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The Effects of COVID-19 on Labour Market Matching in Austria: A Regional Perspective*

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Abstract

This paper examines labour market matching in Austria from 2008 to 2024, focusing on the regional impact of the COVID-19 pandemic. Using monthly administrative data, we estimate Beveridge curves and matching efficiency across federal states. Our results show that while COVID-19 temporarily disrupted labour market matching, mismatch unemployment returned to pre-pandemic levels relatively quickly. However, this national recovery masks persistent regional differences. Many industrial regions experienced structural declines in matching efficiency starting in 2014–2015. These findings highlight the need for regionally targeted labour market and training policies to address lasting disparities and support post-pandemic recovery.

JEL classification: J21, J64
Keywords: Beveridge curve, unemployment, matching efficiency, COVID-19

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1. Introduction

Despite the unprecedented economic disruptions caused by the COVID-19 pandemic and Russia's war of aggression in Ukraine, many EU labour markets exhibited a relatively rapid cyclical recovery in employment indicators. However, this aggregate resilience masks persistent structural vulnerabilities, including spatial and sectoral inequalities, employment insecurity, and challenges to social cohesion. After a temporary increase in labour market slack in 2020, labour shortages quickly reappeared, and slack returned to pre-pandemic lows in most countries. While the onset of the pandemic was associated with an apparent deterioration in matching efficiency in EU labour markets, this increase was relatively mild and was largely reversed subsequently. The re-emergence of labour shortages seems to have been mainly driven by the recovery of the labour market rather than by impediments to labour market reallocation (Duval, Ji, Li, Oikonomou, Pizzinelli, Shibata, Sozzi and Tavares, 2022; Kiss, Turrini and Vandeplas, 2022; Kiss, Morandini, Turrini and Vandeplas, 2022).

However, these aggregate developments at the EU level mask significant heterogeneities across Member States. Kiss, Morandini, Turrini and Vandeplas (2022) found that in most Member States, unemployment and vacancies have returned to their pre-pandemic negative-sloping relationship (the so-called Beveridge curve). However, in some Member States, including Austria, there has been an apparent outward shift of the Beveridge curve, suggesting a deterioration in matching efficiency.[1]

Pizzinelli and Shibata (2023*a*) have shown that while the COVID-19 pandemic initially led to an increase in labour market mismatch in both the US and the UK, the subsequent return to pre-pandemic levels implies that there was no substantial structural reallocation within the labour market. This finding suggests a relatively limited impact of mismatch

[1]Countries with an apparent outward shift also include Denmark, Italy, Luxembourg, and Sweden. In contrast, a possible inward shift of the Beveridge curve can be observed in Croatia and Hungary.

on total employment losses during the pandemic. Similarly, the results of Carrillo-Tudela, Clymo, Comunello, Jäckle, Visschers and Zentler-Munro (2023*a*) for the UK indicate that, despite the ongoing changes in the labour market caused by the pandemic, significant structural reallocation remained limited. However, recent studies suggest that the rise in teleworking opportunities after the COVID-19 pandemic, as highlighted by Kagerl and Starzetz (2023), may have improved matching efficiency by influencing both workers' commuting behaviour and firms' search strategies (Coskun, Dauth, Gartner, Stops and Weber, 2024).

While several studies have looked at country-specific impacts of the COVID-19 crisis on mismatch unemployment, it is essential to investigate how COVID-19 affected labour market matching efficiency and mismatch unemployment at the regional level, as the impact of the crisis likely varied substantially across regions due to differences in industrial composition, public health responses, and local labour market structures, factors that may be obscured in national-level analyses. We contribute to the literature in three key ways. First, we apply a structural Beveridge curve framework grounded in the Mortensen-Pissarides tradition to provide a consistent interpretation of shifts in matching efficiency across regions. Second, we leverage Austria's uniquely detailed administrative data, allowing us to conduct a granular monthly analysis over a 15-year period. Third, our findings contribute to the broader policy debate on the lasting versus transitory effects of COVID-19 on labour markets. By identifying whether mismatches were persistent, our results offer important, policy-relevant insights on the design of re-skilling programs and regional interventions.

This paper analyses labour market matching in Austria since 2008, focusing on how regional developments in labour market matching have contributed to the apparent deterioration in overall matching efficiency. While outward shifts in the Beveridge curve have been observed in other advanced economies, such as the UK and the US (see Barlevy,

Faberman, Hobijn and Şahin (2024); Economics Observatory (2023)), Austria still provides a particularly interesting case study, as it is one of the few countries in the EU where the Beveridge curve indicates a clear outward shift (Böheim and Christl, 2022; Christl, 2020; Christl, Köppl-Turyna and Kucsera, 2016; Kiss, Morandini, Turrini and Vandeplas, 2022). Moreover, Austria remains relatively under-studied in the academic literature, particularly when compared to the extensive attention given to the US and UK labour markets. This makes it a valuable case study not only because of data availability, but also due to its potential to complement insights derived from more frequently analysed countries. Furthermore, the Austrian labour market may offer lessons for other advanced economies, as it has been characterised by tight conditions for a longer period than most. In particular, Austria had one of the lowest unemployment rates in the EU in 2011 and 2012, while the unemployment rate (according to the international definition) has remained consistently close to 5% since the mid-1990s. As of 2024, Austria's unemployment rate remains relatively low and stable at approximately 5%, following a temporary rise to over 6% during the COVID-19 pandemic. In this sense, Austria can be viewed as a forerunner of the tight labour market conditions now observed in many advanced economies. However, its unemployment rate is currently in the mid-range within the EU, with several countries reporting rates below 4% (Eurostat, 2024).

Austria, however, also represents a particularly compelling case study due to its institutional and economic representativeness for other economies. Although relatively small (with a population of around 9 million), Austria features a diverse economic structure that includes advanced manufacturing, services (notably tourism and hospitality), and a rapidly expanding healthcare sector. As a small open economy, it is highly sensitive to global shocks. Like many other European countries, Austria has well-developed welfare and labour market institutions, such as active labour market policies, unemployment insurance, and training programs. These institutions not only offer clear channels for analysing

the impact of macroeconomic shocks on matching effectiveness, but also support the implementation of targeted policy responses. Therefore, insights from Austria's matching dynamics have strong external validity for both Central European and other small open economies within the EU framework.

Furthermore, by focusing on Austria's regional matching patterns, our findings directly contribute to ongoing debates within the EU on strengthening labour market resilience, designing targeted re-skilling programs and calibrating short-term work schemes. Austrian policymakers and social partners have been particularly active in this domain, and our findings can inform both national and cross-border policy design aimed at enhancing preparedness for future shocks.

Not least, Austrian administrative data provide an outstanding source of information. Austria maintains one of the most comprehensive and high-frequency labour market administrative data systems in Europe. The Austrian Public Employment Service (AMS - Arbeitsmarktservice) collects individual-level records on vacancies, hirings, separations, and unemployment at monthly frequency, and these records are harmonized across all nine federal provinces and all major sectors. This allows us to estimate Beveridge curves not only for the national economy but also for each Austrian region and for each sector-region combination. The availability of high-frequency data spanning both the global financial crisis (2008/09) and the COVID-19 pandemic is crucial to our empirical strategy.

Specifically, our analysis draws on highly detailed administrative data from the Austrian Public Employment Service, covering monthly information on unemployment, employment, and job vacancies by region and economic sector from 2008 to 2024. This dataset enables us to examine highly disaggregated labour market segments, including regional labour markets.

Our paper contributes to a growing literature examining how aggregate shocks - such as the global financial crisis or the COVID-19 pandemic - generate uneven effects across

local labour markets. Much of this literature emphasises how local economic structure (e.g., sectoral specialization), worker mobility, and institutional design interact with aggregate disturbances (Autor, Dorn and Hanson, 2013; Notowidigdo, 2020). In particular, understanding regional resilience and the persistence of matching inefficiencies has become central to labour market policy design in the post-COVID era (Chetty, Friedman, Hendren, Stepner and Team, 2020). Our paper adds to this debate by examining how Austria's regional labour markets responded to the COVID-19 shock using the Beveridge curve framework and a structural matching efficiency model.

The Beveridge-curve approach is the workhorse in the study of labour-market matching (e.g. Shimer (2005*a*); Petrongolo and Pissarides (2001)) and has been applied fruitfully at both national and regional levels - for example, by Barnichon and Figura (2015) and Barlevy et al. (2024) for the United States and Klinger and Rothe (2012) for regional labour markets in Germany. Its parameters - such as matching elasticity and efficiency - have clear economic interpretations and the standard matching model naturally accommodates breaks or shifts in the matching function, which we exploit to identify the discrete COVID-19 shock and the subsequent recovery phases.

Like Yu, Song, Ren and Xue (2024) and Elekes, Tóth and Eriksson (2024), we focus on regional labour market adjustment during and after COVID-19, drawing on high-frequency data. Similar to these studies, we are particularly interested in the heterogeneous regional disruptions to matching processes and patterns of worker reallocation. We contribute to and complement this literature by applying a Beveridge curve framework to assess post-pandemic changes in matching efficiency and mismatch unemployment in Austria. This approach offers additional insights into structural labour market dynamics and the resilience of specific sectors and regions. In particular, we simultaneously disaggregate our analysis across Austria's nine federal provinces, and we leverage monthly administrative data rather than quarterly survey data.

In our analysis, we follow a simplified version of the Mortensen and Pissarides (1994) model used by Veracierto (2011) and Böheim and Christl (2022), to estimate Beveridge curves for the labour markets in Austrian regions. The model allows us to estimate changes in matching efficiency across specific labour market in Austrian regions over time. To assess how these changes contribute to unemployment dynamics, we compare observed outcomes with a counterfactual scenario in which matching efficiency is held constant at its pre-crisis average. This approach enables us to isolate the portion of unemployment attributable to deteriorating matching efficiency, commonly referred to as mismatch unemployment. In this framework, matching efficiency is treated as a time-varying parameter in the baseline model and as a fixed reference value in the counterfactual.

