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On the Efficient Unemployment Rates in Europe

George Agiomirgianakis[1,2,3], Georgios Bertsatos[4,5*], George Sfakianakis[3,6]

[1]Department of Accounting and Finance, Hellenic Mediterranean University, Heraklion, Greece
[2]School of Social Sciences, Hellenic Open University, Patras, Greece
[3]Hellenic Scientific Institute on the Economics of Education & Life-Long Learning, Research and Innovation, Athens, Greece
[4]Centre of Planning and Economic Research, Athens, Greece
[5]Gulf One Lab for Computational & Economic Research, Lancaster University, Lancaster, UK
[6]Department of Business Administration, National and Kapodistrian University of Athens, Athens, Greece
Email: *gbertsatos@kepe.gr

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Abstract

Given the high historical records in employment and job vacancies, as well as the low historical records in unemployment rates in 2022, much has been said about the labor markets in Europe recently. In this paper, we investigate the condition of labor markets in European countries; examining whether European economies are at (near) full employment and more specifically, whether their labor markets are efficient, slack, or tight. To this purpose, the novel methodology of Michaillat and Saez (2022) is implemented, and we calculate the efficient unemployment rates u^*. It appears that most of the 19 examined EU labor markets are persistently inefficiently slack over the whole sample period or below full employment. However, there are also a few exceptions as a couple of European countries have exhibited temporarily inefficiently tight labor markets, i.e. the labor market is over full employment. Finally, policy implications are provided to achieve efficiency in labor markets and close the unemployment gaps, focusing especially on tools from the supply side.

Keywords

Europe, Labor Markets, Unemployment, Vacancies

1. Introduction and Motivation of the Research

Statistical evidence suggests that job vacancies have increased sharply worldwide after the pandemic of COVID-19. Indeed, based on recorded data for Europe, we observe a soaring increase in job vacancy rates from 2016 to 2022, with an exception in 2020, as shown in Figure 1.

Moreover, on the other side of the Atlantic, we also see an elevating number of job vacancies per unemployed person in USA and Canada (see Figure 2).

Such increases in job vacancies have raised certain concerns on the future of labor markets both to the general public[1], as well as to international research institutions in answering "why jobs are plentiful while workers are scarce", a question asked in IMF block by Pizzinelli and Shibata (2022).

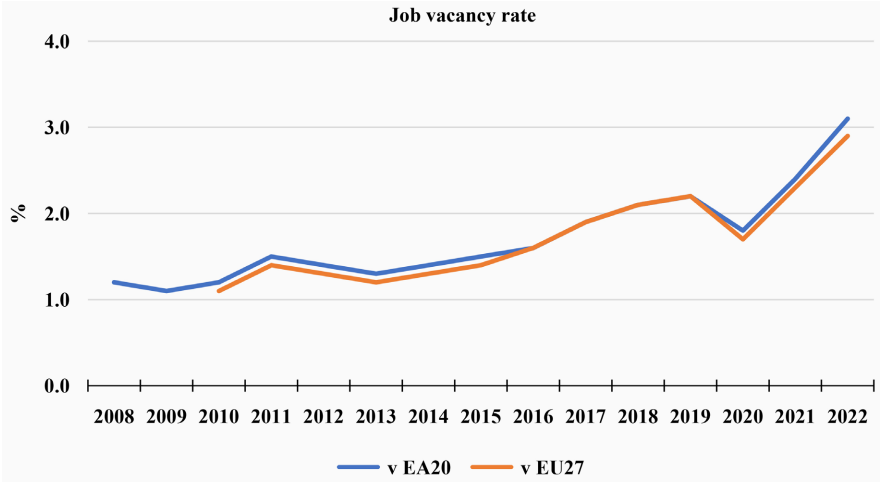


Figure 1. Job vacancy rates in EA20 and EU27. Notes: Job vacancy rates *v* (industry, construction, and services) [*jvs_a_rate_r2*] for Euro Area 20 (EA20) and European Union 27 (EU27) are displayed. In square brackets, the EUROSTAT codes are and in parenthesis some extra details are provided shown for each variable employed. Source: Authors' calculations.

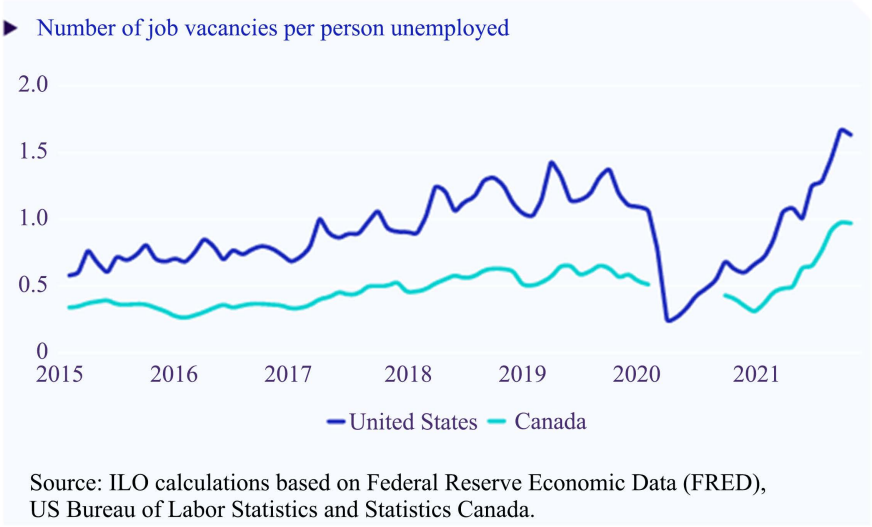


Figure 2. Number of job vacancies per person unemployed. Source: World Employment and social outlook trends 2023, ILO, https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_865332.pdf.

[1]See e.g. https://www.bbc.com/news/business-58543554 for UK and https://www.theguardian.com/business/grogonomics/2016/oct/04/job-vacancies-are-up-so-why-isnt-unemployment-down for Australia.

Also, Blanchard et al. (2022) show that there is stronger economic activity in the US combined with lower matching efficiency in the labor market, and that the ratio of vacancies to unemployment is destabilized after COVID-19 and exhibits an increasing trend (see Figure 3 and Figure 4a in their manuscript).

