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Unemployment across the Euro Area: The Role of Shocks and Labor Market Institutions

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Unemployment across the Euro Area: The Role of Shocks and Labor Market Institutions

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Abstract: This paper analyses the impact of shocks and labor market institutions on unemployment across the Euro Area (EA) from 1999 to 2013. Specifically, I apply an empirical methodology to identify the direct effects of shocks and labor market institutions on unemployment, on the one hand, and the indirect effects of labor market institutions on changing the transmission of shocks to unemployment, on the other hand. The shocks consist of: 1) total factor productivity (TFP) shocks, 2) the real long-term interest rate, 3) labor demand shocks, 4) ECB money supply shocks and 5) ECB unsystematic monetary policy shocks. The labor market institutions cover the unemployment benefit system, active labor market policies (ALMPs), employment protection laws (EPLs), the system of wage determination and the labor tax wedge. The results suggest that the real interest rate and labor demand shocks significantly affect the unemployment rate in the EA. As for labor market institutions, EPLs play a favorable role in reducing unemployment. In contrast, a higher tax wedge tends to have an adverse effect on unemployment, not only directly increasing unemployment but also indirectly amplifying the effects of shocks on unemployment.

Keywords: Unemployment, Shocks, Labor market institutions, Interactions, Monetary policy

JEL codes: E24, J08, E52, F45

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1. Introduction

The recent Global Financial Crisis (GFC henceforth) was associated with job losses for a substantial number of persons, and a strong and persistent increase in unemployment in many European countries. Figure 1 displays unemployment rate paths in the Euro Area (EA) since 1999, both as a whole (the red line) and for 11 individual EA countries. The average unemployment rate across the EA rose from 6.5% in 2007 to 10.8% in 2013.[1] These figures, however, mask large divergences in unemployment rates across countries, from 5.2% in Germany to 26.1% in Spain in 2013. These cross-country differences are not only likely to be strongly influenced by cross-country differences in the magnitude of economic shocks, but also by the institutional framework of national labor markets.

There is a substantial literature which attempts to explain the time series patterns of European unemployment, from the perspective of the role of external shocks and labor market institutions. There is a division between studies which focus on the direct effects of labor market institutions on unemployment and those which consider interactions between shocks and labor market institutions to influence unemployment. A good example studying the direct effects of institutions on unemployment in Europe is Nickell (1997), which considers the relationship between unemployment rates and a set of measures of labor market institutions, based on two cross-sections dated 1983-88 and 1989-1994. This study is further extended by Nickell *et al.* (2005), who investigate the effects of both institutions changing equilibrium unemployment in the long run, and shocks driving the short-run deviations of unemployment from its equilibrium level. They find that changes in labor market institutions explain around 55% of the rise in European unemployment from the 1960s to the first half of the 1990s. On the other hand, Blanchard and Wolfers (2000) (henceforth referred to as BW) use panel data methods to explore the explanatory power of the interactions of shocks and labor market institutions for unemployment in the OECD between 1960 and 1995. The shocks consist of the level of TFP growth, the real interest rate and labor demand shifts. They show that interacting these observed shocks with time invariant institutional variables fits the data well. Subsequently, the basic BW model has been extended and updated by a large body of studies. A good summary of these studies is provided by Bassanini and

[1] Here the average unemployment rate is defined as the unweighted average of the unemployment rates for the 11 individual EA countries.

Duval (2006). The most recent study by Bertola (2017) revisits the BW model and updates the sample period to 2014, to explain the more recent patterns of European unemployment.

In this study, I aim at investigating the patterns of unemployment across the EA between 1999 and 2013. To control for the effect of the introduction of the single currency, I select my sample countries as the first group of countries joining the EA since the official launch of the Euro on 1 January 1999.[2] The corresponding sample period hence begins from 1999. The sample stops with 2013, as later observations would belong to a currently incomplete period for which institutional information is not yet fully available. This sample period covers the GFC and the preceding economic expansion period, featuring a series of dramatic external shocks and important changes in labor market institutions that had taken place in many Southern European countries, such as Italy and Spain, and Central European countries such as Germany.[3]

More specifically, I explore the role of shocks and labor market institutions in influencing unemployment through two steps. First, in the spirit of Nickell *et al.* (2005), I examine the direct effects of shocks and labor market institutions: how much of the evolution of unemployment across the EA can be simply explained by changes in institutions and shocks? Second, I follow the method of BW and investigate the indirect effects of labor market institutions: how do labor market institutions change the transmission of shocks to unemployment?

My contributions to the literature are as follows. First, in contrast to many existing studies, I focus on the EA countries, which have a single monetary policy regime, conducted by the European Central Bank (ECB), and heterogenous labor market conditions. A single monetary policy could help countries to develop more integrated economies and labor markets. However, the underlying differences in labor market institutions are considered to be detrimental to the effectiveness of a single monetary policy framework (Mundell, 1961; McKinnon, 1963). To attempt to explain the unemployment patterns across the EA, I control for the effect of the single monetary policy by the ECB, considering two common monetary policy shocks, namely ECB money supply shocks and ECB unsystematic monetary policy shocks. Second, I

[2] The countries are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain.

[3] The evolution of unemployment covering the period of the GFC is also analyzed by Bertola (2017) and Bachmann and Felder (2020).

enhance the models in the literature by allowing for time-varying data on all institutional variables over time. In BW, the measures of labor market institutions are time-invariant. After that, a group of subsequent studies have updated the sample of BW into time-varying measures for some of the institutions, but focusing on the period between the 1960s and the 1990s. With respect to the measures of institutions for the more recent period, Bertola (2017) constructs the time-varying data for unemployment benefit replacement rates, employment protection laws, union density and the labor tax wedge from the 1960s to 2014. In this study, I extend the time-varying measures for all labor market institutions for the sample period between 1999 and 2013, covering the unemployment benefit system, active labor market policies, employment protection laws, the system of wage determination and the labor tax wedge.[4]

The main results of my analysis reveal that the real interest rate and the labor demand shift significantly affect the unemployment rate in the EA. As for labor market institutions, generous unemployment benefits and pervasive unionization tend to be correlated with increases in the unemployment rate, but could indirectly reduce the impact of shocks on unemployment. The impact of employment protection laws on labor markets is favorable, decreasing unemployment but having no significant interaction with the shocks. Active labor market policies and the coordination in wage bargaining also play a favorable role in affecting unemployment. In contrast, a higher tax wedge tends to have an adverse effect on unemployment, leading to not only higher unemployment but also a larger effect of shocks on unemployment.

The remainder of the paper is organized as follows: Section 2 looks at shocks, both across countries and over time; Section 3 does the same for labor market institutions; Section 4 lays out my empirical methodology; Section 5 reports the main results; Section 6 conducts a set of robustness tests; and Section 7 concludes.

2. Shocks

Following the literature (BW, 2000; Nickell *et al.*, 2005; Rumler and Scharler, 2011), I consider the role of three country-specific shocks and two common monetary policy shocks which might drive the deviations of unemployment from its equilibrium level. Specifically, they include: 1) total factor productivity (TFP) shocks, 2) the real long-term interest rate, 3) labor demand shocks, 4) ECB money supply shocks and 5) ECB

[4] The details are given in the Data Appendix.

unsystematic monetary policy shocks (see the Data Appendix for details).

2.1 Country-specific Shocks

Three country-specific shocks, defined by BW, seem to play a role in affecting unemployment in the recent period (see Bertola, 2017), namely TFP shocks, the real long-term interest rate and labor demand shocks.[5] Particularly, TFP shocks can affect the unemployment rate because it takes time for workers and firms to adjust their expectations to the new productivity growth rate, leading to wage growth mismatching TFP growth for some time. However, once expectations have adjusted, this effect on unemployment should be eliminated in the short run (BW, 2000). Figure 2 plots the evolution of the TFP shocks for each of the EA11 countries.[6] After 1999, TFP growth fluctuates frequently in the runup to the GFC, and then suffers a large decrease during the GFC, followed by a subsequent upswing. These fluctuations have affected countries in a roughly similar fashion. The slowdown in TFP growth during the GFC can lead to a higher unemployment rate, because of wage growth temporarily being in excess of productivity growth, if real wages fail to adjust to it. Theoretically the TFP shock is expected to be negatively associated with the unemployment rate.

The real long-term interest rate, as an influencing factor behind the demand for labor, affects unemployment through changing capital accumulation and in a variety of other ways (Phelps and Zoega, 1998). For example, at a given wage, that is a given ratio of employment to capital, changes in capital accumulation can shift labor demand, which in turn affects unemployment (BW, 2000). There is some evidence that high real interest rates are associated with high unemployment, notably in Fitoussi *et al.* (2000) and BW. Some researchers, however, find very weak effects (e.g., Phelps, 1994, Table 17.2; Nickell, 1998; Nickell *et al.*, 2003). Figure 2 gives the evolution of the real long-term interest rate for each of the sample countries.[7] The red line plots the unweighted average across the EA11. On average, the real interest rate remains relatively stable over time, fluctuating around 2%. For some countries, the real interest rate sharply increases after the GFC. It shows that the real rate in Ireland and Portugal goes up from

[5] The data for constructing the country-specific shocks are variable from the OECD database and the AMECO database. The related webs are http://stats.oecd.org and https://ec.europa.eu/economy_finance/ameco/user/serie/SelectSerie.cfm.

[6] Following Bertola (2017), I use the rate of TFP growth to measure the TFP shock. See the Data Appendix for more details.

[7] The real long-term interest rate is measured by the long-term nominal interest rate less the yearly growth rate of the GDP deflator.

3% in 2007 to 11% in 2011. The higher real interest rate may help to explain the increase in the unemployment rate in Ireland and Portugal since the GFC. In the subsequent empirical analysis, I expect that the real long-term interest rate will be positively related to the unemployment rate.

The measure of the labor demand shock follows BW, which is the sum of the adjusted log wage indicator and the adjusted log employment indicator (less the log of real GDP).[8] Under conditions discussed in Blanchard *et al.* (1997), this measure can capture the unemployment implications of temporarily misaligned real wages. For example, as shown in Figure 2, between 2007 and 2009, the increase in the adjusted labor share, averaged across the EA11, reflects the effect of the increase in the real wage relative to TFP growth ($log(w/a)$), given a dramatic drop in the TFP growth rate in the same period. Generally speaking, the labor demand shocks display heterogenous trends across countries, such as the continuous upward trend in Italy and downward trend in Portugal. Other countries show varying degrees of increases in labor demand after the GFC. On average, labor demand across the EA gradually declines by the eve of the GFC and increases after, as the economy recovers. Overall, I expect that the labor demand shock will be negatively related to the unemployment rate.

2.2 Common Monetary Policy Shocks

The effect of the single currency policy across the EA needs to be considered, such that I also include two common monetary policy shocks from the ECB: ECB money supply shocks and ECB unsystematic monetary policy shocks. These two monetary policy shocks can be treated as proxies for aggregate demand shocks. The ECB controls either the money supply or the short-term interest rate, targeting inflation to ensure price stability. Because of inflation inertia, this leads not only to a change in inflation but also to a change in output, thus affecting unemployment. The mainstream macroeconomic theory, like monetarism, believes that the monetary policy only affects unemployment in the short run. However, some researchers propose that monetary policy could be non-neutral in the long run under the case of price and wage rigidity (e.g., Karanassou *et al.*,

[8] Following BW, I assume that technology is characterized by a Cobb-Douglas production function $Y = (aN)^{\alpha}(K)^{1-\alpha}$, with technological progress assumed to be labor augmenting. Under perfect competition in both goods and labor markets, the marginal product of labor is equal to the real wage (MPL = w), that is $\alpha \cdot a \cdot (Y/aN) = w$. Taking logs on both sides, this yields $log(\alpha) = log(w/a) + log(aN) - log(Y)$, so that a decrease in the log of the labor share, $log(\alpha)$, leads to an equal decrease in the log of the adjusted employment, $log(aN)$, given output and the real wage. Thus, labor demand shocks could be measured by the log of the adjusted labor share, that is, the sum of the adjusted log wage indicator and the adjusted log employment indicator, less the log of real GDP. See the Data Appendix for more details.

2005).

Following Nickell *et al.* (2005), ECB money supply shocks are measured by changes in money supply growth.[9] Figure 3 plots the time path of the money supply shock from the ECB. Roughly speaking, the ECB has twice sharply restricted the rate of money growth, once the early years of the euro's launch and again before the GFC. This conduct is aimed at reducing inflation. The slowdown of the growth rate of the money supply may depress short-term economic growth and increase unemployment. The relationship between money supply shocks and the unemployment rate seems to be negative. Some researchers, however, find very weak effects (e.g., Nunziata, 2002; Nickell *et al.*, 2005).

For ECB unsystematic monetary policy shocks, I follow the measure of Rumler and Scharler (2011), by estimating an interest rate rule (see Equation (1)) and employing its residuals (μ_t^M). More specifically, I estimate a regression with the short-term nominal interest rate as the dependent variable and the current inflation rate and the current output gap as independent variables. In addition, I allow for an inertial response of monetary policy by including one-period lagged values of the dependent variable. The regression is estimated by the generalized method of moments, which is standard in the literature (e.g., Clarida *et al.*, 2000; Gerlach and Schnabel, 2000), and passes the weak instrument tests and over-identifying restriction tests. As instruments, I use the lags of all right-hand-side variables up to lag four.

$$r_t = \alpha + \beta\pi_t + \gamma y_t^{gap} + \delta r_{t-1} + \mu_t^M \quad (1)$$

Data for all variables are quarterly time series covering 1999Q1-2013Q4 and the yearly ECB unsystematic monetary policy shock is measured as the average of the quarterly residuals.[10] Figure 3 gives the evolution of the ECB nominal short-term interest rate and the measure of its unsystematic monetary policy shock. The change of the unsystematic policy shock approximately maps the trend of the ECB interest rate change. Furthermore, apart from the peak between 1999 and 2001, the pattern of the ECB unsystematic policy shock is roughly positively associated with the averaged

[9] The yearly ECB money supply shock is calculated by taking the average of monthly changes in the growth rate of the nominal money stock, that is, the second difference of the log money supply. Data on the nominal money stock are available on the ECB Statistical Data Warehouse, which are monthly monetary aggregates, M2.

[10] Data on short-term nominal interest rate are obtained from the ECB Statistical Data Warehouse, which are nominal interest rates on ECB marginal lending facilities. Data on inflation rates and output gaps are taken from the OECD Economic Outlook No 105 (version May 2019), expressed by the percentage change of CPI on the same period of the previous year and the ratio of the output gap to potential GDP, respectively.

unemployment rate across the EA. By initial observation, my measure seems to reveal that an expansionary monetary policy combats unemployment and a contractionary monetary policy leads to higher unemployment. The effect of the unsystematic monetary policy shock on unemployment is expected to be positive.

