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THE IMPACT OF GDP STRUCTURE ON THE STABILITY OF OKUN'S LAW IN LITHUANIA

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Abstract

This paper provides evidence that the extent to which unemployment rate in Lithuania reacts to the fluctuations in GDP depends on the compositional characteristics of GDP growth. Decomposing GDP growth rate by expenditure approach and estimating simple version of Okun's law, the evidence provided in this paper points towards the conclusion that the GDP growth driven by labour-intense private consumption contributes the most to a change in the unemployment rate. The elasticity of the unemployment rate to capital-intense exports is generally much lower as compared to the elasticity to the domestic demand components. These conclusions are to a large extent confirmed by the estimates obtained by regressing unemployment on GDP growth disaggregated by production approach. Services, agriculture and especially construction – labour-intense production sectors – contribute much more to change in unemployment as compared to manufacturing, the sector characterised by capital-intensity. Referring to the previous studies, these results provide one possible explanation of the unstable and time-varying relationship between the unemployment rate and fluctuations in GDP in Lithuania.

Keywords: unemployment, GDP, Okun's law, Lithuania

JEL Classification: J00, J60

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Any errors that remain are my sole responsibility.

The views expressed in this paper are those of the authors and do not necessarily reflect the official position of the Bank of Lithuania.

Introduction

An increase in economic activity has a positive effect on the labour market variables — employment rises and unemployment rate falls. In the period of economic downturn, reverse processes take place. The phenomenon of negative correlation between gross domestic product (GDP) growth and unemployment over the business cycle is known in economic literature as Okun's law. Quantitative estimation of the relationship of Okun's law gives valuable information about how unemployment is going to evolve under certain economic conditions. Empirical literature on this topic engages, therefore, in estimating Okun's law — evaluates the elasticity of unemployment to GDP, also known as Okun's coefficient, and assesses how much GDP should grow to keep the unemployment rate unchanged. Empirical studies usually estimate two main versions of Okun's law — the simple version or the gap version. The simple version focuses on the relationship between the aggregate annual GDP growth rate and the change in the annual unemployment rate, whereas the gap version is used to determine the relationship between output and unemployment gaps.[*]

Stability tests of Okun's law usually fail to prove that the relationship between the cyclical stance and unemployment is stable and does not change over time. At different times the unemployment response to the same GDP growth rate may vary — it can be stronger or weaker than explained by the average quantitative estimates. This comprises a high degree of uncertainty about cycle-related developments in the unemployment rate. Empirical studies that assessed time-variation in Okun's law include, among others, Sögner and Stiassny (2002), Aranki *et al.* (2010), Daly and Hobijn (2010), Meyer and Tasci (2012) and Österholm (2015). The stability of Okun's law in Lithuania was examined in the Lithuanian Economic Review (Bank of Lithuania 2013) and was found to be rather unstable.[**] However, the relationship between GDP and unemployment is generally considered to be one of the most intuitive macroeconomic relationships and gives some insights about the evolution of unemployment over the business cycle.

The main purpose of this paper is to estimate a simple linear version of Okun's law in Lithuania for the period from 1996 to 2014 and to explain the instability from one possible perspective. More specifically, in addition to estimation of Okun's law from the aggregate data, we work with a disaggregated approach to evaluate the impact of GDP structure on unemployment. In this approach, the change in annual unemployment rate is regressed on GDP components, decomposing the GDP growth rate by expenditure and production approaches.

The evidence found in this paper suggests that an unstable relationship between unemployment and GDP in Lithuania could be explained by the compositional characteristics of GDP growth, i.e. the relationship is dependent on which particular component drives GDP growth in a given period. In disaggregating GDP growth by expenditure approach, it is shown that in Lithuania unemployment is most sensitive to labour-intense domestic demand GDP components, whereas growth driven by foreign trade components contributes less to the change in unemployment. Decomposition of GDP growth by production approach reveals that unemployment is more sensitive to the value-added in labour-intense production sectors, i.e. services, agriculture and, in particular, construction.

