

## BUILDING LITHUANIAN MACRO-ECONOMETRIC MODEL: FORECAST OF AVERAGE WAGES AND UNEMPLOYMENT RATE

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**Abstract.** The importance of economic modelling maintains its positions and plays a relevant role in the analysis of behaviour of national economy due to this analysis of macroeconomic environment is extremely important. Moreover, analysis of regional or even global trends is essential to policy makers. Various types of macro-econometric models have been developed for the analysis of different economic processes and needs. The main goal of article is to create Lithuanian macro-econometric model and to provide three forecast projections (scenarios) of average wages and unemployment rate in Lithuania. Despite the limitations of the use of macroeconomic models during the crisis, it is possible to use such models in scenario analysis. This article also provides analysis of scientific literature of average wages and unemployment rates and statistical data of Lithuanian main economical indicators. The model is based on the Inforum philosophy, on the input-output accounting principles and identities, integrated bottom-up approach. Upon analysis of theoretical and practical aspects conclusions and proposals are provided.

**JEL classification:** C53, C67, D57, E01, E27, E37, J39, J69.

**Keywords:** macro-econometric model, average wages (bruto), unemployment rate, intersectoral analysis, input-output models, Inforum.

**Reikšminiai žodžiai:** makroekonometriniai modeliai, vidutinis darbo užmokestis (bruto), nedarbo lygis, tarpsektorinė analizė, išteklių-panaudojimų modeliai, Inforum.

### 1. Introduction

Following the ongoing worldwide economic crisis it is clearly seen that the prediction of such events is a very tough work and requires a lot of knowledge. Integration of Lithuania into the European Union (EU) had and will have a lasting influence on certain structural changes and social transformation in both sides. Macroeconomic modelling allows evaluation of the macroeconomic environment of a country in a global

context, because changes in economic and political situation in partner countries can significantly influence also economic situation in a small open country (Počas, Ozoliņa 2007), which is also the case of Lithuania.

Furthermore, the economy of Lithuania was one of the fastest growing in the world last decade (1998–2008) as GDP growth rate was positive 9 years in a row. What is more, Lithuania was the last among the Baltic States to be hit by the economic crisis because its GDP growth rate in 2008 was still positive. In the third quarter of 2009, compared to the previous quarter, GDP again grew by 6.1% after five quarters with negative numbers. Unfortunately, the rebound in Lithuania's economy in the third quarter was the fastest in the EU.

Macro-econometric modelling in the post-Soviet Lithuania became a topical area; there were a lot of discussions of macro-econometric modelling alternatives, specificity of modelling the Lithuanian economy. Moreover, very important questions are raised: will the created empirically adequate macro-econometric model be useful in further developments of macro-econometric modelling, e.g., the foreign modelling experience overview and the analysis of Lithuanian specifics were used in Mathematical model of Lithuanian economy for forecasting the macroeconomic processes project documentation and reports.

There were quite many studies based on Integration of Lithuania into the European Union as well. More qualitative aspects of integration were analysed by Kropas (1998) and Vilpišauskas (2001) in their articles, concentrating respectively on possible changes in the monetary system and general issues of importance, methods and constraints of assessment of the integration impact. Quantitative estimates on possible changes of trade flows due to customs union and the common foreign trade policy were provided in the Miškinis and Šegžda (2001), and Ribokas and Vaitkevičius (2001) studies. The estimates of integration caused migration size and its impact on savings; consumption, etc. were researched in Musto *et al.* (2001). There were many other studies analysing the impact of integration (until 2003 there were 35 related research studies initiated only by the European Committee under the Government of the Republic of Lithuania). However, even few of them provided quantitative predictions and concentrated on estimating the effects on separate sectors. The straightforward adding-up of estimated partial effects could give a very biased total picture due to ignorance or doubling of the impact. Therefore there is a need for a general macroeconomic assessment study.

Lithuania has only few developed macro-econometric models, which are able to make forecasts: the one which Government is using (those models were created by Olivier Basdevant and August Leppa and it is using ministries of Finance and Economy of the Republic of Lithuania) and others, being used by several bigger banks. It is important to mention, that Institute of Economics with the help of others institutions was building a medium-sized macro-econometric sectoral model of the Lithuanian economy called LITMOD. A central element in the model is a 12-sector input-output table of the Lithuanian economy facilitating analyses of structural changes.

But these models are restricted and make predictions only for the short or medium runs. Of course, maintaining a macro economic model requires a proper management

of huge amounts of information, trained and highly skilled personnel able to deal with complex computations and persisting problems, and a good knowledge of the countries' macro economy. This is one of the main reasons why there are only few models being used in Lithuania nowadays and one of the reasons to develop a new one, which will provide a sophisticated approach to the future scenarios of the economy, which can be analyzed afterwards.

Thus, macroeconomic models are widely used by international organizations, national governments and larger corporations, as well as by economics consultants and think tanks because a macroeconomic model is an analytical tool designed to describe the operation of the economy of a country or a region. These models are usually designed to examine the dynamics of aggregate quantities such as the total amount of goods and services produced, total income earned, the level of employment of productive resources, and the level of prices. However macroeconomic models give us the opportunity to make forecasts of the countries' economy, therefore creating scenarios to analyze the fluctuations in the near future. The main crash test for the macroeconomic modelling is a historical simulation, or in other words, a forecast of the past things and comparison with already happened. The closer the historical fitting is, the better the model was developed and applied, therefore making it suitable for the future forecasts.

Macroeconomic models could be logical, mathematical, and/or computational; the different types of macroeconomic models serve different purposes and goals. Macroeconomic models may be used to clarify and illustrate basic theoretical principles, they may be used to test, compare, and quantify different macroeconomic theories, may be used to produce "what if" scenarios (usually to evaluate the possible effects of changes in monetary, fiscal, or other macroeconomic policies), and they may be used to generate economic forecasts.