Combining unemployment and job vacancies data for Europe, we obtain an interesting **Figure 3** with the following characteristics: first, employment and vacancies hit high historical records in 2021 and 2022, and second, the unemployment rate has been plummeting to very low levels. In fact, there has been a declining trend in the unemployment rate since 2013 with an exception during the 2020-2021 COVID-19 period. Such a declining movement indicates that economies may shift from structural and cyclical unemployment to frictional unemployment.

In this paper, we rely on a frictional unemployment approach to examine whether European economies are at (near) full employment. Specifically, we apply the novel methodology of Michaillat and Saez (2022) for the case of Europe, and the goal of our research is two-fold. First, to construct and interpret efficient unemployment rates for EU countries and second, to answer the question "Are labor markets efficient, slack, or tight?" and draw policy implications.

The rest of the paper continues as follows. Section 2 discusses briefly related literature review. In Section 3, we explain the research methodology employed, presenting the data we use and the modelling strategy we employ in this paper. Then, we report our results followed by a discussion of them. Section 4 contains concluding remarks and policy implications for EU labor markets.

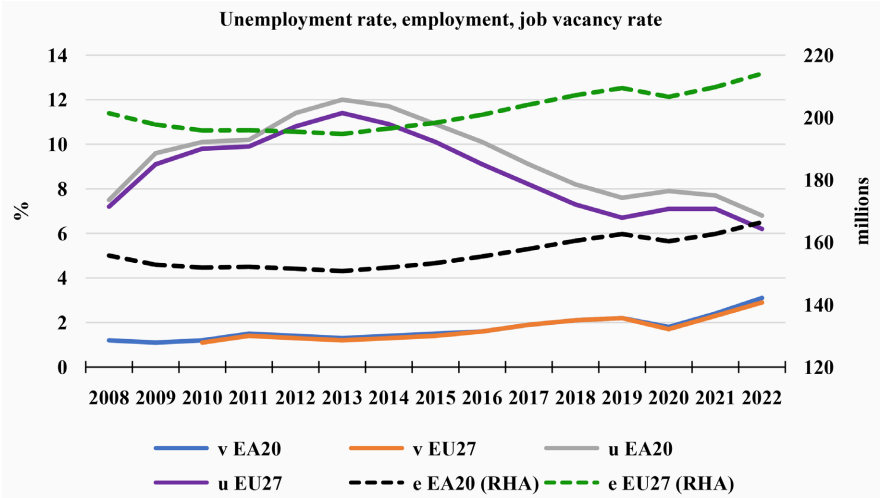


Figure 3. Unemployment rate, employment, and job vacancy rate in EA20 and EU27. Notes: Total employment *e* (domestic concept) [*nama_10_pe*], unemployment rate *u* (from 15 to 74 years) [*tepsr_wc170*], and job vacancy rates *v* (industry, construction, and services) [*jvs_a_rate_r2*] for Euro Area 20 (EA20) and European Union 27 (EU27) are displayed. In square brackets, the EUROSTAT codes are and in parenthesis some extra details are provided shown for each variable employed. Source: Authors' calculations.

2. Literature Review

The theory that deals with unemployment and vacancies, and hence with frictional unemployment, is the Matching Theory, see among others, Diamond (1982) and Mortensen (1982). According to this theory, the matching process is assumed to be costly, both for job seekers and for employers. Also, the nonproductive use of labor is measured by the number of job seekers and job vacancies.

Mortensen and Pissarides (1994) further developed the Matching Theory in a seminal paper on job creation and job destruction. They introduced the idea that firms continually create and destroy jobs as part of their normal operations, and workers are often in transition between jobs and unemployment through the search and matching process. Briefly, they focused on search frictions (e.g. imperfect information, geographical mobility), job creation and destruction, wage bargaining (negotiations between employers and workers), and unemployment dynamics[2].

A more recent development of the Matching Theory is introduced by MS. MS argue that the best marker of full employment is the efficient unemployment rate u^*, estimated as the geometric average of the unemployment rate u and the job vacancy rate v. Namely, it holds that $u^* = v^* = \sqrt{u \cdot v}$ and u^* is the best marker of full employment because it minimizes the nonproductive use of labor $u + v$. MS focus on the US labor market and find that the American labor market is inefficiently slack for most the time, i.e. the unemployment rate is smaller than the efficient unemployment rate and the job vacancy rate.

When it comes to Europe, to the best of our knowledge, there is a gap in the literature in measuring efficient unemployment rates. Therefore, we fill that gap by applying the novel methodology of MS and shedding light on the status of European labor markets; are they at (near) full employment, or do they exhibit slackness/tightness?

3. Research Methodology

3.1. Data

We use annual data for unemployment rates (employees from 15 to 74 years old) and job vacancy rates (all NACE activities) which are obtained from the database of EUROSTAT. The unemployment rate is the unemployed persons standardized with the labor force (employed and unemployed persons). The job vacancy rate is defined as the number of job vacancies over the sum of the number of occupied posts and job vacancies.

We also include Greece in the sample, but since there are no available data for job vacancy rates (all NACE activities), we employ those rates for Industry, Construction, and Services. These sectors capture the greatest part of total economic activity in Greece and consequently, of job vacancy rates.

Therefore, we end up with a sample for 19 European countries covering the period 2008-2022. The countries under consideration are Bulgaria, Czechia, Ger-

[2]Pissarides (2000) extensively covers the search and matching approach to the labor markets.

many, Estonia, Greece, Croatia, Latvia, Lithuania, Luxembourg, Hungary, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, and Norway.

Total data points for the unemployment rate are 285 (strongly balanced), while for the job vacancy rates there are 17 missing values up to 2011 for some countries leading to a sum of 268 observations. These 17 data points for job vacancy rates are dropped from the sample and as a result, neither the efficient unemployment rate nor the unemployment gap can be calculated for these data points. The average (median) unemployment and job vacancy rates are 8.02% (7.00%) and 1.56% (1.30%), respectively, while the corresponding standard deviations are 4.36% and 0.96%. Table 1 displays some descriptive statistics on unemployment and job vacancy rates.

