IV. The natural rate of unemployment and its institutional determinants

by Atanas Hristov and Werner Roeger

This chapter explains movements in the natural rate of unemployment by considering both institutional labour market measures and persistent demand shocks. The study uses a panel data set for 28 EU countries covering 1985-2018. The following institutional variables are found to be key drivers of the natural rate: (i) a measure of the unemployment benefit replacement rate; (ii) a labour tax wedge indicator; and (iii) spending on active labour market policies. Additional elements that have a bearing on the natural rate include demographic factors associated with population ageing - have played a historical role, and persistent demand shocks. The latter developments are related to crisis episodes, such as the unwinding of unsustainable expansions in the housing market. The results suggest that, for a number of countries, the natural rates in 2018 were lower than during the previous business cycle peaks - for example, in 2000 or in 2007 - mainly because of changing demographics, rather than positive cyclical developments (the demand shocks).

IV.1. Introduction

Since 2013 the unemployment rate and its natural rate - the unemployment rate at which price/wage inflation is stable independently of the stage of cycle - are declining in the euro area and European Union (EU). The forecast for the unemployment and natural rate for 2020 is 7.4% and 6.2%, respectively. This is lower than the unemployment rate observed in the pre-crisis boom - 7.5% and 7.2% in the euro area and the EU in 2007, respectively[206]. These changes are partly due to cyclical factors, and partly due to structural causes such as policy changes and other slower-moving factors.

This chapter aims to quantify the structural factors behind these developments. For this purpose, we statistically test the significance of a large set of structural and macroeconomic indicators that are commonly suggested by economic theory and used in empirical studies[207]. Since the focus is to explain movements of the natural rate of unemployment, the analysis considers both structural labour market measures and persistent demand shocks which can drive medium-term fluctuations of the natural rate, e.g. via hysteresis mechanisms. Although the chapter gauges the effects of the natural rate determinants based on a panel of 28 EU economies covering 1985-2018, it pays particular attention to developments in the euro area.

Among the various structural variables tested, several have high explanatory power and appear to be important drivers of the natural rate across the various specifications. These include a measure of the unemployment benefit replacement rate, a labour tax wedge indicator, spending on active labour market policies (ALMPs) and union density. This confirms previous findings[208]. Demographic factors are also found to play a role, especially for the Member States that have joined the EU since 2004. In particular, the fall in the natural rate since 2000 is largely driven by population ageing.

Persistent demand shocks also have a bearing on the natural rate. Such shocks are related to crisis episodes (i.e. unwinding of unsustainable developments). In particular, housing boom-bust episodes have a statistically significant impact on developments in the natural rate. Real interest rate and total factor productivity (TFP) growth, which control more generally for the presence of shocks, also matter. Finally, within-country unemployment

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[206] European Commission, (2019), 'A challenging road ahead', Autumn 2019 Economic Forecast.

[207] See, for example: Nickell, S. (1997), 'Unemployment and labor market rigidities: Europe versus North America', *Journal of Economic Perspectives*, Vol. 11, No. 3, pp. 55-74; Blanchard O. and J. Wolfers (2000), 'The role of shocks and institutions in the rise of European Unemployment: the aggregate evidence', *The Economic Journal*, 110, C1-C33; Bassanini, A. and R. Duval (2006a), 'Employment patterns in OECD countries: reassessing the role of policies and institutions', OECD Economics Department Working Papers, No. 486; Bassanini, A. and R. Duval (2006b), 'The determinants of unemployment across OECD countries: reassessing the role of policies and institutions', *OECD Economic Studies*, No. 42, 2006/1; Orlandi, F. (2012), 'Structural Unemployment and its Determinants in the EU countries' *European Economy – Economic Papers*, No. 455, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission; Gal, P. and A. Theising (2015), 'The macroeconomic impact of structural policies on labour market

outcomes in OECD countries: A reassessment', *OECD Economics Department Working Papers*, No. 1271, OECD Publishing, Paris.

[208] See, for example: Orlandi, op. cit.

dispersion (across different NUTS2 regions) in the EU Member States - signalling labour mobility across regions - is also a significant factor for medium-term changes in the natural rate[209].

IV.2. Natural rate of unemployment in the euro area and the Member States

From the first quarter of 2013 to the end of 2018, employment in the euro area rose by about 9 million (about 14 million in the EU). The employment recovery accelerated in the course of 2014 and gained strength thereafter. In 2018, the euro area unemployment rate fell to 8.2% (6.6% in the EU), about one percentage point below the rate one year earlier (see Graph IV.1). The fall of unemployment in Central and Eastern European countries has been even greater. Whereas improvements in macroeconomic conditions in the aftermath of the global financial crisis have greatly contributed to the fall in the unemployment rate, arguably, the main factor for this decline between 2012 and 2018 in several countries was the fall in the natural rate.

We present results for five group of countries: the euro area Member States (EA); the 10 newly-accepted EU countries without Croatia (EU10); the 13 EU economies which were part of the EU prior to 2004 (AT, BE, DE, DK, ES, IE, IT, FI, FR, NL, PT, SE, UK (EU13)); Member States in the euro area for which the natural rate was falling by more than 1 percentage point since 2012 (BE, DE, ES, FI, IE, MT, PT, EE, LT, LV, SK (EA(FA)); and euro area Member States for which the natural rate was stagnant or even rising since 2012 (AT, CY, EL, FR, IT, LU, NL, SI (EA(ST))[210]. We present aggregates for the country groups weighted by the size of the labour force (aged 15-74) of the respective country relative to the labour force of the whole group.

We look at behaviour and the determinants of the 'natural' rate of unemployment broadly defined as the unemployment rate at which, excluding the effects of supply-side factors such as labour market

reforms, inflation remains stable[211]. For the purpose of this study, we analyse the behaviour of the nonaccelerating wage rate of unemployment (NAWRU). We use the latter term interchangeably with the natural rate (see Box IV.1). To put things in context, we rely on a Phillips curve relation between wage inflation and unemployment, which has a long history in macroeconomics. The concept of the natural rate is often attributed to Milton Friedman and Edmund Phelps[212].

The point of departure in this study is a simple decomposition of the unemployment rate,

$$u_t = \tilde{u}_t^* + \underbrace{(u_t - u_t^*)}_{u_t^{gap}} + \underbrace{(u_t^* - \tilde{u}_t^*)}_{u_t^{med-term}} \quad \text{IV.1}$$

where $\tilde{u}_t^*$ is the structural unemployment and u_t^* is the natural rate. The structural unemployment, $\tilde{u}_t^*$, captures the elements of the unemployment rate that are driven by slow-moving factors such as policy institutions, demographics and even changes in social norms. The unemployment gap, u_t^{gap}, defined as the difference between the observed unemployment rate from the natural rate, is arguably one of the main inputs in the decision-making process in monetary and fiscal policy. Conceptually, it follows that the natural rate of unemployment is the sum of the structural unemployment and a medium-term macroeconomic component, $u_t^{med-term}$. As a result, the logic of the decomposition implies that the natural rate converges to the structural unemployment $\tilde{u}_t^*$ over time as the disturbances driving the medium-term fluctuations $u_t^{med-term}$ fade away.

[209] NUTS stands for Nomenclature of Territorial Units for Statistics, a geocode standard for referencing the subunits of countries established for statistical purposes. Eurostat defines a hierarchy of three NUTS levels for each EU Member State.

[210] We include Croatia in the panel data estimation but due to its short data span exclude it from the newly-accepted EU countries.

[211] The very extensive literature on the natural rate of unemployment over the years has equated 'natural' with long-term, frictional, average, equilibrium, normal, full employment, normal, steady state, lowest sustainable, efficient, Horrick-Presscot trend. Rogerson (1997) discusses how the imprecision in the language used has often led to ambiguity in relation to the concept. Rogerson, R. (1997), 'Theory ahead of language in the economics of unemployment', *Journal of Economic Perspectives*, Vol. 11, pp. 73-92.

[212] Friedman, M. (1968), 'The role of monetary policy', *American Economic Review*, Vol. 58, pp. 1-17; Phelps, E. S. (1967), 'Phillips curves, expectations of inflation and optimal unemployment over time', *Economica*, Vol. 34, pp. 254-281; Phelps, E. S. (1968), 'Money-wage dynamics and labor-market equilibrium', *Journal of Political Economy*, Vol. 76, pp. 678-711.

