Okun’s law and Gender in Sweden

Pernilla Lang
Abstract

This paper investigates whether or not there is a statistically significant relationship between output growth and unemployment rates in the Swedish economy. This relationship is in economics called Okun’s law. Two different methods have been used to estimate the relationship, namely the Growth Version and the Gap Version. The time period investigated has been from 1951 until 2014. Both aggregate and gender disaggregated data over unemployment have been used. The paper will conclude that there is a negative relationship between aggregate unemployment and output growth. Further the results will show that this relationship has changed over time. When observing the results for gender disaggregated data, the results will differ between male and female unemployment.
Table of Contents

Abstract ............................................................................................................................... 2

1.0 Introduction .................................................................................................................. 5
  1.1 Okun’s law ................................................................................................................... 6
  1.2 Purpose ........................................................................................................................ 8

2.0 Empirical models of Okun’s relationship .................................................................. 9
  2.1 The Gap Version ......................................................................................................... 9
  2.2 The Growth Version ................................................................................................. 10
  2.3 The Distributed lag version ....................................................................................... 10
  2.4 Hypothesis testing .................................................................................................... 11

3.0 Theoretical Background ......................................................................................... 12
  3.1 Okun’s coefficient ...................................................................................................... 13

4.0 Literature review .................................................................................................... 15
  Okun’s law over the business cycle .............................................................................. 15
  Age effects in Okun’s law within the Eurozone ........................................................... 15
  Economic growth and Unemployment: An empirical analysis ..................................... 16
  How Growth has Failed to Keep Pace with a Burgeoning Labor Market .................... 16
  Okuns Law in Scandinavian Countries ......................................................................... 17
  An Empirical study on Growth and Unemployment in Swedish counties .................... 17
  Estimating the Okun’s coefficient in the Swedish Economy ........................................... 18
  Summary of previous research ...................................................................................... 19

5.0 Data ............................................................................................................................ 20
  5.1 Descriptive statistics ................................................................................................. 21
  5.2 Method ....................................................................................................................... 22
  5.3 Approach ................................................................................................................... 22

6.0 Results ....................................................................................................................... 26
  6.1 Interpretation of results ............................................................................................. 27
  6.2 Results for male and female ...................................................................................... 28

7.0 Discussion ................................................................................................................ 30

8. References .................................................................................................................. 36

9. Appendix .................................................................................................................... 38
1.0 Introduction

GDP growth and unemployment are two important macroeconomic variables that are often used to analyze how well an economy is performing. GDP refers to the total amount of goods and services produced in a country. GDP growth defines how much this production changes over a time interval, e.g., a year or quarter. This essay will focus on the relationship between GDP growth and unemployment, i.e., the relationship on which Okun’s law is based.

Understanding the relationship between GDP growth and unemployment can be useful for both economists and policy makers. For instance, it is useful to be able to construct macroeconomic models that are largely consistent with the underlying data. Also, if a quantitative relationship between GDP growth and unemployment exists, it can help in the assessment of whether policies designed to increase GDP growth is likely to reduce unemployment, and vice versa.

If an increase in unemployment is essentially due to cyclical movements in the business cycle. There are opportunities to recover this thru a well-balanced stabilization policy. That means to expand demand when unemployment is high, and to curtail demand when inflation accelerates. Monetary policy is one measure for the Central Bank to influence demand by controlling the interest rate. Higher interest rates typically slow down household consumption. This is due to several things. Higher interest rates make it more attractive to save, that is, to postpone consumption into the future, which suppresses current consumption. It also reduces consumption because loans will cost more in interest payments. Finally, higher interest rates makes prices of both financial and real assets to fall as the present value of future returns will be lower. Households who see their wealth shrink become less willing to consume.

This chain of reactions will also affect firms since decreased consumption means decreased demand for goods and services which in turn contributes negatively to an economies GDP growth.

Monetary Policy $\rightarrow$ Interest rates $\rightarrow$ Consumption $\rightarrow$ Demand $\rightarrow$ GDP growth $\rightarrow$ Unemployment

By having an idea of how large the cost of a contractionary monetary policy will be in terms of increased unemployment due to this decline in demand, governments and central banks can be better prepared if such policy measures become necessary.
The labor market is for several reasons crucial to the formulation of monetary policy. Monetary policy cannot and is not tasked with improving labor market performance in order to lower unemployment. However, the Swedish central banks main task to keep inflation close to the two percent target is facilitated when the labor market works well.

Under perfect competition in the labor market, labor supply equals labor demand, and there is no unemployment. However, labor markets typically differ from a perfectly competitive market. This is partly because labor markets include frictions. Frictions means there always exists some level of unemployment but the size can vary depending on for example, how effective the matching process is and how fast changes are taking place in the economy. What determines the level of unemployment is therefore how supply and demand of labor meets.

### 1.1 Okun’s law

A low unemployment rate is said to be better from a welfare perspective. The conclusion is therefore that if increased growth result in decreased unemployment there is a great incentive for policy makers and politicians to take decisions that are favorable for firms operating domestically. This also formed the basis and motivation for Okun's report that resulted in Okun’s law (Okun 1962).

1962, Professor Arthur Okun who was active at Yale University, USA, got the assignment from the government to investigate the relationship between unemployment and GDP growth. Based on data from the US economy between 1947 and 1960, Okun found a negative relationship between GDP growth and unemployment, implying that GDP growth could help to reduce unemployment. Knotek (2007) estimated this relationship based on data that was available to Okun and found that in order to keep unemployment constant, GDP growth have to equal four percent. If GDP growth equaled zero, unemployment will increase by 0.3% per quarter. This result is presented in equation (1). Here, $\Delta u_t$ defines the change in the unemployment rate from one quarter to another ($u_t - u_{t-1}$) and $\Delta y_t$ is the percentage change in GDP from two consecutive quarters. A recurring term in this paper is Okun’s coefficient. This coefficient is defined as the percentage by which unemployment changes when GDP growth changes by one percent. In equation one, this would be minus 0.07 percent.

$$\Delta u_t = 0.30 - 0.07 \Delta y_t$$

After Okun published his findings many other scholars have investigated his results and estimated the relationship for other countries as well as other time periods. The results have
varied considerably and different conclusions have been made. Some scholars have found a similar relationship as Okun did and others have found that even though the output growth has been high, there has not been any reduction in unemployment. On the contrary, some scholars have found that unemployment has increased even though the economy experienced high growth (Hanusch, 2013; Knotek, 2007; Kreishan, 2011). This phenomenon is called jobless growth and contradicts the negative relationship between unemployment and growth that Okun’s law represents. Reasons for this phenomenon will be further explained in the theory section.

Okun’s relationship will vary among economies because political and demographic inequalities exist. It can therefore be disputed whether it is right to call what Okun found a law. The argument is that since results are so different from one country to another, it should rather be seen as a rule of thumb than a law.

Fluctuations in output growth might have a larger effect on the private sector than it has on the public sector. Figure one demonstrates how the number of workers is distributed between the private and public sector and how this has changed over time from 1990. The curve for the private sector has fluctuated up and down more than the public sector. Further, the number of workers has increased by 21.06 percent in the private sector and decreased by 21.07 percent in the public sector.

![Figure (1): number of workers distributed in the private and public sector (SCB)](image-url)
The public sector is different from the private because it has to provide health care, social security and other government services even though the economy is in a recession. Social security expenses in the form of unemployment benefits might decline as people become employed but also increase with higher unemployment rates. The public sector might therefore be affected by fluctuations in demand but not to the same extent as the private. With this as a background, the assumption will be that the private sector is more affected by variations in output growth than the public.