None of the macroeconomic model can exist without statistical data. In Lithuania more or less reliable and comparable macroeconomic data have been mostly available since 1995 due to the change in national accounting system in 1994. Therefore the main problem for econometric modelling, even when using quarterly data, is the short data sample. Another great problem is the transition state of economy. As the economy structure is changing, especially after some larger exogenous shocks, e.g. due to Global financial crisis, the model parameters may be not stable, and even the most important model determinants could change so rapidly that some variables might be significant only in certain periods. In the models of transition economies different approaches are used to deal with this problem. In general, a conclusion could be drawn that in transition countries a special emphasis should be laid on testing for possible parameter changes and non-linearity in preliminarily specified models.

This article will be started by analyzing the past and present developments of macroeconomic models, dedicated for the creating projections of average wages and unemployment rates in other countries or regions.

The main goal of article is to create Lithuanian macro-econometric model called "Lithuanian Macro Model," which will give the opportunity to make forecast for the

average wages and unemployment rate in the long run, reaching year 2020. Apparently the forecast will not be possible without the forecast of the main economic indicators, such as GDP, Personal consumption expenditures, Imports, Exports and other indicators.

## 2. Developed Macroeconomic Models for Average Wages and Unemployment

Macroeconomic models have been used for formulation of economic policy almost in every country of the world. These models not only provide an analytical framework to link the wages, unemployment rates and other economic indicator sides and the resource allocation process in an economy but also may help in reducing fluctuations and enhancing the economic growth, which are two major aspects of any economy. Classical, Keynesian, new Classical and new Keynesian approaches have evolved over time to analyze fluctuations of domestic income, employment and price level over years (Keynes (1936), Hicks (1937), Samuelson (1939), Phillips (1958), Friedman (1968), Phelps (1968), Tobin (1969), Barro and Gordon (1983), Sargent (1986) Goodhart (1989), Nickell (1990), Lockwood Miller and Zhang (1998), IMF (1992)). Empirical validity of these models are tested using either macro-econometric simulations models, applied multi-sectoral general equilibrium models or by using stochastic dynamic general equilibrium models (Wallis (1989), MPC (1999), Pagan and Wickens (1989), Kydland and Prescott (1977)).

From the Neoclassical theory point of view, real wage changes depending on changes in labour productivity in the long-term. According to the Phillips curve theory, real wages are mainly determined by the unemployment rate or nominal wages depending on unemployment and inflation. From theories concerning wage negotiations, the bargaining power of employees depend on unemployment and changes in labour productivity. This means that in the long-term, a wage equation is:

$$\log(w_{PRI}^*) = \alpha_0 - \log(1 + scc) + \alpha_1 \log\left(\frac{Y}{L}\right) + \alpha_2 \log(P_C) + \alpha_3 U + \lambda_2 Q_2 + \lambda_3 Q_3 + \lambda_4 Q_4 \quad (1)$$

If the Neoclassical theory is dominant, the coefficients  $\alpha_1$  and  $\alpha_2$  should equal one and  $\alpha_3$  should equal zero. If the Phillip's curve theory is dominant,  $\alpha_1$  should be insignificant. Finally, if wages are not fully compensated for inflation,  $\alpha_2$  should be between 0.0 and 1.0.

Wage Dynamics Network macro model investigates the dynamics of aggregate wages and prices in the United States (US) and the Euro Area (EA) with a special focus on persistence of real wages, wage and price inflation. The analysis is conducted within a structural vector error-correction model, where the structural shocks is identified using the long-run properties of the theoretical model, as well as the co-integrating properties of the estimated system. Overall, in the long run, wage and price inflation emerge as more persistent in the EA than in the US in the face of import price, unemployment, or permanent productivity shocks.

**Table 1.** Macroeconomic models for average wages and unemployment review

No.	Macro model	Authors	Year	Main aspects
1	Wage Dynamic Network	European Central Bank	2009	A research network consisting of economists from the European Central Bank and the national central banks of the EU countries. The WDN aims at studying in depth the features and the sources of wage and labour cost dynamics and their implications for monetary policy.
2	U.S. Unemployment Movement Dynamic Factor Framework	Heaton, Oslington	2005	Model estimates unemployment between different economic sectors, sectoral shocks are found to account for around half the movement in US unemployment. Shock frequencies, sectoral patterns and flows provide some clues to the identity of some of the shocks driving unemployment.

The model consists of a production function, a wage setting equation, an equation describing price formation, an equation for the unemployment rate and an equation for the import prices in domestic currency. The equations contain a minimum of dynamics in order to simplify the discussion about the long-run properties of the model.

As regards the wage formation, we assume that wages are determined through a bargaining process between firms and employees (or labour unions). This type of models predicts that the bargaining solution will depend on the real producer wage and productivity on the firm side, and on the real consumer wage on the workers side. A simple log-linear form of the wage equation corresponding to the bargaining solution can be written as:

$$w - q = k_1 + \mu(p - q) + \delta h - \Theta u, \quad 0 \leq \mu, \delta \leq 1, \quad \Theta \geq 0, \quad (2)$$

where:  $w$ —the nominal wage rate;  $q$ —the producer price level;  $p$ —the consumer price level;  $u$ —the unemployment rate.

According to (1), the real wage faced by firms (real producer wage) is affected by  $(p - q)$ ,  $h$  and  $u$ . The relative price  $(p - q)$ , which measures the difference between the producer real wage and the consumer real wage, is usually referred to as the *price wedge*, and plays an important role in theoretical wage bargaining models. Its coefficient,  $\mu$ , can be interpreted as a measure of “real wage resistance,” which measures the unions ability to obtain higher wages to compensate for exogenous changes in worker living standards (increases in  $p$  brought about, for example, by changes in indirect taxes). The bargaining solution (1) also implies that an increase in labour productivity,  $h$ , will increase wages, since higher productivity increases the profitability of firms, making them more likely to accept higher wage claims from the unions. The unemployment rate,  $u$ , represents the degree of tightness in the labour market, which influences the

outcome of the bargaining process through the relative bargaining power of the labour unions and employers organizations.

