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APRIL 2024

Working Paper 245

How Far from Full Employment?

The European Unemployment Problem Revisited

Meryem Gökten, Philipp Heimberger and Andreas Lichtenberger

The Vienna Institute for International Economic Studies
Wiener Institut für Internationale Wirtschaftsvergleiche

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MERYEM GÖKTEN
PHILIPP HEIMBERGER
ANDREAS LICHTENBERGER

Meryem Gökten, Philipp Heimberger and Andreas Lichtenberger are Economists at The Vienna Institute for International Economic Studies (wiiw).

The study benefited from funding provided by Open Philanthropy in the context of the 'European Macro Policy Network' (co-ordinated by Dezernat Zukunft).

We are grateful to Bernhard Schütz, Robert Stehrer and three anonymous reviewers for very helpful feedback on earlier versions of this paper. We also benefited from comments at several workshops, including 'The European Unemployment Problem: Past Trajectory, Present Dilemmas and Future Policies' at ETH Zurich (6 June 2023) and '20th STOREP Annual Conference' at the University of Bari (17 June 2023). Any remaining errors are our own.

Abstract

This paper analyses deviations from full employment in EU countries, compared with the US and the UK. We apply the Beveridge (full-employment-consistent) rate of unemployment (BECRU), derived from the unemployment-vacancies relationship. The BECRU is the level of unemployment that minimises the non-productive use of labour. Based on a novel dataset for the period 1970-2022, we find full employment episodes in selected EU countries (Germany, Sweden, Austria, Finland) during the 1970s. The European unemployment problem emerged in the 1980s and 1990s, as Beveridgean full employment gaps increased. In the run-up to the global financial crisis, full employment gaps declined, then increased during the Great Recession. Slack in labour markets increased initially during the pandemic. Labour markets became tighter when recovering from the COVID-19 crisis, but few countries hit full employment. Panel regressions highlight that hysteresis, labour market institutions, structural factors, macroeconomic factors and political factors contribute to explaining full employment gaps.

Keywords: Full employment, unemployment, vacancies, EU, UK, US

JEL classification: E24, E32, E6, J63, J64

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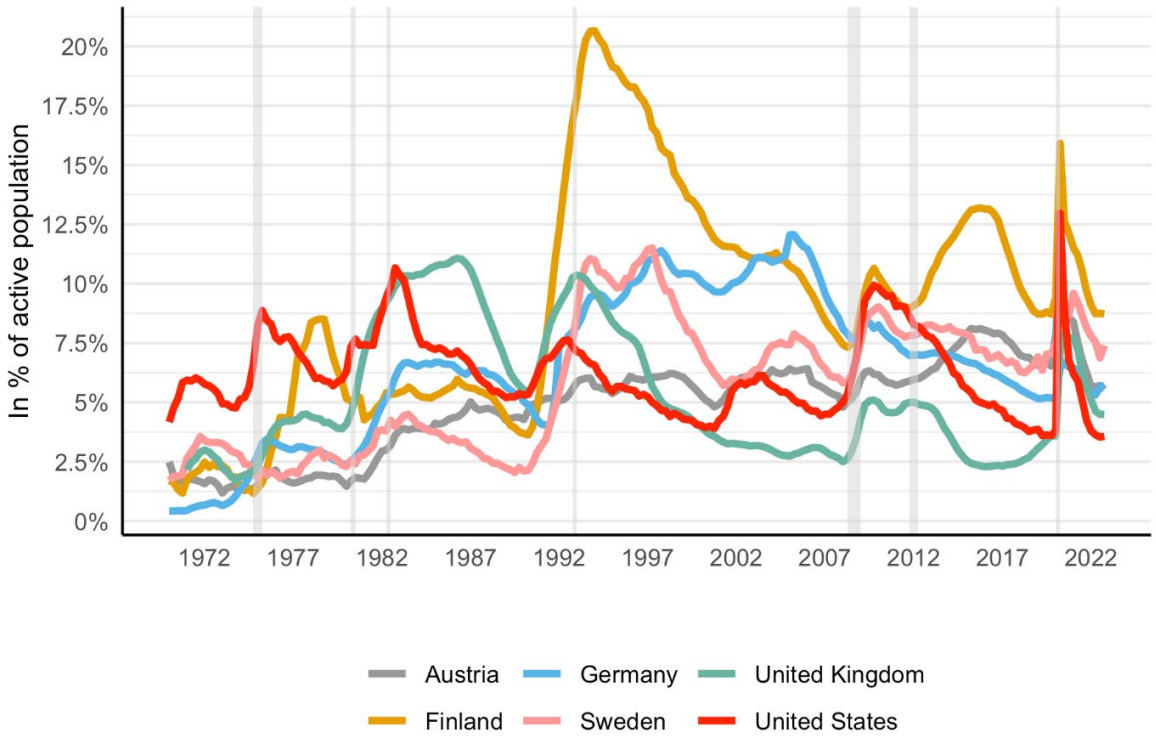
1. Introduction

Macroeconomists and policy makers track closely whether the labour market is slack or overly tight, as this affects whether macroeconomic policy measures should be expansionary or restrictive. Although the level of unemployment at which an economy operates at full employment is non-observable, providing estimations is important when it comes to informing real-time macroeconomic policy debates. However, full employment estimates may also help to shed light on historical labour market developments. In the 1980s and 1990s, high unemployment rates in European countries turned into a key policy challenge as economic research struggled for explanations (Bean, 1994; Ljungqvist and Sargent, 2008). Unemployment rates in many European countries rose so strongly that they markedly surpassed US levels, but Figure 1 highlights that there were important differences between selected EU countries (Saint-Paul, 2004; Blanchard, 2006; Campos et al., 2023).

Figure 1 / Unemployment rates, 1970-2022



Notes: The grey areas in the figure indicate periods of recession in the aggregated OECD Europe sample. A recession is defined as two consecutive quarters of negative real GDP growth. The data for Germany are for West Germany until 1991.
Source: OECD Registered Unemployed Dataset, BLS JOLTS, Michaillat and Saez (2022)

The main contribution is that we are the first to apply a full employment concept derived from the relationship between unemployment and vacancies to a set of European countries; we study the European unemployment problem while taking labour market developments over more than six decades into account. By building on recent seminal contributions by Michaillat and Saez (2021, 2022) on the US case,

we conceptualise full employment as the unemployment rate that minimises the non-productive use of labour in terms of both job seeking and recruiting. We call this the Beveridge (full-employment-consistent) rate of unemployment (BECRU). We contribute to the literature by using a novel quarterly dataset for Germany, Austria, Sweden, Finland and the UK to complement existing data for the US. We analyse how much different countries deviate from full employment over the time period 1970-2022. To complement our analysis of the long panel dataset (high T and small N) with another sample including additional country data (smaller T and higher N), we further construct an extended quarterly dataset for 25 countries, including 23 EU countries[1] plus the UK and the US over the shorter time period 2000-2022. We make the dataset publicly available[2] and will provide regular updates to incorporate new data points that can inform research and policy making. We argue that BECRU estimates are an informative measure of labour market slack, e.g. with regard to predicting the share of persons unemployed and not receiving education or vocational training. Our emphasis on the BECRU is in line with other recent studies that pick up on Beveridgean measures of labour market slack (e.g. Cerrato and Gitti, 2022; Gäddnäs and Keränen, 2023).

Our results shed new light on the extent to which EU countries deviate from full employment during the period of the European unemployment problem of the 1980s and 1990s, in comparison to the US. We show how the historical data compare with recent developments, which have been characterised by debates over whether advanced economies reached full employment when recovering from the COVID-19 crisis; analyse how informative the Beveridgean full employment gap estimates are; and provide econometric evidence on the explanatory factors (labour market institutions, structural factors, macroeconomic factors, political factors, hysteresis) of full employment gaps.

The rest of the paper is structured as follows: Section 2 discusses the theoretical background and derives the full employment gap from the relationship between unemployment and vacancies. Section 3 presents the data and the methodology used for data adjustment. Section 4 introduces new stylised facts on full employment gaps for EU countries in comparison to the UK and the US for the period 1970-2022. Section 5 includes the econometric analysis on the explanatory factors of full employment gaps. Section 6 investigates how informative Beveridgean full employment gaps are and discusses NAIRU (Non-Accelerating Inflation Rate of Unemployment) gaps in comparison. Section 7 presents our conclusions.

[1] Eurostat lacks vacancy stock data for Denmark, and to ensure comparability given differences in vacancy data, we had to exclude Croatia, Czechia, and Luxembourg.

[2] The dataset can be accessed via github: https://github.com/heimbergecon/fullemployment

2. BECRU, full employment gaps and the Beveridge curve

We derive our measure of the full employment gap from the Beveridge curve, i.e. the relation between unemployment and vacancies. Although the concept can be traced back to Beveridge (1944), macroeconomists interested in understanding labour market developments have developed the Beveridge curve into an important organising framework for their research (Nickell et al., 2003; Elsby et al., 2015; Hairault et al. 2015). In using the relationship between unemployment and vacancies to derive a measure of labour market slack, we deviate from the approach of the non-accelerating inflation rate of unemployment (NAIRU), which conceptualises how low the unemployment rate can go before inflation accelerates (Ball and Mankiw, 2002; Galbraith, 1997; Blanchard, 2018), thereby linking the issue of labour market tightness to price stability concerns. While the BECRU is based on thinking about labour market tightness in the vacancy-unemployment space, other approaches to conceptualising full employment – e.g. via links to price stability, or by focusing on involuntary underemployment (Skidelsky and Gasperin, 2021; Mason et al., 2021) – also have their merits.

The Beveridge curve can be approximated by a rectangular hyperbola with the functional form $uv = k$, where *u* is the unemployment rate, v is the vacancy rate, and k is a constant.[3] Hence the Beveridge curve is negatively sloped: u and v are inversely related (e.g. Blanchard and Diamond, 1989). This suggests that reducing vacancies and unemployment is not possible at the same time: in an economic downturn, many people are looking for jobs while there are few vacancies; but when the economy is in an upswing, there are more vacancies with fewer job seekers. A reduction in unemployment allows more people to find a job; however, this comes at a cost, as it forces companies to post more vacancies, which requires them to use more resources for recruiting, at the expense of production. Michaillat and Saez (2021) present assumptions and derivations.

Michaillat and Saez (2022) show that the 'efficient' unemployment rate can be computed as the geometric average of the current unemployment rate and vacancy rate: $u^* = \sqrt{uv}$.[4] We label this the *Beveridge (full-employment-consistent) rate of unemployment,* in short: BECRU.[5] The BECRU is defined as the amount of unemployment minimising the non-productive use of labour in terms of both job seeking and recruiting. The BECRU is the solution to social planners' problem of maximising social welfare subject to the relationship between unemployment and vacancies. The BECRU is a very useful measure as it can be computed based on observable data.[6]

[3] The functional form of a rectangular hyperbola can be derived by estimating the elasticity of the vacancy rate with respect to the unemployment rate, d ln(v)/d ln (u) where an elasticity of -1 corresponds to a hyperbola. According to estimations of structural breaks of the US Beveridge curve the Beveridge elasticity ranges between -0.84 and -1.02, so never far from -1 (Michaillat and Saez 2021).

[4] This formula is based on the assumptions that the Beveridge curve is a rectangular hyperbola and that the Beveridge elasticity is 1.

[5] We avoid the term 'efficiency' and prefer to stick with the original terminology to avoid nurturing a constricting paradigm that tends to preclude other epistemic approaches.

[6] In comparison, the NAIRU relies on strong assumptions concerning non-observable variables and may suffer from estimation bias owing to the application of statistical filtering methods (Galbraith, 1997; Heimberger and Kapeller, 2017).

The full employment gap *g* derived from the Beveridge curve is the difference between actual unemployment and the BECRU: $g = u - BECRU$.[7] If $g = 0$, the economy is operating at the BECRU; if $g > 0$, the labour market is slack, and so unemployment would need to fall to achieve full employment; and if $g < 0$, the labour market is overly tight. In what follows, we use a new quarterly dataset on the full employment gaps for EU countries and the UK in comparison with the US.

