A relationship exists between GDP growth and the activity of the labour market. Rising economic activity has a positive effect on the labour market variables as employment rises and unemployment falls. The reason is that economic growth encourages companies to adapt to the increasing demand for their production and create new jobs to satisfy it. When the economic activity fades, reverse processes take place. In economic theory, the relationship that anticipates a negative correlation between GDP growth and unemployment change is called Okun’s law.

In order to determine how much GDP should grow for the unemployment rate to remain unchanged, or what the changes in the unemployment rate could be if the GDP remains unchanged, the aforementioned relationship is measured quantitatively. The objective of this box is to quantify the relationship between GDP growth and the change in the unemployment rate in Lithuania.

Economic theory offers two main versions of Okun’s law: the difference version and the gap version. The difference version estimates the relationship between the changes in GDP and the changes in unemployment rate. The gap version is used to determine the relationship between cyclical unemployment and the output gap. This box quantitatively evaluates the difference version, with a main focus on the estimation of Lithuanian GDP growth, when the unemployment rate remains unchanged. It also aims to determine whether the relationship between the GDP growth and the change in unemployment rate has always been stable. If this relationship is stable, i.e. does not change over time, GDP growth forecast can be applied as a rule in assessing the unemployment rate changes in the future. If the relationship is unstable, such assessments should be made more cautiously. However, even if it is unstable, the relationship between GDP and unemployment is generally considered one of the most stable macroeconomic relationships and can provide some insights.

Okun’s law in Lithuania in 1999–2012

Okun’s law is estimated by using the data of Lithuania’s GDP growth and the unemployment rate changes in 1999–2012, applying the equation

\[ \Delta U_t = \alpha + \beta Y_{g,t} + \varepsilon_t. \]  

(1)

where: \( \Delta U_t \) — annual change in unemployment rate in percentage points in the quarter \( t \), \( Y_{g,t} \) — real GDP annual change in per cent in the quarter \( t \).

The coefficient \( \alpha \) indicates the change in unemployment rate, when GDP remains unchanged, i.e. when GDP growth rate is set to zero. The ratio \( \beta \) is called Okun’s coefficient. It shows the change in unemployment rate, when GDP growth increases by 1 p.p. Okun’s coefficient is expected to be negative because higher GDP growth is related to lower unemployment, and vice versa. The ratio \(-\alpha/\beta\) shows how much the economy should grow when the annual change in unemployment rate is set to zero.

The results of the estimated relationship based on the Lithuanian data show that coefficient \( \alpha \) is 1.80. Okun’s coefficient \( \beta \) for the entire sample is –0.43, and the ratio \(-\alpha/\beta\) is 4.22 (see Chart B). This means that in 1999–2012, when GDP grew at an average of 4.22 per cent a year, the unemployment rate remained unchanged. With GDP growth on average less than 4.22 per cent a year over the analysed period, unemployment had to increase, and if it was growing by more than 4.22 per cent a year—to decrease. However, in the context of specific quarters this is not always true. For example, in the second quarter of 2012 with an annual GDP growth of 2.1 per cent, the unemployment rate decreased by...
2.3 per cent, although according to the estimated Okun’s law equation it had to rise by about 0.9 per cent. Since these average estimates cannot sufficiently explain the relationship between unemployment and GDP, the stability of the relationship provided with the Okun’s law is examined.

**Stability of the relationship between GDP growth and the change in unemployment rate**

When the relationship between GDP growth and unemployment rate change is stable, the coefficient $-\hat{\alpha}/\hat{\beta}$ should not change much over time. Therefore, equation (1) is assessed using the rolling regressions. This procedure assesses the samples of 10 years (40 quarters), by changing the sample’s start and end dates—subtracting one quarter from the start and adding one quarter to the end. This method allows eliminating historical impact from the estimates. The results of the simple version of the rolling regressions indicate that the relationship between the GDP growth and the unemployment rate change in Lithuania was unstable (see Chart C). The highest $-\hat{\alpha}/\hat{\beta}$ was in the estimated sample from the first quarter of 2001 to the fourth quarter of 2010 (4.97%), whereas the lowest—from the third quarter of 2002 to the second quarter of 2012 (3.85%). It can therefore be concluded that the estimates, obtained from the simple version of Okun’s law, should be used with caution assessing the unemployment rate changes.