U.S. Unemployment Movement in a Dynamic Factor Framework model. The causes of unemployment have been a matter of longstanding dispute in economics. Many different theories of unemployment have been proposed, and disputes over policy at times have been acrimonious. Effective policy depends on understanding the causes of unemployment movements, and a fundamental question is whether these causes are sector-specific or common to all sectors. If sectoral shocks are more important than aggregate shocks then it is needed “micro” models and policy interventions which focus on the relevant sectors. If not then the focus should be on aggregate “macro” models and interventions.

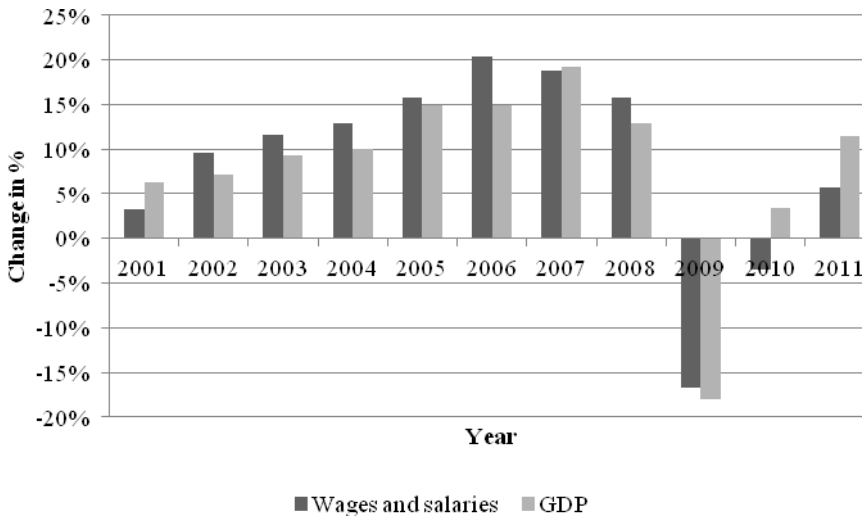
Aggregate models of unemployment have been the most popular according surveys made by Layard, Nickell and Jackman (2005), but there is no shortages of plausible disaggregate models which combine sectoral shocks with slow or incomplete propagation. Lucas and Prescott’s (1974) seminal paper showed how orthogonal product demand sectoral shocks and a search across spatially separated markets generate unemployment. Rogerson (1987) developed this further in a two period, two sectors setting, and in Long and Plosser (1983) model have a sectoral shock real business cycle model. Ljungqvist and Sargent’s (1998) influential turbulence plus skill decay account of European unemployment is from this family of models. Others take a different approach to the shock generating mechanism, with demographic adjustment featuring in Matsuyama (1992) and informational asymmetries in Riordan and Staiger (1993). Robert Hall (2003; 2005) suggests a number of other possible sectoral shock models of unemployment. Any general equilibrium trade theory of unemployment (Matusz 1996, Oslington 2005, Melitz and Cunat 2006) is a sectoral model.

Some other studies have measured the contribution of sectoral shocks to US macroeconomic variables using a variety of methodologies. Long and Plosser (1987) used factor analysis techniques on output for sub-sectors of manufacturing from 1948 to 1981 to assess the importance of sectoral shocks. Norrbin and Schlagenhauf (1988) decomposed 1954 to 1980 US output movements into aggregate, sectoral and regional components using the Engle-Watson DYMIMIC factor analysis techniques. Forni and Lippi (1997) and Forni and Reichlin (1998) considered very finely disaggregated US manufacturing output for the period 1958-86 using their own dynamic factor techniques.

Lithuanian Macro Model will be based on Inforum (**I**nter**i**ndustry **F**orecasting Project at the **U**niversity of **M**aryland) philosophy, which was founded 40 years ago by Dr. Clopper Almon, now Professor Emeritus of the University. Inforum pioneered the construction of dynamic, inter-industry, macroeconomic models which portray the economy in a unique “bottom-up” fashion and input-output tables. Inforum continues to foster cooperation and development of economic knowledge and techniques with partners around the world.

### 3. Analysis of Dynamic Lithuanian Macro Economy Indicators

Wages as a measure is monitored and used by Government or other organizations as a benchmark for the wage level of individual workers in an industry, area or country and as an economic indicator depends on several other basic indicators (GDP, inflation, unemployment, exports). Average monthly labour cost will be analyzed comparing with other macroeconomic indicators. The analysis of the main statistical data of Lithuanian economic indicators related to average wages and unemployment rate is provided below. Data was taken from Lithuanian Department of Statistics and Eurostat. Analyzed period is between years 2001 and 2011.



**Fig. 1.** Annual GDP versus wages and salaries fluctuations, compared to previous year (Lithuanian Department of Statistics database)

In year 2000 GDP was growing by almost 3.5% and wages lagged falling by almost 2% (Fig. 1). But in the next year and several years ahead, till 2008 GDP and wages clearly rose, and the increase was significant. In year 2004 growth rate of GDP and wages almost equalled, reaching more than 7% and next few years ahead, rate of wages increased exceeding growth rate of GDP, reaching its boom of increase in year 2008 totalling more than 20%. As economic recession stroke Lithuanian economy, both measures fell down quite drastically. From this figure we can state that GDP is much related to the level of wages and it influences it quite strongly.