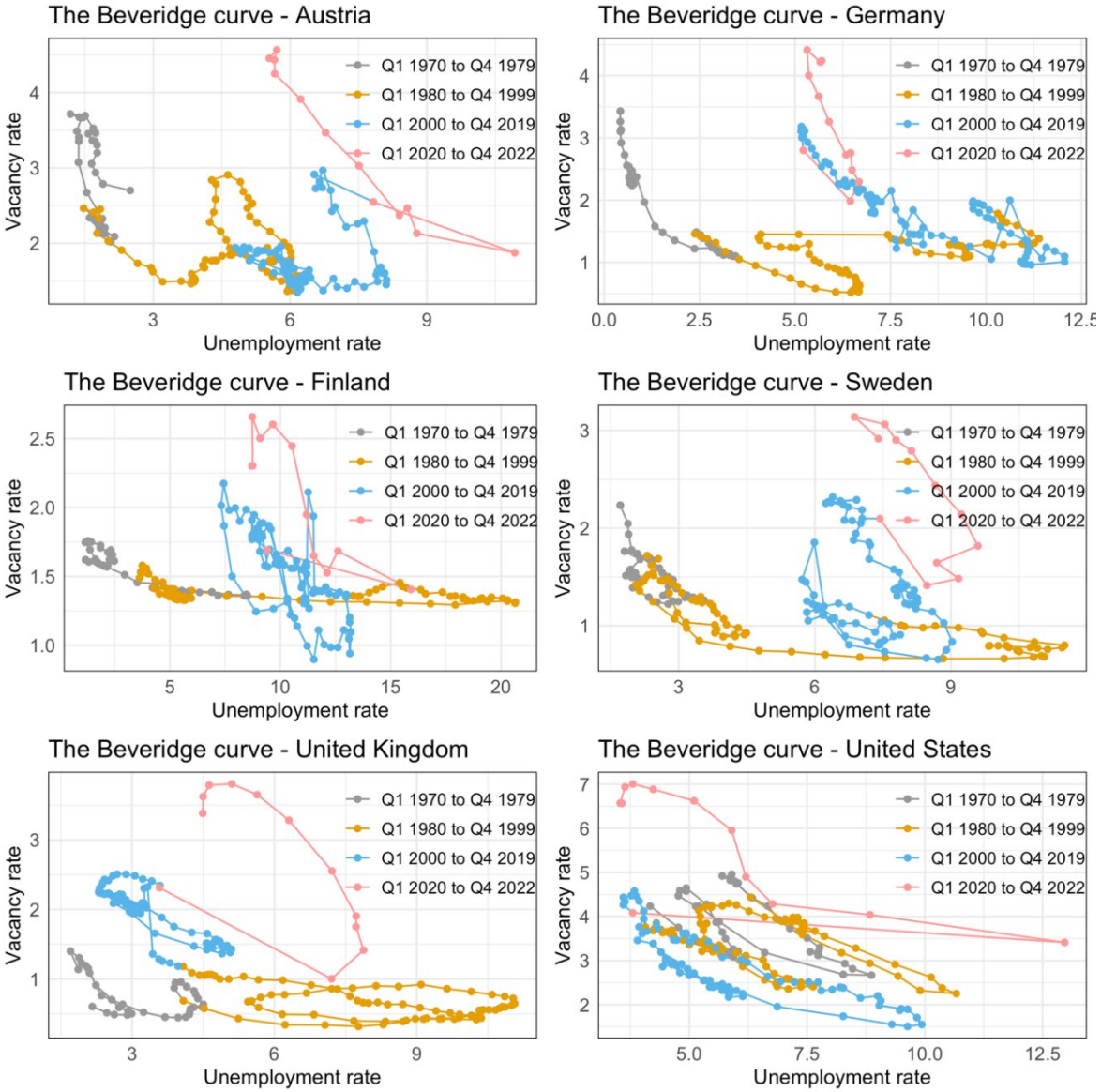
Beveridge curves are subject to shifts over time and vary across countries, reflecting heterogeneity in matching efficiencies and labour market structures. The Beveridge curve captures changes in market tightness. It exhibits two key types of movement. First, changes in overall economic activity lead to movements along the Beveridge curve. During recessions, the curve slopes downward as the vacancy rate decreases and unemployment rises. Conversely, in economic booms, the curve slopes upward, with rising vacancy rates and decreasing unemployment, indicating cyclical labour market dynamics. Second, there can be structural shifts, represented by inward or outward movements of the curve, reflecting changes in matching efficiency or structural changes in the labour market, including in labour market institutions, policy interventions, technological advancements or shifts in industry composition. The distance of the curve from the origin indicates labour market efficiency, i.e. how easily firms and workers can find suitable matches. An outward shift suggests reduced efficiency in finding matches, leading to higher unemployment for a given number of vacancies, while an inward shift implies improved matching efficiency, resulting in lower unemployment for a given number of vacancies (Blanchard and Diamond, 1989; Ball and Mankiw, 2002).

Shifts in the Beveridge curve, which are influenced by matching efficiency and structural changes, are more consistent and less prone to business cycle fluctuations than shifts observed in the Phillips curve. The Phillips curve captures the link between inflation and unemployment and does not directly account for search and matching efficiency in the labour market. Dickens (2008) makes the case that the Phillips curve is more susceptible to shifts and fluctuations than the Beveridge curve.

Figure 2 illustrates the Beveridge curves for our preferred six-country sample: Germany, Sweden, Austria, Finland, the UK and the US, spanning the years from 1970 to 2022. The data points in the figure are distinguished by different colours to indicate four distinct time periods: 1970-1979 (low unemployment rates), 1980-1999 (emergence of the European unemployment problem), 2000-2019 (pre-COVID-19), and 2020-2022 (COVID-19 pandemic). Although downward-sloping curves are observed for most countries in the 1970s, the rise of unemployment rates in the 1980s and 1990s is associated with an outward shift of the Beveridge curve, signalling a substantial decrease in matching efficiency. In the case of the US, the Beveridge curve remained relatively stable until 2000. However, between 2000 and 2019 we observe the most significant inward shift, suggesting a substantial improvement in matching efficiency during that period, which is only to be seen to a smaller extent in some of the European countries. Our Beveridge curve for Germany shows a noticeable inward shift from 2006 onwards, consistent with Klinger and Weber (2016). In a broader comparison including the period of the Great Recession, we also identify patterns in line with the existing literature for other European countries, including the UK (e.g. Arpaia et al., 2014).

[7] Michaillat and Saez (2021) call it the Beveridgean unemployment gap.

Figure 2 / Beveridge curve, 1970-2022



Source: OECD Registered Unemployed Dataset, BLS JOLTS, Michaillat and Saez (2022); own calculations.

3. Data

Given our focus on the European unemployment problem, data availability for vacancy and unemployment rates over more than six decades is a major issue. We are able to construct time series covering the entire period from 1970 to 2022 for Austria, Germany, Finland, and Sweden. Notably, quarterly data for the United Kingdom on labour force and active population only starts from Q1/1971. As a result, the vacancy and unemployment series for the UK are also used from 1971 onwards. Additionally, we incorporate existing US data from Michaillat and Saez (2022) up to the first quarter of 2022. For the remaining three quarters, we update the data for more recent observations by using the Job Openings and Labor Turnover Survey (JOLTS) provided by the US Bureau of Labor Statistics (BLS), which is also the main data source in Michaillat and Saez (2022). In total, this gives us our preferred country sample of six countries (Austria, Germany, Finland, Sweden, US, UK).[8]

We use Eurostat data starting from the 2000s, and for earlier decades we rely on OECD data as our primary data source. The OECD Registered Unemployment and Job Vacancies dataset in the MEI database offers data dating back to the 1970s. In contrast, Eurostat's data only date back to the year 2000 and start even later for some countries. When comparing the Eurostat and OECD data on the stock of unfilled job vacancies, we found significant differences for Germany and Austria, with Eurostat estimates being notably higher than OECD estimates (see Figure 3). The primary reason for this discrepancy is the difference in data sources. While the OECD obtains vacancy data from administrative records, Eurostat relies mainly on job vacancy surveys. According to national statistics institutes (Destatis and Statistik Austria) and Eurostat, the administrative records collected by public employment services cover only parts of the job market, with jobs requiring higher qualifications less frequently reported to these services, as enterprises often do not anticipate finding suitable candidates there. Consequently, to account for the under-reporting of job vacancies with higher qualifications in the OECD dataset, we use the Eurostat data from Q1/2010 onwards as a benchmark.[9] We obtain predicted job vacancy values, derived from regressing Eurostat data on OECD data, for the period Q1/2010 to Q4/2019. We exclude the period of the pandemic from 2020 onwards from the regression, as the pandemic represents a unique period with a significant increase in vacancies that could bias the results. The resulting regression coefficients for individual countries are then applied for adjusting the job vacancy stock data between Q1/1970 and Q4/2009 country-by-country. The assumption of our adjustment approach is that the difference between Eurostat data and OECD data over 1970-2009 is, on average, the same as over 2010-2019. For the period from Q1/2010 onwards, we also use Eurostat data for the vacancy stock of the adjusted time series. Figure 3 compares the unadjusted and adjusted vacancy data.[10]

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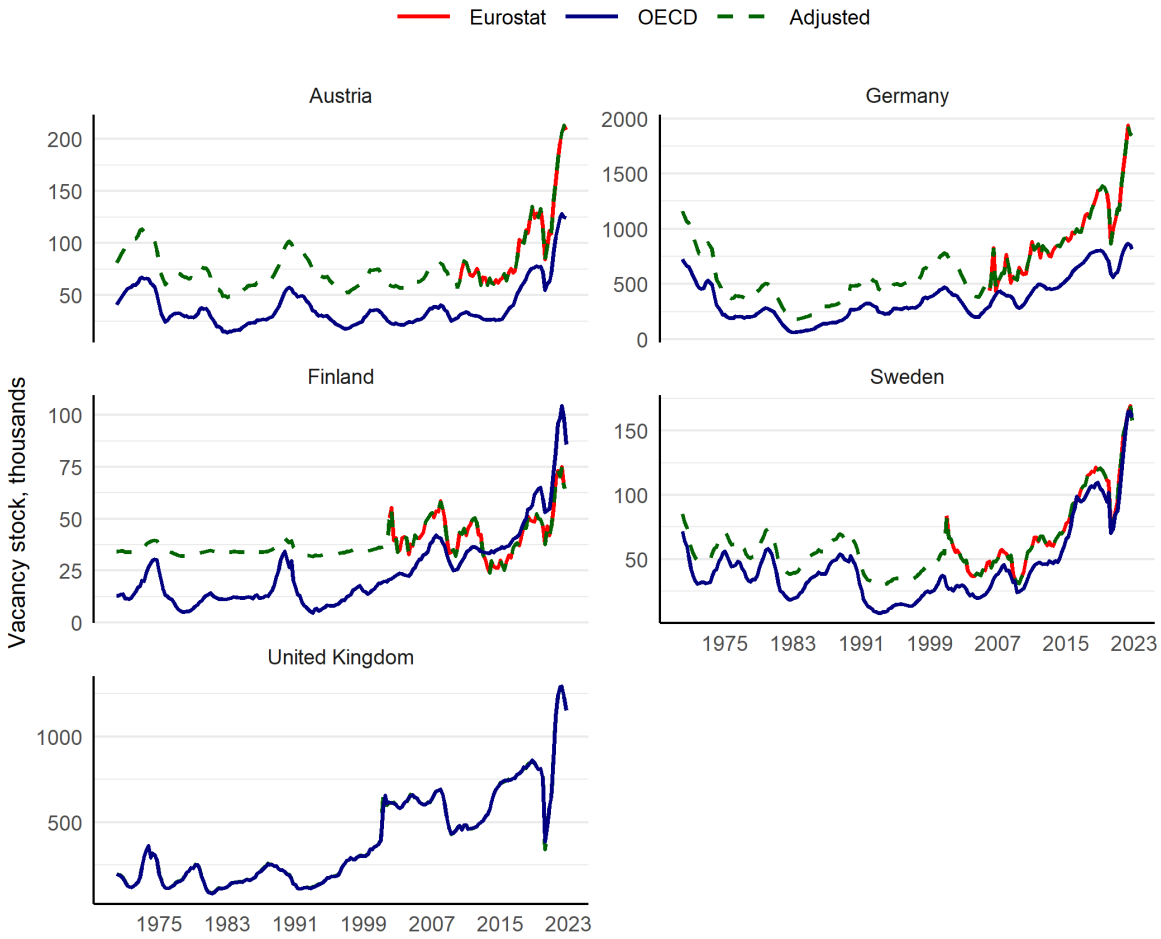
[8] We use quarterly data for the historical analysis of full employment gaps in section 4 and annual data for the regression analysis in Section 5. We obtain annual data on vacancy and unemployment rates by averaging the quarterly data.