Looking deeper into the labor constitution of the private and public sector, one thing stands out. The labor force in the public sector is dominated by women. Most women today work in education, social care and social services which all belong to the public sector (Arbetsmiljöverket, n.d.). Relating this to Okun´s law, women should be less affected by changes in output growth than men and Okun´s coefficient should therefore be smaller for women than for men. Based on these observations, I found it interesting to investigate the relationship between unemployment and economic growth in Sweden for men and women.

1.2 Purpose
The purpose of this study is to investigate whether or not there is a statistically significant relationship between changes in unemployment and GDP growth in the Swedish economy. This relationship is in economics known as the Okun´s law. Both aggregate unemployment data and gender disaggregated data will be used. The time period extends from 1951 to quarter two 2014. There are various ways to estimate this relationship. This essay will essentially use the growth version but results from the gap version will also be presented. A literature review where previous research from other parts of the world as well as for the Swedish economy will point out differences in Okun’s relationship. To conclude the paper, an overview of different events that have occurred in the Swedish economy will be analyzed and discussed as a matter of possible explanations to the results.
2.0 Empirical models of Okun’s relationship
This paper will use two different methods to estimate Okun’s relationship. These two models, which are called the growth version and the gap version, will now be presented in more detail. A third method, called the distributed lagged version will also be presented in order for the reader to understand the literature review. The distributed lag version is an extension of the growth model.

2.1 The Gap Version
I will start by presenting the Gap Version. This version is a bit more complicated than the others because it includes potential GDP and the natural rate of unemployment. These two variables are not observable statistics and therefore they have to be estimated. This makes the estimation of the Gap Version complicated because there are several ways to calculate these variables but no method to confirm their true values.

Okun (1962) defined potential output as the level of output produced in an economy under full employment where no inflationary pressure occurs. The Non-Accelerating Inflation Rate-of-Unemployment also called NAIRU is defined as the unemployment rate where the inflation rate is stable (Lundborg et al 2007). The effect of inflation on unemployment can be explained by saying that when inflation is accelerating, the competitiveness of domestic companies decrease internationally because domestic prices increase relative to foreign prices. The consequence will be decreased demand for domestic goods which in turn leads to increased unemployment.

Over time, real output growth will fluctuate above and below the potential output. These output fluctuations cause firms to lay off workers when output is below its potential and hire workers when output is above potential.

According to Ball et al (2012), the relationship can be derived as;

\[
(1) \quad E_t - E_t^* = \alpha (Y_t - Y_t^*) + \rho \quad \alpha > 0 \\
(2) \quad U_t - U_t^* = \eta (E_t - E_t^*) + \mu \quad \eta < 0 
\]

Where \( E_t \) is the actual employment rate and \( E_t^* \) is the estimated employment rate. \( Y_t \) is actual output and \( Y_t^* \) is potential output, both in money terms. \( U_t \) is the actual unemployment rate and \( U_t^* \) is the natural rate of unemployment. \( \rho \) and \( \mu \) is statistical error terms. Okun’s law can be derived by substituting (1) into (2) and we get equation (3)

\[
(3) \quad U_t - U_t^* = \beta (Y_t - Y_t^*) + \epsilon \quad \beta < 0 
\]
This holds for any production function that includes labor as an input factor and assumes that increased labor will increase output. The final equation of the gap version is presented in equation (4).

\[(U_t - U^*_t) = \beta_0 + \beta_1 (Y_t - Y^*_t) + \epsilon \quad (4)\]

As potential output and the Non-Accelerating Inflation Rate-of-Unemployment are estimated variables, results for estimating Okun’s coefficient based on the Gap Version will vary based on which method that is used. This is something that should be taken into consideration when comparing results from this model.

“The quantification of potential output and the accompanying measure of the gap between actual and potential is at best an uncertain estimate and not a firm precise measure“

Arthur Okun 1962

2.2 The Growth Version

This paper focuses on the growth version that is demonstrated in equation (5). \(\Delta u_t\) is the change in unemployment rate between two consecutive time periods. \(\beta_0\) is an intercept measuring the change in the unemployment rate that will follow if the output growth is zero. \(\beta_1\) is Okun’s coefficient. If the parameter \(\beta_1\) is assumed to have a negative value, it means that there is a negative relationship between unemployment and GDP growth. \(\Delta y\) is the GDP growth rate or the change in GDP from one period to another and \(\epsilon\) is the statistical error term. The Growth Version was the first method Okun used to estimate the relationship.

\[\Delta u_t = \beta_0 + \beta_1 \Delta y_t + \epsilon, \quad (5)\]

2.3 The Distributed lag version

The third method of estimating Okun’s coefficient is the distributed lag version or the dynamic version as it is also called. This version is demonstrated in equation (6) and is based on the growth version. Looking at the first part, it is exactly equal to the growth version and will also be interpreted in the same way. It also includes time lags of the change in the unemployment rate and output growth. This model is useful because output growth is likely to
be affecting unemployment in one or two time periods after the actual change. The drawback of this model is that it can be hard to interpret the results.

\[
\Delta u_t = \beta_0 + \beta_1 \Delta y_t + \beta_2 \Delta y_{t-2} + \beta_3 \Delta u_{t-1} + \beta_4 \Delta u_{t-2} + \epsilon_t
\]

(6)

2.4 Hypothesis testing

The equation that will be estimated is presented below;

\[
\text{Change in Unemployment Rate} = \beta_0 + \beta_1 \ast (\text{Change in Real GDP Growth})
\]

\(\beta_1\) is the parameter that will be tested on a 95 percent confidence interval. If this parameter is statistically significant, it means there is a statistically significant relationship between unemployment rates and real GDP growth in the Swedish Economy.

*The hypothesis testing is therefore stated as; \(H_0: \beta_1 = 0\) and \(H_A: \beta_1 \neq 0\)*
3.0 Theoretical Background

The Solow-Swan model (also called the Standard growth model) is a famous macroeconomic model which focuses on output per worker. The basic interpretation of the model is that capital accumulation will result in economic growth. Solow and Swan meant that if more capital is provided to the economy, this capital would be used to produce more and thus increase output.

Capital accumulation (\( \dot{C} \)) is expressed as; \( \dot{C}_t = I_t - \delta C_t \)

Where \( I_t \) is investment, \( \delta \) is the depreciation rate of capital and \( \dot{C} = dC_t / dt \)

Investments are financed through savings (\( S_t \)) meaning; \( I_t = S_t \) where savings depend on the marginal propensity to save and therefore \( S_t = s Y_t \) where \( Y_t \) is income.

We can now see that income, the savings and depreciation rates will affect capital accumulation. This is important to note because it indicates the relationship between income and growth which will be essential in order to understand the relationship derived between unemployment and growth.

After some derivation and introduction of the labor force (\( n \)) we get the Fundamental Solow Equation of Motion (Carlin 2007), which describes how capital per worker varies over time;

\( \dot{c} = s f (c_t) - (n + \delta) c_t \) is the Fundamental Solow Equation of Motion where \( c_t \) is the current level of capital in the economy.

If \( s f (c_t) = (n + \delta) c_t \) the economy is in its steady state. At this point, capital per worker is constant and therefore also output per worker. However, if \( s f (c_t) > (n + \delta) c_t \) we will see an increase in capital per worker because savings and hence investment per worker are larger than the depreciation rate and the labor force growth. This means that capital per worker will increase and therefore also output per worker.