Graph IV.1: **Actual and natural rate of unemployment**

percent in 2018

percentage points change 2012/2018
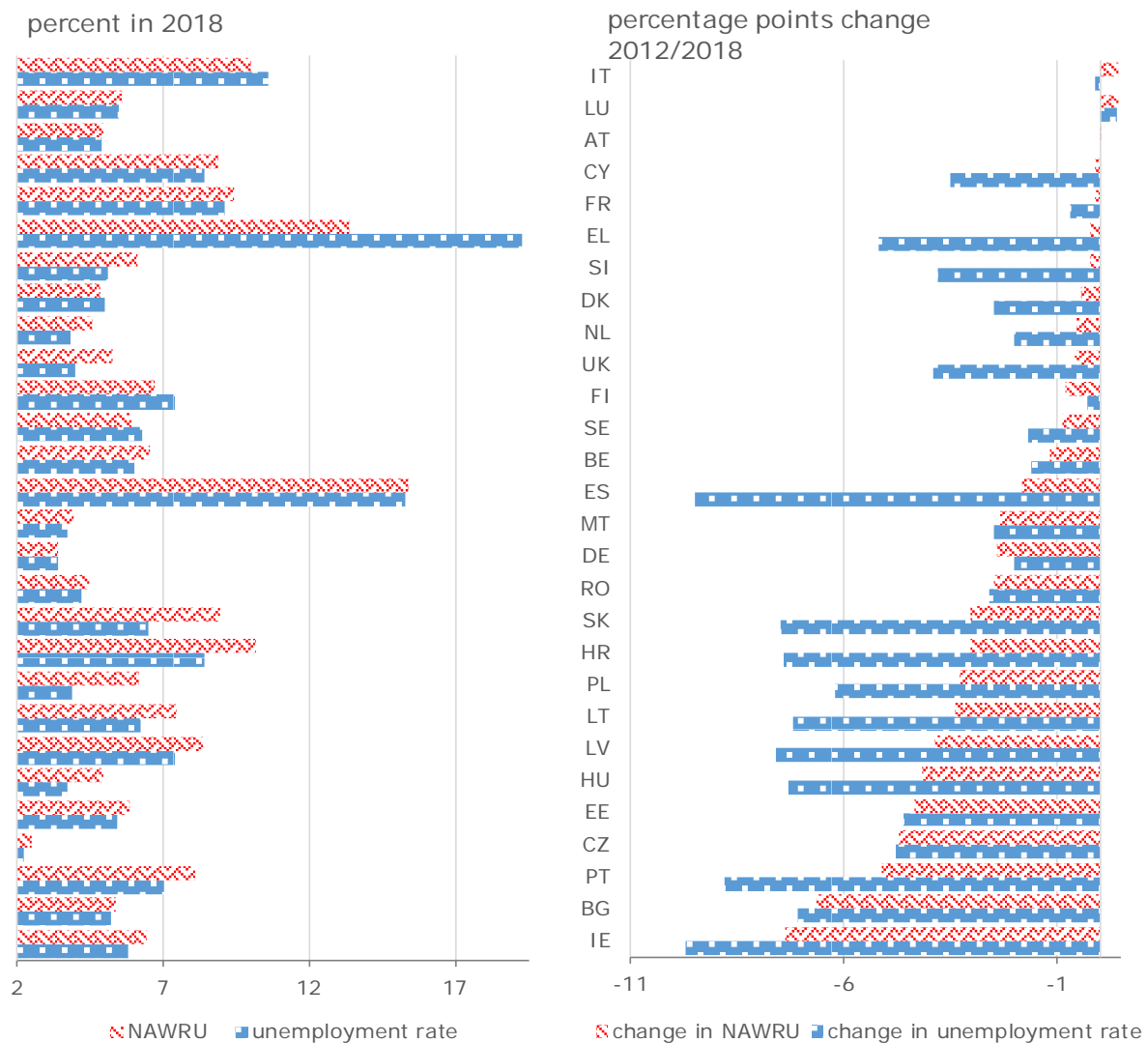
The natural rate refers to the nonaccelerating wage rate of unemployment (NAWRU) estimated according to the EU's commonly-agreed methodology (see Box 1). Countries are ranked according to the degree of change in their natural rates between 2012 and 2018.
Source: Eurostat, Ameco

Some may find the distinction between natural and structural unemployment rate confusing. More precisely, one may ask what drives the wedge between the two unemployment rates, $u_t^{med-term}$. Here, similar to Blanchard (2018), we point out that if, say, a temporary demand shock such as an unexpected rise in the short-term interest rate by the central bank triggers a persistent rise in the natural rate[213], the tightening of monetary policy could cause a recession. Olivier Blanchard reports

that in a 'standard' dynamic stochastic equilibrium model, because of for instance nominal rigidities and/or matching frictions in the labour market, the decline in output will likely accompany a decline in employment. Since capital and labour are quasi-fixed in the short run, by implication, a temporary disturbance may affect the natural rate. This is true both in a 'standard' model and in a model that emphasises 'hysteresis' effects. This implies that the natural rate will steer toward structural unemployment in the long run.

[213] Blanchard, O. (2018), 'Should we reject the natural rate hypothesis?' *Journal of Economic Perspectives*, Vol. 32, No. 1, pp. 97-120.

Box IV.1: NAWRU estimation

The NAWRU is implicitly defined as the equilibrium point of a dynamic system of labour supply and labour demand equations. This equilibrium concept is linked to the Phillips curve debate which is crucial in monetary policy discussions (see, e.g., Phelps, 1967; Friedman, 1968)[1]. The Phillips curve embodies the process through which wages adjust to economic conditions, with adjustment delays reflecting the effects of limited information in the formation of expectations or institutional rigidities. In particular, this implies that different assumptions on the formation of expectations have a bearing on the specification of the Phillips curve. Notable cases include the static or adaptive expectation case which yields the traditional Keynesian Phillips (TKP) curve specification and the rational expectations case which yields the new-Keynesian Phillips (NKP) curve.

Since 2014, the CAM applies a Phillips curve augmented with rational expectations (i.e. the NKP) for 21 EU countries. In addition, it applies the Phillips curve with static/adaptive expectations (i.e. the TKP) to 7 countries[2]. The Phillips curve specification for any particular country is chosen based on the statistical fit of the regression. For example, for Germany CAM applies the Phillips curve with adaptive expectations because such a regression explains changes in wage inflation better. Both the TKP and the NKP specifications are based on identical labour market concepts, differing only in terms of underlying timing and expectation assumptions. Considering both the TKP and the NKP provides a fuller encompassing implementation of the Phillips curve concept, which covers a wider set of alternative expectation assumptions.

The CAM resorts to the standard unobserved component framework which has been proposed by Kuttner (1994) and Gordon (1997) among others to estimate conceptual variables with time-varying behaviour[3]. The unemployment rate u_t is decomposed into the NAWRU, u_t^*, and the unemployment gap, u_t^{gap}, assuming that their dynamic is generated by the stochastic linear processes:

$$\Delta u_t^* = \varepsilon_{u^*t} + n_{t-1},$$

$$\Delta n_t = \varepsilon_{nt},$$

$$\theta(L) u_t^{gap} = \varepsilon_{u^{gap}t},$$

where L denotes the lag operator, $\Delta \equiv 1 - L$ the first-difference, $\theta(L) = 1 - \theta_1 L - \theta_2 L^2$ is an autoregressive polynomial with complex roots, and ε_{u^*t}, ε_{nt}, and $\varepsilon_{u^{gap}t}$ are independent and normally distributed white noises with variance V_l, $l = u^*, n, u^{gap}$. The choice of an integrated random walk process for capturing the NAWRU dynamics is first motivated by its generality: if $V_n = 0$ it reduces to a random walk; if instead $V_{u^*} = 0$, it yields the I(2) model $\Delta^2 n_t = \varepsilon_{nt}$. In addition, the unemployment gap drives the fluctuations of a labour cost indicator in the Phillips curve with either backward or forward-looking expectations, depending on the country. The backward-looking version in current use is such that:

$$\Delta \pi_t^w = \mu_\pi + \beta_0 u_t^{gap} + \beta_1 u_{t-1}^{gap} + \gamma' x_t + \varepsilon_{\pi^w t},$$

where $\Delta \pi_t^w$ represents the change in wage inflation. A second lag of the gap may be added. The vector x_t contains exogenous information about terms-of-trade, labour productivity, and the change in the wage

[1] Phelps, E. S. (1967), 'Phillips curves, expectations of inflation and optimal unemployment over time', *Economica*, Vol. 34, pp. 254-281. Friedman, M. (1968), 'The role of monetary policy', *American Economic Review*, Vol. 58, pp. 1-17.

[2] CAM uses NKP for 21 countries which include Bulgaria (BG), Croatia (HR), Cyprus (CY), Czechia (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Greece (EL), Hungary (HU), Ireland (IE), Latvia (LV), Lithuania (LT), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES), Sweden (SE) and the United Kingdom (UK). The 7 countries which rely on TKP include Austria (AT), Belgium (BE), Germany (DE), Italy (IT), Luxembourg (LU), Malta (MT) and the Netherlands (NL).

[3] Kuttner, K.N. (1994), 'Estimating potential output as a latent variable', *Journal of Business and Economic Statistics*, Vol. 12, No. 3, pp. 361-368. Gordon, R.J. (1997), 'The time-varying NAIRU and its implications for economic policy', *Journal of Economic Perspectives*, Vol. 11, pp. 11-32.

Box (continued)

share, with country-specific loadings via the vector of coefficients γ. For the other EU countries use is made of the forward-looking version with solution:

$$\Delta rulc_t = \alpha \, \Delta rulc_t + \beta_0 u_t^{gap} + \beta_1 u_{t-1}^{gap} + \gamma' \, x_t + \varepsilon_{rulc \ t},$$

where *rulc* represent real unit labour cost and β_1 satisfies the constraint $\beta_1 = \beta_0 \theta_2 (\alpha - .99)/(.99\alpha - 1)$. The shocks $\varepsilon_{\pi^w t}$ and $\varepsilon_{rulc \ t}$ to the two Phillips curves are normally distributed white-noise variables which are independent to the other shocks in the model.

