driving forces and the short-term shocks to key labour market developments.

Finally, the paper presents a policy experiment with the objective of investigating the different reactions of the euro area labour markets to a reduction in labour costs. This question, which has been already addressed by a number of previous empirical papers, is still very relevant in light of the ongoing debate on the need of regaining cost competitiveness in the euro area for two key reasons. First, given current uncertain situation regarding the employment prospects after the 2009 recession, it is important to shed light on the employment implications of a change in labour cost. Second, the 2009 recession implied very different labour market reactions across countries in terms of employment and hours worked, partly due to nominal wage inertia. Thus it is important to understand the implications of a labour moderation strategy on the two margins of adjustment. Given that the estimation horizon used in this paper is relatively up-to-date, i.e. from 1992 to 2009, and the model is able to distinguish between intensive and extensive margins of labour utilisation, the answers provided by the paper to the above policy question represents a new feature.

The paper is organized as follows. Section 2 is devoted to the survey of related papers. The next section 3 presents the model. The dataset and the estimation are discussed in Section 4, while the results of a policy experiment are present in Section 5. Section 6 concludes.

It should be noted upfront that, given the empirical nature of the model and the absence of 'deep' parameters in a sense of structural models, the word shock is used through the paper in the spirit of the traditional macro-modelling environment.

2 The link with related literature

On the modelling side, the literature on small scale labour market models is rather ample. Small scale labour market models or the supply-side block of large macro-models usually involve a production function equation, a labour supply relationships, a labour demand derived from the first order conditions of profit-maximizing or equivalently a cost-minimizing representative firm and a wage setting relation determined by a bargaining process between firms and labour unions (see Layard et al., 1991). On the empirical side, one of the critical problems is the identification of labour demand and supply relationships.

Following Morgan and Mourougane (2005), the labour demand equation is identified by using the value added deflator at factor costs to compute real wages, which is the relevant deflator for firms. By contrast, the wage curve is identified by using the consumption deflator to compute real wages, which is instead the relevant deflator for households. Moreover, labour demand conditions, i.e. the unemployment rate, enter in the wage curve. Following Hansen and Warne (2001) our model entails also a short-term equation for relative prices, that is the consumer/producer price wedge. Such wedge reflects in particular the impact of indirect taxes, terms of trade effects and relative bargaining powers. In the short run, the dynamics of producer prices and of nominal wages is based on a VAR form with identification restrictions.

A similar approach has been followed by Duarte and Marques (2009), where an empirical SVECM involving nominal wages, prices, the unemployment rate, productivity and import prices is estimated for the euro area and the US. The main finding of the paper is that wage dynamics are mainly determined by unemployment shocks in both economies but a significant role is also played by technology shocks in the US and by import price shocks in the euro area. This last result is particularly important as it suggests that in the euro area economies wages tend to be 'de facto' indexed to imported inflation.

On the data side, due to limited availability of reliable time series for hours worked, so far most of the existing studies on euro area countries labour markets measure employment as the number of persons employed (see Mourre, 2006). In this respect, the fact that our model is able to empirically distinguish between the intensive margin (hours worked) and the extensive margin (jobs) represents an important innovation with respect to standard labour market models.

On the estimation side, our econometric approach follows very closely the analysis in Proietti and Musso (2007), where a multivariate structural time series model is used for the estimation of potential output and output gap. Like in Proietti and Musso (2007), in this paper the decomposition of time series into a trend and a cyclical component is model-based and hence does not depend on purely statistical ad hoc techniques. The difference between these two papers lies on the specification of the model used to separate trend and cycle[2].

Finally, regarding the policy content of the paper, a large number of empirical and theoretical works have covered the issue of the relative gains/costs of wage moderation. Partial equilibrium approaches indicate that labour cost moderation generally help employment creation (see Pierluigi and Roma, 2008) and growth (see Estevao, 2005), the same applies to simulations conducted

[2] The reader may also want to consider a summary paper by Hjelm and Jönsson (2010) who overview various approaches to filter the trend component from economic time series, including multivariate model-based approaches.

with large macroeconomic models (see Angelini et al. 2010), where the key mechanism at work is the competitiveness channel which leads to higher growth and employment. While this last study looks at the implication of nominal wage moderation, the two previously quoted studies refer to real wage moderation. In our simulation the focus is on nominal wages, this is because for countries belonging to a monetary union the ability to achieve nominal wage moderation is very important, especially in an environment characterized by moderate price developments.

3 Model

The dynamics of the model is basically composed of two parts: the long-run dynamics and short-run fluctuations. The long-run dynamics is derived from strong theoretical restrictions and it provides a discipline on trends in modelling variables. The short-run dynamics then enriches the structure of the model and makes possible to use the model for forecasting and shock decomposition exercises.

In general terms, any model variable x_t is given as a sum of the trend component and the cyclical component [3]:

$$x_t = \bar{x}_t + \hat{x}_t,$$

where $\bar{x}_t$ is the trend component, and $\hat{x}_t$ is the cyclical component.

3.1 The long-run dynamics

The equations describing the long-run dynamics are given as follows:

$$\bar{y}_t = \bar{e}_t + \bar{h}_t + \varpi_t^z, \tag{1}$$

$$\bar{e}_t + \bar{h}_t = \bar{y}_t - (\bar{w}_t - \bar{p}_t), \tag{2}$$

$$\bar{w}_t - \bar{q}_t = -\gamma_1(\bar{l}_t - \bar{e}_t) + \gamma_2(\bar{y}_t - \bar{e}_t - \bar{h}_t) + \alpha_2 \bar{m}_t, \tag{3}$$

[3] All variables in this paper are considered in logs unless otherwise stated. All variables are also seasonally adjusted.

$$\bar{p}_t = \varpi_t^p, \tag{4}$$

$$\bar{l}_t = \varpi_t^l + \alpha_1 \bar{m}_t, \tag{5}$$

$$\bar{h}_t = \varpi_t^h, \tag{6}$$

where $\bar{y}_t$ is the trend output, $\bar{e}_t$ is the trend number of employees in heads, $\bar{h}_t$ is the trend number of hours worked per employee, $\bar{w}_t$ is the trend in the nominal compensation per total hours worked; $\bar{p}_t$ is the trend GDP deflator at factor costs; $\bar{q}_t$ is the private consumption deflator (which is assumed to follow the same trend as $\bar{p}_t$), $\bar{l}_t$ is the labour force and $\bar{m}_t$ is the trend in the net immigration flows; ϖ_t^k with $k = z, p, l, h$ denote trends in productivity, price level, labor force, and hours worked.

The long run specification of the model is very stylised. In particular, Equation (1) suggests that the production function is formulated as a relation describing average labour productivity which follows in the long run the productivity trend ϖ_t^z. Equation (2) is derived from the first order conditions of the Cobb Douglas production function and expresses the desired total amount of hours worked $(\bar{e}_t + \bar{h}_t)$ as a function of the level of output and and the real product wage $(\bar{w}_t - \bar{p}_t)$. The consumer real wage $(\bar{w}_t - \bar{q}_t)$ is determined by a bargaining process between firms and labour unions. The outcome of this process is described as a relationship between the consumer real wage, average real productivity and unemployment in Equation (3).

The trend price level (ϖ_t^p) is assumed to be the same for the GDP and consumption deflators (Equation 4). Equation (5) says that trend domestic labour force ϖ_t^l is affected by immigration. The long-run dynamics of hours worked is spanned by its trend ϖ_t^h, which reflects slowly-moving institutional features of the economy; see Equation (6).

The structural form implies the following long run elasticities:

$$
\begin{array}{c|cccc}
 & \varpi^l & \varpi^z & \varpi^p & \varpi^h \\
\hline
\bar{l}_t & 1 & 0 & 0 & 0 \\
\bar{y}_t & 1 & 1+\frac{1-\gamma_2}{\gamma_1} & 0 & 1 \\
\bar{e}_t & 1 & \frac{1-\gamma_2}{\gamma_1} & 0 & 0 \\
\bar{w}_t & 0 & 1 & 1 & 0 \\
\bar{p}_t & 0 & 0 & 1 & 0 \\
\bar{q}_t & 0 & 0 & 1 & 0 \\
\bar{h}_t & 0 & 0 & 0 & 1
\end{array} \tag{7}
$$

Given that the parameters γ_1 and γ_2 are not separately identified, only their non-linear combination $\frac{1-\gamma_2}{\gamma_1}$ could be estimated.

To model trends ϖ_t^k, we modify the approach by Harvey and Jaegger (1993). Harvey and Jaegger (1993) propose an `I(2)` process for filtering trends from economic time series. Their process is defined as:

$$\theta_{1t} = \theta_{1t-1} + \theta_{2t-1} + \sigma_1 \eta_{1t},$$

$$\theta_{2t} = \theta_{2t-1} + \sigma_2 \eta_{2t},$$

where η_{it} are independent iid white-noise processes. Standard errors σ_1, σ_2 determine the smoothness of the filtered trend. In particular, if σ_1 is small, the trend θ_{1t} is rather smooth. It is interesting to note that the Leser (1961) filter (later 'rediscovered' in economics as the HP filter) is optimal for processes $x_t = \theta_{1t} + \nu_t$, provided that $\sigma_1 = 0$ and ν_t is an iid white noise sequence. Although, the Harvey-Jaegger model can be used to filter out smooth trends, it is not suitable for forecasting[4].

We therefore opt for an `I(1)` process to model ϖ_t^k, since this would imply that the long-run growth rate in the variables is a stationary process. This is rather a plausible feature especially for productivity and the price level[5]. In more details, we assume the following `ARIMA(3,1,0)` process, which can

[4] Indeed, the problem may happen when the filter identifies a sign change in θ_{2t}. Such a change is then permanent on forecast. As an example, this may happen for trend productivity during a huge recession. If a model identifies in the last period that $\theta_{2t} < 0$, it will then predict an indefinite decline in productivity, which would mean that the model would not be able to forecast any growth recovery no matter how far in the future. Unless one does not believe to such a doomsday story, this is clearly an implausible feature for forecasting.