In general, growth models do not include unemployment in its framework and as we can see, the Solow model is not an exception. Further, modern labor market theories do not include output growth; rather they are based on institutional settings such as the size and power of unions, the bargaining power of workers and unemployment benefits (Bräuninger and Pannenberg, 2002). This means there is little theoretical work done to explain unemployment as dependent on economic growth or vice versa. This creates an issue that Okun’s law has been criticized for, namely its lack of theoretical foundation (Adachi, 2007; Hideyuki, 2007; Owyang and Sekhposyan, 2012).
To create a theoretical relationship between growth and unemployment, scholars have modified the Solow-Swan model to include unemployment. Bräuninger and Pannenberg introduced unemployment into an augmented Solow model. Their results show that a rise of unemployment will reduce growth rates of physical and human capital. This happens because unemployment results in lower incomes and as demonstrated previously, income will affect savings which in turn affect capital accumulation. Also with lower incomes, educational expenditures tend to decrease which leads to declining human capital (Bräuninger and Pannenberg, 2002).

Adachi (2007) integrated the Solow-Swan model with a labor market model. The result was an equation that provides a theoretical base of Okun´s law where unemployment and output growth are dependent on each other. The model is based on the assumption of monopolistically price-setting firms. It determines unemployment endogenously where the labor market is represented by a wage-setting equation derived from efficiency wage and bargaining models taken from Blanchard (1997). Adachi´s equation also includes the elasticity of substitution between labor and capital and the elasticity between unemployment and real wages. This elasticity’s are different among countries and time periods and explains why Okun´s coefficient in theory is not equal among economies, something that most empirical results also find (Hideyuki 2007).

3.1 Okun´s coefficient
The textbook definition of Okun’s law states that there is not a one-for-one relationship between unemployment and GDP growth. More precisely it states that a one percent increase in output growth will not decrease unemployment by more than 0.5 percent (Carlin 2006). There are several reasons to assume that Okun´s coefficient will be less than one in absolute value.

Because of labor hoarding, companies are most likely to adjust their workforce less than proportionally in response to fluctuations in output growth. One reason is that some employees are needed regardless of the level of current production. One example is the human resources and finance department of a company. No matter how many workers the company includes, someone have to take care of administrative tasks.

Another reason is that there are costs associated with hiring and firing employees. The Nordic countries, for example, have regulations that protect workers. This makes it more costly for businesses to make reductions in their labor force when production levels decline. Observing
the East Asian labor market, a part of the world with very low unemployment rates and flexible “hiring and firing” regulations. Comparing countries in this region, one could see that those with less flexible regulations did not have equally strong relationships between growth and unemployment as those countries with more flexible regulations. This is interesting because it shows that labor market institutions have influence over how much the labor market will respond to economic and political changes within the country (Hanusch, 2013).

It is also expensive to train new staff. Therefore, rather than laying off people during a recession, companies may choose to keep them in production. When the current level of production is high, the opposite will occur and companies will initially allow employees to work overtime instead of hiring new staff. In economics, this phenomenon is called labor hoarding and due to this, there is not a one-for-one relationship between output growth and unemployment.

Technological progress is another factor that can affect unemployment even though GDP growth does not change. A technological improvement which makes it possible to substitute labor for machinery will leave people unemployed. For example; in the 1970s, the electronic revolution began to take off in Sweden. Many inventions improved both production and communication. The microprocessor paved the way for the computer and the electronic industry became the major growth industry. At the same time, with technological improvements, skilled workers who could supervise machines were demanded and on the other hand, fewer workers where needed to perform routine tasks that was now handled by machines. The interchangeable ratio was not a one-for-one relationship because more workers were layed off in comparison to worker who got employed to control machines. These changes led to a structural change in the labor market and increased unemployment (Schön 2007).
4.0 Literature review

Below is a presentation of previous research on Okun’s law. Different approaches, results and conclusions will be presented. Thereafter will a short summary of the main conclusions follow.

Okun’s law over the business cycle

M. Owyang and T. Sekhposyan (2012)

In this paper, Okun’s coefficient is estimated based on quarterly data from 1941 until 2011 for the US economy. The distributed lag version has been used and the main objective was to find out whether the relationship between output growth and unemployment changes during recessions. In order to separate recession years from “normal” years, a dummy variable was used to indicate years of recession. To evaluate the stability of Okun’s coefficient during these years, a rolling regression with a twelve years interval was used. If the coefficients are more or less constant over the entire sample, then the estimates over the rolling windows should not differ too much. However, if the coefficient changes at some point during the estimation period, then the rolling estimates should capture this change. The authors base their choice of time interval on dates from National Bureau of Economic Research (NBER) which indicates that the US economy has suffered a recession every 10th year. They therefore choose the time interval to be 12 years in order to make sure that each period covers one recession. Results from the study conclude that the relationship between unemployment and output growth has fluctuated significantly during the time period investigated. Further the authors find that these fluctuations are highly correlated with the business cycle and that unemployment is much more sensitive to changes in GDP growth during recessions.

Therefore, depending on which time period being investigated, the relationship between output growth and change in unemployment can vary significantly. By dividing longer time periods into several shorter ones, results can turn out differently. The conclusion is therefore that it is of great importance which time period that is investigated and also if the economy is in a recession or not, before judging the value of the coefficient.

Age effects in Okun’s law within the Eurozone

O. Hutengs and G. Stadtmann (2013)

This paper confirms that the correlation between Okun’s coefficient and the business cycle is even stronger for younger people. The data for this paper is based on observations between 1983 and 2001 where the measures of unemployment have been disaggregated into different
age groups. By estimating Okun’s equation for each country and age cohort separately, they found that Okun’s coefficient clearly becomes reduced in absolute value with increasing age in all countries.

As it might be harder for younger people to become employed, they will suffer much more during recessions when unemployment in general increase. But it also means that they will benefit more when the economy is expanding. Employers might feel more comfortable in employing someone with previous experience and gratifying references.

**Economic growth and Unemployment: An empirical analysis**

*Fuad M Kreishan (2011)*

Between 1970 and 2008, GDP growth has reached rates as high as 8.6 percent in the Jordanian economy. However, in contradiction to Okun’s law, no decline in unemployment rates can be observed. This paper models the relationship between GDP growth and unemployment using the growth version. A Dickey-Fuller test assured that the variables were stationary and the Durbin-Watson test was applied to check for first order serial correlation. The regression analysis does not result in statistically significant parameters. The conclusion is therefore that there is no relationship between unemployment and GDP growth in Jordan. The author claims that one explanation is that people in Jordan do not seem to have the acquired education or skills needed for the available vacancies. A second reason was that people seemed to have high reservation wages and therefore preferred to stay unemployed rather than accepting a job that matched their level of qualification. In fact, 50 percent of the unemployed stated that they preferred to stay at home rather than working for the wage they were offered. Discussed was also that foreign workers accepted the prevailing wages and there was therefore no incentive for employers to raise wages as there was sufficient labor provided from abroad. The article is interesting because it points out that high GDP growth does not reduce unemployment in all cases.

**How Growth has Failed to Keep Pace with a Burgeoning Labor Market**

*J Keller and K. Nabil (2007)*

Jordan is not the only example contradicting Okun’s law. This report concludes that many countries in North Africa and the Middle East (MENA countries) experience positive changes in GDP growth but no decline in unemployment rates. However, the results in general for this area are not as striking as they were for Jordan. In general, MENA countries have not experienced the same high level of growth as Jordan alone. The authors in this article agree
that low levels of education contribute to high unemployment rates. But the greatest issue seems to be a labor force that is growing at a much higher rate than GDP growth. The outcome will therefore be an increase in unemployment rates. The only adjustment to help decrease unemployment in this case is to reduce wages. If the cost of employing people is reduced, employers might have incentives to employ more people. Then again, the problem of high reservation wages occurs as real wages decline.