The remainder of this paper is structured as follows. Section 1 presents the theoretical background for explaining the possible instability of Okun's law. Section 2 describes data and

[*]It should be noted that there is much uncertainty in estimating the gap version of Okun's law. As both output and unemployment gaps are not observable variables and should be estimated applying certain techniques, Okun's law estimates are dependent on the methods used to calculate trend GDP and unemployment.

[**]The evidence provided in the Lithuanian Economic Review (2013) relates only to stability testing of the GDP growth rate needed to keep the unemployment rate unchanged, not the elasticity of unemployment to GDP. Instability is confirmed estimating both static and dynamic versions of Okun's law.

presents empirical procedures to estimate the relationship between unemployment and output in Lithuania. Section 3 summarises the estimation results.

1. Literature review: reasons for time-variations in Okun's law

Understanding the relationship between GDP growth and unemployment over the business cycle can provide valuable insights as to how unemployment should evolve under certain economic conditions. However, stability testing of Okun's law for many countries usually fails to confirm the time-invariant correlation between unemployment and GDP growth (Aranki *et al.* 2010; Dali, Hobijn 2010; Meyer, Tasci 2012; Österholm 2015; Bank of Lithuania 2013). In the economic literature, the most prevalent explanation for time-varying Okun's law is linked to changes in the labour force, lagging response of unemployment to GDP at the inflection points of the business cycle, legal framework for labour relations, changes in the GDP structure, etc.

The relationship between GDP growth and unemployment might be rather different at the cycle turning points as compared to the normal state of the economy. Such phenomena as "labour hoarding" at the onset of economic downturn or "jobless growth" at the start of the recovery may be the cause of time variations in Okun's law.[*] If the periods of jobless growth are protracted, a higher GDP growth rate would be needed for the unemployment rate to decline. A similar reasoning applies under protracted time periods of labour hoarding — higher GDP decline would be needed for the unemployment rate to rise.

The labour force participation rate also varies over the business cycle. In the periods of economic downturns, the labour participation rate might decrease, i.e. react pro-cyclically to the changes in economic activity. In economic literature this is known as the "discouraged worker effect". Under these circumstances the unemployment rate should increase at a slower pace than what could be considered normal. In a similar vein, a rise in the participation rate in the period of economic recovery would hamper a decrease in the unemployment rate. These cyclical variations in the participation rate cause the unemployment rate to vary less than the economic activity.[**] If, on the other hand, the participation rate reacts counter-cyclically, i.e. the so-called added worker effect,[*] changes in the participation rate would lead to a larger increase in the labour force than could be expected under normal economic conditions. This would lead to a faster increase in unemployment and a higher variation in the unemployment rate than changes in the economic activity would suggest.

The relationship between unemployment and GDP might also change owing to the structural changes in the economy. In general, it is considered that a shift from capital- to labour-intense production technology or vice versa might cause permanent shifts in unemployment. In the short-run, the instability of Okun's law might be observed depending on the component that drives GDP growth in the certain period of time. We focus on the latter issue and in the remainder of this paper investigate the effect of the GDP structure on Okun's relationship in Lithuania.

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[*] At the initial stages of economic upturns, firms do not immediately adjust to the increase in demand for their products and services by hiring more. When the increase in demand becomes permanent and it cannot be satisfied with the current capacity of employed, new jobs are created, leading to labour market recovery. At the early stages of economic downturn, reverse processes take place — the GDP growth rate falls, whereas employment does not.

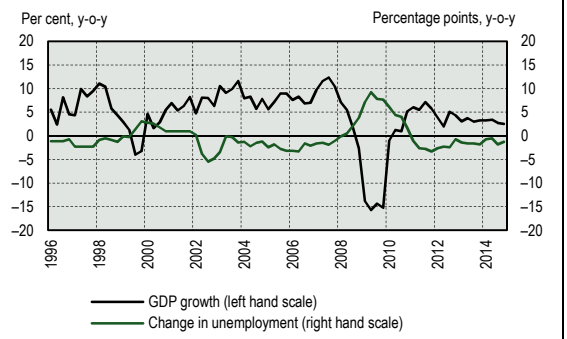
[**] The participation rate could decline during periods of economic crisis, because some labour market participants have difficulty finding a job and eventually quit the labour force. During economic upturns, greater opportunities to find a job would cause the opposite tendencies — additional entrance into the labour market.