[5] At least in the case of well anchored monetary policy.

produce smoothed growth trends slowly varying around a long-run value:

$$\varpi_t^k - \varpi_{t-1}^k = \theta_{1t}^k, \tag{8}$$

where θ_{1t}^k follows a stationary process:

$$\theta_{1t}^k = \rho_1 \theta_{1t-1}^k + \theta_{2t-1}^k,$$

$$(\theta_{2t}^k - \mu^k) = \rho_2(\theta_{2t-1}^k - \mu^k) + \theta_{3t-1}^k,$$

$$\theta_{3t}^k = \rho_3 \theta_{3t-1}^k + \varepsilon_t^k,$$

with ε_t^k being an i.i.d. white noise sequence, and $0 \leq \rho_i < 1$ for $i \in \{1, 2, 3\}$. The fact that stochastic innovations enter directly only the third equation implies that θ_{1t}^k follows a slowly varying smooth process.

The interpretation of model (8) is the following: θ_{1t}^k can be considered as the trend growth rate of the variable ϖ_t^k, which moves around a target θ_{2t}^k. This target grows in a steady state by μ^k and is shocked by an invertible MA(1) process, represented by θ_{3t}^k. Note that the process is similar to the one used in Carabenciov et al. (2008) (and in related IMF-based models) to filter low-frequency movements in output and unemployment. The difference with respect to Carabeniciov et al. (2008) is that we add a process θ_{3t}^k, which adds an additional flexibility to the spectral properties of the low-frequency component.

3.2 Formulation of the state-space model

The short run dynamics of the model is governed by a VAR(1) process. Both short and long term components are then combined in a single state space model, which is then used for model estimation and simulation. The observation variables are transformed to annualised quarterly growth rates [6].

Hence the observed growth rate of the labor force is given by:

$$l_t - l_{t-1} = \left(\bar{l}_t - \bar{l}_{t-1}\right) + \left(\hat{l}_t - \hat{l}_{t-1}\right) + \nu_t^l = \theta_{1t}^l + \left(\hat{l}_t - \hat{l}_{t-1}\right).$$

The observed growth rate of output is given by:

$$y_t - y_{t-1} = (\bar{y}_t - \bar{y}_{t-1}) + (\hat{y}_t - \hat{y}_{t-1}) = \theta_{1t}^l + \left(1 + \frac{1-\gamma_2}{\gamma_1}\right)\theta_{1t}^z + (\hat{y}_t - \hat{y}_{t-1}),$$

[6] Here, we assume that we measure and filter only growth rates. In models where additional restrictions (in the form of e.g. accounting identities or equilibrium conditions) were imposed, it would be beneficial to measure also the level of variables directly. However, we do not have additional restrictions here and thus no efficiency is lost by measuring the growth rates only.

where the second equality follows by virtue of long-run elasticities [7]. Similarly, the observed employment is given by:

$$e_t - e_{t-1} = (\bar{e}_t - \bar{e}_{t-1}) + (\hat{e}_t - \hat{e}_{t-1}) = \theta^l_{1t} + \frac{1-\gamma_2}{\gamma_1}\theta^z_{1t} + (\hat{e}_t - \hat{e}_{t-1}).$$

The observed nominal wage inflation $\pi^w_t \equiv w_t - w_{t-1}$ is given by:

$$\pi^w_t = \bar{w}_t - \bar{w}_{t-1} + \hat{\pi}^w_t = \theta^p_{1t} + \theta^z_{1t} + \hat{\pi}^w_t.$$

Analogous formulae apply for changes in the GDP and consumption deflators:

$$\pi^y_t = \theta^p_{1t} + \hat{\pi}^y_t,$$

$$\pi^c_t = \theta^p_{1t} + \hat{\pi}^c_t.$$

Measurement noise is not included in the system.

4 Data and estimation of the model

With respect to previous empirical work on labour market models, the dataset used is very up-to-date. Data have quarterly frequency and span from 1992Q1 to 2009Q4 for Belgium, Germany, Spain, France, Italy and the Netherlands. The choice of this sample period has been dictated both on the basis of statistical and economic grounds. On the statistical side, this sample period excludes the data problem related to the German unification and to a number of missing back data for some countries, in particular hours worked. On the economics side, this period excludes the strong cost and price disinflationary process underwent during the 1980s by most euro area countries. While this implies reducing the volatility of the series and thus limiting their explanatory power, the choice of limiting the estimation to this relatively recent sample period is more economically founded, as it excludes the transition to a different monetary policy regime. All data used are adjusted for seasonality.

Unit wages are measured as gross compensation (including social security contributions) per hours worked and labour productivity is measured as real GDP per total hours worked. Given that the unemployment rate features also the model, which is typically measured in heads, a distinction is made between the intensive and extensive margins. Real GDP and its deflator are measured at factor costs. The private consumption deflator is used as a measure for consumer prices. The wedge between the consumption and GDP deflators

[7] Indeed, results in Table (7) imply that $\bar{y}_t = \varpi^l_t + \left(1 + \frac{1-\gamma_2}{\gamma_1}\right)\varpi^z_t$.

captures the effect of taxes, administered prices, as well as those of relative import prices on wage bargaining. In this regards external shocks are feeding throughout the model via this wedge. As typically done in the empirical literature the identification problem of the labour demand and supply equations is solved by assuming that real product wages is what matters for firms (labour demand) and real consumer wage is what matters for employees or unions (wage curve).

Regarding some properties of the data, it is worth mentioning that quarterly series of hours worked have been only very recently made available for the euro area countries by the national statistical offices. These data, while new, confirm the long term downward trend in the estimated data available at the annual frequency. As evident from Figure 1 the employment gains across the euro area countries were mainly determined by the creation of new jobs, while the working time per person has declined substantially during the past 20 years. As reported in Leiner-Killinger et al. (2005), the decline in hours worked is attributable to the increased use of part-time working arrangements, which is often related to the greater number of women entering the labour market, to institutional factors such as tax wedges which create disincentive to work, or to specific policy measures including changes in working time regulations, such as the introduction of the 35 hours week in France in 2000. During the 2009 recession, in some euro area countries the reduction in total hours was a temporary phenomenon, primarily driven by the introduction of government-sponsored short-time work measures and flexible working time arrangements (such as working time accounts).

Labour market reforms pursued in the early and mid 2000s in the largest euro area countries aimed at increasing the flexibility for new hire to enter and leave new occupations have provided strong incentives for part-time jobs at the expense of the total amount of hours worked. Given this decoupling between hours worked per person and employment it appears very relevant also for policy purposes to measure the unit wage as compensation per total hours worked rather than as per person employed, which is instead typically done in earlier empirical works on labour demand and supply (see for example Mourre, 2006). In particular, during the 2009 recession the dynamics of hourly compensation remained rather strong, while that of compensation per employee has moderated significantly.

The model described in Section 3 implies the following state space form:

$$x_t = Ax_{t-1} + M + \Sigma_x \epsilon_t, \tag{9}$$

$$y_t = Cx_t, \tag{10}$$

where the state vector x_t contains the vectors of the long-run growth rates θ_{1t}, their drivers θ_{2t}, θ_{3t}, cyclical parts of the model; the matrix A contains the long-run block based on the process (8) and the VAR block, which drives the short-run dynamics; the matrix M contains μ^x in the appropriate locations; $\Sigma_x \epsilon_t$ maps structural innovations to θ_{3t} and to the cyclical part; and finally the matrix C adds the two components to the vector of the observable variables y_t. The part of this matrix, which corresponds to the long-run dynamics is based on the long-run elasticities reported in (7).

The Kalman filter is used for state filtering and smoothing, forecasting, likelihood evaluation and shock decomposition. The formulae for filtering, smoothing, and likelihood evaluation are rather standard (e.g. Harvey, 1989). Given the smoothed estimate of the state $x_{T|T}$ and its covariance matrix $P^x_{T|T}$ (T denotes the last observation), the h-step (unconditional) prediction of $y_{T+h|T}$ can be computed simply as:

$$y_{T+h|T} = C \left[A^h x_{T|T} + \left(\sum_{g=0}^{h} A^g \right) M \right],$$

and its covariance matrix can be derived as follows:

$$P^y_{T+h|T} = C P^x_{T+h|T} C',$$

where the state prediction covariance matrices $P^x_{T+h|T}$ satisfy the recursion:

$$P^x_{T+h+1|T} = A P^x_{T+h|T} A' + \Sigma_x \Sigma_x',$$

with the initial condition given by the Kalman filter output $P^x_{T|T}$.

The conditional forecast can be also easily derived. To condition the forecast on a set of variables, it is sufficient to run the filter on the model with a suitably redefined observation matrix C. The approach used for implementing conditional forecast maintains trends fixed on the unconditional projection. In this way, we can attribute the difference between conditional and unconditional forecast to the cyclical part of the model. Also, following Koopman and Harvey (2003), the Kalman filter can be 'inverted' to inquire how observations in each series translate to the model assessment of trends and cycles.

Finally, the model is used to perform shock decomposition, which is computed as follows: based on the smoothed states $x_{t|T}$, we can recover the smoothed residuals $\epsilon_{t|T}$. Then, the shock contribution to the ith observable variable from the jth shock is defined as $\sum_{s\geq 0} \iota^{ij}_s \epsilon^j_{t-s|T}$, where $\epsilon^j_{t-s|T}$ is the jth element of $\epsilon_{t-s|T}$, and ι^{ij}_s is the (i,j) element of the impulse response ($\iota_s = C A^s \Sigma_x$). Note that our definition of the shock decomposition cumulates the effects of *current and past* shocks (the alternative decomposition could be defined in terms of *current* shocks plus the effect of the *initial conditions*).

We estimate the model using a pseudo-Bayesian approach (as in Hong and

Chernozhukov, 2003): we maximize the likelihood with some prior imposed on long-run growth rates[8] and on selected signs of impulse responses for the short-run dynamics. Its interesting to mention, that only for Italy the prior affects the estimation results. For the rest of countries, the mode of the posterior distribution would be almost equal to the maximum likelihood estimator[9].

Figures 2, 3, 4, 5, 6, and 7 show recursive point forecasts for the six euro area countries since 2004. All charts show annualized quarterly changes. Recursive point forecasts show that in all cases the model can track the short-term dynamics rather well, with the exception of the labour force in Germany, France, Italy, and the Netherlands. This may be due to the fact that in these countries the labour force has shown in the recent past very little procyclicality, due to some structural factors, such as aging of population. Figures 9 to 14 compare the relative accuracy of the model forecasts (denoted as the BPS model based on the first letters of authors' names) with forecasts generated by the 'random walk' model, by unrestricted VAR(1) and unrestricted VAR(2) processes[10] at forecast horizons from 1 to 8 quarters. The figures display the root mean square errors (RMSE) relative to BPS; the RMSE of the presented model being normalized to one. Typically, for most countries, BPS does a better job for nominal wages and inflations, while the for labor force the unrestricted VARs seem to be better. The ordering for the rest of variables is inconclusive.