**Fig. 2.** Inflation versus wages and salaries fluctuations  
(Lithuanian Department of Statistics database)

In year 2000 inflation fell together with wages, reaching almost 1% and 2% fall accordingly (Fig. 2). Next year, both indicators rose almost 2 times compared to previous year, but in year 2002 and 2003 inflation growth was negative, as wages growth was clearly positive. Next four years ahead, inflation rose along with growth of wages, till economic recession hit Lithuania in 2009, following with decreased both wages and inflation indicators. The relationship between these two indicators is more than clear, but the growth levels may lag for one or two years and the size of growth is not proportional at all, wages rise or fall is much more bigger, reaching two or even more times bigger fluctuations.

Another important economic indicator is unemployment, which is one of the most visible indicators of economic activity. The rate of unemployment typically rises considerably during recessions then falls as the economic recovers.

From economy point of view, labour is another commodity; that is, something bought and sold in an open, competitive marketplace. Like any market, the demand for and supply of labour is either in equilibrium or disequilibrium. The former “market-clearing” state exists when supply exactly equals demand, the latter whenever supply and demand fall out of kilter. Importantly, whenever external circumstances permit, internal forces impel a market in disequilibrium toward equilibrium. Technically, whenever the equilibrium point falls short of the full-employment mark, certain amount of what Keynes called “involuntary” unemployment is inevitable. Even Keynesianism arch critic, the monetarist Milton Friedman, believed there was a “natural rate” of unemployment (Hall, 1995).



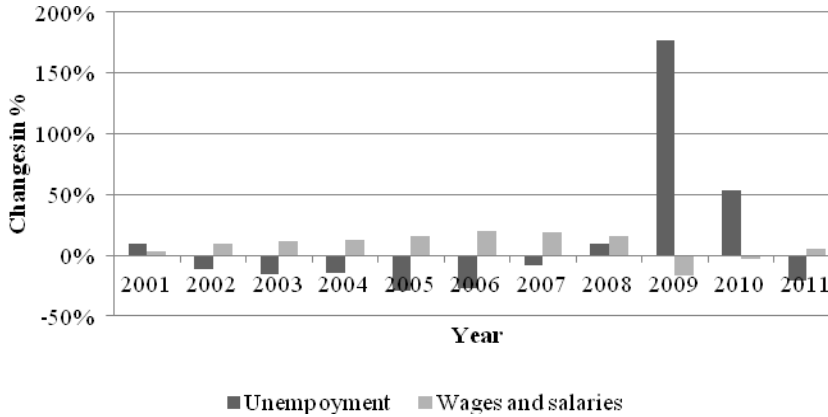


Fig. 3. Unemployment versus wages and salaries fluctuations, compared to previous year (Lithuanian Department of Statistics database)

In year 2000 unemployment rose by 2.7% compared to previous year, accordingly average wages fall by almost 2% (Fig. 3). Following next years, annual unemployment rate was stably decreasing by approximately 1 to 3% till the year 2008, when unemployment rate increased by almost 2%. Respectively average wages was increasing from year 2001 till 2008; the increase rate was quite big, reaching more than 20% in year 2008. Afterwards the economic recession struck Lithuania, followed by drastically increased unemployment rate, reaching more than 8% and fall of the average wages by 5%. Average wages is highly related to the unemployment rate by the inverse relationship, meaning when one indicator is falling the other follows with the increase.

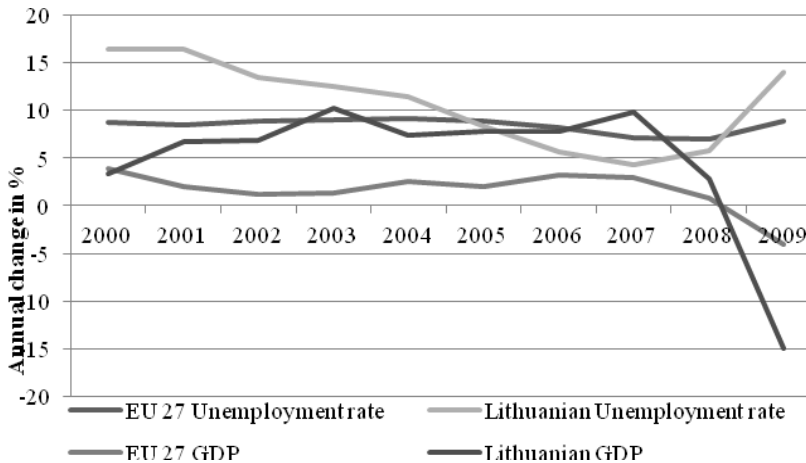


Fig. 4. Unemployment rate versus GDP fluctuations (Lithuanian Department of Statistics database)

Matching Lithuanian GDP growth with unemployment growth we see opposite tendency. The same like in EU, but more fluctuation (Fig. 4), since 2000 due to improving economic condition, increase of export to Russia (post crisis period in Russia) and neighbour countries, growing domestic demand, increasing of foreign direct investment GDP is growing and unemployment is moving in inverse direction. As since 2000 till 2007 we saw positive tendency (GDP was growing, unemployment rate was decreasing) since 2007 we see invertible negative tendency (GDP is decreasing, unemployment growing).

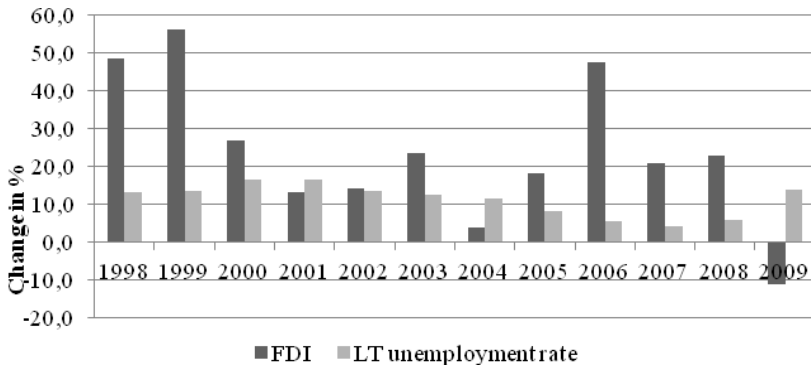


Fig. 5. FDI versus unemployment rate fluctuations  
(Lithuanian Department of Statistics database)

Foreign Direct Investment (FDI) is one the most essential economic factors. Especially for the developing economy FDI is one the critical factor. As Lithuanian economy is considered as developing, extremely after integration to EU and Schengen zone, this factor is really essential. We would like to match annual change in% of FDI to unemployment rate. This analysis will release if FDI have any reasonable influence on unemployment rate (Fig. 5).