We show that the COVID-19 pandemic had only a modest impact on the Austrian labour market overall. Mismatch unemployment increased significantly, but in aggregate, it returned to pre-pandemic levels. Regional labour markets in Austria also showed a common COVID-19-induced rise in mismatch unemployment, but the speed of recovery varied significantly across states.

The paper is structured as follows. Section 2 introduces the matching model that is used in the empirical analysis, while section 3 describes the calibration of the model and the underlying data. In section 4 we summarise our results at both the national and regional levels. Section 5 discusses the results and section 6 concludes.

2. Theoretical Background

In general, labour market matching refers to the process through which job seekers and employers are paired, conditional on search behaviour, preferences, constraints, and frictions such as information asymmetries, spatial distance, skill gaps, and institutional settings. Mismatch unemployment can arise not only from imperfect information and mobility constraints but also from structural differences in economic composition, demo-

graphic dynamics, and the quality of institutions across regions.

We follow the approach of Veracierto (2011) which was also used by Böheim and Christl (2022). Workers in the labour market can be either employed, denoted as E_t, or unemployed, denoted as U_t. Employed workers are separated from their current jobs with probability λ_t, the so-called separation rate. Unemployed workers, on the other hand, find new jobs according to a matching function that depends on the number of Unemployed U_t, the number of vacancies in the economy V_t, and on the matching efficiency A_t. We define a Cobb-Douglas matching function as follows:

$$M_t = A_t U_t^{\alpha} V_t^{1-\alpha} \tag{1}$$

where $0 \leq \alpha \leq 1$.

We can then identify the number of unemployed individuals at time t as follows:

$$U_t = U_{t-1} - M_t + (E_t) \cdot \lambda_t. \tag{2}$$

Assuming profit-maximising firms, the free-entry condition must be satisfied:

$$k = \frac{M_t}{V_t} \cdot J_t \tag{3}$$

this implies that the cost of posting a vacancy (k) must be equivalent to the probability of filling a vacancy ($\frac{M_t}{V_t}$) multiplied by the discounted value of profits generated by a job (J_t).

Given that the matching efficiency (A_t), the separation rate (λ_t), and the discounted value of profits generated by a (filled) job (J_t) are exogenous in our model, an initial unemployment level (U_0) generates an endogenous steady-state path for (M_t, V_t, U_{t+1}) in our model.

In the steady state, we assume a constant matching productivity (A) and a constant separation rate (λ). The steady state of our model economy can be defined as an initial unemployment level ($U_0 = U$), such that the endogenous path for $M_t = M$, $V_t = V$ and $U_t = U$ generated by the model remains constant over time:

$$M = AU_t^{\alpha} V_t^{1-\alpha} \tag{4}$$

$$M = E * \lambda = (1 - U) \cdot \lambda. \tag{5}$$

Combining equation (4) and equation (5), we obtain the first steady-state condition:

$$U = \frac{\lambda}{\lambda + A(\frac{V}{U})^{1-\alpha}}. \tag{6}$$

Equation (6) defines the negative relationship between unemployment and vacancies and can be interpreted as our Beveridge curve. An increase in the separation rate shifts the Beveridge curve to the right, while an increase in the matching efficiency (A) shifts the Beveridge curve downwards. The discounted value of profits generated by a job (J) has no impact on the Beveridge curve.

Combining equation (4) and equation (6), we obtain the second steady-state condition:

$$k = A * \left(\frac{U}{V}\right)^{\alpha} \cdot J. \tag{7}$$

Equation (7) defines the job-creation curve and depicts a positive relationship between unemployment and vacancies. The separation rate has no effect on the job creation curve; however an increase in both, the matching efficiency (A), and the discounted value of profits generated by a job (J) rotates the curve clockwise.

To deviate from the steady state long-term relationship between unemployment and

vacancies, we allow A, J and λ vary over time in Equations (7) and (8).

Having estimated the α parameter in our model, we can calculate the matching efficiency parameter A_t. By using a constant matching efficiency parameter A^{stab}, we can then identify the predicted vacancy rate, conditional on the observed unemployment rate, as follows:

$$V_t = \left[\left(\frac{\lambda_t}{U_t} - \lambda\right)\frac{1}{A}\right]^{\frac{1}{1-\alpha}} \cdot U_t. \tag{8}$$

We define the mismatch unemployment estimate, U_t^m as the difference between our model estimate with a variable matching efficiency, U_t, and the predicted unemployment rate under a stable matching efficiency, U_t^{stab} (where the stable matching efficiency, A^{stab}, represents the average matching efficiency between 2008 and 2014):

$$U_t^m = U_t - U_t^{stab} = \frac{\lambda_t}{\lambda_t + A^{stab}\left(\frac{V_t}{U_t}\right)^{1-\alpha}} - \frac{\lambda_t}{\lambda_t + A_t\left(\frac{V_t}{U_t}\right)^{1-\alpha}} \tag{9}$$

While our model is rooted in equilibrium search theory, we acknowledge that real-world matching dynamics are shaped by institutional arrangements, such as Austria's uniform short-time work scheme, which interact with local economic structures. Our empirical approach reflects this by examining both model-based efficiency metrics and the context in which they evolve.

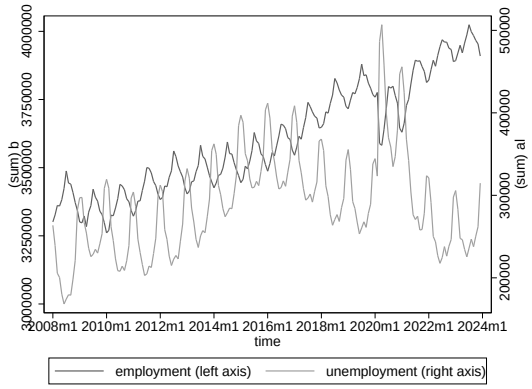
3. Data and Calibration

We use monthly data from the Austrian Public Employment Service (AMS) covering the period from 2004 to 2024. This dataset provides detailed information on the sector and region in which individuals are employed, the sectors in which the unemployed previously worked, and the sector of advertised vacancies (AMS Österreich, 2023). At the regional level, we focus on the nine federal states of Austria. Additionally, at the sectoral level, we

have information at the NACE 2 (NACE Rev. 2) level.[2] Specifically, we have data for 89 different economic activities. Given the small number of people employed and unemployed in each of these specific sectors, and the interchangeability of workers within these narrowly defined sectors, we aggregate this information to a higher level, namely into six broad sectors: industry, construction, wholesale and retail, hospitality, public administration and other sectors.

As shown in Figure 1a, the Austrian labour market is characterised by strong seasonality, particularly in the construction sector. Unemployment can vary by up to 100,000 individuals between the winter and summer months. Currently, the Austrian economy exhibits a low unemployment rate of about 300,000 individuals, while employment is at an all-time high of nearly 4 million individuals.

Figure 1: The Austrian Labour Market Over Time



(a) Employment and Unemployment

(b) Unemployment and Vacancy Rate

Additionally, Figure 1b shows that the unemployment rate decreased significantly after the COVID-19 pandemic and, according to the national definition, stood at around 6% at the beginning of 2024.[3] The vacancy rate is at a record high of about 3%, indicating a

[2]NACE (Nomenclature of Economic Activities) provides a framework for classifying statistical data according to the economic activities of an economy.

[3]Unemployment in Austria, as defined by the AMS, refers to individuals who are not in employment, are actively seeking work, and are registered with the AMS. The national method for calculating the

very tight labour market.

Looking at the regional characteristics of the Austrian labour market, Table 1 shows that approximately 23.5% of the Austrian labour force (about 920,000 individuals) is located in the capital, Vienna (Wien), followed by Upper Austria (Oberösterreich) with 17.3% (about 670,000 individuals) and Lower Austria (Niederösterreich) with 16.7% (about 650,000 individuals). Vorarlberg (4.3%, about 170,000 individuals) and Burgenland (2.8%, about 110,000 individuals) have the lowest proportions of the labour force in Austria. An analysis of the place of residence of the unemployed shows that most of them live in Vienna (34.7%). Interestingly, at the same time Vienna is home only to slightly less than a quarter of the total Austrian labour force. In contrast, although Upper Austria accounts for 17.3% of the total Austrian labour force, only 11.4% of the unemployed reside in this region.

