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The Effects of COVID-19 on Labour Market Matching in Austria: A Regional and Sectoral Perspective^{*}

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Abstract

This paper examines labour market matching in Austria since 2008, with a particular focus on the effects of the COVID-19 pandemic at the regional and sectoral level. We use comprehensive monthly administrative data and apply a standard matching model to estimate Beveridge curves for different labour market segments. Despite the disruptive effects of the COVID-19 pandemic, overall labour market conditions were relatively stable, with mismatched unemployment returning to pre-pandemic levels. This return to pre-pandemic levels is confirmed at the regional level. However, a sectoral analysis, as well as a sectoral regional analysis, reveals lasting effects in the hospitality and health care sector. **JEL classification**: J21, J64

Keywords: Beveridge curve, unemployment, matching efficiency, COVID-19

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1. Introduction

EU labour markets proved resilient to the economic disruptions caused by the COVID-19 pandemic and Russia's war of aggression in Ukraine. 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 in the Beveridge curve, suggesting a deterioration in matching efficiency.¹

Pizzinelli and Shibata (2023) 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 the absence of substantial structural reallocation within the labour market. This finding suggests a relatively limited impact of mismatch on total employment losses during the pandemic. Similarly, the results of Carrillo-Tudela, Clymo, Comunello, Jäckle, Visschers and Zentler-Munro (2023) for the UK indicate that, despite the ongoing changes in the labour market caused by the pandemic, significant

¹Countries 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.

structural reallocation remained limited. However, recent studies suggest that the increase in teleworking opportunities after the COVID-19 pandemic, as highlighted by Kagerl and Starzetz (2023), may have improved matching efficiency in the labour market by influencing the commuting behaviour of workers and the search behaviour of firms (Coskun, Dauth, Gartner, Stops and Weber, 2024).

This paper analyses labour market matching in Austria since 2008, focusing on how sectoral and regional developments in labour market matching have contributed to the apparent deterioration in overall matching efficiency. Austria provides a particularly interesting case study, as it is one of the few countries in the EU where the Beveridge curve indicates a clear deterioration in labour market matching (Böheim and Christl, 2022; Christl, 2020; Christl, Köppl-Turyna and Kucsera, 2016). Moreover, the Austrian labour market may offer lessons for other advanced economies, as it has been characterised by tight conditions for longer than in most other countries. 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 been continuously close to 5% since the mid-1990s. According to the latest data, the unemployment rate in Austria is still relatively low and robust, hovering around 5% as of late 2023, after a brief period above 6% during the pandemic. However, these levels are currently in the medium range within the EU, while a number of countries register rates below 4% (Eurostat, 2024).

In our analysis, we use highly detailed administrative data from the Austrian Public Employment Service (AMS) regarding the number of unemployed, employed and job vacancies by region and economic sector on a monthly basis from 2008 to 2023. This data allows us to focus on very specific labour market segments, such as regional labour markets or labour markets by industry, or both. 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 Austrian labour market segments. The model enables us to estimate changes in matching efficiency across specific labour market segments. By establishing a hypothetical model that assumes constant matching efficiency allows us to estimate mismatch unemployment.

We show that the COVID-19 pandemic had only a small impact on the Austrian labour market overall. Mismatch unemployment increased significantly, but, in aggregate it returned to pre-pandemic level. Looking at regional developments, we observe the same phenomenon. However, if we focus on sectors, as well as on sectors across different regions of Austria, we find a long-term impact of the COVID-19 pandemic in the hospitality and health care sectors, where mismatch unemployment remained significantly above pre-pandemic level. Over the longer term, it appears that the Austrian labour market experienced a deterioration in matching efficiency around 2014-2015, which has proven to be permanent thus far.

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 we employ. In section 4 we summarise our results at the national, regional and sector levels, and section 5 concludes.

2. Theoretical Background

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 $0 \le \alpha \le 1$.

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 $\left(\frac{M_t}{V_t}\right)$ 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:

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

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

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

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

$$V_t = \left[\left(\frac{\lambda_t}{U_t} - \lambda \right) \frac{1}{A} \right]^{\frac{1}{1-\alpha}} \cdot U_t.$$
(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 2018 and 2014):

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

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. Table C.1 shows our aggregation of the NACE2 classification into the six sectors used in our analysis.

