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Augmented okun's law within the emu: working-time or employment adjustment? a structural equation model

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Abstract

This paper examines the output-unemployment-working-time nexus within the European Monetary Union (EMU) with a dedicated focus on the impact of the Great Recession (2007-2013). Using recursive structural equation model (R-SEM) for the first time on this topic, we estimate an augmented Okun's law equation that includes the number of worked hours. The results confirm the existence of a significant and negative relation between output and unemployment and reveal a significant and positive relation between output gap and working-time. Three groups of countries according to the type of labour market response to an output variation have been identified. A first group characterized by a unilateral unemployment response, a second group characterized by a working-time response and a third group characterized by a complementary effect of both unemployment and working-time adjustment towards an output variation.

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1. Introduction

Sound knowledge of the adjustment mechanisms between output gap and unemployment is essential to elaborate adequate and efficient public policies. With the Great Recession (2007-2013), this relation has been deeply challenged, especially within the European Monetary Union (EMU). While the degree of integration of this region is significant, compared to other regional cooperation, European national labour markets didn't respond the same way when the economic growth declined. For example, unemployment rates exploded in Spain or in Greece, increasing respectively 20% and 25% over the period 2007-2013, while unemployment rate in Germany or in Austria were maintained at a low level over the same period.

What are the mechanisms behind this disparity? To identify and study the factors explaining such a disparity, we use Okun's law (1962) concept that establishes empirical evidence of a significant and negative relation between output gap and unemployment gap. Okun (1962) while studying this relationship for the US finds that a one-percentage point increase in unemployment is associated to a three percent decrease in output. A wide empirical literature widely investigated Okun coefficients all over the world. Examples can be found in Coen and Hickman (2006), Lee (2000), Harris and Silverstone (2001), Sögner and Stiassny (2002), Malley and Molana (2008), Apergis and Rezitis (2003), Adanu (2005), Villaverde and Maza (2007, 2009) or Durech, Minea, Mustea and Slusna (2014). Within the EMU, European labor markets' employment responses to a variation of output are usually less than in the US, even if since the 80's Okun coefficients increase thanks to a lower employment protection (Blanchard and Illing, 2004).

In this paper, we assume that Okun's equation is incomplete. While facing an economic downturn (growth), employers can choose between two options: firing (hiring) someone or adjusting the working time of their employees by reducing (increasing) the number of worked hours. In other words, employers can decide to use internal flexibility to adjust their working labour force to a variation of the output, instead of recruiting or firing someone. This recourse depends of course on the degree of regulation of the labour market. The Great Recession highlights this phenomenon for several European countries. A recent growing literature tries to explain this strategy, as for example, Marelli, Signorelli and Tyrowicz (2012), Reisenbichler and Morgan (2012), Bentolila, Cahuc, Dolado, and Le Barbanchon (2012), Rinne and Zimmermann (2013) or Kümmerling and Lehndorff (2014). Most results shed light on Germany and to a lesser extend Italy, as strong cases of internal flexibility recourse, while Spanish and Irish labour markets responses focus on employment strategies. However these studies do not directly investigate the relations between output gap, unemployment and worked hours. In this regard, we decide to use an augmented Okun's equation that includes unemployment rate but also working-time.

This study makes several main contributions to the current empirical literature on this research area: first, to estimate our augmented Okun's equation we use for the first time in the literature, a Recursive Structural Equation Model (R-SEM). More robust than a simple

OLS regression commonly used to estimate Okun coefficients, the R-SEM allow us to take into account the relationship between unemployment rate and working-hours. Second, we increase our knowledge of the adjustment mechanisms between output gap, unemployment rate and working-time. Third, as we investigate this output-unemployment-working time nexus within the EMU-12, referring to its twelve historical State Members, we can better understand how the EMU functions, over the period 1995-2013.

The rest of the paper is organized as follows. Section 2 describes the methodology and data while section 3estimates and analyzes the main results. We conclude in the last section.