[9] While phantom vacancies are acknowledged in existing literature (Cheron and Decreuse, 2017; Albrecht et al., 2022), their overestimation is less concerning in the context of administrative data. This is because administrative data promptly removes filled positions and already addresses underestimation issues. Müller et al. (2023) use administrative data and argue that, with regard to Austrian vacancy data, they are not flooded with phantom vacancies.

[10] Starting in Q1/2013, Finland implemented a new job vacancy survey methodology, involving a revision in the sample design. Consequently, the vacancy stock estimated through survey data was lower than the figures provided by the

Figure 3 / Comparison of the vacancy stock data, 1970-2022

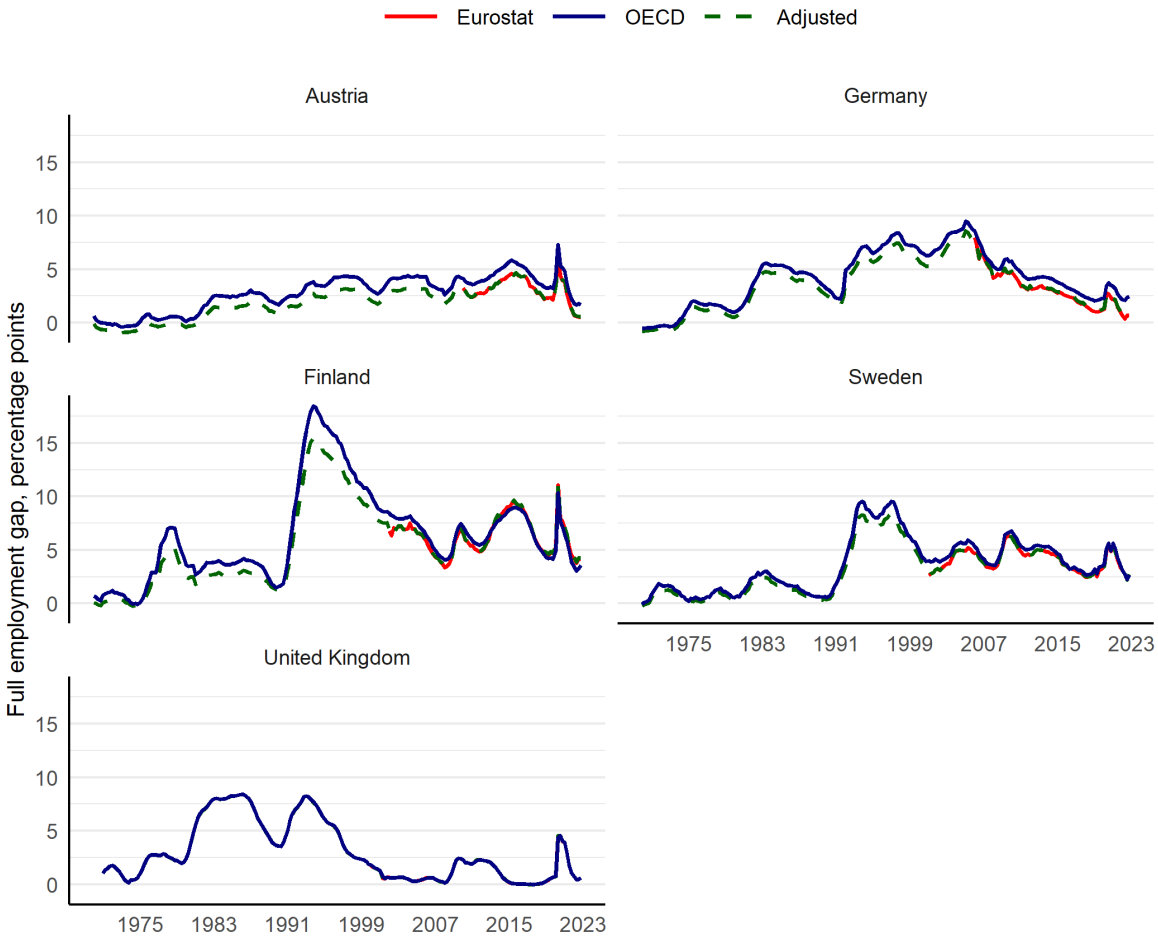


Source: OECD Registered Unemployed Dataset and Eurostat

Figure 4 presents the comparison of the full employment gap estimates using OECD, Eurostat and adjusted data for the vacancy stock. The adjustment of the vacancy stock data results in an upward shift in the Beveridge (full-employment-consistent) rate of unemployment (BECRU). As a result, the adjusted full employment gaps appear smaller than those calculated with raw OECD data, suggesting that labour markets are tighter than indicated by the administrative data. It is important to note that the differences vary across countries. The most significant differences are observed for Finland and Austria, with an average difference in adjusted/unadjusted full employment gaps between 1970-2010 of -1.16 and -0.92 percentage points, respectively. This is followed by smaller differences in Germany and Sweden (0.7 and 0.53 percentage points, respectively), while the UK exhibits almost no difference in estimates.

OECD administrative data. To ensure consistency and comparability with the other countries in our sample, we also used the Eurostat data as the benchmark for Finland.

Figure 4 / Comparison of the full employment gaps, 1970-2022



Source: OECD Registered Unemployed Dataset and Eurostat

Data quality concerns regarding job vacancy statistics have been emphasized in previous literature, particularly in certain countries where differences in definitions and sampling practices contributed to data quality issues (Kettner and Stops; 2008, Elsby et al., 2015). In the EU, job vacancy statistics are compiled under the framework of Regulation 453/2008, and Eurostat conducts data quality checks to ensure comparability and reliability throughout the dataset. However, the low job vacancy rates in certain Southern European countries, notably Spain, have been a subject of debate. Although these low rates may initially imply limited employment prospects and economic stagnation, the literature also argues that the situation might stem from local customs and practices (Boscá et al., 2017). Particularly in Spain, the prevalence of distinct recruitment methods and the extensive reliance on temporary contracts can result in a reduced tally of formally reported job vacancies. This applies beyond Spain, highlighting the need to understand distinct labour market practices when interpreting job vacancy data across member states and recognising the potential for data discrepancies that could underestimate job vacancy rates arising from these custom-induced variations. However, this concern is not a major one for our main sample of six countries, as their labour markets and recruitment processes are notably more transparent. Our primary concern lies in potential downward bias resulting from the under-reporting of high-skill jobs in administrative data, a factor we have taken into consideration. The adjustment procedure for high-skill

job vacancies, as identified through the labour force survey, significantly improves the comparability of registered vacancy data within our preferred country sample.

We use active population data from the OECD Short-Term Labour Market Statistics dataset to calculate both unemployment rates and vacancy rates. Although this dataset provides comprehensive quarterly statistics for most countries, data for Sweden and Finland are available only from 1998 onwards. To ensure continuity in the dataset, we supplement the Swedish data with statistics on active population and unemployment levels from the Population by Labour Market Status database published by Statistics Sweden (SCB). To mitigate the impact of seasonal fluctuations on variables that were not originally available in seasonally adjusted values, we use a seasonal ARIMA model to adjust for seasonality in the data. For Finland, OECD data are available only from 1998 onwards for the active population and from 1981 onwards for unemployment levels. To extend the dataset, we include archived OECD data obtained from FRED. Similar to the approach taken for adjusting vacancy data, we use predicted values to modify archived unemployment and the active population data to correspond with the more recent OECD observations.

Although the preferred dataset covering six countries over the period 1970-2022 allows us to analyse the European unemployment problem in historical perspective, the larger country sample for 2000-2022 provides additional valuable insights for understanding labour market slack in more recent years. It should be noted, however, that vacancy data quality for some of the countries in the extended sample is lower than for our preferred six-country sample. As mentioned earlier, some of the added countries may under-report the number of vacancies, and so our full employment gap estimates in the larger country sample have to be interpreted more cautiously.

To cover a larger group of EU member states over the period 2000-2022, we supplement the Eurostat data with information from other national sources such as ISTAT (Italian National Institute of Statistics), and DARES (the French government's Ministry of Employment). For France, we employ vacancy stock data from DARES, and for Italy, we use vacancy rate data from ISTAT. For the remaining EU member states, we obtain data on vacancy stock, unemployment levels, and active population from Eurostat. Despite variations in data availability across countries, we are able to create an unbalanced data series from 2000 to 2022 that covers 23 EU Member States. We exclude Croatia, Czechia, and Luxembourg from our dataset to ensure data comparability, as Eurostat's vacancy data for these countries relies on administrative data rather than survey data, which could lead to underreporting.

Finally, we also account for various different definitions of the vacancy rate. There is no standardised instruction on how to calculate the vacancy rate, leading to the existence of different versions. In this paper, we use the approach of Michaillat and Saez (2022), calculating the vacancy rate as the ratio of the vacancy stock to the active population (*unfilled vacancy stock/active population * 100*). Eurostat and OECD use slightly different definitions, considering the ratio of vacancy stock to total labour demand.[11] Additionally, the vacancy rate is sometimes expressed as the ratio of the stock of unfilled vacancies to the number of unemployed (*unfilled vacancy stock / number of unemployed*. Figure A 1 in appendix A shows the data for different vacancy rate definitions. As expected, there is minimal difference between our definition (ratio of vacancy stock to the active population) and the vacancy stock to total labour demand definition. However, we prefer using the vacancy rate relative to active population, since using

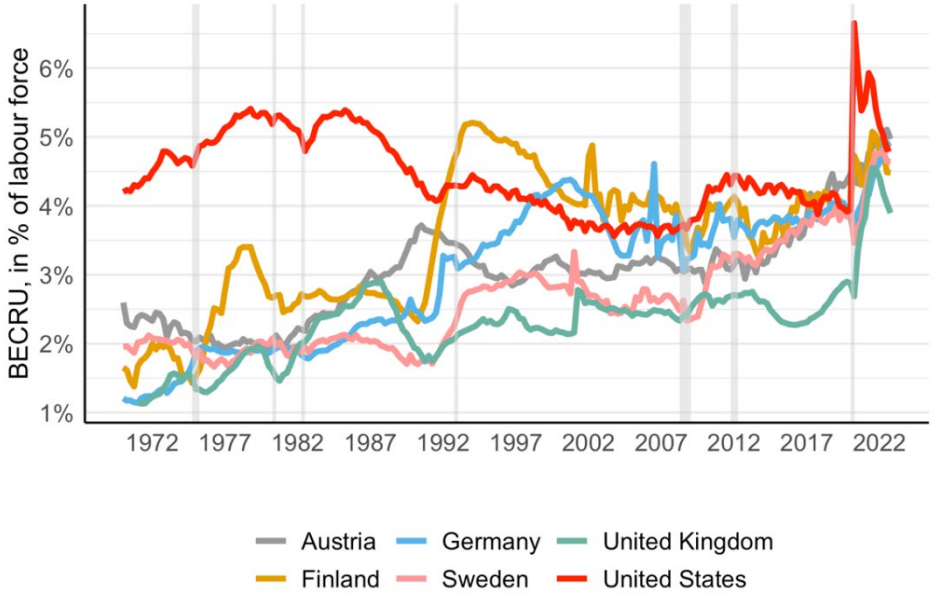
[11] Total labour demand is defined as the sum of the unfilled vacancy stock and all filled vacancies (or the number of employed) (*unfilled vacancy stock / (number of employed + number of unfilled vacancies) * 100*).

this denominator is consistent with expressing the unemployment rate in percent of active population. Using the same denominator for vacancy and unemployment rates also ensures consistency of definitions in estimating the BECRU. The vacancy-to-unemployment ratio is also used in research and policy analysis, and it delivers lower values than the vacancy rate in percent of active population. However, using the vacancy-unemployment ratio would not allow us to consistently compare the vacancy rate and unemployment rate. In short, we choose to adopt the vacancy rate definition of Michaillat and Saez (2022) to ensure comparability and consistency of definitions.