[*] This effect is considered to be more commonplace among women. If a husband is the family's main bread-winner and he becomes unemployed during a crisis, women in such families are more likely to participate more actively in the labour market in order to cushion the reduction of household income.

2. Data and estimation method

We examine how changes in GDP structure affect unemployment in Lithuania by estimating three equations within the simple approach of Okun's law. We regress the unemployment rate on the aggregate GDP growth rate and on GDP growth rate decomposed by expenditure and production approaches. All equations are estimated based on quarterly data; the sample period covers Q1 1996–Q4 2014. The GDP growth and unemployment rate series are presented in Figure 1, showing a negative correlation between these two variables.

Figure 1. Unemployment and GDP in Lithuania 1996–2014



Source: Statistics Lithuania.

The first equation with constant parameters relates changes in the unemployment rate to the aggregate GDP growth and is given by

$$\Delta U_t = \alpha + \beta Y_t^g + \varepsilon_t, \quad (1)$$

where ΔU_t is the annual change in the unemployment rate in percentage points in quarter t, and Y_t^g is the annual percentage change in real GDP in quarter t. Error term ε_t is assumed to have standard properties, namely $\varepsilon_t \sim iid(0, \sigma^2)$. This equation is estimated by the ordinary least squares (OLS). In representation (1), coefficient α indicates the change in the unemployment rate, when GDP remains unchanged, i.e. when the GDP growth rate is set to zero. Coefficient β is Okun's coefficient — it shows the average elasticity of unemployment to GDP, i.e. how much the unemployment rate would change, when GDP grows by 1 additional percentage point. Okun's coefficient is expected to be negative, i.e. higher GDP growth is associated with lower unemployment rates. Ratio $-\alpha/\beta$ shows how much GDP should grow to keep the unemployment rate unchanged. This ratio also could be seen as a break-even point — for the GDP growth rate being lower than $-\alpha/\beta$ unemployment should rise and vice versa.

The second and third equations with constant parameters regress changes in the unemployment rate on the disaggregated GDP growth rate and are given by

$$\Delta U_t = \alpha + \sum_i \beta_i Y_{i,t}^g \omega_i + \varepsilon_t, \quad (2)$$

where ΔU_t is defined as above, whereas $Y_{i,t}^g$ denotes annual percentage changes in real GDP components in quarter t. By expenditure approach, $Y_{i,t}^g$ components are the growth rates of private consumption C_t^g, government consumption G_t^g, investment I_t^g, exports of goods and services EX_t^g and imports IM_t^g.* By production approach, $Y_{i,t}^g$ consists of agriculture ZU_t^g, manufacturing PR_t^g, construction ST_t^g and services PSL_t^g. These equations are also estimated by the OLS and the error term has standard properties. In equation (2) the coefficient β_i is the individual Okun's coefficient

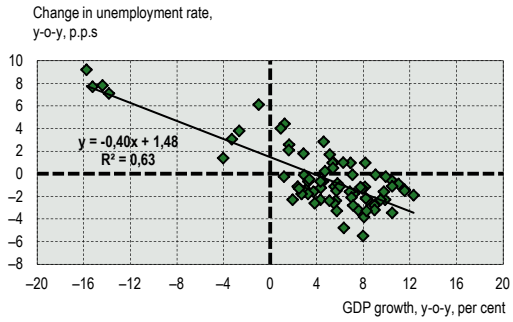
*Equation (2) is derived by approximating equation (1) as $\Delta U_t = \alpha + \beta Y_t^g + \varepsilon_t = \alpha + \beta\left(C_t^g \omega_c + I_t^g \omega_I + G_t^g \omega_G + EX_t^g \omega_{EX} - IM_t^g \omega_{IM}\right) + \varepsilon_t$. GDP growth is similarly decomposed into production components.

of GDP components and ω_i is the moving-average weight of each individual component in GDP.[**] The product of $\beta_i \omega_i$ shows the elasticity of unemployment to individual GDP component, i.e. how much the rate of unemployment would change as the GDP component increases by 1 percentage point. Sum $\sum_i \beta_i \omega_i$ would yield the unemployment rate elasticity to GDP.