Table 1. Descriptive statistics of unemployment and job vacancy rates, full sample.

	Unemployment rate u	Job vacancy rate v
Mean	8.02%	1.56%
Median	7.00%	1.30%
Standard deviation	4.36%	0.96%
Max	27.50%	6.30%
Min	2.00%	0.40%
Number of observations	285	268

Notes: This table shows descriptive statistics for the unemployment and job vacancy rates for all countries in our sample. The maximum value for unemployment rate and job vacancy rate correspond to Greece in 2013 and Czechia in 2019, respectively. On the other hand, the minimum value for unemployment rate belongs to Czechia in 2019, and the minimum value for job vacancy rate is found in three countries: Luxembourg (2009), Poland (2012-2013), and Portugal (2010-2013). Source: Authors' calculations.

3.2. Model and Calculations

This section is dedicated to the modelling strategy we employ in this paper.

We follow the novel methodology initiated by MS. According to this approach a metric of the efficient unemployment rate by the name of "u star" u^*, which is defined as the square root of the unemployment rate u and job vacancy rate v (see Equation (1)).

$$u^* = \sqrt{u \cdot v} \tag{1}$$

Also, it holds that u^* equals v^* in equilibrium. MS study the American labor market from the 30 s and find that it is inefficiently slack for most of the time, except for a few periods (World War 2, Korean War, Vietnam War, the end of Donald Trump's Presidency, and since May 2021) where the labor market is inefficiently tight.

During periods with $u > u^*$, the labor market is inefficiently slack or below full employment. This also holds when $u > v$. In such a case, reducing u and

increasing v would reduce inefficiency (or "waste" according to MS), given the tradeoff and the inverse relation between u and v across the Beveridge curve. Alternatively, it is more difficult for an employee to find a job.

On the other hand, when $u < u^*$, the labor market is inefficiently tight or over full employment. This also holds when $u < v$. If the labor market is inefficiently tight, then reducing inefficiency (or "waste") could be achieved via increasing u and reducing v. In other words, it is more difficult for a firm to hire new employees.

Furthermore, labor market efficiency is achieved when $u = u^*$ or $u = v$. In such a case, the labor market operates at full employment. Finally, another expression to describe the labor market is through the unemployment gap, defined as $u - u^*$. Namely, it is the deviation of unemployment rate u from the efficient unemployment rate u^*, and it is countercyclical (see MS). So, when the unemployment gap is equal to zero, the labor market is at full employment. Respectively, when the gap is positive (negative) then, the labor is inefficiently slack (tight) and under (over) full employment.

3.3. Results

Following the above modelling, we have constructed Figure 4 and Figure 5 showing the cross-sectional average and median, respectively, of the efficient unemployment rate u^*. It seems that the efficient unemployment rate is stabilizing around 3.2% in the sample under consideration.

Table 2 presents the efficient unemployment rate u^* and Table 3 presents the unemployment gap $u - u^*$ for the countries in our sample. Luxembourg had the smallest u^* values from 2008 to 2011 (the average is 1.7%), and from 2012 onwards Poland faces the lowest efficient unemployment rate taking values around 2%. When it comes to the maxima points, there are 6 countries competing for the 1st place with the highest efficient unemployment rate. Czechia and Greece

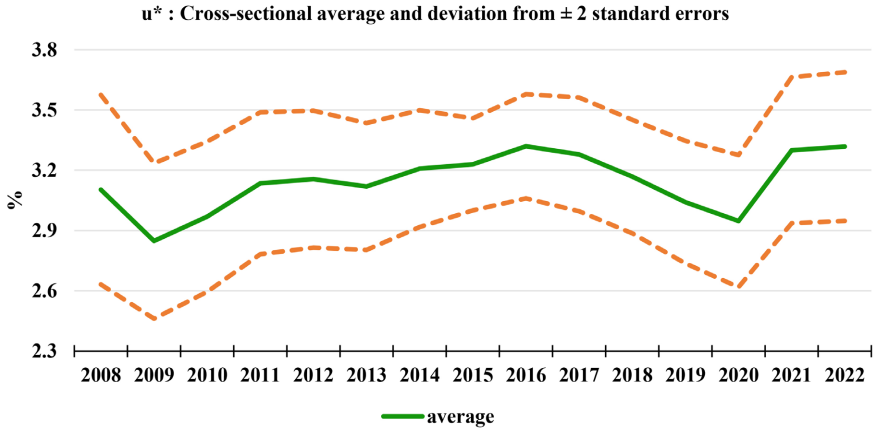


Figure 4. Efficient unemployment gap and cross-sectional average. Notes: This figure shows the cross-sectional average efficient unemployment rate u^* (green solid line) and the deviation of cross-sectional mean from ±2 cross-sectional standard errors (orange dashed line). Source: Authors' calculations.