This study does not compute the NAWRU but relies on estimates by the EU's commonly-agreed methodology (CAM). The approach used by CAM seeks to identify the natural rate by exploiting the connection between wage inflation and the state of the labour market based on a version of an accelerationist expectations-augmented Phillips curve[214].

While the level of the natural rate of unemployment is not known with certainty, estimates by the Commission's Directorate-General for Economic and Monetary Affairs (DG ECFIN) as well as various institutions suggest that it has dropped over time: According to CAM the NAWRU for the euro area aggregate declined by more than 1 percentage point from 9.4% to 8.1% in 2018. To the extent that the effects of structural reforms are captured by estimates of the natural rate of unemployment only with a lag, the effective size of the labour market slack (i.e. the distance between the unemployment rate and its structural level) would be higher than the one currently observed.

IV.3. Determinants of the natural rate: a brief literature review

Various factors have been proposed as contributing to developments in unemployment and its natural rate. This chapter divides the determinants of natural rate into two types, namely *structural* and *macroeconomic/cyclical*[215]. Structural determinants are features of the labour market that have a bearing on its long-term functioning. The

four *labour market policy* indicators used in this chapter that fall into this category and are directly related to institutional features are: the *unemployment benefit net replacement rate*, the *labour tax wedge*, the *degree of union density*, and the *expenditure on active labour market policies*. This study also takes a more general view, arguing that changes in *demographic structure* - defined as variations in shares of the working-age population in each age group over time - matter for labour market outcomes, particularly unemployment.

The second category includes macroeconomic determinants, which include changes in the *long-term real (inflation-adjusted) interest rate*, variations in *technological progress*, *construction activity* (housing boom-bust) effects, and *industrial confidence*. In addition, this report finds *within-country unemployment dispersion* (across different NUTS2 regions) - signalling labour mobility across regions - to be an important factor for NAWRU.

The following paragraphs include a brief literature review and a discussion of recent developments in the determinants of the natural rate of unemployment.

IV.3.1. Labour market policy indicators

The focus of this study is to empirically quantify the effect of labour market institutions on the level rather than on the nature of the natural rate and in turn on the structural unemployment. Not all labour market policies have a clear-cut, identifiable, theoretically- or empirically-significant effect. This is partly because the labour market institutions jointly determine structural unemployment by looking at the system as a whole and interactions between its separate parts, rather than at individual policies. Another reason is the complexity even of individual labour market instruments. The inability to summarise complicated reforms into a single number, in addition to the lack of a sufficiently

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(214) Havik, K., Mc Morrow, K., Orlandi, F., Planas, C., Raciborski, R., Roeger, W., Rossi, A., Thum-Thysen, A., and V. Vandermeulen (2014), 'The production function methodology for calculating potential growth rates and output gaps', *European Economy – Economic Papers*, No. 535, Directorate-General for Economic and Monetary Affairs (DG ECFIN), European Commission.

(215) Blanchard and Wolfers, op. cit. Orlandi, op. cit.

long time-series, may lead to the conclusion that a policy's effects are insignificant, even if the theory predicts otherwise. Instruments that have been revealed as statistically significant are discussed below. Note that the study's authors could not find that interactions between policy instruments or between instruments and macroeconomic shocks have an effect on the level of the natural rate[216].

Unemployment benefit net replacement rate: The net replacement rate in unemployment measures the proportion of previous in-work income that is maintained after several months of unemployment. This insurance framework points to two separate effects of insurance on unemployment. The first is through its effect on search intensity, and thus the matching between unemployment and vacancies. The second is through the reservation wage, as higher unemployment benefits are likely to lead to an increase in the bargained wage. Both effects in turn imply an increase in equilibrium unemployment duration, and thus an increase in the natural rate. Guided by search theory, much empirical work has looked into the effects of the schedule of unemployment benefits on job searching by the unemployed. There has been however little empirical micro work on the other channel, namely the effects of unemployment insurance on bargained wages. This reflects a more general shortcoming, a still poor empirical understanding of wage determination in environments especially such as in Europe where both individual and collective bargaining are likely to play a role.

Due to their costs, net replacement rates are higher in the wealthier EU Member States (see Graph IV.2). These expenditures had been declining in the EU13 economies while remaining fairly stable in the EU10 states. Even at the height of the global financial crisis, these expenditures in the EU10 never exceeded one-third of the spending in the old Member States. The recent increase in 2015 of net replacement rates in the EU13 is related to policy reforms in Italy. Italy replaced the previous system of unemployment benefits by increasing the coverage in relation to eligibility for unemployment benefit support.

Tax wedge: Taxes on labour income comprise income taxes and contributions to the social security system (both by employers and by employees). Taxation on labour income creates a wedge between the real producer labour costs and the purchasing power of the net wage. Higher taxes increase marginal costs for firms. Furthermore, trade unions demand a higher gross wage rate after rises in labour tax. Both effects lead to higher unemployment[217].

Graph IV.2 plots the tax wedge. The tax wedge has steadily gone down in most EU countries since the 1990s. In many countries, it stands at below 30%. The tax burden on labour nevertheless remains high. After the Eurogroup agreement in September 2015, several Member States have undertaken reforms to address the high tax wedge on labour[218]. More recently, however, reform efforts have decreased, with Member States pointing to the financing of labour tax reductions as a key challenge.

Union density: Greater unionisation is commonly found to be associated with higher unemployment levels[219]. The likely explanation for this is that higher union density reduces competition in labour markets, leading to relatively higher labour costs. Graph IV.2 plots union density - the proportion of union membership, based either on survey data or calculated on the basis of administrative data. However it does not show the significant differences between country groups (EU10 vs EU13) and countries. A number of EU13 countries witnessed a significant drop in union density, most notably Austria, Germany, France, Ireland, the Netherlands, Portugal and the UK. During their transition to market-based economies, the EU10 experienced a significant fall in trade union

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[216] While the results suggests that union density does not have an effect on unemployment, the study nevertheless uses it in the regressions. Box I.3 discusses the reasons.

[217] Some authors (e.g., Blanchard 2006) argue that consumption taxes have no effect on unemployment since they are a burden both on employed and unemployed people and therefore have no effect on the reservation wage. Analogue to this argumentation Pissarides (1998) finds in different wage bargaining models that taxes on labour income hardly influence the unemployment rate if the replacement rate is proportional to the after-tax earnings. However, this is not always the case and one can argue (Nickell, 2006) that a certain degree of real wage rigidity will lead to higher labour costs when labour taxes go up.

[218] Kalyva, A., Princen, S., Leodolter, A., and C. Astarita (2018), 'Labour Taxation and Inclusive Growth', *European Economy – Discussion Papers*, No. 84, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission.

[219] Nickell S., Nunziata L. and W. Ochel (2005), 'Unemployment in the OECD since the 1960s. What do we know?', *The Economic Journal*, Royal Economic Society, Vol. 115, No. 500, pp. 1-27.

