London Metropolitan Business School

Economics Subject Group

Test of Okuns Law for the 10 Eastern European Countries

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This project is submitted in part fulfilment of the requirement for the completion of a BA International Economics at the London Metropolitan University. The work is the sole responsibility of the candidate.

Abstract:

Okun's Law is one of those rare things in economics, describing an enduring relationship between two of macroeconomics' most important variables. This study aimed to investigated this relationship and examine the significance of other variables that influence the Unemployment/real GDP relationship, and achieved this objective with some success. The nature of the countries that were under examination in this study also provides us with some extra insight into the relationship between these two principal economic variables by showing that the original estimate of Okun's law that states three points of real GDP for each 1 percent reduction in the unemployment rate can be revised up to four points for those countries experiencing rapid economic development. This study also examines the significance of pooled estimates in order to see the significance of co-integration and discovers random effect show less significant results than fixed effects when pooled data is analysed.

Contents:

List of Diagrams:

List of Tables:

Introduction 1.

This Project will explore to what extent the principles of Okun's law apply today when economic statistical data of the European Union accession countries is tested. Okun's law, established in 1962 following a study into the American economy, describes a relationship between output and unemployment. "Each extra percentage point above 4% (full employment) has been associated with about a 3% decrease in real GNP". The Theory of Okuns law takes on a new significance in the current political and economic climate. The relationship between output and Growth will always be fundamental to economic study and policy making and analysis of economic performance. It is because this apparent sturdiness and permanence of Okun's law, virtues one doesn't often find in economic laws, that has lead many economists to believe that a study into this law will yield relevant and meaningful analysis and conclusions.

The Countries that have been chosen to be surveyed in this study are the new member countries of the European Union in Eastern Europe. The precise aims of this project are; to collect the unemployment, economic growth, labour force and capital stock data for each country. To use the data to establish an economic relationship between the two variables unemployment and real GDP in order to form Okun's coefficient needed to see the effect changes in unemployment have on a countries real GDP. To use the data to find out the non accelerating growth rate of unemployment (the rate of unemployment a country must keep to in order to keep real GDP growing at a stable level). It is also important to obtain the coefficient for these other two variables with respect to real GDP too. A pool of data for each coefficient will then be created in order to analyse any possible significance of co-integration between the economies. These cross sectional time series' will then be presented showing fixed effects and random effects. All of the above results will then be analysed and critically looked at. Any aberrations in the data will be discussed, and the cause of any unexpected result will be investigated. After reviewing the findings from the regressions and pools of these original variable it may be necessary to explore the effects of other economic factors. If it is deemed necessary additional variables will be added to each country model, where possible, as a way of analysing what variables determine the Okun coefficient and explore any underlying problems as to why a particular country's data may not be significant.

Upcoming chapter include a review of the literature that was read before the study was underway and during the course of the study including background reading and previous published papers on the subject. Within this section there is a review of the data sources from where the statistics required to undertake this project were obtained. Following that the data and methodology of the project is explored in greater detail, and explanations of how data that is presented in a meaningful form for the project was extracted from the raw data that was obtained, and explanations into the calculation of NAGRU. These statistics are then analysed. First written analysis is undertaken, followed by econometric analysis firstly by working our individual country statistics to form equations, and then through pooled data from cross sectional time series. The value of the cross sectional time series data is then analysed and potential additional variables are scrutinised for suitability and then tested in pooled samples. The results of these pools follow that and conclusions are reached. Diagrams, tables and visual aids are presented throughout the study.

Review of Literature and research 2:

The reading that I will do for this project is mainly made up of articles written by other people who have been investigating the Okun's law relation between countries before. Including the articles I mentioned before by Dritsaki and Dritsakis, Lal, I. Sulaiman, D. Anwer Jalil, M and Hussain, A. I will also read Layard, Nickell and Jackman's Unemployment, particularly the chapters concerning labour power and trade unions. Blanchard's Title macroeconomics covers the background to Okun's law very effectively. In order to get some information on the economic conditions of the countries I will be analysing I will also read the "Economic Transition in Central and Eastern European Countries" by Samadian (2006). The nature of this project will also require me to undertake a large amount of statistical research. As in all other studies into Okun's law, data of a wide range of macro economic variables must be collected in order to undertake statistical and econometric analysis.

Background reading 2.1.:

Background reading into the macroeconomic foundations of Okun's law was done in the book Macroeconomics by Olivier Blanchard. Blanchard book covers all aspects of macroeconomics and gives a detailed outline of the principles of Okun's law and the foundations that underlie it. Blanchard's description of Okun's law does differ however from the description of the law used by the economists writing papers and carrying out empirical studies into it. Blanchard states that Unemployment is the dependent variable in the Equation for Okun's law, but empirical studies calculate Okun's law by using real GDP as the dependent variable. For the purpose of my study, I will follow the example of previous published papers, rather than that of Blanchard's text book, and I will use real GDP as my dependent variable and unemployment as the independent variable. The published studies also find the coefficient of all variables in the equation in order to test the significance of these variables and account for certain structural changes. This is something that Blanchard doesn't mention, and consequently the background reading hasn't provided this method of calculation. Once again I will follow the example of previous published papers, rather than Blanchard's textbook.

Other background reading was done into the economic backgrounds of the countries that I will be surveying. The book I have used for this is that by Samadian, who wrote "Economic Transition in Central and Eastern European Countries". This book gives an up to date and detailed account of the economic conditions in those countries up to and including the first years of E.U. membership. This knowledge will be backed up by researching the effects of trade union density and activity for the countries that are OECD members. This work will be done by using the OECD web site.

What this study will also attempt to do which previous studies have not is try to explain deviations in the Okun coefficient between countries through labour market conditions such as trade union density among other things. Layard, Nickell and Jackman's book on unemployment will be important background reading in order to understand these things, and although the book does not provide any ready made variable of labour power, the data I will collect following my research will be put into context following the reading of the relevant chapters of this book, and help me to formulate my own variable to insert into Okun's equation.

Reading of previous studies 2.2:

Research into previous studies on Okun's law was done by searching on Google scholar and REPEC ideas. Previous studies into Okun's law all focus on a group of countries of either similar geographical location as done by Dritsaki and Dritakis' study into the Mediterranean countries of the European Union or studies analyse countries that can be segregated into economic groupings such as the study done by Freeman, who has studied panel tests of Okun's law for 10 Industrialised countries. I think that comparative studies into Okun's law are far better served by taking this regional or relevant categorisation of economy, so this is the example I will follow. Studies such as Freeway's and Malley's that cover a wide range of countries that have little relation to each other often come up with too wide a variety of results from which it is impossible to draw meaningful conclusions from. My aim is to Study the ten eastern European countries that are the newest members of the European Union. All of these countries are similar economically in that they all emerged from a planned economic system into a free market system at around the same time, and they are all in the same geographical location.