3. Labor Market Institutions

Labor market institutions influence unemployment in two ways. First, some of them affect the ease with which unemployed individuals can be matched to available job vacancies; Second, some institutions tend to raise wages in a direct fashion despite excess supply in the labor market. There may be institutions common to both ways. In line with the literature (e.g., Nickell, 1997; BW, 2000; Nickell *et al.*, 2005), I capture the institutional setting of national labor markets by using eight indicators.[11] They cover the unemployment benefit system, active labor market policies (ALMPs), employment protection laws (EPLs), the system of wage determination and the labor tax wedge for each country. I next describe these labor market institutions in more detail.

3.1 Unemployment Benefit System

The unemployment benefit system influences unemployment either because of its impact on the effectiveness with which the unemployed are matched to available jobs or because of its effect on wages. On the one hand, unemployment benefits directly affect the readiness of the unemployed to fill vacancies. The likelihood of taking up a job decreases when unemployment benefits are more generous. Hence, it tends to result in a longer unemployment duration and make for a more stagnant labor market with a higher proportion of the long-term unemployed. On the other hand, due to lower opportunity costs of unemployment, generous unemployment benefits push up the reservation wage. Indeed, empirical evidence suggests that unemployment benefits have a significant adverse effect on unemployment (e.g., Nickell *et al.*, 2005). There is fairly clear micro evidence on the positive impact of benefit levels and entitlement durations on the duration of individual unemployment spells (Katz and Meyer, 1988; Meyer, 1988; Carling *et al.*, 1996). Considering the important aspects of the unemployment benefit system are the level of benefits and the length of time for which they are available, I select the benefit replacement rate and the benefit duration as the

[11] The institutional measures are: 1) the replacement rate of unemployment benefits; 2) unemployment benefit duration; 3) a measure of active labor market policies; 4) employment protection index; 5) union contract coverage; 6) union density; 7) a measure of employer and union coordination in wage bargaining and 8) the tax wedge.

measures of the unemployment benefit system.[12]

Figure 4 presents the time paths of two measures of the benefit replacement rate, namely the replacement rate during the 1st year of unemployment and the average replacement rate during years 2 to 5 of an unemployment spell, and Figure 5 plots the time path of an index of benefit duration for each sample country. The benefit replacement rates in nearly all countries are at a comparable level expect for Ireland and Italy, in which countries the benefit levels are relatively low. It is remarkable that there is a sharp rise in the replacement rate in Portugal in 2010, but which almost returns to the previous level after 2012. As for benefit duration, most countries are committed to reducing the duration of entitlement. However, Austria and Spain tend to keep the duration very stable and Ireland and Luxembourg even slightly increase their benefit duration. To make a comparison among countries, Austria and Belgium provide relatively generous unemployment benefits, especially characterized by the longest benefit durations. While the unemployment benefits in Ireland are featured by the long benefit duration but low replacement rate. In contrast, the benefit system in Italy is different, reflected by having both the shortest benefit duration and the lowest benefit level.

3.2 Active Labor Market Policies (ALMPs)

ALMP programmes aim at reducing unemployment by improving the job matching process and by enhancing opportunities for the unemployed to accumulate skills and work experience affecting their job search behavior. Thus, unemployed individuals become more employable. The literature indicates that ALPMs do have a negative correlation with the unemployment rate, based on both multi-country studies (e.g., Scarpetta, 1996; Nickell, 1997; Elmeskov *et al.*, 1998) and microeconometric studies (e.g., Martin and Grubb, 2001; Calmfors *et al.*, 2002).

Figure 6 shows the evolutions of two measures for public expenditures on ALMPs in each of the EA11, which are public expenditures on ALMPs as a share of GDP and public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force, respectively. For the gross expenditures on ALMPs (as a share of

[12] The OECD reports data on the net unemployment benefit replacement rate at two earnings levels for three different family types in 14 different duration categories. I derive two measures of the benefit replacement rate to express the level of benefit: the average net replacement rate during the 1st year of unemployment and the average net replacement rate during years 2 to 5 of an unemployment spell. I also derive an index of benefit duration, which is equal to [0.6 * (2nd and 3rd year replacement rate) + 0.4 * (4th and 5th year replacement rate)] / (1st year replacement rate). See the Data Appendix for the details.

GDP), the evolutions are heterogenous across countries. Roughly speaking, Belgium, France, Germany, Italy, Netherlands and Spain have experienced a reduction in their expenditures on ALMPs. The notable country is Germany, in which there is a sharp fall in the spend on ALMPs, reducing from above 1% to around 0.3% of GDP. In contrast, Austria and Luxembourg increase their ALMPs spends to 0.6% of GDP. However, the evolution of public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force is stable in most countries, roughly remaining around 10%. Italy and Spain spend relatively less on ALMPs, below 10% and further reducing to about 2%. Additionally, Netherlands devotes most resources to ALMPs to offset their generous unemployment benefits (see benefit duration in Figure 5) and to push the unemployed into work, but nonetheless been reducing the spend on ALMPs.

3.3 Employment Protection Laws (EPLs)

EPLs are the proxies for the costs firms face when they dismiss an employee and are therefore the indicators of the flexibility of a labor market. The stricter EPLs, the more costly it is for employers to lay off workers. EPLs have an impact on the effectiveness with which the unemployed are matched to available jobs, but the specific impact is not clear-cut. In terms of outflows from unemployment, the impact of EPLs can go two ways. EPLs may tend to make firms more cautious about filling vacancies, which slows the speed at which the unemployed move into work. However, the introduction of EPLs may also lead to an increased professionalization of the personnel function within firms, which can increase the efficiency of job matching (e.g., the case in Britain in the 1970s; see Daniel and Stilgoe, 1978). By contrast, such laws will reduce involuntary separations and hence lower inflows into unemployment. Furthermore, EPLs may also have a direct impact on pay, since they raise the job security of existing employees, encouraging them to demand higher pay increases. Overall, the impact of EPLs on unemployment is ambiguous. The results presented by Lazear (1990), Addison and Grosso (1996), Elmeskov *et al.* (1998) and Nickell and Layard (1999) do not add up to anything decisive, neither do more recent studies (e.g., Bachmann and Felder, 2020).

The OECD reports indicators measuring the strictness of the regulation covering the individual dismissal of employees on regular contracts and temporary contracts. The indicators range from one to six, with higher values representing stricter regulation. Figure 7 plots the evolutions of the indicators on both regular and temporary contracts. In addition, it also shows a summary indicator of overall employment protection, which

is the average of indicators for regular contracts and temporary contracts. On average, France and Luxembourg tend to have comparatively strict and stable regulation relative to other countries. In contrast, the employment protection in Ireland is the weakest. Notable changes include the relaxation of the laws on temporary contracts in Germany and Italy before 2004. Spain has also relaxed the laws on temporary contracts several times since 2006 and the laws on regular contracts since 2010. Portugal experiences a staged and greater reduction on the strictness of EPLs on both regular contracts and temporary contracts over the whole sample period.

3.4 System of Wage Determination

Turning to those factors which have a direct impact on wages, the obvious place to start with is the institutional structure of wage determination. In my sample of countries, the majority of workers have their wages set by collective bargaining between employers and trade unions at the plant, firm, industry or aggregate level. The overall outcome depends on the percentage of employees who are union members (union density), the proportion of employees covered by collective agreements (union contract coverage) and the degree of coordination of wage bargaining. Generally, greater union density and coverage can be expected to exert upward pressure on wages, hence raising equilibrium unemployment. In particular, on the one hand, with higher wage resistance initially, more job matches are destroyed as a reaction to an adverse shock, leading to higher inflows into unemployment (Bertola and Rogerson, 1997). On the other hand, because trade unions aim to protect the jobs of their members, this motive fosters the segregation of labor markets, making it harder for outsiders, the unemployed, to enter employment, hence reducing outflows from unemployment (Bachmann and Felder, 2020). But these adverse effects can be offset if wage bargaining across the economy is highly coordinated (Nickell and Layard, 1999).

Figures 8 and 9 present the evolutions of the measures for union density and union contract coverage for each country.[13] In most of the EA11, union density tends to be less than 50% and is gradually declining. Union membership in Belgium and Finland tends to be high (around 55% and 70% of employees, respectively). For some countries in which there is a wide gap between density and coverage, it is because union

[13] The data on union density, union coverage and coordination in wage bargaining are available on the ICTWSS Database. version 6.0. Amsterdam: Amsterdam Institute for Advanced Labour Studies (AIAS), University of Amsterdam. June 2019.

agreements are extended by law to cover non-members in the same sector. This situation is most noticeable in France, which has the lowest union density at around 10% but one of the highest levels of union coverage at above 90%.

In Figure 10, I plot the time paths of the indicator measuring the coordination in wage bargaining. Notable changes are the reductions in wage-setting coordination in Ireland and Portugal, and the increases in coordination in Luxembourg and Spain. Comparing among countries, wage bargaining tends to be coordinated to the highest degree in Belgium and to the lowest degree in France.

3.5 Labor Tax Wedge

The labor tax wedge measures the difference between the labor cost to the employer and the corresponding net take-home pay of the employee, which includes income taxes and payroll taxes.[14]The impact of the labor tax wedge on unemployment remains a subject of some debate. Layard *et al.* (2005) argue that the tax wedge directly impacts on wages and in turn affects unemployment through real wage resistance. For example, if labor tax rates go up, the real post-tax consumption wage must fall if the real labor costs per employee facing firms are not to rise. Any resistance to this fall will lead to a rise in unemployment. This argument suggests that increases in the labor tax rate may lead to a temporary rise in unemployment. However, BW believe that the labor tax wedge affects mainly the wage, not unemployment. Because taxes, such as income taxes, are likely to be roughly neutral, which by their nature apply equally on the unemployed and the employed. And payroll taxes also may not matter very much if the unemployment benefit system tries to achieve a stable relation of unemployment benefits to after-tax wages. Empirically, many studies do find a strong adverse relationship between the tax wedge and unemployment (e.g., Nickell, 1997; Belot and van Ours, 2004).

Figure 11 plots the changes in the measure of the tax wedge (as a percentage of total labor cost for the employer) for each country, based on the OECD data. All countries exhibit a stable level over the period from 1999 to 2013. The tax wedges roughly remain between 30% and 40% of total labor cost, apart from Ireland and Luxembourg with less

[14] My measure of the tax wedge is based on OECD data, which is the sum of personal income taxes, payroll taxes paid by employers and all social security contributions (from employers and employees) less the family benefits they receive in the form of cash transfers as a percentage of total labor cost. Thus, compared with Nickell *et al.* (2005), this measure does not incorporate consumption taxes.

than a 20% tax wedge.

4. Estimation Methodology

I aim to test the impact of the shocks and labor market institutions discussed above on unemployment patterns across time and countries. Following BW and Nickell *et al.* (2005), I do this in two steps: Section 4.1 considers the direct effects of shocks and labor market institutions; and Section 4.2 considers the indirect effects of labor market institutions.

In the following expressions, the subscript i is a country index, t a period index, j an institution index and k a shock index. The dependent variable, u_{it} is the unemployment rate in country i in period t. The independent variables include X_{ijt} and Y_{ikt}, which represent the value of institution j in country i in period t, and the value of shock k in country i in period t, respectively. In addition, all regression models include country fixed effects c_i and period fixed effects d_t. The country fixed effects control for unobservable country factors that are constant over time. The period fixed effects control for unobservable time factors that are common across countries. e_{it} is the error term.

4.1 Direct Effects of Shocks and Institutions

The equation in the first step relies on a simple linear relation between the unemployment rate and a set of measures of labor market institutions and observable shocks. The equation used is the following:

$$u_{it} = c_i + d_t + \sum_j \beta_j X_{ijt} + \sum_k \gamma_k Y_{ikt} + e_{it} \quad (2)$$

The direct effect of labor market institutions on the unemployment rate is captured by the parameters β_j. The direct effect of the shocks is captured by the parameters γ_k.

4.2 Indirect Effects of Institutions

In the second step, two variant forms of Equation (2) capture the contribution of interactions between shocks and institutions on unemployment patterns across the EA, that is, the indirect effects of institutions. In the spirit of BW, the equations are as following:

$$u_{it} = c_i + \left(1 + \sum_j \beta_j X_{ijt}\right) d_t + e_{it} \quad (3)$$

$$u_{it} = c_i + d_t + \left(1 + \sum_j \beta_j X_{ijt}\right)\left(\sum_k \gamma_k Y_{ikt}\right) + e_{it} \quad (4)$$

In Equation (3), the unemployment rate is explained by the unobservable common time effects interacted with the institution variables, called the unobservable shock specification, corresponding to the basic equation in Table 1 of BW. Equation (4) replaces the unobservable time effects by a set of observable shocks discussed in Section 2, named the observable shock specification, corresponding to Table 5 of BW.

With respect to the sample used for all regressions, as mentioned above, the sample countries are the first group of countries which joined the EA at the official launch of the Euro on 1 January 1999: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. The sample period begins from 1999 and ends in 2013, covering the GFC and the preceding economic expansion period. Additionally, all the measures of the independent variables (shocks and institutions) are constructed as deviations from their sample mean across time and countries. All regressions are estimated by non-linear least squares, in line with the literature (BW, 2000; Bertola *et al.*, 2007). I use non-linear least squares because the shock coefficients, both for the unobservable shocks in Equation (3) and for the observable shocks in Equation (4), are simultaneously estimated both for the shocks alone and for the interaction with institutions. Equation (2) is also estimated by non-linear least squares, in order to keep the estimates comparable.

It is worth noting that I use annual data for all estimations, rather than the five-year averages used by BW. BW split the observation period into 8 five-year sub-periods. For each sub-period, they compute the average of annual data for each variable. Instead, I look at year-to-year movements in institutions and in shocks following Belot and van Ours (2001) and Nickell *et al.* (2005), which allows for a fully exploration of the dynamic effects.

Another difference from BW in this study is the regressions are based on time-varying measures of all eight labor market institutions, instead of the time-invariant measures. In BW, the measures of labor market institutions are time-invariant, which are the averages of 1983-88 and 1989-94 values from the Nickell (1997) database. However, BW further construct time series for replacement rates and for employment protection. After that, a group of subsequent studies have updated the sample of BW into time-varying measures for some of the institutions, like Belot and van Ours (2001), Bassanini and Duval (2006), Bertola (2017) and Bachmann and Felder (2020). In this study, the methods for constructing the time-varying measures of institutions are introduced in

Section 3 and detailed in the Data Appendix.

5. Estimation Results

5.1 Direct Effects of Shocks and Institutions

We begin by examining the direct effects of shocks and labor market institutions on unemployment evolutions across the EA between 1999 and 2013. Table 1 presents the estimation results of Equation (2). Column I reports the coefficient estimates by regressing the reduced form of Equation (2), only focusing on shocks, column II only focusing on institutions, and column III combining both together.