Table 2. Efficient unemployment rate (in %) u^*, full sample.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bulgaria		2.18	2.69	2.81	2.93	3.02	2.82	2.71	2.62	2.23	2.16	1.94	2.02	2.06	1.97
Czechia	3.75	2.84	2.42	2.46	2.65	2.51	2.82	3.35	3.41	3.36	3.51	3.55	3.78	3.78	3.25
Germany				3.65	3.45	3.30	3.39	3.32	3.14	3.20	3.19	3.20	3.12	3.44	3.69
Estonia	3.71	3.49	4.09	4.00	3.74	3.47	3.22	2.99	3.42	3.49	3.12	2.85	3.13	3.25	3.35
Greece		4.04	3.74	4.01	4.14	4.69	4.88	3.87	4.06	3.59	3.40	3.22	2.55	2.97	3.54
Croatia					4.00	3.72	3.95	4.22	4.58	4.36	3.80	3.15	2.87	3.49	3.35
Latvia	3.51	3.97	4.19	4.41	4.42	4.22	3.89	3.85	3.92	4.07	4.21	4.42	4.12	4.53	4.40
Lithuania	3.14	2.63	3.27	3.72	3.47	3.26	3.10	3.16	3.20	3.37	2.95	2.97	3.32	3.57	3.38
Luxembourg	1.75	1.43	1.62	1.98	2.02	2.03	2.30	2.84	2.97	2.87	3.09	3.09	3.19	3.17	3.39
Hungary	3.18	3.00	3.35	3.48	3.32	3.50	3.28	3.19	3.11	3.04	3.16	2.92	2.93	3.07	3.12
Netherlands	3.28	2.73	2.74	2.83	2.85	2.96	3.22	3.42	3.46	3.50	3.32	3.30	3.08	3.99	4.10
Poland		2.22	2.41	2.41	2.01	2.03	2.12	2.12	2.23	2.21	2.16	1.91	1.50	1.93	1.79
Portugal			2.10	2.27	2.51	2.56	2.91	2.75	2.80	2.85	2.53	2.55	2.20	2.57	3.00
Romania		2.49	2.05	2.08	2.02	2.23	2.47	2.73	2.77	2.42	2.24	2.07	2.00	2.24	2.24
Slovenia	2.10	2.03	2.26	2.56	2.67	2.84	3.41	3.42	3.69	3.81	3.57	3.22	2.92	3.53	3.46
Slovakia	3.51	3.46	3.39	3.30	3.35	3.37	3.45	3.22	3.11	2.98	2.79	2.53	2.32	2.47	2.47
Finland		3.62	3.99	4.05	4.12	3.26	3.36	3.50	3.75	4.04	4.03	3.84	3.85	4.39	4.44
Sweden		2.59	3.21	3.42	3.46	3.37	3.58	3.75	3.83	3.93	4.00	4.04	3.97	4.60	4.82
Norway			2.96	2.99	2.84	2.92	2.77	2.93	2.99	2.97	2.96	3.04	3.11	3.63	3.30

Notes: This table shows the efficient unemployment (in %) for all countries in our sample. Grey shading denotes no available data for the job vacancy rate v and thus, no efficient unemployment rate can be calculated. Orange (light blue) shading represents the cross-sectional maxima (minima) points of the efficient unemployment rate. Source: Authors' calculations.

Table 3. Unemployment gap (in %) $u - u^*$, full sample.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bulgaria		4.62	7.61	8.49	9.37	9.98	8.58	6.49	4.98	3.97	3.04	2.26	3.08	3.24	2.33
Czechia	0.65	3.86	4.88	4.24	4.35	4.49	3.28	1.75	0.59	−0.46	−1.31	−1.55	−1.18	−0.98	−1.05
Germany				2.15	1.95	1.90	1.61	1.28	0.96	0.60	0.21	−0.10	0.78	0.26	−0.59
Estonia	1.79	10.01	12.61	8.30	6.26	5.13	4.18	3.41	3.48	2.31	2.28	1.65	3.87	2.95	2.25
Greece		5.56	8.96	13.89	20.36	22.81	21.62	21.03	19.54	17.91	15.90	14.08	13.75	11.73	8.96
Croatia					12.00	13.58	13.35	11.98	8.52	6.84	4.70	3.45	4.63	4.11	3.65
Latvia	4.19	13.53	15.31	11.79	10.58	7.68	6.91	6.05	5.68	4.63	3.19	1.88	3.98	3.07	2.50
Lithuania	2.66	11.17	14.53	11.68	9.93	8.54	7.60	5.94	4.70	3.73	3.25	3.33	5.18	3.53	2.62
Luxembourg	3.35	3.67	2.78	2.92	3.08	3.87	3.60	3.86	3.33	2.63	2.51	2.51	3.61	2.13	1.21
Hungary	4.62	7.00	7.85	7.52	7.68	6.70	4.42	3.61	1.99	1.16	0.54	0.48	1.37	1.03	0.48

Continued

Netherlands	0.42	1.67	2.26	2.17	2.95	4.34	4.18	3.48	2.54	1.40	0.48	0.10	0.72	0.21	−0.60
Poland		5.98	7.29	7.29	8.09	8.27	6.88	5.38	3.97	2.69	1.74	1.39	1.70	1.47	1.11
Portugal			8.90	10.63	13.29	13.84	11.19	9.85	8.40	6.15	4.57	3.95	4.70	4.03	3.00
Romania		4.41	4.95	5.12	4.78	4.87	4.33	4.07	3.13	2.48	1.96	1.83	3.00	3.36	3.36
Slovenia	2.30	3.87	5.04	5.64	6.23	7.26	6.29	5.58	4.31	2.79	1.53	1.28	2.08	1.27	0.54
Slovakia	5.99	8.54	11.01	10.30	10.65	10.83	9.75	8.28	6.59	5.12	3.71	3.27	4.38	4.33	3.63
Finland		4.58	4.41	3.75	3.58	4.94	5.34	5.90	5.05	4.56	3.37	2.86	3.95	3.31	2.36
Sweden		5.81	5.39	4.38	4.54	4.73	4.42	3.65	3.17	2.77	2.40	2.76	4.33	4.20	2.68
Norway			0.54	0.21	0.26	0.48	0.73	1.37	1.71	1.23	0.84	0.66	1.29	0.77	−0.10

Notes: This table shows the unemployment gap (in %) $u-u^*$ for all countries in our sample. Grey shading denotes no available data for the job vacancy rate v and thus, no unemployment gap can be calculated. Orange shading denotes inefficiently tight labor markets as the unemployment gap is negatively valued. Source: Authors' calculations.