Although in the case of some variables the forecast performance of our model is as good as VARs models, the advantage of the state-space framework used should be stressed. The state-space formulation allows to easily make conditional forecasts or to incorporate external judgements. For example, if the forecaster has an extra information (say from sectoral experts) about the likely evolution of only some of the model variables, then she can run conditional

[8] All simulations reported in this paper are taken with respect to the mode of the posterior.
[9] For Italy, the maximum likelihood estimator would result in extremely low standard errors of innovations in the process (8). This would mean that the long-run growth rates would be almost constant, which is an undesirable feature for forecasting purposes.
[10] A reader may ask why we have chosen the VAR order of the maximum lag 2. The reason is that VARs with higher lags are better at the very short forecast horizons (1 quarter), but their forecasting ability deteriorates rapidly for longer forecast horizons (for horizons greater than 3, they are much more worse than any of the four models considered). This effect is likely due to over-parametrization of higher-order VARs. The reader may want to refer to the lucid discussion by Tiao and Xu (1993) for the intuition why some models can be 'good' at short forecast horizons, but fail completely at longer horizons.

forecasts based on this piece of information. It is sufficient to redefine the matrix C from the observation equation 10 (it just means to delete rows of the matrix C corresponding to variables for which the information is not available). The same approach can be used if some variables are measured with a lag or lead comparing to the other variables.

Similarly, if the forecaster doubts regarding the real time release of some observations (for example, the national account-based wages are too different from the census-based wages) and fears that the figure may be subject to significant revisions, she could add a measurement noise to Equation 10 and run the filter and forecast with the last observation subject to the measurement noise.

Furthermore, the state-space framework can incorporate the 'expert-information' about unobserved trends. For example, if the model yields the implausible decomposition of a series into trend and cyclical components, it is possible to force the model to a more plausible decomposition by a suitable expansion of the observation matrix C for a given period. By this, the expert can impose her preferred decomposition for one or more series. Finally, comparing to the ad-hoc filtering techniques (such as the HP filter), model-based filters have automatic adaptation property at the end of the sample (since they are based on the optimal Bayesian updating) and hence the problem of the end-point bias is alleviated.

Figures 15 to 20 show the historical shock decomposition for four variables. The left column displays the decomposition to the model trends and to the cyclical component, while the right column shows the decomposition of the cyclical part of the variable. Also in this case the charts show annualized quarterly changes.

Focusing on the left column of the figures 15 – 20, from a cross-country perspective it is interesting to note that the model reading of the 2009 crisis is that of an almost entirely cyclical episode, i.e. trend developments have not been affected by the crisis. The only exception is Spain, were a clear downward movement in employment and an upward movement in hours worked can be observed. As to the evolution of the cyclical component during the past 10 years, Germany is the only country which appears characterized by opposite movements of employment and labour participation shocks in explaining the dynamics of employment and hours worked. Indeed, across the euro area countries, Germany is the country which witnessed the smallest employment creation between 1999 and 2008 and a sharp downward trend in the labour force. In other words, the chart suggests that in Germany employment creation was labour-demand and not labour-supply driven. As to the shock decomposition of the cyclical component of German GDP, this has been mainly dominated by a productivity shock. Indeed, a key issue for the German economy is that many years of productivity gains were translated only very marginally and very late into employment creation.

As regards, the evolution of the cyclical components in France, all shocks appear to have contributed to the downward adjustment of employment during the recession. In Italy, according to the model, a relatively favorable internal term of trade could explain the benign employment movements in the early 2000s and could prevent a larger fall of employment in the 2009 crisis.

Finally in the case of Spain, the fall in employment between 2008 and 2009 is explained by a decline in trend labor force. In the case of trend output growth such a decline is compensated by an increase in trend productivity growth. This result, which of course entails a high degree of uncertainty, would suggest that a rebalancing of the supply side determinants of growth is taking place in Spain. Such a rebalancing might deliver, if persistent, a more sustainable growth model for the Spanish economy.

5 A policy experiment: the effect of wage moderation on the job-richness of the economic recovery

The 2009 recession, which is covered in the dataset used for the estimation, has lead to very different employment responses across the euro area countries. In particular, Germany and to a lesser extent Italy, Belgium and the Netherlands have witnessed a significant degree of labour hoarding, stronger than in previous recessions, while Spain saw an exceptionally strong labour shedding. While labour hoarding is a common characteristics across the euro area countries, the particularly strong resilience of the labour market to the sharp economic downturn was mainly due, in the first group of countries, to the extensive use of special measures to support employment. By contrast, the employment losses observed chiefly in Spain were related to the sharp downward correction of a strongly labour intensive sector, namely construction, in an environment characterized by very loose firing conditions (due to a high rate of temporary contracts). In light of this heterogeneity in labor market adjustments across euro area countries, the employment prospects in a recovery scenario appear highly uncertain, as it might be the case that firms would downward adjust employment once special schemes to keep jobs are expired or that they would gradually return to higher levels of hours worked per persons waiting long before new job opportunities are created. On the other hand, it might also be the case that in those countries witnessing strong labour shedding the recovery may provide a relatively stronger impulse to employment.

This section tries to answer the following policy question: to which extent a stronger degree of hourly wage moderation than that recently witnessed could strengthen the job-richness of the economic recovery after the 2009 recession?

The simulation exercise consists of quantifying the different elasticities of a 1% drop in the unit wage level across euro area countries. These elasticities are derived by taking the difference between the unconditional forecasts delivered by the our model in a two-year horizon and the conditional forecasts, where a 1% drop in the wage level in the course of the first year (2010) has been assumed. Such a drop is obtained by reducing the wage rate in each quarter of 2010 by a proportional amount leading to a 1% fall with respect to the baseline level for the year as a whole. The drop in the level of wages is permanent, i.e. no unwinding has been implemented in the subsequent year. The simulation results are reported in Figure 8.

In general, this empirical model confirms the welfare gains (higher employment) which could be achieved via wage moderation even in the short-run. However, the reaction of such a wage shock entails different implications in terms of margins of adjustment. It appears, in particular, that gains in both hours worked and persons employed could take place in such a scenario in Germany, France, the Netherlands and in the medium term (2011) in Belgium. By contrast the same shock would induce, in the case of Spain, a very strong employment creation, especially in 2011, at the expense of hours per person, leading in any case to an overall gain in terms of total hours worked.

In the case of Spain the finding of a trade off between the evolution of the two margins of adjustment reflects past behaviour of the two variables, and the relatively limited information content of hours worked. The very strong reaction of employment to a unit wage reduction - which cumulates to an increase in the employment level of 2.5% after two years and is translated in an even larger fall in the unemployment rate - reflects the very high degree of wage inertia historically observed with respect to labour market conditions. As a matter of fact, the Spanish unemployment rate shot up by almost 10 percentage points since the beginning of the 2009 recession, while compensation has remained almost unaffected by the sharp change in labour market conditions. This feature has been found also in other empirical cross-country works[11]. Such a huge employment correction has been partially driven by the burst of the housing bubble and partially by the strong bias towards fixed-term contracts. The model reading of such a situation is that even a small decline in the wage rate would strongly impact on employment and would also lead to a strong fall in the labour force. An important caveat is that this rather stylised model cannot capture sectorial adjustments and therefore tends to over-weight the possibility for the unemployment rate to swiftly return to pre-crisis levels.

In the case of Italy the wage shock leads to a rather small reaction of hours worked and a small and negative reaction of employment in persons. The sum

[11] See Pierluigi and Roma (2008)

of the two margins implies an overall almost nil impact of the negative wage shock. The result is related to the very weak empirical link between wage dynamics and hours developments in Italy, as it emerges from the very small reaction of the labour demand to labour costs developments[12].

All in all, looking at the aggregate variable (EA6), one can conclude from this exercise that wage moderation would certainly help employment creation and - to a lesser extent - an upward adjustment in hours. In the case of Spain, the results suggest that a moderation in the dynamics of the wage rate would be highly beneficial for preventing further employment losses.

6 Conclusions

This paper presents a new macro tool for monitoring and forecasting labour market developments across the six largest euro area countries. The model is primarly empirical but relies on theoretical underpinning in the derivation of the trends. The forecasting properties of the estimated model are satisfactory as they generally improve on first and second order VAR models and random walk processes.

The paper also shows that labour market adjustments differ substantially across euro area countries, as it emerges from the contributions of the long-term drivers and short-term shocks to key labour market developments.

Finally, the model is used to assess the employment impact of a reduction in the nominal hourly wage rate. The results of this policy experiment would suggest that in an environment characterized by significant labour hoarding, achieving moderate wage growth significantly helps delivering a more job-intense recovery. The simulations also show that countries tend to differ in their adjustment of hours worked versus job creation in response to a nominal wage cut, most likely in relation to the different institutional settings. In Spain, wage moderation appears particularly beneficial for preventing further employment losses after the sharp labour shedding witnessed in 2009. By contrast, in France, Italy and Belgium a lower nominal wage rate triggers an higher response of hours worked rather than jobs. In Germany and the Netherlands both margins of adjustment are equally positively affected by a nominal wage reduction.

[12] See Pierluigi and Roma (2008) and European Commission (2006).