4. Revisiting the European unemployment problem: Stylised facts from a full employment perspective

Figure 5 shows BECRU estimates, which minimise the non-productive use of labour in terms of both job seeking and recruiting, over the time period 1970-2022 for our six preferred countries. Figure 6 shows the Beveridge full employment gaps, i.e. the difference between actual unemployment and the BECRU.

Figure 5 / Beveridge (full-employment-consistent) rate of unemployment (BECRU), 1970-2022



Notes: The grey areas in the figure indicate periods of recession in the aggregated OECD Europe sample. A recession is defined as two consecutive quarters of negative real GDP growth. The data for Germany are for West Germany until 1991. The Beveridge full-employment-consistent rate of unemployment (BECRU) is calculated as: $BECRU = \sqrt{uv}$.
Source: OECD Registered Unemployed Dataset, BLS JOLTS, Michaillat and Saez (2022); own calculations.

We can derive the following five major stylised facts.[12]

1. The BECRU changes over time and shows different levels across countries. In Germany, Austria, Sweden and Finland, the BECRU was mostly below 2.5% during the 1970s; in the fourth quarter of 2022 it stood at 4.9%, 5%, 4.6% and 4.5%, respectively. The average BECRU of these four economies mostly increased during the late 1980s and 1990s. This was the period when the Beveridge curves in the EU countries of our sample shifted outwards. In comparison, the BECRU of the US was on average significantly higher in the 1970s and 1980s, but decreased during the 1990s, a period during which the US Beveridge curve shifted inwards. The case of the UK falls somewhere

[12] Figure A 2 in Appendix A provides additional information on unemployment rates and vacancy rates in Germany, Austria, Finland, Sweden, the UK and the US for the period 1970-2022.

in between. Like its European peers, the UK started with a lower BECRU in the 1970s. However, after a period of increase in the 1980s, when the UK Beveridge curve initially shifted outwards, the BECRU stabilised and even dropped slightly in the 1990s and 2010s when the Beveridge curve shifted inwards (see Figure 2 for the Beveridge curves of individual countries).

2. Unlike the UK and the US, all four EU countries recorded full-employment episodes during the 1970s, indicated by Beveridge full employment gaps below zero. For the EU countries (but not for the US), the 1970s is the period with the smallest distance of the Beveridge curve to the origin, which indicates the highest efficiency of firms and workers in finding suitable matches.
3. The European unemployment problem of the 1980s and 1990s emerges in terms of increasing full employment gaps in all four EU countries. The full employment gap in the US reached its highest level in the early 1980s and was close to zero in the late 1990s. Although the full employment gap in the UK fell below 2 percentage points in the fourth quarter of 1999, Finland, Germany, Sweden and Austria recorded full employment gaps of 9, 6.0, 4.7 and 2.2 percentage points, respectively. The experience of EU countries in the 1980s and 1990s was characterised by non-reversion of the full employment gap to its level at the end of the previous business cycle.
4. We observe an increasing full employment gap following the global financial crisis of 2007/08 in all countries, but to a varying extent. There is a particularly pronounced increase in labour market slack in Finland during the early 1990s, following the sharp decline of Finnish-Soviet trade with the collapse of the Soviet Union.[13]
5. Full employment gaps tend to decline during economic expansions. This is, for example, evident from the move towards tighter labour markets during the expansion that preceded the global financial crisis.
6. Full employment gaps initially increased during the first phase of the COVID-19 pandemic, which started in early 2020, given historically unprecedented changes in the Beveridge curve (Lubik, 2021; Kiss et al., 2022). However, when recovery set in, labour markets in all six countries experienced a substantial decline in full employment gaps and became significantly tighter. Yet, the US was the only country to hit full employment among the six countries covered in Figure 6, as the Beveridge full employment gap moved into negative territory.

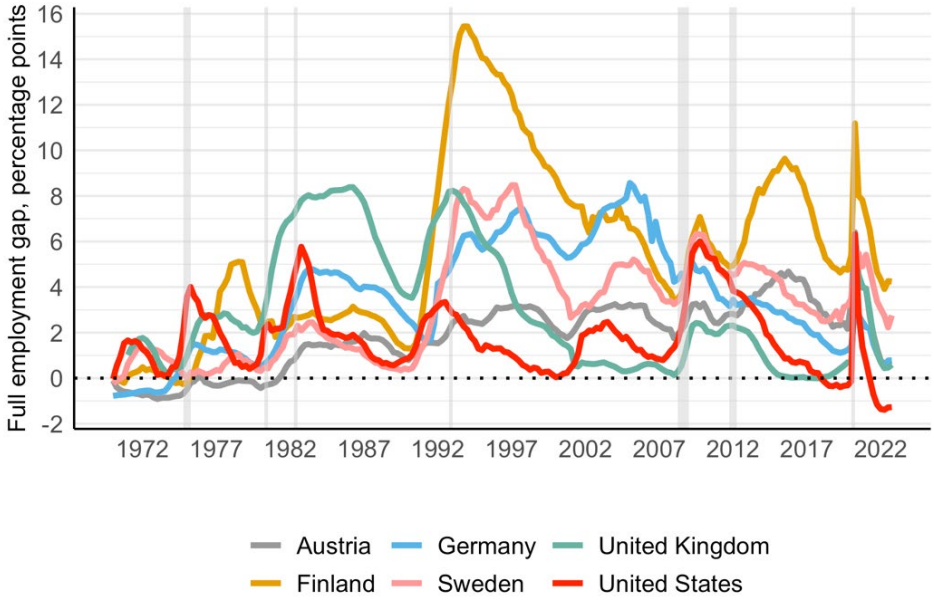
As the countries in our sample made use of job retention schemes during the pandemic (OECD 2020), the constructed full employment gaps may underestimate unused labour capacity, which might lead to a false sense of labour market tightness during the recovery from the Covid-19 crisis. However, data on underemployment rates – based on full time equivalents per active population – do not contradict the results of our full employment gap measure (see Table A1 and Figure A6 in Appendix A).

Owing to limited data availability, we were only able to show BECRU and full employment gap estimates over the full time period 1970-2022 for the six countries discussed above. However, Figure A 3 in Appendix A shows BECRU estimates over the time period 2000-2022 for a much larger set of 25 countries, including 23 EU countries plus the UK and the US. Although we are not able to analyse the European unemployment problem during the 1980s and 1990s for the extended country sample, the data nonetheless provide additional information about recent labour market developments and are further used

[13] During 1991–1993, Finland experienced its most severe economic contraction since the 1930s. The heavy dependence on Soviet trade, particularly in manufacturing sectors, posed significant challenges when the Soviet market collapsed. The absence of an alternative market for these goods, combined with costly restructuring and a sudden surge in energy costs, played pivotal roles in the Finnish Great Depression (Gorodnichenko et. al, 2012).

as a robustness check for the regression estimation of our tested hypotheses in section 5. However, while the quality of the vacancy data for the preferred six countries is high, we note that vacancy data for some of the countries captured in the extended country sample could be improved; full employment gaps have to be interpreted more cautiously in particular for the Southern and Eastern EU countries.

Figure 6 / Beveridge full employment gap for six countries, 1970-2022



Notes: The grey areas in the figure indicate periods of recession in the aggregated OECD Europe sample. A recession is defined as two consecutive quarters of negative real GDP growth. The data for Germany are for West Germany until 1991. The Beveridge full employment gap (g) is calculated as $g = u - BECRU$.
Source: OECD Registered Unemployed and Job Vacancies Dataset, BLS JOLTS, Michaillat and Saez (2022); own calculations.

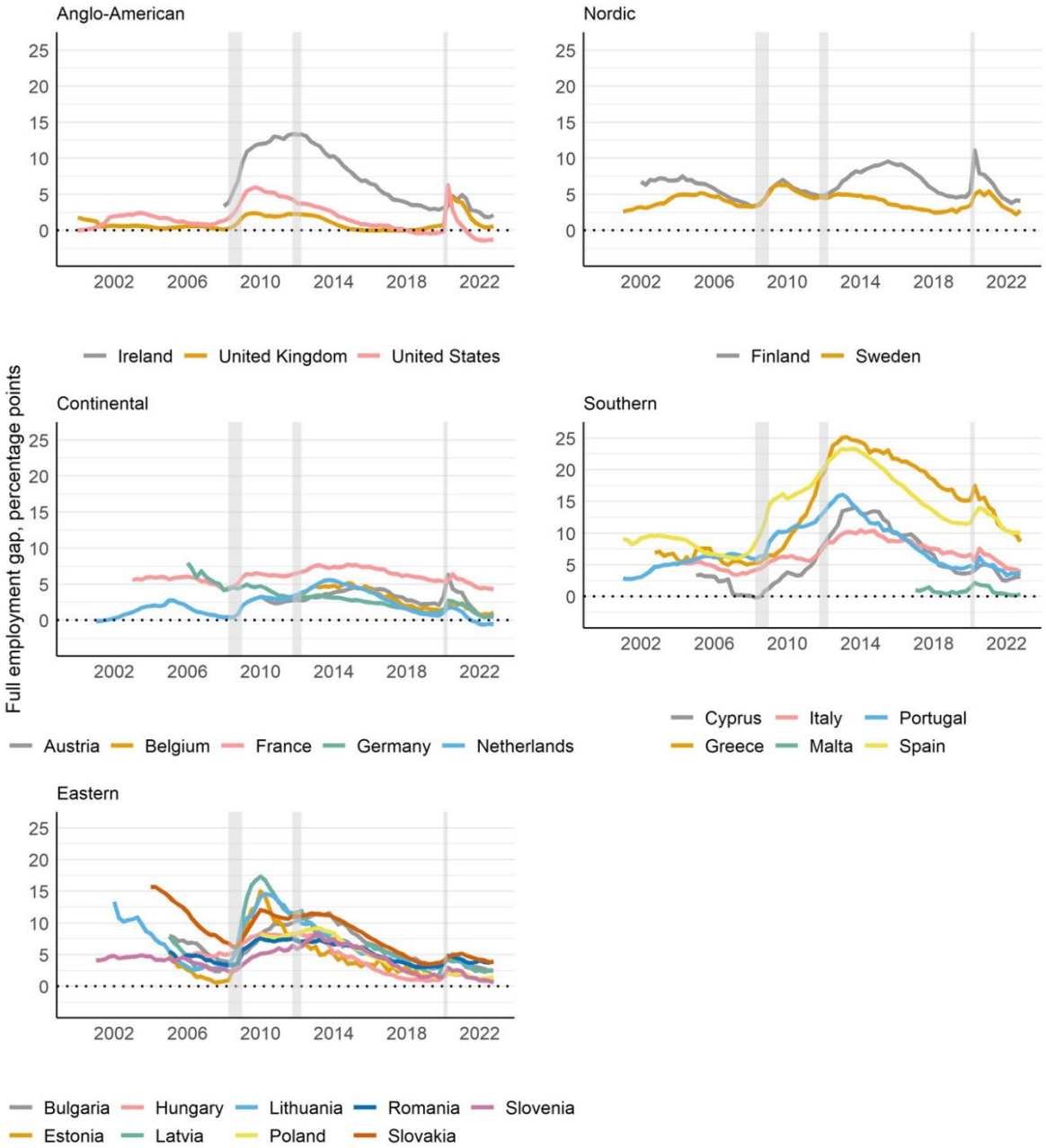
With this caveat in mind, Figure 7 shows full employment gaps for the extended country sample.[14] The estimates confirm that the full employment gap tends to increase during slumps and to fall during recoveries or booms. In particular, full employment gaps increased during the slowdown following the financial crisis of 2007-2008, where the increase was much less pronounced in Continental and Nordic EU countries than in Eastern and Southern EU countries. The group of Southern EU countries experienced a severe push away from full employment during the euro crisis of 2011-2013.[15] There was a general move towards a reduction in labour market slack across the whole EU before the pandemic, followed by a spike in unemployment gaps when the COVID-19 crisis hit. When recovery set in, labour markets in virtually all the countries covered in Figure 7 became tighter, although to varying degrees. Our data suggest that the Netherlands is the only EU country to hit the full-employment-consistent rate of unemployment during the pandemic recovery, thereby joining the US. Similarly, underemployment rates for the Netherlands and the US also show sizable reductions (see Figure A6 in appendix A). For the euro area as a whole, we find that the population-weighted average of the full employment gap is still close to 3% at the end of 2022, while the US exhibits a negative full employment gap (see Figure A5 in Appendix A). This suggests that there is significantly more slack in euro area labour markets than in the

[14] For the extended EU country sample beyond our preferred six country sample, we used Eurostat data on unemployment rates.