Graph IV.2: **Labour market policies**
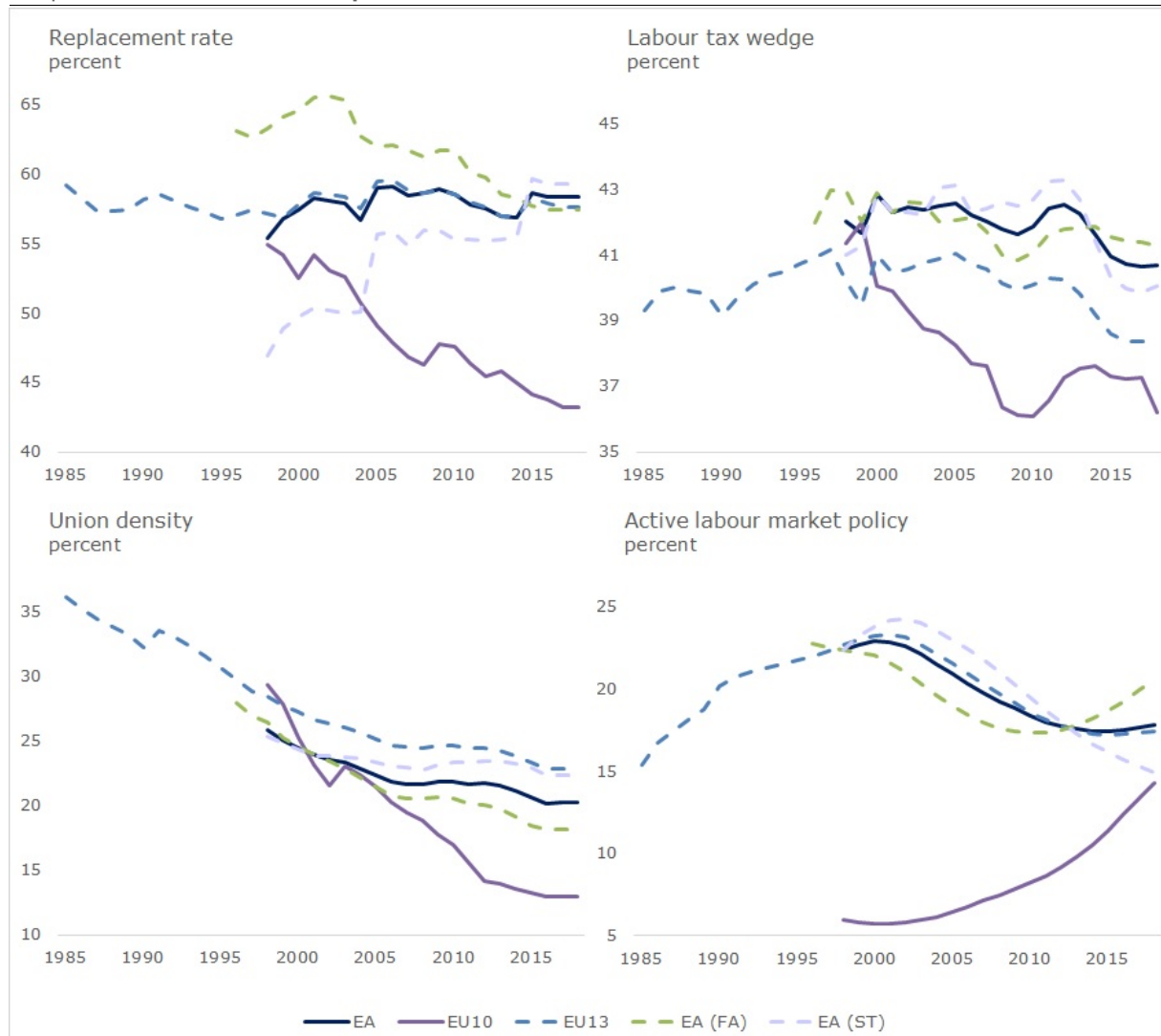
The graph shows the evolution of indices of the unemployment benefit net replacement rate, the labour tax wedge, union density and spending on active labour market policies for five group of countries since 1985. The unemployment benefit net replacement rate measures the average net unemployment benefit as a percent of previous in-work income before the job loss across wage levels (100% and 67% of average wage income), family status (a recipient has no children and is either single, married with a partner that has no income or with a partner that has an income) and benefit durations (selected unemployment periods include 2, 7, 13 and 60 months). The net unemployment benefits include general unemployment benefit, housing benefit and social assistance. The labour tax wedge is defined as income tax on gross wage earnings plus the employee's and the employer's social security contributions, expressed as a percent of the total labour costs of the earner (gross earnings plus the employer's social security contributions plus payroll taxes). Due to data availability, we use the labour tax wedge for single people without children earning 67% of the average wage income. Union density is measured as the proportion of union members of the total number of wage and salary earners, adjusted for non-active and self-employed members. Active labour market policy is measured as the trend (HP-filter) of spending per unemployed as a percent of GDP/per capita. Spending includes all labour market interventions except out-of-work income maintenance and support, and early retirement. The country indices are aggregated into country groups by using the share of country's labour force to the labour force of the group as a weight. Mnemonics on country groupings are listed in Chapter IV.2.
Source: Eurostat, Ameco, OECD, DG EMPL

membership. The institutional framework put in place during the socialist era to protect labour did not survive the transition period.

Active labour market policy: By helping potential employees find vacancies and refresh their skills in line with the latest job market requirements, ALMPs present an opportunity to decrease

unemployment and increase labour market participation. This may be mainly for two reasons[220]. First, some ALMPs, such as training programmes, aim to decrease the risk of people becoming unemployed again by improving

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[220] Boone, J., and J. C. van Ours (2004), 'Effective active labor market policies', *CEPR Discussion Paper*, No. 4707.

workers' competencies. Second, besides facilitating job-search, ALMPs can be used for 'activation'. This makes them more likely to motivate job-search, given that some people who receive benefits try to avoid complying with programme requirements. This latter effect is likely to be greater when unemployment benefits amount to more than the wage of potential job offers. Indeed, the literature on programme evaluation has shown that careful combination of active and passive policies can be effective in reducing the disincentivising effect of generous unemployment benefits[221].

Graph IV.2 shows that ALMPs have increased in the EU10 but decreased in the EU13, after a peak around the beginning of the 2000s. Spending on ALMPs is expressed as the trend of spending per unemployed person as a percentage of GDP per capita. The series is de-trended in order to take out cyclical and automatic changes due to increases in unemployment unrelated to policy changes. Most EU10 countries entered the 1990s with their economic model relatively uncompetitive compared to the other Member States. The closing down or restructuring of businesses led to massive lay-offs. At the same time, these countries did not have the resources to introduce costly labour market measures such as more generous unemployment benefits and ALMPs. Such measures were either non-existent at the beginning of the transition or much less generous. Over time however and also due to the global financial crisis, several EU10 countries have ramped up spending on ALMPs.

Demographic developments: When studying structural unemployment one usually considers aggregate indicators such as tax wedges, union density, benefit replacement rates, etc. However, this approach implicitly assumes that one can define a homogenous aggregate wage equation. This has also been the approach followed in the literature for estimating aggregate structural unemployment[222]. But this is most likely a very

strong assumption, since wage behaviour probably differs across different groups. One could, for example, imagine that wage behaviour differs by skill.

Another interesting dimension, the one pursued in this study, is to consider age-specific wage setting and labour demand. There is evidence that middle-aged workers are employed in relatively stable jobs due to considerable work experience but also have a relatively low labour supply elasticity because of family and financial commitments[223]. Because of commitments, for instance related to paying down a mortgage, such workers may delay retirement, are less likely to quit a job and have a higher job-finding rate following a spell of unemployment[224].

Younger workers on the other hand are less likely to have stable jobs, as they are generally less experienced and are still searching for new job opportunities. They may also be more mobile both regionally (within a country but also across countries) and professionally. Older workers are sometimes confronted with more adverse labour demand conditions because of doubts about their resilience and they may also be more costly for firms[225]. However, at least historically, they also have the option of early retirement. It is therefore likely that there is a difference in structural unemployment across age groups. Thus, changes in the demographic composition of the labour force (population of working age) can have an impact on the structural unemployment rate. There is also a

[221] Autor, D., Li, A., and M. Notowidigdo (2019), 'Preparing for the work of the future' Cambridge, MA: Abdul Latif Jameel Poverty Action Lab.

[222] The microeconomic literature, in contrast to the macroeconomic one, has long recognised the significance of demographic trends. For example, many microeconomic studies have tried to assess the importance of individual or family socio-economic aspects as determinants of individual labour market outcomes (Ashenfelter and Ham, 1979; Stratton, 1993). Ashenfelter, O., and J. Ham (1979), 'Education, Unemployment, and Earnings', *Journal of Political Economy*, Vol. 87, No. 5, pp. S99-116. Stratton, L. (1993), 'Racial Differences in Men's Unemployment', *Industrial and Labor Relations Review*, Vol. 46, No. 3, pp. 451-463.

[223] The literature suggests that the labour supply of low-income workers, second earners and older workers is more responsive to taxation than that of other groups of workers. Diamond, P.A. (1980), 'Income taxation with fixed hours of work', *Journal of Public Economics*, Vol. 13, pp. 101-110. Pissarides, C. (1998), 'The impact of employment tax cuts on unemployment and wages; The role of unemployment benefits and tax structure', *European Economic Review*, Vol. 47, pp. 155-183. Saez, E. (2000), 'Optimal income transfer programs: Intensive versus extensive labor supply responses', NBER Working Paper, No. 7708.

[224] Zator, M. (2019), 'Working more to pay the mortgage: Household debt, consumption commitments and labor supply', Working Paper, Northwestern University.

[225] Axelrad, H., Malul, M. and I. Luski, (2018), 'Unemployment among younger and older individuals: does conventional data about unemployment tell us the whole story?', *Journal for Labour Market Research*, Vol. 52, No. 3; Marmora, P., and M. Ritter (2015), 'Unemployment and the retirement decisions of older workers', *Journal of Labor Research*, Vol. 36, No. 3, pp. 274–290; Johnson, R.W. (2004), 'Trends in job demands among older workers, 1992–2002', *Monthly Labor Review*, Vol. 127, No. 48.

second dimension - the structural unemployment rate is likely to respond differently to structural policy measures by age group, i.e. there may be interaction effects between demographic and structural policy indicators.

This chapter quantifies the effect of demographics on unemployment (see Box IV.2). This is not the first study to rely on demographic changes to clean the unemployment rate of composition effects in the labour force. There is a strand of the labour economics literature which infers the natural rate by using observable labour market indicators such as measures of job vacancies and the flows into and out of unemployment, demographic composition of the labour force, or using mismatch indicators of unemployment[226].

The chapter contributes to the existing literature by using age-cohort models to estimate aggregate trends for unemployment[227]. The novelty of the study is to gauge the demographic effects and compute the aggregate structural unemployment in a unified framework. In contrast, previous research has separately quantified the cohort-specific structural unemployment and, then, in a second step constructed the aggregate unemployment trend. To avoid the two-step procedure, we present a simple model that motivates the regression framework for studying demographic effects in a structural unemployment regression

(see Box IV.2)[228]. The bottom line of the analysis is that since age-specific characteristics co-determine the unemployment rate for each cohort, structural unemployment across age groups may be significant. This implies that demographic changes may alter the aggregate structural unemployment, everything else being equal.