We firstly look at the role of shocks. The most significant shock, no matter which specification, is the real long-term interest rate, revealing a positive impact on the unemployment rate. Specifically, a rise in the real interest rate of 8 percentage points, as has happened in Ireland and Portugal between 2007 and 2011, leads to an increase in the unemployment rate of 7% if leaving institutions out, or 5% if allowing for both shocks and institutions. These magnitudes are consistent with the coefficients reported in Bertola (2017, Tables 4 and 10) which are estimated over the sample period 1960-2014. Furthermore, for the specification that allows for shocks and institutions (Column III), labor demand shocks become strongly significant, with the expected sign. A decrease in the labor demand shock of 10 percentage points, translates into an increase in the unemployment rate of about 3%. Additionally, the impact of TFP shocks on the unemployment rate is negative in Column III but insignificant. Finally, ECB money supply shocks and unsystematic monetary policy shocks do not show any significant effects.

With respect to the direct effects of labor market institutions on unemployment, all coefficients of institutions have the expected signs when they are significant. ALMPs expectedly display negative association with the unemployment rate. Increasing the expenditures on ALMPs tends to reduce the unemployment rate. The negative impact of EPLs on the unemployment rate is not theoretically surprising. The strong system of EPLs is correlated with reductions in the unemployment rate due to lower inflows into unemployment as mentioned in Section 3. As for the labor tax wedge, its significantly positive coefficient suggests that large tax wedges are positively correlated with institutional constraints on wage flexibility, hence inducing higher unemployment. Union density might in principle capture some of the institutional features on real wage

resistance. On the other hand, wage-setting coordination is significantly correlated with reductions in the unemployment rate, as might be expected. A generous unemployment benefit system, in terms of both benefit levels and benefit durations, tends to be associated with increases in the unemployment rate, which is in line with the literature (e.g., Scarpetta, 1996; Elmeskov *et al.*, 1998 and Nickell and Layard, 1999). However, the estimate here is not as large as results in these previous studies, which on average indicate a 1.1 percentage point rise in equilibrium unemployment for every 10 percentage point rise in the benefit replacement rate (Layard *et al.*, 2005), but it is comparable to the study focusing on more recent data by Bertola (2017).

5.2 Indirect Effects of Institutions

Turning to the indirect effects of labor market institutions on the unemployment rate, Table 2 reports the estimation results of two equations allowing for interactions between shocks and institutions, namely the unobservable shock specification and the observable shock specification.

As for the coefficient estimates of the unobservable shock specification (see Column I), when I estimate the coefficients all measures of institutions are constructed as deviations from the cross-country mean. In this way, the time effects give the evolution of unemployment for a country with mean values for all eight institutions. Hence, the estimate implies that the time effects are highly significant and generate a rise in the unemployment rate between 1999 and 2013 of 1.31 percentage points if a country had mean values for all eight institutions. This is much smaller than the 7.3 percentage points reported in BW and the 6.9 percentage points in Nickell *et al.* (2005), because of the differences in the sample period and countries, and the use of time-varying institutions rather than time invariant institutions.

Then, the institutions which can be significantly interacted with time effects include ALMPs, tax wedge and union coverage. Specifically, ALMPs have significantly negative shock-interaction coefficients, mitigating the impact of shocks on unemployment. Moreover, union coverage's interaction coefficient is positive, as might be expected, amplifying the impact of shocks. The institution with the unexpected sign is the tax wedge, which leads to a smaller effect of shocks on unemployment.

Column II in Table 2 shows the regression results of the observable shock specification that allows for both observable shocks and the interactions with institutions. Firstly, the

effects of the real interest rate and the labor demand shock on unemployment are strongly significant and very similar to the estimated results in Table 1. But the magnitude of the effect of the real interest rate becomes larger than that in Table 1, and the effect of the labor demand shift becomes smaller. An increase in the real interest rate of 8 percentage points leads to an increase in the unemployment rate of around 8%. A reduction in the adjusted labor share of 10 percentage points leads to a rise in the unemployment rate of about 2%. In addition, the impacts of TFP shocks and ECB monetary policy shocks are still insignificant. Secondly, for the interaction terms showing the institutions' indirect effects, more institution variables become significant, including the replacement rate, tax wedge, union coverage and union density. There is some evidence that higher replacement rates tend to reduce the impact of the shocks on unemployment, which does not seem to be in line with theoretical predictions. However, it is consistent with the results reported by Bachmann and Felder (2020, Table 2), who also find the diminished (but insignificant) role of the benefit replacement rate for the same period covering 1999-2013. The interaction effect of ALMPs is negative but loses its significance in the observable shock specification. The tax wedge's interaction becomes positive and very significant. Higher tax wedges tend to amplify the impact of shocks on unemployment, which is in line with Bertola (2017, Table 6) and with the theoretical prediction. Finally, two indicators related to trade unions display significantly negative interaction effects. The negative interaction coefficient of union density is consistent with the coefficient estimate reported in Bertola (2017, Table 6). Higher degrees of union density and union coverage lead to a smaller effect of shocks on the unemployment rate. One explanation is the objective of trade unions is to provide job security to their members, which leads to more moderate labor market reactions, with both lower worker inflows into unemployment in response to an adverse shock and lower worker outflows from unemployment under a favorable shock.

To summarize, the shocks significantly affecting the unemployment rate are the real interest rate and the labor demand shift. Higher real interest rates and less labor demand increase the unemployment rate. As for labor market institutions, generous unemployment benefits tend to directly increase the unemployment rate but could indirectly reduce the impact of shocks on unemployment. Trade unions show the same role as the unemployment benefit system. ALMPs and wage-setting coordination play a favorable role on affecting unemployment. The impact of wage-setting coordination

is more about directly reducing unemployment, while ALMPs tend to alleviate unemployment in both a direct and an indirect way. The impact of EPLs on the labor market is also favorable, decreasing unemployment but with no significant interaction with shocks. In contrast, a higher labor tax wedge tends to have an adverse effect on unemployment, leading to not only higher unemployment but also a larger effect of shocks on unemployment.

6. Robustness

In order to support the findings with respect to the role of shocks and institutions in affecting unemployment, I run a battery of robustness tests.

First, Tables 3, 4 and 5 look at the implications of using alternative measures for some of the institutions. Table 3 presents the estimation results based on Equation (2), Table 4 for Equation (3) and Table 5 for Equation (4). In each table, column I reports the results using alternative measure for ALMPs, that is, public expenditures on ALMPs as a share of GDP. Column II reports the results using alternative measure for the replacement rate, which is the average replacement rate during years 2 to 5 of an unemployment spell. Column III and IV report the results using alternative measures for EPLs, namely the indicators measuring the strictness of EPLs on regular contracts and temporary contracts, respectively. The most significantly different results from using alternative measures concern ALMPs, such that they tend to increase unemployment and have no significant interaction with shocks. The replacement rate, by using its alternative measure, tends to diminish the impact of shocks on unemployment, which is consistent with the results in Table 2. The direct effects of EPLs on both regular contracts and temporary contracts on unemployment are very similar to Table 1, displaying negative and significant coefficients. However, it is interesting that the stricter EPLs on regular contracts tend to reduce the impact of shocks on unemployment, while the stricter EPLs on temporary contracts tend to increase the impact of shocks, as shown in Table 5. Coefficients on other labor market institutions and shocks are largely the same as in Tables 1 and 2.

Second, I evaluate the cross-sectional stability of the results. That is, I delete one country at a time from the sample and re-estimate Equations (2) and (4). Table 6 shows re-estimation results of Equation (2) and Table 7 for Equation (4). In Table 6, dropping one country at a time makes little difference to the results. In Table 7, the labor tax

wedge is always significant while benefit duration and EPLs are always insignificant, regardless of which country is excluded. The effect of union coverage is no longer significant when Portugal or Spain is dropped from the estimation. Wage setting coordination is found to be negatively significant when dropping Finland or France. Additionally, it is worth noting the importance of Portugal in determining the interaction coefficient on ALMPs. When dropping Portugal, the interaction coefficient on ALMPs becomes negatively significant.

Third, I also test the period stability of my results by re-estimating Equations (2) and (4) on different sub-periods, namely 2000-2006 and 2007-2013, to see if the period before or after the GFC influences the results. The estimation results are displayed in Table 8. Overall, the results are robust and do not appear to be driven by any particular period.

Finally, I test endogeneity for the results in the estimation of Equations (2) and (4). Endogeneity poses a threat for identification, because of the potential for reverse causality between the evolution of unemployment on the one hand, and institutions and shocks on the other hand. Institutional reforms may be induced by unfavorable labor market conditions, and changes in unemployment may influence the shocks. I therefore run regressions on Equations (2) and (4) with: 1) shock measures lagged by one period; and 2) institution measures lagged by one period. The estimated results with lagged shocks are presented in Table 9 and the results with lagged institutions are shown in Table 10. Comparing with the original results in Tables 1 and 2, the results of Equation (2) are very consistent and robust. However, for Equation (4), the lagged models display more institutional variables which significantly interact with shocks. To be more specific, for the re-estimation of Equation (4) with lagged shocks, the replacement rate coefficient changes sign, amplifying the impact of shocks on unemployment. The interaction coefficients of EPLs and wage setting coordination become significantly negative, as expected. However, union coverage becomes insignificant in the lagged model. With respect to the re-estimation of Equation (4) with lagged institutions, benefit duration and coordination in wage bargaining have significantly negative shock-interaction coefficients. The coefficients on the other labor market institutions and shocks are consistent with those in Table 2.

7. Conclusion

In this study, I examined the role of shocks and labor market institutions in explaining unemployment patterns across the EA countries for the time period 1999 to 2013. In my analysis, I employed the methodology of BW and Nickell *et al.* (2005), to separately identify the direct effects of shocks and labor market institutions on unemployment on the one hand, and the indirect effects of labor market institutions on changing the transmission of shocks to unemployment on the other hand. I extended the existing literature by using time-varying data and analyzing the time period of the GFC as well as the preceding decade.

The results suggest the following. First, the real long-term interest rate and the labor demand shock tend to have a significant direct impact on the unemployment rate in the EA. Particularly, an increase in the real interest rate or a decrease in labor demand push up the unemployment rate. However, two monetary policy shocks from the ECB do not show any significant impact on national labor markets. Second, generous unemployment benefits and large tax wedges tend to be correlated with increases in the unemployment rate, while EPLs, ALMPs and wage-setting coordination play a favorable role in reducing unemployment. Third, unemployment benefits, tax wedges and trade unions further play important channeling roles on affecting the transmission of shocks to national labor markets. Higher tax wedges tend to have an adverse effect and amplify the impacts of shocks on unemployment. In contrast, unemployment benefit generosity and pervasive unionization lead to a smaller effect of shocks on the unemployment rate.

Finally, we can have some confidence that the findings are robust despite the high variations in the sample data during the GFC. Labor market institutions across the EA countries are generally employment-friendly apart from the tax wedge. The outlook toward the unemployment problems in the EA could be mildly optimistic if lower real interest rates and resurgent labor demand can persist into the future.

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Data Appendix

Dependent variable:

Unemployment rate

Definition: The number of the unemployed as a percentage of labor force.

Construction: This is calculated by unemployment divided by labor force.

Source: OECD, ALFS Summary tables.

Country-specific shocks:

Total factor productivity shock

Definition: The rate of TFP growth.

Construction: The logarithmic first difference of the AMECO database's total economy factor productivity series.

Source: The Annual Macroeconomic (AMECO) database, May 2019 update.

Real long-term interest rate

Definition: The nominal long-term interest rate less the current rate of inflation (unit: percentage).

Construction: Difference between the long-term nominal interest rate and the current rate of inflation. The inflation rate is measured by the growth rate of the GDP deflator.

Source: The Annual Macroeconomic (AMECO) database, May 2019 update.

Labor demand shock

Definition: Following BW, I assume that technology is characterized by a Cobb-Douglas production function $\mathrm{Y} = (aN)^{\alpha}(K)^{1-\alpha}$, with technological progress assumed to be labor augmenting. Under perfect competition in both goods and labor markets, the marginal product of labor is equal to the real wage ($\mathrm{MPL} = \mathrm{w}$), that is $\alpha \cdot a \cdot (Y/aN) = w$. Taking logs yields $log(\alpha) = log(w/a) + log(aN) - log(Y)$, so that a decrease in the log of the labor share, $log(\alpha)$, leads to an equal decrease in the log of the adjusted employment, $log(aN)$, given output and the real wage. Thus, labor demand shocks could be measured by the log of the adjusted labor share, that is, the sum of the adjusted log wage indicator and the adjusted log employment indicator, less the log of real GDP.

Constructions: To obtain the data of labor demand shocks, I need to construct the adjusted log wage indicator ($log(w/a)$), the adjusted log employment indicator ($log(aN)$) and the log of real GDP ($log(Y)$), respectively. First, the adjusted log wage indicator can be computed by the AMECO data: I begin to construct labor efficiency, that is $log(a)$ above, by calculating the log of the ratio of "total factor productivity: total economy" to "adjusted wage share: total economy: as percentage of GDP at current prices". Then, I subtract labor efficiency from the log of "real compensation per employee, deflator GDP: total economy". Next, I follow BW to adjust this wage measure for taking account of gradual adjustment of factor proportions. Thus, the final adjusted log wage indicator is an average of the adjusted wage with weight 0.8 on the current year and 0.2 on the previous year. Second, the adjusted log employment indicator also can be computed by the AMECO data: adding labor efficiency to the log of "employment, persons: all domestic industries (National accounts)" proxies the adjusted log employment indicator. Finally, the log of real GDP can be obtained by the OECD data, that is, calculating the log of "gross domestic product (output approach), OECD base year".

Hence, the labor demand shock, measured by the log of the adjusted labor share, is the sum of the adjusted log wage indicator and the adjusted log employment indicator less the log of real GDP.

Sources: AMECO database, OECD.

Common monetary policy shocks:

ECB money supply shock

Definition: Changes in money supply growth.

Constructions: The yearly ECB money supply shock is calculated by taking the average of monthly changes in the growth rate of the nominal money stock, that is, the second difference of the log money supply. The nominal money stock is monthly monetary aggregates, M2 (unit: millions of Euro).

Source: ECB, Statistical Data Warehouse.

ECB unsystematic monetary policy shock

Definition: The residuals from estimating an interest rate rule.

Constructions: As shown in Equation (1), I use the nominal short-term interest rates (r_t)

as the dependent variable and one period lagged values of the dependent variable (r_{t-1}) as the independent variable along with: constant, the current inflation (π_t), and the current output gap (y_t^{gap}). As instruments, I use the lags of all right-hand-side variables up to lag four. The regression is estimated by the generalized method of moments and passes the weak instrument tests and over-identifying restriction tests. We can have some confidence that the instruments are exogenous and not weak.

$$r_t = \alpha + \beta\pi_t + \gamma y_t^{gap} + \delta r_{t-1} + \mu_t^M \quad (1)$$

The residuals are obtained by regressing Equation (1) using quarterly time series of all variables covering 1999Q1-2013Q4. The annual ECB unsystematic monetary policy shock is measured as the average of the quarterly residuals. Data on short-term nominal interest rates are nominal interest rates on ECB marginal lending facilities. Data on inflation rates and output gaps are expressed by the percentage change of CPI on the same period of the previous year and the ratio of the output gap to potential GDP, respectively.