Table 1: Labour Market Characteristics, by Federal State

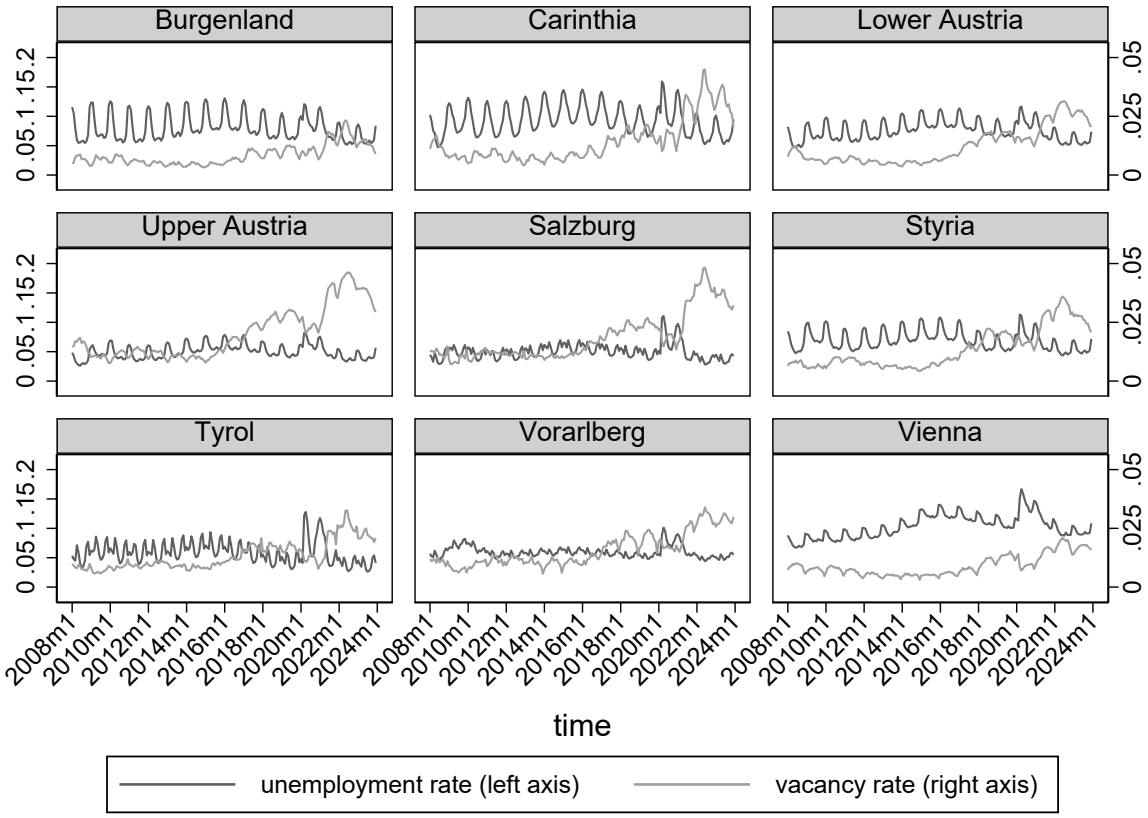
Region	Labour Force		Employed		Unemployed	
Burgenland	108,959	2.8%	100,106	2.8%	8,853	2.9%
Carinthia	231,100	6.0%	209,181	5.8%	21,919	7.3%
Lower Austria	648,298	16.7%	598,407	16.7%	49,891	16.6%
Upper Austria	671,325	17.3%	637,178	17.8%	34,147	11.4%
Salzburg	261,828	6.7%	248,419	6.9%	13,408	4.5%
Styria	535,976	13.8%	498,206	13.9%	37,770	12.6%
Tyrol	339,795	8.8%	319,460	8.9%	20,336	6.8%
Vorarlberg	166,787	4.3%	156,773	4.4%	10,014	3.3%
Vienna	919,075	23.7%	814,867	22.7%	104,208	34.7%
Total	3,883,144	100.0%	3,582,598	100.0%	300,546	100.0%

Figure 2 illustrates the differences in unemployment and vacancy rates between regions. As expected and in line with the data above, Vienna has the highest unemployment rate among the regions, currently standing at around 11%. Conversely, regions such as Tyrol, Salzburg, Vorarlberg and Upper Austria currently have unemployment rates close to 5%.

unemployment rate sets the number of registered unemployed persons in relation to the labour force potential. The labour force potential is defined as the sum of the number of unemployed persons and the number of employees subject to compulsory social insurance, as recorded by the umbrella organisation of Austria's social insurance institutions.

While the unemployment rate has fallen slightly in recent years, the vacancy rate has risen sharply in several regions, particularly in Upper Austria and Salzburg, and has recently been well above 3%. Moreover, Vorarlberg has recently shown a marked upward trend in the vacancy rate.

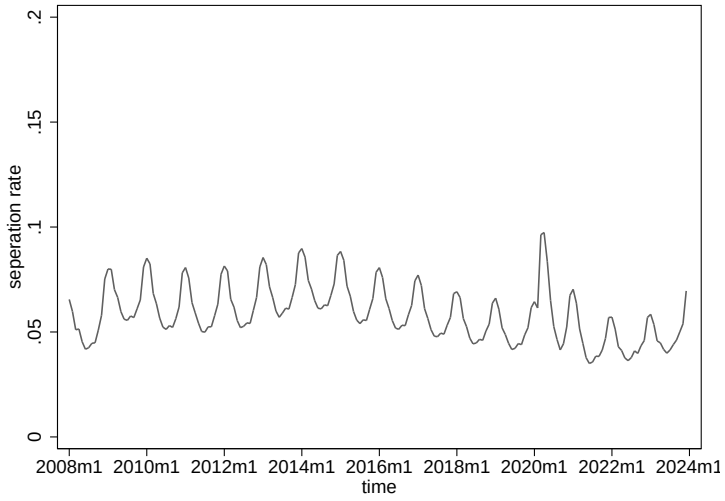
Figure 2: Unemployment and Vacancy Rate in Austria, by Federal State



The data we use from the AMS does not include information on the separation rate. Therefore, we need to approximate the job-finding rate using additional information. We employ the method described by Shimer (2012), which involves using information on the number of unemployed individuals segmented by duration over time. Specifically, we have data on the unemployed segmented by sector, region, and duration of unemployment in four intervals: 0-2 months, 3-5 months, 6-11 months, and 12 months or more. This allows us to

estimate the job-finding rate, from which we can then derive the exit rate. Shimer (2012) shows that the cyclical behaviour of this approximation of the job-finding rate closely mirrors that of the standard job-finding rate, with the levels also aligning as predicted. Figure 3 illustrates the stability of the separation rate in Austria, which hovers around 6% over time. However, a slight decrease in the rate can be observed from 2014 onwards, interrupted by a significant increase due to the COVID-19 pandemic. Detailed trends in separation rates by federal state are shown in Figure C.1 in the Appendix.

Figure 3: Separation Rate in Austria



To estimate the α parameter, we follow the approach outlined by Shimer (2005*b*), who argued that the separation rate does not play a crucial role in generating unemployment fluctuations. Following the methodology proposed by Veracierto (2011), we can estimate the α parameter for our model within each region and economic sector.

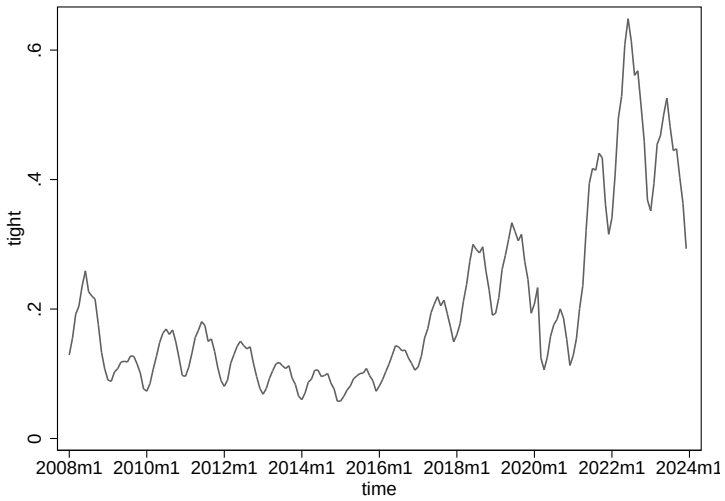
4. Results

4.1. Results Based on Aggregated Data for Austria

With fairly stable unemployment rates and increasing vacancy rates in all sectors of the Austrian economy, it is evident that labour market tightness in Austria has increased

accordingly.[4] Figure 4 shows the evolution of labour market tightness in Austria from 2008 to 2024. After a brief increase at the beginning of the financial crisis, labour market tightness remained relatively stable in the first half of the 2010s. However, from 2016 onwards, labour market tightness started to rise in line with the increase in the vacancy rate, as shown in Figure 1b. Subsequently, due to the collapse in labour demand caused by the COVID-19 pandemic, both vacancy rates and labour market tightness fell to levels similar to those in the early 2010s. As the pandemic receded, labour market tightness rose to unprecedented levels in 2022 before easing as the economy slowed down at the end of our observation period.[5]

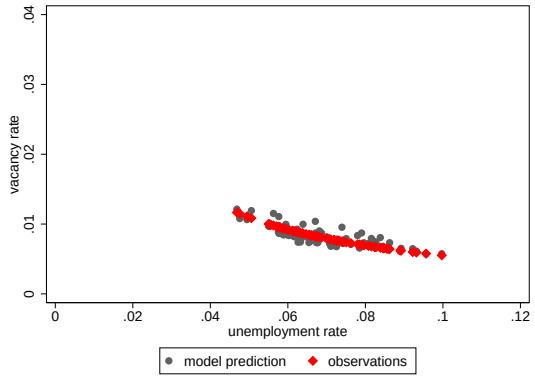
Figure 4: Labour Market Tightness in Austria



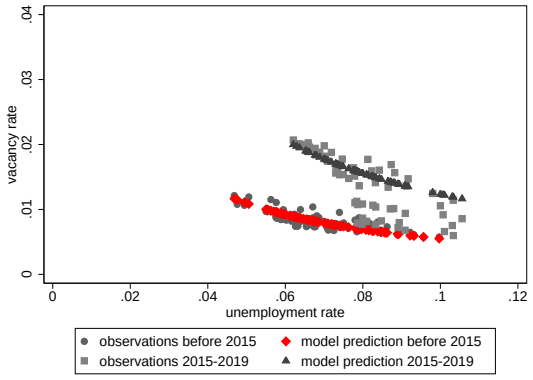
However, it is reasonable to assume that the easing of the labour market is only a temporary phenomenon. This assumption is based on the continuing outward shift of the Austrian Beveridge curve. Figure 5 shows the Austrian Beveridge curve over three time periods: first from 2008 to 2015, then from 2015 to the start of the pandemic in 2020, and finally for the period since 2020. The continuous increase in the vacancy rate contributes

[4] Labour market tightness is defined as the ratio of the number of vacancies to the number of unemployed.
[5] For a recent economic outlook for Austria, see Scheiblecker and Ederer (2024).