Of these two studies Freeman's will be the study that I will follow closest in terms of presentation. All studies follow the path of static time series regression analysis, and test the reliability and relevance of their hypothesis and their findings and my study will be the same as this but in terms of providing graphic representations of the problems and exploring the background to the sampled countries' political situation my study will most resemble Freeman's. Freeman's study into 10 industrialised countries also includes cross sectional time series analysis and panel tests by using pooled estimates for particular groups of countries in his data, particularly those countries that are EU members. Freeway identifies the importance of this as being by stating "the use of pooled estimates seems particularly appropriate in light of the ongoing integration of the European economic community, and the evolving centralisation of European monetary policy." Other studies do not adopt this approach, but because of the geographical and ideological links between the countries in my study it would be appropriate for me to do the same.

The use of filters in order to exclude potential aberrations in data is a feature of Freeway's study. He utilises the band-pass filter method in order to "eliminate both high frequency and low frequency components." Other studies also include a system of filtering out unexpected components of the data but this method has been criticised by Cogley who states that "there is a disconnect between the theory and macroeconomic applications, for the theory applies to stationary Random processes and applications involve non stationary variables." In practice measured cycles are not perfectly predictable because filters only approximate what is judged to be high or low frequency data so I have chosen not to apply any filter to the data that is collected for my study.

The general conclusion reached by all studies is that the Okun coefficient in all cases is highest in the countries that have a high level of industrialisation, this is to say that unemployment is more reactive to changes in real GDP the more industrialised that country is. Reasons for this are put forward most prominently in Malley and Molana's study and include things such as lower trade union density in developed countries and a greater links between different economic

sectors in developed countries. I am sure that the results of my study will resemble this vague conclusion, but this is the conclusion that other studies end with, and I would like to take mine a bit further. Previous studies do not look at labour market conditions in their surveyed countries, and no consideration is given to migration statistics that concern issues of unemployment. This study will aim to fill this gap in the academic literature by testing the significance of these effects on the changes in real GDP in the hope that by doing so a greater strength and depth of answer will be provided into understanding why cross country coefficients for Okun's law differ.

Research 2.3:

All of the data streams of macro economic variables required in order to complete this study will be obtained from the economic and social data service. The ESDS collect and form data from source websites, and the data that I will be sourcing from them will be originally IMF international financial statistics. The IMF is the most reliable and comprehensive compiler of international financial statistics. The data collected from them will be figures on unemployment, real GDP, Labour force size, domestic capital formation and industrial production. I will also be using the ESDS in order to obtain labour market statistics and information. This will be useful because the conditions of the labour market in these countries' will be the determinants of the results I find, therefore I will need to access data such as migration and job availability in order to carry out a comprehensive analysis. The Original source of the majority of this data will be from Eurostat – The European Union's statistic compiling department. Finally data on trade union membership and density will have to be obtained. This is only available for four of the countries I am surveying because of data availability. This data will be collected from the OECD, and not all of the surveyed countries are OECD members. The OECD will also provide me with information on the type of trade union activity that takes place in the surveyed country, and this will help me to analyse the effects of a country's trade union activity, rather than just analysing by looking at the statistics.

Data and Methodology 3:

To undertake he study various sets of data streams were required to be accessed and analysed. Most importantly, in order to calculate the non accelerating growth rate of unemployment (NAGRU), data on labour force and capital stock was collected and in order to calculate the Okun coefficient GDP statistics and data on unemployment rates was required for all of the countries being surveyed. The NAGRU statistic is the weighted sum by 0.3 and 0.7 % respectively of the percentage annual increase in capital stock and labour force. It gives us the value that the level of unemployment must be at in order to keep economic growth constant. The time period of the data extends from a maximum of 1992-2008, but because of the nature of some of the data for the countries I have surveyed, for reasons that will be discussed at length later in the study, the start data for each country's data streams varies. This data was all collected from the IMF via the economic and social data service website (www.esds.ac.uk). Data on trade union activity for some of the member countries has been collected in order to see whether a country's trade union density has a relevant effect on the relationship between unemployment and real GDP. Trade union data was collected from the OECD (www.oecd.org). The significance of net migration for each of the surveyed countries is also to be tested through regression analysis. Data for migration flows for these countries was collected from the EU databank Eurostat (www.eurostat.eu). The equation is built around these statistics in the following form

Real GDP = -Okuns Coefficient (Annual change in unemployment – (labour force + Capital stock))

$$G\text{-}Gt\text{-}1 = -\beta\ (U\text{-}Ut\text{-}1 - (L(0.7)+K(0.3)))$$

Capital stock measures the value of acquisitions of new or existing fixed assets by the business sector, governments and households, and is derived from the gross domestic fixed capital formation (GDFCF) statistic provided by the IMF. The E.U defines this statistic as consisting of "resident producers' investments, deducting disposals, in fixed assets during a given period. It also includes certain additions to the value of non-produced assets realized by producers or institutional units. Fixed assets are tangible or intangible assets produced as outputs from production processes that are used repeatedly, or continuously, for more than one year". (www.eurostat.ec.europa.eu). Blanchard prefers to use an industrial production measure as the second component in calculating NAGRU, but capital stock could be seen as a more adequate measure in this case of a country's increasing in total productivity compared to the Industrial production data stream because capital stock encompasses a country's whole economic productivity sector whilst excluding the increase trend in labour productivity or labour force size that is already taken into account through the labour force statistic. Industrial production is a solid measure of the growth of the manufacturing sector of a county, it fails to separate the role of capital in such growth. Also, in the interest of keeping consistent with pre existing studies, such as that by Freeman, I will use capital as my measure into the NAGRU statistic. In order to obtain capital stock from the GDFCF statistic certain mathematical processes had to be followed. This data was in national currency units, and not adjusted to inflation, so by using the Inflation rate data for each country I adjusted the GDFCF's figures by multiplying the first year's GDFCF figure by the same year's inflation %, and continuing this process until the end of each country's time series. But to get the figure of capital stock the rate of depreciation must be used on the country's pre-existing capital.

The Formula I have used to calculate capital stock is the following:

Kt+1 = (1-∂) Kt+It, Where K= capital, I = GDFCF, ∂ = the rate of depreciation. (∂ = 0.11) and g is the previous years rate of growth.

In Equilibrium

$$Kt+1 = (1+ g)\ Kt \quad , \quad g = 0.015$$

Therefore,

$$(1+g)\ Kt = 1-\partial)\ Kt + IG,$$

$$Kt = IG/\ g+\partial.$$

An average of 5 years of this data range was collected and measures to calculate the average annual change in capital stock, rather than the full data range.

The Okun Coefficient is calculated by finding out how growth and unemployment match each other. The coefficient gives the effect of deviations of unemployment on real GDP. To work out the estimate I have simply calculated average annual change in real GDP for each country and divided it by the average annual change in unemployment.