3. Empirical results

The results of the estimated relationship between the unemployment rate and the aggregate GDP growth in Lithuania for 1996–2014 show that coefficient $\hat{\alpha}$ is 1.48. Okun's coefficient $\hat{\beta}$ for the entire sample is –0.40, and the ratio $-\hat{\alpha}/\hat{\beta}$ is 3.7 (see Fig. 2, Tables 1 and 2). This implies that on average in 1996–2014 a real GDP growth of 3.7 per cent was associated with a stable rate of unemployment. Consequently, for GDP growth lower than 3.7 per cent, the unemployment rate had a tendency to increase, and for GDP growth higher than 3.7 per cent the unemployment rate tended to decrease. As was noted above, such a quantitative relationship between unemployment and GDP in Lithuania is found to be time-varying (Bank of Lithuania 2013).

Figure 2. Okun's law in Lithuania 1996–2014



Sources: Statistics Lithuania; the author's calculations.

3.1. Okun's law: expenditure approach

In the case of disaggregation of the GDP growth rate by expenditure approach, analysis of estimates of individual $\hat{\beta}_i$'s (see Table 1) reveals that unemployment dynamics differs substantially depending on which GDP component is driving growth. The unemployment rate in Lithuania appears to be most sensitive to the growth of two domestic demand components, namely, private consumption and investment, whereas government consumption and external demand contributes less to unemployment change. Okun's coefficient for private consumption is almost twice as large as in the case of exports. Apparently, domestic demand is typically associated with labour-intensive production processes, whereas foreign demand induces more capital-intensive production processes. A considerable share of exports in Lithuania consist of industrial goods (including oil) and re-exports — these production processes require relatively low input of labour or no labour input at all. The impact of investment growth on the unemployment rate is also considerable, although somewhat lower than that of private consumption, as a high share of capital goods in Lithuania is imported. Although government consumption is also strongly associated with labour-intensive production processes, the unemployment rate in Lithuania shows only somewhat higher sensitivity to this GDP component as compared to foreign trade components.

[**]The weight of each individual GDP component in quarter t is calculated as $\omega_{i,t} = Y_{i,t} / \sum_i Y_{i,t}$. The weight ω_i appearing in equation (2) is calculated as a four-quarter moving-average according to the formula $\omega_i = \frac{1}{4}\sum_{j=0}^{3} \omega_{i,t-j}$. Such calculation reduces variability of the shares and takes into account the most recent developments. Read more about the method in Anderton and Tewolde (2011) and ECB (2012).

Table 1

Estimates of Okun's coefficient and elasticity of unemployment to GDP components — expenditure approach [+]

GDP and GDP components	Okun's coefficient, aggregated	Okun's coefficient to GDP components β_i	Average weight of GDP component	Unemployment elasticity to GDP and its components
Y_t^g	–0.40*** (0.03)		1.00	–0.38
$\omega_c C_t^g$		–0.38*** (0.07)	0.63	–0.24
$\omega_G G_t^g$		–0.26*** (0.11)	0.22	–0.06
$\omega_I I_t^g$		–0.30*** (0.10)	0.19	–0.06
$\omega_{EX} EX_t^g$		–0.22***(0.05)	0.55	–0.12
$\omega_{IM} IM_t^g$		0.16*** (0.06)	0.58	0.09
$\bar{R}^2$	0.63	0.67		
N	76	76		