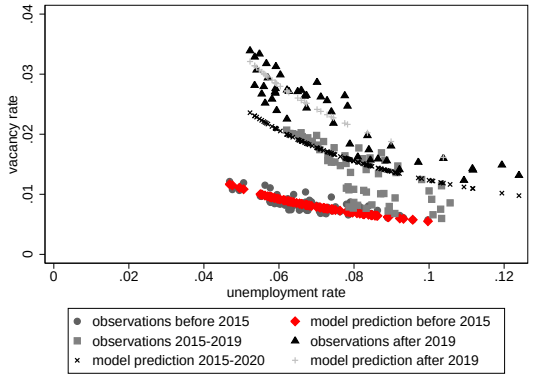
Figure 5: The Austrian Beveridge Curve Over Time



(a) 2008-2015



(b) 2008-2020



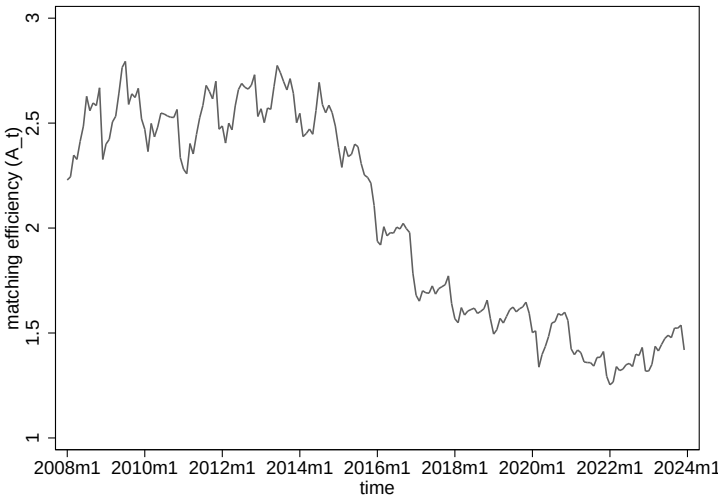
(c) 2008-2023

to the steady outward shift of the Beveridge curve.

The long-standing decline in matching efficiency in Austria is certainly an important factor contributing to this shift. Matching efficiency measures how quickly unemployed individuals and job vacancies are matched in the economy. Figure 6 shows the matching efficiency in Austria for the period 2008 to 2024. Matching efficiency remains relatively stable until 2014, after which it declines rapidly. During the COVID-19 pandemic, matching efficiency dropped further, but appears to stabilise towards the end of the observation period. Therefore, there is no evidence of an increase after the pandemic at the aggregated level.

The decrease in matching efficiency is accompanied by a general decrease in the unem-

Figure 6: Matching Efficiency in Austria



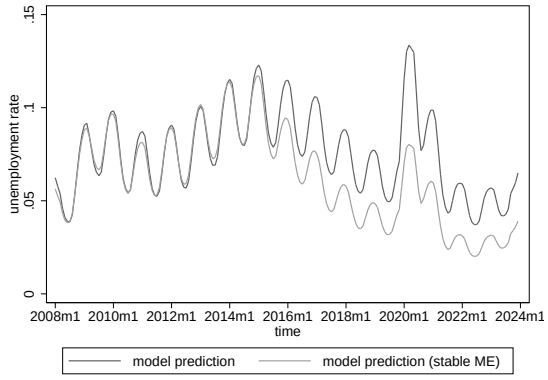
ployment rate at that time. However, Figure 7a shows the difference between the estimated unemployment rate with decreasing matching efficiency and the counterfactual assumption of constant matching efficiency, as was the case before 2014. The differences clearly illustrate an upward shift in the unemployment rate due to the reduced matching efficiency compared to the unemployment rate in the case of a stable labour market matching.

Not surprisingly, the decreasing matching efficiency also leads to an increase in mismatch unemployment in Austria (see Figure 7b). Mismatch unemployment started to increase significantly in 2015.[6] As argued by Schiman (2021), a strong labour supply shock due to the opening of the Austrian labour market to the then-new Eastern European member states of the European Union could itself cause a shift in the Beveridge curve.[7] However, such a supply-side-driven shift should be temporary, and the Beveridge curve should return to its pre-shock level within a few years. In contrast to Schiman (2021), we show that the shift of the Beveridge curve in the mid-2010s is driven by a decline in

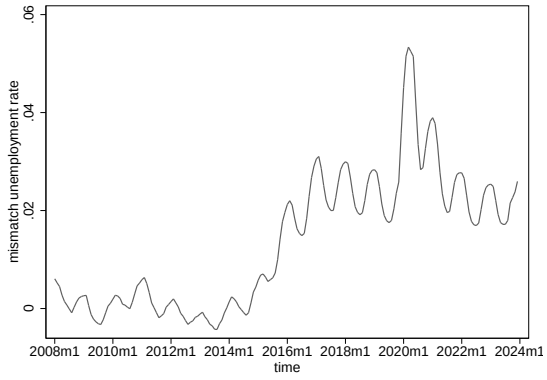
[6]Mismatch unemployment occurs when vacancies and job seekers do not match.

[7]Austria opened its labour market, after a transition period of 7 years, in May 2011 and January 2014 for countries that became EU Member States in 2004 and 2007, respectively.

Figure 7: Unemployment Rate



(a) Unemployment Rate - Stable Matching Efficiency



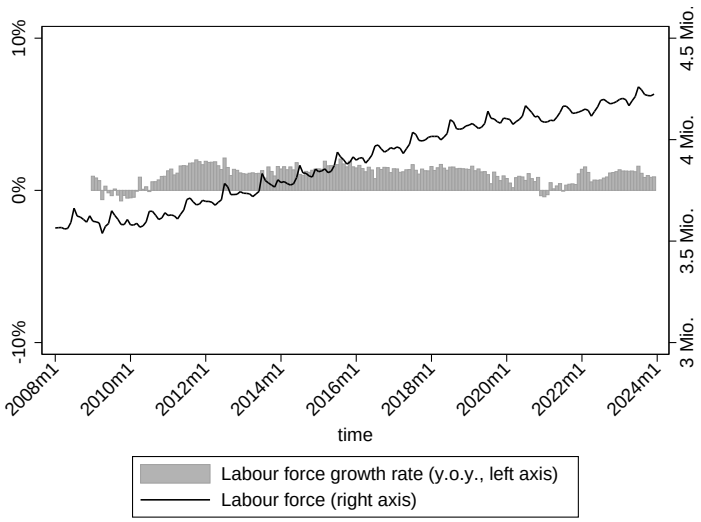
(b) Mismatch Unemployment Rate

matching efficiency and is therefore more permanent.

Later, with the outbreak of the COVID-19 pandemic in 2020, mismatch unemployment increased further. However, with the end of the pandemic-related measures, mismatch unemployment returned to pre-pandemic levels. This is consistent with the findings of Pizzinelli and Shibata (2023*a*) for the US and the UK. However, these results may differ across regions and sectors.

The rise in mismatch unemployment during the pandemic coincided with a temporary slowdown in labour force growth in Austria, partly due to policy measures such as short-time work and pandemic-related labour market exits. As shown in Figure 8, the labour force has since fully recovered and is currently above pre-pandemic levels. The earlier slowdown likely reflected both short-term disruptions from COVID-19 and structural demographic factors such as the ongoing retirement of the baby-boom generation.

Figure 8: Labour Force Development

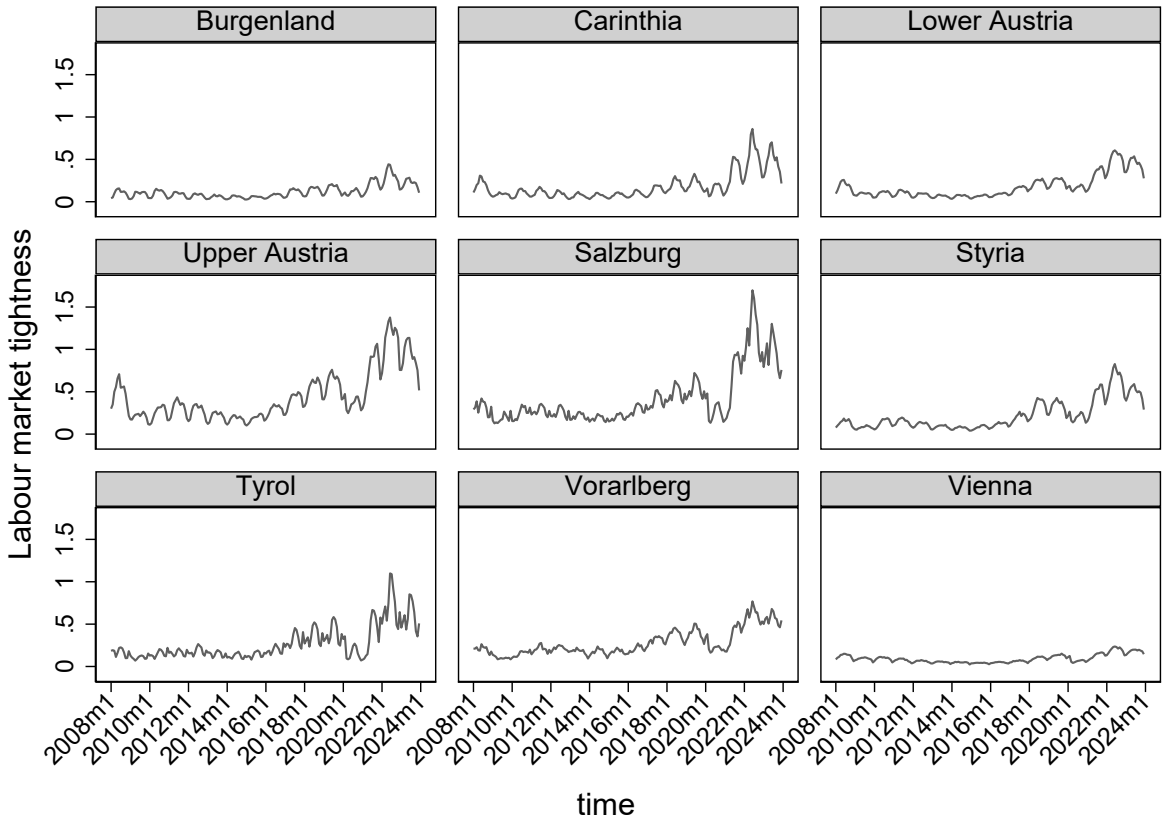


4.2. Results by Federal State

After the aggregated analysis, the focus now turns to the regional labour market situation in Austria. Common trends as well as different developments in the individual federal states can be seen in Figure 9. It is striking that the situation in Vienna differs from that in the non-metropolitan regions. In Vienna, the tightness of the labour market remains very stable over the period from 2008 to 2024. The situation in Burgenland is almost as stable, with a slight upward trend at the current margin. This upward trend is slightly more pronounced in Lower Austria, Vorarlberg, Carinthia and Styria. In Upper Austria and especially in Salzburg, the tightening has been more pronounced. The structure of the economy is undoubtedly an important factor here, and we will analyse and discuss it in detail in the next subsection and section.