The next step is to perform a time series regression for the two variables economic growth and unemployment. This will give us the exact coefficient. This will be done by using econometrics modelling programme eviews 6. This will give us the exact figure for the coefficient that allows us to see how responsive the unemployment rate is when economic growth slows down, or recession is entered. Okun states that the equation is "miss-specified if it is assumed that all other variables in the equation are on their equilibrium paths", meaning that it is wrong to assume that the other variables in the equation; capital formation and labour force, change exactly with unemployment. For this reason the significance of capital formation or industrial production will be tested in regression results as well as the relationship between output and unemployment. This was done in other studies that I am aware of. By testing the significance of all variables over time the equation will look like this, and this is the final composition of the equation that will be used in this study:

$$Gt-1 = -\ \beta y\ (U-Ut - (\beta l\ Lt+ \beta k\ kt))$$

Aberrations in the Data 3.1:

The data for Bulgaria presented the most aberrations for me, and the non existence of the variable labour power until the year 2000, combined with the high Inflation rates that meant throughout the calculation of Gross Domestic Fixed Capital Formation results were skewed, meant that I only began to analyse the data from the year 2001. Thus the results are representative of a smaller time period for Bulgaria than all other countries, and this is perhaps the reason why the

data for Bulgaria shows the highest NAGRU and the highest Coefficient. The range of data for Labour force numbers range is far higher than any other country, and the fact that data for this statistic showed a decrease in labour force of 1.68% in 2002 to an increase in labour force of 30.29% the following year. This shows that the data may in part be somewhat unreliable because there is no suggestion in any other piece of data that this is a reliable statistic. This is mirrored by the fact that If one uses the GDFCF embodied method of calculating NAGRU because that would meant that the data shows Bulgaria requiring an annual economic growth rate of 21.64% in order to keep unemployment stable.

As already discussed in the methodology chapter of the report, the data for the Czech Republic begins in 1993 due to the separation of the state of Czechoslovakia in 1992, but I could only start calculating the data from 1997 due to the non existence of the labour force statistic until 1996. Czech data can also be noted for further missing labour force statistics in 2003, 2007 and 2008. For the purposes of this study 2003 was included and the average adjusted accordingly. Other than this Czech data has no missing pieces or unusual contents.

Even though they were due to be included, missing and inconsistent data sets for the Estonian economy I have had to omit them from this study.

The data for Hungary was calculated from 1992 so as to avoid the GDP growth statistic of – 12 % recorded in 1991. Such a statistic would prove to be a negative slant on all of the following calculations. The two missing years in the labour force data were covered for when calculating the average rate of labour force increase and the final result of this was zero anyway so made little difference. Such a high rate of inflation at the beginning of the time series could have affected the GDFCF calculations, but the recorded result of 2.12% NAGRU is not too far off what I would expect a realistic result to show.

Latvia's data was analyzed from 1994 because, similarly to Hungary, Latvia recorded an unusually low economic growth rate in 1993 of -11.4%. There was also a ridiculously high figure for industrial production in 1992 which has been discounted. Once again some labour force data is missing. In this case it is missing in the year 1995, and the following year there is a recorded drop in labour force of almost 10%. This is the overall cause of the negative figure in this column. Like many of the countries, unemployment rises until the late 1990's until stabilizing at around 8%.

The data for Lithuania was very constant. Starting in 1996 there was only one year of negative economic growth, in 1999, and very high growth rates in the early 21st century. There were two years of a slump in industrial production and this was mirrored by a drop in GDFCF in the same years, meaning that both methods of calculating NAGRU show similar results.

The data for statistics used to form the Okun equation and coefficient for Poland starts in the year 1992 because that is the first year that Labour force is recorded. The data remains stable after that, with no unusual or unexpected results.

Romania's data starts in 1995 but unfortunately the final two years (2007 and 2008) cannot be included because of the non existence of labour force data. The data is characterised by big fluctuations in a large number of the data sets. These fluctuations are most greatly seen in the country's annual GDP data.

Slovakia's data starts at the year 1993, which is the year that the country came into existence following the breakup of Czechoslovakia. The country data has a few missing pieces of labour force data in the years 1996, 1998, 2007 and 2008, but apart from that the data seems stable and records similar results to the Czech Republic, but with higher unemployment rates.

The data for Slovenia has been analyzed back to the year 1993 for all sets. There are no real surprises in the data; the figures are consistent with each other and the other countries in the area. As with most of the other countries the first years of the data are set amidst a backdrop of inflation and so consequently the GDFCF figures could be distorted for this reason. GDP growth remained positive throughout the entire time period.

Hypothesis of the values of variables and coefficients 4:

Previous studies have shown, and a small appreciation of the meaning of the variables considered would lead to the obvious hypothesis that there is a negative relationship between real GDP and unemployment, the value of this coefficient tends to be between -1 and -5 in previous studies. These studies have all also shown that when a countries' unemployment level rises above the natural rate GDP growth falls in all cases, and it is expected that my study will show the same relationship between these two variables.

The second statistic in Okun's law is labour force. Based on the evidence of past studies labour force size is expected to show an upward trend that is slower than the growth rate of capital stock and GDP, but without the volatility of these two variables. Estimates of the value of the coefficient between labour force size and real GDP growth in past studies all show a positive relationship of 1< and there should be no reason for me to expect different results to this.

Previous studies show the level of capital stock tends to be growing at its fastest rate during periods of consistent accelerating economic growth. Freeman's study into OECD countries shows a much higher % increase in capital stock for Japan in the period1965 – 1978 than all other countries, and all surveyed countries surveyed record higher growth in capital stock for this time period than the following time period of 1979-1998. This is mirrored by Drisaki and Dritsakis' study when one looks at the economic data for Greece. A cursory glance at the real GDP growth rates for the countries I have surveyed gives an indication that we can expect high values of capital stock growth, and high estimates of NAGRU. Results of previous studies show a value to the coefficient < 1when changes in capital stock is tested against real GDP growth rates, but the results of this test in past studies are all shown to be significant. The presentation of how each data stream has changed over time for each country, and each country's NAGRU statistic is shown in table 1.

Values of the variables 4.1:

Table 1.

Country	Average Real GDP growth %.	Average annual % change in unemployment	Average Unemployment rates %.	Average annual % change in Capital stock.	Average annual % change in Labour Force.	Estimate of Nagru with weighted results of K(0.3) and L(0.7) respectively.
Bulgaria	6.13%	-2.15%	11.87%	12.54%	5.94%	7.92%
Czech Republic	3.21%	0.03%	7.89%	5.78%	0%	1.73%
Hungary	2.78%	-0.12%	7.98%	16.52%	0%	4.96%
Latvia	5.89%	0.13%	7.93%	10.1%	-0.86%	2.43%
Lithuania	6.08%	-0.11%	8.14%	3.35%	-.48%	0.67%
Poland	5.4%	-0.25%	14.42%	5.11%	-.08%	1.48%
Romania	3.55%	-0.23%	7.88%	19.38%	0.14%	5.91%
Slovakia	5.38%	-0.43%	13.61%	1.18%	0.52%	0.72%
Slovenia	4.29%	-0.3%	12.22%	8.61%	0.39%	2.86%

Analysis of results for the values of variables 4.2.