[15] Figure A4 shows population-weighted full employment gaps for the different country groups.

US. This is consistent with recent IMF work, which shows that the rise in core inflation in the euro area in 2022 was not driven by economic overheating, but by large headline shocks in the context of energy price increases – unlike in the US, where there is evidence that the labour market is overly tight (Autor et al. 2023; Dao et al., 2023).

Figure 7 / Beveridge full employment gap for the extended sample of 25 countries, 2000-2022



Notes: The grey areas in the figure indicate periods of recession in the aggregated OECD Europe sample. A recession is defined as two consecutive quarters of negative real GDP growth. The data for Germany are for West Germany until 1991. The Beveridge full employment gap (g) is calculated as $g = u - BECRU$. The classification of EU countries into Continental, Nordic, Southern and Eastern countries builds on Arts and Gelissen (2002).
Source: Eurostat, ISTAT, DARES, BLS JOLTS, Michaillat and Saez (2022); own calculations.

5. Predictors of full employment gaps

5.1. HYPOTHESES AND ECONOMETRIC MODEL

In what follows, we discuss factors that may contribute to explaining full employment gaps. We formulate hypotheses based on theoretical considerations on how we expect these factors to be related to full employment gaps. The hypotheses are motivated by various strands of the literature on the European unemployment problem.

First, the European unemployment literature has highlighted the potential role of hysteresis, where higher unemployment persists even after the event that initially pushed unemployment upwards no longer plays a role. Blanchard and Summers (1986) argue that classical or New Keynesian macroeconomic theories struggle to explain the European unemployment problem in the 1970s and 1980s. An alternative explanation builds on hysteresis theory: an increase in unemployment rates or a move away from full employment can be persistent if the structural rate of unemployment shifts upwards (Ball and Onken, 2022). We proxy for hysteresis in unemployment by including the lag of the full employment gap, where a statistically significant positive coefficient in the regressions would suggest that past values of the full employment gap correlate with full employment gaps contemporaneously, which would indicate persistence.[16] Another approach to accounting for hysteresis is to control for long-term unemployment. However, as data on long-term unemployment is not available for all six countries in our sample over the full time period (there are no data for some countries during the 1970s and 1980s), we do not include long-term unemployment in our baseline regression specification but include it as an additional explanatory variable in our robustness test section in Appendix C.

Second, we hypothesise that labour market institutions are significantly associated with full employment gaps. A voluminous literature has argued that rigid labour market institutions contribute to (persistently) high unemployment, which may help explain the rise in unemployment in many European countries from the 1970s to the 1990s (OECD, 1994; Nickell, 1997; Baccaro and Rei, 2007). In this context, the role of employment protection legislation (EPL) has been analysed prominently. The expectation based on the standard competitive model is that higher employment protection increases unemployment and, therefore, the full employment gap: resource costs rise owing to a decline in the freedom to contract; insiders demand higher wages; and the economy's ability to adjust to external shocks declines, which inhibits the reallocation of labour, thereby slowing job creation. However, the introduction of market imperfections may overturn this result (Heimberger, 2021). The overall impact of EPL depends on the degree of wage flexibility, the labour demand function, labour turnover and other factors (Boeri, 1999; Boeri and Jimeno, 2005). We use the OECD's Employment Protection Legislation Index to measure the extent of job protection.[17] When it comes to the role of labour market institutions, trade unions also feature prominently. In this context, the power of organised labour in wage negotiations may not only affect business decisions, but also the extent to which governments focus on the political goal of

[16] An additional benefit of including the lagged dependent variable is its technical feature of controlling for unobserved heterogeneity and endogeneity issues in panel data analysis.

[17] For the period 1970-1984, we have to use the EPL indicator provided by Blanchard and Wolfers (2000), which we merge and make consistent with the OECD EPL index over 1985-2019.

reaching full employment (Pissarides, 2006). One hypothesis is that a decline in labour power leads to a lower priority being placed on full employment policies, thereby contributing to an increase in full employment gaps. However, insider-outsider theory (Lindbeck and Snower, 2001) suggests the opposite: if trade unions support the insiders (members) by pushing for higher wages and benefits, but undermine the interests of the outsiders (the unemployed or non-union members), then more powerful trade unions can be related to higher full employment gaps. We collect data on trade union density; higher union density proxies higher labour power, and vice versa (see Table 2).[18]

Third, we formulate the hypothesis that structural factors contribute to explaining full employment gaps. Economic globalisation promotes increased international competition between companies. It is ex ante unclear whether this leads to offshoring of jobs and larger full employment gaps, or whether higher integration across borders helps to reduce full employment gaps. We measure economic globalisation by using the KOF Globalisation Index, which captures the dimensions of trade and financial globalisation (Gygli et al., 2019). Another important structural factor that could affect full employment gaps is total factor productivity (TFP) growth, which can potentially contribute to lowering unemployment if it raises output and employment, so that using the same amount of resources allows for producing more goods and services (Blanchard and Wolfers, 2000). However, TFP growth may also induce job losses in some sectors of the economy, as more productive businesses produce the same amount of output with fewer employees, where the effect may also depend on the level of education and the flexibility of the labour market (Moreno-Galbis, 2012). Furthermore, we consider that population developments may relate to labour market outcomes by using the growth rate of the active population. The relationship between population growth and unemployment is complex, and might be positive or negative (Makarski et al., 2023). A larger active population will increase the labour supply, thereby increasing the competition for jobs, which may push up the full employment gap. However, a growing active population may also increase the demand for goods and services, thereby stimulating growth and reducing full employment gaps.

Fourth, we consider whether macroeconomic factors play a role. We hypothesise that higher capital accumulation is related to lower unemployment (and vice versa), which is akin to a short-run Keynesian demand relation. We measure capital accumulation as the ratio between real gross fixed capital formation and the real net capital stock (Heimberger et al., 2017). We also test whether a decline in public-sector capital accumulation has a stronger or weaker impact on full employment gaps than private-sector capital accumulation. Changes in capital accumulation are correlated with cyclical conditions. In our robustness test section in Appendix C, we also include a further regression specification that uses the output gap variable as an additional control variable for business cycle shifts. Furthermore, we account for the potential impact of inflation. Here, we would expect a negative relationship with full employment gaps if there were a trade-off between unemployment and inflation, as such a trade-off is often a modelling feature in the empirical literature (Nickell, 1997).

Fifth, political forces can support an increase in employment levels or de-emphasise full employment (Kalecki, 1943). Political majorities in countries can be business- or worker-oriented, with different implications for how high full employment ranks on governments' priority lists. We hypothesise that more left-leaning governments tend to emphasise full employment (Hibbs 1977), while right-wing governments push for more conservative economic policies that prioritise goals such as fiscal discipline or price stability over full employment – an association which has also been addressed with limited explanatory

[18] We do not account for other labour market institutions, such as the unemployment benefit replacement rate, owing to problems with data coverage during the 1970s and 1980s.

power (Kickert et al. 2015). We construct a variable for the left-right orientation based on data concerning the political inclination and majority relationships of governments on a scale ranging from zero (far-right) to ten (far-left).[19]

We specify the following baseline econometric model to test the hypotheses related to hysteresis, labour market institutions, structural factors, macroeconomic factors and political factors:

$$FEGAP_{i,t} = \alpha + \beta\, H_{i,t-1} + \gamma\, L_{i,t-1} + \delta\, S_{i,t-1} + \theta\, M_{i,t-1} + \eta\, P_{i,t-1} + \zeta_i + \xi_t + \varepsilon_{i,t} \quad (1)$$

$FEGAP_{i,t}$ is the Beveridge full employment gap in country i and year t; $H_{i,t-1}$ captures hysteresis in unemployment proxied by $FEGAP_{i,t-1}$, the lag of the dependent variable; $L_{i,t-1}$ is a vector with variables capturing lagged labour market institutions; $S_{i,t-1}$ includes lagged structural factors; $M_{i,t-1}$ refers to lagged macroeconomic regressors; $P_{i,t-1}$ refers to lagged political factors. We follow many studies in the empirical unemployment literature, using lagged values for the control variables to 'mitigate endogeneity concerns (though, admittedly, not solving them)' (Felbermayr and Gröschl, 2014, p. 98). Furthermore, theoretical considerations suggest that labour market institutions, structural factors, macroeconomic factors and political factors may only affect full employment gaps with a lag. ζ_i refers to country-fixed effects, which we include to account for unmeasurable, time-invariant country-specific characteristics; and $\varepsilon_{i,t}$ represents the error term. ξ_t are time-fixed effects, which capture time-varying shocks that hit all countries. The groups of explanatory variables (H, L, S, M and P) correspond to the hypotheses formulated above. Table 1 lists detailed definitions and data sources for all variables. Table A 6 in appendix A reports descriptive statistics.

An important question is how to estimate equation (1), which represents a dynamic panel data model. As we include both a lag of the dependent variable as well as country-fixed effects, using ordinary least squares (OLS) regression could potentially bias the coefficient estimates (Nickell, 1981). However, Judson and Owen (1999) use Monte Carlo simulations to show that the bias depends on T, the number of years in the panel. They argue that when $T > 30$, the bias can be ignored, as a least squares dummy variable estimator then performs at least as well as or better than GMM and other alternatives. This is important for our setting, as the annual dataset is characterised by $T = 50$ for our preferred six-country sample (1970-2019). With our data structure of large T but small N, using a GMM estimator is not advisable. Hence, we follow the recommendation in Judson and Owen (1999) and estimate the fixed-effects model using OLS. We conducted a series of pre-tests including multi-collinearity analysis, panel unit root tests, and panel cointegration tests (see Appendix B), which support our econometric approach.

[19] Data for the dimension of left-right leaning political majorities and governments were constructed by combining datasets from erdda (Bergman et al., 2019; Bergman et al., 2021; Hellström et al., 2021), parlgov (Döring et al., 2023), cpds (Armingeon et al., 2022), and v-party (Lindberg et al., 2022; Pemstein et al., 2020). The main outcome was the real value variable *LRG* (left-right dimension of the government based on parlgov data) that describes the political inclination of the current government and political majority. The annual LRG variable of elected governments is computed as weighted average of the recorded left-right indicator of each ruling party and the number of their cabinet seats. Data on the left-right indicator (i.e. the political inclinations) of European parties are taken from the parlgov dataset, and for the US we used information from the v-party dataset that presents evaluations on the political directions of each party. Information about the distribution of cabinet seats to the different parties is collected by the erdda dataset for European countries and by the cpds dataset for several democratic countries, including the US.