The Beveridge curves for the individual federal states are shown in Figure 10. Similar to the tightness of the labour market, shifts in the Beveridge curves are visible in all federal states. Firstly, there is the shift after 2015, which is also reflected in the change in matching efficiency. Secondly, we can see an outward shift with the start of the COVID-19 pandemic in all federal states. However, the magnitude of these outward shifts in the Beveridge curve

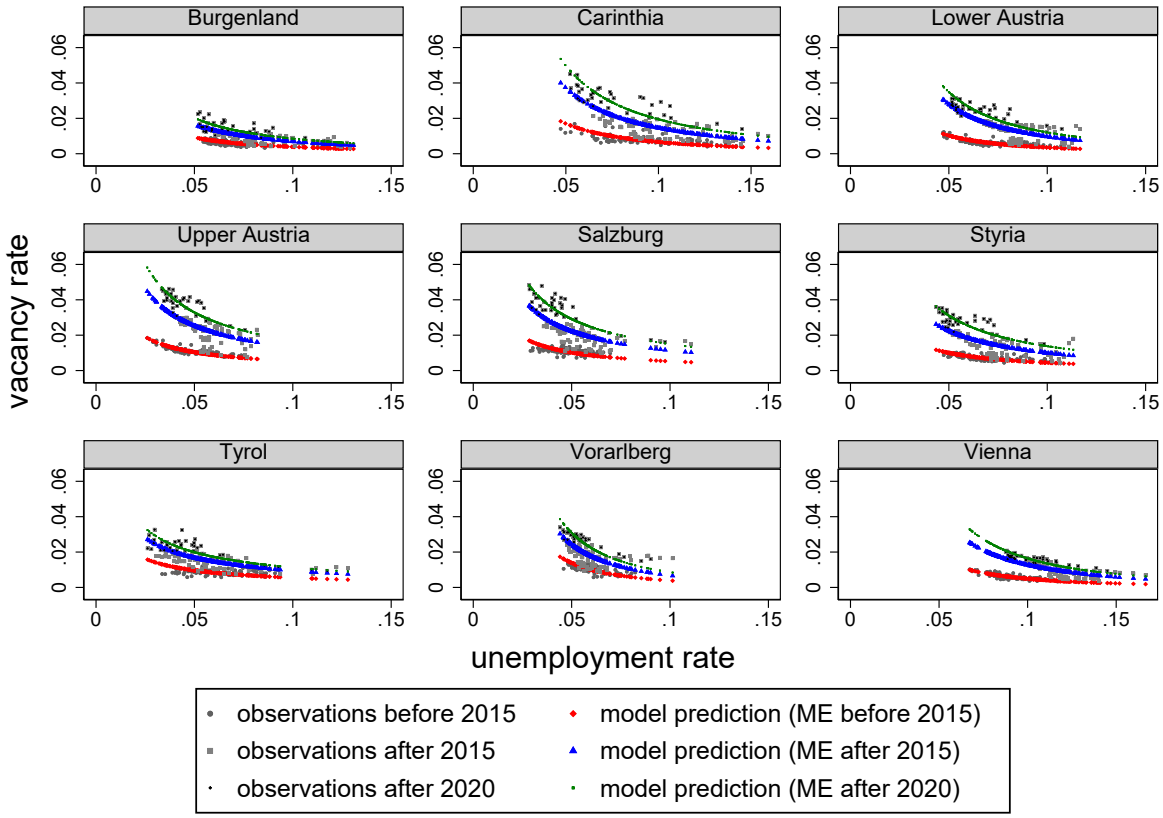
Figure 9: Labour Market Tightness by Federal State



over time differs markedly from one federal state to another.

The shifts in Carinthia, Salzburg, Upper Austria and Styria are particularly pronounced, while those in Burgenland, Tyrol and Vorarlberg are less pronounced. While there are several factors that can cause a shift in the Beveridge curve, such as changes in the separation rate, changes in labour supply, and changes in matching efficiency (Christl, 2020), our results suggest that matching efficiency seems to be the more important measure in explaining the shifts in the Beveridge curves across federal states. There is a clear rightward shift of the Beveridge curve and a decline in matching efficiency in all federal states after 2014. Furthermore, the COVID-19 pandemic, from 2020 onwards shifted the Beveridge curves, and matching efficiency decreased. However, we also can see a recovery

Figure 10: Beveridge Curves by Federal State

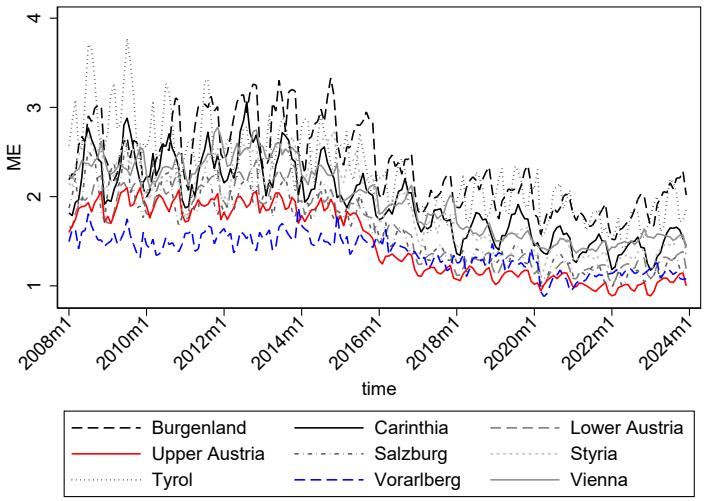


in matching efficiency at the beginning of 2022 in most of the regions.

The matching efficiency in the individual federal states is shown in Figure 11. With the exception of Vorarlberg, a decrease in matching efficiency is observed in all federal states. In Vorarlberg, although there is also a minimal decrease, the matching efficiency remains almost constant over the period under consideration. The decrease in matching efficiency is noticeable in many federal states from 2014 onwards. However, at the end of our sample in 2024, we can also observe a slight recovery of matching efficiency in most of the federal states, with the exception of Vorarlberg. This also suggests that the impact of the COVID-19 pandemic on the matching process may have been temporary.

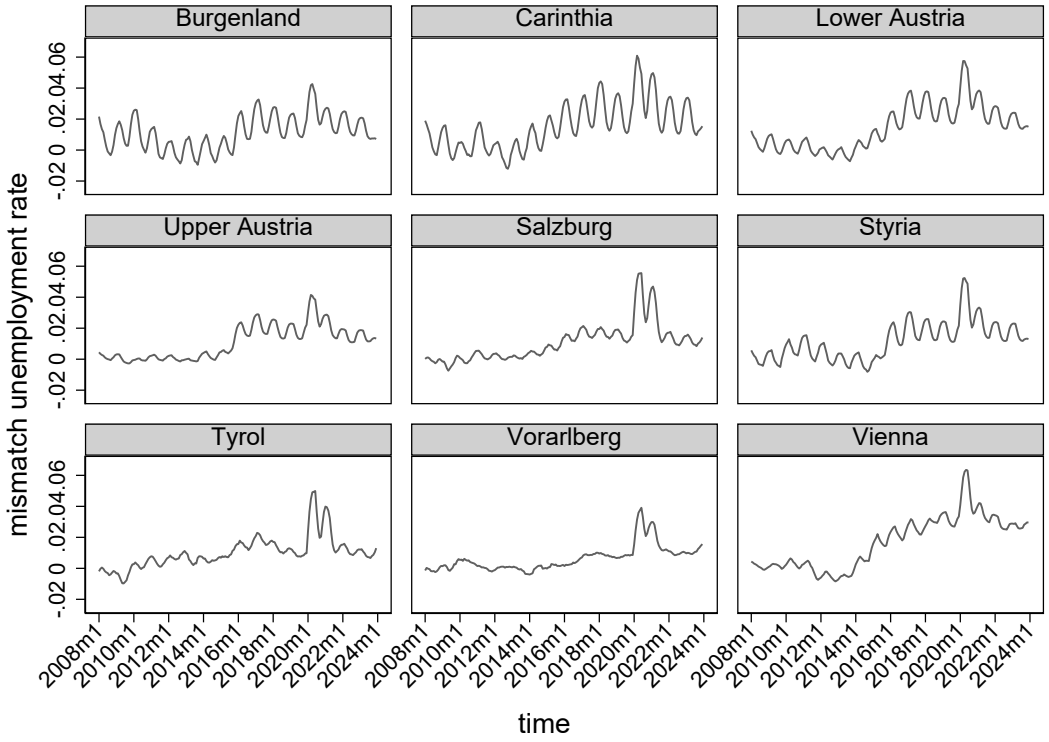
Mismatch unemployment is shown in Figure 12. In Vorarlberg, as in Tyrol, mismatch