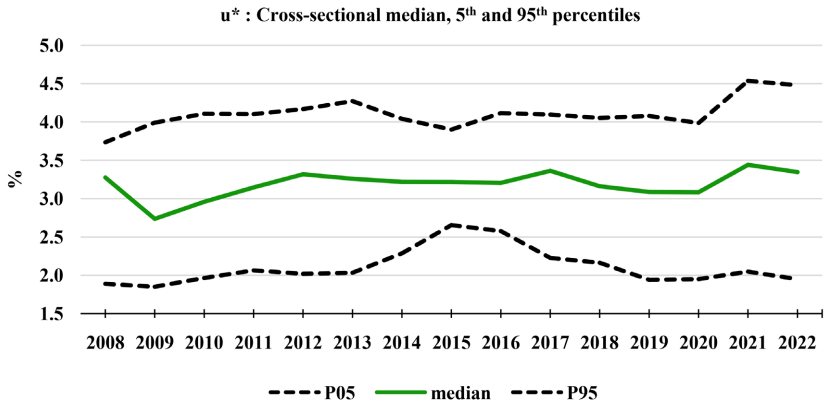


Figure 5. Efficient unemployment gap and cross-sectional median. Notes: This figure shows the cross-sectional median efficient unemployment rate u^* (green solid line), and the 5th and 95th cross-sectional percentiles (black dashed line). Source: Authors' calculations.

had the highest u^* in 2008 and 2009, respectively, and then Latvia took the lead from 2010 to 2012. In 2013 and 2014 Greece returned to the 1st position, Croatia surpassed all countries in sample from 2015 to 2017, and then Latvia returned to the 1st place in the period 2018-2020. Finally, Sweden exhibits the highest values in u^* in 2021 and 2022.

In Table 3, one can see the unemployment gap defined as the deviation of u from u^*. Numbers in cells with orange shading denote negative unemployment gap and thus, inefficiently tight labor market. There are 10 observations with negative values in the unemployment gap, or 3.7% of total data points, and the rest 258 observations correspond to positive unemployment gaps, or 96.3% of total data points. We notice that the labor markets are inefficiently slack, i.e. $u-u^*>0$, in all countries and time periods examined, except for Czechia (2017-2022), Germany (2019, 2022), Netherlands (2022), and Norway (2022).

Figure 6 shows the fitted Beveridge curve[3] (orange hyperbola) for the full sample under consideration. There is an inverse relation between u and v, so at the same time, there cannot be a same movement of these two elements[4]. In fact, if one element increases, then the other decreases due to the Beveridgean inverse relationship.

Generally, a shift of the Beveridge curve to the right (left) implies a worse (better) matching performance and reveals structural changes in the labor market. Conversely, a movement to the left (right) along the Beveridge curve denotes increased tightness (slackness) and reflects cyclical changes (e.g. booms and slumps).

Furthermore, one can observe in Figure 6 that most of the blue dots lie in the inefficiently slack area and some of them are in the inefficiently tight area. Moreover, there are a few blue dots near the 45-degree black line that denote greater efficiency relative to the other dots in the upper or the lower part of the plot. Such an observation is insightful, and we elaborate more on the efficiency in the next subsection.

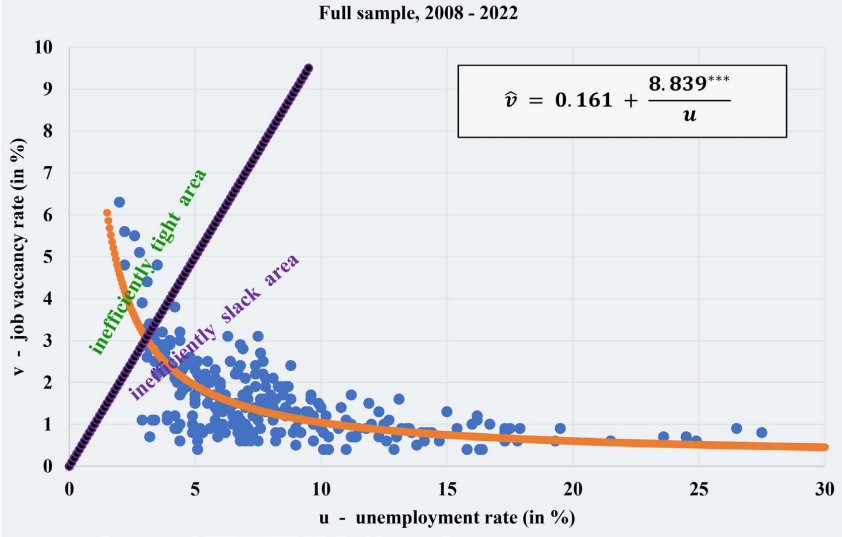


Figure 6. Beveridge curve in the full sample over the 2008-2022 period. Notes: This figure shows the fitted Beveridge curve (orange hyperbola) for the full sample based on pooled OLS estimator, covering the 2008-2022 period. Blue dots correspond to the actual pairs of annual unemployment rate u and job vacancy rate v. The black line is the 45-degree line. Data points above (below) the 45-degree line denote an inefficiently tight (slack) labor market. *** denotes statistical significance at 1% level. Source: Authors' calculations.

[3]For more detailed analysis on "Beveridge Curve", see among others, Blanchard and Diamond (1989), and Elsby et al. (2015).

[4]Fed Chair Powell (2022) argues that there can be a path of reducing vacancies without a material worsening in the unemployment rate. However, Blanchard et al. (2022) argue there is no magic wand for such an effect. They are skeptical on such arguments and support the negative relationship between unemployment and vacancy rates. In fact, they show that that, on average, 1-percentage-point drop in v is linked to 0.4, 0.7, and 1.5 percentage-point increase in u over the next 6, 12, and 24 months, respectively, from the month of the peak vacancy rate. In the same vein, Domash and Summers (2022) show that, on average, it takes 13 months to reduce vacancies by 20% and such a drop is associated with a 3-percentage-point increase in the unemployment.

3.4. On the Labor Market Efficiency

This subsection presents an experiment involving the unemployment gap and the efficiency of the labor market. Previously we found that most observations (more than 96%) indicate inefficiently slack labor markets with positive unemployment gaps, whilst less than 4% of total observations imply inefficiently tight labor markets with negatively valued unemployment gaps. Thus, an interesting question arises. What if lenient criteria are adopted (to account as well for any measurement error in the raw data under consideration), defining labor efficiency when the unemployment gap ranges between specific values around zero?