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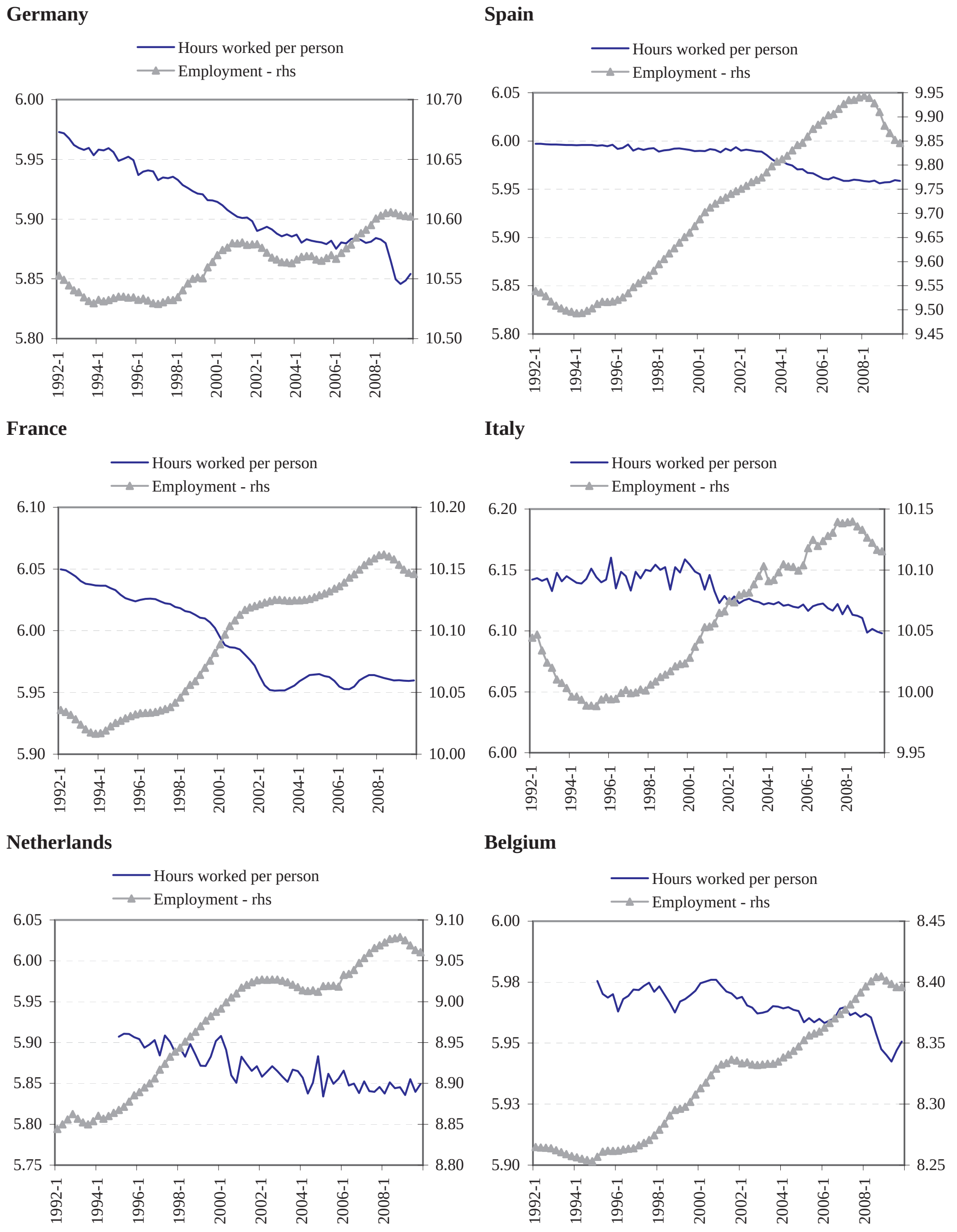
Fig. 1. Hours worked and employment developments across euro area countries



Note: data shown in logs. In the case of NL and BE data for hours worked start in 1995-1
Source: own computation on Eurostat data