Figure 11: Matching Efficiency by Federal State



unemployment visibly increases during the COVID-19 pandemic, while previous increases are smaller and occur later than in other regions. A similar pattern, although perhaps less clear-cut, is also observed in Salzburg and Burgenland regions. The other non-metropolitan provinces show a slightly stronger increase in mismatch unemployment over time. This increase is particularly pronounced in Vienna since 2014. The clear increase in mismatch unemployment in Vienna could be consistent with the view that the deterioration of matching efficiency after 2014 is linked to the opening of the labour market to the new Eastern European member states of the European Union at that time. Vienna facilitates access to the labour market, firstly because of its geographical proximity and excellent transport connections. Secondly, existing migrant networks in Vienna make it easier for new workers from Eastern Europe to establish themselves (Ebner-Zarl, Huber, Glaser and Schönherr, 2025). At the same time, some regions close to Austria's borders with new Member States (e.g., Burgenland) do not show a similar increase in mismatch unemployment. Moreover, the timing of the increase in mismatch unemployment (around 2014 or 2015 in most regions) does not coincide with the opening of the Austrian labour market to ten accession countries in 2011. Hence, the regional evidence for the accession hypothesis is overall not

Figure 12: Mismatch Unemployment Rate by Federal State

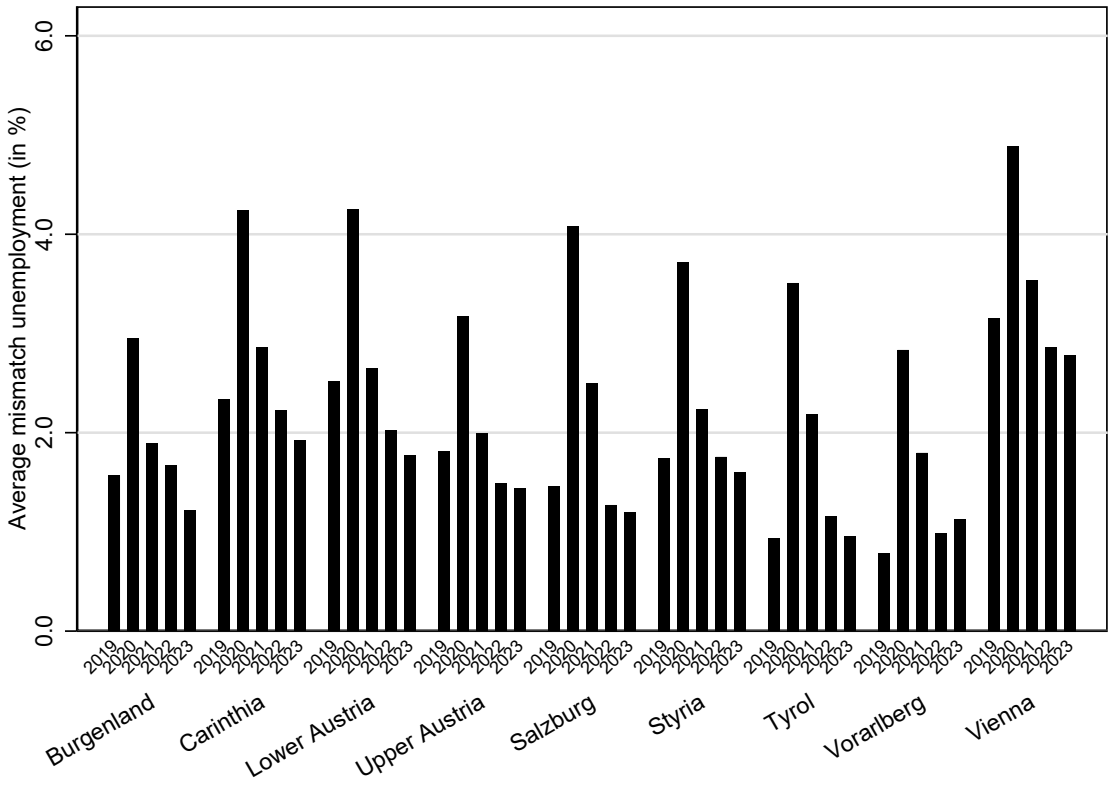


strong.

Focusing on the COVID-19 pandemic impact, Figure 13 shows the evolution of average mismatch unemployment across Austrian federal states between 2019 and 2023. In all regions, mismatch unemployment increased markedly in 2020 and 2021, reflecting pandemic-related disruptions to labour market matching processes.

From 2022 onward, most federal states exhibited a gradual decline in mismatch unemployment, indicating a partial normalization of matching efficiency. However, the pace and extent of the recovery varied across regions. Most regions already returned to pre-pandemic levels in 2022, with the exeption of Burgenland, Tyrol and Vorarlberg. While 8 regions showed clear improvements by 2023, Vorarlberg showes more persistent frictions, suggesting that regional labour markets adjusted at different speeds following the COVID-19 shock.

Figure 13: Mismatch Unemployment Rate by Federal State - The COVID-19 pandemic



4.3. Specialisation, Resilience and Externalisation

In addition to these detailed findings, we observe trade-offs between regional specialisation and resilience, as well as evidence of externalisation processes. Regarding the trade-off between specialisation and resilience, we find that manufacturing-intensive regions such as Upper Austria, Styria, and Salzburg experienced the most pronounced outward shifts in their Beveridge curves and the steepest declines in matching efficiency after 2014. Their dependence on export-oriented industries made them more susceptible to global demand shocks, illustrating a trade-off in which the productivity advantages of specialisation came at the cost of reduced resilience to external disruptions.

In contrast, tourism-dependent border regions such as Tyrol and Vorarlberg experienced more moderate disruptions in labour market matching during both the 2015 economic

shock and the COVID-19 pandemic. These regions, while subject to pronounced seasonal fluctuations in labour demand, have developed institutional and logistical capacities to adjust through the use of temporary and seasonal workers. This ability to mobilise flexible external labour helped buffer the impact of shocks, though it also reflects a dependence on non-local labour supply as part of their resilience strategy.

When it comes to externalisation processes, cross-regional and cross-border labour flows also contributed to differentiated labour market dynamics. In Vienna, for example, labour market tightness remained relatively stable, yet mismatch unemployment increased significantly after 2014. This can be partly attributed to Vienna's role as a hub for Eastern European workers, where firms increasingly relied on migrant networks and daily commuters from lower-wage neighbouring regions to fill vacancies, effectively externalising part of the matching process.

Sectoral externalisation was particularly evident in fields such as information technology and professional services, especially in urban centres like Vienna and Graz. During the pandemic, remote work enabled many firms in these sectors to fill positions without relying on the local labour supply. Although our administrative data does not explicitly identify remote hires, the relatively muted decline in matching efficiency in these sectors (not shown) is consistent with a shift towards externally sourced or remote labour, reducing regional sensitivity to local disruptions.

In the overall assessment, our analysis reveals a notable uniformity in labour market responses across Austria's diverse regions during and after the COVID-19 pandemic. This is particularly striking given the varied economic structures of Austria's federal provinces, for instance, the industrial orientation of Upper Austria versus the tourism-dependent economies of Tyrol and Salzburg.

Several factors contribute to this regional homogeneity. Austria implemented nationwide labour market interventions, such as the Kurzarbeit (short-time work) scheme and

extended unemployment insurance benefits, which were largely applied uniformly across all provinces, providing a consistent baseline for labour market stabilization. Re-skilling and training programs were also offered nationwide under federal coordination, though their implementation exhibited some regional variation in response to local labour market needs.

Similar patterns have been observed in other countries with centralized labour market institutions and uniform policy responses. In Germany, the nationwide Kurzarbeit scheme effectively mitigated employment losses during the pandemic across federal states, despite regional variations in COVID-19 incidence and economic structure. Bellmann, Bellmann and Hübler (2024) demonstrate that short-time work was instrumental in preventing involuntary layoffs, thereby contributing to employment stability. Complementing this, Christl, De Poli, Hufkens, Peichl and Ricci (2023) show that short-time work and related discretionary measures significantly cushioned income losses and helped mitigate regressive impacts across regions. In France, the activité partielle scheme proved effective in preserving employment during the pandemic. Cahuc, Kramarz and Nevoux (2021) provide empirical evidence that the program safeguarded jobs, particularly in firms facing substantial revenue losses, while maintaining a low fiscal cost per job saved. In the United Kingdom, Adams-Prassl, Boneva, Golin and Rauh (2020) find that the Coronavirus Job Retention Scheme played a crucial role in stabilizing employment by preserving employer-employee relationships and preventing widespread layoffs across sectors and regions. These cases highlight how centralized policy interventions can enhance regional labour market resilience during systemic shocks. Our study adds to this literature by demonstrating Austria's experience of similar institutional uniformity in both policy implementation and employment outcomes.

4.4. Robustness

As a general validation, we look on how well our model predicts the unemployment rate, as shown in Figure A.1 for the model for Austria, as well as in Figure A.2 for all

the Austrian regions. We can see that our model predicts the unemployment rate very precisely, indicating that our model parameters are well estimated.

However, to check the robustness of our findings on regional Beveridge curve shifts and matching efficiency, we also conduct a a panel Autoregressive Distributed Lag (ARDL) specification estimated via the Pooled Mean Group (PMG) estimator, following the approach of Bonthuis, Jarvis and Vanhala (2016). This complementary regression framework allows us to test whether the COVID-19 pandemic was associated with statistically significant changes in the slope and intercept of the regional Beveridge curve. As shown in Appendix B, we find that the long-run relationship between unemployment and vacancy rates steepened significantly during the pandemic period, consistent with a temporary increase in labour market mismatch. The post-COVID period shows a reversion. These results support our baseline model's conclusions about regional matching dynamics.

Our PMG-based Beveridge curve estimation suggests a significant steepening during the COVID-19 period, implying rising mismatch. This is consistent with the findings of Figura and Waller (2024), who argued that such shifts reduce the probability of soft landings by constraining the labour market's ability to reduce vacancies without raising unemployment. However, we observe partial reversion post-COVID, in line with matching efficiency returning to pre-pandemic levels.

5. Discussion and Policy Implications

Our results suggest that the observed outward shift in the Beveridge curve in Austria is not primarily driven by cyclical labour market fluctuations but reflects a deterioration in matching efficiency. While there is also indication of a cyclical component in the Beveridge curve, if the underlying cause were purely a change in labour market tightness - driven, for instance, by increased job postings in a recovery - one would expect temporary mismatches, which would diminish over time. However, the persistent and regionally differentiated

outward movement of the Beveridige curve, particularly in several Austrian federal states, indicates a potential deterioration in matching efficiency.

