

OKUN'S LAW: AN EMPIRICAL INVESTIGATION INTO EUROZONE GROWTH AND UNEMPLOYMENT

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The financial crisis has had a profound impact on the Eurozone in terms of monetary and fiscal policy. In this econometric investigation, Stephen Garavan examines whether the relationship between growth and unemployment stipulated by Okun's Law has continued to hold during this period of economic turmoil. He uses panel data and a fixed effects regression to analyse this and to determine whether there is asymmetry in the short-run relationship between economic growth and changes in unemployment, concluding that Okun's Law remains an important rule-of-thumb for policymakers.

Introduction

Okun's Law (Okun, 1962) describes a simple stylized fact: in the short-run, there is a tight negative relationship between economic output and changes in unemployment. This simple observation became a fixture in most undergraduate macroeconomic textbooks (see for example Sørensen and Whitta-Jacobsen, 2010). Okun's Law, which describes how unemployment can fall by a fixed proportion as output grows above a certain rate, contains within it two basic implications of interest. Firstly, pro-growth economic policy is immediately justified under an assumption that low unemployment is a desirable outcome for policy-makers. Secondly, if this condition does indeed hold, economic growth is required *ceteris paribus* in all time periods in order to maintain, or indeed decrease, nominal unemployment level. The necessity for perpetual growth is built in to Okun's framework for understanding the short-run relationship between growth and unemployment.

The purpose of this paper is to offer a reassessment of Okun's law for the Eurozone between 2002 and 2013. This period not only saw the onset of the Great Recession but also sharp structural change within the currency block. Recent literature (IMF, 2010) has indicated that Okun's Law broke down during the Great Recession and for the U.S. finds little correlation between output growth and unemployment. Of particular interest to this paper will, therefore, be an empirical investigation into whether Okun's Law did indeed undergo a structural change following the Great Recession for the Eurozone countries. Similarly, an empirical investigation into asymmetries within the relationship between output growth and unemployment will be attempted. In effect, an

assessment of whether the relationship between economic growth and unemployment differs during periods of expansion and contraction will be conducted.

Literary Review

Okun's Law has been estimated by a number of different methodologies in economic literature. For example, Knotek (2007) gives an assessment of the various methodologies by which Okun's Law can be calculated. The difference method provides the empirical methodology, which this paper will attempt to follow. In effect, this method captures a contemporaneous correlation between output growth and unemployment. By regressing real output growth on changes in the unemployment rate, a simple ratio of the coefficient for output growth to changes in the unemployment rate can be found. This provides the rate of output growth that is consistent with a stable unemployment rate.

Moosa (1997) has shown that the magnitude of Okun's Law tends to vary. The country and time period chosen for study, as well as the model specifications and controls chosen, were all shown to affect the magnitude of Okun's Law. The variation in Okun's Law between countries is also presented by Ball et al. (2013). Importantly, they assert that Okun's Law remains valid following the Great Recession of 2008. Economou and Psarinos (2013) show that the short-run relationship between output growth and unemployment is weaker for countries with labour market protection. Given the relative level of labour market protection in Europe, this finding might indicate that a weaker short-run relationship between economic growth and unemployment could be found in the Eurozone compared to the U.S.

The heterogeneity within the short-run relationship between output growth and changes in unemployment is further explored by Silvapulle et al. (2004). Okun's Law is shown to be asymmetric, where the short-run relationship between positive and negative cyclical economic growth and unemployment are shown to be quantitatively different. Virén (2001) asserts that this is of particular importance within the European Monetary Union as the various countries within it could be on different stages within their own business cycles. Various methods have been used to attempt to estimate and control for this asymmetry. Giovanni Busetta, and Dario Corse (2012) create a Heaviside step function into which the economic growth rate is econometrically split into its positive and negative effects.

