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Okun's Law in Austria

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Abstract

We estimate the classic and the dynamic variant of Okun's law for the Austrian labor market. We find that, for recent periods, the growth rate necessary to stabilize the unemployment rate equals 2.8 percent. Moreover, we find that the rate has been growing in recent quarters due to the increasing labor force size and the effects of the crisis. The latest prediction of the employment threshold lies above 3 percent, much above forecasted GDP growth up to 2017.

Keywords

Unemployment, Growth, Okun's Law, Austria

I. Introduction

When the financial crisis hit the Austrian economy in 2009, a huge decline of almost 4 percent in real GDP was observed. Most people expected an increase in the unemployment rate; however, this expectation did not come true. At least until 2012, the unemployment rate stayed on quite a stable level, while GDP growth remained low for several years after the crisis. This brings into question whether the relationship between the unemployment rate and GDP growth – also known as Okun's law – has changed over time.

Okun's law goes back to Okun (1962) and describes a long-run relationship between output and the unemployment rate. In its simplest form, it is often stated as a three-to--one relation, i.e. a decrease of one percent in real output increases unemployment by 0.3 percent. Hence, the law determines how much growth in the economy is necessary to stabilize the unemployment rate. If growth lies above this threshold, the unemployment rate decreases and vice versa. The original findings of Okun have been criticized in the literature following his publication. Dornbusch and Fischer (1988) find that estimates of potential output and the link between unemployment and the GDP gap change over time

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and cannot be taken as a constant rule. Cuaresma (2003) shows that the contemporaneous effect of growth on unemployment is not symmetric and significantly higher in recessions. Empirical estimates indicate that a two to three percent GDP growth above natural or average GDP growth causes unemployment to decrease by one percentage point and vice versa (see Blanchard and Fischer (1989) or Romer (1996)). Mankiw (1994) argues that Okun's rule of thumb is closer to two than to three percentage points. Sögner (2001) analyzes the dependence of unemployment growth on annual real GDP growth for Austria. He finds neither structural breaks nor outliers in Okun's law in a sample of quarterly Austrian data covering the period 1977 to 1995. Moreover, Sögner (2001) found that neither changes in the political system, governmental employment programs nor migration have caused a systematic change in Austria's Okun's law.
Hence, he estimates Okun's law at a constant level of 4.16 Percent in the period between 1977 to 1995. Sögner and Stiassny (2002) again analyzed Okun's law for 15 OECD countries for the time period between 1964 and 2000 and found structural breaks in the Okun relation for some OECD countries, but not for Austria.
Discussion regarding the stability of Okun's law came up in many countries after the global financial crises. In the US, for instance, unemployment declined considerably despite weak growth. Several papers address this question – Meyer, Tasci et al. (2012) and (Owyang, Sekhposyan et al., 2012) for the US, Beaton (2010) for the US and Canada, Österholm (2016) for Sweden and Ball, Leigh and Loungani (2013) for 20 advanced economies.
In a recent paper, Christl, Köppl-Turyna and Kucsera (2016) showed that recent developments in the Austrian labor market can be attributed to an undergoing structural change in some of the most important sectors of the Austrian economy. Such changes might indeed influence Okun's law and thus questions the stability of Okun's law that has been reported for the period before the year 2000 by Sögner (2001) and Sögner and Stiassny (2002).
This paper contributes to the discussion on Okun's law's stability by analyzing the development of Okun's law in Austria for the time period from 1970 to 2015. Our results suggest that it is not stable over time. The estimated models show that, after entry into the European Union, the employment threshold decreased by almost one percentage point. Even though the employment threshold was decreasing, we again found an upward trend in recent years. This contrasts with findings for other European countries, such as Sweden, where Österholm (2016) showed that the employment threshold decreased continuously over the period from 2004 to 2014.
In section II, we describe the data and in section III we briefly present the empirical model. Section IV presents the empirical findings and robustness analyses. Finally, Section V concludes the paper.