2. Methodology and data

2.1 Methodology

While Okun's law can be estimated through two versions, the difference version and the gap version, it is customary to use the latter one which takes into account cyclical deviations from long-term trends, so do we. The common gap equation is:

$$y_t - \bar{y} = \alpha + \beta_1(u_t - \bar{u}) + \varepsilon_t \quad (1)$$

Where y_t is the output, $\bar{y}$ is the log of potential output (trend of GDP), u_t is unemployment, $\bar{u}$ is the natural rate of unemployment rate (trend unemployment), β_1 is the Okun coefficient, α is the constant and ε_t is the error term. Besides, $(y_t - \bar{y})$ captures the cyclical level of output (output gap), while $(u_t - \bar{u})$ reflects the cyclical of unemployment (unemployment gap).

As explained earlier, we assume that Okun's equation is incomplete and needs to be augmented by adding working-time dimension on the right-hand side of the equation, near unemployment gap term. We will therefore be able to capture another dimension of employers' response to an output gap variation. Augmented Okun's equation becomes:

$$y_t - \bar{y} = \alpha + \beta_1(u_t - \bar{u}) + \beta_2(wt_t - \overline{wt}) + \varepsilon_t \quad (2)$$

Where wt_t is the number of worked hours and $\overline{wt}$ is the potential number of worked hours (trend working-time). β_2 is the working-time gap coefficient where $(wt_t - \overline{wt})$ captures the cyclical level of working-time (working-time gap).

To estimate the unobserved variables$\bar{y}$, $\bar{u}$ and $\overline{wt}$, among several detrending techniques the empirical literature recognizes, we choose to apply Hodrick-Prescott (HP, 1997) filter[1].

2.2 Data

The study uses yearly data and covers the period from 1995 to 2013 for the first twelve historical EMU Member States. We capture the output by real GDP in million of US Dollar,

[1]We also used Baxter-King filter for robustness check. Results are available upon request.

in constant prices (*GDP*), while unemployment is measured by the unemployment rate (*UR*) as defined by OECD. Working-time (WT) is measured by the average annual hours actually worked per worker given by OECD. Appendix 1 reports a selection of summary statistics for the three series.

Conducting R-SEM regression requires two preconditions on the data. First, our data series have to be stationarity and second Pearson correlations between unemployment and working-time gaps have to be enough high to obtain results different from simple OLS regression.

Table 1: Individual Unit Root Tests / Stationary tests for output, unemployment and working-time gaps

		HP		
Country	**Method**	**GDP_gap**	**UR_gap**	**P_gap**
EMU – 12	*ADF*	-3.44**	-2.8**	-3.4**
	KPSS	0.052	0.0675	0.05
Austria	*ADF*	-3.54***	-3.09**	-4.17***
	KPSS	0.051	0.0575	0.0506
Belgium	*ADF*	-3.74***	-3.06**	-4.28***
	KPSS	0.0481	0.0541	0.0417
Finland	*ADF*	-3.74***	-3.7**	-3.32**
	KPSS	0.0399	0.0469	0.0499
France	*ADF*	-3.59***	-3.19**	-4.04***
	KPSS	0.0467	0.0545	0.0488
Germany	*ADF*	-3.84***	-2.5	-4.83***
	KPSS	0.0397	0.0788	0.0325
Greece	*ADF*	-2.03	-2.1	-3.41*
	KPSS	0.15	0.153	0.0682
Ireland	*ADF*	-3.1**	-2.31	-1.7
	KPSS	0.13	0.08	0.0809
Italy	*ADF*	-5.51***	-3.46***	-3.91***
	KPSS	0.0387	0.0726	0.05
Luxembourg	*ADF*	-2.95*	-3.06*	-3.39*
	KPSS	0.071	0.0658	0.0533
Netherlands	*ADF*	-3.1**	-2.31	-4.32***
	KPSS	0.061	0.0849	0.045
Portugal	*ADF*	-3.21**	-2.8*	-6.34***
	KPSS	0.0887	0.0931	0.0303
Spain	*ADF*	-2.5	-2.4	-2.29
	KPSS	0.119	0.088	0.1

Notes:
1.*, ** and *** denote respectively 10%, 5% and 1% level of significance.
2. Results are based on HP computations.