Most unexpected results came in the falling labour force size in three countries; Latvia, Lithuania and Poland and the zero change in labour force size in the Czech Republic and Hungary. This goes against the hypothesis that labour force size should be on a stable upward trend. Annual labour force size was shown to have increased in Bulgaria much more than any other of the tested countries, at an average annual increase of 5.94%. There is also a large variation in the results for capital stock % change inn each country. Although all countries retain a positive average growth rate for their respective sampled time periods, and the range of the recorded increases in economic growth doesn't differ greatly from one country to another, the range of results of capital stock growth is quite large. The largest rate of growth in capital stock is in Romania, who recorded an average annual rate of 19.38%, 18.2% larger than the lowest country in this data set Slovakia.

Czech Republic and Latvia are the only two countries whom, albeit slightly, record an increasing annual % increase in unemployment. Al other countries record a falling rate of unemployment somewhere between the range of -0.1% to -

0.5% with the exception of Bulgaria who, on account of the smaller time period of measurement and high unemployment rate at the start of their time series, show an annual fall of 2.15%. This may be the reason that underlies, their higher than other countries annual increase in labour force size.

Formulating Hypotheses before the regression analysis 5:

Section 5 of the study will formulate the hypotheses for each individual variable to be tested in the Okun equation. At this point regression is being done individually for each country and each variable

Hypothesised value for the Okun coefficient 5.1:

As discussed earlier, the Okun coefficient measures the effect that a change in unemployment has on real GDP growth. The relationship is expected to be a negative one, economic growth should fall when unemployment increases, and this result has been obtained by all previous studies in the vast majority of examples. However, because of the results in Czech Republic and Latvia that show there to be an increase in unemployment at the same time as an increase in GDP growth, I am not necessarily going to expect a strong relationship in the Okun coefficient in these countries, Indeed the relationship may turn out to be positive, rather than negative.

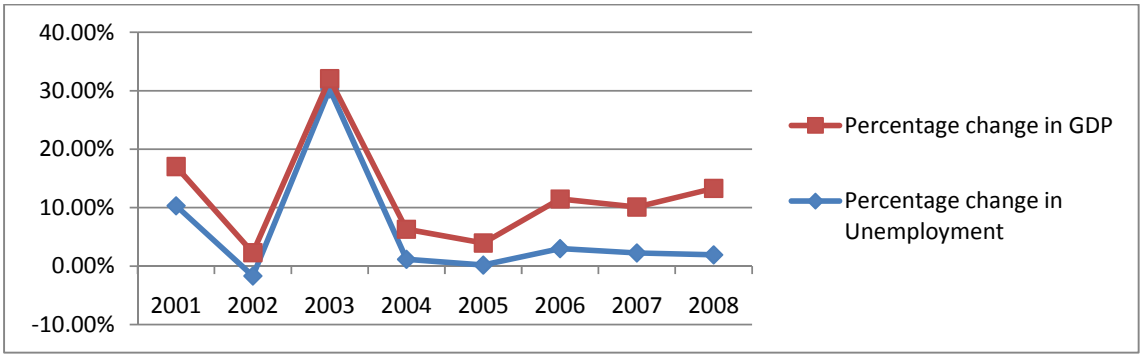
H0= no effect of unemployment on real GDP if $p>0.10$

H1= negative effect of unemployment on real GDP, $p<0.10$

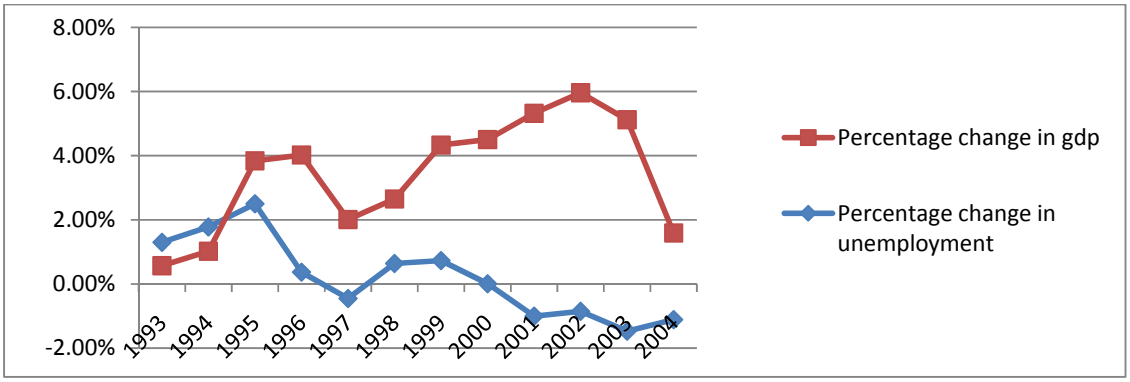
So we can reject the null hypothesis if t-statistic is > t-table

Cyclical components of real GDP growth and Unemployment:

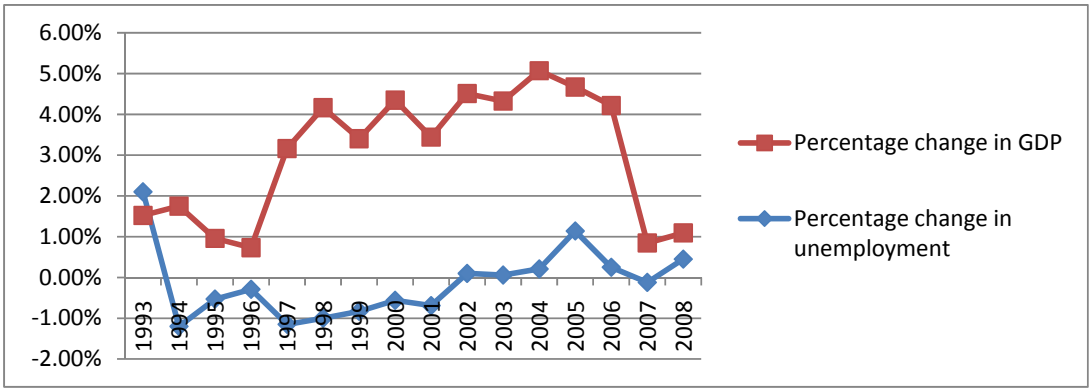
Bulgaria: Diagram 1



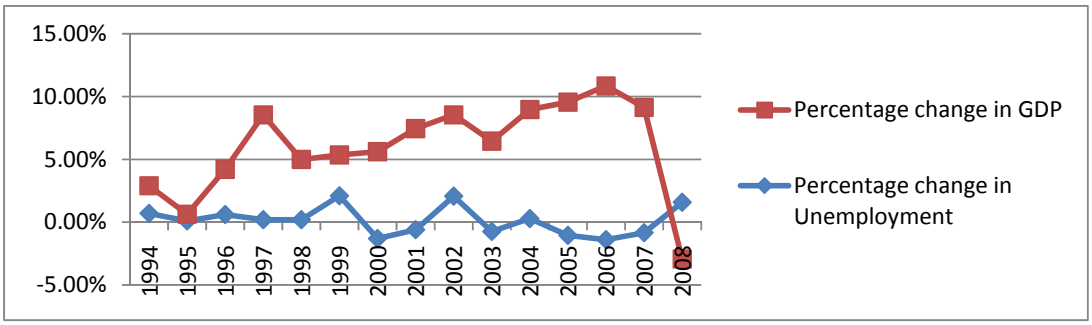
Czech Republic: Diagram 2



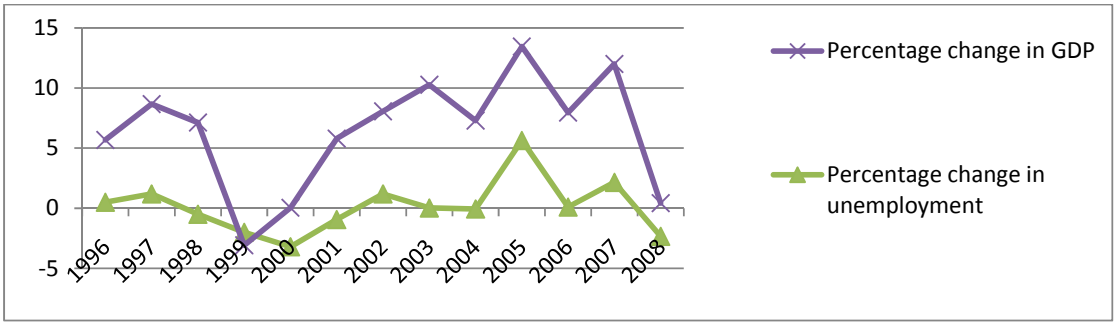
Hungary: Diagram 3



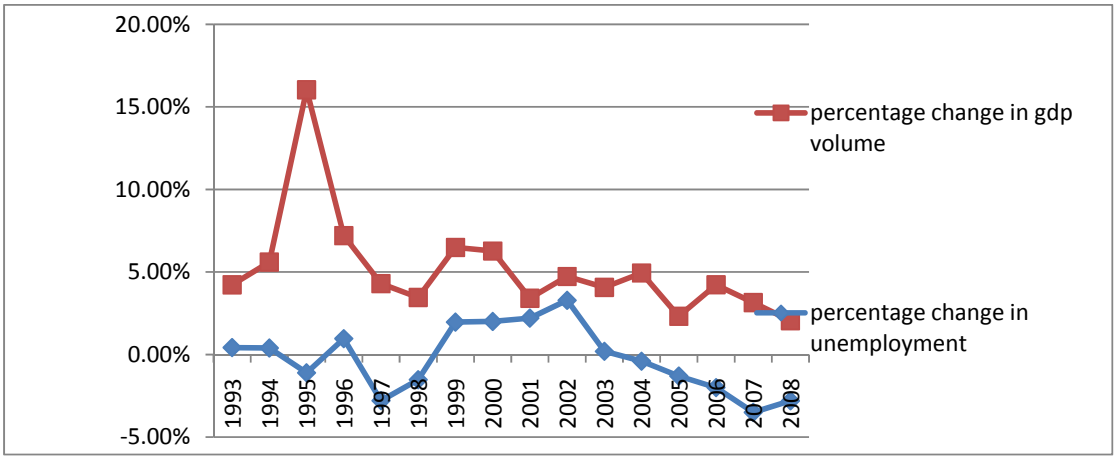
Latvia: Diagram 4



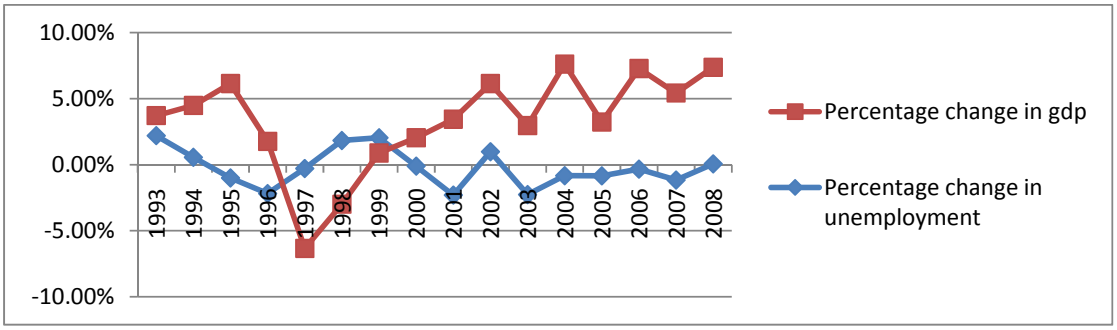
Lithuania: Diagram 5



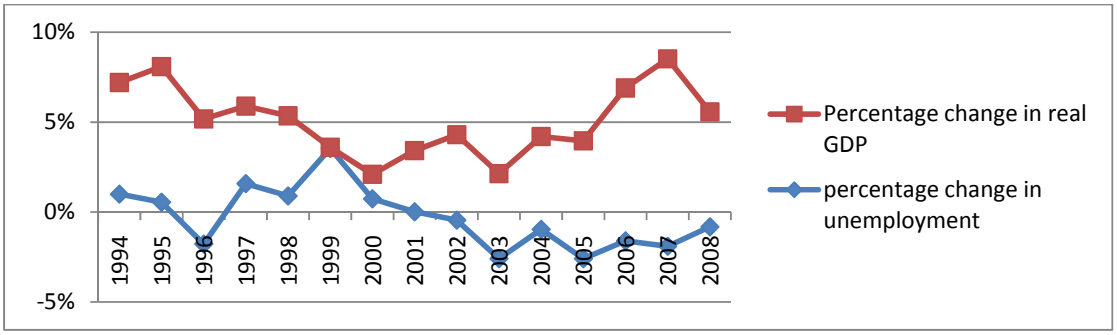
Poland: Diagram 6



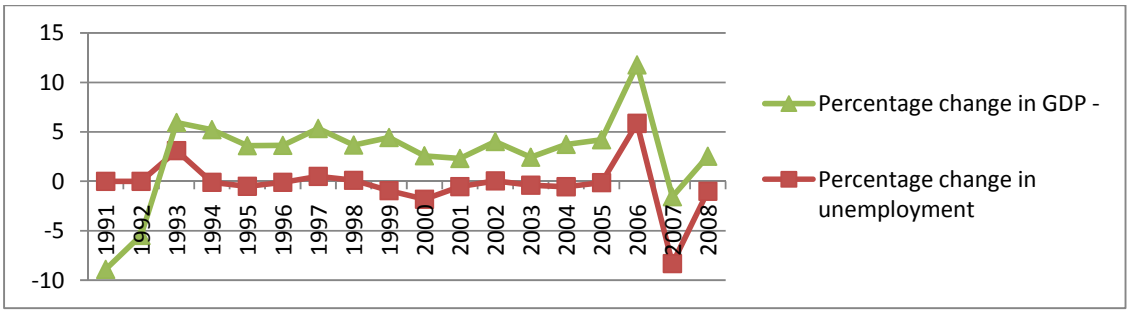
Romania: Diagram 7



Slovakia: Diagram 8



Slovenia: Diagram 9



Hypothesised value for Labour force 5.2:

Past studies have all shown a small positive value of the coefficient in the relationship between labour force size and capital stock. This can be attributed to the fact that, as mentioned earlier, labour force tends to rise at a consistent and steady rate. There is no reason to believe that the results will be any different for this study for those countries that have shown to have a small annual increase in labour force size, but for those countries that show zero increase, or even a fall, the results of this regression may be more interesting, and related to the cyclical components of each variable to see if there is a significant goodness of fit. Once again significance will be tested at 10%.