II. The Data

In the following analysis, we use both yearly and quarterly data. As yearly data are available for a longer period, the main part is based on these data. Nevertheless, in order to provide more accurate results, and also as a robustness check, the analysis is repeated using quarterly data. This section describes both datasets.

The yearly data on unemployment is taken from Public Employment Service Austria (AMS), which counts all registered unemployed persons. Real GDP growth is taken from the database of the Austrian Federal Economic Chamber. Both time series are available from 1950 until 2014.
The quarterly real GDP growth and unemployment data are taken from the OECD database. Similarly to the yearly data, the second series count all registered unemployed persons. Unlike the yearly data, however, the quarterly time series are available only for a shorter period and cover the time span from Q1 1988 until Q1 2015. Both series are seasonally adjusted.
A visual inspection of the data in use reveals that the unemployment rate might be stationary, whereas the GDP index has been showing an upward trend. Yet a simple visual inspection cannot allow us to easily determine the stationarity of the unemployment series or whether the trend observed for GDP is deterministic or stochastic. To test for the stationarity of the time series, we use the ADF test and the PP test. The test results for the variables of interest are presented in Table 1. Both tests suggest that the level data has a unit root, also when considering the possibility of a deterministic trend in the real GDP index.

Table 1: Unit root tests (p-values)

	U		log(rGDP)	
	ADF	PP	ADF	PP
	Yearly data			
level	0.04	0.72	0.46	0.86
level, trend			0.30	0.29
dif	0.03	0.01	0.01	0.01
	Quarterly data			
level	0.29	0.05	0.79	0.96
level, trend	–	–	–	–
dif	0.00	0.00	0.00	0.00

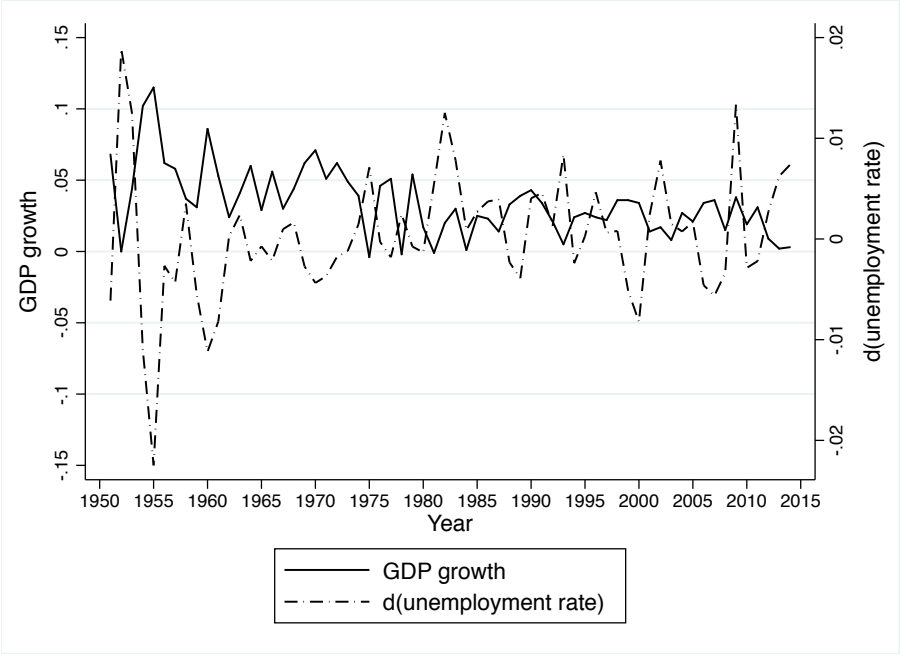
Taking first differences solves the problem of non-stationarity. We still need to check whether the data is not cointegrated. Using information criteria, we can establish that one lag of the differenced data should be used to test for cointegration. The results of the Johansen test are presented in Table 2.