**Searching for a more stable representation of Okun’s law**

Searching for a more stable representation of Okun’s law was evaluated for Lithuania. As the business cycle may affect the labour market variables with a lag, the dynamic equation may be expected to better explain the relationship between GDP and unemployment. This version is applied by including GDP growth lags. In addition, for persistence the equation may include the lag of one or more periods of unemployment rate change. The dynamic equation not only indicates that a permanent relationship exists between the variables, but also often improves data fit. The relationship between the GDP growth and the change in unemployment is determined by the following dynamic equation

$$\Delta U_t = \alpha + \beta_0 g_{t-1} + \beta_1 U_{t-1} + \rho \Delta U_{t-1} + \varepsilon_t.$$  

(2)

The coefficient $(\beta_0 + \beta_1)/(1 - \rho)$, derived from this equation, is Okun’s coefficient, and the ratio $-\hat{\alpha}/(\hat{\beta}_0 + \hat{\beta}_1)$ shows how much the economy should grow to keep the unemployment rate stable over the corresponding period. It is important to note that the estimates are sensitive to the equation specification.

The estimates of the dynamic version show that the coefficient $-\hat{\alpha}/(\hat{\beta}_0 + \hat{\beta}_1)$ is equal to 4.08 per cent over the full sample. However, $-\hat{\alpha}/(\hat{\beta}_0 + \hat{\beta}_1)$ coefficient in the rolling regressions varies considerably due to the fluctuations in $\hat{\alpha}$ and $\hat{\beta}$ over different periods. The estimated coefficient $-\hat{\alpha}/(\hat{\beta}_0 + \hat{\beta}_1)$ was 5.51 per cent over the sample of the first quarter of 1999 to the fourth quarter of 2008, and 4.42 per cent over the sample of the fourth quarter of 2002 to the third quarter of 2012 (see Chart D). Therefore, the estimated dynamic version of Okun’s law for Lithuania is instable as well. These estimates should be used with caution when forecasting even approximate changes in unemployment rate.

**Instability interpretation**

Because of short time series, there are limited possibilities to analyse in detail the reasons why the Okun’s coefficient and the GDP growth rate at which the unemployment rate does not change are unstable in Lithuania. However, there are theoretical explanations of this instability, and they apply to both Lithuania and other countries.
One explanation is that during the boom phase of the business cycle companies do not immediately adjust to the increased demand for their production. When economic activity increases, higher demand is first handled with current employees, increasing the number of hours worked and raising the labour productivity. Therefore, the GDP grows and unemployment reduction is suppressed for some time. Economic phenomenon when GDP grows whereas employment does not is called jobless growth. If the increase in demand is permanent and present employees can no longer satisfy it, employers create new jobs and increase the number of employed. Another reason for Okun’s coefficient to vary is the change in labour force activity over the business cycle: during the economic boom, with greater opportunities to find a job, inactive people can choose to enter the labour market and therefore the unemployment rate falls more slowly. Therefore, employment and unemployment varies less than the economic activity. These reasons mean that in the beginning of the business cycle or in the case of longer than usual period of jobless growth, the Okun’s coefficient may increase. This is associated with higher GDP growth rate that is needed for the unemployment rate to decline.