We conduct as a first step unit root and stationarity tests using the unit root Augmented Dickey-Fuller (ADF) test and the stationarity Kwiatkovski-Phillips-Schmidt-Shin (KPSS) test. The results reported in table 1 show that our three series are stationary for ten out of twelve EMU Member States (exceptions are Spain and Greece) and for the EMU-12 as a whole.

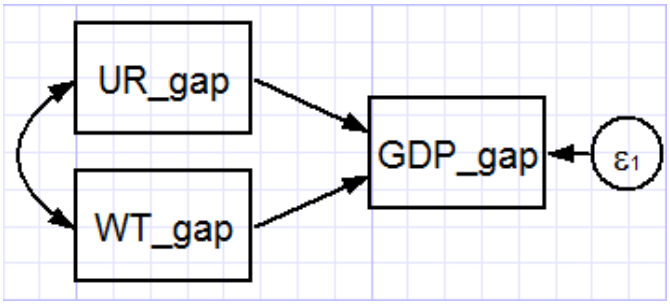
As a second step, we measure Pearson correlations between unemployment and working-time gaps (table 2) within the EMU-12. Eight out of twelve EMU Member States have a correlation higher or equals to 0.30, namely Austria, Belgium, Finland, Greece, Ireland, Netherlands, Portugal and Spain (exception are Germany, France, Italy and Luxembourg). Here we have also found unexpectedly positive correlations for some of the countries including France, Greece, Luxembourg and Spain. However, as our sample covers the period of the great recession, one can link the noise in the data, to the several other factors that also caused variation in the unemployment, yet not accounted for in this model.

Table 2: Pearson correlations between unemployment and working-time gaps

	Pearson Correlation
Austria	-0.46
Belgium	-0.56
Finland	-0.30
France	0.13
Germany	-0.09
Greece	0.67
Ireland	-0.84
Italy	-0.25
Luxembourg	0.20
Netherlands	-0.30
Portugal	-0.30
Spain	0.59
EMU-12	**-0.23**

We are able now to specify our R-SEM. Figure 1 represents the path diagram describing it. We estimate the structural model with the maximum likelihood (ML) method. Compared to the Ordinary Least Squares (OLS) regression that only includes the first step of R-SEM regression, R-SEM proceeds in four steps. After having estimated a first preliminary set of values for the coefficients, it estimates an adjusted covariance matrix. This latter allows estimating a second round of set of values. The process ends when convergence is obtained.

Figure 1: Path diagram



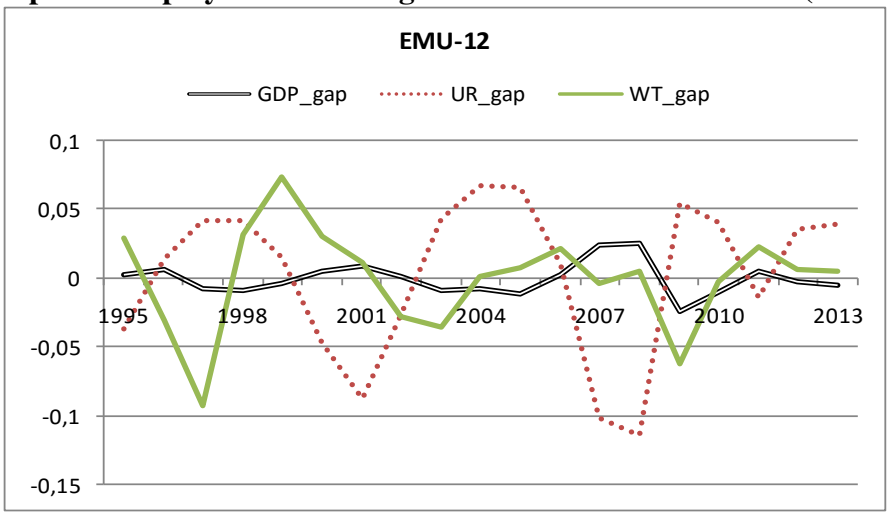
We are now able to estimate the R-SEM and to discuss our results in section 3.