Further, it is important to note whether the output growth is capital or labor intensive. If growth increases because machines produce more goods, than it may have little effect on unemployment. However, in the case of the countries discussed in this report, this does not seem to be the case. On the contrary, the authors claim that the output growth has been highly “employment friendly”.

**Okuns Law in Scandinavian Countries**

*O.Hutengs and G.Stadtmann (2014)*

This essay investigates Okun’s relationship in a gender and age specific context. The time period investigated is from 1984 until 2011. To estimate Okun’s coefficient for the different groups, the growth version is used. Okun’s coefficient is calculated for five different age cohorts and dummy variables have been inserted to separate these different age groups. Results of the estimates show that the younger the cohort, the larger becomes Okun’s coefficient in absolute value.

When estimating Okun’s coefficient on gender-disaggregated data, a separate model for each gender was executed. There was a much better fit for the model estimated on data for men then for women. Further, coefficients for male cohorts were both bigger and more significant than for women.

**An Empirical study on Growth and Unemployment in Swedish counties**

*L.Jönsson, M.Aitol (2006)*

The purpose of this study is to investigate Okun’s relationship based on county level data for the Swedish economy. The time period for estimation is 1986 until 2003. To do this, data on unemployment levels for each county and the gross county product have been used. A dummy variable was added to indicate a shift in the unemployment rate between 1991 and 1992 due
to changes in the political direction, in this case the new inflation target. Okun´s coefficient is then estimated separately for each county using the growth version.

An interesting result from the study is that the largest (in absolute value) point estimate of Okun´s coefficient was found for Skåne. The authors then compare this estimate with the same estimate for Stockholm. They choose Stockholm with the motivation that these counties have similar structures when it comes to size and infrastructure. Further the authors indicate that the public sector has a lot less impact on Okun´s relationship because it is weakly related to growth. However, it turns out that 75 percent was employed in the private sector in Stockholm and 25 percent in the public sector, while the corresponding numbers for Skåne were 64 percent privately employed and 36 percent publicly employed. This would not support the thesis that large private employment explains the differences between counties. By instead looking at the composition of the private activity, one can see that Skåne has almost twice as large manufacturing industries as Stockholm, 29 percent against Stockholm’s 15 percent. This could explain why the correlation between unemployment and the growth of the gross county product is stronger in Skåne than Stockholm.

**Estimating the Okun´s coefficient in the Swedish Economy**

_M.Källman, H.Nordell (2012)_

This essay investigates Okun´s relationship in the Swedish economy. With the use of the _Growth, Gap_ and the _Distributed lag version_, Okun´s coefficient has been estimated for the time period between 1983 and 2010. For the _Growth Version_, robust standard errors and a lag of three time periods have been applied. The estimated parameters are statistically significant for both the _Growth_ and the _Gap Version_ where Okun´s coefficient turned out to be –0.3 and –0.43. The distributed lag version showed significant values for all estimated parameters except one. Further it resulted in an adjusted R² value of 0.925 which is twice as high as for the growth version.

The author’s final comments on the results are that the _Gap Version_ implies a very low R² and therefore explains so little of the relationship between GDP growth and unemployment that it should not be trusted. The explanation given is that the _Gap Version_ uses estimates for potential GDP and NAIRU. Because of this, they found the _Growth Version_ to give the most reliable results even though the R²–value was much lower compared to the _Distributed Lag_
**Summary of previous research**

To summarize the articles presented and to point out some main conclusions, I would first like to mention that the results seem to be strongly dependent on which time period and group of people that Okun’s relationship is estimated for. By investigating the cohort of younger people during a recession, Okun’s coefficient might turn out to be much higher in absolute value than for older cohorts during the same time period. Therefore, what might be valid during one time period for one group of people may not be valid for another.

Not only age and time periods seem to influence results. One can also expect to find differences between genders. In the introduction I discussed that results may not be as significant for women as they would be for men because women are over-represented in the public sector (Arbetsmiljöverket, n.d.) and that this sector seem to be less sensitive to output fluctuations. Hutengs and Stadtmann (2014) paper further strengthens this theory.

We should also be aware that all economies do not experience that unemployment decline when their output growth increases. Different factors such as wages, a growing labor force and capital intensive growth can mean that even though an economy has had high growth rates, no decline in unemployment will occur. This has been exemplified in the articles related to the MENA countries. These articles imply that structural changes and reforms of the labor market would need to be implemented in order to decrease unemployment.
5.0 Data
In order to calculate Okun’s coefficient, data over GDP growth and unemployment rates was used. Yearly data for Swedish real GDP was retrieved from konjunkturinstitutet. Quarterly data for real GDP growth was retrieved from Sweden Statistics.

Data over potential output and the natural rate of unemployment also originate from konjunkturinstitutet. They base their estimates on data from Statistics Sweden. The report was from August 2014 and contained quarterly data.

Yearly unemployment rates were sent to me from the Swedish labor office. Data over quarterly unemployment rates for men and women was retrieved from Statistics Sweden. Individuals in the underlying data sample were between 16 to 64 years old. Unemployed in this group is defined as individuals who were without work during the reference week but who looked for work in the past four weeks (the reference week and three weeks back) and could work during the reference week or begin within 14 days of the reference week. Unemployed persons also include persons who have found a job that starts within three months, provided they could have worked the reference week or begin within 14 days of the reference week.

A comment about the data; In October 2007, the official definition of people unemployed was changed. In accordance with EU regulations, full-time students who seek work were included in the group of unemployed and thus in the labor force. Previously this group was not included in the labor force.
5.1 Descriptive statistics
In table (1), the expression \((U_t - U_{t-1})\) indicates that the data has been adapted to fit the growth version of Okun's law. In this case it means that the unemployment rate from the previous time period \((U_{t-1})\) has been subtracted from the value of the current time period \((U_t)\). By doing so, we get the change in unemployment rates between two consecutive time periods.

For some years, data for GDP growth were not available. Therefore the real GDP in money terms have been used to calculated growth rates. The equation used to calculate growth is; \((Y_t - Y_{t-1}) / Y_{t-1} * 100\). This equation will indicate which variables this has been done for in table one.

The final variable used for regressing Potential Output was Potential Real GDP in millions of kronor minus Actual Real GDP in millions of kronor \((Y_{Actual} - Y_{Potential})\).