When economic activity fades, the economy experiences reverse processes—often companies do not tend to immediately reduce the number of workers. Economic phenomenon when GDP falls whereas employment does not is called labour hoarding. Labour force activity also changes: more people withdraw from the labour force and therefore unemployment increases slower than usual. At the beginning of a crisis employment and unemployment also vary less than the economic activity. Therefore, at the beginning of the economic downturn, Okun’s coefficient may be smaller than usual. This is associated with lower GDP growth that is needed for the unemployment rate to decline. In the case of Lithuania, the dynamic version of the rolling regressions gives the lowest Okun’s coefficient when the years of 1999 and 2009 (i.e. the years of economic downturn) are included in estimation. Thus, the dynamic equation of Okun’s law is likely to capture the effect of labour hoarding as labour force activity increased during the recent economic downturn.

The relationship between GDP growth and unemployment also depends on other factors such as technological changes, legal framework of labour legislation, active labour market measures, GDP structure changes and demographic changes.

References

1 The estimation used unemployment rate and real GDP time series in 1998–2012. Quarterly unemployment data are published by Statistics Lithuania since 2002, and therefore historical data are interpolated from the published bi-annual unemployment data in 1998–2001. Due to the structural breaks in the labour market data (labour force, unemployed and employed) the data was not seasonally adjusted.
2 This identity is derived from the equation (1), setting $\Delta U_t$ to zero, and evaluating the regression $\Delta U_t = a + \beta Y_{t-1}$. Stationarity is tested using the Augmented Dickey–Fuller test, with 10 per cent significance level. Endogeneity is tested as an instrument. The test shows no endogeneity at 10 per cent significance level.
3 Statistically, this relationship is estimated by ordinary least squares (OLS). Because of autocorrelation, Newey–West Heteroscedasticity and Autocorrelation Corrected Standard Errors are applied. All estimated coefficients are statistically significant at a 10 per cent significance level. Data generating processes are stationary, i.e. $\Delta Y_t – \Gamma(0)$ and $Y_{t-1} – \Gamma(0)$. Stationarity is tested using the Newey–West Heteroscedasticity and Autocorrelation Corrected Standard Errors are applied. All estimated coefficients are statistically significant with 10 per cent significance level. This identity is derived from the equation (1), setting $\Delta U_t$ to zero, and evaluating the regression $\Delta U_t = a + \beta Y_{t-1}$. Stationarity is tested using the Augmented Dickey–Fuller test, with 10 per cent significance level. Endogeneity is tested as an instrument. The test shows no endogeneity at 10 per cent significance level.
4 Newey–West Heteroscedasticity and Autocorrelation Corrected Standard Errors are applied. All estimated coefficients are statistically significant with 10 per cent significance level. This identity is derived from the equation (1), setting $\Delta U_t$ to zero, and evaluating the regression $\Delta U_t = a + \beta Y_{t-1}$. Stationarity is tested using the Augmented Dickey–Fuller test, with 10 per cent significance level. Endogeneity is tested as an instrument. The test shows no endogeneity at 10 per cent significance level.
5 Various Okun’s law specifications were applied in the search for a stable relation. The estimated equations included alternative variables (e.g., gross national income instead of GDP, the ratio of employed and population, labour force or employment instead of unemployment); a dynamic version of Okun’s Law is used, etc.
6 Okun’s coefficient is derived from equation (2), obtaining the following equation specification: $\Delta U_t = \frac{a + \beta_0 + \beta_1 Y_{t-1}}{1-p}$. This dynamic equation representation is chosen for Lithuania by combining the economic logic and the statistical significance of the estimates. The determination coefficient $R^2$ of the entire sample is 0.89.
7 For autocorrelation, the equations are estimated using the Newey–West Heteroscedasticity and Autocorrelation Corrected Standard Errors. The estimated coefficients are statistically significant at 10 per cent significance level, except the coefficient $\beta_0$ in the samples from the first quarter of 1999 to the fourth quarter of 2008, from the second quarter of 1999 to the first quarter of 2009, and from the first quarter of 1999 to the second quarter of 2009. These estimates have not been eliminated due to comparability reasons.