One challenge for the model presented here is that the cohort-specific effect is constant, pinned down by age-specific characteristics. There is evidence however that this effect my change over time. For example, today, older workers participate in the labour market at a higher rate than three decades ago. Similarly, young workers (aged 15-24), due to the increasing length of their education, participate at a much lower rate than in the 1990s. The results discussed here are broadly preliminary, meant to present the size of the demographic effects. The extension of this work would necessarily need to capture the evolution of these age effects on unemployment, for instance by using additional explanatory variables, such as educational attainment and the organisation of the pension system.

Graph IV.3 shows that the developments for all the main demographic groups, both in the old and the new EU Member States. These graphs, similar to the conclusions in numerous studies, suggest that the EU's population is likely to decrease in the coming decades as a result of an extended period of relatively low fertility, coupled with - specifically in the case of the new Member States - migratory patterns. The falling share of children and young people in the working-age cohort and total population could result in labour market shortages in specific countries and in particular occupations. By contrast, the rise in life expectancy (for both men and women) in the EU means that the number and share of the elderly in the total population will continue to increase.

[226] Blanchard, O.J., and P. Diamond (1989), 'The Beveridge curve', *Brookings Papers on Economic Activity*, Vol. 20, pp. 1-76. Daly, M.C., Hobijn, B., Sahin, A., and R.G. Valletta (2012), 'A search and matching approach to labor markets: Did the natural rate of unemployment rise?', *Journal of Economic Perspectives*, Vol 26, pp. 3-26. Perry, G.L. (1970), 'Changing labor markets and inflation', *Brookings Papers on Economic Activity*, Vol. 1, pp. 411-448. Summers, L. H. (1986), 'Why is the unemployment rate so very high near full employment?', *Brookings Papers on Economic Activity*, Vol. 17, pp. 339-396. Shimer, R. (1998), 'Why is the U.S. unemployment rate so much lower?', In: Bernanke, B., Rotemberg, J. (eds.), *NBER Macroeconomics Annual*, MIT Press, Vol. 13, pp. 11-61. Brauer, D. (2007), 'The natural rate of unemployment', Working Paper 2007-06, Congressional Budget Office. Barnichon, R., and G. Mesters (2018), 'On the demographic adjustment of unemployment', *Review of Economics and Statistics*, Vol. 100, pp. 219-231. Sahin, A., Song, J., Topa, G., and G.L. Violante (2014), 'Mismatch unemployment', *American Economic Review*, Vol. 104, pp. 3529-3564.

[227] Aaronson, S., Cajner, T., Fallick, B., Galbis-Reig, F., Smith, C., and W. Wascher (2014), 'Labor force participation: Recent developments and future Prospects', *Brookings Papers on Economic Activity*, Vol. 2014, pp. 197-275. Hornstein, A., and M. Kudlyak (2019) 'Aggregate labor force participation and unemployment and demographic trends', Federal Reserve Bank of Richmond Working Paper No. 19-08, March 2019.

[228] The Box presents in detail the sources and computation of the demographics dataset used in the analysis.

Graph IV.3: **Shares of working - age population in several age cohorts**
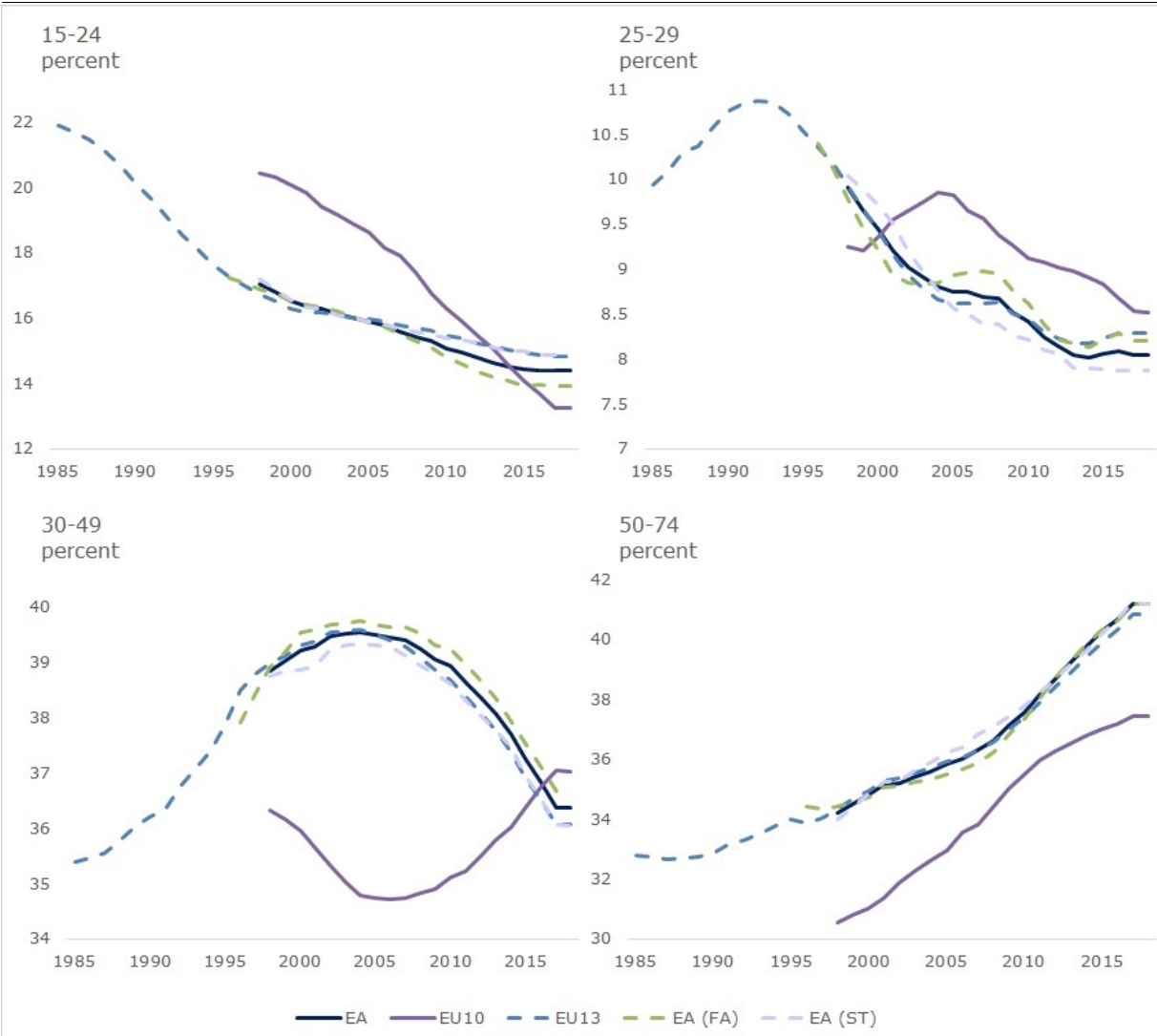
15-24
percent

25-29
percent

30-49
percent

50-74
percent

EA ——— EU10 ——— EU13 – – EA (FA) – – EA (ST) – –

The country indices are aggregated into country groups by using the share of country labour force to the labour force of the group as a weight. Mnemonics on country groupings are listed in Chapter IV.2.
Source: Eurostat

Box IV.2: Labour market model with demographics

This Box outlines the main insight from the model in Hristov and Roeger (2020) which studies the long-term effect of demographic changes on labour market outcomes[1]. The modelling framework focuses on demographic heterogeneity and leaves aside short-term dynamics. Think of a competitive labour market composed of the four age groups, $i = vy, y, m, o$; that is, very young, young, middle-aged, and old cohorts. The innovation to other standard models is that the labour market is segregated in the sense that workers belonging to different age groups have different wage behaviour. Aggregate production is a composite of age-specific labour, with age-specific output elasticities. The age-specific real wage clears the market and determines the equilibrium employment for each cohort. Since wage is a function of age-specific characteristics, the model predicts that differences in structural unemployment *across age groups* may be sizeable. This allows one then to augment a standard regression in the empirical literature on labour market institutions with the role of demographics. This yields the following structural unemployment equation (excluding the error term)

$$\tilde{u}_t^* = (\tau_i + mup_m) + (mup_{vy} - mup_m)s_{vyt} + (mup_y - mup_m)s_{yt} + (mup_o - mup_m)s_{ot} + \sum_k \gamma_k S_k,$$

where mup_i denotes an age-specific demographic fixed effect for one of the four age groups; τ_i is country-specific dummy; s_{it} stands for the share of the cohort size i to the working age population in time t. Structural unemployment, $\tilde{u}_t^*$, is also a linear function of structural labour market indicators, S_k. The sensitivity of structural unemployment to the latter is given by γ_k.

In this equation, the country-fixed effect contains the mark-up of the middle-aged group (note this mark-up can be negative or positive), while the coefficient of the population shares for the old and the young must be interpreted as mark-up differences between the respective age cohort and the middle-aged group. The interpretation of these coefficients is straightforward. If, on average, the unemployment rate of age group i is higher/lower than age group m, we expect a positive/negative coefficient. The coefficient should approximately measure the average difference in the unemployment rate between age group i and the middle-aged cohort, m,

$$Mean(\tilde{u}_{it}^*) - Mean(\tilde{u}_{mt}^*) = mup_i - mup_m, \text{ for } i \neq m.$$

For implementing this in the panel regression, the following demographic variable is constructed

$$DEMO_t = \big(Mean(u_{vyt}) - Mean(u_{mt})\big)s_{vyt} + \big(Mean(u_{yt}) - Mean(u_{mt})\big)s_{yt} + \big(Mean(u_{ot}) - Mean(u_{mt})\big)s_{ot} \quad [2]$$

Finally, using the newly constructed variable and constraining its coefficient to one, $1^{constrained}$, one arrives at a definition of the structural unemployment rate, a building block in the regression analysis in the paper

$$\tilde{u}_t^* = (\tau_i + mup_m) + 1^{constrained} DEMO_t + \sum_k \gamma_k S_k.$$

Statistically, one cannot reject the hypothesis that the coefficient for the demographic variable equals 1.