The final variable for NAIRU is the natural rate of unemployment minus the actual unemployment rate \((U_{Actual} - U_{NAIRU})\).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description of the variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Unemployment Rate 1951-2013</td>
<td>Yearly data for unemployment rates as a percentage of the labor force. The difference between two consecutive years. ((U_t - U_{t-1}))</td>
</tr>
<tr>
<td>2.Real GDP growth 1951-2013</td>
<td>Yearly data for real GDP growth rate. The percentage change in real GDP between two consecutive years.</td>
</tr>
<tr>
<td>3.Unemployment Rate 1951-1990</td>
<td>Is the same data as for “Unemployment 1951-2013” only shortened to include data from 1951 until 1990. ((U_t - U_{t-1}))</td>
</tr>
<tr>
<td>4.Real GDP growth 1951-1990</td>
<td>Is the same data as for “GDP growth 1951-2013” only shortened to include data from 1951 to 1990.</td>
</tr>
<tr>
<td>5.Unemployment Rate 1991-2013</td>
<td>Is the same data as for “Unemployment 1951-2013” only shortened to include data from 1991 until 2013. ((U_t - U_{t-1}))</td>
</tr>
<tr>
<td>6.Real GDP growth 1991-2013</td>
<td>Is the same data as for “GDP growth 1951-2013” only shortened to include data from 1991 to 2013.</td>
</tr>
<tr>
<td>8.Unemployment Rate Male 1993-2014</td>
<td>Quarterly data for gender disaggregated data. Male unemployment rates between 1993 and 2014. ((U_t - U_{t-1}))</td>
</tr>
<tr>
<td>9. Unemployment Rate Female 1993-2014</td>
<td>Quarterly data for Gender disaggregated data. Female unemployment rates between 1993 and 2014. $(U_t - U_{t-1})$</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>10. Real GDP growth 1993-2014</td>
<td>Quarterly data for GDP in fixed prices, reference year 2013. Millions of kronor. When the growth version have been estimated, growth rates have been calculated $(Y_t / Y_{t-1}) / Y_{t-1} * 100$</td>
</tr>
</tbody>
</table>

**Table (1): Descriptive Statistics**

### 5.2 Method
The final outcome of this paper will be two estimated models with one containing male unemployment and the second female unemployment. For the reader I will refer to these models as *Model M* and *Model F*. But first will the three models based on aggregate unemployment data be estimated. These models will be referred to as *Model One*, *Model Two* and *Model Three*.

All models state the relationship between unemployment and output growth where the dependent variable is the change in unemployment rates and GDP growth is the independent variable. For *Model One* the data is based on yearly observations from 1951 to 2013. This time period will then be divided into two different sub periods. The break will take place between 1990 and 1991. The period before 1991 will be presented by *Model Two* and the period after by *Model Three*. *Model M* and *Model F* are based on quarterly data for male and female unemployment between the first quarter of 1993 and the second quarter of 2014.

The period between 1993 and 2014 will then be estimated for the total population with the use of the *Gap Version*. This model will be called *Model Gap*.

### 5.3 Approach
A common problem with time-series data is that the variables are non-stationary. When a variable is non-stationary it means that its mean value increases or decreases over time. On the contrary, a stationary variable is one whose statistical properties are such that mean and variance are constant over time. This is less of a problem when the variables are expressed in percent. If the variable is measured in percentage terms, there is less reason to believe that the variable would be non-stationary as GDP growth does not increase significantly over time.
By plotting the data one can see if the values are increasing over time and if so, show signs of being non-stationary. However, to confirm whether the variable is stationary or not, a Dickey-Fuller test has been carried out for all variables. The test examines whether or not a variable contains a unit-root. The null hypothesis for the test is that it contains a unit root and therefore is non-stationary. The alternative hypothesis claims that the variable does not have a unit-root and is stationary.

Results for the Dickey-Fuller test is presented in Appendix, table (2). The results show that all models except the Gap Version have stationary variables. Both variables in the Gap Version were non-stationary. This could indicate that the model is highly correlated for non-causal reasons (Studenmund 2014 p.404).

It is likely that current and past GDP growth will affect future GDP growth. Due to the business cycle, growth rates might be negative during recessions and positive when the economy is expanding. Because of this, there is a correlation between two consecutive time periods. To examine if there is serial correlation, a Durbin-Watson test was executed for all regressions. If the d-statistic is below the critical value of dL then the null hypothesis of no positive serial correlation cannot be rejected. The Durbin-Watson test indicated positive serial correlation for some of the models; results are presented in table one in Appendix. This means that standard errors are underestimated which results in overestimated t-values. This increases the risk of type one errors as it is more likely that we reject the null hypothesis for the model due to overestimated t-values. To correct for serial correlation, I have used the Newey-West standard errors. This way of estimating leaves coefficients unchanged and only takes care of error terms including serial correlation (Studenmund, 2014, p.342).

To test for heteroskedasticity a Breusch-Pagan/Cook-Weisberg test was used. All chi-square values were strongly indicating that heteroskedasticity did not exist for any of the estimated models.

When plotting the data and observing the overall fit for the regressions one can distinguish a non-linear pattern for model one. To better see if this might be the case, an augmented component-plus-residual plot also called augmented partial residual plot was done (see figure 2). This plot makes it easier to see nonlinearities in the data. Plotting the first model, one can see that the smoothed line is fluctuating above and below the ordinary regression line, and the entire pattern does not seem to be completely uniform. The other models seem to follow the
ordinary regression line much better. Except for some potential outliers, the plots for those models follow the ordinary regression line well and non-linearity should not be a problem.

![Graph]

Figure (2): augmented partial residual plot

Non-linearity can be caused due to omitted variables and/or incorrect functional form. To test for specification errors, a link-test was carried out. Specification for this test can be read about in “Introduction to SAS” under paragraph 2.6 (Statistical Consulting Group n.d). Results for the Link-Test are presented in table (3) in Appendix. A significant t-value was found for Model One and the hypothesis that the model is specified correctly can be rejected. For the other models, t-values are not significant and hence further actions are not required. Adding omitted variables is one way of correcting for specification errors. As this model only includes one independent variable it is most likely that the model misses some explanatory variables in order to explain the unemployment change. However, Okun’s growth version does only include one independent variable and therefore will no other variables be included.

The second reason for specification errors and non-linearity is incorrect functional form. Correcting for this can be done with the use of another functional form. In model one; a double-log form could be used with the motivation that the elasticity between the two variables is to be constant but not the slope. Also by looking at the augmented partial residual plot, one can distinguish a curve liked shape indicating that a double-log could be used. However, the unemployment variable includes so many observations with negative values
that using it as a log variable would eliminate the number of observations from 110 to 25. I will therefore proceed with a linear model because the number of observations would be so small. But also with the motivation that a linear functional form is in line with previous studies, and will therefore make my results easier to compare with the results from other papers.

The Ramsey test examines whether a model suffer from omitted variables or not and the null hypothesis is that the model got no omitted variables. The p-values for all tests are very small and therefore the test confirms that all models do suffer from omitted variables as was suspected.
## 6.0 Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta_0$</th>
<th>t-value $\beta_0$</th>
<th>$\beta_1$</th>
<th>t-value $\beta_1$</th>
<th>Obs</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1 1951-2013</td>
<td>0.60</td>
<td>5.0</td>
<td>-0.20</td>
<td>-5.8</td>
<td>62</td>
<td>0.35</td>
</tr>
<tr>
<td>Model 2 1951-1990</td>
<td>0.37</td>
<td>2.9</td>
<td>-0.12</td>
<td>-3.2</td>
<td>39</td>
<td>0.21</td>
</tr>
<tr>
<td>Model 3 1991-2013</td>
<td>0.68</td>
<td>2.9</td>
<td>-0.23</td>
<td>-4.0</td>
<td>22</td>
<td>0.41</td>
</tr>
<tr>
<td>Model Gap</td>
<td>2.87</td>
<td>18.1</td>
<td>-0.057</td>
<td>-13.8</td>
<td>86</td>
<td>0.69</td>
</tr>
<tr>
<td>Model Male</td>
<td>0.10</td>
<td>0.97</td>
<td>-0.197</td>
<td>-2.05</td>
<td>85</td>
<td>0.04</td>
</tr>
<tr>
<td>Model Female</td>
<td>0.06</td>
<td>0.63</td>
<td>-0.079</td>
<td>-0.91</td>
<td>85</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*Table (3): Results for linear regression*

Some of the models are characterized by positive serial correlation. Inference in these models is therefore based on the Newey-West Standard Errors. Table (4) presents the result. It can be concluded that all models are still statistically significant even after the use of Newey-West Standard Errors.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta_0$</th>
<th>$\beta_1$</th>
<th>t-value $\beta_1$</th>
<th>Observations</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>0.6</td>
<td>-0.20</td>
<td>-4.23</td>
<td>62</td>
<td>-0.3, -0.10</td>
</tr>
<tr>
<td>Model 2</td>
<td>0.4</td>
<td>-0.12</td>
<td>-3.64</td>
<td>39</td>
<td>-0.2, -0.05</td>
</tr>
<tr>
<td>Model Gap</td>
<td>2.9</td>
<td>-0.057</td>
<td>-12.7</td>
<td>86</td>
<td>-0.07, -0.05</td>
</tr>
</tbody>
</table>

*Table (4): Results for linear regression with Newey-West Standard errors*
6.1 Interpretation of results

This section outlines the results obtained from the estimated models. Looking at the t-values for each model, we can reject the null hypothesis for all models except Model Female. A more in-depth analysis of the results for the models will now follow.