Empirical Approach

In an attempt to evaluate Okun's law for the Eurozone between 2002 and 2013, a panel dataset was selected. Its advantage over time-series data is that it allows for the control of unobservable time-invariant factors. This is a considerable advantage when one imagines the cultural and other time invariant factors which effect the labour market across the Eurozone. Firstly, a simple difference version Okun's Law, as described by Knotek, will

be discussed.

$$\Delta U_{i,t} = \beta_0 + \beta_1 GDPg_{i,t} + a_i + \epsilon_{i,t} \quad (1.1)$$

The variable $GDPg_{(i,t)}$ is the main explanatory variable. The estimator β_1 should show the basic relationship between GDP growth and a change in unemployment. This should be expected to be negative, that is, as GDP growth increases, unemployment should be expected to fall.

The variable a_i captures the unobserved time invariant factors within the model. This parameter should capture factors such as country-specific labour market or cultural features which do not change across the time period in question. If such features were not controlled for, spurious relationships could be generated during econometric estimation.

From equation 1.1 it will be also possible to estimate the level of output growth that the Eurozone would on average need in order to maintain stable unemployment, in accordance with the method proposed by Knotek (2007).

$$\bar{g}_i = -\beta_0 / \beta_1 \quad (1.2)$$

Under *ceteris paribus* conditions, \bar{g}_i is the rate of output which policy makers will need to achieve in order to avoid rising unemployment.

Equation 1.2, through the inclusion of additional variables, can be used to test for whether Okun's Law underwent a regime change following the Great Recession. It can further be used to test for asymmetry within the relationship between both positive and negative economic growth and unemployment.

$$\Delta U_{i,t} = \beta_0 + \delta_1 dY(2008-2013)_t + \beta_1 GDPg_{i,t} + \beta_2 (+\Delta yDUMMY)_{i,t} + \beta_3 POSITIVEGROWTH_{i,t} + \alpha_i + \epsilon_{i,t} \quad (1.3)$$

The variable $dY(2008-2013)_t$ is a dummy variable, which takes on a value of zero if the observation is between 2002 and 2007 inclusive, and a value of one if between 2008 and 2013 inclusive. The variable $(+\Delta yDUMMY)_{i,t}$ is a dummy variable, which is given a value of zero for years with negative growth (i.e. recession years) and a value of one for years of positive growth. To avoid perfect collinearity, for both measures only one temporal dummy variable is included (Wooldridge 2013).

The variable $\beta_3 POSITIVEGROWTH_{i,t}$ is an interaction term between $(+\Delta yDUMMY)_{i,t}$ and $GDPg_{i,t}$. If the estimated coefficient on this term β_3 can be shown to be statistically significant, the short-run relationship between economic growth and unemployment can be shown to be asymmetric. That is, positive and negative economic

growth rates have a statistically different relationship to the change in unemployment.

Equation 1.1. and 1.2 were first estimated using both the Random Effects (RE) estimation and Fixed Effects (FE) estimation methods. A Hausman Test (Wooldridge 2013) was conducted to test for the most appropriate method. The Fixed Estimation method (Wooldridge 2013) was shown to be preferable, and so this was used for estimating the above model. This method of estimation also makes econometric sense from a theoretical perspective. FE estimation removes the unobserved time-constant factors within the model that vary across Eurozone countries. By theoretical definition, this variable contains serial correlation since it is constant across time, which supports its removal by FE estimation. Furthermore, RE estimation relies on the assumption that $Cov(\alpha_i, x_{it})=0$ (Wooldridge 2013). By intuition, it would appear likely that those country-specific time-invariant factors such as labour-market regulations would be correlated with economic growth. The grounding assumption of RE estimation would appear violated. Both theory and empirical testing therefore both supports this paper's choice of FE estimation.

A further issue that requires attention is the possibility of autocorrelation within the panel time-series unemployment and GDP data. A test for first-order autocorrelation on STATA failed to show any at any reasonable significance level and so this potential problem was discounted due to lack of immediate statistical evidence.

Data

All data was obtained from the IMF online database (IMF 2015). The panel consists of the 19 current European Union member states who use the Euro as their legal tender. These are as follows: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia and Spain. The time period in question is from 2002 to 2013 inclusive. Some of these countries such as Latvia and Lithuania only joined the Eurozone in 2014 and 2015 respectively. It is important to note that this paper is not an attempt at understanding the impact of the Euro on the short-run relationship between economic growth and employment. Rather it is a simple exploration of this dynamic for the countries that currently make up the monetary block. For this reason, Lithuania and Latvia, along with the other countries which joined the Eurozone during this papers years of study, were included.