Fig. 2. Germany – recursive forecast

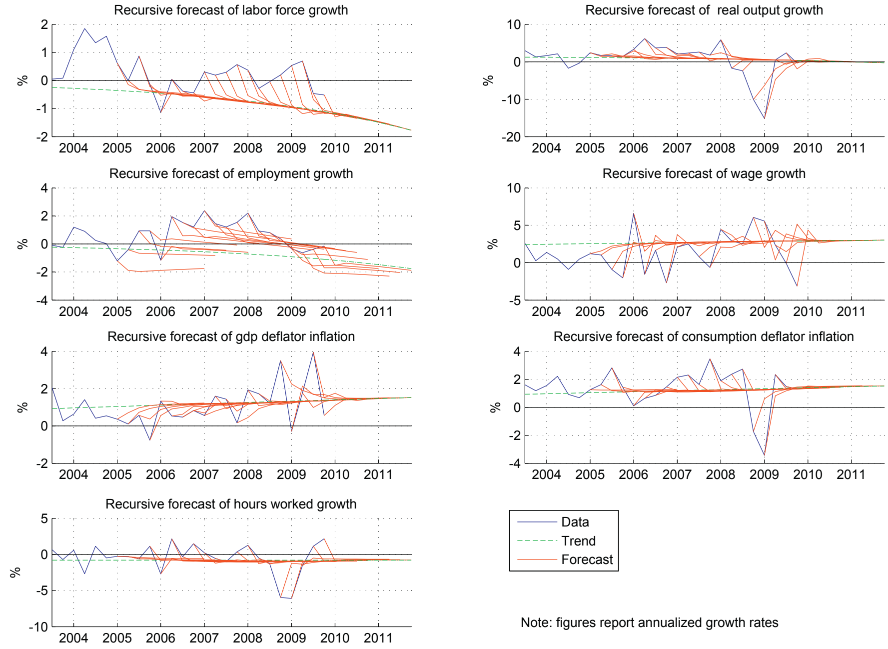


Fig. 3. France – recursive forecast

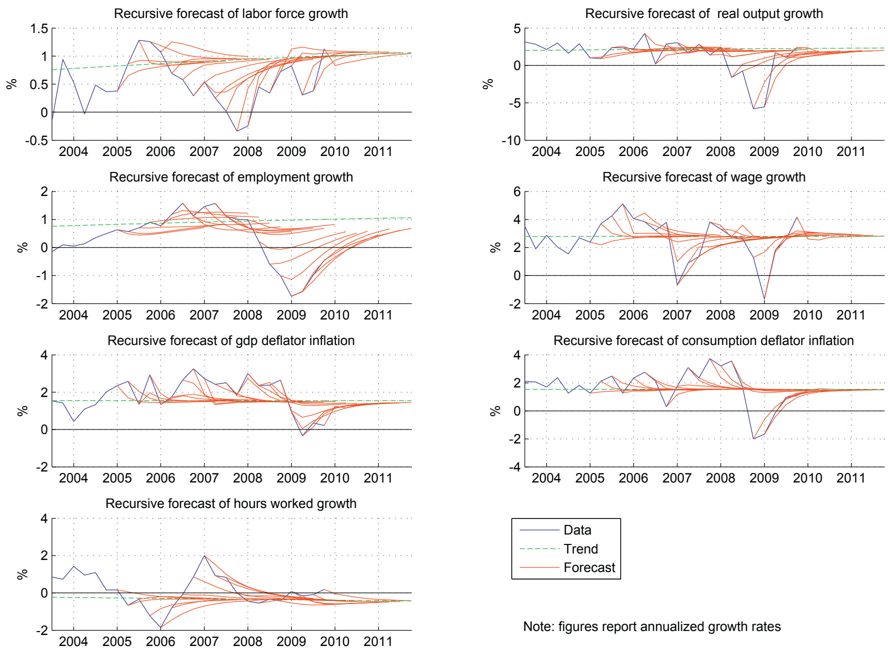


Fig. 4. Italy – recursive forecast

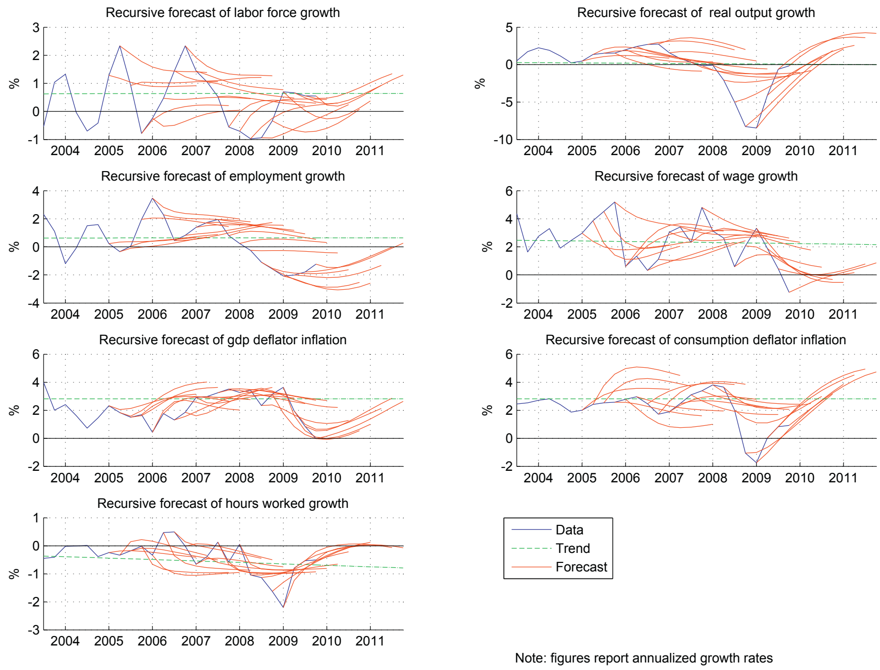


Fig. 5. Spain – recursive forecast

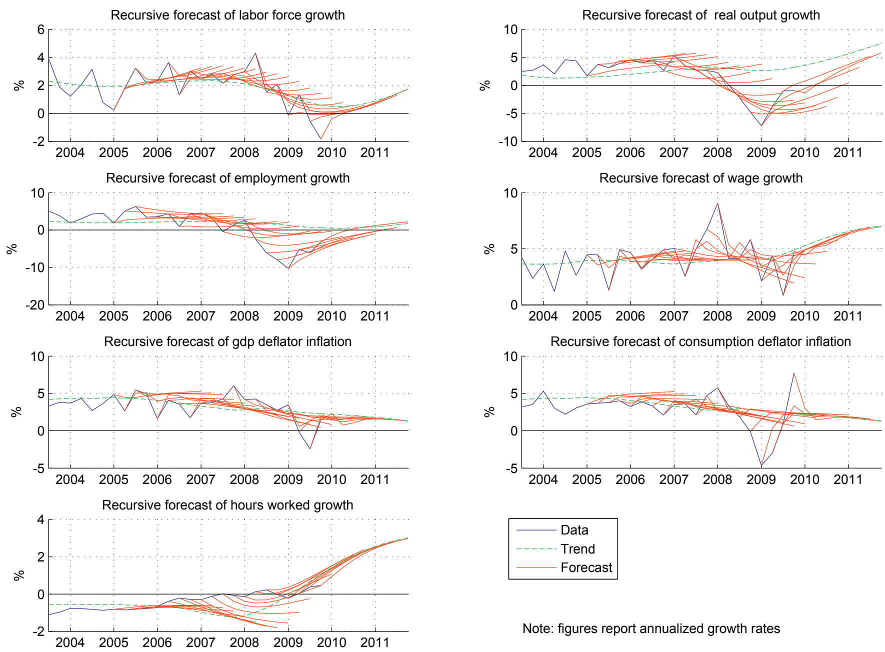


Fig. 6. Belgium – recursive forecast

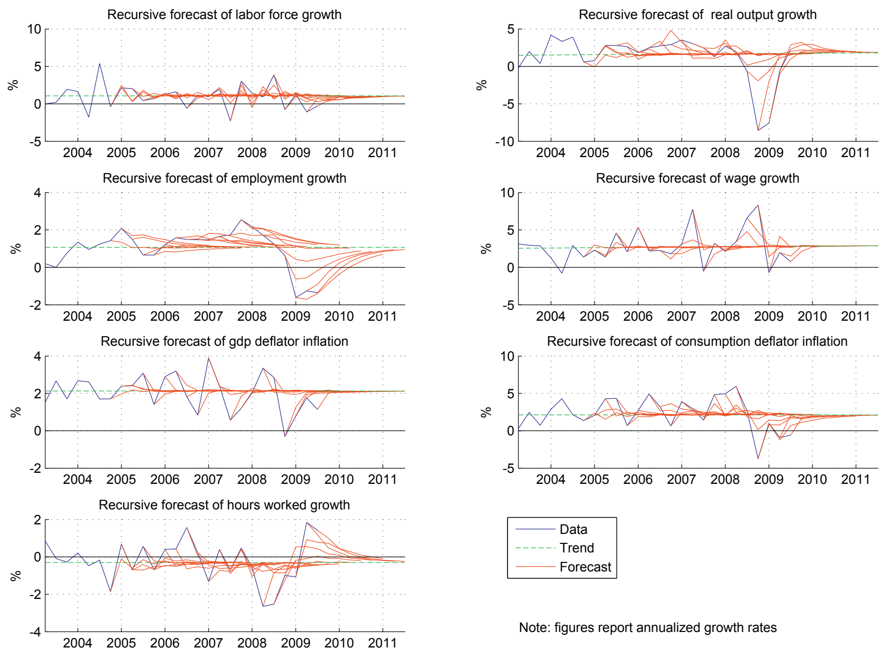


Fig. 7. The Netherlands – recursive forecast

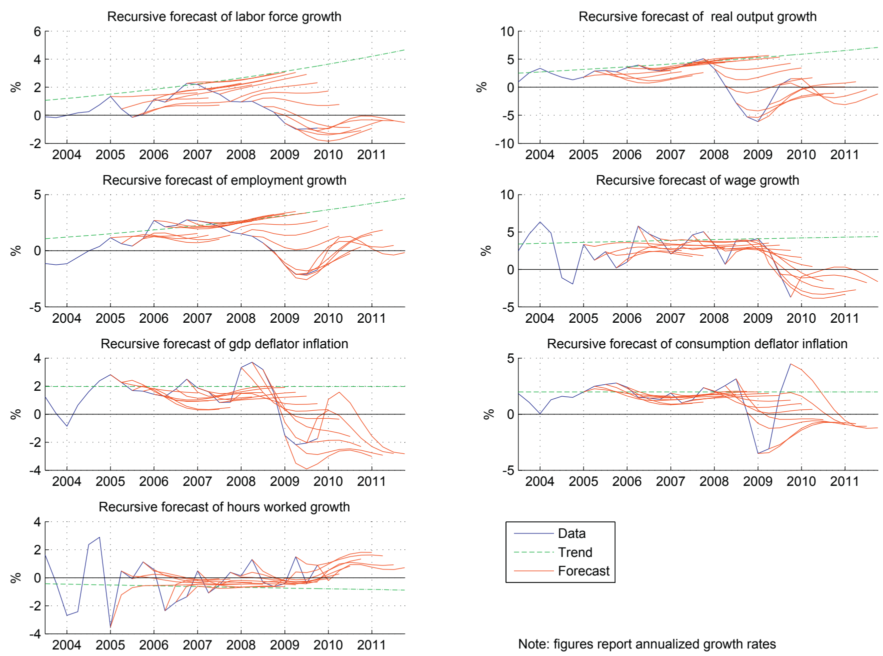
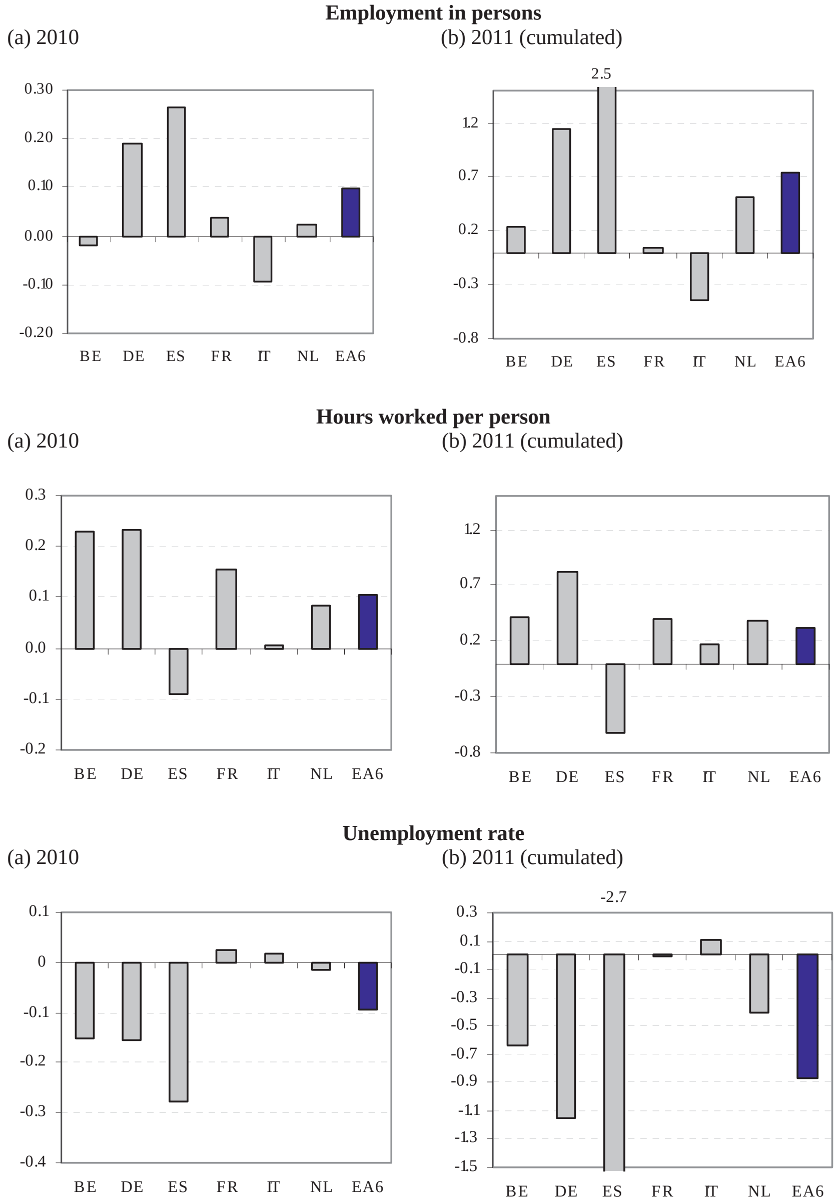