Model one: Okun´s relationship for total population between 1951 and 2013

\[ \Delta u_{\text{Model One}} = 0.60 - 0.20 \Delta y_t \]

Interpretation; if output growth equals zero, unemployment will increase by 0.6% per year. To keep unemployment constant, growth need to equal 3% per year. On average during this time period, growth has been 2.4% (SCB) and unemployment has actually increased from 1.1% to 4.53% that is an increase of 3.42% on average. Using the estimated model to calculate the change in unemployment if growth had been 2.4% the result is that unemployment should have increased by 0.12% per year.

Below are the results of Model Two and Model Three.

\[ \Delta u_{\text{Model Two}} = 0.37 - 0.12 \Delta y_t \quad (1951 \text{ to } 1990) \]
\[ \Delta u_{\text{Model Three}} = 0.68 - 0.23 \Delta y_t \quad (1991 \text{ to } 2013) \]

Comparing model two with model three we can clearly see that the estimate of Okun’s coefficient has almost doubled in absolute value. This means that output growth have a much larger effect on unemployment after 1991 than before.

Källman and Nordell (2012) estimated Okun´s coefficient for the Swedish Economy between 1983 and 2010, almost the same time period as for Model Three. Note however that in their regression, the 1990´s crisis is included. Further, the period before the 1990´s crisis is characterized by lower unemployment rates in comparison with the period after. This should certainly affect their estimates of Okun’s coefficient to be different from mine and indeed, their value of \( \beta_1 \) turned out to be –0.3 (Källman and Nordell 2012), a bit higher than my value of –0.23.

Gap Model: Okun´s law for total population between 1993 and 2014

\[ \Delta u_{\text{Model Gap}} = 2.87 - 0.057 \Delta y_t \]
The interpretation of the growth version and the gap version is different. Okun’s coefficient for the Gap Version will indicate how much the unemployment gap will be reduced by an associated increase in the GDP gap.

To clarify the interpretation of my results; if the GDP gap increases by one million kronor, the unemployment gap will be reduced by 0.057 percent. The hypothesis testing for the Gap Version is the same as for the Growth Version but the equation estimated is a little bit different, as can be seen from the equation below.

\[
(\text{Actual Unemployment Rate} - \text{NAIRU}) = \beta_0 + \beta_1 * (\text{Actual GDP growth} - \text{Potential GDP growth})
\]

The t-statistic for the Gap Version was –13.82. The Dickey-Fuller test indicated that both variables are non-stationary. This means that the model might be correlated for non-causal reasons which in turn lead to over-estimated t-values. One way to correct for this is by the use of the Error Correction Model (ECM). In other studies where the Gap Version has been estimated, Econometric techniques (such as the ECM-model) have been applied. I am not familiar with this type of econometric methods. I did therefore strongly doubt my results when I estimated this model with such simplified means. However, referring to Arshad (2010) which estimates Okun’s coefficient with the gap version between 1993 quarter 1 and 2009 quarter 2, Okun’s coefficient results in a value of –0.06 and a t-statistic of –15.52. When he thereafter estimates Okun’s coefficient using the ECM-model the t-statistic decrease in absolute value but are still highly significant. Further, only \(\beta_0\) is affected and the estimated \(\beta_1\) does not change hence it remains to be –0.06.

6.2 Results for male and female

Okun’s law for male population between 1993 and 2014

\[ \Delta u_{\text{Model M}} = 0.10 - 0.197 \Delta y_t \]

Interpretation; if output growth increases by one percent, male unemployment will decline by 0.197% per quarter.

Okun’s law for female population between 1993 and 2014

\[ \Delta u_{\text{Model F}} = 0.06 - 0.079 \Delta y_t \]

The estimated parameter in this model was not statistically significant and we will therefore accept the null hypothesis to be true.
Little research has been done previously when it comes to gender disaggregated data and the Okun’s relationship. The only paper I found in order to compare my results is Hutengs and Stadtmanns (2014) which is also presented in the literature review. This paper examines whether or not Okun’s coefficient for male unemployment is significantly higher in absolute terms than for female. This is not what I have tested for. However, the authors found the coefficient for male unemployment to be significantly higher than for female in all Scandinavian countries, except for Sweden. My results showed that Model M was statistically significant but Model F was not, it can thus be said that Okun’s coefficient for Model M was significantly larger than for Model F. The authors also relate their results to the same underlying explanation as I do. Namely that male workers are overrepresented in industries that is sensitive to fluctuations in GDP growth, such as the private sector.
7.0 Discussion

Sweden has a history of very low unemployment rates. These low unemployment rates were based on factors that could not be sustained in the long-run, such as the fast-growing, tax-funded public sector and repeated devaluations. In the early 1990s, the Swedish unemployment doubled in only two years (Figure 3). The economy became subjected to different kind of macroeconomic changes: an oil crisis, slower productivity growth, increased international competition, new work organizations and new technologies (Schön 2007).

During the 1970’s, the real interest rate was at the very low level around minus five percent. By 1982 it had increased by around ten percentage points (Schön 2007). This meant in turn that the value of the domestic real assets quickly fell, with concomitant increases in savings and reduced consumption. This interest rate shock gave rise to a sharp fall in domestic demand for goods and labor, particularly in the goods-producing sectors that were focused on domestic markets (Schön 2007).

This chain of reactions contributes negatively to any economy’s GDP and positively on unemployment. This could therefore explain the shift in unemployment around 1990 that can be observed in figure (3).

![Figure (3): unemployment rates and GDP growth from 1951 until 2013 (SCB)](image)

After the 1990’s Sweden experienced a strong increase in productivity growth that was partly an effect of the strong rationalization and elimination of less efficient firms during the crisis (Schön 2007). Output growth also took pace and the economy returned to growth levels equal
to the levels before 1990. However, looking at Figure (3), we can observe that unemployment rates have not gone back to the same levels as before 1990.

So why did not unemployment rates go back to the pre-crisis level when growth started to take off again? Might it be that a functional weakening of the Swedish labor market had occurred after the crisis? One way of investigating this is by looking at the Beveridge curve. We can think of this curve as a graphical representation of the relationship between unemployment and the job vacancy rate. It normally has vacancies on the vertical axis and unemployment on the horizontal (Carlin 2006 p.122). If an outward shift is detected, the matching process is less efficient because an outward shift means that unemployment and vacancies have increased. Previous research have not found any signs of outward shifts in the Swedish Beveridge curve before 1991, on the contrary, inwards shifts have been detected (Forslund and Krueger 1997). However, after the 1990’s crisis, an outward shift has been detected (Forslund and Krueger 2010, Karlson and Skånberg 2012), meaning that maybe it has become harder for employers to find “the right man for the job” after the 1990 crisis due to inefficiencies in the matching process.