Some data series required for this paper were not immediately available on the IMF database and required some calculations. The change in unemployment was calculated manually by taking the unemployment percentage of the previous year away from the unemployment percentage of the current year in order to calculate a panel dataset as follows.

$$U_{i,t} - U_{i,t-1} = \Delta U_{i,t} \quad (2.1)$$

This method required obtaining panel statistics on the year 2001 from the IMF database in order to calculate the 2002 time period. One can certainly imagine unobserved statistical variations within this method of calculation, such as the change in unemployment being as a result of high migration of members of the labour force and so this can only serve as a rough guide for this paper. The time dummy variable, $dY(2008-2013)_i$, was calculated on excel as was the positive growth dummy variable, $+\Delta yDUMMY$. The panel interaction term between the positive growth dummy and GDP growth rate, $POSITIVEGROWTH_{i,t}$, was created using STATA statistical software. The GDP growth rate was readily available on the IMF word data base.

Variable	Obs	Mean	Std. Dev	Min	Max
Change in Unemployment	228	.2832719	1.803206	-4.382	9.8
GDP Growth	228	1.835285	4.098916	-14.814	11.621
dY 2008-2013	228	.5	.5011001	0	1
Positive Growth Dummy	228	.7850877	.4116652	0	1
Positive Growth	228	2.670184	2.68373	0	11.621

Table 1. Summary Statistics used in this paper.

Table 1 gives a list of summary statistics used in this paper. A quick visual examination of the nineteen Eurozone countries can also be presented. The graphical representation indicates, as expected, a faint negative relationship between a change in unemployment, $\Delta U_{i,t}$, and the growth rate of national Gross Domestic Product, $GDPg_{i,t}$.

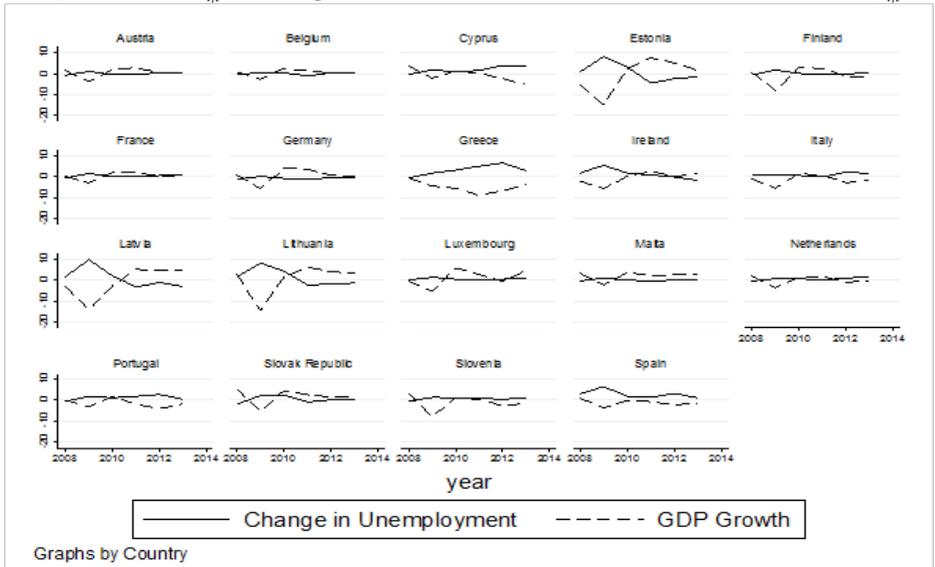


Figure 1: Relationship between $\Delta U_{i,t}$ and $GDPg_{i,t}$ for the Eurozone countries between the years 2002-13.

Empirical Results

The results from the FE estimation of equation 1.1 are shown in Table 2. An R-squared of 0.633 is obtained. 63.3% of the variation within the change in unemployment for the Eurozone is explained by the economic growth rate. The growth rate itself is seen to be statistically significant at the 1% level. The coefficient is listed as -0.356. This appears to confirm the working assumption that there is a negative short-run relationship between output growth and changes in unemployment.