Specifically, we first apply a ±50 basis-point range and then, we double it to ±100 basis points (bps). If

$$-50 \text{ bps} < \text{unemployment gap} < +50 \text{ bps} \tag{2}$$

then, we have efficiency in the labor market. Next, we define efficiency in the labor market if

$$-100 \text{ bps} < \text{unemployment gap} < +100 \text{ bps} \tag{3}$$

According to Table 4, efficiency is achieved in 14 out of 268 observations (see "1" and green shading), or 5.2% of total observations, as the respective unemployment gap lies in the range of ±50 basis points. Such condition is satisfied in 1 year (2017) in Czechia, in 3 years (2018, 2019, 2021) in Germany, in 2 years (2019, 2022) in Hungary, in 4 years (2008, 2018, 2019, 2021) in Netherlands, and in 4 years (2011, 2012, 2013, 2022) in Norway. Moreover, observations with unemployment gap smaller than −50 bps are 7 out of 268 observations (see "2" and orange shading), or 2.6% of total observations, denoting inefficiently tight labor markets. Czechia exhibits 5 out of these 7 observations and specifically during the 2018-2022 period. Also, Germany and Netherland in 2022 face unemployment gap smaller than −50 bps. Finally, the rest 247 observations out of 268 total observations denote periods with unemployment gap larger than +50 bps and inefficiently slack labor markets.

Once we double the range to ±100 bps, it turns out that only Czechia faces periods characterized by inefficiently tight labor market (see Table 5). Particularly, in 2018, 2019, 2020 and 2022 the unemployment gap equals less than −100 bps. However, Czechia also exhibits periods (2008, 2016, 2017 and 2021) with the unemployment gap falling in the range of ±100 bps. Therefore, in these periods the Czech labor market enjoyed efficiency. Besides Czechia, the German, Hungarian, Dutch, Slovenian and Norwegian labor markets appear to be efficient in at least one period from 2008 to 2022. Specifically, there are 30 data points (see "1" and green shading) out of 268 observations in the sample, or 11.2% of total observations, denoting efficiency. Finally, the rest of the countries (except Slovenia) exhibit inefficiently slack labor market since there are consecutive periods with unemployment gap larger than +100 bps.

To summarize findings according to our experiment, 1) Czechia appears to be the only country with inefficiently tight labor market in recent years, 2) Germany

Table 4. Unemployment gap falling in the range of ±50 basis points.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bulgaria		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Czechia	0	0	0	0	0	0	0	0	0	1	2	2	2	2	2
Germany				0	0	0	0	0	0	0	1	1	0	1	2
Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greece		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia					0	0	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hungary	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Netherlands	1	0	0	0	0	0	0	0	0	0	1	1	0	1	2
Poland		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Portugal			0	0	0	0	0	0	0	0	0	0	0	0	0
Romania		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Finland		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweden		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norway			0	1	1	1	0	0	0	0	0	0	0	0	1

Notes: "1" corresponds to values in the unemployment gap within the ±50 basis-points range (green shading), "0" corresponds to values in the unemployment gap greater than +50 basis points implying inefficiently slack labor market, and "2" corresponds to values in the unemployment gap below −50 basis points denoting inefficiently tight labor market (orange shading). Grey shading denotes no available data for job vacancy rate v and thus, no unemployment gap can be calculated. Source: Authors' calculations.

Table 5. Unemployment gap falling in the range of ±100 basis points.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bulgaria		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Czechia	1	0	0	0	0	0	0	0	1	1	2	2	2	1	2
Germany				0	0	0	0	0	1	1	1	1	1	1	1
Estonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greece		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia					0	0	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Continued

Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hungary	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1
Netherlands	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Poland		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Portugal			0	0	0	0	0	0	0	0	0	0	0	0	0
Romania		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Slovakia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Finland		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweden		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Norway			1	1	1	1	1	0	0	0	1	1	0	1	1

Notes: "1" corresponds to values in the unemployment gap within the ±100 basis-points range (green shading), "0" corresponds to values in the unemployment gap greater than +100 basis points implying inefficiently slack labor market, and "2" corresponds to values in the unemployment gap below −100 basis points denoting inefficiently tight labor market (orange shading). Grey shading denotes no available data for the job vacancy rate v and thus, no unemployment gap can be calculated. Source: Authors' calculations.

and Norway face an efficient labor market most of the periods covered in this paper, 3) Hungary and Netherlands also achieve efficiency in their labor market in recent years, and 4) Bulgaria, Estonia, Greece, Croatia, Latvia, Lithuania, Luxembourg, Poland, Portugal, Romania, Slovenia, Slovakia, Finland and Sweden are the countries with persistently inefficiently slack labor markets.

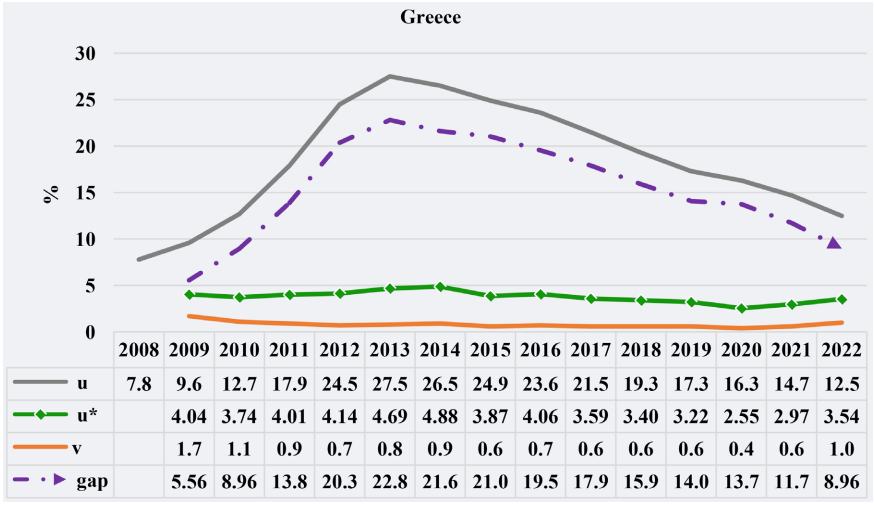
3.5. The Case of Greece

In this subsection, we focus our analysis on Greece. Figure 7 depicts the time-series of unemployment rate, job vacancy rate, efficient unemployment rate, and the unemployment gap defined as the deviation of unemployment rate from efficient unemployment rate.