One further explanation could be that hysteresis has occurred. When unemployment levels increased, people got used to a lower standard of living and it became more socially accepted to be unemployed. This might make people reluctant to return to work even though a job is offered. This together with high unemployment benefits may result in that people choose to stay at home instead of being employed.

To clarify how this would impact Okun’s relationship I will give a more in-depth explanation. Let us assume that a firm needs to hire more labor because its production level has increased. If the firm finds it difficult to encounter workers with the skills acquired for the job, they will most likely not employ anyone. The reversed reasoning goes for the case of hysteresis. Here it would be the potential employee who made himself unavailable to the employer. In both cases the result might be that the employer chooses to let staff work overtime in order to keep up with production. This would mean that the relationship between unemployment and output growth would be weakened and that Okun’s coefficient would be smaller after the 1991 crisis. This argument does however go against my results where Okun’s coefficient actually increased in absolute value after the 1990’s crisis.

In 1993, the Swedish central bank announced the new target for inflation. The target was set at two percent and in order to give the economy a chance to adjust, the central bank decided
that this would be implemented earliest 1995. In 1997, expected inflation was in line with the new inflation target. After that, there have been discussions whether or not actual inflation has equaled the targeted inflation. Lars EO Svensson, former Deputy Governor for the Swedish Central Bank, have claimed that between 1997 and 2011, actual inflation have been on average 1.4 percent (Svensson, 2013). Svensson stated that this has consequences in the form of reduced employment and I will now explain why. Wages are normally set in advance and are based on the expected inflation. To keep the real wage constant, wage setters will increase current wages by the expected increase of prices, in this case two percent. This means that the unit labor cost will rise by two percent. Because actual inflation was on average 1.4 percent, prices levels have not increased as much as wages. This results in higher real wages and hence higher real labor costs for firms. In order for firms to keep their profits constant, they would need the actual inflation to equal expected inflation. As this has not been the case, labor costs have been too high and firms are therefore reluctant to employ new labor even though demand has increased. Does this mean that Okun’s coefficient could have become larger after the 1990’s crisis? Probably not, as this makes labor more costly for firms, a bigger increase in the production level would be needed before firms could take on extra costs.

Referring to Figure (1), we could see that the amount of people employed in the private sector have increased over time in comparison with the public sector. Since the private sector is more sensitive to output growth than the public, it means that more people are affected by output growth after the crisis than before. This means that when the level of production increase, which it did after the crisis, more people will be affected by it. This could contribute to the fact that Okun’s coefficient increased after the crisis.

The period before the 1990’s crisis is known for a quite stable period. The period after on the other hand, includes both the aftermath of the 1990’s crisis, the burst of the IT-bubble and the financial crisis of 2008. This could be interesting as it seems like Okun’s coefficient is larger in absolute value during recessions (Owyang and Sekhposyan 2012 , Hutengs and Stadtmann 2014). The motivation behind is that due to Sweden’s strong labor legislation, it is much harder for firms to lay off workers during a recession than it is to employ when the economy expands. If this is true for the Swedish economy, it would mean that Okun’s coefficient is larger in absolute value after 1990.
Until 1993, employment agencies were not permitted in Sweden. After the deregulation, the extent of the staffing sector activity gradually increased and broadened. There are several reasons why there is a staffing industry. Perhaps the most important thing is uncertainty. Recruitment is associated with major non-recurring costs in the form of advertising, selection and introduction. If the employment is expected to be prolonged these costs are less important, but if the employment is expected to be short, for example during a peak in demand, they may constitute a barrier to employment. Labor legislation also plays a role. For example, the employment protection law makes it costly for businesses that, in the context of reduced demand, would like to reduce the number of employed by notice.

Konjunkturinstitutet indicates that more companies have chosen to hire staff through agencies after the financial crisis compared to before (Konjunkturläget, 2012). Because this form of employment is more adjustable towards fluctuations in demand, we can expect that it has a positive effect on Okun’s coefficient. The implementation of employment agencies can therefore be a contributing factor to why Okun’s coefficient is larger in absolute value after the 1990’s crisis.

I have now discussed some events in the Swedish Economy that could have affected the relationship between growth and unemployment. So far, only total unemployment has been discussed. I will now discuss the results from the two gender disaggregated models.

Okun’s coefficient was statistically significant for Model M but not for Model F. We have already discussed that the public sector is not as sensitive as the private to output fluctuations. Further, we said that the public sector was dominated by women and the private by male workers. Table six below is a list to support these assumptions. The list presents the seven largest occupations in Sweden and the shares of male versus female workers each profession consist of.
The seven largest occupations in Sweden 2012

<table>
<thead>
<tr>
<th>Profession</th>
<th>Total</th>
<th>Female %</th>
<th>Male %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nurses, Healthcare assistants (P)</td>
<td>172 829</td>
<td>93</td>
<td>7</td>
</tr>
<tr>
<td>2. Care and personal assistants (P)</td>
<td>153 117</td>
<td>81</td>
<td>19</td>
</tr>
<tr>
<td>3. Vendor, Specialist dealer</td>
<td>108 105</td>
<td>62</td>
<td>38</td>
</tr>
<tr>
<td>4. Childcare (P)</td>
<td>95 519</td>
<td>86</td>
<td>14</td>
</tr>
<tr>
<td>5. Business seller</td>
<td>91 070</td>
<td>29</td>
<td>71</td>
</tr>
<tr>
<td>6. Pre-primary education (P)</td>
<td>87 222</td>
<td>92</td>
<td>8</td>
</tr>
<tr>
<td>7. Other office staff</td>
<td>86 449</td>
<td>75</td>
<td>25</td>
</tr>
</tbody>
</table>

*Table (6). Reference: (SCB, 2014b)*

Professions in table (6) that is marked with; (P) after the name of the profession indicates that it belongs to the public sector. We can see that they are all dominated by female workers. In fact, for both municipalities and county councils, women comprise 80 percent of the employed. This compares with the state, where the distribution is broadly equal between men and women. In 2011, the number of women employed in the state was 117,500, while the number of men was barely 113,400 (Gustafsson and Johansson 2012). This makes it clear that female workers are over represented in the public sector.

Note however that after the first private pre-school opened 1986, the privatization of schools and health care increased during the 1990´s (Svensson S 2014). This means that a part of the public sector have been absorbed by the private. This might also partly explain why we can see an increasing number of workers in the private sector in Graph One.

To conclude the results of Model F; the theory that Okun´s coefficient would be smaller in absolute value for Model F is confirmed by the results. There is also evidence that the public sector, which is less sensitive to output fluctuation, is dominated by female workers and that this in turn is the underlying motivation to why the Okun´s coefficient is not statistically significant for Model F.

*Model M* gave a significant estimate of Okun´s coefficient. We will now look at what kind of professions that male workers engage in. Table (7) presents the seven most common male
professions. Some of those employed in any of these professions, might work for the government or elsewhere in the public sector but to the larger extent, these professions belong to the private sector. Because male workers are over represented in the private sector, and the same is more sensitive to output fluctuations, this may explain the result for Model \(M\).