Sources: ECB, Statistical Data Warehouse; OECD, Economic Outlook No 105 – May 2019.

Time-varying institutions:

The replacement rate of unemployment benefits

Definition: The net replacement rate in unemployment is the ratio of the net household income during a selected month of the unemployment spell to the net household income before the job loss. The original data are the net unemployment benefit replacement rate at two earnings levels (average and two-thirds of average earnings) for three different family types (single, with dependent spouse, with spouse at work) in 14 different duration categories (2 months, 4 months, 6 months, 8 months, 10 months, 12 months, 18 months, 24 months, 30 months, 36 months, 42 months, 48 months, 54 months and 60 months).

Construction: The average net replacement rate during the 1st year of unemployment, averaged over two income situations (100% and 67% of average earnings) and three family situations (single, with dependent spouse, with spouse at work); The average net replacement rate during years 2 to 5 of an unemployment spell, averaged over two income situations (100% and 67% of average earnings) and three family situations

(single, with dependent spouse, with spouse at work). The data are available since 2001 for all countries of the sample. I impute the values for 1999 and 2000 from the values in 2001.

Source: OECD, net replacement rates in unemployment.

Unemployment benefit duration

Definition: An index of benefit duration equal to [0.6 * (2^{nd} and 3^{rd} year replacement rate) + 0.4 * (4^{th} and 5^{th} year replacement rate)] / (1^{st} year replacement rate).

Construction:

2^{nd} and 3^{rd} year replacement rate: the average net replacement rate during years 2 to 3 of an unemployment spell, averaged over all categories.

4^{th} and 5^{th} year replacement rate: the average net replacement rate during years 4 to 5 of an unemployment spell, averaged over all categories.

1^{st} year replacement rate: the average net replacement rate during the first year of unemployment, averaged over all categories.

The data are available since 2001 for all countries of the sample. I impute the values for 1999 and 2000 from the values in 2001.

Source: OECD, net replacement rates in unemployment.

Active labor market policies

Definition: The measures of ALMPs cover the expenditures on active programs excluding public employment services and administration[15], which include training, employment incentives, sheltered and supported employment and rehabilitation, direct job creation and start-up incentives.

Construction: The OECD reports "public expenditures on ALMPs as a share of GDP (%)" and "public expenditures on ALMPs, national currency units". For "public expenditures on ALMPs, national currency units", I use this to calculate public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force. The number of the unemployed and labor force are available on the OECD. The data on nominal GDP are also obtained from the OECD.

[15] Because the data are not available for Italy before 2004.

Source: OECD, public expenditure and participant stocks in LMP.

Employment protection index

Definition: The OECD reports indicators measuring the strictness of the regulation covering the individual dismissal of employees on regular contracts (EPRC) and temporary contracts (EPT) (excludes collective dismissals). I select version 1 for keeping in line with the literature (BW, 2000; Nickell *et al.*, 2005; Bachmann and Felder, 2020).

Construction: Following OECD Employment Outlook (1999, Table 2.5) and BW, I also calculate a summary indicator of overall employment protection, which is the average of indicators for regular contracts and temporary contracts.

Source: OECD, strictness of employment protection – individual dismissals (regular contracts)/temporary contracts.

Union contract coverage

Definition: Employees covered by valid collective bargaining agreements as a proportion of all wage and salary earners in employment with the right to bargaining, expressed as percentage, adjusted for the possibility that some sectors or occupations are excluded from the right to bargain.

Construction: For the missing values, I impute the previous nearest year's value which is available.

Sources: OECD, collective bargaining coverage

Union density

Definition: The ICTWSS database reports union density rate, which is net union membership as a proportion of wage and salary earners in employment. Net union membership indicates total union membership minis union members outside the active, dependent and employed labor force (i.e. retired workers, independent workers, students, unemployed).

Source: J. Visser, ICTWSS Database. version 6.0. Amsterdam: Amsterdam Institute for Advanced Labor Studies (AIAS), University of Amsterdam. June 2019.

Coordination in wage bargaining

Definition: The ICTWSS database reports an indicator of the degree of coordination

based on a set of expectations about which institutional features of wage setting arrangements are likely to generate more or less coordination.

Source: J. Visser, ICTWSS Database. version 6.0. Amsterdam: Amsterdam Institute for Advanced Labor Studies (AIAS), University of Amsterdam. June 2019.

Tax wedge

Definition: The labor tax wedge measures the difference between the labor cost to the employer and the corresponding net take-home pay of the employee for a single-earner couple with two children earning 100% of average earnings. The OECD reports the tax wedge (%), which is the sum of personal income taxes, payroll taxes paid by employers and all social security contributions (from employers and employees) less the family benefits they receive in the form of cash transfers as a percentage of total labor cost.

Thus, compared with Nickell *et al.* (2005), this measure above does not incorporate consumption taxes but incorporate family benefits.

Construction: Since its values are missing for all countries in 1999, I use the data of 2000 instead.

Source: OECD, Taxing Wages.

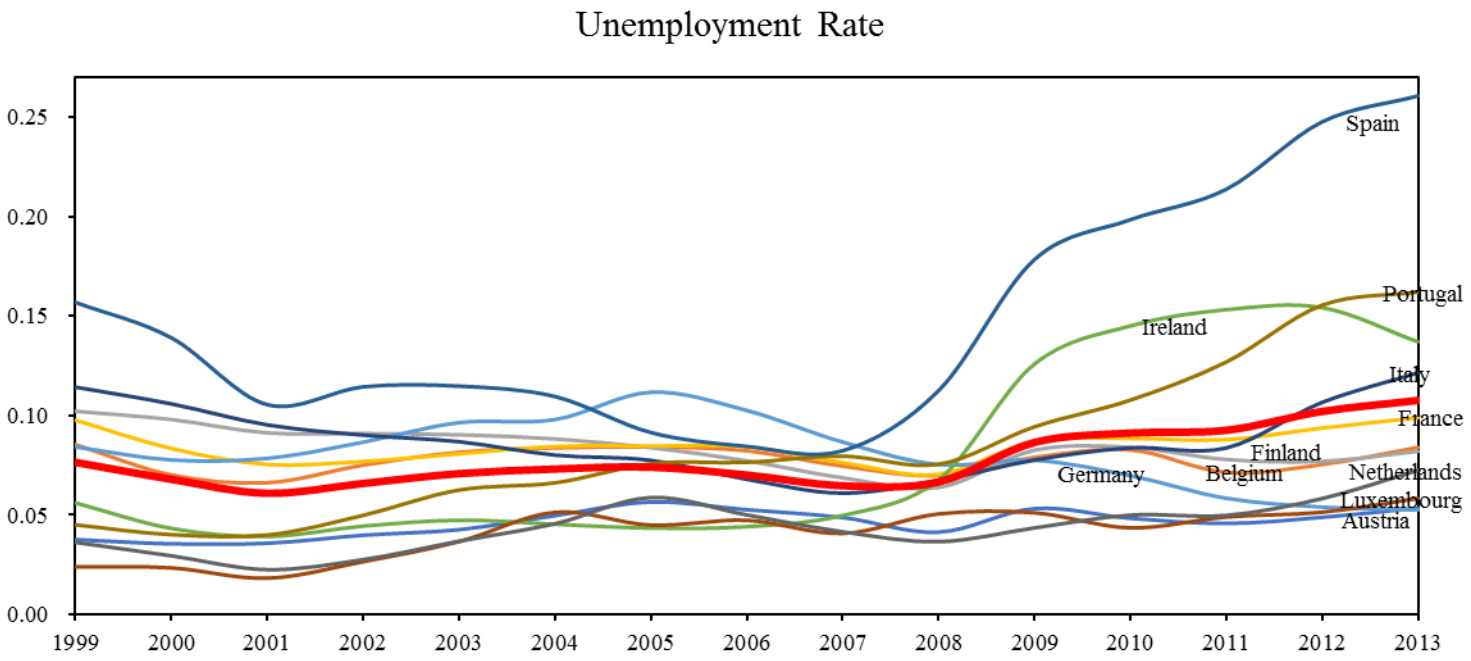

Figure 1: Annual unemployment rates for EA11. Red line plots unweighted average (see the Data Appendix for definition and source).

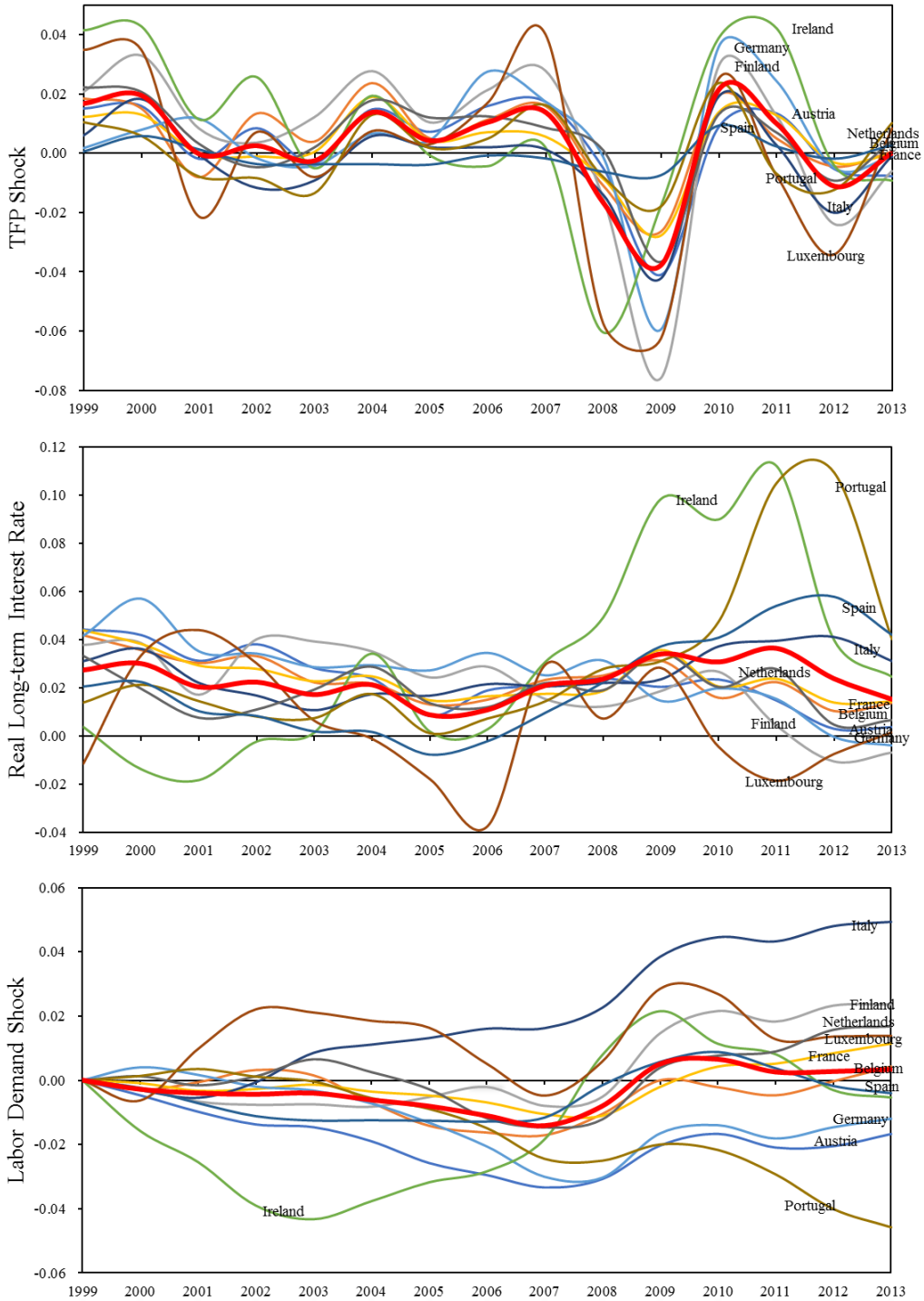

Figure 2: Time paths of annual country-specific shock indicators for EA11 (see the Data Appendix for definitions, constructions and sources). Red lines plot unweighted averages. Labor demand shocks are normalized to equal zero in 1999.

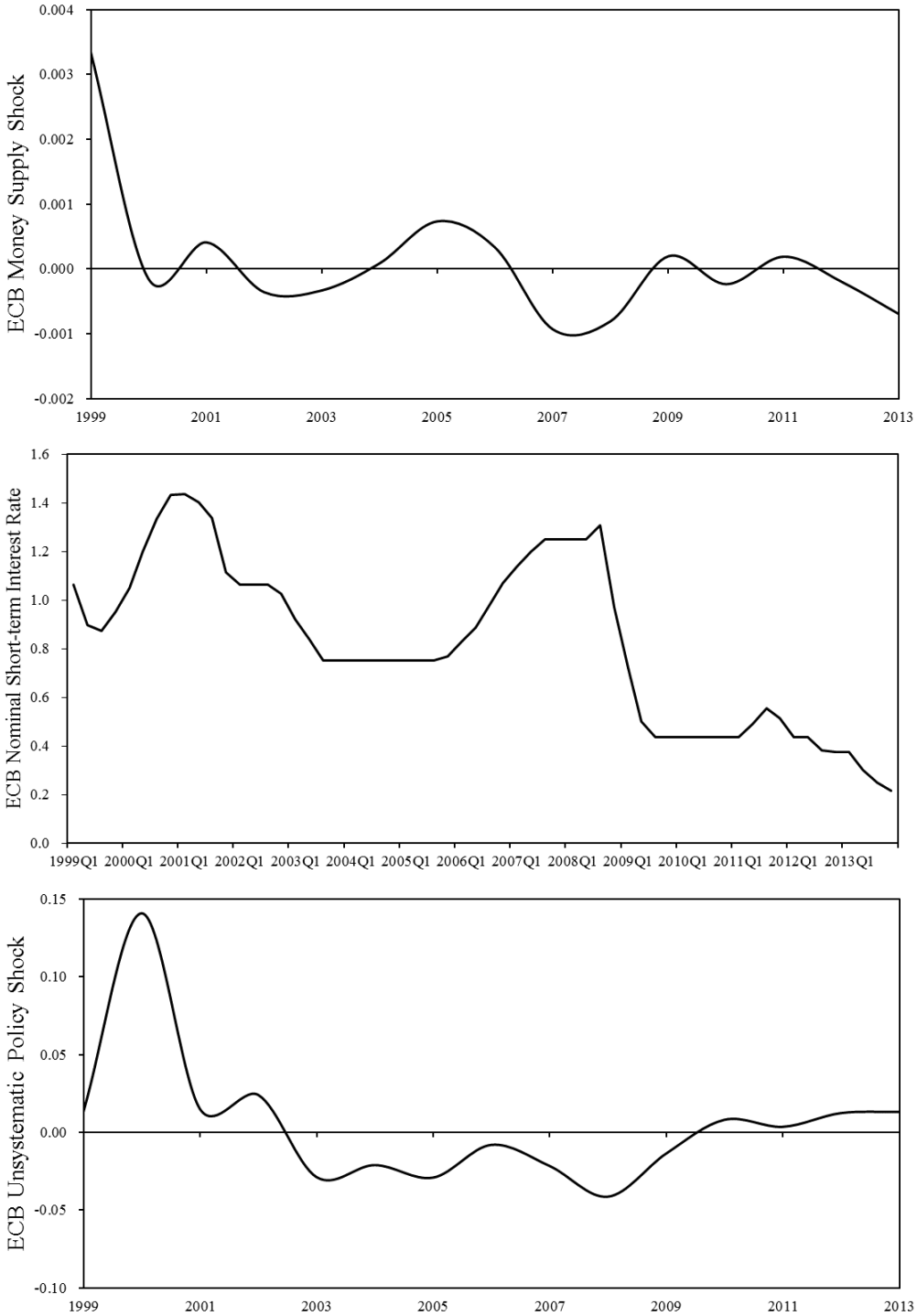

Figure 3: Time paths of common monetary policy shocks across the EA (see the Data Appendix for definitions, constructions and sources).