It turns out that the Greek labor market persists to be inefficiently slack over the examined period, i.e. it holds that $u > u^* = v^* > v$ (see Figure 7)[5]. Furthermore, the efficient unemployment rate hovered around 3% to 4% with few deviations from that range and specifically in 2013, 2014, and 2020. The historical average (median) efficient unemployment rate is 3.77% (3.80%) and the historical standard deviation equals 0.63%.

Regarding the unemployment gap, it seems that there was an upward trend from 2009 to 2013 implying destabilization of the Greek labor market, whereas since 2014 there is a declining movement and a rosier side in terms of achieving efficiency in the labor market. In fact, the unemployment gap peaked at almost 23% in 2013 and plummeted 9 years later to near 9% in 2022. We also must note

[5]Voulgaris et al. (2005) explore dynamics in job creation and job destruction in Greece.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
u	7.8	9.6	12.7	17.9	24.5	27.5	26.5	24.9	23.6	21.5	19.3	17.3	16.3	14.7	12.5
u*		4.04	3.74	4.01	4.14	4.69	4.88	3.87	4.06	3.59	3.40	3.22	2.55	2.97	3.54
v		1.7	1.1	0.9	0.7	0.8	0.9	0.6	0.7	0.6	0.6	0.6	0.4	0.6	1.0
gap		5.56	8.96	13.8	20.3	22.8	21.6	21.0	19.5	17.9	15.9	14.0	13.7	11.7	8.96

Figure 7. On the greek labor market. Notes: This figure shows the unemployment rate u, job vacancy rate v, efficient unemployment rate u^*, and the unemployment gap $u-u^*$ for Greece.

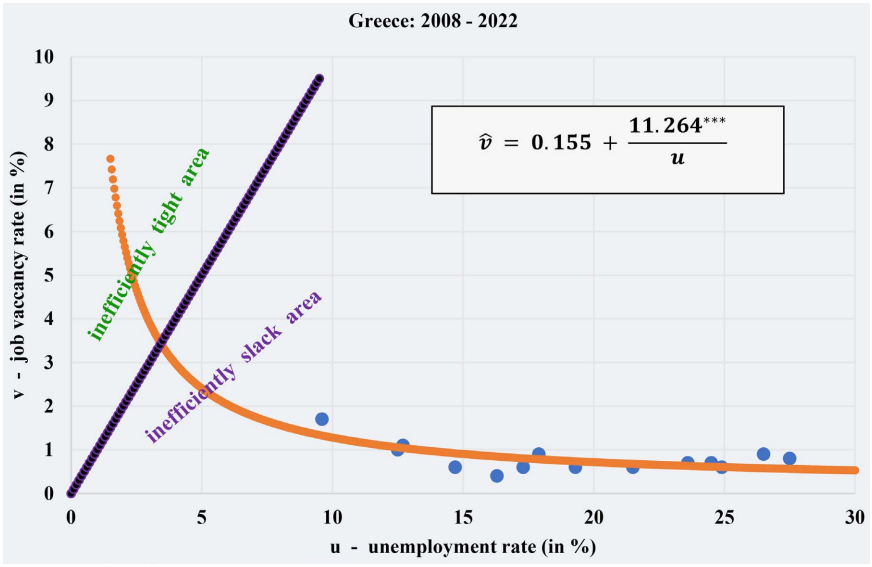


Figure 8. Greece's Beveridge curve over the 2008-2022 period. Notes: This figure shows the fitted Beveridge curve (orange hyperbola) for Greece based on OLS estimator, covering the 2008-2022 period. Blue dots correspond to the actual pairs of annual unemployment rate u and job vacancy rate v. The black line is the 45-degree line. Data points above (below) the 45-degree line denote an inefficiently tight (slack) labor market. *** denotes statistical significance at 1% level. Source: Authors' calculations.

that the job vacancy rates v are under-reported in Greece[6]. The labor deficit in tourism industry, agriculture, and hospitals, as well as given that employees in these sectors have been working overtime for the last few years, imply greater job vacancy rates. As a result, the unemployment gap $u-u^*$ should be smaller than it is.

[6]Tsekeris et al. (2023) also point out that there is some underreporting in job vacancies in Greece.

Figure 8 presents the fitted Beveridge curve (orange hyperbola) for Greece and the period 2008-2022. One can notice that there is much to be done to reduce job mismatching and bridge the gap between unemployment and job vacancy rates as the Greek labor market is inefficiently slack over the examined period. Since there are no blue dots neighboring the 45-degree black line, the Greek labor market is far inefficient. Furthermore, comparing Figure 3 and Figure 7, we may also note that Greece appears to lag in job creation and subsequently to creation of job vacancies compared with the EU. Thus, if policy convergence is required in EU, a two-action policy is needed in the Greek labor market: 1) to reduce job mismatching, and 2) to bridge the gap between unemployment and job vacancy rates as the Greek labor market is persistently inefficiently slack over the examined period.

4. Concluding Remarks—Policy Implications

The efficient unemployment rate u^* of Michaillat and Saez (2022) can be a valuable tool both for policymakers and businessmen as it can provide: 1) a more accurate picture of the labor market's "health" in each economy, and 2) a way of assessing how difficult it is to find a job (from an employee's perspective) or to hire new employees (from a firm's point of view).

Bringing the unemployment gap $u-u^*$, if any, to a value close to zero implies an efficiently functioning and stabilized labor market. MS argue that interest rate cuts are an optimal policy for reducing the positive unemployment gap (inefficiently slack labor market) through reducing unemployment via increased investment. Also, given the inverse relationship between unemployment and job vacancy rates, decreasing interest rates will also lead to higher job vacancy rates v, reducing further the positive unemployment gap. Alternatively, it is optimal to raise interest rates when the unemployment gap is negative (inefficiently tight labor market). In such a case, unemployment is expected to rise due to decreased investment, and given the Beveridgean negative relationship between u and v, job vacancy rate is anticipated to drop. Consequently, the unemployment gap increases and takes values closer to zero. The two cases described here are shown in the top right and bottom left parts of Table 6.

According to our findings in this paper, most European labor markets are inefficiently slack and the unemployment gap $u-u^*$ is positively valued (employment is below full employment), with few exceptions—especially in Czechia

Table 6. Central bank's interest rate changes and labor market's condition.