Fixed Effects Estimation Variables	changeunemployment
GDPg	-0.356*** (0.0188)
Constant	0.936*** (0.0798)
Observations	228
Number of countries	19
R-squared	0.633

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 2: Fixed Effects Estimation Regression Output for model 1.1.

Given the statistical significance of the estimated sample coefficients from equation 1.1., the growth rate that the Eurozone would be required to maintain in order to achieve a stable rate of unemployment \bar{g} , can be estimated. Following the methodology discussed by Knotek (2007), this paper found that on average the Eurozone would require annual growth rates of 2.6%, when rounding to a single decimal point, in order to maintain a stable unemployment rate.

The results from the FE estimation of equation 1.3 is similarly shown in Table 2. The inclusion of the dummy variables and the interaction term appears to improve the models ability to fit the data sample. The R-squared obtained is 0.665, which is a small increase on the R-squared of 0.633 obtained from the simple regression of equation 1.1.

Fixed Effects Estimation Variables	changeunemployment
GDPg	-0.531*** (0.0465)
dY 2008-2013	-0.171 (0.182)
Positive Growth Dummy	0.429 (0.277)
Positive Growth	0.259*** (0.0724)
Constant	0.314 (0.311)
Observations	228
Number of countries	19
R-squared	0.665

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table 3: Fixed Effects Estimation Regression Output for model 1.3.

The negative short-run relationship between economic growth and changes in unemployment is similarly seen again. The coefficient on the economic growth variable remains statistically significant at the 1% level. A coefficient point estimate of -0.531 was obtained. Ceteris paribus, this implies that an economic growth rate of $\pm 1\%$ should lead to a corresponding inverse change in unemployment of $\pm 0.531\%$. The interaction term between the positive growth rate dummy variable and the growth rate, $(+\Delta yDUMMY_{i,t})$ is also seen to be statistically significant at the 1% level. This paper shows some evidence of asymmetry within the short-run relationship between economic growth and changes in unemployment. In effect, the relationship between positive growth rates and the change in unemployment is statistically different from the relationship that exists between negative growth rates and changes in unemployment. The time dummy variable $dY(2008-2013)_t$ is not statistically significant at any reasonable significance level. Thus, this paper cannot conclude with certainty that the statistical short-run relationship between economic growth and changes in unemployment underwent any sort of regime change between the two temporal phases of 2002 to 2007 and 2008 to 2013.

Conclusions

The analysis presented in this paper appears to confirm the working assumption that there is indeed a negative short-run relationship between changes in the growth rate and changes in unemployment for the Eurozone within the period of 2002 to 2013 inclusive. This relationship however, was found to be asymmetric. Positive and negative economic growth rates were found to have statistically different short-run relationships to changes in unemployment. However, no significant change to Okun's Law can be observed for the years preceding and the years following the onset of the Great Recession. In other words, the findings of this paper support the literature that there was no regime change involving Okun's Law over the period in question.

This paper therefore, supports the view put forward by Ball et al. (2013) which advocated the idea that Okun's Law remains a valid rule-of-thumb for policy makers concerned with unemployment. The importance of pro-growth economic policy remains as valid to the Eurozone today as it was during the last years of the Great Moderation following the turn of the millennium. Despite the economic upheavals and dislocations which accompanied the Great Recession, *ceteris paribus* growth remains a vital component to maintaining a stable employment level. As briefly discussed in the introduction, economic predictions of a low-growth future, advocated by those such as Gordon (2012), paint a stark prediction for changes to unemployment in the context of the relationship between growth and employment explored by this paper.

This paper provides a platform upon which much more extensive work could be completed. An interesting extension could be to apply a more focused approach to assessing whether the Euro itself had an impact on the short-run relationship between economic growth and unemployment. This could perhaps be attempted by increasing the sample size of countries to include a weighted-average of non-Eurozone European nations to act as a control. Further investigation into the effect of country-specific labour-market characteristics could be attempted by controlling for levels of unemployment assistance or minimum wage. Controlling for inequality within each member state could also be of interest. This field of study provides many opportunities for further investigation to deepen our understanding of macroeconomic variables such as growth and unemployment in the wake of the financial crisis.

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