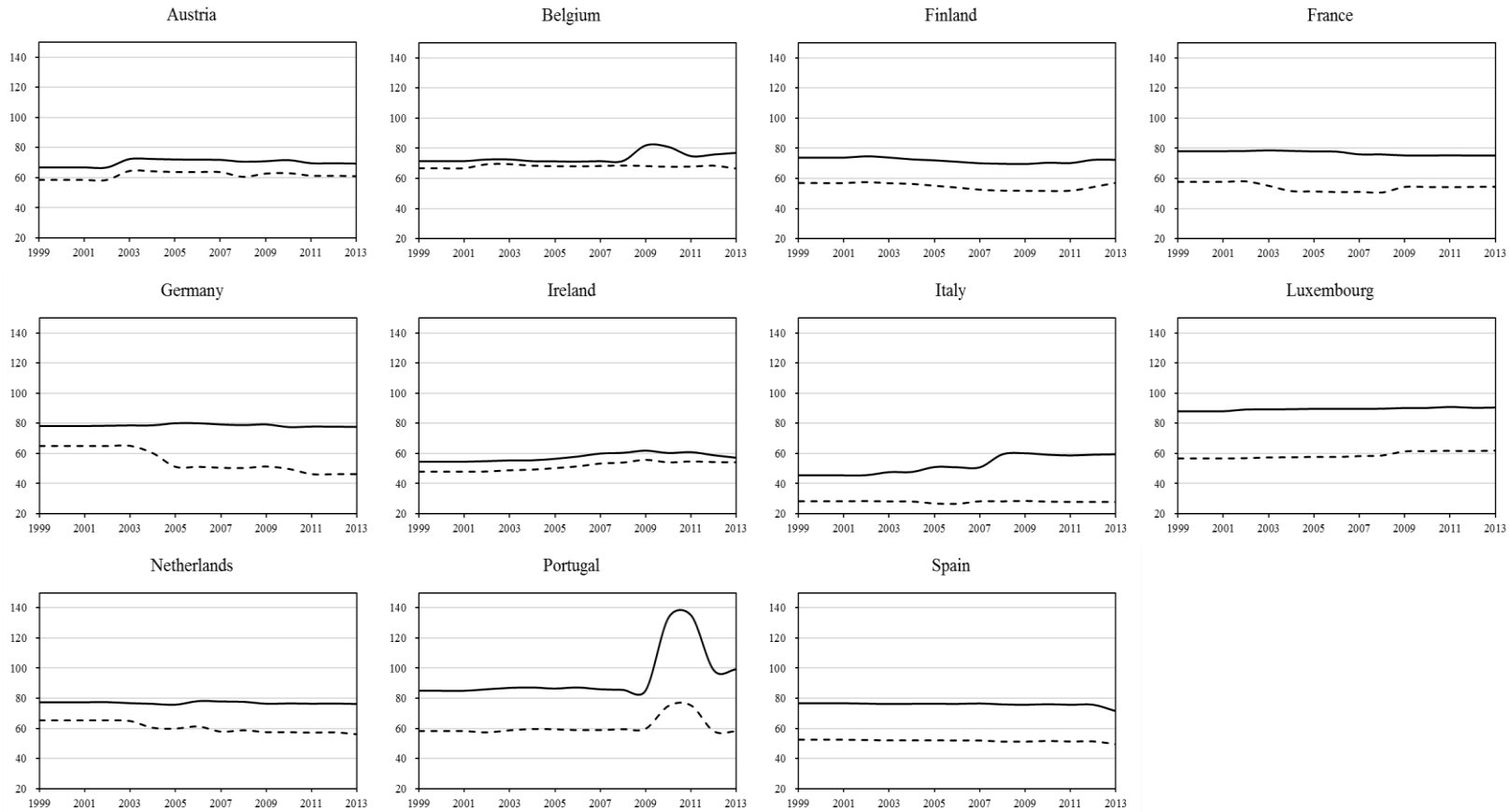

Figure 4: Time paths of the unemployment benefit replacement rate (%) for EA11. The solid line represents the average net replacement rate during the 1st year of unemployment and the dash line represents the average net replacement rate during years 2 to 5 of an unemployment spell (see the Data Appendix for definitions, constructions and sources).

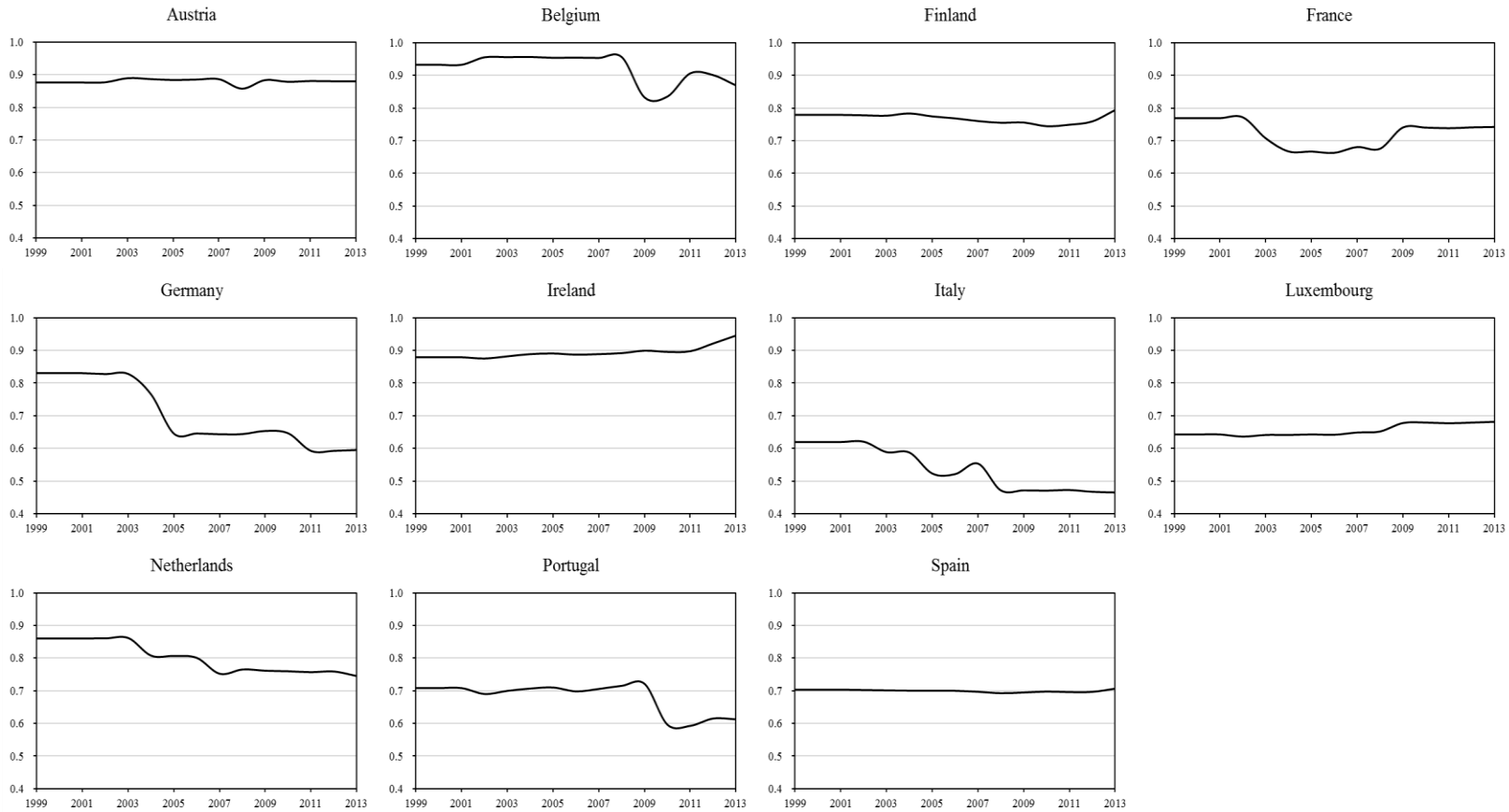

Figure 5: Time paths of the index of benefit duration for EA11 (see the Data Appendix for definitions, constructions and sources).

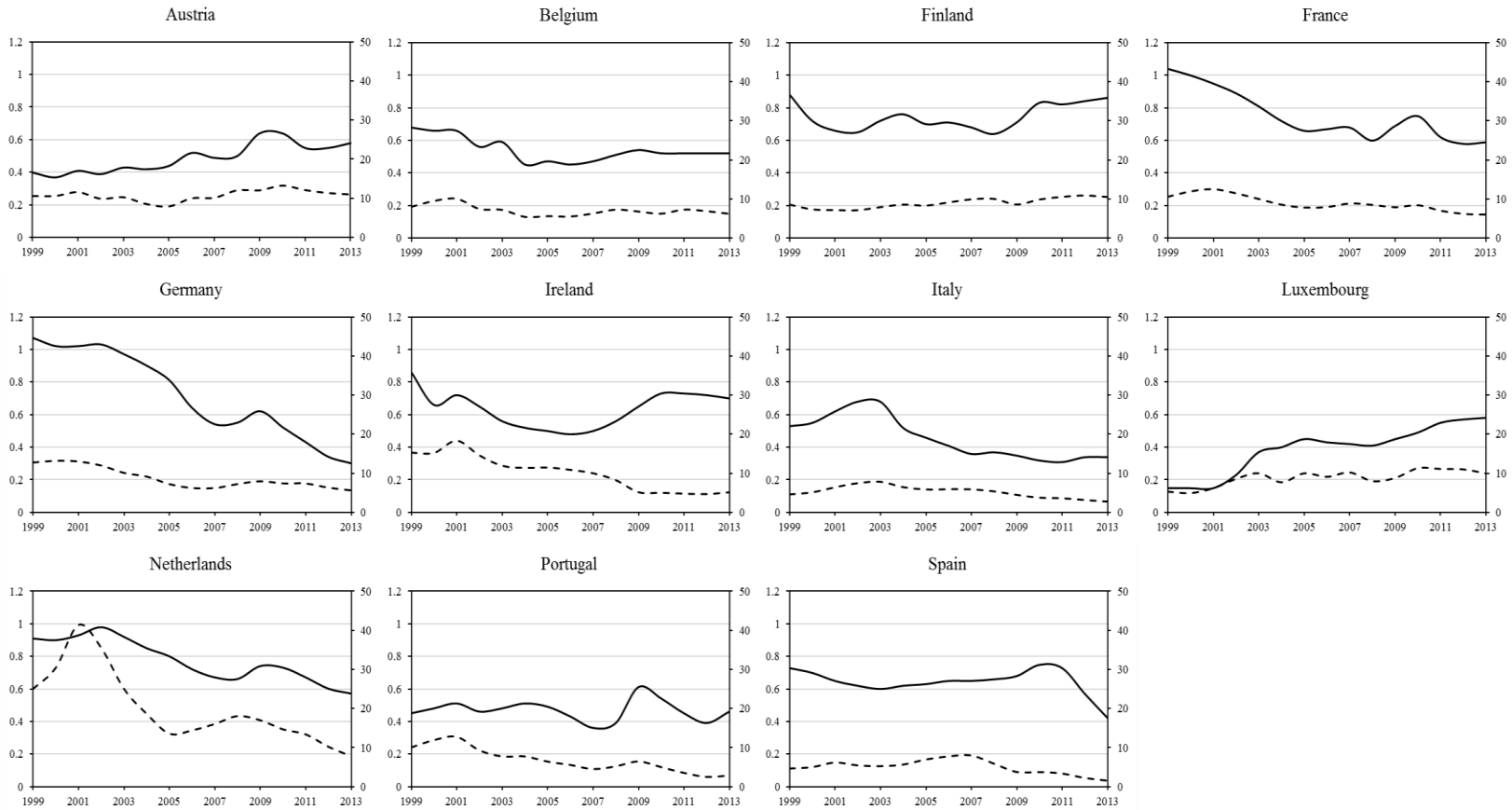

Figure 6: Time paths of the measures for public expenditures on ALMPs for EA11. The solid line represents public expenditures on ALMPs as a share of GDP (%) (left axis) and the dash line represents public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force (%) (right axis) (see the Data Appendix for definitions, constructions and sources).