Notes: [+]White heteroscedasticity–consistent standard errors are applied to account for autocorrelation. Data generating processes are stationary, i.e. $\Delta U_t \sim I(0)$ and $Y_{g,t} \sim I(0)$. Stationarity is tested using the Augmented Dickey-Fuller test, with a 10% significance level. The calculated average weight is taken as a simple average of the four-quarter moving shares of GDP components over the period from 1996 to 2014 (see also Anderton and Tewolde (2011) and ECB (2012). In calculations of the shares of GDP components $\omega_{i,t}$, it is assumed that $Y_t = \sum_i Y_{i,t}$. The cut-off date is 23 September 2015. The figures in parentheses indicate standard errors; *, **, *** statistical significance at the 10%, 5% and 1% levels respectively.
Source: the author's calculations.

Turning to unemployment elasticities weighted with respect to the expenditure component's share in GDP (see Table 1), we see that a 1 percentage point increase in private consumption growth leads to 0.24 percentage point fall in the unemployment rate. A similar increase in export growth would lead to a decline in the unemployment rate by 0.12 percentage points. Due to relatively small weights, a 1 percentage point increase in government consumption and investment contributes to a decline in the unemployment by just 0.06 percentage point.

3.2. Okun's law: production approach

Unemployment elasticities to GDP components could also be analysed by decomposing the GDP annual growth rate by production approach.

Estimates of individual $\hat{\beta}_i$'s (see Table 2) show that unemployment is most sensitive to the value-added in construction, which is one of the most cycle-sensitive and labour-intense sectors of the economy; the sensitivity is also quite large in agriculture and somewhat lower in services. The individual $\hat{\beta}_i$ estimate for the manufacturing sector is insignificant, suggesting no cyclical reaction of the unemployment rate to the value-added created in this sector. Comparing these results to the previous findings, where Okun's law was estimated by disaggregating GDP via the expenditure approach, it is possible to draw some parallels between the results obtained by these two approaches. The unemployment rate sensitivity to the changes in the value-added in the construction sector is related to the domestically produced investment goods and their development is a labour-intense production process. Insignificance of the value-added in manufacturing could be

explained by the fact that industrial production is an inherently capital-intensive process and manufacturing is the most export-oriented sector in the economy. Assessing the sensitivity of unemployment with regard to services, it should be noted that services rendered by this sector require a substantial input of labour and are mostly associated with (private and government) consumption in the domestic market. Lastly, agriculture, although to a high degree an export-oriented sector in Lithuania, is characterised by high labour-intensity.*

Table 2

Estimates of Okun's coefficient and elasticity of unemployment to GDP components — production approach+

GDP and GDP components	**Okun's coefficient, aggregated**	**Okun's coefficient to GDP components, β_i**	**Average weight of GDP components**	**Unemployment elasticity to GDP and its components**
Y_t^g	–0.40***		1.00	–0.36
	(0.03)			
$\omega_{ZU} ZU_t^g$		–0.77*	0.04	–0.03
		(0.44)		
$\omega_{PR} PR_t^g$		–0.03	0.22	–0.01
		(0.17)		
$\omega_{ST} ST_t^g$		–0.84***	0.07	–0.06
		(0.22)		
$\omega_{PSL} PSL_t^g$		–0.40***	0.67	–0.27
		(0.11)		
$\bar{R}^2$	0.63	0.65		
N	76	76		

Notes: see notes for Table 1.
Source: the author's calculations.

With regard to unemployment elasticities (see Table 2), a considerable share of services in GDP in Lithuania contributes the most to the change in the unemployment rate. A 1 percentage point increase in the value-added in this sector leads to a decrease in the unemployment rate by 0.27 percentage points. Since construction and agriculture weights in GDP are much lower as compared to services, the impact of the value-added in these sectors on the dynamics of the unemployment rate is accordingly less profound. An increase in the value-added of construction and agriculture by 1 percentage point contributes to a decrease in the unemployment rate by 0.06 and 0.03 percentage points, respectively. Capital-intensity in the manufacturing sector leads to acyclical reaction of unemployment to GDP growth in this sector.