3. Empirical Results

3.1 Pictorial Evidence

We first plot the cyclical components of output, unemployment and working time series based on HP computations (figure 2). For the EMU-12 as a whole, figure 2 shows clear evidence of a negative relationship between output and unemployment gaps, thus confirming Moosa's (1997) observation that the output and unemployment gaps often tend to cross close to the zero line. Figure 2 also shows positive relationship between output and working-time gaps, except for years 2004 and 2005. Looking into country-wise details (in appendix 2), we find narrow relations between output, unemployment and working-time gaps for 7 out of 12 countries (Belgium, Germany, France, Finland, Ireland, Italy, and Netherlands).

Figure 2: Output-unemployment-working time nexus for the EMU-12 (1995-2013)



3.2 Empirical Evidence

The second step is dedicated to Okun and working-time's coefficients estimation. We first estimate our R-SEM for the EMU-12 and subsequently for its Member States (table 3). For EMU-12 during the overall sample period, only Okun coefficient is significant and negative, equals to -0.18. However, a closer look, focussing on the Great Recession, records not only a significant and higher Okun coefficient of -0.21 but also to a significant and positive working time coefficient of 0.20. The covariance between unemployment and working time is however non-significant. This result implies that the increase in the unemployment over the

said period was not primarily due to the decrease in working time but due to the overall economic condition of the region. In this regard, the working-time crisis response at EMU level is obvious: employers during the recession took the opportunity to adjust their labour force to the output variation with an adjustment of the number of worked hours. However, one must take caution that as, besides using annual data, the sample period includes the years of Great Recession, the results are likely identified from only a partial segment of the overall business cycle and may not fully reflect general dynamics over the entire business cycle.

Table 3: Results of the R-SEM

	1995-2013			Great Recession (2007/13)		
Country	β_1	β_2	cov.	β_1	β_2	cov.
EMU-12	**-0.18*** **	**NS**	**NS**	**-0.21*** **	**0.20*** **	**NS**
Austria	-0.64***	NS	+	NS	0.42***	+
Belgium	-0.47**	0.96***	+	NS	2.11***	+
Finland	-2.96***	NS	NS	-2.67***	NS	+
France	-1.17***	NS	NS	NS	NS	+
Germany	-1.07***	0.71***	NS	-1.47***	0.74***	+
Greece	-1.41***	NS	+	-2.1***	NS	+
Ireland	-1.4***	NS	+	-2.69***	NS	+
Italy	-0.87*	0.78*	NS	-0.52**	1.21***	+
Luxembourg	NS	-0.87***	NS	NS	-1.02**	+
Netherlands	-0.91***	NS	NS	-1.1***	NS	+
Portugal	-1.16***	NS	NS	-1.68***	NS	NS
Spain	-0.10***	NS	+	-0.12***	NS	+

Notes:
1. *, ** and *** denote respectively 10%, 5% and 1% level of significance. NS means Not Significant.
2. $\beta_1$is the Okun coefficient and $\beta_2$is the working-time coefficient. Cov represents the covariance between unemployment gap and working-time gap.
3. OLS regression has been conducted for robustness. Results, available upon request, show differences with R-SEM results concerning some Member States.

Table 3 also shows the results of R-SEM for the twelve individual EMU Member States. All of them show significant Okun coefficients over the whole period of 1995-2013 (with the exception of Luxembourg), thus establishing a valid negative relationship between the output and unemployment gaps, in accordance with Okun's law. As expected, the results highlight sizeable variations among the Member States. The magnitude of Okun coefficients deviates from -2.96 for Finland to -0.10 for Spain. These results are in line with most of the previous studies (Villaverde and Maza, 2009; Binet and Fouquau, 2013).Besides, the results reveal when significant a positive relation between output and working-time gaps (with the exception of Luxembourg).Here it is worth-noting that we find smaller coefficient for the EMU-12 is mainly due to the heterogeneity bias which is well explained through the significant variance in the magnitudes of coefficients for individual economies.