[1] Hristov, A. and W. Roeger (2020), 'Demographic trends and structural unemployment', forthcoming.

[2] Observe that $Mean(u_{vyt}) - Mean(u_{mt}) = Mean(\tilde{u}_{vyt}^*) - Mean(\tilde{u}_{mt}^*)$; that is, to avoid complicating the analysis, one uses the difference between the *actual* cohort-specific unemployment rates, instead of the difference between the *structural* cohort-specific unemployment rates.

(Continued on the next page)

What are the stylised facts about unemployment by age across countries? There is a noticeable unemployment pattern across age groups. Graph **1** shows that in all countries groups with younger workers – i.e. the 15-25 and 25-29 age groups - have higher unemployment rates compared with middle-aged workers - the 30-49 cohort, while the unemployment rate of older workers aged 50-74 is close to that of middle-aged ones([3]).

Graph 1a: **EU10**

Graph 1b: **EU13**

Source: Eurostat
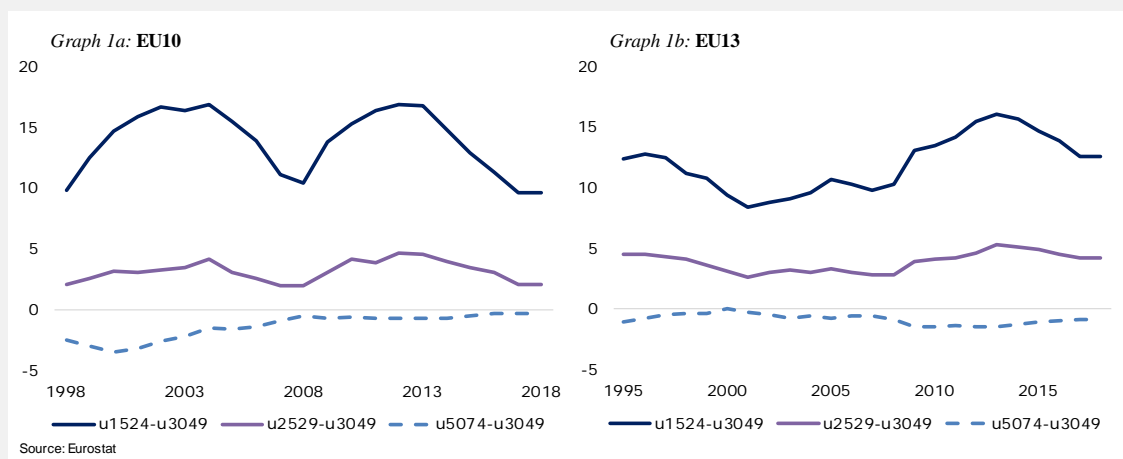
The relative stability of unemployment rate differentials across age groups supports the hypotheses that the demographic effect should largely show up as an age-specific fixed effect.

([3]) The graph presents the difference in unemployment rates between different cohorts (15-24, 25-29, 50-74) and the middle-aged (30-49). Differences in country cohort-specific unemployment rates are aggregated into country groups by using the share of country labour force to the labour force of the group as a weight.

IV.3.2. Macroeconomic effects

Apart from institutional measures, medium-term economic developments and cyclical factors also affect the NAWRU. A number of studies have identified a theoretical link between demand conditions and the NAWRU([229]). These studies have usually relied on models featuring labour market rigidities. To keep it short, this study briefly outlines only the most significant factors, namely total productivity growth, real interest rate developments, construction activities and industrial confidence. We find that within-country unemployment dispersion may also cause fluctuations in the NAWRU.

Total factor productivity: The effects of TFP on unemployment are theoretically ambiguous. An increase in TFP growth can reduce the demand for labour and therefore increase unemployment. But productivity growth can also reduce the

unemployment rate by driving a wedge between wages and the reservation wage (proxied by unemployment benefits) if the reservation wage is not fully indexed to the market wage. This latter effect seems to be the dominant factor. In sum, this implies that a subpar productivity growth pushes up the unemployment rate.

Average annual TFP slowed down below 1.5% in the 1990s in the EU13 and below 0.5% after the onset of the great financial crisis (Graph IV.4). In other words, the ability of the firms to pay out the wages prevalent prior to the slowdowns had decreased. This phenomenon partly explains the rise in the natural rate during periods of slowdowns in TFP.

Real interest rate: The real interest rate can potentially affect employment due to its effect on investment. The episode of strongly declining real rates after 2009 stabilised both investment and unemployment (see Graph IV.4).

([229]) Blanchard and Wolfers, op. cit. Orlandi, op. cit.

Construction activity: Buoyant credit growth, or 'credit booms', sometimes associated with a rise in construction activity, often presents a trade-off between immediate, strong economic performance and the risk of a future economic bust. The risk of a bust - where a phase of significant credit growth is followed by a financial crisis or economic stagnation – can notably increase when there is a boom in house prices.

This study finds that the NAWRU is negatively related to the size of the construction sector. During housing booms the construction sector provides employment opportunities to low skilled workers who in turn face difficulties getting reallocated to new jobs if there is a bust. Graph IV.4 shows how the build-up of construction activity prior to the global financial crisis in 2008-2009 led to a major scaling down of the sector in the subsequent years.

Unemployment dispersion: This indicator cannot be traced back to any particular policy but to a number of them. More specifically, within-country unemployment dispersion depends on regional-specific factors, such as population, available capital, ideas and skills, formal and informal collaborations, and capacity to evolve, create and disseminate knowledge, and react to changes. Variations in macroeconomic and policy trends, including those that are unrelated to labour markets - such as housing policy, interact with the regional characteristics to generate a variety of unemployment rate patterns.

For example, after the accession of the economies of Central and Eastern Europe to the EU, these interactions may have contributed to the fall in aggregate and within-country regional unemployment rates, with an associated convergence of less-developed regions to the EU average income levels[230]. On the other hand, since the onset of the new millennium, they may have led to a rise in within-country unemployment dispersion in a number of EU countries. These economies have observed a decrease in their labour

mobility and a formation of regional 'pockets' of low-skill, low-income population[231].

Graph IV.4 plots the unemployment dispersion indicator[232]. Except for the EA(ST) Members States, average subnational regional disparities in all country-group economies have trended down since 2014, after rising from the early 2000s. For the EA(ST) economies, however, regional dispersion still hovers around the levels observed during the euro area debt crisis in 2012-2014.

IV.4. Structural unemployment

What are the macro outcomes of these institutional differences? The study focuses on the impact of labour market institutions on unemployment. As noted in Chapter IV.2, the evolution of the NAWRU across regions is quite heterogeneous. In the old Member States (EU13) the NAWRU has been fairly stable and declined somewhat after 2013. New Member States started with a higher NAWRU but had a significantly lower NAWRU at the end of the sample period. This declined further after 2013. However there is also substantial heterogeneity between individual EU countries. A divergence occurs around mid-2000.

Graph IV.5 plots the main results based on the panel regression with institutional and demographic trends for the EA, EU13 and EU10 as well as for EA(FA) and EA(ST). The graph shows how changes in labour market indicators and demographics translated into changes in structural unemployment. The latter are explained in Box IV.3.

For EA and EU13 countries structural policy measures have helped reduce the unemployment rate. A fall in the labour tax wedge has been especially instrumental in the decline. This effect was partly counteracted by reductions in ALMP measures. If one adopts a somewhat longer perspective, one can see that demographic trends

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[230] Żuk, P., and L. Savelin (2018) 'Real Convergence in Central, Eastern and South-Eastern Europe', *ECB Occasional Paper*, No. 212.

[231] Iammarino, S., Rodriguez-Pose, A., and M. Storper (2019), 'Regional inequality in Europe: evidence, theory and policy implications', *Journal of Economic Geography*, No. 19, pp. 273–298.

[232] The construction of the within-country unemployment dispersion (across different NUTS2 regions) in the EU Member States is based on the long-term unemployment rates in the regions, but excludes outliers. The regional 90/10 disparity is defined as the difference between the long-term unemployment rates in the region at the 90th percentile of the country's regional unemployment distribution minus the region at the 10th percentile.