Obviously there is not any substantive relationship between FDI and unemployment rate according Lithuanian Statistic Department data. Since 1998 till 2008 it was only positive tendency in FDI despite this unemployment dispersion was significant. In 2001 it reached peak at highest point of 16.5% after that lowest peak in 2007 of 4.3%.

One more factor can be added to this evaluation. Since 1990 as Lithuania became independent privatization process has started. Due to privatization many state enterprises were sold to foreigners. So as issue of privatization in FDI statistic it is complex to recognize which funds really goes as FDI and which funds were used for buying state enterprises.

For such small country as Lithuania export is the main driver of economy. As the domestic market is small, almost all Lithuanian companies consider the possibility to export goods or service, especially after Lithuania's integration into the EU and Schengen zone.



**Fig. 6.** Export versus unemployment rate fluctuations  
(Lithuanian Department of Statistics database)

Analysis shows that in some period there is real relationship of these factors. As example since 2003 till 2005 export was growing otherwise unemployment was dropping. But matching 2005–2007 there is opposite tendency as export was decreasing and unemployment was doing either. This mismatching could be related to booming Lithuanian economy since 2005–2008 and very huge domestic householder expenses (financed by loans mainly from Scandinavian banks). During this period consumer index increased drastically. For many companies it was enough to sell their products, service in domestic market without thinking about export. As the result income was booming too (Fig. 6).

Analyzing these factors, in 2008, Lithuanian export increased by 20% compared to 2007. Despite the fact that global recession already had been started in the EU and USA. Analyzing unemployment rate for 2008 we see pretty figures 5.8% comparing to 2007 it was 4.3%. I can relate this to strong export in 2008. Due to robust economic crisis in 2009 Lithuanian export dropped as never down. It decreased by 27%. From our point of view, this factor also influenced unemployment rate.

#### 4. Macro-Econometric Lithuanian Macro Model and its Equations

After the analysis of historical data of Lithuanian macro economy, the forecast of Lithuanian average wages and unemployment rate will be provided. The work will be done by using Inforum philosophy and program called G7, but it will be modified to match the Lithuanian macro economy issues. This program was chosen because it allows to build a macro-econometric model for Lithuania and to make a forecast with minimum errors. The next step will be to make the forecast of Lithuanian average wages and unemployment rate.

Creation of a macroeconomic forecast of the Lithuanian economy involves many steps. Before making the forecast of Lithuanian average wages and unemployment rate, we need to create a model for the whole Lithuanian economy, which includes main macroeconomic data: GDP, Private Consumption Expenditures and Gross Domestic Investment, Exports, Imports and other indicators. The process of creation this model is explained below.

The model is based on Lithuanian historical macroeconomic data starting from the year 2000 till year 2009. First step is creating a Master file for the model. It is a vital part for the model as it contains all the equations, required to calculate the main macroeconomic data, to calculate the behaviour ratios and make the transition of exogenous variables. The exogenous variables are used by the model but are not determined by it; the endogenous variables are both used in the model and are determined by it.

The main equation for this model will be the calculation of GDP, which will be an endogenous variable and will be calculated by the following formula:

$$GDP = C + V + FE - FI + G, \quad (3)$$

where: *GDP*–Gross domestic product; *C*–Personal consumption expenditures; *V*–Gross private domestic investment; *FE*–Exports; *FI*–Imports; *G*–Government consumption expenditures and gross investment.

For the calculation and forecast of average wages it will be added historical values of labour employment. The wages equation will be a regression, depending on inflation and labour productivity. Labour productivity is calculated by dividing total output by employment. Next equation is for unemployment forecast:

$$\text{unr} = 100 \times (\text{lfc} - \text{emp})/\text{emp} \quad (4)$$

(where: *unr*–unemployment rate; *lfc*–labour force; *emp*–employment).

As explained above, both GDP in real terms and in current prices are endogenous variables, which are calculated by other endogenous and exogenous variables. All the calculations, except average wages, will be used both in real terms and in current terms.

Personal consumption expenditures are an endogenous variable in this model, which is calculated by the regression which is equal to the change in exports and government consumption expenditures and gross investment. The same procedure will be done with Personal consumption expenditures in real terms.

The next endogenous variable, which is regressed in this model, is Gross private domestic investment. The regression for it is equal to Private fixed investment, currently in nominal terms. The same procedure goes with Gross private domestic investment in real terms.

Another variable which is regressed and is required for the calculation of GDP is imports. The imports are equal to regression with Exports, Gross domestic investment and Personal consumption expenditures. The same procedure is with the Imports regression in real terms.

Since there is no possibility to forecast the Exports of the country, unless a multi-national model has been built, the Exports will be taken as a projection. The same will be done for Government consumption expenditures and gross investment, as this is fully enough for the current phase of the created model.

Also GDP Deflator is introduced, which is endogenous indicator in this model. The main purpose of it is to calculate the dynamics of average wages and unemployment rate.

Now all the mentioned above can be summarized in a single Master (Table 2) file.