While analysing regional Beveridge curves is standard, sectoral Beveridge curves (re-

 $^{^{2}}$ NACE (Nomenclature of Economic Activities) provides a framework for classifying statistical data according to the economic activities of an economy.





(a) Enployment and Unemployment

(b) Unemployment and Vacancy Rate

lating sectoral vacancies to unemployment by sector of previous employment) are less common. Nevertheless, this can be justified by the fact that workers are usually not very mobile across sectors. As shown in Table C.2, the proportion of unemployed individuals who found a job in the same sector after becoming unemployed between 2007 and 2023 is generally quite high in Austria. In construction, more than 90%, and in hospitality, more than 85%, of the unemployed found employment in the same sector, in the public sector as well as in wholesale and retail and industry, the rates are around 75%. More importantly, these figures appear to be very stable over time.

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. Additionally, Figure 1b shows that the unemployment rate decreased significantly after the COVID-19 pandemic and is currently around 6% according to the national definition. The vacancy rate is at a record high of about 3%, indicating a 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 unemployed persons. An analysis of the place of residence of the unemployed shows that most of them live in Vienna (34.7%). Interestingly, Vienna is home 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.

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%

Table 1: Labour Market Characteristics, by Federal State

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%. 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.

Table 2 provides a summary of the primary labour market variables across the sec-



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

toral labour markets in Austria. The sectoral breakdown shows that the public sector (comprising public administration, education, and health and social work) is particularly important, accounting for almost a quarter of the labour force, followed by wholesale and retail (14.9%) and industry (14.8%). Approximately 7.4% of the labour force is employed in construction and 6.1% in hospitality. Looking at the unemployment rate within each sector, it can be seen that it is significantly higher than the corresponding share of the labour force in construction (10.2%) and hospitality (13.0%), indicating a higher level of unemployment in these sectors.

Figure 3 shows that the unemployment rate decreased in all sectors after the COVID-19 pandemic but remains significantly higher than the Austrian average in construction

Sector	labour	force	emplo	yed	unemp	oloyed
Industry	574,332	14.8%	$548,\!430$	15.3%	25,902	8.6%
Construction	287,064	7.4%	$256,\!266$	7.2%	30,797	10.2%
Wholesale and retail	579,040	14.9%	$535,\!119$	14.9%	43,921	14.6%
Hospitality	$235,\!690$	6.1%	$196,\!566$	5.5%	39,124	13.0%
Public sector	948,781	24.4%	$910,\!395$	25.4%	38,386	12.8%
Others	$1,\!258,\!238$	32.4%	$1,\!135,\!821$	31.7%	$122,\!416$	40.7%
Total	3,883,144	100.0%	$3,\!582,\!598$	100.0%	$300,\!546$	100.0%

Table 2: Labour Market Characteristics, by Sector

(18.6%) and hospitality (11.0%). Conversely, the unemployment rate in industry and the public sector is currently below 4%. With regard to the search behaviour of firms, particularly high vacancy rates can be observed in hospitality (4.1%), wholesale and retail (3.3%), and other activities (3.4%). In addition, the vacancy rate increased significantly in all sectors after the COVID-19 pandemic, which, together with the falling unemployment rate, indicates a significant tightening of the labour market.

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 4 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 and sector are shown in Figures C.1 and C.2 in the



Figure 3: Unemployment and Vacancy Rate in Austria, by Sector

Appendix.

To estimate the α parameter, we follow the approach outlined by Shimer (2005), 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.³ Figure 5 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 3. 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 in recent quarters.⁴

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 6 shows the Austrian Beveridge curve over three time

³Labour market tightness is defined as the ratio of the number of vacancies to the number of unemployed. ⁴For a recent economic outlook for Austria, see Scheiblecker and Ederer (2024).

Figure 5: Labour Market Tightness in Austria



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 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.⁵ Figure 7 shows the matching efficiency in Austria for the period 2008 to 2024. Matching efficiency remains relatively stable until 2014, after which it declines rapidly. After the onset of the COVID-19 pandemic, matching efficiency stabilises, although there is still a slight downward trend. However, 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 unemployment rate at that time. However, Figure 8a 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

 $^{^5\}mathrm{In}$ general, matching efficiency measures how quickly unemployed individuals and job vacancies are matched.