Table 1 / Variables used in the regression analysis

Variable	Abbreviation	Unit	Source
Full employment gap (difference between the actual unemployment rate and the BECRU in percentage points)	FEGAP	Percentage points of the labour force	OECD, Eurostat; own calculations
1) Unemployment hysteresis (H)			
Lag of the full employment gap	$FEGAP_{t-1}$	Percentage points of the labour force	OECD, Eurostat; own calculations
Lag of long-term unemployment (+)	LTU_{t-1}	Share of long-term unemployed in total unemployment (%)	OECD
2) Labour market institutions (L)			
Lag of employment protection legislation (+)	EPL_{t-1}	Index for strictness of employment protection (individual and collective dismissals, regular contracts)	OECD for 1985-2019; IMF (2003) for 1970-1984
Lag of trade union density (-)	$UDENS_{t-1}$	Share of employees that are union members (%)	OECD[20]
3) Structural factors (S)			
Lag of economic globalisation (-)	$EGLOB_{t-1}$	Economic globalisation index (0-100)	KOF (Gygli et al., 2019)
Lag of total factor productivity growth (-)	TFP_{t-1}	Total factor productivity (annual growth; %)	AMECO (Autumn 2022); own calculations
Lag of active population growth (~)	$ACTPOP_{t-1}$	Seasonally adjusted annual growth rate of the population aged 15 and over (%)	OECD
4) Macroeconomic factors (M)			
Lag of capital accumulation (-)	$ACCU_{t-1}$	Real gross fixed capital formation/real net capital stock * 100	AMECO (Autumn 2022); own calculations
Lag of public capital accumulation (-)	$PUCA_{t-1}$	Real gross fixed capital formation in the public sector/real net capital stock * 100	AMECO (Autumn 2022); own calculations
Lag of private capital accumulation (-)	$PRCA_{t-1}$	Real gross fixed capital formation in the private sector/real net capital stock * 100	AMECO (Autumn 2022); own calculations
Lag of inflation (-)	$INFL_{t-1}$	Consumer price index (annual growth rate)	OECD
Lag of output gap (-)	OG_{t-1}	Difference between actual and potential output (% of potential output)	AMECO (Autumn 2022)
5) Political economy (P)			
Lag of left-right dimension of government (-)	LRG_{t-1}	Degree of the current government in being very right (0) to very left (10)	erdda, parlgov, cpds and v-party; own calculations[19]
Time-sensitive dummies			
1980s dummy	Eighties	Binary dummy set to 1 for all the years in the 1980s	Own calculations
1990s dummy	Nineties	Binary dummy set to 1 for all the years in the 1990s	Own calculations
Financial crisis dummy	FinancialCrisis	Binary dummy set to 1 for the years 2008-2009	Own calculations
Euro crisis dummy	EuroCrisis	Binary dummy set to 1 for the years 2011-2012	Own calculations
Cluster variables			
European country group dummy	DCLU_EU	Binary dummy, set to 1 for Austria, Germany, Finland, Sweden, and UK	Own calculations
US country group dummy	DCLU_US	Binary dummy, set to 1 for the US	Own calculations
Liberal welfare state dummy	DCLU_LIB	Binary dummy set to 1 for US and UK	Own calculations
Social democratic welfare state dummy	DCLU_SOD	Binary dummy set to 1 for Sweden and Finland	Own calculations
Conservative welfare state dummy	DCLU_CON	Binary dummy set to 1 for Austria and Germany	Own calculations

Notes: Own illustration. The signs in brackets indicate the expected sign, where (+) points to an expected positive relationship with full employment gaps, (-) suggests a negative correlation, and (~) indicates that there is no clear prediction.

[20] Union density data progress smoothly over time without any big jumps and are consistently available for our six countries between 1970 and 2019, except for two observations for the US in the years 1981 and 1982. While other research used a simple averaging approach to impute for not available data points regarding union density in the US (see Hirsch et al. 2001), we impute for the two observations with a more advanced approach of utilizing a Kalman filter (e.g. Adejumo et al. 2021, Poncela et al. 2021).

5.2. MAIN REGRESSION RESULTS

Table 2 shows panel regression results. We include groups of explanatory variables in several steps, as this allows us to check whether the estimated coefficients are robust to controlling for other dimensions. Model (M1) starts by accounting for hysteresis represented by the lag of the full employment gap. We find that the lagged value of the full employment gap is significantly associated with contemporaneous full employment gaps, which points to unemployment persistence. This is consistent with the hypothesis that hysteresis plays a role, which is also confirmed in Appendix C, where the long-term unemployment variable is also significantly related to an increase in the full employment gap.

Model (M2) adds explanatory variables for labour market institutions. Both, employment protection legislation and trade union density are significantly related to full employment gaps. This finding will change when including other control variables as described below.

Model (M3) adds structural factors. It shows that higher TFP growth predicts lower full employment gaps. This suggests that, on average, an increase in TFP growth is related to a mitigation of the unemployment problem. We do not find a significant coefficient for economic globalisation in model (M3). However, higher active population growth is significantly related to lower full employment gaps. This suggests that the increase in labour supply and jobs competition arising from a growing active population may, on average, be less important than the overall strengthening of demand for goods and services. The point estimate of UDENS has also increased and become highly significant: an increase in trade union density is positively related to full employment gaps. This is inconsistent with the prediction that more powerful trade unions, on average, are related to a stronger full employment focus. The result, however, may be rationalised with insider-outsider theory (Lindbeck and Snower, 2001), where stronger unions serving the interests of their members (insiders) may reduce employment opportunities for outsiders, as they focus on achieving higher wages for existing employees, rather than higher employment levels. However, this finding will also be discussed below, as the regression specifications for different sample subsets partly yield different results.

Model (M4) adds macroeconomic factors. Capital accumulation is not significantly related to full employment gaps, which is inconsistent with the theoretical prediction that higher investment is related to a decline in full employment gaps. Notably, we find a positive and significant inflation coefficient. This suggests that, on average, there is no trade-off between inflation and full employment gaps.

The last variable to be added to our benchmark model (BM) helps us to account for the role of political factors, as model (M5) controls for the left-right orientation of governments. We find that more left-leaning governments are associated with a decline in full employment gaps. This is consistent with the hypothesis that they put more emphasis than right-leaning governments on full employment.[21]

[21] While promoting full employment is often high on the agenda when it comes to the electoral pledges of left parties, Aaskoven (2019) finds for 22 OECD countries that left-wing governments increase public employment levels during election years, but not on average. The literature suggests that the ability of left-leaning governments to promote progressive social policies depends on the strength of trade unions (Korpi, 2006). Hence we also included an interaction term between the left-right political orientation of a government and the labour union density variable in another specification, but the regression results did not point to a significant interaction term. Results are available upon request.

Table 2 / Regression results of our baseline specification

	FEGAP							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	M1	M2	M3	M4	M5/BM	BM+D.T	BM+D.X	BM+D.X (2008-2019)
$FEGAP_{t-1}$	0.931***	0.913***	0.932***	0.920***	0.904***	0.831***	0.643***	0.894***
	(0.015)	(0.022)	(0.023)	(0.021)	(0.024)	(0.013)	(0.026)	(0.268)
EPL_{t-1}		0.248**	0.367*	0.184	0.151	-0.045	0.169	-0.260
		(0.123)	(0.197)	(0.196)	(0.207)	(0.202)	(0.188)	(2.389)
$UDENS_{t-1}$		0.024*	0.029***	0.035***	0.039***	0.024***	0.036***	-0.086*
		(0.013)	(0.010)	(0.012)	(0.013)	(0.008)	(0.011)	(0.050)
TFP_{t-1}			-0.267***	-0.237***	-0.229***	-0.215***	-0.218***	-0.140
			(0.048)	(0.052)	(0.053)	(0.039)	(0.056)	(0.136)
$EGLOB_{t-1}$			-0.010	-0.020	-0.024	0.032***	-0.040	-0.198
			(0.024)	(0.028)	(0.030)	(0.009)	(0.032)	(0.121)
$ACTPOP_{t-1}$			-0.119***	-0.122**	-0.121**	-0.142**	-0.137**	0.026
			(0.044)	(0.054)	(0.056)	(0.068)	(0.053)	(0.095)
$ACCU_{t-1}$				-0.063	-0.069	-0.104	-0.060	-0.145
				(0.063)	(0.055)	(0.096)	(0.045)	(1.301)
$INFL_{t-1}$				0.069*	0.069*	0.091***	0.063*	0.515**
				(0.038)	(0.037)	(0.016)	(0.033)	(0.217)
LRG_{t-1}					-0.056*	-0.110***	-0.029	-0.185**
					(0.031)	(0.038)	(0.022)	(0.079)
Eighties						0.002		
						(0.192)		
Nineties						0.571***		
						(0.185)		
FinancialCrisis						0.692***		
						(0.239)		
EuroCrisis						0.002		
						(0.123)		
$FEGAP_{t-1}$ x DCLU_EU							0.296***	-0.098***
							(0.038)	(0.032)
Observations	296	296	296	296	296	296	296	78
R^2	0.871	0.874	0.902	0.905	0.906	0.897	0.912	0.796
Adjusted R^2	0.841	0.844	0.877	0.880	0.881	0.891	0.888	0.685
F Statistic	1,613.475***	549.432***	360.245***	278.361***	249.468***	186.227***	239.417***	19.464***
	(df = 1; 240)	(df = 3; 238)	(df = 6; 235)	(df = 8; 233)	(df = 9; 232)	(df = 13; 277)	(df = 10; 231)	(df = 10; 50)

Notes: Dependent variable: FEGAP. Details on the variables used are available in Table 1. Estimates for the constant and for country-fixed effects are not shown for brevity. ***, ** and * refer to statistical significance at the 1%, 5% and 10% level, respectively. Cluster-robust standard errors are shown in parentheses.

We further extend our benchmark model BM by adding specific time-related dummies (BM+D.T). Model (M6) does not include year-fixed effects as in the previous specifications; instead, we now control for dummy variables for the 1980s, the 1990s, the financial crisis-related recession of 2008-2009, and the Euro crisis of 2011-2012. We include these variables to test for period-specific effects on full employment gaps. We find a positive and significant coefficient of the Nineties dummy and the financial crisis dummy, whereas the coefficient of the Eighties dummy and the Euro crisis lack significance. This suggests that there was something specific to how full employment gaps were affected during the 1990s

and the financial crisis, when many advanced economies experienced a marked rise in unemployment.[22] Missing significance for the Euro crisis dummy can be related to the sample of countries in our long panel data set, since the shorter panel between 2000 and 2019 with more European countries does show a significant association of the Euro crisis and FEGAP (see Table A 16). Importantly, coefficient estimates of the other control variables remain robust. The only major difference is that the coefficient of economic globalisation turns positive and significant.

Focusing on the relation of the European unemployment problem and our Beveridgean measure of full employment gaps, we extend the benchmark model by including dummies with interaction terms where we interact a dummy for European countries[23] with the lagged FEGAP variable (BM+D.X) in column (7). While point estimates and significance levels are in line with the ones of the benchmark model of column (5), our full employment gap measure confirms the observation of the European unemployment problem: an increase in the lagged full employment gap of the EU block correlates with a significantly stronger increase of the full employment gap than in the US. Conducting the same regression on a reduced time span of our panel, namely for the period from the financial crisis onwards (2008-2019, column (8)), we find a significantly negative coefficient of the interaction term which suggests that the impact of lagged full employment gaps on contemporaneous full employment gaps over the 2008-2019 was weaker in the European countries than in the US, suggesting that hysteresis was of less importance than in earlier decades. Robustness tests in the following section offer a more detailed analysis regarding the main findings.

5.3. ROBUSTNESS CHECKS

For further robustness checks, we ran several additional regression specifications that can be found in Appendix C. In our first test we extended the analysis by applying the same regression approach as in section 5.2 with a focus on individual country dummies, using the US as the reference country. All results of the main regression results prove robust, while we also find significant hysteresis effects for each single European country (see column (4) in Table A7). Additionally, we also grouped the European countries according to the concept of European welfare states – with the US and the UK pertaining to the group of liberal welfare states, Austria and Germany being part of the conservative welfare states group, and Finland and Sweden as part of the Nordic social democratic welfare state group (Esping-Andersen, 1990). This regrouping also confirms our main results for European welfare states (see columns (5) and (6) in Table A7).