Fig. 8. Impact of a 1% drop in hourly compensation



Note: EA6 is the weighted average of the six euro area countries

Fig. 9. Forecasts' competition: Germany

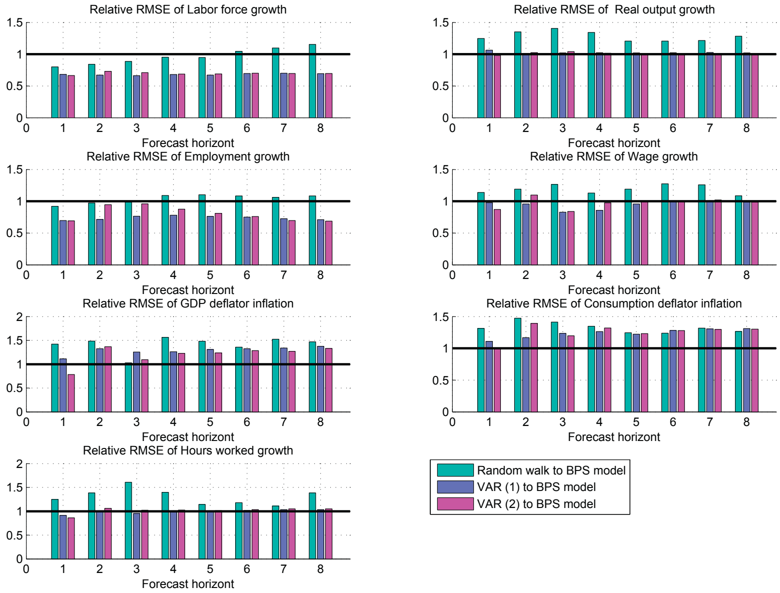


Fig. 10. Forecasts' competition: France

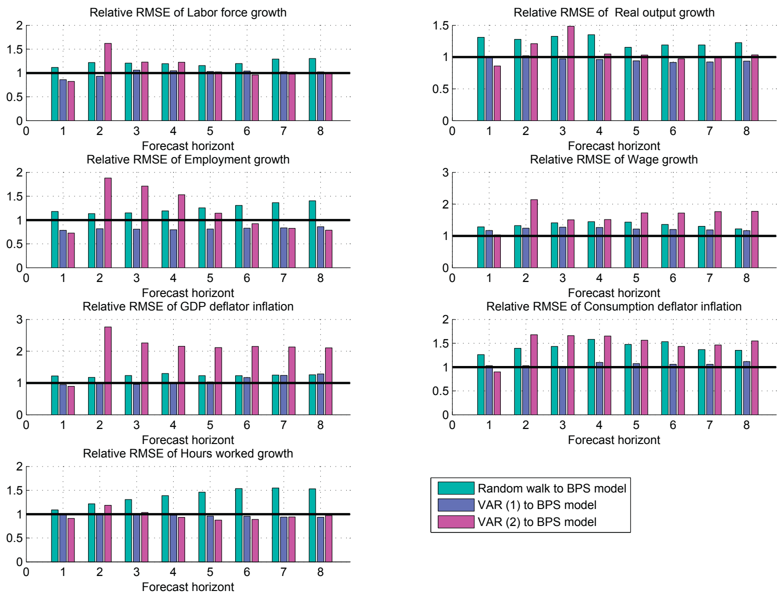


Fig. 11. Forecasts' competition: Italy

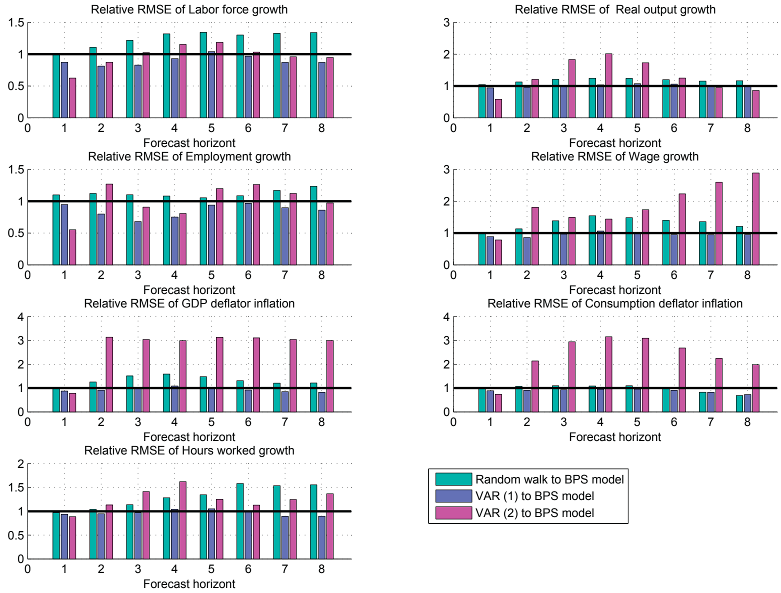


Fig. 12. Forecasts' competition: Spain

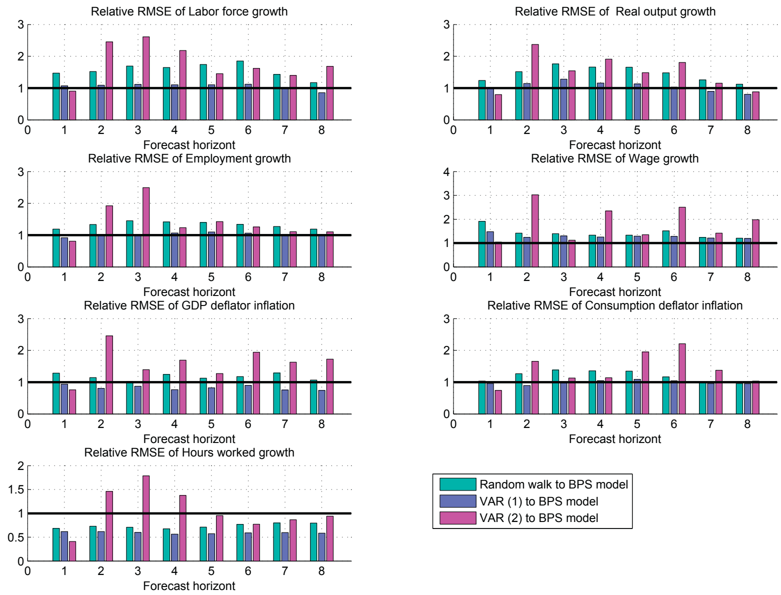


Fig. 13. Forecasts' competition: the Netherlands

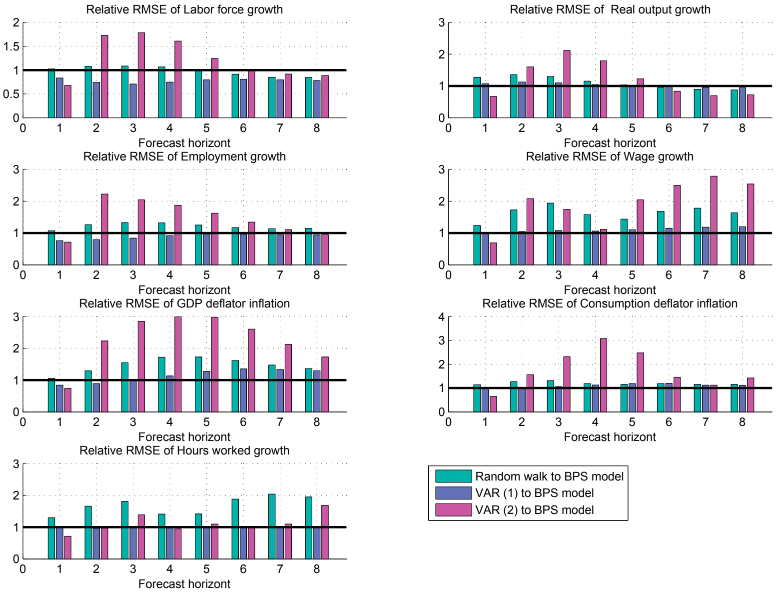


Fig. 14. Forecasts' competition: Belgium

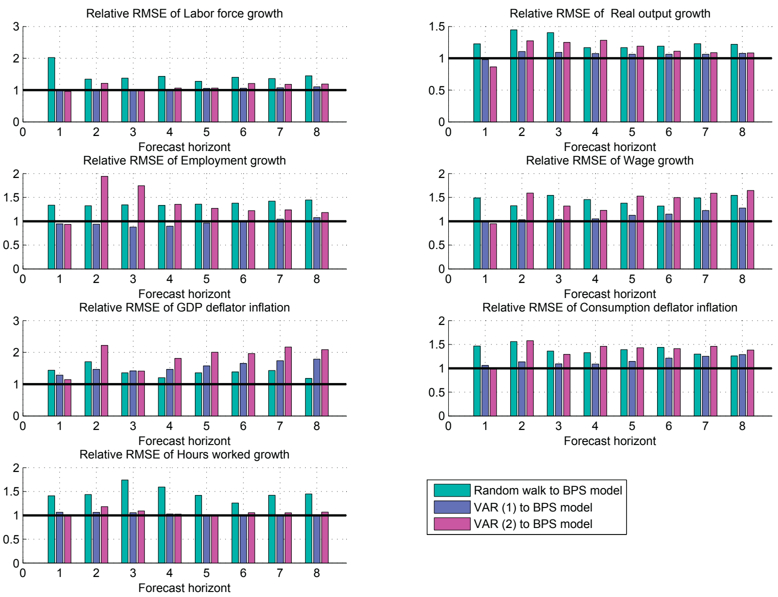
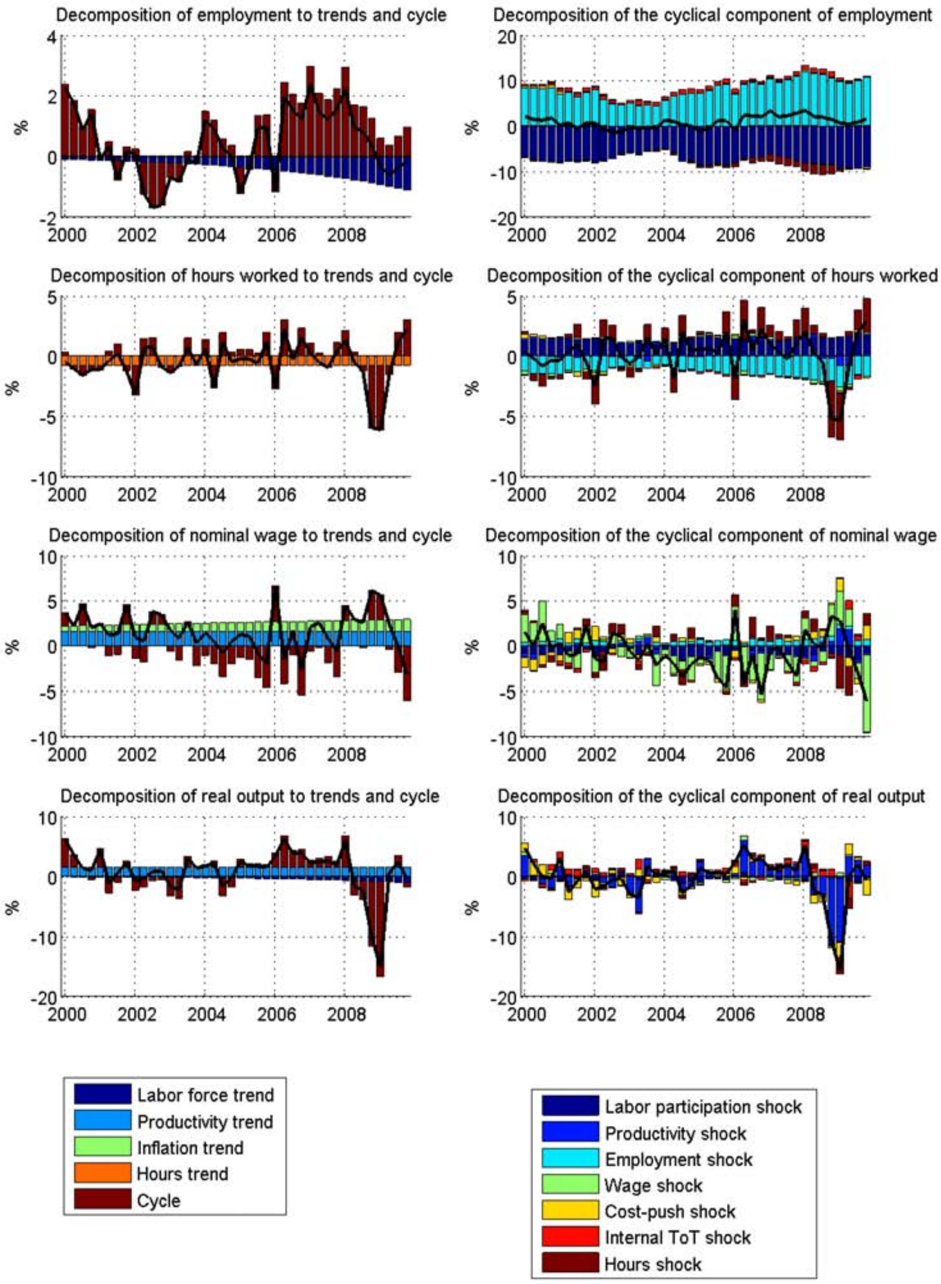
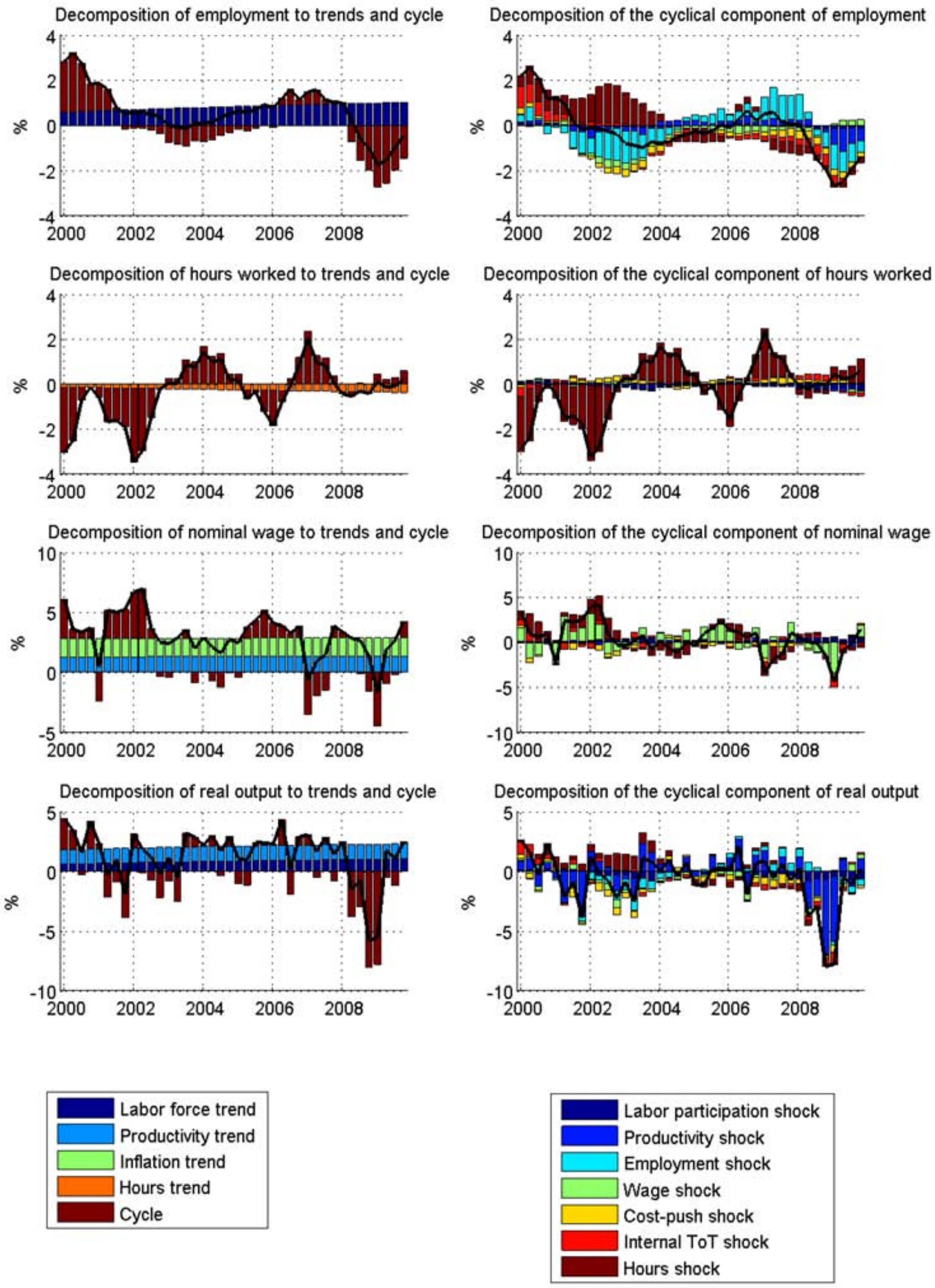