Figure 6: The Austrian Beveridge Curve Over Time

Figure 7: Matching Efficiency in Austria







(a) Unemployment Rate - Stable 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 8b). 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 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) for the US and the UK. However, these results may differ

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

⁷Austria 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.





across regions and sectors.

Interestingly, this sharp increase in mismatch unemployment has occurred at the same time as we observe a significant decline in the labour force growth in Austria, also due to policy measures such as short-time working. It is worth noting that the labour force has fully recovered from the pandemic and is still well above pre-pandemic levels. The slowdown reflects both COVID-19-related exits from the labour force and the general trend of the retirement of the baby-boom generation.

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 (Figure 10). It is striking that the situation in Vienna differs from that in the non-metropolitan Länder. 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 it in detail in the next section.



Figure 10: Labour Market Tightness by Federal State

The Beveridge curves for the individual federal states are shown in Figure 11. 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 over time differs markedly from one federal state to another.

The shifts in Carinthia, Salzburg, Upper Austria and Styria are particularly pro-



Figure 11: Beveridge Curves by Federal State

nounced, 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 has had a minimal impact on the Beveridge curves, and the matching efficiency remains relatively constant.

The matching efficiency in the individual federal states is shown in Figure 12. With the

Figure 12: Matching Efficiency by Federal State



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. 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 13. In Vorarlberg, as in Tyrol, mismatch 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



Figure 13: Mismatch Unemployment Rate by Federal State

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. 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 strong.

4.3. Results by Sector Level

Following the analysis of the individual federal states, an examination of the specific economic sectors in Austria is now conducted. Figure 14 illustrates the tightness of the labour market for each sector in Austria. It can be seen that the tightness in each sector has increased over time, especially since the outbreak of the COVID-19 pandemic. However, we can also see that the tightness decreased significantly in 2023, highlighting a weakening of economic conditions. Of particular note are the increases observed in hospitality, industry and wholesale and retail. There is also an increase in cyclical patterns in construction. Although less pronounced, the increase in labour market tightness is also evident in the public sector and the residual sector.





time

The Beveridge curves for the individual sectors are shown in Figure 15. There is a notable outward shift in the Beveridge curves for the public sector, wholesale and retail, industry, and the residual sector. There is also an outward shift of the Beveridge curve in construction, although the relationship is not as pronounced prior to 2015. The situation in the hospitality sector is particularly unclear. The rightward shift of the Beveridge curves also coincides with a decline in matching efficiency at the sectoral level.



Figure 15: Beveridge Curves by Sector

In terms of matching efficiency (see Figure 16), there is a clear decline in the public sector, particularly since 2014, during which a steady decline is observed. There has also been a significant decline in the construction sector since 2014. Although less pronounced, the decline in matching efficiency is also visible in the other sectors. It is worth noting that

sectors with a particularly pronounced decline in matching efficiency also show a more pronounced shift to the right of the Beveridge curve. This phenomenon is particularly evident in the public sector.

Figure 16: Matching Efficiency by Sector



Since 2014, an increase in mismatch unemployment has been observed across all sectors (see Figure 17). The most notable increase can be seen in the hospitality and wholesale and retail sectors. However, the increase is also clearly visible in the public sector and the residual sector. The increase is less pronounced in the industrial and construction sectors. Overall, it is evident that mismatch unemployment correlates with a decline in matching efficiency. While in most sectors, mismatch unemployment returned to pre-pandemic levels, or even to lower levels, we can see that mismatch unemployment in the public sector (driven by the health care sector) reaches its all-time high in 2024, and mismatch unemployment is also above pre-pandemic levels in the hospitality sector.

It is also noteworthy that in most sectors the mismatch unemployment has returned to pre-COVID-19 levels, but remains substantially above pre-pandemic levels in the public sector. There is also a tendency for a slight further increase in the hospitality sector, although this is observed only at the current margin. As shown in Figure 18, the decline



Figure 17: Mismatch Unemployment Rate by Sector

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in the public sector is mainly due to developments in the health care sector. This is most likely related to the increasingly apparent poor working conditions in the sector, as well as the general tendency of people to be less inclined to work in the sector after the COVID-19 pandemic. This finding is consistent with the findings of Shen, Eddelbuettel and Eisenberg (2024) for the US, which suggest that the pandemic may have a lasting impact on workers' willingness to remain in health care jobs. In the hospitality sector, it remains to be seen whether a reversal of the trend or a stabilisation of matching efficiency can be achieved.