Table 2: Cointegration test

Max rank	Parms	Eigenvalue	Trace	Crit. value
		Yearly data		
0	2		10.38	15.41
1	5	0.14	0.55	3.76
2	6	0.01		
		Quarterly data		
0	6		14.94	15.41
1	9	0.09	5.09	3.76
2	10	0.05		

We cannot reject the null hypothesis that there is no cointegrating relationship between GDP and the unemployment rate, therefore the OLS method can be applied, since the differenced series of the unemployment rate and real GDP growth are stationary. Figure 1 presents the development of the first differences of the unemployment rate and GDP growth over time.

Figure 1: Unemployment rate (first difference) and real GDP growth



Source: Public Employment Service Austria (AMS) and Austrian Federal Economic Chamber (WKO)

III. The empirical model

Traditionally, Okun's law states the empirical relationship between changes in the unemployment rate Δu_t and changes in output Δy_t. The "classical version" of Okun's law can be written as:

$$\Delta u_t = \beta_0 + \beta_1 \Delta y_t + \epsilon_t, \tag{1}$$

where β_1 is the so-called "Okun's coefficient". One would expect Okun's coefficient to be negative, so that output growth is associated with a falling unemployment rate and negative output growth is associated with a rising unemployment rate. The ratio $-\beta_0/\beta_1$ measures the rate of output growth consistent with a stable unemployment rate, or, in other

words, how quickly the economy would typically need to grow to maintain a given level of unemployment, the so-called "employment threshold".
To control for the lagged reaction on the labor market, the lags of the variables are included in the model, which leads to the "dynamic version" of Okun's law. Changes in Okun's law (Okun's coefficient) are affected by the business cycle, and also by the variation in the timing and relation between growth and unemployment rates (see, e.g. Knotek II, 2007). These facts suggest that the dynamic version of Okun's law should be the preferred model. Additionally, Meyer et al. (2012) suggest allowing for non-linear changes in the relationship between growth and changes in unemployment, which might solve the instability problem of the classic Okun's law.

$$\Delta u_t = \beta_0 + \beta_1 \Delta y_t + \beta_2 \Delta y_{t-1} + \beta_3 \Delta y_{t-2} + \gamma_1 \Delta u_{t-1} + \gamma_2 \Delta u_{t-2} + \epsilon_t \qquad (2)$$

Another reason for including past changes in the unemployment rate as explanatory variables in the dynamic version of Okun's law is to eliminate serial correlation in the error terms, which might constitute a problem when regressing the difference version of Okun's law.[4]
In this paper, we examine both versions of Okun's law for Austria to see whether the results for Okun's coefficient as well as for the employment threshold are robust across the different specifications.

IV. Results

Okun's law – the classical model

The linear relationship between changes in the unemployment rate and real GDP growth, as stated by Okun's law (Equation 1) will be tested for statistical significance in this section.

As expected, Okun's coefficient estimated for the period between 1970 and 2014 is negative and highly significant (see Table 3, Column 2). The rate of output growth that is consistent with a stable unemployment rate $\left(-\frac{\beta_0}{\beta_1}\right)$ equals 3.62 percent, with a 95% confidence interval between 2.97 and 4.27 percent.

Subsequently, we split the sample into two periods, one for the period within the European Union (from 1995 onwards) and one before entering the European Union (Table 3, Columns 3 and 4). Okun's coefficient is again negative and highly significant. The employment threshold $\left(-\frac{\beta_0}{\beta_1}\right)$ in the time period between 1995 and 2014 is distinctly lower, at 2.78 percent, and distinctly higher for the period between 1970 and 1995, at 4.42 percent.

[4] An alternative specification of Okun's law is called the "gap version". This states the relation between the gap of the actual unemployment rate u_t and the natural rate of unemployment u_t* and the output gap the difference between the actual output y_t and the potential output y_t*.

$$(u_t - u_t*) = \beta_0 + \beta_1 (y_t - y_t*) + \epsilon_t. \qquad (3)$$

As the interpretation of the coefficients differs strongly from the interpretation of the traditional and dynamic equation, we focus only on these two equations.