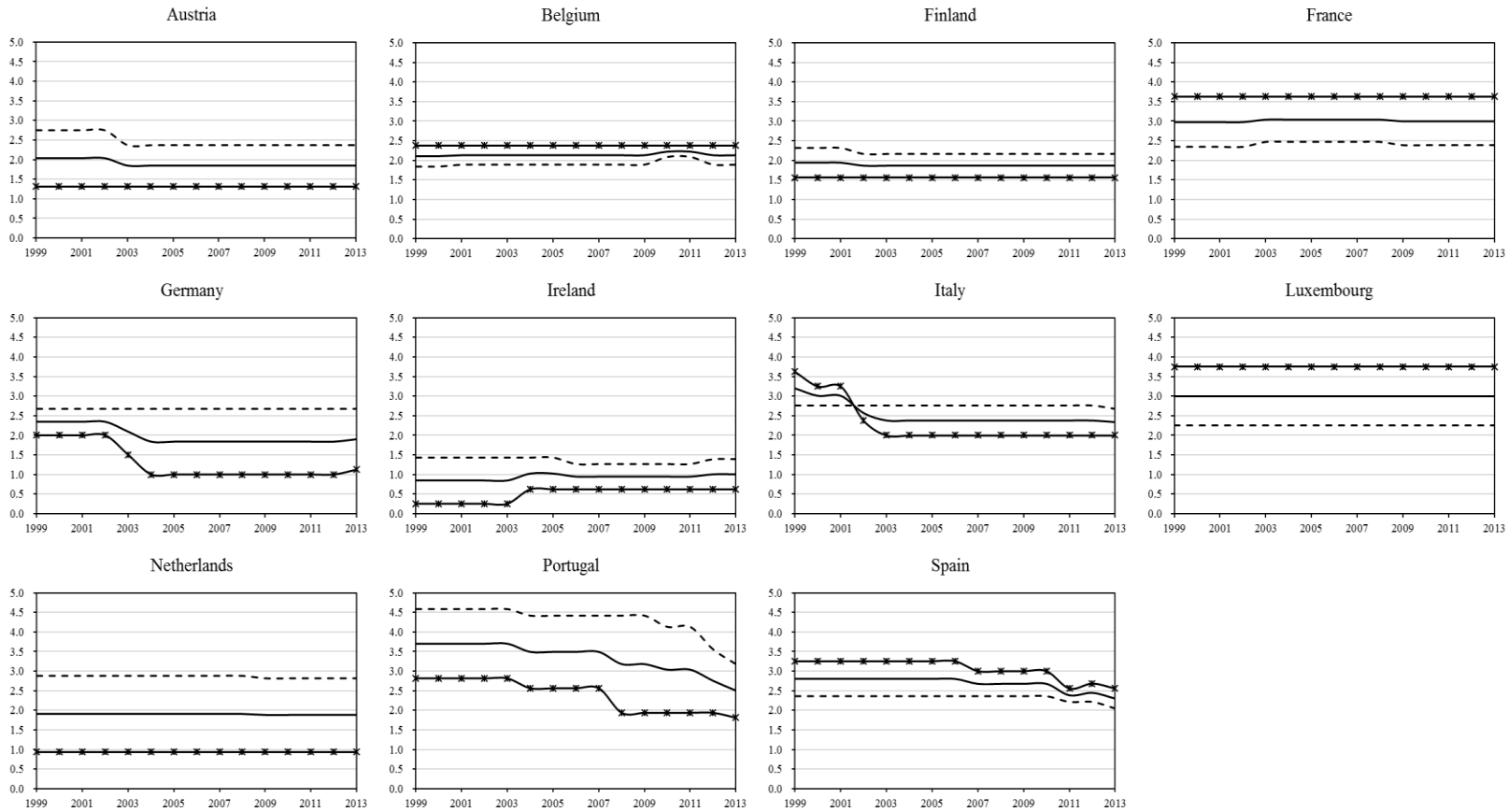

Figure 7: Time paths of the indicators measuring the strictness of employment protection laws for EA11. The dash line represents the indicators measuring the strictness of regulation of individual dismissal of employees on regular contracts, the star line represents the indicators measuring the strictness of regulation of individual dismissal of employees on temporary contracts and the solid line represents the summary indicators taking average of indicators for regular contracts and temporary contracts (see the Data Appendix for definitions, constructions and sources).

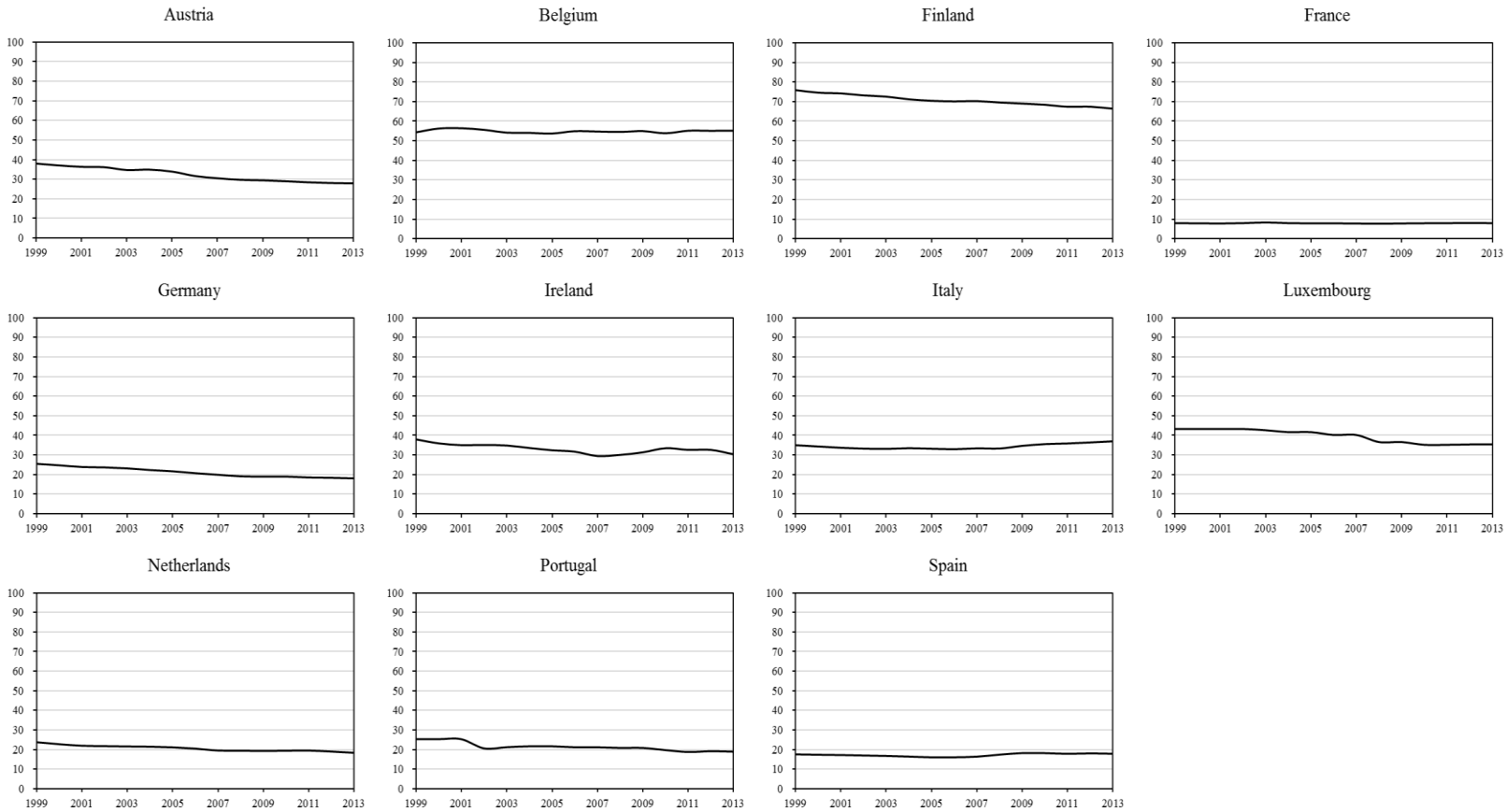

Figure 8: Time paths of the measure for union density (%) for EA11 (see the Data Appendix for definitions, constructions and sources).

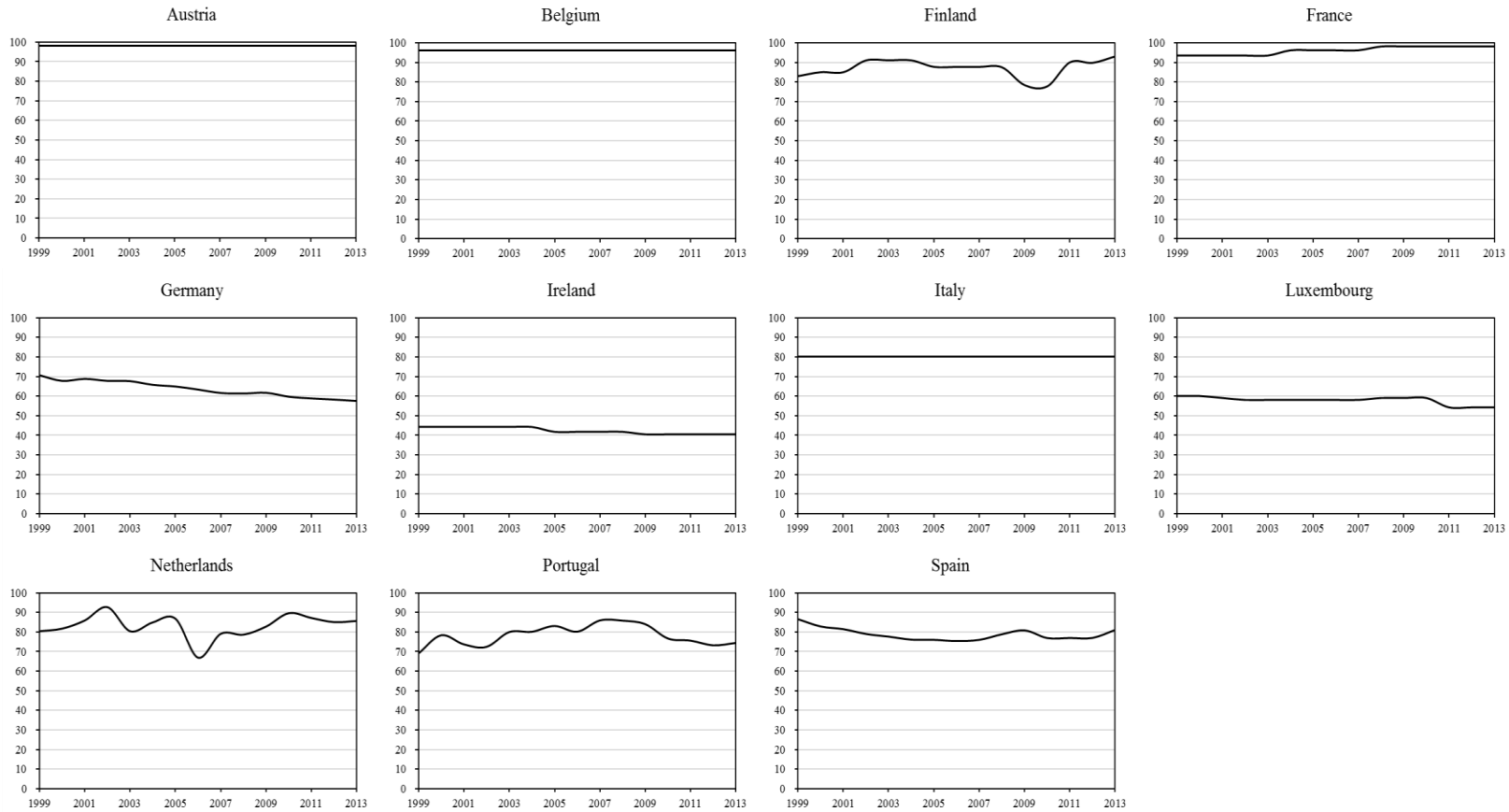

Figure 9: Time paths of the measure for union contract coverage (%) for EA11 (see the Data Appendix for definitions, constructions and sources).

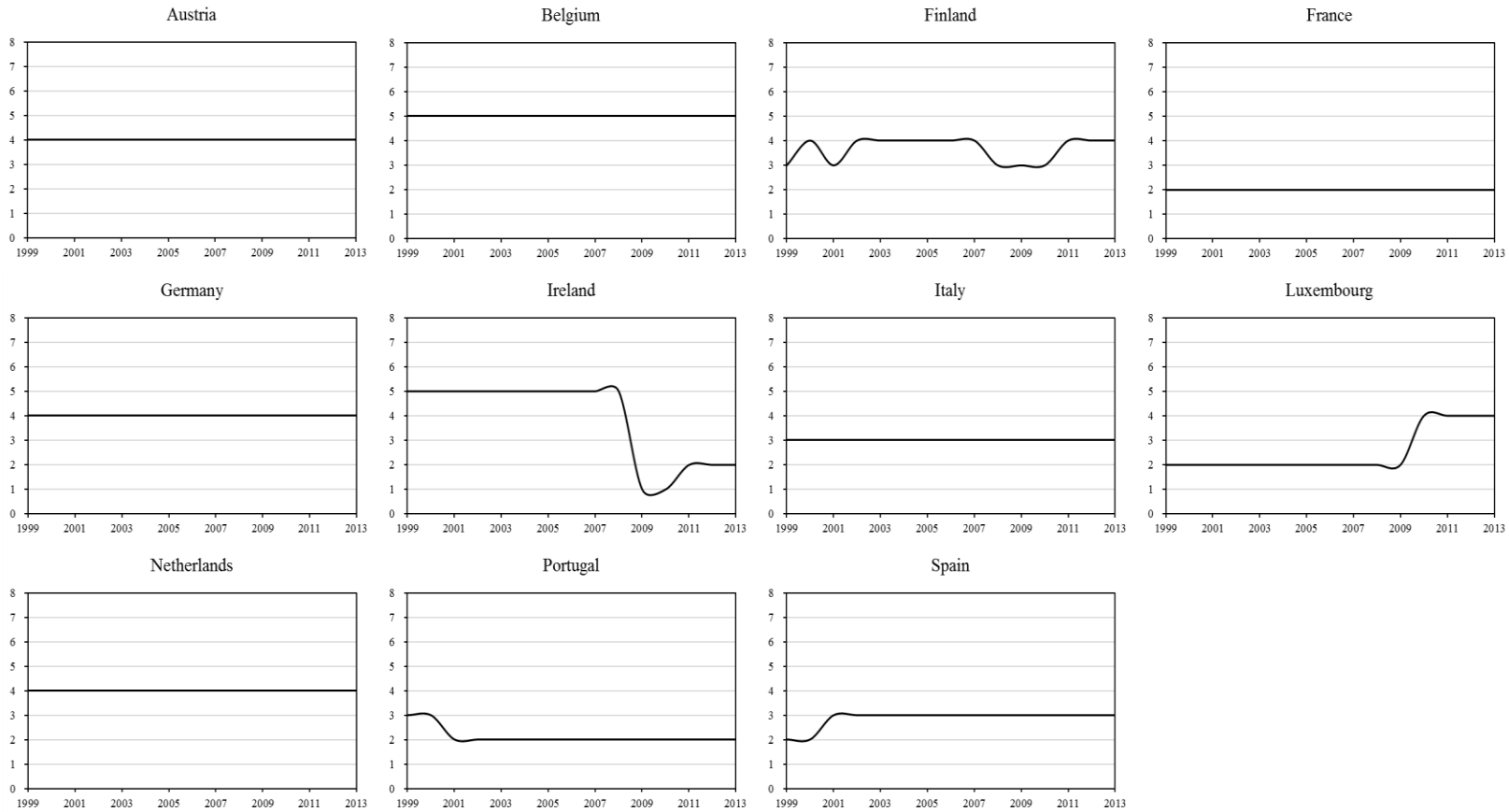

Figure 10: Time paths of the indicator measuring coordination in wage bargaining for EA11 (see the Data Appendix for definitions, constructions and sources).