**Table 2.** The config Master file for G7

Master
# Lithuanian Macro Model Master file
# 7 exogenous (not counting time)
# 3 behavioural ratios for feR, lp
checkdup y
fex time = time
# Personal consumption expenditures equation
add cR.sav
r c = fe, g
add c.sav
r cR = feR, gR
# Gross private domestic investment equation
add vR.sav
r vR = vfR
add v.sav
r v = vf
# Imports equation
add fiR. `sav
r fiR = feR, vR, cR
add fi.sav
r fi = fe, v, c
# GDP Real
f gdpR=cR+vR+feR-fiR+gR
# GDP Nominal
f gdp = c + v + fe - fi + g
# GDP deflator
f gdpD=gdp/gdpR
# Behaviour relationship for exports
fex feBR = feR/(cR+vR-fiR)
f feR = feBR*(cR+vR-fiR)
f fe = feR*gdpD
# Labour productivity behaviour ratio
fex lpBR = gdpR/emp
f emp = gdpR/lpBR

```

# Calculation of average wages
add awag.sav
check gdpR 1.0
# Labour Force behavioural ratio
fex lfcBR = lfc/tpop
f lfc = lfcBR * tpop
# Calculation of Unemployment Rate
f unr = 100. * (lfc-emp)/emp
check gdpR 1.0
end

```

Lines that begin with # are just comments and are ignored by the computer. Lines that begin with an “f” form the variable on the left by the expression on the right. The end command signals the end of the master file for the model building program. Lines below it do not go into the model but have another function.

Every equation in Master file (Table 2) is an identity, so this approach has earned its label as identity-centred modelling. Essentially, identities to replace variables that are hard to think about are replaced by others that are easier to grasp intuitively. Good use of identities is essential for good modelling. This recognition of the central role of identities in modelling is in stark contrast to the way that they are usually dismissed in econometric texts with the comment that an identity can be used to eliminate a variable. Of course it can, and then one is left with a variable that is hard to think about without the handle—the identity—that gives an easy way to think about it.

## 5. Output of Lithuanian Macro Model

The Lithuanian Macro Model have been successfully built and run, providing with the forecast of average wages and unemployment rate in Lithuania. Now follows step by step explanation what is the output of the model for Lithuanian average wages and unemployment rate.

*Moderate scenario.* Analyzing the historical simulation of average wages in moderate scenario (Fig. 7) it can be seen that the reproduction really fit, only the year 2009 was forecasted to decrease a little bit more, than it was actually. From the forecast it can be stated that the average wages will decrease in year 2010 to the value of 1939.92 LTLL and afterwards will stabilize in year 2011 and will start to increase further. The rise at the beginning will be quite slow, as the economy is recovering from the worldwide crisis, also the employers will not be rushing with the increase of wages for their employees, but in year 2015 we can see a significant increase to 2107.39 LTLL (bruto), which may lead to the fact that Lithuanian economy may fully recover from the recession and economically will be strong to introduce EURO as a main currency. Afterwards the increase will stabilize again and will follow the trend of the inflation, reaching average wages of 2469.2 LTLL (bruto) in year 2020.

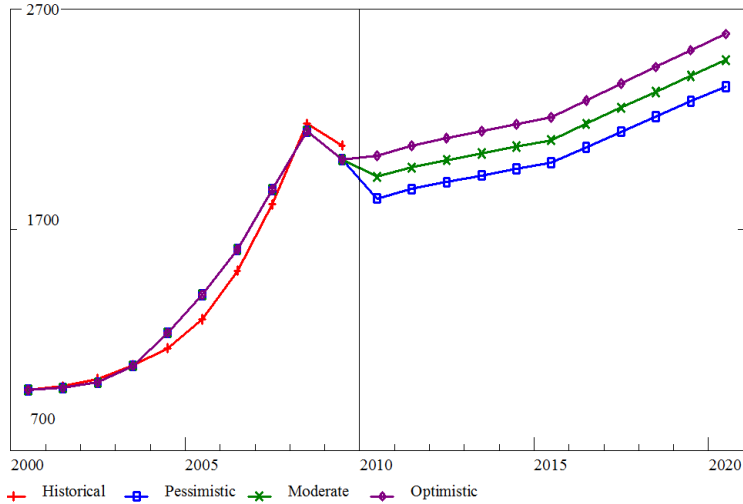


Fig. 7. Forecast projection of average wages (bruto), LTLT

*Pessimistic scenario.* In a pessimistic scenario the labour productivity was decreased by 5% compared to the moderate scenario. The decrease of 5% in *Labour productivity* had a significant impact on the average wages trend (Fig. 7). The forecast of the year 2010 shows that the level of average wages will be slightly higher than in the year 2007, afterwards following a slow increase. The breaking point will remain the same—the year 2015—as in the moderate scenario, leading to conclude that 2015 will be a full recovery of the recession, leading to a faster further increase. In year 2018 the level of average wages will overcome level in best economic times of 2008 and will continue to increase reaching average wage of 2350.10 LTLT (bruto) in year 2020. So to sum up the decrease of labour productivity leads to a significant decrease in average wages, if compared to numerical expression, the decrease of 5% in labour productivity has led to a decrease of 4.8% in average wages.

*Optimistic scenario.* Labour productivity increased by 5% compared to moderate scenario. So the increase in 5% of labour productivity resulted in significant influence on the average wages (Fig. 7). Starting from the forecast of year 2010, the level of average wages slowly increases till the year 2014, and afterwards follows with even bigger increase from year 2015. The optimistic scenario shows that the level of year 2014 will reach the level which was in the year of the highest average wages in 2008 and the next year will follow with even higher increase leading to a biggest level of average wages than it was ever before. The average wages forecast will reach a value of 2588.30 LTLT (bruto) in the year 2020, which states that a high inflation may set in or Lithuania average living standards will increase significantly during the 10 years period from now. To conclude, the increase in 5% of labour productivity in optimistic scenario resulted in a very significant increase on the level of average wages (bruto), and in numerical expression led to 4.8% increase in total for the analyzed period. Meaning that average wages depends mostly on labour productivity ratio and partly on the inflation.