Table 3: Regression results for the classical formulation of Okun's law

	Dependent variable:		
	ΔU		
	1970–2014	1970–1995	1995–2014
Δ GDP	-0.178^{***}	-0.194^{***}	-0.175^{**}
	(0.025)	(0.026)	(0.099)
Constant	0.006^{***}	0.008^{***}	0.005^{**}
	(0.001)	(0.001)	(0.002)
Observations	64	45	20
Adjusted R^2	0.446	0.559	0.100
Residual Std. Error	0.005 (df = 62)	0.004 (df = 43)	0.005 (df = 18)
F Statistic	51.636^{***} (df = 1; 62)	56.784^{***} (df = 1; 43)	3.120^{***} (df = 1; 18)
D-W stat.	1.84	1.69	2.42
Breusch-Godfrey p-val	0.53	0.36	0.30
Employment threshold	0.0362	0.0442	0.0278
LL 95%	0.0297	0.0332	0.0140
UL 95%	0.0427	0.0469	0.0415
Note:			*p<0.1; **p<0.05; ***p<0.01

Figure 2: Rolling regression – classical formulation of Okun's law (yearly data)

Note: The figure presents the real output growth necessary to stabilize the unemployment rate that results from the rolling regression (with the length of 20 years) of classical formulation of Okun's law for yearly data. The sample starts with 1950 to 1970 and ends with the period 1994 to 2004.

To test the stability of these results over time, we use a rolling regression method for different time periods with a length of 20 years. The sample starts with the period 1950 to 1970 and ends with the period 1994 to 2014. Figure 2 shows the development of the rate of real output growth that is needed for a stable unemployment rate.
We can see that the employment threshold changes significantly over time. While in the 1970s it was close to 3.5 percent real GDP growth, it rose to 5.5 percent in the 1990s. Since entering the European Union, the threshold continuously has decreased to a level of 2.7 percent nowadays. Nevertheless, at the end of the examined period, and thus for the period comprising the recent financial crisis, the employment threshold has again started to increase.

Okun's law – dynamic model

The dynamic model adds more lags of real GDP and of the differences in the unemployment rate. The model specification is highlighted in Equation 2. The number of optimal lags in the model indicated by the Akaike's information criterion is two. Adding the lag structure to the model still shows statistically significant coefficients for Okun's law (Table 4, Column 2).

Table 4: Regression results for the dynamic formulation of the Okun's law before and after entering the EU

	Dependent variable:		
	ΔU		
	1970–2014	1970–1995	1995–2014
ΔGDP	-0.118^{***}	-0.139^{***}	-0.002
	(0.026)	(0.025)	(0.081)
ΔGDP_{t-1}	-0.076^{**}	-0.040	-0.418^{***}
	(0.032)	(0.034)	(0.084)
ΔGDP_{t-2}	0.015	-0.009	-0.056
	(0.032)	(0.035)	(0.110)
ΔU_{t-1}	0.138	0.230^{*}	-0.170
	(0.110)	(0.128)	(0.200)
ΔU_{t-1}	-0.248^{**}	-0.291^{**}	-0.613^{***}
	(0.114)	(0.131)	(0.186)
Constant	0.006^{***}	0.007^{***}	0.012^{***}
	(0.001)	(0.002)	(0.004)
Observations	62	43	18
Adjusted R^2	0.589	0.664	0.640
Residual Std. Error	0.004 (df = 56)	0.004 (df = 37)	0.003 (df = 12)
F Statistic	16.053^{***} (df = 5; 56)	17.613^{***} (df = 5; 37)	7.034^{***} (df = 5; 12)
D-W stat.	2.27	2.36	1.81
Breusch-Godfrey p-value	0.06	0.04	0.31