H0= no effect of unemployment on labour force if $p>0.10$

H1= negative effect of unemployment on labour force, $p<0.10$

So we can reject the null hypothesis if t-statistic is > t-table

Hypothesised value for capital stock 5.3:

Given that all countries showed positive levels of annual % increase in capital stock over their surveyed time periods we can expect all values of the coefficient that expresses the relationship between capital stock and real GDP to be positive. This goes against the findings of Freeman's study into Okun's law following his study of OECD countries, who found a very small negative relationship between the variables, but this study can be expected to show different results because for many of the cases capital stock grew much faster than real GDP. It is possible to realistically expect some positive relationships to be highlighted here, particularly in countries such as Romania and Hungary, whom recorder rapid growth in capital stock. A 10% significance level will once again be used.

H0= no effect of unemployment on capital stock if $p>0.10$

H1= negative effect of unemployment on capital stock, $p<0.10$

So we can reject the null hypothesis if t-statistic is > t-table

Results of regression 6.

Table 2. Table of results

Variable / Country	Okuns coefficient (βu)	t-statistic for Okuns Coefficient	p-value for Okuns coefficient	Labour force coefficient (βl)	t-statistic of labour force coefficient	p-value for labour force coefficient	Capital stock coefficient (βk)	t-statistic for capital stock coefficient	p-value for capital coefficient
Bulgaria	-2.71*	-5.17	0.0021	0.03*	2.77	0.0324	0.02*	35.18	0.0000
Czech Republic	0.26	0.14	0.8884	-0.11	-1.25	0.2468	0.03*	2.59	0.0608
Hungary	-5.44*	-4	0.0013	0.14*	3.88	0.0019	0.01*	7.3	0.0019
Latvia	1.87	0.36	0.7241	-0.21	-1.01	0.3333	0.02*	3.	0.0018
Lithuania	-2.74	-1.35	0.2035	-0.06*	-2.45	0.0323	0.02*	2.92	0.0170
Poland	0.83	0.52	0.6134	-0.07*	-2.13	0.0427	0.01	1.46	0.2172
Romania	-4.2*	-3.9	0.0013	-0.01*	-3.8	0.0035	0.01*	3.22	0.0324
Slovakia	-3.44*	-2.77	0.0160	0.17*	4.64	0.0012	0.01*	7.76	0.0015
Slovenia	-4.54*	-3.4	0.0039	0.67*	6.30	0.0000	0.02*	32.58	0.0001

The results are presented in table form above, and show the results of each coefficient for each country, t- statistic and the p-value that sows level of significance. *denotes a significant value.

Results of Regression analysis for the Okun Coefficient 6.1:

The results show different values than the estimates, but most significant estimates of the coefficient are around -4. The response to changes in real GDP due to changes in unemployment was highest in Hungary, with much lower but similar results in Romania, Slovakia and Slovenia. By contrast, unemployment is relatively unresponsive to changes in real GDP in Lithuania and Bulgaria, but the results of the regressions of these countries show expected results. Surprisingly the results show a very small positive relationship between a fall in unemployment and a fall in real GDP for Latvia and Poland, this is inverse from the expected result and go beyond what basic logic and understanding of economic principles would suggest, but looking a little deeper into the data of these two countries provides us with an explanation. Both Poland and Latvia are two of only three countries in the sample that have a decreasing labour force size and increasing unemployment rates over the time series; the third country that shows an decrease in labour force size is Lithuania which records a very small and insignificant negative relationship between unemployment and real GDP. Both Latvia and Poland record relatively normal real GDP growth when compared to the other sampled countries, but Latvia records much higher annual capital stock growth than all other countries, and Poland shows a higher than average annual industrial production increase. What this may suggest is that in the years when these countries were experiencing high economic growth, the number of jobs or employed people was not actually rising. This can most definitely be seen in the Latvia data. The same can be said for the Czech Republic.

The real GDP pattern in Poland follows the same path as all other countries in the data, in that it begins to increase at a slower rate in the second half of the 2000's decade, but for Poland, as opposed to other countries, unemployment is also falling at this time of a slowdown in real GDP growth. Reasons for this can be seen in the migration statistics for Poland, which shows that following their entry into the European Union in 2004. Since entry into the European Union Poland has seen the fourth highest amount of total emigration out of all of the EU member states (www.eurostat.ec). This emigration has consisted mainly of people of working age who are seeking employment opportunities elsewhere in the European community in areas where there are a job shortage or low wages in Poland. In Poland, when a worker is unemployed he or she is simply able to emigrate to find work and that is why unemployment statistics have fallen for Poland in a time when real GDP was also falling, hence the unexpected result of Okuns' coefficient. These patterns can be seen in the cyclical components of real GDP growth and unemployment diagrams below.

Both the regressions for Poland and Latvia record a p-value that is higher than the significance level of .10, as do Czech Republic and Lithuania. This may be because of the significance of other factors such as those discussed before and other that will be tested for later. Lithuania shows a coefficient that is in the range of values that we might expect, but the p-value shows the result of the regression is not reliable.

We can reject the null hypothesis for Bulgaria, Hungary, Romania, Slovakia and Slovenia.

We can accept the null hypothesis Czech Republic, Latvia, Lithuania and Poland.

Results of Regression analysis for Labour force 6.2.

The results for tests into the relationship between labour force size and real GDP are shown in table 2. The results show a mixture of positive and negative relationships for the countries, with four positive and 5 negative relationships. But two countries show a p-value of test statistic of greater than 10%. Looking at the coefficients for the countries for which we can reject H0 we can see that the relationship between labour force and real GDP is always between -1 and 1, which is in line with the expectations. The largest significant result for a positive relationship between the two variables was recorded in Slovenia with the second highest result in Slovakia. These are two countries that have expanding labour forces. The largest value for a significant negative result is seen in Poland. This is in line with what we would expect for Poland, whom recorded a fall in labour force size over their time period. There also exists a significant negative result for Lithuania for the same reasons. Because there is a mixture of positive and negative results the test becomes 2 sided, and the significance level drops to 5%. Therefore, we can;

We can reject the null hypothesis for Bulgaria, Hungary, Lithuania, Poland, Romania, Slovakia and Slovenia.

We can accept reject the null hypothesis for Czech Republic and Latvia.

Results of regression analysis for capital stock 6.3:

Results for the coefficient between real GDP and Capital stock can be seen in table 2. The results indicate a very small positive relationship for every country, with only Poland failing the significance test. The positive relationship is

contrary to the results shown in other studies, most of which indicate a very small negative relationship. The largest coefficient value belongs to the Czech Republic, and the smallest significant value belongs to Romania, but the results are so miniscule it is hardly worth drawing too many conclusions into cross country differences.