	⇧ interest rates	⇩ interest rates
Slack labor market	×	✓
Tight labor market	✓	×

Notes: This table relates changes in the interest rates by a central bank to the status of that country's labor market.

in recent years. Therefore, considering the unprecedented aggressive interest rate hikes by the European Central Bank, even if the ongoing inflation is a cost-push one (see e.g. Bertsatos, 2023), European countries facing inefficiently slack labor markets are expected to face distortions in their labor markets. This is so because the unemployment rate is expected to rise in such a case, and the job vacancy rate is anticipated to fall given the Beveridge curve, magnifying the already positive unemployment gap[7]. So, what can be done in the not-so-rosy cases where interest rates are high and the labor market is below full employment (see top left part of **Table 6**), or during low interest rates and labor market over full employment (see bottom right part of **Table 6**)? Or generally, when changing interest rates is an unavailable option for a country (e.g. for the countries in the Eurozone)?

Now, we turn our analysis into how central banking could act in the case of slack and tight labor markets. The main goal of central banks is to stabilize inflation around 2% and keep prices stability over the medium term through either conventional or unconventional monetary policy. Stabilizing labor markets is a secondary target, if any. This leaves a lot of room for other policies (e.g. supply-side policies) to affect u and v. So, there must be other policies to stabilize the labor market and increase its efficiency. Namely, bring the unemployment rate as close as possible to the efficient unemployment rate: $u_t - u_t^* \to 0$.

Particularly, emphasis could be given to the supply side to achieve better job matching and reduce unemployment. This is useful when the unemployment gap is positive, especially during periods characterized by high interest rates. Policy actions such as investing in and promoting *Vocational Rehabilitation and Retraining Centers* (possibly through engagement and active role of Public Employment Services) to align education and industries demands, and promoting investments in research, innovation, and start-up companies are indicative actions. See, for example, the Apprenticeship Vocational Schools (EPAS) of the Greek Public Employment Service (*DYPA*, former *OAED*) and the Institute of Vocational Training (IEK DYPA)—"Initial Vocational Training"—in Greece. Also, other policies and initiatives could involve better and high-quality information for the unemployed persons, focusing on upskilling and reskilling of the labor force, as well as emphasizing on incentives and transport grants for internal migration depending on the needs of each region in the country examined. Moreover, structural reforms in the education system and the ever-changing labor market could bridge the gap (reduce job mismatching) between universities, businesses, and the evolving needs of the market[8]. To sum up, given this battery

[7]Unemployment increases substantially after vacancies reaching their maximum value (see Blanchard et al., 2022; Domash & Summers, 2022). Hence, given the high historical records in the vacancy rate (see **Figure 3**) in Europe, the European unemployment rates u are expected to rise once the job vacancy rates v start to decline.

[8]OECD (2023) argues that the gap between schooling and employment could be bridged by vocational training. Also, reducing teachers' administrative work and boosting their wages, along with effective early career guidance could positively contribute to the needs of the changing labor markets. In the same vein, Tsekeris et al. (2023) suggest several recommendations relating to the restructuring of the education system, as well as to linking all types of education to the labor market.

of actions, u decreases, and given the inverse relationship because of the Beveridge curve, v increases, and the unemployment gap closes.

Furthermore, there could be another set of actions aiming to increasing v, and thus reducing u due to the Beveridgean inverse relationship. As a result, the positive unemployment gap would close and approach values near zero. Such a set of policies in increasing five include: 1) stimulating economic growth, promoting job-intensive industries, and providing sector-specific incentives for expansion and creation of new job vacancies, 2) promoting favorable legislations for entrepreneurship, improving the ease of doing business, and reducing administrative/bureaucratic processes and complex regulations, 3) providing favorable terms for access to capital for SMEs and tax incentives, especially those in job-intensive industries (e.g. services, manufacturing, tourism, technology), 4) reducing flexibility in some sectors (e.g. food and tourism) by hiring new employees instead of well-paying overtime to the current ones, and 5) stimulating inclusive growth through eliminating the enduring gender pay gaps (equalize job earnings between men and women, and reduce gender bias and discrimination in the workplace) and equal access to education and providing a fraction of new job vacancies to marginalized communities, i.e. these are actions that could benefit the whole society and improve social cohesion as well. Yet, it is important to highlight that boosting the job vacancy rates requires a nexus of economic policy acts requiring the engagement of several participants, such as businessmen and public services, and of course cooperation between them (see e.g. public-private partnerships, PPPs).

Last but not least, a policy mix could also emerge involving both reducing unemployment and increasing job vacancies (see the previous two paragraphs above). In such a case, the positive unemployment gap could close faster and approach zero values. However, when the labor market is over full employment, especially in a low-interest-rate environment, actions in reducing v (and thus increasing u due to Beveridge curve) are recommended such as applying automated processes, or adopting opposite strategies from those aiming to increase job vacancies (see above), if and when such strategies are feasible. Thus, v decreases (u increases), the unemployment gap closes, and the labor market becomes efficient and stabilized[9].

Finally, we offer some directions for future research. First, our work could be extended to more countries, potentially with data of higher than annual frequency, and be useful for monitoring the domestic labor market by drawing tailor-made implications for policymakers. Second, revisiting existing topics with the use of the efficient unemployment rate u^* instead of the typical unemployment rate u may offer grounds for fruitful discussion. See, for example, the case

[9]We should also note that (severe) financial meltdowns, pandemics, or wars, can cause a dramatic drop in job vacancies and increase sharply unemployment due to sluggish economic conditions and activities. However, these are not of course available options for a country to reduce the tightness of its labor market.

of Phillips Curve[10], or Okun's Law, or even Non-Performing Loans (NPLs) modelling. Do the results remain robust with this suggested substitution, or do the findings drastically alter should we consider vacancy rates combined with the unemployment rates? Future work may shed light on such issues.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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[10]For example, Darvas and Martins (2021) argue that inflation forecasting failures could be attributed to underestimation of the labor market slack, or overestimation of the Phillips-curve relationship. Thus, in such a case or other similar case, it would make sense to reexamine this topic after replacing u with u^*.

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