Fig. 15. Historical decomposition for Germany



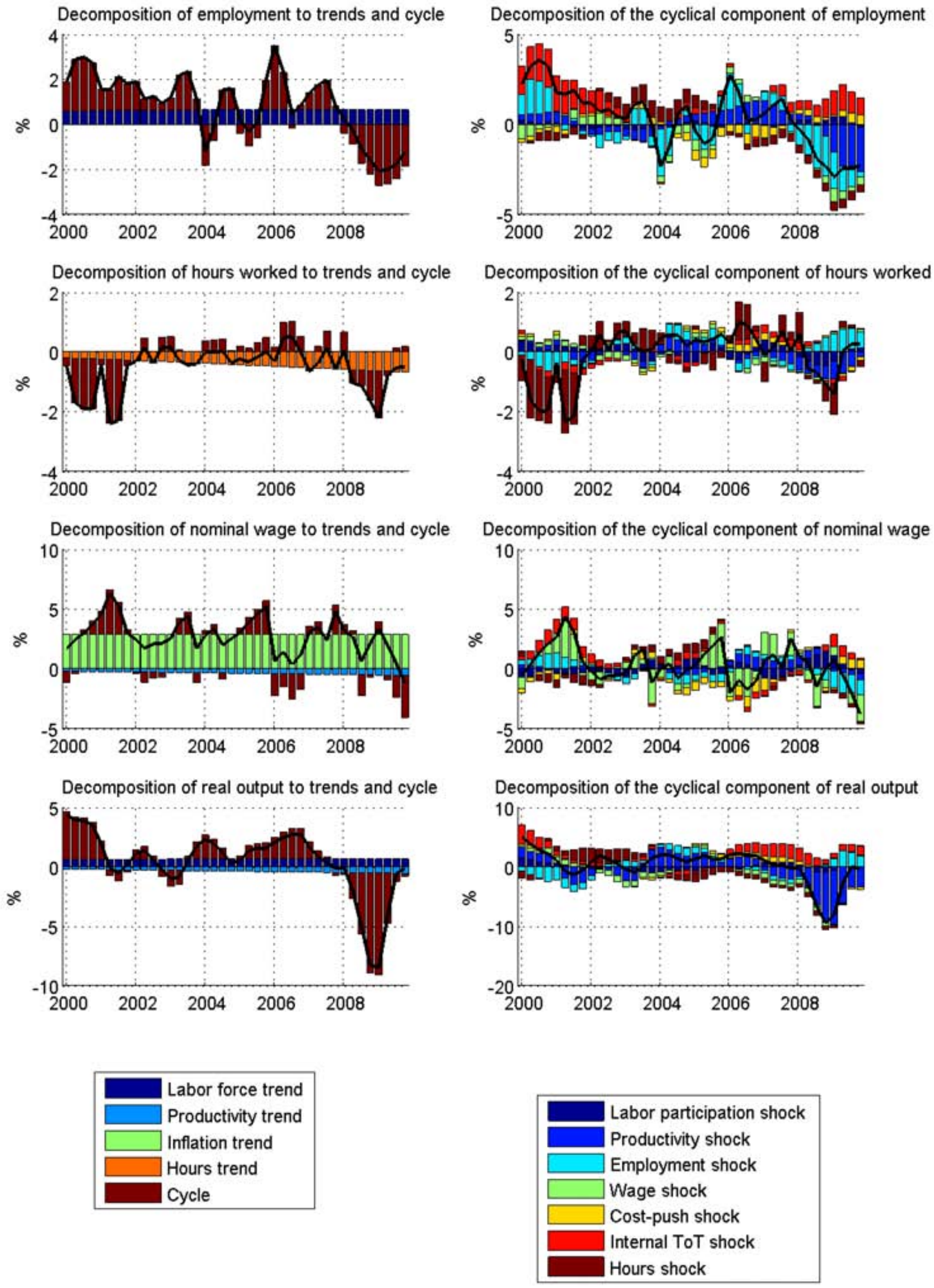
Note: Figures report in annualized growth rates.