We can reject the null hypothesis for Bulgaria, Czech Republic, Hungary, Latvia, Lithuania, Romania, Slovakia and Slovenia.

We can accept the null hypothesis for Poland.

Cross sectional time series analysis 7.

Cross sectional time series testing combines both cross sectional data analysis and time series data analysis, and in doing so allows you to look at how multiple variables change over time. Individual regressions of time series data cannot control for time varying effects, nor can individual regressions provide sufficient variability to differentiate among closely grouped variables. Pooled cross sectional time series data can do both. Table 3 below shows the results of the coefficients and their significance when the data is pooled and estimated with fixed effects. And table 4 shows the results of the coefficients and their significance when the data is pooled and estimated using random effects. The coefficients presented indicate the result of fixed effect because fixed effects presented the most significant data for all variables. The hypothesis of H0 is rejected as we can see a goodness of fit for all t-statistic values and p-values; we can conclude that for the countries sampled, pooling the data provides us with significant results.

Table 3: Fixed effect cross sectional time series

Variable	Unemployment (u)	Labour Force (l)	Capital Stock (k)
Pooled Sample Results.	-2.67	-0.01	0.01
Average value of t- statistic	-4.41	-1.84	3.41
P-value	0.0000	0.0694	0.0764
Number of countries with significant of results	5	7	8

Table 4: Variable effect cross sectional time series

Variable	Unemployment (u)	Labour Force (l)	Capital Stock (k)
Pooled Sample Results.	-0.84	0	0
Average value of t- statistic	-2.08	-0.37	0.25
P-value	0.04	0.71	0.8118
Number of countries with significant of results	5	3	2

From the differing results that fixed effect and random effects give us we can see that fixed effect have a greater significance on the data than random effects. The best explanation for this is that the data does not arise from random causes, rather the variables are precise and non random. In pooled data analysis, the term fixed effect estimator is used to refer to an estimator for the coefficients in the regression model. If we assume fixed effects, we impose time independent effects for each entity that are possibly correlated with the regressed variable. Using random effects also fails to provide any significantly high enough number to be considered as a coefficient. Comparing the pooled estimates with the individual country estimates creates a strong case for pooling. Estimates for Okun's coefficient for the individual countries are above (in magnitude) the pooled estimate. This is also the case for the other two variables, and the pool allows us to see the correct relationship that labour force and capital should have with real GDP, negative and positive respectively. From this we can draw the conclusion that co integration between the countries' economies is possible.

Test of additional variables 8.

In addition to the estimates of these variables done by existing studies, I will also be testing the level of significance that trade union density and net migration have on real GDP growth. I will do this because of the limitations that other studies have come up against when discussing structural changes in the labour market, or the employment/GDP relationship over time.

The data for trade union density is only reliable for the countries I am studying that are part of the OECD member countries, so I will only be able to test this for Czech Republic, Hungary, Poland and Slovakia. This data will be collected from the OECD website. The hypothesis behind this is to show that a higher trade union density for a country will mean unemployment is less reactive to changes in economic output in years that economic growth is lower than the NAGRU level. Trade union density has been falling in the years for which are being surveyed almost every year and for each country. The test will be done by calculating the annual percentage change in trade union density.

We can possibly expect to see a significant relationship between net migration and economic growth given the results that were shown earlier in the regression analysis of Okun's coefficient for Czech Republic and Latvia. The measure used will be net migration/total population and this will be tested against real GDP.

Using a 10% significance level the data will be calculated for each country and then pooled together in the form of cross sectional time series. The results of these pools of additional coefficients are shown in table 5.

Table 5

Variable	Trade union density	Net Migration
Pooled sample results	83.91	-23775.39
Average value of t-statistic	2.88	-1.08
p-value	0.01	0.2892
Number of countries with significant of results	3/4	2/6

From the results we can notice straight away that trade union density does fit with changes in real GDP for the four tested countries but net migration does not. Only two out of the 6 countries tested a significant level for net migration over total population, those countries being Poland and Czech Republic. It is interesting that we get a significant effect of trade union density on real GDP. The real effect that we can expect trade unions to have on the economy is that they would make changes in unemployment have a larger effect on real GDP. Trade union activity ranges from increasing wages for members to ensuring that companies practise policies such as labour hoarding that don't allow them to lay off a large proportion of their members. The percentage of trade union density in these surveyed countries has been falling,

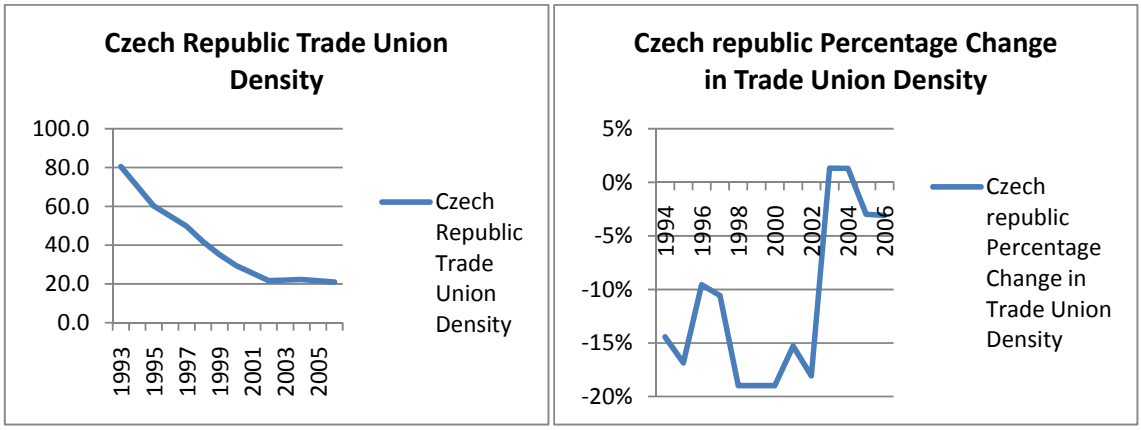
but because it is falling at an ever slower rate, even with some increase at the start of the 2000's in some places, increasing levels of real GDP reflect this, hence the positive relationship.