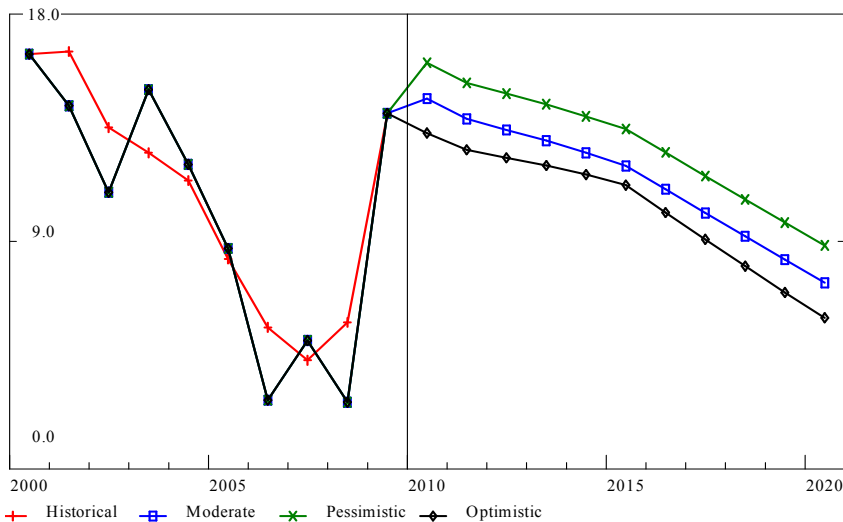


Fig. 8. Forecast of unemployment rate, %

*Moderate Scenario.* For unemployment rate historical simulation and forecast projection (Fig. 8), we are using the figures of executed projections of employment and labour force. Having this data, we can run unemployment equation. The discrepancy in historical simulation is not substantial. In addition, according to the macro model the unemployment rate in 2010 will reach the peak; afterward start to decrease reaching 7.36% in 2020.

*Pessimistic Scenario.* Analyzing the data we can see substantial growth of unemployment comparing to moderate scenario. For example, in moderate scenario in 2020, unemployment rate is 7.36% and in pessimistic scenario, it reached 8.83%. Comparing pessimistic forecast with historical data it can be said what the level of 2005 unemployment rate of pessimistic scenario will reach in 2020. So it is determined what this is really pessimistic scenario for Lithuanian economy. We can explain this by a decrease in export that has caused a decrease in GDP and other economic factors. Obviously not only export made such an influence on unemployment rate. By changing export behavioural ratio all variables in this ratio has changed too. Labour force remains the same as in the moderate scenario.

*Optimistic Scenario.* This scenario provides nice numerical as we see on figure 42 of unemployment rate. Comparing to moderate it is decrease by 1.4% in 2020. As pessimistic scenario provides increase in unemployment by 1.5%. In such an economic projection, we are getting a real booming economy. However, this unemployment rate is not something impossible or unrealistic. Going back to historical data, we see that such figures Lithuania already has had in 2007 when unemployment rate was even lower 4.3%, and in 2008 it was quite the same 5.8%.



## 6. Further Development of Lithuanian macroeconomic model

The main goal of further development was development and improvement of Lithuanian macroeconomic model using G7 program. At current stage it is made quarterly historical simulation and forecast of main economic variables. Model is forecasted unemployment rate and average wages by quarter till 2020 year.

The underground and basis for further development is “QUEST” Quarterly economic structural model of the US economy.

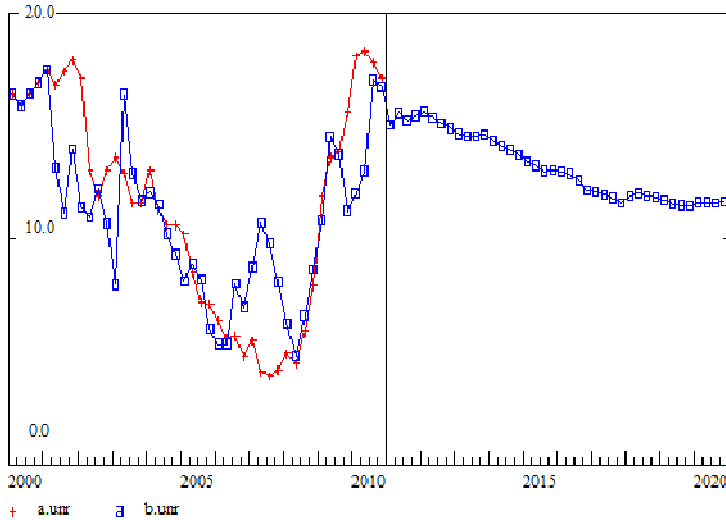
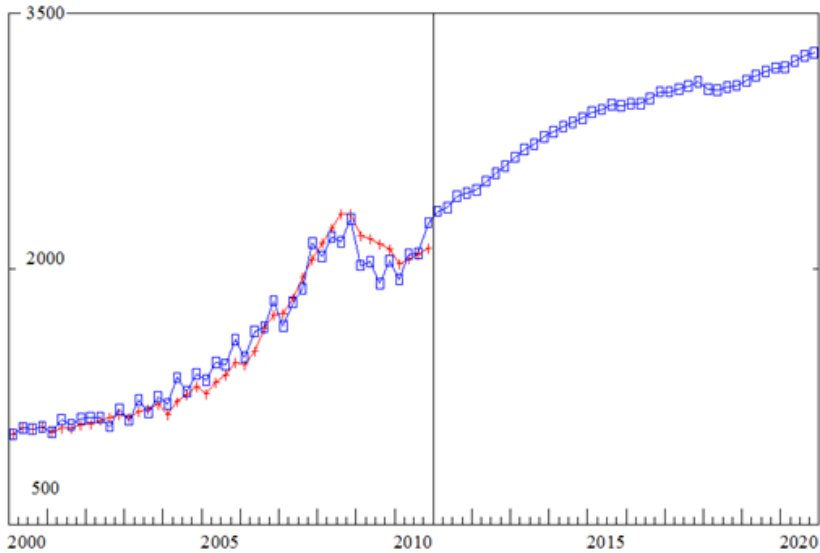