Figure 18: Beveridge Curve and Mismatch unemployment in the Health Care Sector



In Appendix A we delve into the more desegregated results for industry-specific regional labour markets. Our results highlight that regional differences in mismatch unemployment across Austrian regions are limited. Furthermore, it is worth noting that the long-term trends are particularly similar across the industry-specific regional labour markets.

5. Conclusion

Labour market tightness has increased in Austria over the last fifteen years. As the increase in vacancy rates occured 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 over the period. 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 of the regions and sectors in Austria.

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 in Austria and across every Austrian federal state. 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.

Across sectors, however, it appears that the COVID-19 pandemic may have had more than a temporary effect in at least two sectors of the Austrian economy. In particular, there is evidence of a sustained decline in matching efficiency in the public sector even after the end of the COVID-19 pandemic. This decline can largely be attributed to the health care sector, which forms part of the public sector. Similarly, in the hospitality sector, it is not entirely clear that the pandemic constituted merely a temporary disruption. Tightness in the labour market remains significantly higher than it was prior to the pandemic. In contrast to other sectors, there are no clear signs of labour market slack in the public sector and hospitality. Additionally, the COVID-19 pandemic has adversely affected matching efficiency in both sectors, with mismatch unemployment not having returned to pre-pandemic levels. These results are further corroborated within regions of the Austrian labour market. The increase in the health care sector is particularly pronounced in East Austria, while mismatch unemployment in the hospitality sector is escalating in West Austria. Future data be required to validate these early indications.

These findings have clear policy implications. First, efforts should be made to alleviate labour market pressures, particularly in the health and hospitality sectors. This could involve supporting labour supply by activating underrepresented groups, and increasing working hours for those currently in part-time employment. Such policies could contribute to reducing labour market tightness. Furthermore, attention should be directed towards improving working conditions in sectors that may be experiencing a shortage of applicants. Finally, targeted measures should be implemented to enhance matching efficiency, particularly through the concerted efforts of public employment services.

Our analysis of Austria is intended to be both interesting and instructive in its own right and to serve as a starting point and basis for policy-makers. The exceptionally tight labour market, especially in the public and health care sectors, will undoubtedly pose a challenge for society. In addition, Austria's critical hospitality sector should be closely monitored. It is imperative that a framework is put in place to prevent the temporary effects of the COVID-19 pandemic from evolving into long-term challenges. For researchers and policymakers in other countries, Austria can serve as an instructive case study. Many countries are struggling with tightening labour markets, often driven by developments in specific sectors.

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Appendix A. Results by region and sector

After conducting the geographical and sectoral analyses, the focus will now shift to integrating both dimensions. Geographically, Austria is divided into three NUTS-1 regions: Eastern Austria, Western Austria, and Southern Austria. Eastern Austria comprises the federal states of Lower Austria, Burgenland, and the capital city, Vienna. Western Austria consists of the federal states of Upper Austria, Salzburg, Tyrol, and Vorarlberg. While Southern Austria encompasses Styria and Carinthia.

In Eastern Austria, a shift of the Beveridge curve outward is evident across all sectors post-2014 (see Figure A.1). This shift is particularly pronounced in the public sector, with a notable shift observed after 2020. This confirms the pattern observed at the sectoral level, indicating a stronger rightward shift of the Beveridge curve alongside a decline in matching efficiency. As previously demonstrated, this phenomenon is particularly pronounced in the public sector. The public sector holds significant importance in Eastern Austria, primarily due to the presence of numerous large public employers in the capital city, Vienna. Therefore, a similar scenario to the federal analysis is plausible. Conversely, such a shift is either absent or minimal in the other sectors. In the hospitality and construction industries, the outward shift post-2014 is least significant and least discernible. This further confirms the pattern already identified at the sectoral level.

The observed changes in the Beveridge curve for Eastern Austria are nearly identical to those found in Southern Austria (see Figure A.2). Only in the hospitality industry is a slightly more pronounced rightward shift of the Beveridge curve evident after 2020.