Such a decline could be explained by sectoral shifts and changing labour demand driven by technological transformation, accompanied by a shortage of adequately skilled workers, potentially resulting from delays in training and education systems. Although these factors are difficult to separate empirically using only aggregate Beveridge curve data, the regional analysis adds valuable nuance: we find that federal states with strong manufacturing sectors (like Upper Austria and Styria) tend to show greater increases in mismatch over time. This could be related to technological change and increased skill requirements in manufacturing (OECD (2024)), or to difficulties in adjusting the workforce quickly enough to the evolving industry needs (OECD (2023)).

Migration and labour mobility can help mitigate the mismatch, at least temporarily, by directing available skills where they are needed most. However, in Austria, migration inflows may no longer be sufficient to offset these structural mismatches. In Vienna, for instance, we observe rising mismatch despite high labour inflows, suggesting that the skills of incoming workers are not well aligned with local vacancies. Future labour market policy may therefore need to include more targeted efforts to attract talent from other regions or countries based on reported skill shortages.

These developments highlight the need for effective skills and education policy at both the national and regional levels to resolve the mismatch unemployment in Austria. As the labour market evolves - particularly due to digitalization, green transition policies, and industrial transformation - skills must keep pace. A lack of coordination between labour demand and the education/training system can increase structural mismatch, as workers are unable to transition smoothly into changing sectors. The OECD (2019) stresses that adult learning systems must become more responsive, especially in regions undergoing economic restructuring.

Our regional analysis also underscores that the developments in the labour market in Austria are far from uniform. Although some states, especially those with flexible, seasonal labour markets such as Vorarlberg or Tyrol, show smaller shifts in their Beveridge curves, others are clearly under strain. This suggests that regional policy responses should be tailored. Austria's labour market policy is largely centralised, but areas such as skills provision, vocational training, and regional planning can and should be implemented with attention to local conditions.

Finally, the COVID-19 pandemic provides an interesting test case. Our results indicate that the pandemic did not fundamentally alter pre-existing regional patterns of mismatch and labour market tightness. The federal government applied broad, uniform policy instruments such as short-time work (Kurzarbeit) and extended unemployment benefits, which likely stabilised employment but did not reverse long-term structural mismatches. This mirrors findings in other European countries (e.g. Germany or France), where COVID-19 policies preserved jobs but did not address underlying skill gaps or sectoral mismatches (Adams-Prassl et al. (2020), Cahuc et al. (2021)).

In conclusion, the Austrian labour market shows signs of structural transformation, which is uneven across regions and sectors. While nationwide stabilisation tools remain crucial, they must be complemented by flexible, regionally sensitive policies focused on skills, migration, and sectoral change. Without such targeted efforts, mismatch unemployment is likely to remain elevated, even in times of strong labour demand.

While both the post-2015 period and the COVID-19 pandemic were associated with outward shifts of the Beveridge curve in Austria, their underlying dynamics and implications differ markedly. The earlier shift (2015–2019) appears structural and persistent, characterized by a steady decline in matching efficiency across most regions, particularly in industrial hubs such as Upper Austria and Styria. This suggests deeper frictions likely linked to technological change, skill mismatches, and evolving sectoral demand. In contrast,

the COVID-19 crisis triggered a sharper but more transient disruption: matching efficiency fell temporarily, and mismatch unemployment spiked, but both indicators largely returned to pre-pandemic levels within two years. This pattern, mirrored in our regional and robustness analyses, suggests that pandemic-related frictions were predominantly cyclical - driven by temporary shutdowns, uncertainty, and sectoral freezes - rather than reflecting lasting structural reallocation. Thus, the Beveridge curve shifts following COVID-19 should be interpreted more cautiously, as their long-term structural significance remains uncertain.

A comparison of Austria's Beveridge curve dynamics across recent episodes reveals key differences in the persistence and nature of labour market mismatches. The Euro Area Sovereign Debt Crisis (2010–2013) had a limited and largely cyclical impact on Austria's labour market, with no lasting shift in matching efficiency or the Beveridge curve. In contrast, starting around 2014–2015, we observe a structural and persistent outward shift in the Beveridge curve, indicating a deterioration in matching efficiency that continued through the late 2010s. This shift appears linked to long-term structural factors, including industrial transformation, demographic changes, and skill mismatches, particularly in regions with strong manufacturing sectors. The COVID-19 pandemic triggered a sharp but temporary disruption: matching efficiency declined and mismatch unemployment rose, but both recovered relatively quickly. Our findings suggest that while COVID-19 introduced short-term frictions, the structural transformation initiated in the mid-2010s remains the dominant force shaping Austria's labour market matching outcomes.

6. Conclusion

Labour market tightness has increased in Austria over the last fifteen years. As the increase in vacancy rates occurred while the unemployment rate remained broadly unchanged, we have observed a significant decline in matching efficiency during our observation period, leading to a substantial increase in mismatch unemployment. This decline in

matching efficiency primarily accounts for the observed rightward shift of the Beveridge curve. Importantly, this shift appears to consist of both structural and temporary components: we identify a clear structural outward shift during the period 2015–2019, while the shift observed during the pandemic period (2020–2022) is smaller and less uniform. However, the COVID-19 pandemic seems to have had only a temporary impact, at least at the aggregate level. Labour market tightness, matching efficiency, and mismatch unemployment appear to have returned to pre-pandemic levels in most regions in Austria, though it remains possible that some longer-term effects are still unfolding.

The results at the level of the federal states show a high degree of homogeneity. The increase in labour market tightness, the decrease in matching efficiency, the resulting increase in mismatch unemployment, and the rightward shift of the Beveridge curve are evident nationwide and across all Austrian federal states. The structural shift observed in the years before the pandemic is reflected in most federal states, and the temporary effect of the COVID-19 pandemic on mismatch unemployment is also confirmed at the regional level, where mismatch unemployment returned to pre-crisis levels. Nevertheless, we remain open to the possibility that some regions may still experience lingering effects, making it premature to entirely rule out a longer-term component.

These findings have clear policy implications. First, efforts should be made to alleviate labour market pressures. This could involve supporting labour supply by activating underrepresented groups, increasing working hours for those currently in part-time employment and improving job quality in high-pressure sectors. These measures may help reduce labour market tightness. Finally, targeted measures should be implemented to enhance matching efficiency, particularly through the concerted efforts of public employment services.

Our results confirm recent findings that suggest local labour markets can exhibit a high degree of resilience to large shocks when institutional buffers are strong and external labour mobility is possible (Carrillo-Tudela, Clymo, Comunello, Jäckle, Visschers and Zentler-

Munro, 2023*b*; Pizzinelli and Shibata, 2023*b*). The case of Austria, where nationwide policy schemes like short-time work (*Kurzarbeit*) were uniformly applied, illustrates how centralized policy can mitigate spatial disparities in outcomes. Nevertheless, persistent mismatch underscores the need for place-based policies that address structural frictions in reallocation. Our findings also echo recent insights on the role of remote work and external labour sourcing in buffering regional shocks. These dynamics warrant further investigation using matched administrative and firm-level data.

We hope that this analysis of Austria serves as both a meaningful case study and a useful reference for researchers and policymakers. Many countries are struggling with tightening labour markets, often driven by developments in specific regions.

While our analysis offers important insights into labour market matching and mismatch unemployment at the regional level in Austria, it is not without limitations. First, the structural Beveridge curve model, while standard in the literature, abstracts from several important labour market dimensions, such as wage adjustments, changes in working hours, the role of atypical or precarious employment, and endogenous vacancy posting behaviour by firms. Second, our results rely on the assumption of a Cobb-Douglas matching function and use estimated separation rates based on duration data, which introduces additional uncertainty.

Future research could extend this work in several directions. First, combining administrative data with firm-level or matched employer-employee datasets could shed light on firm-side search behaviour and recruitment bottlenecks. Second, integrating qualitative insights could help identify regional or sector-specific barriers to matching that are not observable in quantitative data. Finally, replicating this approach in other small open economies with rich administrative data could help assess the generalisability of our findings beyond the Austrian context.

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Appendix A. Model validation