3.3. Comparison of results with other studies

Results for the Lithuanian case are, in general, in line with the ECB (2012) study that aimed to analyse the elasticity of the unemployment rate to GDP components disaggregated by expenditure approach in the euro area countries. In that study it was found that the euro area unemployment rate responded to domestic demand more strongly than to external demand GDP components over the

*The results of this study could be, to a large extent, confirmed by calculating the labour share of income in these sectors. For example, in 2013, income labour share in the construction sector was above 50 per cent, in agriculture — 43 per cent, in manufacturing — slightly above 30 per cent, and in business services — almost 38 per cent. The income labour share is calculated as a ratio between total labour costs and nominal value added (in per cent).

analysis period from 1996 to 2011.[*] However, there are differences that are worth mentioning. In particular, the overall Okun's coefficient in Lithuania in 1996–2014 is much higher (0.40%) than the estimates for the euro area (0.29%) in 1996–2011. This shows that unemployment in Lithuania is generally more sensitive to changes in economic activity — a 1 percentage point growth in GDP leads to reduction in the unemployment rate by 0.40 percentage points, whereas in the euro area countries — by 0.29 percentage points. These differences could be explained by examining the response of unemployment with regard to each GDP component.

GDP structure in the euro area is different than in Lithuania. The share of private consumption in GDP in Lithuania is higher than in the euro area (0.63 and 0.56 respectively), and individual $\hat{\beta}_i$ for this GDP component is also somewhat larger in Lithuania (0.38) than in the euro area countries (0.36). Thus, both greater labour-intensity and a higher share of private consumption in GDP contribute to higher unemployment elasticity estimates with respect to this GDP component in Lithuania than in the euro area countries.[**]

Notwithstanding that the shares of foreign trade components in GDP are similar, individual $\hat{\beta}_i$ for exports in Lithuania is considerably higher than the one for the euro area countries (0.22 and 0.07 respectively). This suggests that exports in Lithuania should be much more labour-intense, also leading to considerably higher unemployment elasticity to exports in Lithuania than in the euro area countries.

Government consumption and investment, although differing somewhat in their shares in GDP or sensitivity of the unemployment rate to changes in these GDP components, contribute quite similarly to the change in the unemployment rate in Lithuania and in the euro area countries.[***] Overall, divergences in unemployment response to private consumption and exports to a high extent determine the differences between Lithuania and the euro area countries.

Conclusions

This paper provides evidence that the extent to which the unemployment rate in Lithuania reacts to the fluctuations in GDP depends on the composition of GDP growth. The reaction of the unemployment rate to the GDP growth differed considerably in 1996–2014, depending on which GDP component drove the growth. The estimation of Okun's law's relationship with the GDP growth rate decomposed by expenditure approach provided evidence that the GDP growth driven by labour-intense private consumption contributes the most to a change in the unemployment rate. The elasticity of unemployment to capital-intense exports generally is much lower than to the domestic demand components. These conclusions are in line with the estimates obtained by disaggregating the GDP growth rate by production approach. Changes in the activity of construction, services and agriculture — all of which are labour-intense production sectors — contribute much more to a change in the unemployment as compared to the manufacturing sector, which is the most capital-intense sector in economy. These findings provide one possible explanation for the unstable and time-varying relationship between the unemployment rate and GDP fluctuations in Lithuania.

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[*] Lithuania joined the euro area in January 2015 and was therefore not included in the sample analysed in ECB (2012).

[**] This also contributes to higher overall elasticity of unemployment to aggregate GDP.

[***] More precisely, the share of investment is somewhat higher in the euro area countries, but this GDP component is more labour-intense in Lithuania, leading to the similar unemployment elasticity estimates in both datasets. Government consumption forms similar shares of GDP and the unemployment rate sensitivity to changes in this GDP component is very similar in Lithuania and in the euro area. This leads also to a very similar reaction of unemployment to this GDP component.

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