Fig. 16. Historical decomposition for France



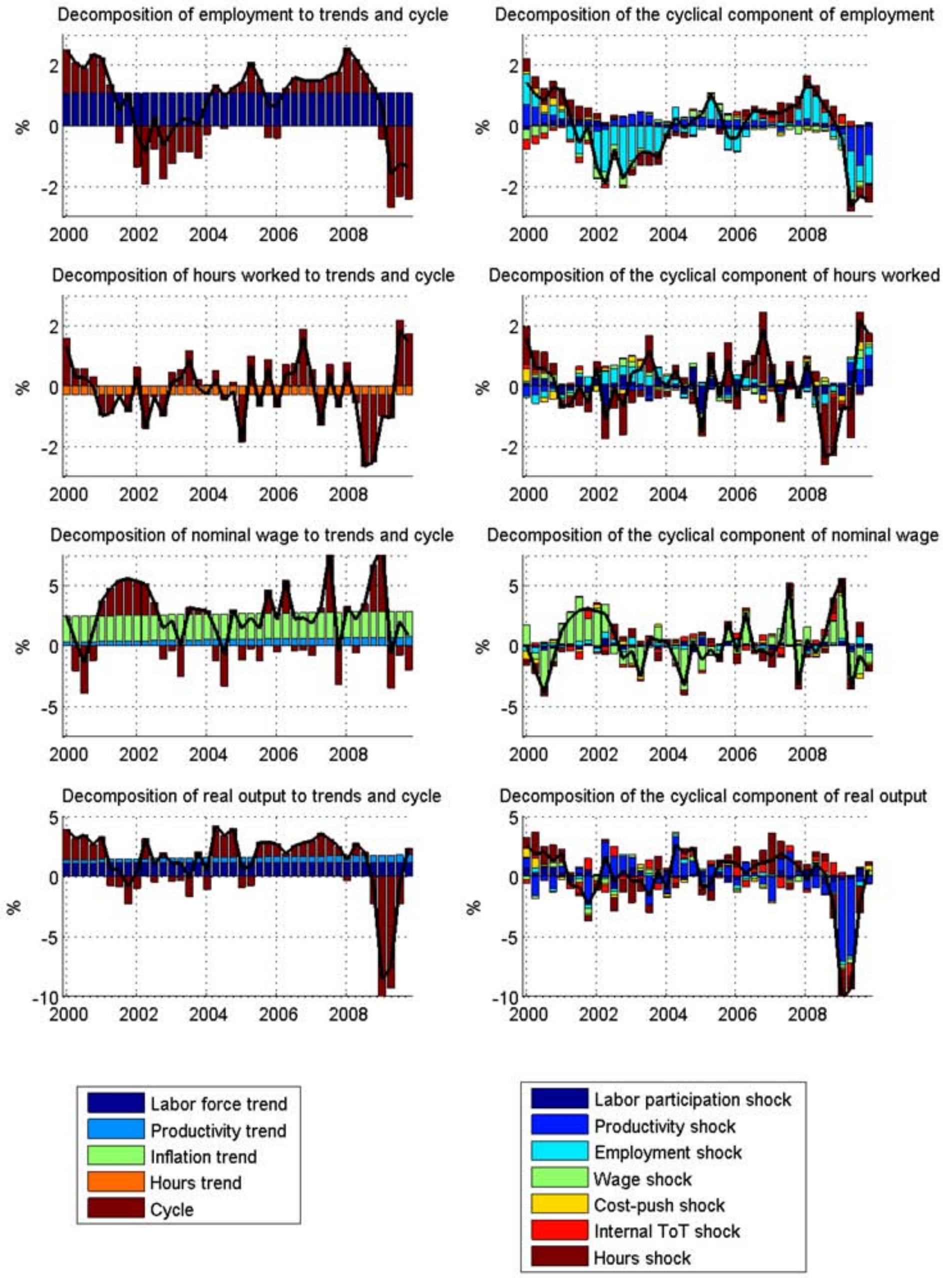
Note: Figures report in annualized growth rates.

Fig. 17. Historical decomposition for Italy



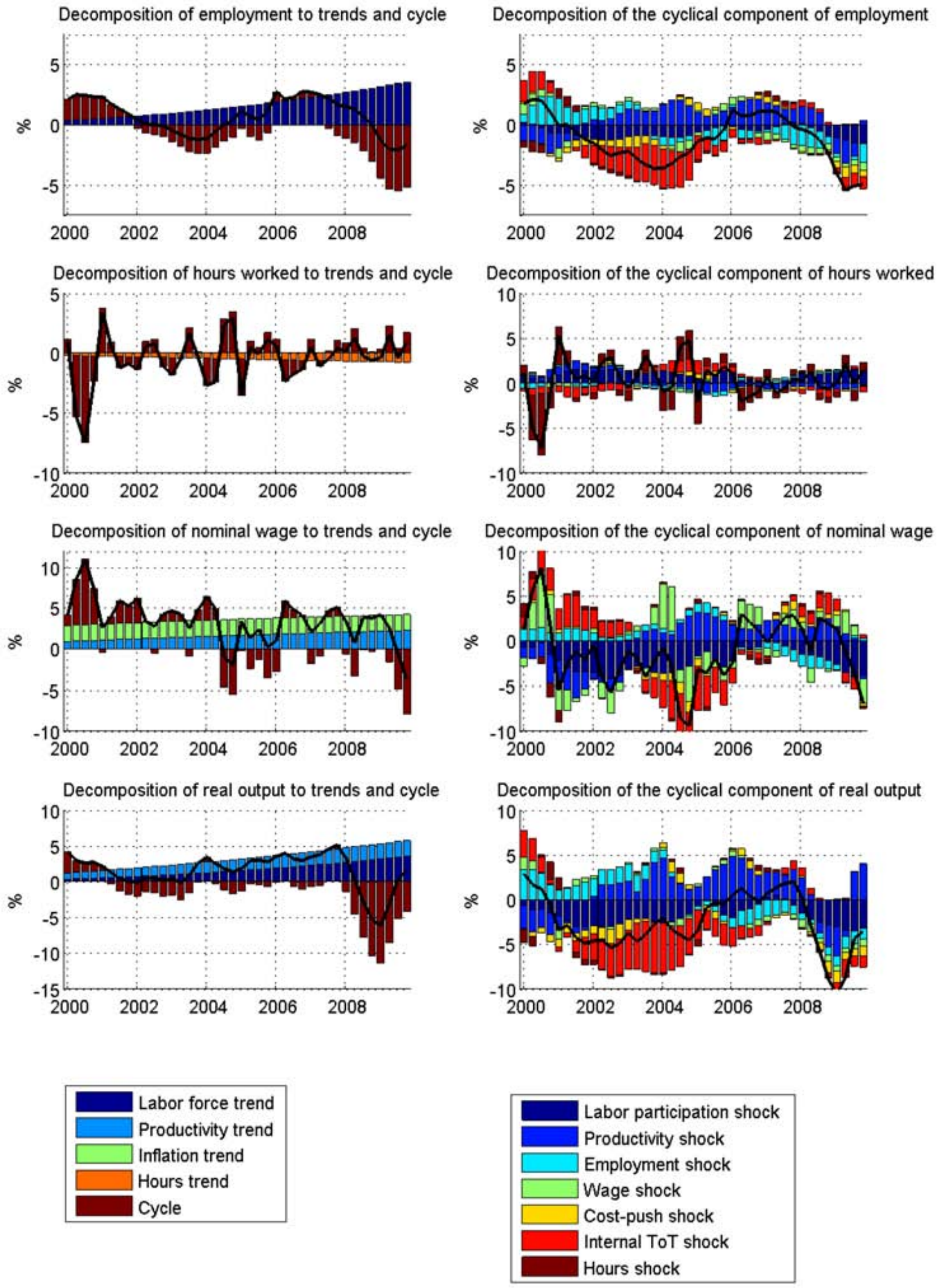
Note: Figures report in annualized growth rates.

Fig. 18. Historical decomposition for Belgium



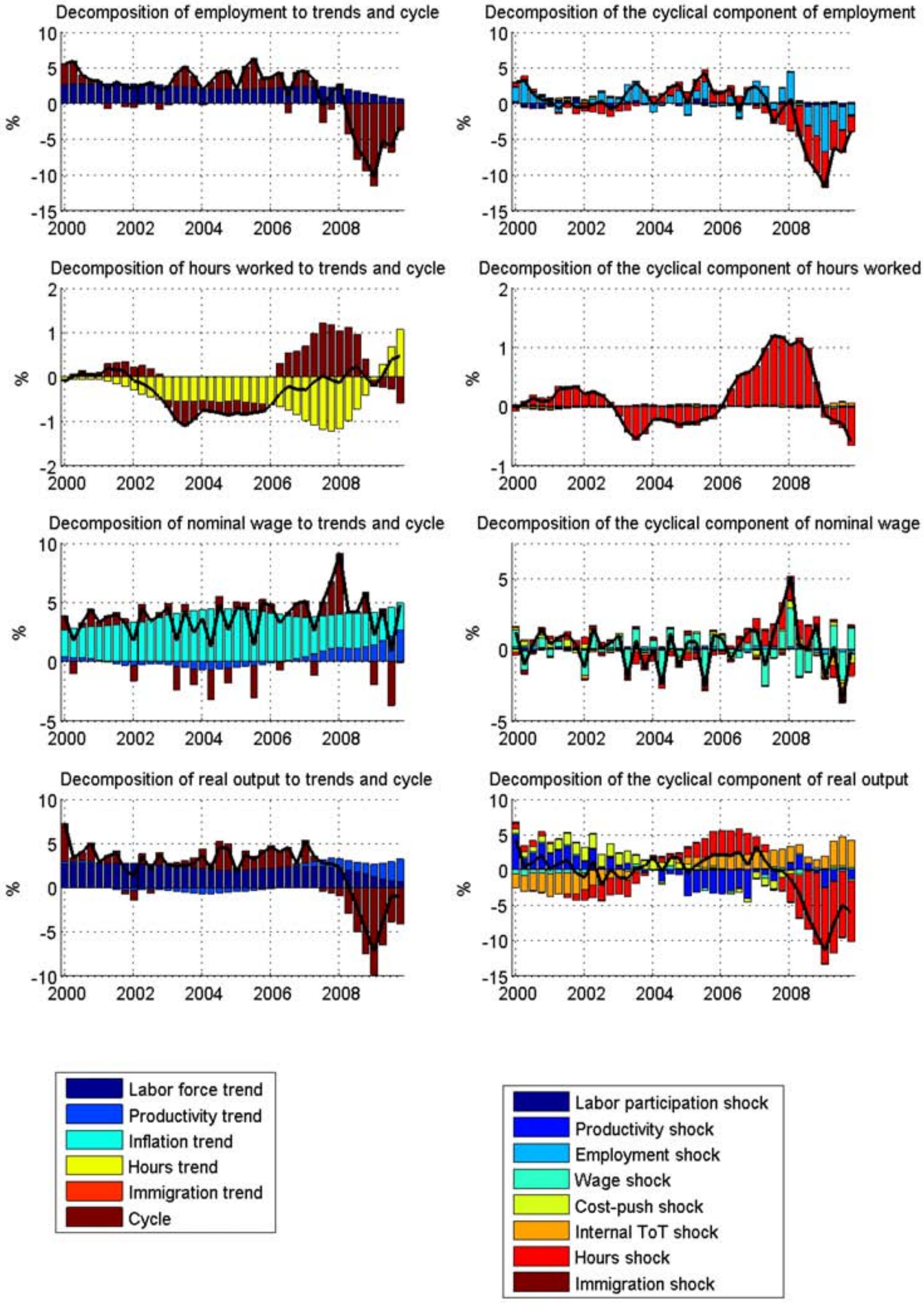
Note: Figures report in annualized growth rates.

Fig. 19. Historical decomposition for the Netherlands



Note: Figures report in annualized growth rates.

Fig. 20. Historical decomposition for Spain



Note: Figures report in annualized growth rates.