The five most common occupations for men in Sweden 2012

<table>
<thead>
<tr>
<th>Profession</th>
<th>Amount of men</th>
<th>Total</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business seller</td>
<td>64 531</td>
<td>91 070</td>
<td>71</td>
</tr>
<tr>
<td>System analysts, Programmers</td>
<td>63 014</td>
<td>78 734</td>
<td>80</td>
</tr>
<tr>
<td>Truck and lorry drivers</td>
<td>53 928</td>
<td>56 697</td>
<td>95</td>
</tr>
<tr>
<td>Building carpenters and joiners</td>
<td>46 651</td>
<td>47 268</td>
<td>99</td>
</tr>
<tr>
<td>Warehouse assistants</td>
<td>45 008</td>
<td>56 660</td>
<td>79</td>
</tr>
<tr>
<td>Vendor, specialty retail</td>
<td>41 106</td>
<td>108 105</td>
<td>38</td>
</tr>
</tbody>
</table>

*Table (7). Reference: (SCB, 2014a)*

To summarize the results and the discussion around it. No explanation could be found from neither growth or labor market theory to why Okun´s coefficient increased in absolute value after the 1990’s crisis. Some events that have affected the economy during the time period investigated have been discussed. Some of them contradicts my results and some motivates them. I have already mentioned that Okun´s law has been criticized of lacking theoretical background and that Okun´s relationship might be nothing more than a statistical relationship. If this is true, it might be that no clear explanation can be found in order to explain my results fully. The limited time period for this work do not allow me to investigate this further. Althoug I have to say, it would be very intresting to dig deeper into the subject.
8. References


9. Appendix

<table>
<thead>
<tr>
<th>Regression</th>
<th>d-statistic</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model One</td>
<td>1.199</td>
<td>5% two-sided level of significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$d_{1,47}$-$1.54d_{u}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive Serial Correlation</td>
</tr>
<tr>
<td>Model Two</td>
<td>1.32</td>
<td>5% two-sided level of significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$d_{1,34}$-$1.44d_{u}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive Serial Correlation</td>
</tr>
<tr>
<td>Model Three</td>
<td>1.19</td>
<td>5% two-sided level of significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$d_{1,12}$-$1.31d_{u}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inconclusive</td>
</tr>
<tr>
<td>Model Gap</td>
<td>1.10</td>
<td>5% two-sided level of significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$d_{1,62}$-$1.67d_{u}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive Serial Correlation</td>
</tr>
<tr>
<td>Model Male</td>
<td>1.90</td>
<td>5% two-sided level of significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$d_{1,56}$-$1.60d_{u}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Positive Serial Correlation</td>
</tr>
<tr>
<td>Model Female</td>
<td>1.91</td>
<td>5% two-sided level of significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$d_{1,56}$-$1.60d_{u}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No Positive Serial Correlation</td>
</tr>
</tbody>
</table>

Table one; results of the Durbin-Watson test

<table>
<thead>
<tr>
<th>Variable</th>
<th>1% Critical Value</th>
<th>Test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Unemployment Rate</td>
<td>-3.565</td>
<td>-5.192</td>
</tr>
<tr>
<td>1951-2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.Real GDP growth</td>
<td>-3.562</td>
<td>-5.676</td>
</tr>
<tr>
<td>1951-2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.Unemployment Rate</td>
<td>-3.662</td>
<td>-4.646</td>
</tr>
<tr>
<td>1951-1990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.Real GDP growth</td>
<td>-3.655</td>
<td>-3.887</td>
</tr>
<tr>
<td>1951-1990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.Unemployment Rate</td>
<td>-3.750</td>
<td>-3.663</td>
</tr>
<tr>
<td>1991-2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-3.000 at 2% Critical Value)</td>
<td></td>
</tr>
<tr>
<td>6.Real GDP growth</td>
<td>-3.750</td>
<td>-3.874</td>
</tr>
<tr>
<td>1991-2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.NAIRU – Unemployment Actual</td>
<td>-3.5</td>
<td>-2.238</td>
</tr>
<tr>
<td>1993-2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.Unemployment Rate Men</td>
<td>-3.5</td>
<td>-8.482</td>
</tr>
<tr>
<td>1993-2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.Unemployment Rate Women</td>
<td>-3.5</td>
<td>-8.989</td>
</tr>
<tr>
<td>1993-2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.Real GDP growth</td>
<td>-3.5</td>
<td>-6.694</td>
</tr>
<tr>
<td>1993-2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.GDP Potential − GDP Actual</td>
<td>-3.5</td>
<td>-1.711</td>
</tr>
<tr>
<td>1993-2014</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table two; Results of Dickey-Fuller Test
<table>
<thead>
<tr>
<th>Model</th>
<th>Critical Value</th>
<th>Test Statistic</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model One</td>
<td>2.0</td>
<td>2.38</td>
<td>Specified incorrectly</td>
</tr>
<tr>
<td>Model Two</td>
<td>2.0</td>
<td>0.55</td>
<td>Specified correctly</td>
</tr>
<tr>
<td>Model Three</td>
<td>2.0</td>
<td>0.96</td>
<td>Specified correctly</td>
</tr>
<tr>
<td>Model Gap</td>
<td>2.0</td>
<td>3.49</td>
<td>Specified incorrectly</td>
</tr>
<tr>
<td>Model Male</td>
<td>2.0</td>
<td>1.24</td>
<td>Specified correctly</td>
</tr>
<tr>
<td>Model Female</td>
<td>2.0</td>
<td>0.97</td>
<td>Specified correctly</td>
</tr>
</tbody>
</table>

*Table (3): Results of Link Test*
In Table (4) present the amount of observations, the mean value, standard deviations and each variables Maximum and Minimum value be presented.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Min Value</th>
<th>Max Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Unemployment Rate 1951-2013</td>
<td>62</td>
<td>0.055</td>
<td>0.73</td>
<td>-1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>2. Real GDP growth 1951-2013</td>
<td>64</td>
<td>2.681</td>
<td>2.14</td>
<td>-5.0</td>
<td>6.8</td>
</tr>
<tr>
<td>3. Unemployment Rate 1951-1990</td>
<td>39</td>
<td>0.014</td>
<td>0.45</td>
<td>-0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>4. Real GDP growth 1951-1990</td>
<td>40</td>
<td>3.0</td>
<td>1.76</td>
<td>-1.6</td>
<td>6.8</td>
</tr>
<tr>
<td>5. Unemployment Rate 1991-2013</td>
<td>22</td>
<td>0.07</td>
<td>1.06</td>
<td>-1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>6. Real GDP growth 1991-2013</td>
<td>24</td>
<td>2.1</td>
<td>2.60</td>
<td>-5.0</td>
<td>5.6</td>
</tr>
<tr>
<td>7. NAIRU 1993-2014</td>
<td>86</td>
<td>1.22</td>
<td>1.74</td>
<td>-1.7</td>
<td>4.9</td>
</tr>
<tr>
<td>8. Unemployment Rate Men 1993-2014</td>
<td>85</td>
<td>-0.019</td>
<td>0.84</td>
<td>-1.8</td>
<td>2.1</td>
</tr>
<tr>
<td>9. Real GDP growth 1993-2014</td>
<td>85</td>
<td>0.63</td>
<td>0.94</td>
<td>-3.8</td>
<td>2.8</td>
</tr>
<tr>
<td>10. Unemployment Rate Women 1993-2014</td>
<td>85</td>
<td>0.012</td>
<td>0.75</td>
<td>-1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>10. Real GDP 1993-2014</td>
<td>85</td>
<td>4.64</td>
<td>7.79</td>
<td>-35.1</td>
<td>23.8</td>
</tr>
<tr>
<td>11. Potential GDP 1993-2014</td>
<td>86</td>
<td>29.1</td>
<td>25.5</td>
<td>-13.5</td>
<td>83.8</td>
</tr>
</tbody>
</table>

*Table (4); Descriptive Statistics*