We can best incorporate trade union density into the full Okun equation by seeing subtracting its effect from the NAGRU statistic. This would allow unemployment to be at a higher level, without effecting economic growth, which is exactly the effect of trade unions. A revised estimate of the Okun equation could therefore be:

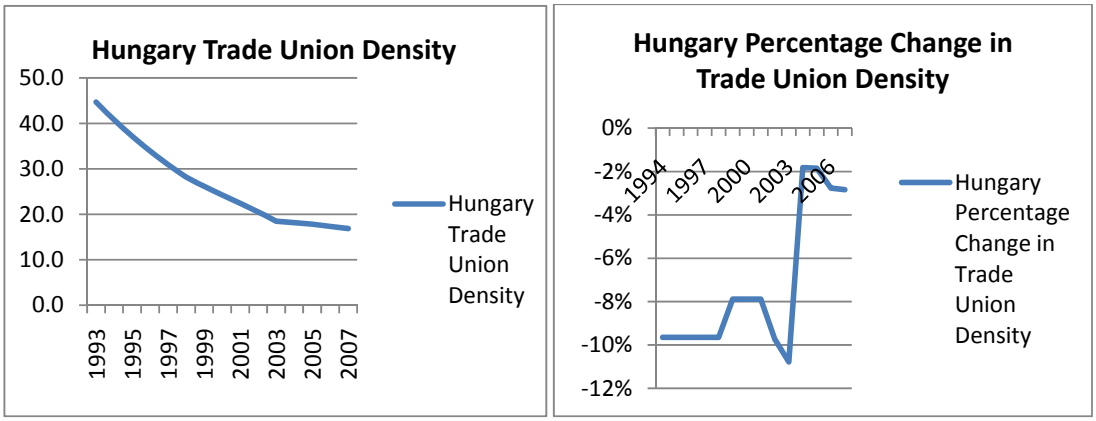
$$Gt\text{-}1 = - \beta y\ (U\text{-}Ut\text{-}1 – (\beta l\ L + \beta k\ K – \beta tu\ TU))$$

Where TU= % change in trade union density.

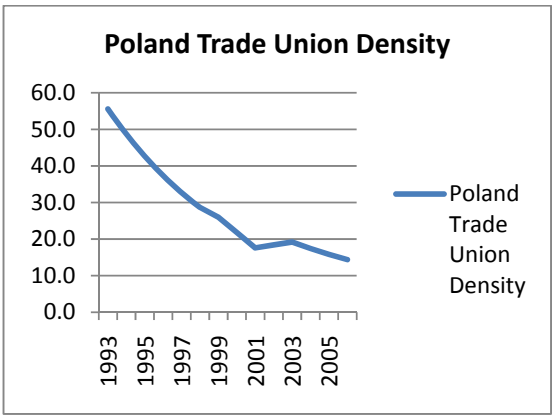
Diagrams 10 and 11:

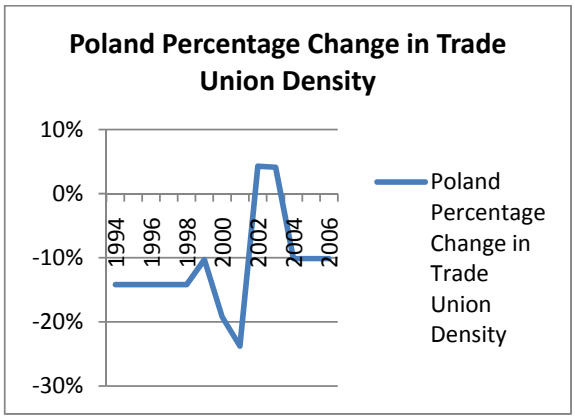


Diagrams 12 and 13:

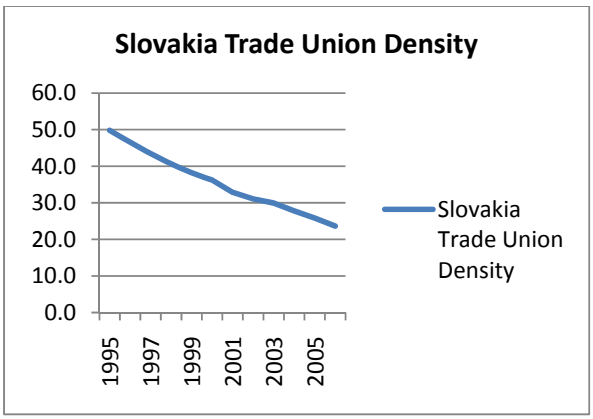


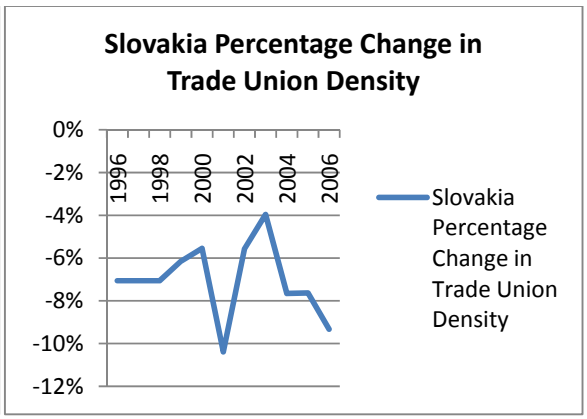
Diagrams 14 and 15:





Diagrams 16 and 17.





Contrary to what was hypothesised, net migration was seen to have no significant effects overall when the data was pooled together, and only two out of the six countries for whom it was tested didn't receive the null hypothesis. It could still be maintained however that the presence of migration should not be discounted from the equation when Okun's coefficient is measured. Economic migrations often have a motive for moving based on their job prospects and potential higher earnings abroad that can support a family at home. An unemployed worker in Poland would no longer count as an unemployed if they were to move abroad to seek work, and should they attain work in the receiving country it is estimated that on average 12% of that economic migrants wages will be sent home. (homeoffice.gov.uk). If this is the case then the home country of that economic migrant would be experiencing lower than before unemployment (because the unemployed worker had moved abroad) whilst experiencing higher than before real GDP because of the money that is being sent home by the economic migrant to family who consequently spend or invest that money in their home economy. Following the line of this argument, it therefore follows that in order to obtain a more accurate relationship of the Okun

coefficient, the number of net migration should be added onto that country's unemployment figure. By doing this the effects of migration could be incorporated into the model without disturbing the significance of any other variables.

Conclusion 9:

The key findings of this study are that changes in the unemployment rate do not always fit with real GDP. The relationship between unemployment and real GDP for those countries with significant result of the coefficient is generally higher for the countries that have been tested in this study compared to the results of the coefficient found in Okun's original study, and other studies that test the relationship for developed countries by one percentage point of GDP. This is because the countries in this study are experiencing greater growth rates than countries that are already industrialised. Fixed estimates of pooled data reveal more significant results than random estimates, and fixed estimates are significant enough to conclude that co integration between the countries in this study is possible. Variables aside from those that make up the original Okun equation have a significant value and can be used to further improve the accuracy of analysis of how real GDP and unemployment react to each other. The accuracy of the results of this study could potentially be further improved by using a data filter to filter out streams of data that go beyond the expected frequency of results, and therefore supply a potentially fairer result. It should also be said that this study could be taken further by examining further into additional coefficients to see if other variables can have a significant effect on the NAGRU or Okun relation. Given more time it would be interesting to study the effects of things such as minimum wage laws, collective bargaining power and other variables related to labour laws that can affect the ease by which a slowdown in growth can affect unemployment. It would also be interesting to analyse the Okun relationship in years to come to see whether or not the development of a countries economy does have the expected effect of reducing the Okun coefficient in line with test of the relation for OECD countries and other developed economies. Most importantly we can conclude that despite slight departures from the expected results, Okun's law continues to keep its aura of enduring permanence in the world of macroeconomics.

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Data Sources 10.2:

www.esds.ac.uk

www.oecd.org

www.ec.europa.eu/eurostat.