Figure A.1: Beveridge Curves by Sector in Eastern Austria



In contrast to the rest of the country, Western Austria exhibits more pronounced shifts in the Beveridge curve within the industrial sector and the residual sector (see Figure A.3). The patterns observed in the remaining sectors align with those previously identified.

Looking at mismatch unemployment, the pattern in Eastern Austria aligns with the trend observed for the sectors at the aggregate level (see Figure 17). Once more, the most substantial increase is evident in the hospitality and wholesale and retail sectors. In the construction sector, mismatch unemployment increased from very low levels before 2015 to about 5% afterwards. The increase in mismatch unemployment during the COVID-19 pandemic is visible but not particulary pronounced. The hospitality sector in Eastern Austria shows a very similar pattern before the COVID-19 pandemic, however, during the



Figure A.3: Beveridge Curves by Sector in Western Austria



COVID-19 pandemic the mismatch unemployment surged to about 15% before returning to pre-pandemic levels of approximately 5%. The industrial sector in general is characterized by low mismatch unemployment, and no significant increases can be observed during the period under review. The wholesale and retail sector also exhibits an increase in mismatch unemployment after 2015 to about 5%, and a increase during the COVID-19 pandemic to about 7%; however, mismatch employment has been declining continuously since the end of the pandemic. Conversely, the increase is comparatively lower in the public sector. However, the public sector is the only sector in Eastern Austria that does not return to pre-pandemic levels.

The evolution of mismatch unemployment in the individual sectors in the southern



Figure A.5: Mismatch Unemployment Rate by Sector in Southern Austria

region mirrors that of Eastern Austria (compare Figures A.1 and A.2). However, the increase in mismatch unemployment in the public sector in recent years is lower than that in the other sectors.

In general, differences in the same sectors across regions are limited. We can see that there is higher mismatch unemployment in the industrial, wholesale and retail, and public sector in Southern Austria, while mismatch unemployment is typically higher in Eastern Austria in the construction sector. In Western Austria, differences are especially visible in the hospitality sector, where mismatch unemployment dropped substantially during the COVID-19 pandemic, but is on the rise again in recent years. This is especially driven by a significant drop in labour market tightness. It is worth noting that the long-term trends



Figure A.6: Mismatch Unemployment Rate by Sector in Western Austria

are very similar across industry-specific regional labour markets, with the exceptions of the public sector and the hospitality sector.

Figure B.1: Model Validation - Unemployment Rate



Appendix B. Model validation



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



Figure B.3: Model Validation - Unemployment Rate by Sector



Figure B.4: Model Validation - Unemployment Rate in Eastern Austria by Sector



Figure B.5: Model Validation - Unemployment Rate in Southern Austria by Sector



Figure B.6: Model Validation - Unemployment Rate in Western Austria by Sector

Appendix C. Additional Figures and Tables

Table	C.1:	NACE	Classification
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	NACE1	Classification
А	agriculture, forestry and fishing	others
В	mining and quarrying	others
С	manufacturing	industry
D	electricity, gas, steam and air conditioning supply	industry
Ε	water supply; sewerage, waste management and remediation activ-	industry
	ities	
\mathbf{F}	construction	construction
G	wholesale and retail trade; repair of motor vehicles and motorcycles	wholesale and retail
Η	transportation and storage	others
Ι	accommodation and food service activities	hospitality
J	information and communication	others
Κ	financial and insurance activities	others
L	real estate activities	others
Μ	professional, scientific and technical activities	others
Ν	administrative and support service activities	others
Ο	public administration and defence; compulsory social security	public sector
Р	education	public sector
Q	human health and social work activities	public sector
R	arts, entertainment and recreation	others
\mathbf{S}	other service activities	others
Т	activities of households as employers; undifferentiated goods- and	others
	services-producing activities of households for own use	
U	activities of extraterritorial organisations and bodies	others

Conflict of interest

The authors report there are no competing interests to declare.

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Table C.2: Job Finding Rate 2007-2023 within the Same Sector

sector	JFR
Construction	91.0%
Hospitality	87.7%
Industry	75.1%
Wholesale and retail	74.9%
Public sector	77.2%
others	87.1%

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



Data Availability Statement

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



Figure C.2: Separation Rate in Austria by Sector

time