Graph IV.4: **Macroeconomic variables**
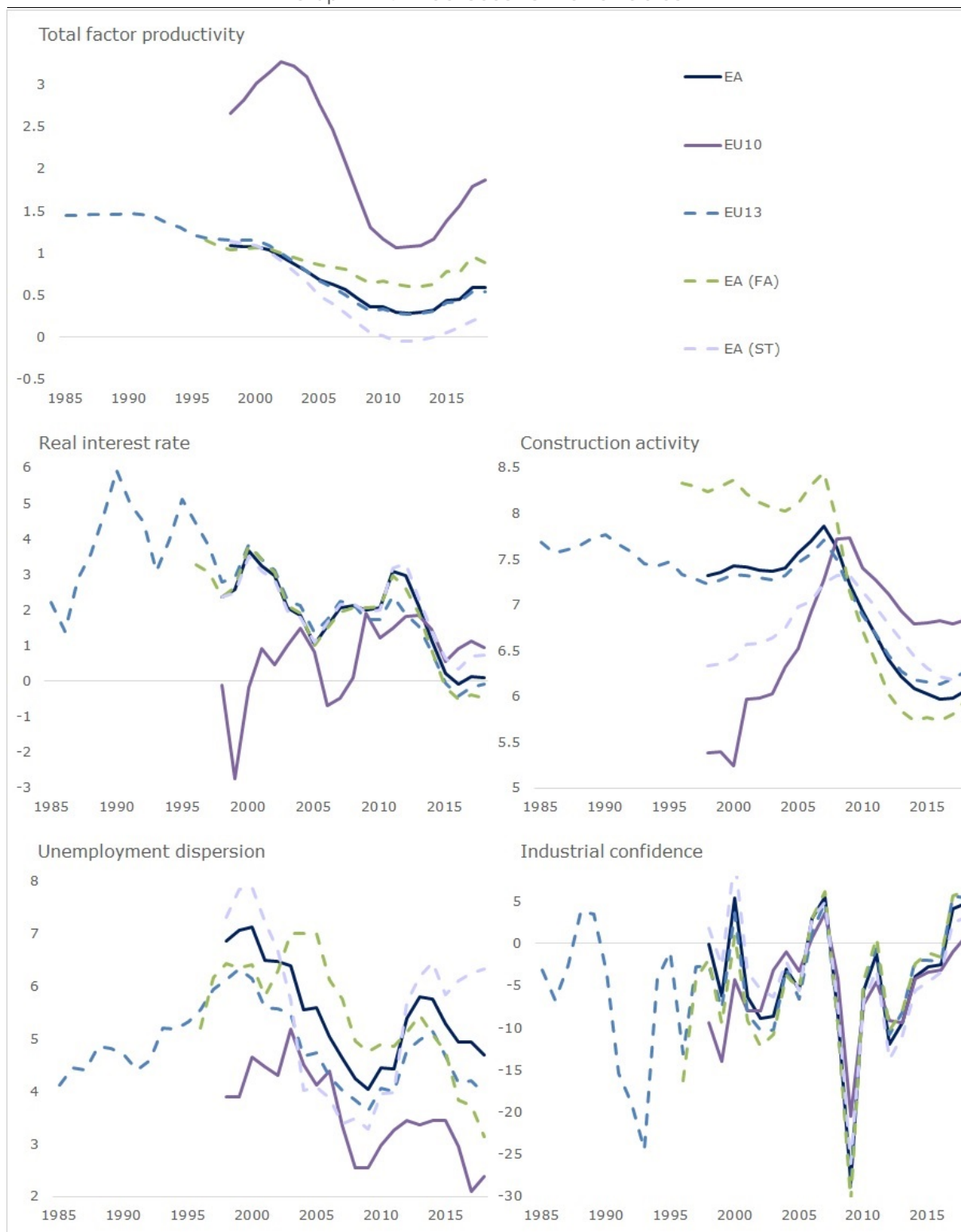
The country indices are aggregated into country groups by using the share of country labour force to the labour force of the group as a weight. Mnemonics on country groupings are listed in Chapter IV.2.
Source: Eurostat, Ameco, DG ECFIN

exert secular downward pressure on the unemployment rate. In the context of this study, this is the result of a decline in younger age cohorts that typically have higher average unemployment

rates. This is partly due to population ageing, but is also related to migration.

The results suggest that for a number of countries the gauged structural unemployment rates in 2018 were lower than during the previous business cycle peaks - for example, in 2000 or in 2007 - mainly because of the changing demographic structure rather than changes in the institutional measures. This implies that without strong cyclical headwinds in the coming years and without comprehensive restructuring of the economies due to the coronavirus-related recession in 2020 - for example, due to a spike in labour-replacing automation, the natural rate will continue to trend downwards.

The stronger decline of unemployment in EU10 countries can be explained from a structural perspective by a more comprehensive labour market approach, namely by using all structural labour market policies in an employment-friendly way[233]. In particular, EU10 countries have increased ALMP measures, albeit from a low level. These economies have also reduced the labour tax wedge and the level of their net replacement rate of unemployment benefits.

It is also interesting to look at why some countries have managed to reduce structural unemployment while others have been less successful. For this purpose, the study separates the euro area countries into two groups. Comparing EA(FA) to EA(ST) countries shows that the difference in performance is explained by the comprehensiveness of the measures. Successful countries have combined labour tax reforms with ALMP measures but have simultaneously made in-work income relatively more attractive reducing the level of their net replacement rate of unemployment benefits. This can be framed as a carrot and stick approach to labour markets. Those countries that were less successful in reducing the structural unemployment rate, concentrated more on tax policies. But they did not accompany these measures with other labour market policies. Neither did they increase their spending on ALMPs or redesign their unemployment benefit system to be more employment-friendly, i.e. progressively decreasing benefits in line with unemployment duration[234].

IV.5. Conclusions

After a period of rising unemployment following the 2009 recession, the unemployment rate has now fallen to 7.6% in 2019. This is more than 1 percentage point lower than the unemployment rate in the early 2000s when the euro area (EA) economy was in a similar cyclical position. The nonaccelerating wage rate of unemployment (NAWRU) is also declining, especially since 2013. This chapter explores the possible structural factors that can explain this development.

The study finds that demographic factors associated with population ageing helped reduce unemployment over the last two decades. Results suggest that for a number of countries the gauged natural rates in 2018 are lower than during the previous business cycle peaks - for example, in 2000 or in 2007 - mainly because of the changing demographics structure rather than positive cyclical developments.

On policy measures, the study can broadly distinguish between one group of countries that has managed to reduce structural unemployment, and another group that has been less successful. The first group has adopted comprehensive labour market policy measures, combining labour tax reductions with activation policies and making in-work income relatively more attractive by reducing the level of their net replacement rate of unemployment benefits. The second group focused on labour tax reductions but either negated or counteracted this by reducing their active labour market measures and increasing the net replacement rate of unemployment benefits.

[233] Arpaia A., Kiss, A., and A. Turrini (2014) 'Is unemployment structural or cyclical? Main features of job matching in the EU after the crisis', *European Economy - Economic Papers 2008 – 2015*, No. 527, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission.

[234] Implementing effective active labour market policies is difficult and costly. It should be stressed that the efficacy of the different components of ALMPs may be quite heterogeneous.

For the empirical investigation, the paper uses a panel data set for 28 EU countries for the period 1985-2018. For the countries that joined the EU in 2004 (CZ, EE, HU, LT, LV, PL, SI and SK), in 2007 (BG and RO) and in 2013 (HR), the analysis focuses on the period after 1997. Due to a lack of measurable data for all countries as well as policy and institutional reforms over time, the panel is not balanced. Short time-series make it difficult to plausibly and correctly measure the effects of structural reforms on unemployment, especially for the 'new' EU countries. That is, the absence of long enough time-series fails to guarantee enough variability in individual countries' labour market institutions. On the other hand, the shorter sample for these countries is more meaningful for the analysis, as one can exclude the effect of the transition from a centrally-planned to a market-based economy as a confounding factor on the level and dynamics of their unemployment rate. The chosen period therefore guarantees that the 28 countries operated under similar institutions and rules, as they were either part of the EU or striving to join it. Then, if no additional confounding effects were present, one can 'directly' measure the effects of structural policy changes on unemployment.

The goal of this paper is to gauge the long-term effects of changes in policies - exogenous variations independent of the current state of the economy - rather than comparing countries with a different institutional mix[1]. If the modelling framework can plausibly quantify these effects, one can then confidently claim to have measured the long-term fixed point towards which the unemployment/NAWRU rate converges, in the absence of any further policy movements. The most straightforward way to obtain this is to use the fixed-effect panel estimation, which can be calculated by relying on time-series variations within countries. Including country fixed-effects in the estimation controls for unobserved as well as difficult to capture time-invariant features related to the historical relations, institutional setup, social norms, etc. Observe that many of the country policies are directly associated with these broader country features. For this reason, omitting the fixed-effects in the estimation could lead to a bias in the gauged policy effects. Similar to the empirical literature on labour market institutions, the paper relies on a straightforward linear model of the form

$$u_{ct}^* = \tau_c + \sum_k \gamma_{kc} S_{kct} + \sum_j \alpha_{jc} M_{jct} + \epsilon_{ct} \,,$$

where the index c denotes the country, the index t the year and the idiosyncratic error term ϵ_{ct} is independent and normally distributed white noise; τ_c is a country-specific intercept accounting for the heterogeneity of the dependent variable not captured by the time-varying factors; M_j is a vector representing a macroeconomic variable j; S_k denotes a vector for policy indicator k. Two comments are in order. First, the dependent variable in the regression is the NAWRU estimate, provided by DG ECFIN according to CAM. Second, as shown in Box 2, the study augments the standard regression by a demographic index

$$u_{ct}^* = \tau_c + 1^{constrained} \; DEMO_{ct} + \sum_k \gamma_{kc} S_{kct} + \sum_j \alpha_{jc} M_{jct} + \epsilon_{ct} \,.$$

The key results are presented in Table 1. The first variant of the regression restricts the set of explanatory variables to labour market institutional indicators and the role of demographics. Three of the institutional factors are highly significant. These alone can explain 40% of the variation in the NAWRU. Union density is insignificant and its effect is null in a multivariate specification with all countries. One reason for this is the possibility that the latter interacts with other labour market institutions. There is evidence for this proposition, but for the sake of brevity, this will be investigated in more detail in future work. The study also looked at the robustness of the results for the set of countries. In general, dropping one country at a time makes little difference to the reported evidence (not shown here). There are two notable exceptions. First, the UK is very important for determining the coefficient of union density. This again supports the intuition that either heterogeneity among countries or interactions among institutions, or both together, may be responsible for the insignificance of union density. The other exception is the importance of Denmark and Sweden in determining the effect of the net wage replacement rate.