In a second test, we adapted our regression approach of equation (1) by averaging our yearly data over a period of three and five years to account for business cycle dynamics (e.g. Romero and McCombie, 2016). The results generally confirm the takeaway of the regression output of Section 5, although some point estimates are smaller, while standard errors increased, leading to fewer significant coefficient

[22] The 1990s were marked by a strong rise in globalisation (e.g. Gygli et al. 2019), but we already control for a globalisation variable in the regressions. The global financial crisis was a particularly strong global crisis event originating in subprime mortgage markets and the transatlantic financial system, where turbulences in financial markets and the banking sector spilled over to the real economy (e.g. Tooze 2018).

[23] Following the literature on the European unemployment problem (e.g., Blanchard & Summers, 1986; Gali, 2015) which compared the US with major European economies for exploring the European unemployment problem, we put all European countries of our 1970-2022 sample into the European block (AUT, DEU, FIN, SWE, GBR) to facilitate comparisons with the US.

estimates; this can be seen as a consequence of the reduction in the data variation through the averaging process (see Table A8 and Table A9).

Furthermore, we substituted the left-hand-side variable of equation (1) with the NAIRU gap, i.e. the difference between actual unemployment and the NAIRU (NAIRUGAP). Although we note some variations in the sign and size of coefficient estimates, we do not find major differences between the NAIRUGAP results of Table A10 and FEGAP results of Table 2. TFP_{t-1} is consistently related to lower NAIRUGAP values, as well as $ACTPOP_{t-1}$ and LRG_pg_{t-1}, while EPL_{t-1} and $ACCU_{t-1}$ are insignificant in all specifications. NAIRUGAP regression specifications are more consistent than FEGAP specifications with regard to the significance level of the explanatory variables. The most obvious difference is that $EGLOB_{t-1}$ does typically show an insignificant relationship with FEGAP, but shows a negative and significant relationship with NAIRUGAP.

Next, we include another set of regressions with additional regressors. Table A11 shows that the effect sizes and statistical significance of estimators remain almost the same, contributing to the consistency of our estimation results. We compare our benchmark model (1) with other tested variables, which include (2) the output gap (OG) as an additional measure for business cycle shifts; (3) a different hysteresis measure, namely long-term unemployment (LTU); (4) a separation of the accumulated capital into a public (PUCA) and private (PRCA) rate; and (5) a different variable to measure the left-right share of governments, which is based on cpds instead of parlgov data.[24]

Adding an additional control for output gaps does not change the estimates of our benchmark regressors. In case of utilizing long-term unemployed instead of the lagged full employment gap we also find a positive and significant relationship of regressor LTU_{t-1} with FEGAP; however, we find some differences regarding other regressors, as standard errors increased for UDENS, ACTPOP, and INFL and made them insignificant; this has to been seen against the background of a significantly smaller sample size (227 instead of 296 observations) due to missing data on long-term unemployment for some countries in our sample in earlier years (for Austria LTU data are only available from 1994 onwards, for Germany from 1983 onwards, Finland misses several years between 1980 and 1995).[25] The other two extensions of splitting up our capital accumulation variable and using the alternative LRG variable with a lower indicator precision do not yield significant results regarding the newly introduced variables.

To account for macroeconomically relevant events, such as adopting the Maastricht Treaty and entering the Eurozone, we extend our benchmark model by further dummy variables and split the whole panel into subperiods (see Table A12). We find that the Maastricht dummy as well as the Eurozone dummy are associated with a decline in full employment gaps. We then split our long run sample into shorter

[24] Whereas parlgov lists the number of seats of political parties in parliament and government, cpds only shows the government composition in percentage of total cabinet posts for three clusters, namely a right-wing, a centre and a left-wing cluster. Since the clustering into only three categories is not as informative as the party inclination based on parlgov data on a scale between 0 and 10, we utilize the cpds based LRG variable (LRG_cp) only for a robustness check and refer to the parlgov based LRG variable (LRG_pg) as the main LRG variable for our baseline regression specification. However, an advantage of the cpds data is that they are fully consistent, including all countries in our dataset between 1960 and 2020. Parlgov, on the other hand, does not contain information on the US regarding cabinet seats. Hence, US data for the LRG_pg variable were imputed with the help of cpds data.

[25] While the number of observations diverges from our main regression specification, we do find similarities in the mentioned estimates and their significance levels with regards to a regression model on a subset of our six-country panel of more recent episodes. Conducting our regression approach on our long run panel for a restricted period of 2000-2020 also results in insignificant $UDENS_{t-1}$ and $ACTPOP_{t-1}$ estimates (see Table A 12).

subperiods (i.e., the period of 1970-1992 before the Maastricht Treaty, the years between the Maastricht Treaty and the introduction of the Eurozone 1993-1998, the time from establishment of the Eurozone until the year before the financial crisis 1999-2007, the time after the financial crisis 2008-2020, and the period from 2000-2020). Our main conclusions regarding full employment gaps remain robust as the picture for most coefficient estimates does not change.

To further explore the role of different time periods regarding the European unemployment problem, we include an interaction term with a European dummy and lagged full employment gaps (comparable to column (7) of Table 2) in specifications for decade subsets of our six-country panel. Results in Table A13 suggest that hysteresis effects are stronger in the European countries than for the US in the periods of the 1970s, 1980s, and most pronounced during the 1990s. While the US records a positive and significant association between $FEGAP_{t-1}$ and FEGAP in the 1970s, there is no significant sign of hysteresis for the US between 1980 and 2009. After the financial crisis, for the years 2010-2019, we find significantly smaller hysteresis for Europe than for the US. These observations are also in line with results from Table A12, which reports that hysteresis for the European cluster is still larger between 1999 and 2007 than for the US; however, there is a shift for the subsequent period from 2008 to 2020. We also find different results on the coefficients of active population growth in the subset analysis. There is a less significant relationship of active population growth with full employment gaps over 2000-2019 than over the longer time period. As active population growth slowed down in many countries compared to earlier decades, our results suggest that the correlation with full employment gaps weakened (see Table A12, Table A13, and Table 2).

Conducting the same analysis with the NAIRUGAP instead of the FEGAP mostly yields similar results (see Table A14). Differently though, for the period 2000-2009 hysteresis based on the NAIRU gap is larger for the European cluster, while for the FEGAP we do not find a significantly different impact for Europe compared to the US. According to the FEGAP measure, the 1990s are the last decade where European countries recorded significantly larger hysteresis than the US. According to the NAIRUGAP measure, however, Europe also shows significantly larger hysteresis in the 2000s.

Deepening the analysis of heterogeneities between European countries and the US, we interact each single baseline regressor with the US dummy variable (see Table A15). The results suggest similar patterns for predictors of European and US full employment gaps, respectively. Estimated coefficients are not significant for EPL_{t-1} and $EGLOB_{t-1}$; but the estimates are negative and significant for TFP_{t-1}. Noteworthy differences are the estimates for active population growth and public capital accumulation, which only correlate in the European case with a reduction of full employment gaps, though not for the US. The finding regarding public capital accumulation complements results of previous regressions where the jointly estimated coefficient estimates of total capital accumulation (i.e., the sum of public and private capital accumulation) for all six countries on full employment gaps were negative but non-significant.

Finally, we also applied our regression approach of equation (1) to a bigger panel dataset of 25 countries between 2000 and 2022 (see Table A16). The results confirm the significant relationships of FEGAP with $FEGAP_{t-1}$, EPL_{t-1}, $ACCU_{t-1}$, $INFL_{t-1}$ and TFP_{t-1}. The differences in results that we encounter can be related to the circumstances of the sample periods since our regression for the 2000-2019 subset of our six-country sample also shows similar results (see column (9) in Table A12).

6. Are Beveridgean full employment gaps informative?

This section provides some first insights into whether our Beveridgean full employment gap estimates are informative, and how they compare with estimates of the NAIRU. Figure A7 in appendix A compares actual unemployment rates, our BECRU estimates, and the European Commission's NAIRU estimates for our preferred data sample of six countries for the period 1970-2022. The European Commission estimates the NAIRU by using a Kalman Filter based on a state-space Phillips curve model (Havik et. al, 2014). We rely on the most recent NAIRU estimates of the European Commission from the November 2023 AMECO release.

Our BECRU estimates vary over time, but they move less than the NAIRU estimates. Our finding that the BECRU is more stable supports the theoretical observation that the Beveridge curve and related measures are less susceptible to shifts and fluctuations than Phillips curve relationships (Dickens, 2008). In the 1970s NAIRU estimates in Germany, the UK, Sweden, and the US were at times even lower than the BECRU estimates. However, in the 1980s and 1990s the NAIRU estimates increased more strongly than the BECRU estimates. This implies that Beveridgean full employment gaps during the 1980s and 1990s are typically larger than NAIRU unemployment gaps, where the latter are calculated by the difference between actual unemployment and the NAIRU. In 2022, the US is the only country that shows a higher BECRU than NAIRU. For all countries in our sample except for the US, the BECRU estimates currently point to a greater degree of labour market slack than the NAIRU estimates.

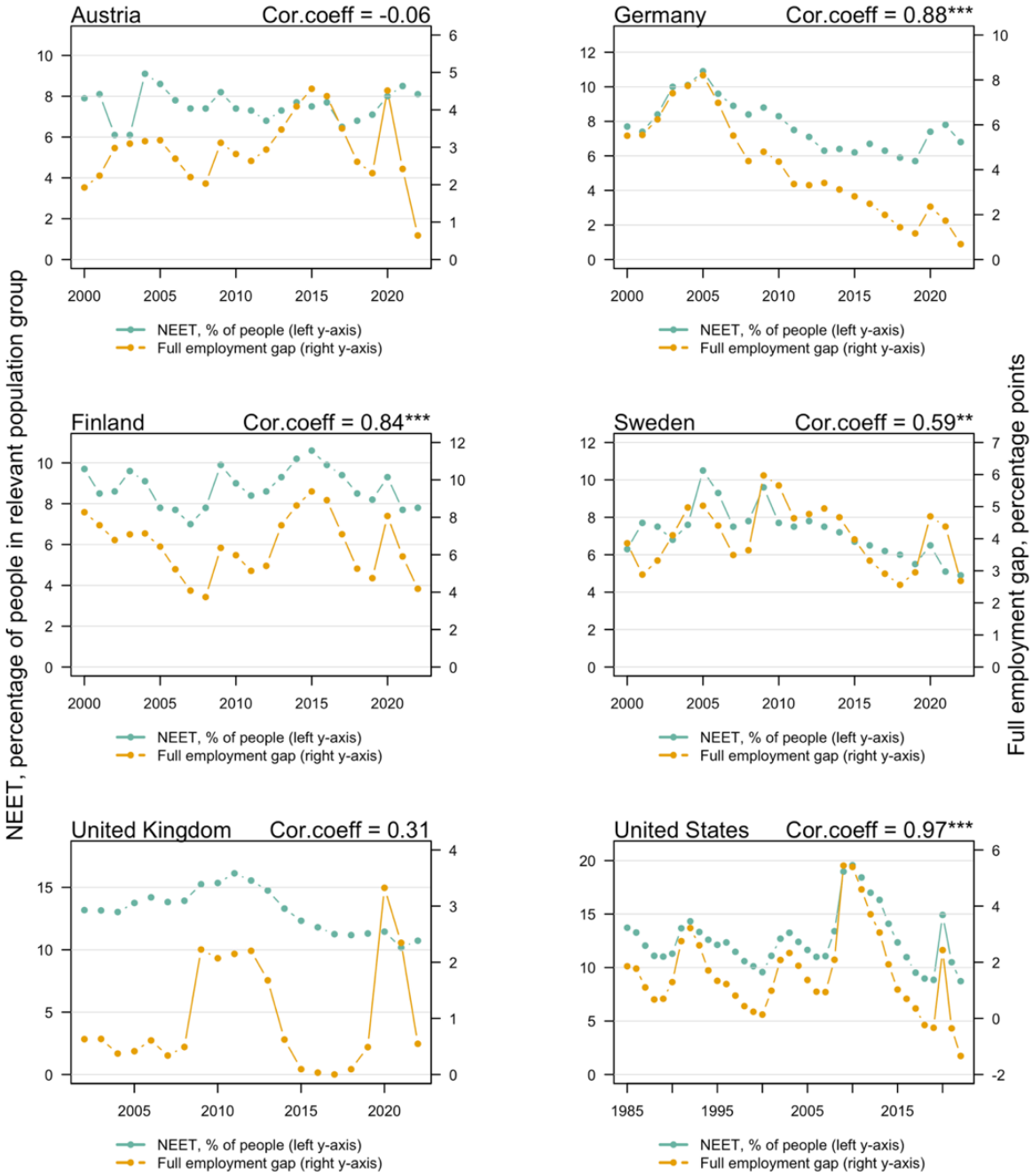
Minimising the non-productive use of labour should be connected to a more efficient allocation of resources, enhanced skill development opportunities, and reduced barriers to employment. To test whether the BECRU is a good measure for macroeconomic efficiency, we focus on the share of youth who are unemployed and not receiving education or vocational training ('Not in education, employment or training' – NEET). The reason for this focus is that NEET individuals can partly be seen as an indicator of unused human capital: high NEET rates suggest that young people could contribute to a larger extent to productive activities but are currently not doing so, which reflects inefficiencies. If the BECRU minimises the non-productive use of labour, we would expect a (close to) zero full employment gap to be related to a low share of youth who are unemployed and not receiving education or vocational training ('Not in education, employment or training' – NEET)[26]. This is indeed what we typically find in Figure 8, which shows the development of NEET (left y-axis) and the Beveridgean full employment gap (right y-axis) over 2000-2021[27] for our preferred six-country sample. For all countries except for Austria and the UK, there is a strong positive relationship, and the data show that NEET is typically lowest when