Figure A.1: Model Validation - Unemployment Rate

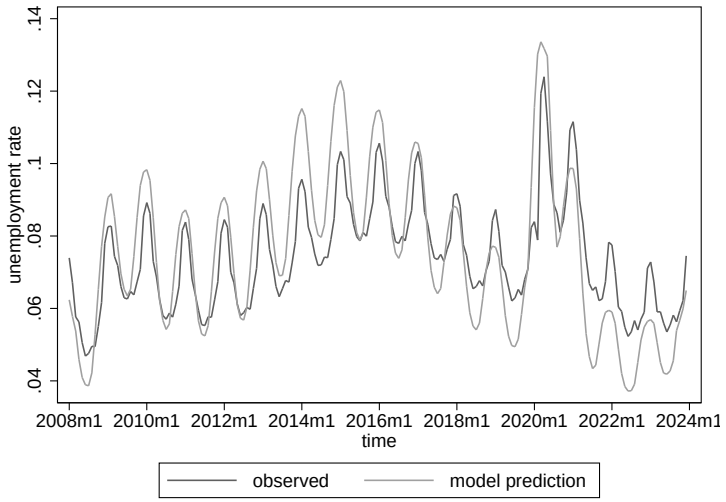
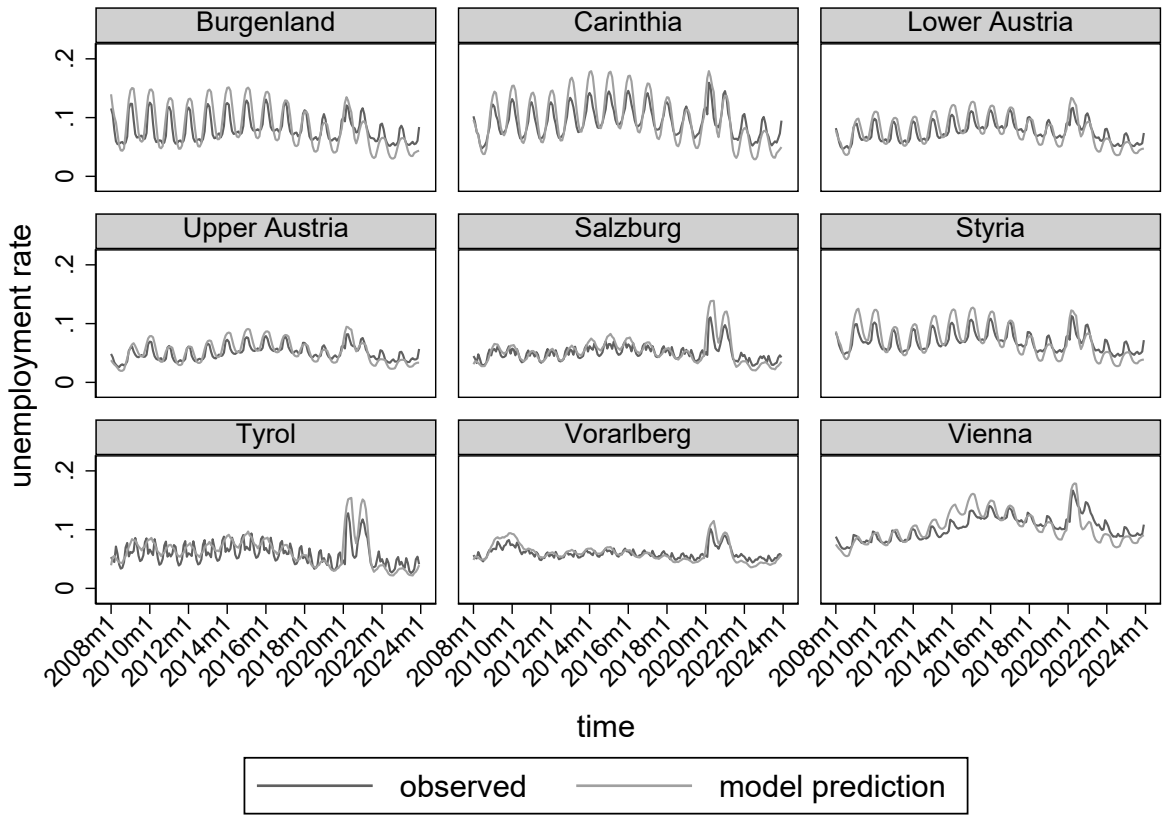


Figure A.2: Model Validation - Unemployment Rate by Federal State



Appendix B. Robustness checks

To check the robustness of our results, we estimate the Beveridge curve for Austria's nine regions using a panel Autoregressive Distributed Lag (ARDL) framework (Bonthuis et al., 2016; Christl et al., 2016) implemented via the Pooled Mean Group (PMG) estimator. The Beveridge curve characterizes the long-run relationship between unemployment and vacancy rates. Our specification allows for differential responses during the COVID and post-COVID periods by including time dummies and interaction terms.

The estimated long-run model is specified as:

$$\begin{aligned}\log(\text{urate}_{it}) = \alpha_i + \beta_1 \log(\text{vrate}_{it}) + \beta_2 \cdot \text{COVID}_t \\ + \beta_3 \cdot \log(\text{vrate}_{it}) \cdot \text{COVID}_t + \beta_4 \cdot \text{PostCOVID}_t \\ + \beta_5 \cdot \log(\text{vrate}_{it}) \cdot \text{PostCOVID}_t + \varepsilon_{it}\end{aligned} \tag{B.1}$$

where urate_{it} is the unemployment rate and vrate_{it} the vacancy rate in region i at time t. COVID_t and PostCOVID_t are period dummies identifying the COVID-19 crisis (2020m1–2021m6) and the post-COVID period (2021m7 onward), respectively.

The estimation results confirm a statistically significant negative long-run relationship between unemployment and vacancy rates, consistent with the Beveridge curve framework. Specifically, the long-run elasticity of unemployment with respect to the vacancy rate is estimated at -0.64, implying that tighter labour markets are associated with lower unemployment over time.

We use data after the Beveridge curve shift in 2014 and find evidence of a structural shift during the COVID-19 period. The interaction between the vacancy rate and the COVID dummy is negative and statistically significant (-0.27), indicating that the Beveridge curve steepened during the pandemic - suggesting heightened labour market mismatch or friction. The COVID dummy itself is also significantly negative, reflecting an intercept shift and

thus a downward movement of the Beveridge curve. These findings are in line with an outward shift of the Beveridge curve.

In the post-COVID period, the interaction term remains negative (−0.20), though only marginally significant at the 10% level. This suggests that while the labour market partially rebounded after the crisis, the Beveridge curve did not fully return to its pre-COVID shape. The post-COVID intercept is also negative but not statistically significant at conventional levels.

Table B.1: Pooled Mean Group (PMG) Estimation Results
Dependent variable: $\Delta \log(\text{Unemployment Rate})$

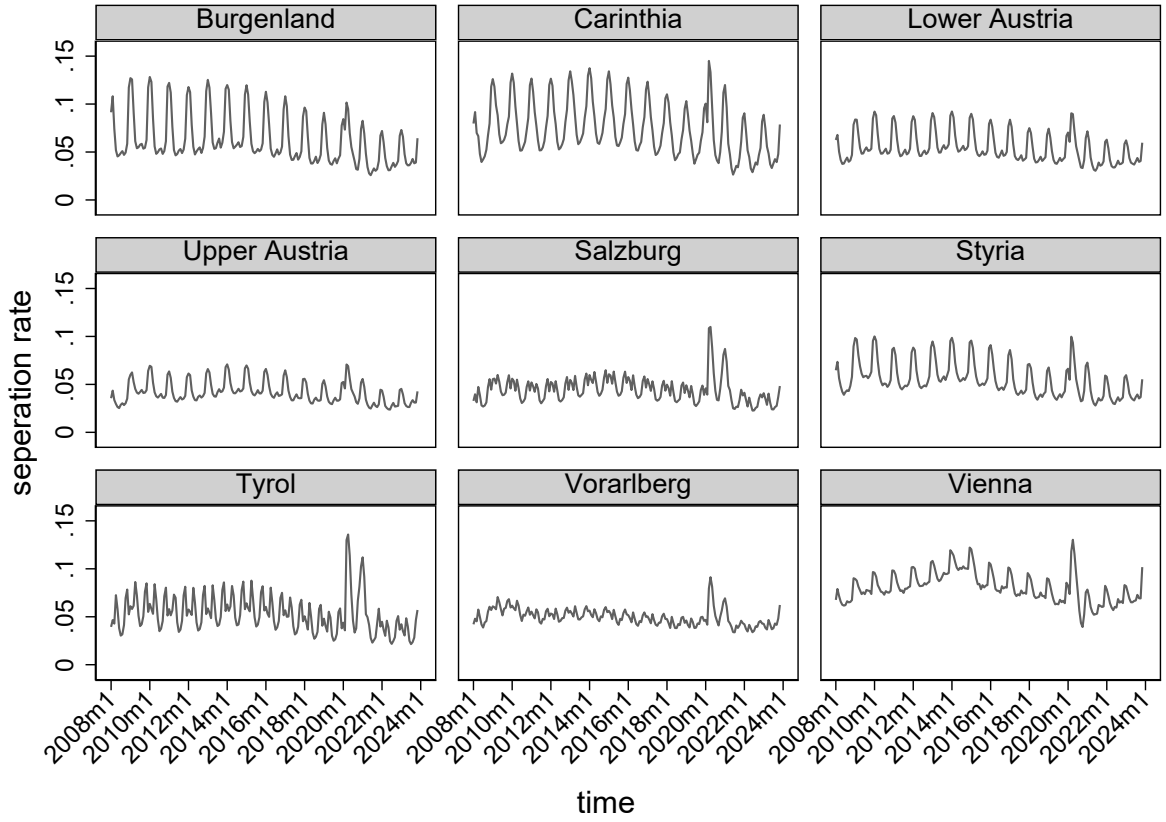
Variable	**Coefficient**	**Std. Error**	**Significance**
Long-run coefficients			
log(vrate)	−0.636	0.057	***
covid	−0.825	0.271	**
log(vrate_COVID)	−0.274	0.067	***
postCOVID	−0.577	0.374	
log(vrate_postCOVID)	−0.197	0.102	
Short-run dynamics			
Error correction term (EC)	−0.270	0.039	***
D1.log(vrate)	−0.393	0.067	***
Constant	−1.466	0.221	***

Note: *** p<0.001, ** p<0.01, * p<0.05. The model is estimated using PMG on 9 Austrian regions with 918 observations. COVID and PostCOVID are time dummies; interaction terms allow for slope shifts in the Beveridge curve.

These findings are consistent with an increase in labour market mismatch during the COVID-19 crisis. The significant steepening of the Beveridge curve, reflected in the negative interaction term between the vacancy rate and the COVID dummy, suggests that rising vacancies became less effective at reducing unemployment. This is a key symptom of matching inefficiency. A reversion is observed in the post-COVID period. The slope remains slightly more negative than in the pre-pandemic period, although the difference to the pre-COVID period is not statistically significant.

Appendix C. Additional Figures and Tables

Figure C.1: Separation Rate in Austria by Federal State



Conflict of interest

The authors report there are no competing interests to declare.

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Data Availability Statement

The data that support the findings of this study are available at the webpage of the Austrian Public Employment Service (AMS).

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AI Use Disclosure

During the preparation of this manuscript, we used OpenAI's ChatGPT (version GPT-4, June 2024) to support language editing. The content was reviewed and verified by the authors to ensure accuracy and compliance with academic standards. No generative AI tools were used for data analysis, interpretation of results, or original research content.