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[1]   These two are likely related. Due to conciseness, the issue goes beyond the scope of the current analysis.

Box (continued)

Table 1:

Estimated effects of labour market institutions on NAWRU

	EU	EU
Data ends	2018	2018
Data starts	1985	1985
Dependent Variable	NAWRU	NAWRU
	(1)	(2)
Replacement rate (rr)	0.074**	0.057**
	0,03	0,03
Labour tax wedge (tw)	0.283***	0.232***
	-0,05	0,03
Union density (ud)	-0,034	-0,007
	0,03	0,03
ALMP (HP filtered trend)	-0.094***	-0.088***
(almptr)	0,02	0,02
Demographics	1,000	1,000
	constr	constr
Regional dispersion 90/10		0.252**
(disp)		0,10
Total factor productivity		-0.340**
(PF trend)		0,14
Real interest rate		0,059
r		0,06
Construction activity		-0.398***
(cons)		0,14
Industrial confidence		-0.022**
(conf)		0,01
SD residuals (all MS)	1,37	1,17
Observations	704	704
Number countries	28	28

* p < 0.1, ** p < 0.05, *** p < 0.01, robust standard errors.
The table reports different panel regression results with country fixed effects. Heteroskedasticity-robust controls both for cross-sectional dependence as well as for autocorrelation. The coefficient of the demographic index is constrained to 1. The row 'SD residuals' reports the standard deviation of the estimated error terms.

It appears that in these two countries, most likely due to the interactions of the replacement rate with other labour institutions, the NAWRU is less sensitive to this variable.

In the second regression, a variety of macroeconomic variables control for medium-term variation in the NAWRU. This paper extended the dataset of Orlandi (2012) by looking at a broad set of macroeconomic variables proposed in various related studies - namely, changes in share prices, government budget balances, terms-of-trade shocks, variation in CPI inflation, household debt, industrial confidence, etc. Among these, all but the last two and within-country unemployment dispersion - which this study detected as an important factor for aggregate unemployment - proved robust and significant. In the reported multivariate regression results, the paper does not control for changes in household debt due to multicollinearity issues, related to total factor productivity and the latter variable. As seen in Table 1, all estimated coefficients of the labour market institutions remain broadly unchanged with respect to the previous variant, signalling their robustness.

Recognising that medium-term changes are captured by the deviations of the macroeconomic variables from their historical averages

$$\underbrace{(u_{ct}^* - \tilde{u}_{ct}^*)}_{u_{ct}^{med-term}} = \sum_j \alpha_{jc} \left(M_{jct} - \bar{M}_{jc} \right),$$

one can compute structural unemployment based on the estimated panel regression

$$\tilde{u}_{ct}^* = \tau_c + 1^{constrained} \; DEMO_{ct} + \sum_k \gamma_{kc} S_{kct} + \sum_j \alpha_{jc} \bar{M}_{jc} \, .$$

where $\bar{M}_{jc}$ denotes the historical average of the respective macroeconomic variables. As discussed above, the structural unemployment captures the elements of the unemployment rate that are driven by slow-moving factors such as policy institutions, demographics and changes in social norms. Conceptually, one would expect the natural rate of unemployment to converge to the structural over time in the absence of shocks, $\epsilon_{ct+n} = 0$, and policy changes, $\Delta S_{kct+n} = 0$, for all n > 0. Hristov et al (2017) use this particular feature of structural unemployment to anchor the NAWRU estimation at sample end[2]. In general, the use of unobserved component models to estimate the NAWRU has been strongly criticised due to some excessive pro-cyclicality at the sample end, especially in the neighbourhood of turning points. The issue is the intrinsic uncertainty of the future path of unemployment that drives the gauged NAWRU close to the observed unemployment rate at sample end. This uncertainty may however be reduced by augmenting the information set with structural labour market indicators to which the NAWRU is supposed to converge in a certain number of years. The resulting NAWRU estimates in turn incorporate information about both the business cycle and labour market characteristics.

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[2] Hristov, A., C. Planas, W. Roeger and A. Rossi (2017), 'NAWRU Estimation Using Structural Labour Market Indicators', *European Economy Discussion Papers*, No 069, European Commission.

Graph IV.5: **Determinants of structural unemployment**
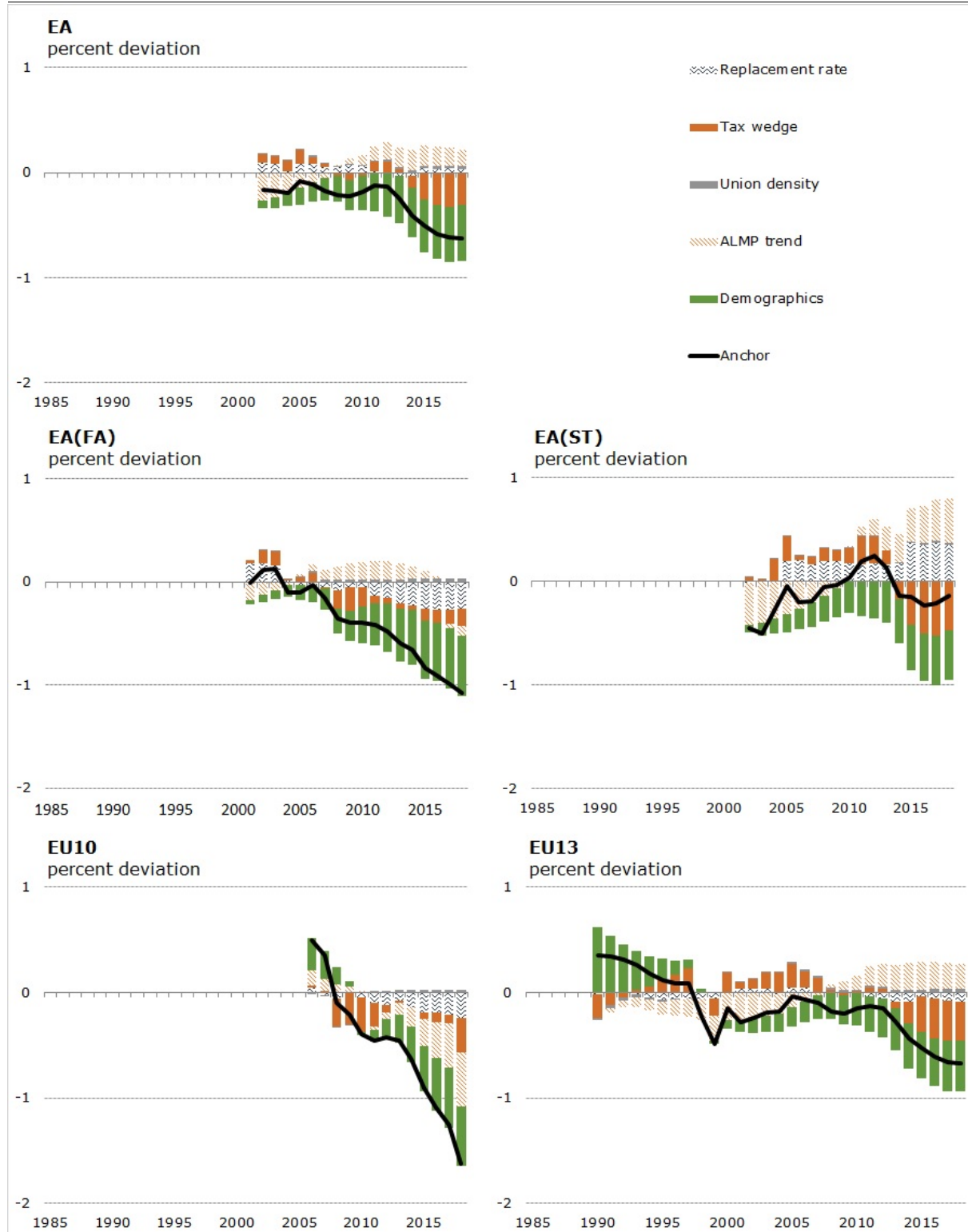
Deviations of the structural unemployment rate from its sample average derived from a panel regression of EU-28 standardised unemployment rates on an index of net replacement rate, tax wedge, union density, expenditures on active labour market policies, index of demographic changes as well as an index of macroeconomic indicators (see Box 3). Mnemonics on country groupings are listed in Chapter IV.2.
Source: Authors' estimates