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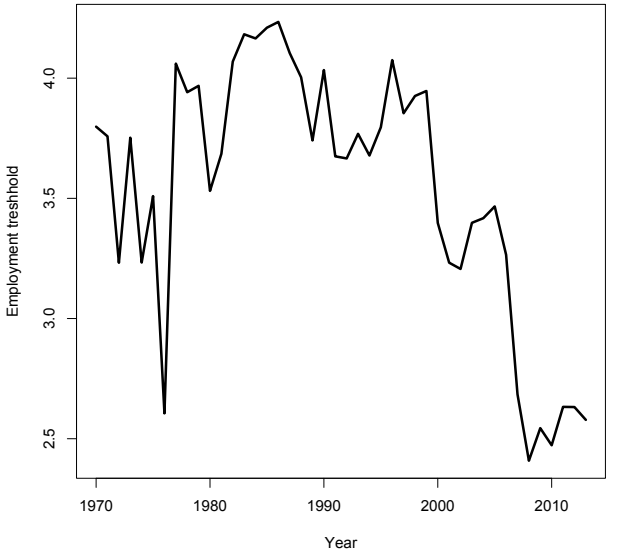
	Dependent variable:		
		ΔU	
	1970–2014	1970–1995	1995–2014
Employment threshold	0.0350	0.0384	0.0257
LL 95%	0.0294	0.0326	0.0228
UL 95%	0.0405	0.0440	0.0295
Note:			*p<0.1; **p<0.05; ***p<0.01

In the dynamic version of Okun's law, the rate of output growth consistent with a stable unemployment rate $\left(-\frac{\beta_0}{\beta_1+\beta_2+\beta_3}\right)$ is 3.50 percent in the long-run relation between 1970 and 2014, with a 95% confidence interval of 2.94 percent to 4.05 percent.
Dividing the sample again into two periods, before and after entering the EU, we can again observe that the estimation results are not constant over time (Table 4, Columns 3 and 4). While in the period between 1970 and 1995 reactions of the labor market to changes in GDP growth have taken place almost without any delay (β_1 is highly significant, while the lags show no significance), in the period between 1995 and 2014, the labor market seems to react a year later to changes in output (β_2 is highly significant). The employment threshold rises to 3.84 percent for the period 1970 to 1995, while it is generally lower, at the level of 2.57 percent, for the period within the European Union.

Figure 3: Rolling regression – dynamic formulation of the Okun's law (yearly data)



Note: The figure presents the real output growth necessary to stabilize the unemployment rate that results from the rolling regression (with the length of 20 years) of the dynamic formulation of Okun's law for yearly data. The sample starts with 1950 to 1970 and ends with the period 1994 to 2014.

To test the stability of these results over time, we again use the rolling regression method for different time periods with the length of 20 years. The sample starts with the period 1950 to 1970 and ends with the period 1994 to 2014.
The employment threshold changes significantly over time. In the 1970s, the threshold was close to 3.5 percent real GDP growth. By 1990 it had risen to its maximum of 4.3 percent. Since entry into the European Union, the threshold has continuously decreased to the level of 2.6 percent. Analogously as for the case of the classical Okuns law, an increase in the threshold at the end of the examined period can be observed.

Okun's law for quarterly data

As a robustness test, we conduct the same analysis for quarterly data. In particular, we are interested in the results of the rolling regression that provides insights regarding the development of Okun's coefficient over time. In order to compare the results of the regression from yearly and quarterly data, we estimate Okun's law for the period after accession to the EU. Table 5 highlights the results of the regression. The first column shows the classical equation of Okun's law, while the second column presents the dynamic version with one lag of the unemployment growth variable (indicated by the Akaike's information criterion).

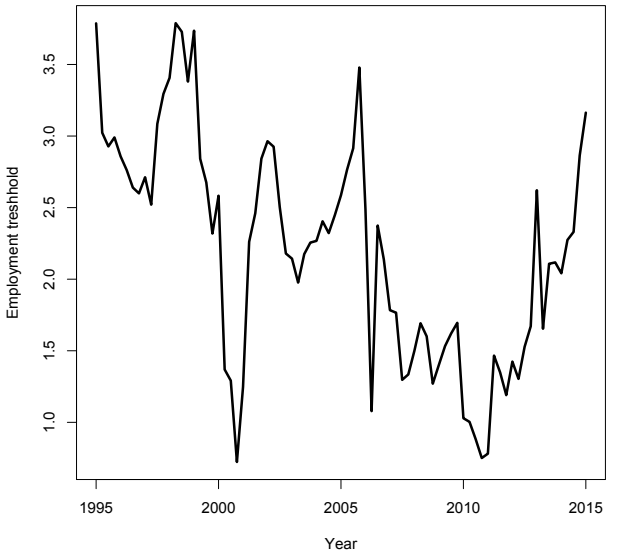
Table 5: Regression results for quarterly data