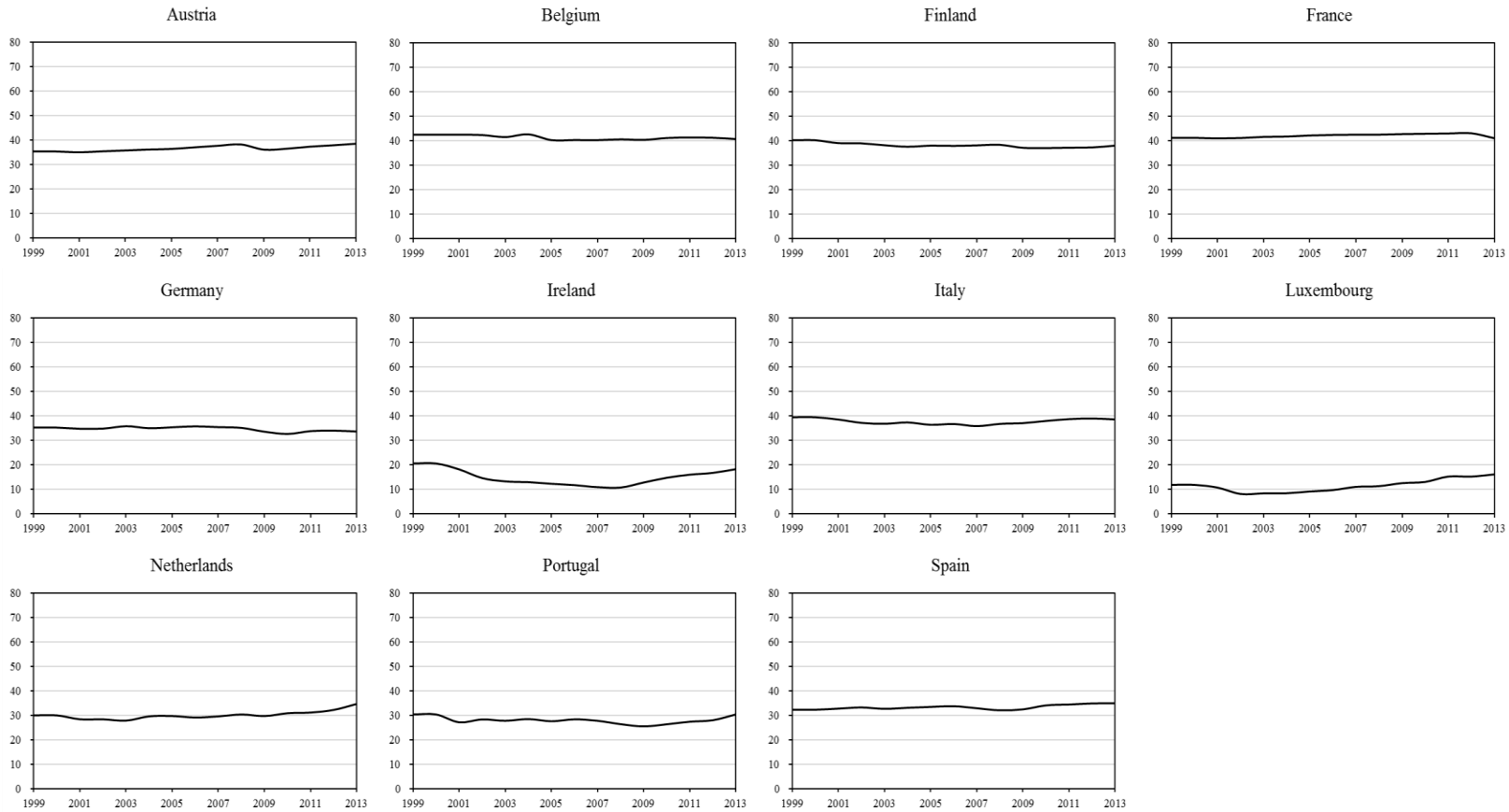

Figure 11: Time paths of the measure for the tax wedge (% of total labor cost) for EA11 (see the Data Appendix for definitions, constructions and sources).

Table 1 Direct Effects of Shocks and Institutions on Unemployment

	Dependent Variable: u		
Independent Variables	I	II	III
Time effects*	0.0450	0.0248**	0.0389
	(0.26)	(2.59)	(0.11)
Direct effect of shocks (γ_k):			
Labor demand shock	-0.206		-0.276**
	(-1.59)		(-2.05)
TFP shock	0.182		-0.0124
	(1.48)		(-0.10)
Real interest rate	0.827***		0.595***
	(11.09)		(6.54)
ECB money supply shock	-1.70e-10		-0.000000835
	(-0.00)		(-0.00)
ECB unsystematic policy shock	-3.87e-10		0.000000127
	(-0.00)		(0.00)
Direct effect of institutions (β_j):			
Replacement rate†		0.000741**	-0.00000302
		(2.50)	(-0.01)
Benefit length		0.304***	0.191***
		(6.93)	(4.50)
Active labor policy‡		-0.00247***	-0.00110**
		(-4.76)	(-2.19)
Employment protection§		-0.0609***	-0.0349***
		(-5.61)	(-3.28)
Tax wedge		0.00283***	0.00348***
		(2.72)	(3.66)
Union coverage		-0.0000828	0.000314
		(-0.18)	(0.76)
Union density		0.00192**	0.00129
		(2.10)	(1.42)
Coordination		-0.0122***	-0.00825***
		(-4.58)	(-3.28)
Country effects	yes	yes	yes
Adjusted R^2	0.781	0.795	0.843
Parameters	31	34	39
Observations	165	165	165

t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01

* Time effects: Estimated time effect for 2013 minus estimated time effect for 1999 ($d_{2013} - d_{1999}$).

† This measure of the replacement rate refers to the average net replacement rate during the 1st year of unemployment.

‡ This measure of ALMPs refers to public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force.

§ This measure of EPLs refers to the summary indicator taking average of indicators for EPLs on regular contracts and EPLs on temporary contracts.

Table 2 Effects of Interactions between Shocks and Institutions on Unemployment

	Dependent Variable: u	
Independent Variables	I	II
Time effects*	0.0131***	0.0547***
	(2.83)	(4.71)
Direct effect of shocks (γ_k):		
Labor demand shock		-0.156***
		(-3.60)
TFP shock		0.0787
		(0.81)
Real interest rate		0.981***
		(10.74)
ECB money supply shock		1.908
		(0.97)
ECB unsystematic policy shock		-0.00908
		(-0.19)
Indirect effect of institutions (β_j):		
Replacement rate†	-0.0159	-0.0173**
	(-0.74)	(-2.56)
Benefit length	4.807	0.129
	(1.57)	(0.11)
Active labor policy‡	-1.157**	-0.0202
	(-2.48)	(-1.00)
Employment protection§	-1.468	0.254
	(-1.44)	(1.35)
Tax wedge	-0.712**	0.0833***
	(-2.60)	(5.12)
Union coverage	0.275**	-0.0320***
	(2.46)	(-3.08)
Union density	-0.0215	-0.00839*
	(-1.03)	(-1.70)
Coordination	-0.472	-0.0771
	(-1.48)	(-1.07)
Country effects	yes	yes
Adjusted R^2	0.861	0.857
Parameters	34	39
Observations	165	165

t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01

* Time effects: Estimated time effect for 2013 minus estimated time effect for 1999 ($d_{2013} - d_{1999}$).

† This measure of the replacement rate refers to the average net replacement rate during the 1st year of unemployment.

‡ This measure of ALMPs refers to public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force.

§ This measure of EPLs refers to the summary indicators taking average of indicators for EPLs on regular contracts and EPLs on temporary contracts.

Table 3 Direct Effects of Shocks and Institutions. Alternative Measures

	Dependent Variable: u			
Independent Variables	I	II	III	IV
Direct effect of shocks (γ_k):				
Labor demand shock	-0.413***	-0.275**	-0.262*	-0.354***
	(-3.03)	(-2.12)	(-1.86)	(-2.72)
TFP shock	-0.0479	-0.0164	0.0251	-0.0105
	(-0.39)	(-0.13)	(0.20)	(-0.08)
Real interest rate	0.694***	0.604***	0.589***	0.650***
	(8.00)	(6.81)	(6.06)	(7.34)
ECB money supply shock	-7.76e-14	-0.0000803	-0.00000101	0.00261
	(-0.00)	(-0.00)	(-0.00)	(.)
ECB unsystematic shock	1.12e-13	-0.0000100	-0.00000124	-0.0000415
	(0.00)	(-0.00)	(-0.00)	(.)
Direct effect of institutions (β_j):				
RR1[l]	-0.000372		0.00000398	0.0000491
	(-1.19)		(0.01)	(0.17)
RR25[*]		-0.000117		
		(-0.25)		
Benefit length	0.0706	0.197***	0.140***	0.191***
	(1.32)	(4.43)	(3.53)	(4.35)
ALMPs1[l]		-0.00108**	-0.000847*	-0.00102**
		(-2.21)	(-1.73)	(-2.04)
ALMPs2[†]	0.0365**			
	(2.30)			
EPLs regular[‡]			-0.0307**	
			(-2.44)	
EPLs temporary[§]				-0.0173***
				(-2.71)
EPLs[l]	-0.0243**	-0.0351***		
	(-2.31)	(-3.42)		
Tax wedge	0.00334***	0.00349***	0.00344***	0.00353***
	(3.46)	(3.79)	(3.61)	(3.71)
Union coverage	0.000380	0.000322	0.000331	0.000350
	(0.93)	(0.80)	(0.81)	(0.85)
Union density	0.00211**	0.00128	0.00185*	0.00103
	(2.19)	(1.46)	(1.97)	(1.12)
Coordination	-0.00960***	-0.00824***	-0.00761***	-0.00831***
	(-3.93)	(-3.31)	(-2.99)	(-3.26)
Time and country effects	yes	yes	yes	yes
Adjusted R^2	0.844	0.843	0.837	0.841
Parameters	39	39	39	39
Observations	165	165	165	165

t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01
[*] RR25: the average net replacement rate during years 2 to 5 of an unemployment spell.
[†] ALMPs2: public expenditures on ALMPs as a share of GDP.
[‡] EPLs regular: the indicators measuring the strictness of EPLs on regular contracts.
[§] EPLs temporary: the indicators measuring the strictness of EPLs on temporary contracts.
[l] The definitions of RR1, ALMPs1 and EPLs are consistent with those in Table 1 and 2.

Table 4 Interactions between Time Effects and Institutions. Alternative Measures

	Dependent Variable: u			
Independent Variables	I	II	III	IV
Time effects:	0.0410***	0.0133***	0.0134***	0.0155***
	(5.27)	(2.85)	(2.66)	(3.45)
Indirect effect of institutions (β_j):				
RR1[l]	0.00812		-0.00703	-0.0246
	(0.76)		(-0.26)	(-1.32)
RR25[*]		-0.0320		
		(-0.80)		
Benefit length	0.728	6.873*	4.753	5.992**
	(0.52)	(1.82)	(1.43)	(2.18)
ALMPs1[l]		-1.141**	-1.081**	-0.985***
		(-2.50)	(-2.42)	(-2.92)
ALMPs2[†]	-0.640			
	(-0.60)			
EPLs regular[‡]			-1.263	
			(-0.93)	
EPLs temporary[§]				-0.347
				(-1.19)
EPLs[l]	-0.440	-1.389		
	(-1.20)	(-1.37)		
Tax wedge	-0.0995***	-0.704***	-0.633**	-0.584***
	(-2.73)	(-2.63)	(-2.56)	(-3.14)
Union coverage	0.0332*	0.272**	0.238**	0.216***
	(1.88)	(2.49)	(2.39)	(2.97)
Union density	-0.00248	-0.0213	-0.0193	-0.0127
	(-0.27)	(-1.03)	(-0.90)	(-0.78)
Coordination	-0.855***	-0.425	-0.535	-0.408
	(-4.27)	(-1.29)	(-1.58)	(-1.52)
Time and country effects	yes	yes	yes	yes
Adjusted R^2	0.734	0.861	0.858	0.859
Parameters	34	34	34	34
Observations	165	165	165	165

t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01
[*] RR25: the average net replacement rate during years 2 to 5 of an unemployment spell.
[†] ALMPs2: public expenditures on ALMPs as a share of GDP.
[‡] EPLs regular: the indicators measuring the strictness of EPLs on regular contracts.
[§] EPLs temporary: the indicators measuring the strictness of EPLs on temporary contracts.
[l] The definitions of RR1, ALMPs1 and EPLs are consistent with those in Table 1 and 2.

Table 5 Interactions between Shocks and Institutions. Alternative Measures

	Dependent Variable: u			
Independent Variables	I	II	III	IV
Direct effect of shocks (γ_k):				
Labor demand shock	-0.165***	-0.152***	-0.258***	-0.161***
	(-3.52)	(-3.36)	(-4.06)	(-4.58)
TFP shock	0.0820	0.0764	0.0652	0.0747
	(0.83)	(0.81)	(0.63)	(0.70)
Real interest rate	1.008***	0.960***	1.083***	1.033***
	(11.24)	(10.71)	(11.06)	(11.52)
ECB money supply shock	1.673	1.892	1.650	0.473
	(0.81)	(0.98)	(0.75)	(0.26)
ECB unsystematic shock	-0.0365	0.0000671	-0.00345	-0.0273
	(-0.70)	(0.00)	(-0.06)	(-0.60)
Indirect effect of institutions (β_j):				
RR1[l]	-0.0171**		-0.0121**	-0.0116*
	(-2.45)		(-2.04)	(-1.81)
RR25[*]		-0.0307**		
		(-2.43)		
Benefit length	-0.437	2.132*	-1.346*	1.119
	(-0.34)	(1.77)	(-1.81)	(1.10)
ALMPs1[l]		-0.0196	0.00278	-0.0202
		(-0.94)	(0.18)	(-1.04)
ALMPs2[†]	0.307			
	(0.53)			
EPLs regular[‡]			-0.145*	
			(-1.95)	
EPLs temporary[§]				0.295***
				(3.24)
EPLs[l]	0.210	0.276		
	(1.17)	(1.39)		
Tax wedge	0.0783***	0.0837***	0.0681***	0.0893***
	(4.17)	(4.96)	(5.74)	(5.96)
Union coverage	-0.0297***	-0.0319***	-0.0160**	-0.0342***
	(-2.87)	(-2.94)	(-2.42)	(-3.97)
Union density	-0.00952*	-0.00766	-0.0113***	-0.0107**
	(-1.90)	(-1.52)	(-2.66)	(-2.32)
Coordination	-0.0979	-0.0750	-0.132**	-0.0712
	(-1.47)	(-1.00)	(-2.26)	(-1.08)
Time and country effects	yes	yes	yes	yes
Adjusted R^2	0.856	0.857	0.859	0.866
Parameters	39	39	39	39
Observations	165	165	165	165

t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01
[*] RR25: the average net replacement rate during years 2 to 5 of an unemployment spell.
[†] ALMPs2: public expenditures on ALMPs as a share of GDP.
[‡] EPLs regular: the indicators measuring the strictness of EPLs on regular contracts.
[§] EPLs temporary: the indicators measuring the strictness of EPLs on temporary contracts.
[l] The definitions of RR1, ALMPs1 and EPLs are consistent with those in Table 1 and 2.