To usefully discuss our results, we divide our sample into three groups of countries on the basis of the stimulus variation towards output variation (table 4). The first group gathers EMU countries for which there is a complementary effect between unemployment gap and working-time time towards output gap variation. This group includes Germany and Italy for the Great Recession period. However, national labour market crisis responses are not the

same: in Germany, the adjustment is emphasized on the unemployment gap (-1.47 compared to -1.07 for the whole period), while working-time coefficients are comparable (0.74 compared to 0.71 for the whole period). On the contrary, the adjustment by the Italian labour market is emphasized on the working-time gap (1.21 compared to 0.78 for the whole period). Roots of this difference can be found in the German labour market reforms launched in 2000s through Hartz-reforms period and their revision during the last years of 2000s, which introduced a high degree of flexibility on the labour market. Before the crisis, a set of working-time schemes already existed well represented by the "mini-jobs" and short-time concepts, which couldn't be more used by the employers when the Great Recession started in 2007.Wage flexibility and decentralized collective bargaining mechanisms complete the German labour market toolkit. Italian working-time schemes are more recent and strong sharing-time measures have mainly been taken at the beginning of the Great Recession, explaining why working-time coefficient is much higher during this period than for the whole period. Besides, the Italian system of wage bargaining is comparable to the German one, characterised by a broad regulation and a high level of collective agreement coverage.

The second group of countries is characterized by a preponderant role of employment adjustment during the Great Recession. Finland, Greece, Ireland, Netherlands, Portugal and Spain belong to this group. National unemployment rates, especially in the youth population, exploded when the economic downturn started in 2007/08. In Spain and in the Netherlands for example, national employment protection legislations promoted temporary contracts for decades. As firing costs of temporary workers were significantly lower than for permanent workers and as regulations on the use of short-term contracts were lighter, the main transmission mechanism of the economic shock in 2007 has been temporary employment. Then, in the middle of the crisis, these flexibility measures combine changes in working time and in wages.

Table 4: European labour market crisis responses to output variation

	Unemployment	**Working-time**	**Both**
1995-2013	Austria, Finland, France, Greece, Ireland, Netherlands, Portugal, Spain	Luxembourg	Belgium, Germany, Italy
Great Recession (2007/13)	Finland, Greece, Ireland, Netherlands, Portugal, Spain	Austria, Belgium, Luxembourg	Germany, Italy, EMU-12

The last group of countries is characterized by a preponderant role of working-time adjustment during the Great Recession. Austria, Belgium and Luxembourg belong to this third group. In Belgium, short-time working schemes and overtime measures widely used by employers implied a lower declined in employment than the reduction of the number of worked hours. In the middle of the crisis, agreements on flexible working-time arrangements between employers and trade unions completed the Belgian labour market legislation. Belgium is also characterised by a regulated system of wage bargaining with several inter-sectoral agreements and the important role of the government. In Austria, short-term working measures were quickly amended, when the crisis started, towards more flexibility. Luxembourg stands out as there is a negative relation between working-time gap and output

gap, while at the same time the country has not been significantly affected by the Great Recession.

It is also worth explaining that the wide disparity in national labour market crisis responses within the EMU-12 must be associated to a difference of the intensity of the shock on the national GDP and to the previous national divergences in competitiveness.

4. Conclusion

This study investigates output-unemployment-working-time nexus within the EMU-12 for the first time by using an augmented Okun's equation over the period 1995-2013. By estimating a recursive structural equation model, we obtained several interesting results that we compare with the Great Recession period (2007-2013). We first confirm empirical evidence of a significant and negative relation between output and unemployment within the EMU. Besides, a significant and positive relation between output and working-time is found for some of the EMU Member States, especially during the Great Recession.

Three main transmission channels of labour market crisis responses are identified: a first channel which corresponds to a complementary effect of employment adjustment and working-time measures; a second channel which highlights a preponderant role of employment adjustment, while the last channel highlights a preponderant role of working-time adjustment.

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