	Dependent variable:	
	ΔU	
	Classic	Dynamic
ΔGDP	-0.156^{***}	-0.124^{***}
	(0.022)	(0.019)
ΔU_{t-1}		0.004^{***}
		(0.001)
Constant	0.001^{***}	0.001^{***}
	(0.0002)	(0.0002)
Observations	82	81
R^2	0.395	0.574
Adjusted R^2	0.387	0.563
Residual Std. Error	0.001 (df = 80)	0.001 (df = 78)
F Statistic	52.232^{***} (df = 1; 80)	52.442^{***} (df = 2; 78)
D-W stat.	1.27	2.17
Breusch-Godfrey p-val	0.001	0.22
Employment threshold	0.0255	0.0237
LL 95%	0.0172	0.0149
UL 95%	0.0337	0.0326

Note: *p<0.1; **p<0.05; ***p<0.01

The results are in line with the ones based on yearly data (see Tables 3 and 4). In the classical version of Okun's law, the indicated rate of output growth consistent with a stable unemployment rate after the entry to the EU equals 2.55 percent (in comparison to 2.78 percent using yearly data). Similarly, the employment threshold indicated by the dynamic version of Okun's law is also slightly lower for quarterly data, namely 2.33 percent (2.57 for the yearly data).
Since more observations are available for the quarterly data, for the stability analysis we again use the rolling regression method for different time periods with the length of five years (20 quarterly observations). The results of the rolling regression are depicted in Figure 4.

Figure 4: Rolling regression – dynamic formulation of Okun's law (quarterly data)



Note: The figure presents the real output growth necessary to stabilize the unemployment rate that results from the rolling regression (with the length of 20 observations) of the dynamic formulation of Okun's law for yearly data. The sample starts with Q1 1990 to Q4 1994 and ends with the period Q2 2010 to Q1 2015.

One can observe that the employment threshold changes significantly over time. Since entry to the European Union, the threshold continuously decreased, to 1 percent by 2010. After this, the threshold increased again to the current value of 3 percent.

Discussion of the results

In this section, we compare the employment threshold development over time for the classical and dynamic formulation of Okun's law as well as for the development indicated by the quarterly data. Since the dynamic model controls for the changes in the dynamics of unemployment, only this model is introduced for the quarterly data.

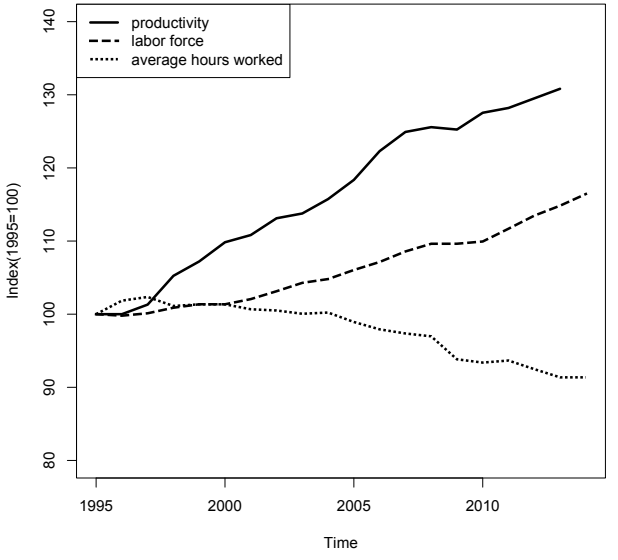
Figure 5: Comparison of employment thresholds

Comparing the results of the classical and the dynamic Okun's law, we can see that the development of the employment threshold is quite similar at the beginning and at the end of the time series, but in the period between 1990 and 2000, the employment threshold rises for the classical Okun's law, while it remains quite stable for the dynamic one. The reason is that in this period the change in the output seems to affect employment later than in the periods before (see Table 4). Since the dynamic model covers these changes, it does not show any reaction in Okun's coefficient in this period.