Fig. 9. Forecast of quarterly unemployment rate, LTL

By analyzing two lines it is obviously seen quite close fitting of statistical data and forecasted projection. Of course there is some discrepancy, however in general there is close fitting. The lowest rate of unemployment was in period since 2005 till 2008. Afterward, due to a worldwide economic crisis unemployment rate started to grow. Only since 2010's second quarter did it start to decrease. Observing the forecast we see a fluctuation of unemployment rate. Since 2012 a small decrease of unemployment rate is seen; however in 2013 -2014 a very slow decrease or even increase in unemployment rate is seen. Afterward there is substantial decrease till second quarter of 2016. And since 2016 it is seen increase of unemployment rate and some fluctuation with decrease trend.

The highest unemployment rate, according to statistical data, in 2010 second quarter, was 18.3%. According to the forecast in 2010 second quarter, unemployment rate was 12.98% it is seen some discrepancy. However already in fourth quarter of 2010 it is almost the same numbers in forecast it is 16.71% and statistical data provided 17.10% close fitting. The forecast provided in 2020 fourth quarter 11.63% unemployment rate similar level was in 2004. As is seen, the forecast does not provide an optimistic scenario. It is quite moderate, taking into account the unstable situation in worldwide economy, such a scenario could be real and should be estimated as one of the possibilities.



**Fig. 10.** Forecast of quarterly average wages, LTL

Analyzing the historical simulation of average wages (Fig. 10) it can be seen that the reproduction of historical data really fitted, only the year 2009 was forecasted to decrease a little bit more, than it was actual. This kind of result looks very promising. The forecast shows that the average wages will continue to rise with some volatility till the last quarter of 2015, reaching value of 2964.77 LTL, afterwards falling to 2955.13 LTL in the next quarter. This forecast projection may lead to some divergences in economy, especially in the field of labour. Furthermore the increase of average wages continues and reaches the value of 3098.05 LTL in 2017 last quarter, where it falls again in the next year to the value of 3049.32 LTL. Further the rise slows little bit comparing with previous periods and in last quarter of year 2020 average wages will reach 3267.45 LTL. In overall, from the end of year 2010 till the end of 2020, average wages is forecasted to increase by approximately 43%. The leap in average wages looks really joyful and optimistic but having in mind that average wages from year 2000 till the end of the year 2010 increased more than twice, the projection looks real.

## 7. Conclusions

Macroeconomic models hold their significance in understanding the important parts of the countries' economy.

To properly forecast and create scenarios of average wages, already created models have to be examined thoroughly to understand the movements of the main economic indicators.

None of the forecast is available without proper analysis of countries macroeconomic indicators. Also correct statistical data have to be collected and correctly understood.

Short review of model creation process is provided. Also, article describes model outcomes of three various scenarios of average wages and unemployment rate—moderate, pessimistic and optimistic.

The forecast have concluded that the average wages fluctuate dependently with the labour productivity ratio, which is an important factor of every country.

The level of average wages which were seen in Lithuania in the year 2008 will be approximately reached in the year 2012-2014—depending on the further behaviour of the economy.

The forecast of unemployment is interrelated to productivity ratio, export, labour force; these factors are crucial for the unemployment forecast in this model.

The level of unemployment will reach the level before the recession in the year 2018–2020.

The forecast shows that the economy of Lithuania will recover in the year 2016, leading to a quite rapid increase of average wages and a decrease in unemployment rate.

Regarding the forecast, the peak of unemployment will be in 2010; afterward, in all 3 scenarios, the unemployment will go down. The overall economic climate will change towards a positive tendency.

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## LIETUVOS MAKROEKONOMETRINIO MODELIO KŪRIMAS: VIDUTINIO DARBO UŽMOKESČIO IR NEDARBO LYGIO PROGNOZĖ

Jelena STANKEVIČIENĖ, Albertas GRUODIS, Adrian LOKUTIJEVSKIJ, Ūla URBAITĖ

**Santrauka.** Ekonominio modeliavimo svarba išlaiko savo pozicijas ir vaidina svarbų vaidmenį tiriant nacionalinės ekonomikos pokyčius ir makroekonominės tendencijas. Regioniniai ir globaliniai makroekonominių rodiklių pokyčiai įtakoja priimamus ekonominės politikos sprendimus. Tokių sprendimų priėmimą palengvina įvairūs makroekonometriniai modeliai skirti ekonominių procesų analizei. Straipsnio tikslas – sukurti Lietuvos makro-ekonometrinių modelių ir pateikti tris scenarijus vidutinio darbo užmokesčio ir nedarbo lygio prognozes Lietuvoje. Tyrimo rezultatai parodė, kad nepaisant makroekonominių modelių naudojimo apribojimų krizės metu, galima naudoti tokius modelius įvairių makroekonominių scenarijų analizei. Straipsnyje analizuojami vidutinio darbo užmokesčio ir nedarbo lygio kitimo tendencijos Lietuvoje, kartu su pagrindiniais makroekonominiais rodikliais. Siūlomas makroekonominis modelis grindžiamas Inforum filosofija, išteklių-panaudojimų analizės principais ir tapatumu, integruotu „iš apačios į viršų“ metodu. Išanalizavus teorinius ir praktinius aspektus, pateikiamos išvados ir pasiūlymai.

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