Table 6 Cross-Sectional Stability. Equation (2)

	Direct effect of institutions (β_j)[§]										
Institutions	Austria	Belgium	Finland	France	Germany	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain
RR1[*]	-0.00000302	-0.00000302	-0.00000302	-0.00000302	-0.00000302	-0.00000302	-0.00000302	-0.00000302	-0.00000302	-0.00000302	-0.00000302
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)
Benefit length	0.191***	0.191***	0.191***	0.191***	0.191***	0.191***	0.191***	0.191***	0.191***	0.191***	0.191***
	(4.53)	(4.52)	(4.50)	(4.54)	(4.54)	(4.55)	(4.46)	(4.49)	(4.55)	(4.52)	(4.53)
ALMPs1[†]	-0.00110**	-0.00110**	-0.00110**	-0.00110**	-0.00110**	-0.00110**	-0.00110**	-0.00110**	-0.00110**	-0.00110**	-0.00110**
	(-2.22)	(-2.21)	(-2.21)	(-2.20)	(-2.21)	(-2.22)	(-2.21)	(-2.21)	(-2.23)	(-2.21)	(-2.22)
EPLs[‡]	-0.0349***	-0.0349***	-0.0349***	-0.0349***	-0.0349***	-0.0349***	-0.0349***	-0.0349***	-0.0349***	-0.0349***	-0.0349***
	(-3.32)	(-3.32)	(-3.32)	(-3.33)	(-3.32)	(-3.33)	(-3.31)	(-3.31)	(-3.34)	(-3.32)	(-3.33)
Tax wedge	0.00348***	0.00348***	0.00348***	0.00348***	0.00348***	0.00348***	0.00348***	0.00348***	0.00348***	0.00348***	0.00348***
	(3.70)	(3.69)	(3.69)	(3.69)	(3.69)	(3.70)	(3.68)	(3.68)	(3.70)	(3.67)	(3.51)
Union coverage	0.000314	0.000314	0.000314	0.000314	0.000314	0.000314	0.000314	0.000314	0.000314	0.000314	0.000314
	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)	(0.77)
Union density	0.00129	0.00129	0.00129	0.00129	0.00129	0.00129	0.00129	0.00129	0.00129	0.00129	0.00129
	(1.44)	(1.43)	(1.41)	(1.43)	(1.43)	(1.44)	(1.42)	(1.43)	(1.44)	(1.43)	(1.44)
Coordination	-0.00825***	-0.00825***	-0.00825***	-0.00825***	-0.00825***	-0.00825***	-0.00825***	-0.00825***	-0.00825***	-0.00825***	-0.00825***
	(-3.28)	(-3.28)	(-3.28)	(-3.26)	(-3.27)	(-3.29)	(-3.26)	(-3.28)	(-3.29)	(-3.28)	(-3.29)

Notes: The table gives the coefficient of each institution variable when one country at the time is dropped, as well as the country which is dropped.
t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01
[*] This measure of the replacement rate refers to the average net replacement rate during the 1st year of unemployment.
[†] This measure of ALMPs refers to public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force.
[‡] This measure of EPLs refers to the summary indicators taking average of indicators for EPLs on regular contracts and EPLs on temporary contracts.
[§] Corresponding to Equation (2).

Table 7 Cross-Sectional Stability. Equation (4)

	Indirect effect of institutions (β_j)[§]										
Institutions	Austria	Belgium	Finland	France	Germany	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain
RR1[*]	-0.0130**	-0.00722	-0.00449	-0.00449	-0.00811*	-0.0107**	-0.00710	-0.0135**	-0.0128**	-0.00475	-0.00312
	(-2.31)	(-1.52)	(-1.12)	(-1.13)	(-1.81)	(-2.08)	(-1.61)	(-2.38)	(-2.25)	(-1.47)	(-1.32)
Benefit length	0.361	-0.190	-0.743	-0.724	0.310	-0.468	-0.0421	0.135	0.464	-0.947	-0.131
	(0.37)	(-0.25)	(-1.13)	(-1.11)	(0.40)	(-0.58)	(-0.06)	(0.14)	(0.47)	(-1.20)	(-0.36)
ALMPs1[†]	-0.0102	-0.00926	-0.00114	0.000314	-0.00707	-0.00741	-0.00669	-0.0114	-0.0107	-0.0372***	-0.00117
	(-0.64)	(-0.71)	(-0.10)	(0.03)	(-0.57)	(-0.52)	(-0.58)	(-0.69)	(-0.66)	(-2.66)	(-0.26)
EPLs[‡]	0.181	-0.0258	-0.106	-0.111	0.134	-0.0381	0.0590	0.187	0.202	-0.217	-0.0383
	(1.08)	(-0.24)	(-1.21)	(-1.28)	(0.84)	(-0.34)	(0.43)	(1.09)	(1.18)	(-1.57)	(-0.61)
Tax wedge	0.0754***	0.0597***	0.0496***	0.0500***	0.0441***	0.0602***	0.0404***	0.0726***	0.0778***	0.0289**	0.00762*
	(5.14)	(5.22)	(4.85)	(4.89)	(3.63)	(5.47)	(3.67)	(5.05)	(5.14)	(2.31)	(1.80)
Union coverage	-0.0269***	-0.0163**	-0.0117**	-0.0111**	-0.0168**	-0.0187***	-0.0155**	-0.0268***	-0.0285***	-0.00440	-0.00313
	(-3.00)	(-2.47)	(-2.08)	(-2.00)	(-2.34)	(-2.70)	(-2.34)	(-2.95)	(-3.08)	(-0.68)	(-1.19)
Union density	-0.00724*	-0.00583*	-0.00411	-0.00594*	-0.00458	-0.00780**	-0.00408	-0.00651	-0.00722*	-0.0102***	-0.000775
	(-1.77)	(-1.71)	(-1.34)	(-1.93)	(-1.47)	(-2.15)	(-1.39)	(-1.57)	(-1.74)	(-2.70)	(-0.57)
Coordination	-0.0509	-0.0575	-0.0832*	-0.0907*	0.0275	-0.0656	0.0144	-0.0538	-0.0510	0.0882	-0.0143
	(-0.76)	(-1.05)	(-1.67)	(-1.81)	(0.48)	(-1.17)	(0.27)	(-0.79)	(-0.75)	(1.39)	(-0.42)

Notes: The table gives the coefficient of each institution variable when one country at the time is dropped, as well as the country which is dropped.
t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01
[*] This measure of the replacement rate refers to the average net replacement rate during the 1st year of unemployment.
[†] This measure of ALMPs refers to public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force.
[‡] This measure of EPLs refers to the summary indicators taking average of indicators for EPLs on regular contracts and EPLs on temporary contracts.
[§] Corresponding to Equation (4).

Table 8 Period Stability

	Direct effect of institutions (β_j)[§]		Indirect effect of institutions (β_j)[‖]	
Institutions	2000 - 2006	2007 - 2013	2000 - 2006	2007 - 2013
RR1[*]	-0.0000382	0.0000442	-0.00522	-0.0126*
	(-0.14)	(0.15)	(-1.36)	(-1.70)
Benefit length	0.184***	0.191***	0.114	1.017
	(4.44)	(4.55)	(0.20)	(0.79)
ALMPs1[†]	-0.00118**	-0.00155***	-0.0000346	-0.00124
	(-2.39)	(-3.36)	(-0.00)	(-0.07)
EPLs[‡]	-0.0408***	-0.0391***	-0.0263	0.309
	(-4.00)	(-3.75)	(-0.25)	(1.54)
Tax wedge	0.00396***	0.00317***	0.0227***	0.0927***
	(4.36)	(3.38)	(3.05)	(4.97)
Union coverage	0.000396	0.000302	-0.0112**	-0.0381***
	(0.98)	(0.75)	(-2.38)	(-3.28)
Union density	0.00120	0.000602	-0.00164	-0.0101*
	(1.40)	(0.71)	(-0.57)	(-1.90)
Coordination	-0.00898***	-0.00798***	-0.0432	-0.0693
	(-3.63)	(-3.19)	(-0.83)	(-0.95)

Notes: The table gives the coefficient of each institution variable when regressing on different sub-periods.
t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).
* p<0.10 ** p<0.05 *** p<0.01
[*] This measure of the replacement rate refers to the average net replacement rate during the 1st year of unemployment.
[†] This measure of ALMPs refers to public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force.
[‡] This measure of EPLs refers to the summary indicators taking average of indicators for EPLs on regular contracts and EPLs on temporary contracts.
[§] Corresponding to Equation (2).
[‖] Corresponding to Equation (4).

Table 9 Test for Endogeneity. Lagged shocks

	Dependent Variable: u			
Independent Variables	I	II	III	IV
Direct effect of shocks (γ_k):				
Labor demand shock	-0.276**	-0.506***	-0.156***	-0.782***
	(-2.05)	(-3.70)	(-3.60)	(-5.19)
TFP shock	-0.0124	-0.116	0.0787	0.0525
	(-0.10)	(-0.95)	(0.81)	(0.36)
Real interest rate	0.595***	0.481***	0.981***	0.926***
	(6.54)	(4.67)	(10.74)	(8.16)
ECB money supply shock	-0.000000835	-0.00153	1.908	-3.010
	(-0.00)	(.)	(0.97)	(-0.44)
ECB unsystematic shock	0.000000127	0.0000208	-0.00908	0.117
	(0.00)	(.)	(-0.19)	(1.30)
Direct or Indirect effect of institutions (β_j):				
RR1*	-0.00000302	-0.000201	-0.0173**	0.00771**
	(-0.01)	(-0.59)	(-2.56)	(1.99)
Benefit length	0.191***	0.181***	0.129	-0.120
	(4.50)	(4.04)	(0.11)	(-0.22)
ALMPs1†	-0.00110**	-0.00108**	-0.0202	0.0107
	(-2.19)	(-2.03)	(-1.00)	(1.28)
EPLs‡	-0.0349***	-0.0253**	0.254	-0.143**
	(-3.28)	(-2.17)	(1.35)	(-2.18)
Tax wedge	0.00348***	0.00318***	0.0833***	0.0381***
	(3.66)	(3.07)	(5.12)	(4.85)
Union coverage	0.000314	-0.00000403	-0.0320***	-0.00267
	(0.76)	(-0.01)	(-3.08)	(-0.75)
Union density	0.00129	0.00126	-0.00839*	-0.0120***
	(1.42)	(1.36)	(-1.70)	(-3.40)
Coordination	-0.00825***	-0.0126***	-0.0771	-0.118***
	(-3.28)	(-5.04)	(-1.07)	(-3.93)
Time and country effects	yes	yes	yes	yes
Adjusted R^2	0.843	0.821	0.857	0.813
Parameters	39	39	39	39
Observations	165	154	165	154

Notes: This table shows the sensitivity of the results in Table 1 and 2 by replacing shocks with their one period lagged values. Column I presents the original results of Equation (2), corresponding to Column III in Table 1. Column II presents its comparison results estimated by lagged shock values. Column III presents the original results of Equation (4), corresponding to Column II in Table 2. Column IV presents its comparison results estimated by lagged shock values.

t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).

* p<0.10 ** p<0.05 *** p<0.01

* This measure of the replacement rate refers to the average net replacement rate during the 1st year of unemployment.

† This measure of ALMPs refers to public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force.

‡ This measure of EPLs refers to the summary indicators taking average of indicators for EPLs on regular contracts and EPLs on temporary contracts.

Table 10 Test for Endogeneity. Lagged institutions

	Dependent Variable: u			
Independent Variables	I	II	III	IV
Direct effect of shocks (γ_k):				
Labor demand shock	-0.276**	-0.232	-0.156***	-0.365***
	(-2.05)	(-1.63)	(-3.60)	(-3.86)
TFP shock	-0.0124	0.123	0.0787	0.0456
	(-0.10)	(1.10)	(0.81)	(0.55)
Real interest rate	0.595***	0.502***	0.981***	0.967***
	(6.54)	(6.03)	(10.74)	(9.92)
ECB money supply shock	-0.000000835	-0.00000315	1.908	2.601
	(-0.00)	(-0.00)	(0.97)	(1.22)
ECB unsystematic shock	0.000000127	0.00000482	-0.00908	-0.0171
	(0.00)	(0.00)	(-0.19)	(-0.34)
Direct or Indirect effect of institutions (β_j):				
RR1*	-0.00000302	0.000148	-0.0173**	-0.00820**
	(-0.01)	(0.59)	(-2.56)	(-2.40)
Benefit length	0.191***	0.176***	0.129	-1.849**
	(4.50)	(4.41)	(0.11)	(-2.35)
ALMPs1†	-0.00110**	-0.000918**	-0.0202	-0.00272
	(-2.19)	(-1.98)	(-1.00)	(-0.21)
EPLs‡	-0.0349***	-0.0359***	0.254	-0.124
	(-3.28)	(-3.24)	(1.35)	(-1.29)
Tax wedge	0.00348***	0.00389***	0.0833***	0.0689***
	(3.66)	(4.08)	(5.12)	(5.43)
Union coverage	0.000314	0.000148	-0.0320***	-0.0200***
	(0.76)	(0.35)	(-3.08)	(-2.70)
Union density	0.00129	0.000183	-0.00839*	-0.0104**
	(1.42)	(0.20)	(-1.70)	(-2.41)
Coordination	-0.00825***	-0.00792***	-0.0771	-0.119**
	(-3.28)	(-3.13)	(-1.07)	(-2.42)
Time and country effects	yes	yes	yes	yes
Adjusted R^2	0.843	0.840	0.857	0.865
Parameters	39	39	39	39
Observations	165	154	165	154

Notes: This table shows the sensitivity of the results in Table 1 and 2 by replacing institutions with their one period lagged values. Column I presents the original results of Equation (2), corresponding to Column III in Table 1. Column II presents its comparison results estimated by lagged institution values. Column III presents the original results of Equation (4), corresponding to Column II in Table 2. Column IV presents its comparison results estimated by lagged institution values.

t statistics in parentheses (Standard errors are estimated using robust Huber/White sandwich formation).

* p<0.10 ** p<0.05 *** p<0.01

* This measure of the replacement rate refers to the average net replacement rate during the 1st year of unemployment.

† This measure of ALMPs refers to public expenditures on ALMPs per unemployed worker as a share of GDP per member of the labor force.

‡ This measure of EPLs refers to the summary indicators taking average of indicators for EPLs on regular contracts and EPLs on temporary contracts.