The dynamic version of Okun's law indicates that the rolling regression results for quarterly data lie under the ones indicated by the yearly data. This has its roots in the shorter estimation period for the rolling regression using quarterly data (although in the regressions the number of the observations remains same). Nevertheless, the employment threshold decreased after entering the EU and remained low until 2010. The reason for this decline is the stepwise deregulation of the job market. Job markets react to changes in output along with the business cycle, suggesting that the long-run unemployment rate is not constant over time. Since wage reductions in the lower growth phases might negatively affect the productivity of workers, companies attempt to avoid wage reductions and prefer to react either with external (lay-offs) or internal (reduction of working hours, restructuring) adjustments. Those adjustments depend heavily on regulations in the labor market. High

employment protection reduces not only lay-offs in recessions and slowdowns, but also the reemployment possibilities during recoveries (the expected costs of firing are taken into account at the time of the employment decision by the employer). In a flexible job market, such as in the US, the employer might prefer external over internal adjustments during a slowdown or a recession, while in starkly regulated job markets such as in Germany or Austria, the unemployment rate reacts only moderately, whereas the hours worked reduce significantly (see, e.g. Cazes, Verick and Al Hussami (2013)). These factors contribute to the fact that strongly regulated job markets typically require higher growth rates to keep the unemployment rates stable. Hence, after the 2009 crisis, the employment threshold has increased again. This increase is especially visible when we use quarterly data.
Following Cazes et al. (2013), three factors are responsible for the short-run increase in the employment threshold: an increase in hours worked per worker, an increase in productivity of the workers and an increase in the size of the labor force. Figure 6 depicts these indicators for the case of Austria, and shows a strong increase in the size of the labor force after 2011, whereas productivity growth remains low. The hours worked per worker show a general downward trend that does not seem to have changed in recent years.

Figure 6: Development of labor market characteristics



Source: OECD and EUROSTAT

Additionally, Balakrishnan, Das and Kannan (2010) suggest that the short-time work programs that were often used in countries such as Germany and Austria during the crisis might have kept Okun's coefficient low during this period, and therefore the employment threshold remained low until 2013. Once the programs were no longer used, the employment coefficient rises sharply in our case.

The influence of other labor market conditions on the employment threshold is not discussed in this paper, but will be the focus of future research. Ball et al. (2013) suggest that the cross-country differences in Okun's coefficient are partially explained by idiosyncratic features of the national labor markets. This implies that, in the long run, changes in national labor market conditions might influence Okun's coefficient and therefore the employment threshold. Among these factors, employment protection and other job market regulations require special attention.

V. Conclusion

Our results suggest that the employment threshold – the GDP growth that is needed for a stable unemployment rate – is not stable over time. All the estimated models show that, after entry to the European Union, the employment threshold decreased by almost one percentage point. This is in line with other studies in the literature[5].

The empirical examination of Okun's law in Austria suggests that an increase in real GDP between 2.3 and 3.0 percent was necessary in the period since entry to the European Union in order to keep the unemployment rate constant. Even though the employment threshold was decreasing until 2010, all models show a strong upward trend in recent years. Following Cazes et al. (2013), we relate this finding to the increase in the labor supply in the Austrian labor market.

Real GDP growth in the coming years is forecasted to be low, in particular much lower than the predicted employment threshold. Combining GDP forecasts with the results of the recent employment thresholds that are suggested by Okun's law for past years leads to the conclusion that not even the most optimistic GDP forecast will in any case be close to the employment threshold. Therefore, the probability of increasing unemployment in the coming years seems to be high. Keeping in mind that the labor force in Austria is constantly growing not only because of the recent restrictions to the early retirement, but also because of increasing immigration, the unemployment rate in Austria will increase further in the next years if the predicted GDP growth forecasts turn out to be true. As a result, there seems to be no sign of relaxation in labor market conditions in Austria until 2017.

[5] Österholm (2016) shows a similar decrease after Sweden entered the European Union.

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