[26] For EU member states, the data are sourced from Eurostat, which offers annual NEET rate of individuals aged 15 to 24 years. In the UK, the Office for National Statistics (ONS) publishes quarterly statistics focused on the NEET rate of individuals aged 15 to 24 years. For the US, data is gathered from the Bureau of Labor Statistics (BLS), which releases monthly data concerning the NEET rate of individuals aged 16 to 24 years. As the data from the US and UK are sourced from monthly or quarterly reports, we aggregate the data to obtain annual figures.

[27] NEET data for the period 1970-1999 are unavailable.

actual unemployment is close to the BECRU.[28] As Figure A8 in Appendix A shows, the correlation of NAIRU gap estimates with NEET is considerably weaker at the individual country level.

Figure 8 / NEET rate and BECRU full employment gap estimates, 2000-2022



Notes: ***, ** and * refer to statistical significance at the 1%, 5% and 10% level, respectively.
Source: Eurostat, OECD, BLS JOLTS, Michaillat and Saez (2022), ONS; own calculations.

[28] In the UK, the weaker average correlation between NEET and the full employment gap is mainly due to the performance during two crises: the recession that followed the global financial crisis, and the pandemic-related recession. In Austria, NEET jumped around in the early 2000s; and NEET still increased in 2021 when the full employment gap was already falling.

To investigate whether our full employment gap estimates do reasonably well in predicting NEET, we estimate the following panel model:

$$NEET_{i,t} = \alpha + \beta\ SLACK_{i,t} + \gamma\ ACTPOP_{i,t} + \zeta_i + \xi_t + \varepsilon_{i,t} \quad (2)$$

where $NEET_{i,t}$ refers to NEET in country *i* and year *t*; $SLACK_{i,t}$ is the labour market slack measure, i.e. either the Beveridgean full employment gap (FEGAP) or the NAIRU unemployment gap (NAIRUGAP); $ACTPOP_{i,t}$ is the growth rate of the active population (aged between 15 and 64 years); ζ_i refers to country-fixed effects; ξ_t captures time-fixed effects; $\varepsilon_{i,t}$ is the error term.

We are interested in predicting NEET in the years running up to the COVID-19 crisis using different labour market slack measures, FEGAP and NAIRUGAP, and comparing the results. We use the period 2000-2014 as the training sample in our preferred dataset, and the 2015-2019 observations for the out-of-sample forecast. Table 3 shows the panel regression results based on equation (2) for the training sample. We find that higher full employment gaps are significantly related to higher NEET (and vice versa); but this also holds for the NAIRU unemployment gap. We find that the adjusted R-squared is significantly higher for the model including the Beveridgean full employment gap compared with the NAIRU unemployment gap. We then estimate out-of-sample root mean squared error (RMSE) forecasts, which measure the average distance between the values predicted by the model and the actual values. We find that the RMSE for model (1), including the full employment gap as a regressor, is 3.51, which is lower than the 4.29 for model (2). As a lower RMSE suggests that a model performs better, our results suggest that the Beveridgean full employment gaps do better than the NAIRU unemployment gaps in predicting NEET. A graphical representation that compares the fitted values of the different models with the NEET data can be found in Figure A 9 in Appendix A.

Furthermore, we want to test if the Beveridgean full employment gaps do well compared with NAIRU unemployment gaps in predicting inflation. To test this, we again run a panel regression model with country- and time-fixed effects, where we regress core inflation[29] on the labour market slack indicator, and further control for labour productivity growth (PROD), measured in terms of GDP per hours worked:

$$CINFL_{i,t} = \alpha + \beta\ SLACK_{i,t} + \gamma\ PROD_{i,t} + \zeta_i + \xi_t + \varepsilon_{i,t} \quad (3)$$

In reference to Table 3 we want to emphasise that the models for inflation prediction (columns (3) and (4)) do not produce significant F-statistics or significant predictors. Results in model (3) show that higher full employment gaps are related to lower core inflation (and vice versa), although not significantly so; but this also holds for the NAIRU unemployment gaps in model (4), which also show a negative and insignificant coefficient. Given the insignificance of the predictors, out-of-sample predictions are not promising. To ensure comparability, we still report out-of-sample RMSE values. We find that the RMSE for model (3), including the full employment gap as a regressor, is 0.51, which is only slightly above the 0.48 for model (4). The similarity of predicted values of the FEGAP and NAIRUGAP estimates is visualised in Figure A 10 in Appendix A. Hence, our results suggest that the Beveridgean full

[29] Due to the need for inflation coverage of multiple countries for a time period between 1970 and 2022 we utilize inflation data provided by the World Bank (Ha et al. 2021). Since we want to explore the relation between our labour market slack measures and underlying, common trends in prices we make use of the available core inflation data which are based on headline inflation excluding the volatile components of energy and food.

employment shows a similarly poor performance in predicting core inflation compared with NAIRU unemployment gaps.

While the results presented in this section provide preliminary insights, future research should do more to analyse how informative the Beveridgean full employment gaps based on BECRU estimates actually are. Our preliminary findings suggest that the Beveridgean full employment gap estimates are informative in important respects, e.g. when it comes to predicting NEET, but might be less informative in other respects, e.g. when it comes to predicting core inflation. For example, future research could provide more in-depth testing on whether Beveridgean full employment gaps do better in predicting inflation for other country samples.

Table 3 / Predicting NEET and core inflation (covering the period 2000-2014)

	NEET		CINFL	
	(1)	(2)	(3)	(4)
FEGAP	1.000***		-0.029	
	(0.209)		(0.072)	
NAIRUGAP		1.361***		-0.104
		(0.309)		(0.090)
ACTPOP	-0.607***	-0.564***		
	(0.203)	(0.212)		
PROD			0.031	0.026
			(0.091)	(0.089)
Observations	88	88	88	88
R^2	0.671	0.599	0.009	0.027
Adjusted R^2	0.566	0.471	-0.307	-0.282
F Statistic (df = 2; 66)	67.281***	49.211***	0.285	0.925

Notes: Estimates for the constant and for country-fixed and time-fixed effects are not shown, for brevity. ***, ** and * refer to statistical significance at the 1%, 5% and 10% level, respectively. Cluster-robust standard errors are shown in parentheses.

7. Conclusions

This paper has analysed deviations from full employment in European countries and the US. By building on seminal contributions by Michaillat and Saez (2021, 2022), we have relied on a full employment measure derived from the Beveridge curve, the relationship between unemployment and vacancies. We call this measure the Beveridge (full-employment-consistent) rate of unemployment (BECRU), which is the amount of unemployment that minimises the non-productive use of labour. Our work contributes to the literature by conceptualising full employment via the BECRU and applying it to a larger European country sample.

We find that BECRU estimates differ across countries and can change over time. European countries experienced a marked rise in full employment gaps – defined as the difference between actual unemployment and the BECRU – in the 1980s and 1990s, as the European unemployment problem emerged. The 1990s and the financial crisis of 2008-2009 appear as periods with strong increases in full employment gaps. The full employment gaps in the US showed more wave-like patterns compared with the step-wise increases in full employment gaps of EU countries over time, which could be explained by the interaction of macroeconomic shocks with different labour market structures (e.g. Blanchard and Wolfers 2000; Campos et al. 2023). According to our full employment gap estimations, full employment gaps in European countries were reduced before the global financial crisis, then increased strongly during the Great Recession.

Our analysis further suggests that the Eurozone and most individual member countries have recently experienced significantly more labour market slack than conventional NAIRU and output gap estimates produced by organisations such as the European Commission suggest. The European Commission's NAIRU and output gap estimates point to less slack during and after the euro crisis than our full employment gap estimates (Brooks and Fortun, 2020; Heimberger and Kapeller, 2017). A BECRU-oriented policymaker may promote more expansionary macroeconomic policies than a NAIRU-oriented policymaker when Beveridgean full employment gaps point to more slack. Vice versa, an unfilled vacancies perspective may hint at more restrictive macroeconomic policies when the Beveridgean full employment gap is closed or even negative.

A caveat with regard to full employment gaps based on the BECRU is that our estimates depend on the quality of the underlying vacancy data. Owing to our interest in understanding full employment gaps over the past five decades, our research approach is restricted by the availability of quality long-term time series. Previous studies have reported on the shortcomings of aggregate unemployment and vacancy data (Komlos, 2021; Fontanari et al., 2022). We argue that our preferred sample of six countries provides good-quality vacancy data, but there could be under-reporting of vacancies to an unknown degree, in particular for some of the countries in the extended country sample. Further improvements in the availability and reliability of the vacancy data would be helpful for further research. Furthermore, while the Beveridge full employment gap used in our study provides important information for researchers and policy makers on whether labour markets are overall slack or tight, a notable limitation is that our approach does not deal with informal employment, underutilised labour (Komlos, 2021;

Fontanari et al., 2022), or the quality of jobs in the vacancy-unemployment space. The BECRU approach builds on a whole economy perspective, but this does not account for how different groups of labour market participants are affected. Extensions of our work, therefore, could aim at estimating full employment gaps by age, education and race, which will require using a different methodology. Future research could also provide case studies for selected advanced economies and key periods (for example, EU integration) to better understand full employment-supportive economic, political and institutional circumstances in comparison to environments characterised by larger full employment gaps. Finally, our framework could be extended to emerging-market economies and developing countries to allow for comparisons with advanced economies.

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IMPRESSUM

Herausgeber, Verleger, Eigentümer und Hersteller:
Verein „Wiener Institut für Internationale Wirtschaftsvergleiche“ (wiiw),
Wien 6, Rahlgasse 3

ZVR-Zahl: 329995655

Postanschrift: A 1060 Wien, Rahlgasse 3, Tel: [+431] 533 66 10, Telefax: [+431] 533 66 10 50
Internet Homepage: www.wiiw.ac.at

Offenlegung nach § 25 Mediengesetz: Medieninhaber (Verleger): Verein "Wiener Institut für Internationale Wirtschaftsvergleiche", A 1060 Wien, Rahlgasse 3. Vereinszweck: Analyse der wirtschaftlichen Entwicklung der zentral- und osteuropäischen Länder sowie anderer Transformationswirtschaften sowohl mittels empirischer als auch theoretischer Studien und ihre Veröffentlichung; Erbringung von Beratungsleistungen für Regierungs- und Verwaltungsstellen, Firmen und Institutionen.

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