KEYNESIAN MACROECONOMIC MODEL OF THE REPUBLIC OF MACEDONIA: ECONOMIC THEORY AND BEHAVIOURAL EQUATIONS*

INTRODUCTION

In the period March-August 2008, Macroeconomic Policy Department within the Ministry of Finance worked on developing small and simple macroeconomic model. Main objective of the model is to serve as a credible tool for producing forecasts of macroeconomic aggregates in the Republic of Macedonia. Moreover, the model can be also used to understand the functioning of the Macedonian economy, as well as to examine the effects of economic policies either ex ante or ex post. The model includes real, fiscal, monetary and external sector, and distinguishes economic agents as being private agents and the government. Level of disaggregating in the model is such that it can be applied on a wider range of economic policy makers, private agents and analysts, whereby they can incorporate, following simple methodological instructions, their opinions, expectations and assumptions in the model.

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This article is an attempt to present the basic behavioural equations in the macroeconomic model of the Republic of Macedonia (hereinafter: MMRM), paying special attention to its economic logic and theory underlying the econometric estimation. The paper is not aimed at describing the functioning of the developed model, nor at presenting or assessing the forecasts derived therefrom. Thus, it is a small contribution to complete documenting of the developed model.

Main conclusions from the individual equations give a clear picture of the trends in the Macedonian economy. Personal consumption is driven only by the available income, while interest rates appear insignificant, due to the absence of financing the consumption through borrowing. Similar, investments are determined mainly by the income, while interest rate is also insignificant. However, higher sensitivity of investments to interest rate changes, compared to previous research, points out to an increase of the importance of financing investments through borrowing. With respect to labour market, employment is positively affected by the economic activity, whereby labour costs are an important factor only in the short run. Wages are determined by the unit labour costs, and less by the

opportunity costs of working – the unemployment benefits. According to the concept of ineffective labour supply, wage does not depend on labour supply, i.e. unemployment, and the slow restoring of equilibrium of this equation reflects the rigidity of the wages in Macedonia. With respect to trade, we have the export dependent on both foreign demand and domestic production. Despite the fact that ratio of relative prices was on the verge of significance, we believe that export is price elastic. Unlike export, import is price inelastic, and it is driven mainly by private consumption, and less by export, but is sensitive to investments.

This study is organized as follows: short summary is presented below on the goals and scope of macroeconomic modelling, in particular MMRM. Third part presents the estimated equations and underlying economic reasoning, while the last part concludes the study.

MACROECONOMIC MODELLING: SUMMARY AND SCOPE

In the last few decades, using econometric equations has become one of the most important ways of considering economic problems and offering solutions and recommendations for the economic policy makers. On the basis of so called macro-econometric models, these equations should help in understanding how the economy functions and to serve as credible tool for producing macroeconomic forecasts. However, "Remember that all models are wrong; the practical question is how wrong they have to be to not be useful" (Box and Draper, 1987). Thus, the product of macroeconomic modelling should be verified by the economic logic and reasoning, even by the economic intuition.

Spectrum of macroeconomic models ranges from models purely based on data to purely theoretical models (Deutsche Bundesbank, 2000). For instance, models estimated with vector autoregressive equations (VAR) are strictly based on data, without any theoretical assumptions. On the other side of the spectrum are the general equilibrium models (CGE and DSGE), which assume that the behaviour of economic agents is optimal and they opt to achieve equilibrium, whereby through the process of evaluation and/or calibration, the model will be allowed to fit into a given data set.

Models based on equations which allow variables to interact in many ways are in the middle of such model spectrum, but they apply restrictions on the econometric specifications derived from the economic theory. These are the structural vector autoregressive (SVAR) models and the vector error correction models (VECM). MMRM is based on VECM equations.

MMRM is an aggregate model with profound theoretical basis and is a systemized stylized representation of the overall Macedonian economy. It is built in the Keynesian framework (IS-LM model), where the IS curve represents the goods market, while the LM curve represents the money market. Basics of the IS-LM model can be found in any standard macroeconomic textbook, and we would like to point out at Mankiw (2007), Abel and Bernanke (2007), Mishkin (2008) and so on.

There are many examples of small macroeconomic models in the literature, each having its own specifics. Classic small model of open economy is the one of Dornbusch (1976). More sophisticated specifications of prices and wages can be found in Taylor (1980), Buiter and Miller (1981, 1985) and Fuhrer and Moore (1995); recent models allow for inflation persistence, as well. Blake and Westaway (1996) upgrade the Fuhrer-Moore model for the case of open economy. There are alternatives of closed economy developed as well, without explicit contracting, but with incorporated inflation persistence (Ball, 1997; Svensson, 1997); cases of open economy (Ball, 1999; Svensson, 1998); models with rational expectations (Svensson, 1997, 1998) and so on.

BEHAVIOURAL EQUATIONS AND ECONOMIC THEORY

Basis for developing behavioural equations within MMRM lies in the economic theory. "Co-integration" is the most often used technique in modelling, which separates long-run structural parameters from short-run dynamic adjustment. First, with the equations we estimate the long-run economic relationships between macroeconomic variables (for instance, income and consumption), and then we estimate the process of adjustment, i.e. the process of correction of "errors", which arises from short-run deviations of the variables from the long-run equilibrium. Short-run equations can also include variables not included in the long-term relationship. Thus, both short- and long-run behaviour of economic agents is caputred (Wooldridge, 2007).

Endogenety could be an issue with some equations, which is present, among other things, when the dependent variable affects one of the independent variables (for instance, income affects investments, and investments affect income) and unables precise estimations of the parameters when applying the conventional models. However, since we apply the Johansen co-integration technique, where each variable is dependent and independent at the same time, we believe than endogeneity is not an issue, i.e. the parameters are unbiased.

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For the purpose of estimating behavioural equations, quarterly data are used for the period from the first quarter in 1998 to the fourth quarter in 2007. Quantitative techniques are applied for approximating variables for which the official statistics publishes no quarterly data. Conventional deseasonaling techniques (X-12 method, multiplicative) are applied to variables for which it is known or is assumed that follow seasonal pattern. Statistical characteristics of the series are analysed with the conventional unit-root and co-integration tests[1]. Small letters denote variables in logarithms, hence parameters represent elasticities, i.e. represent the percentage change of the dependant variable as a result of a change of the independent variable by 1%. Δ sign before the variable refers to the first differential, while the asterisk next to the parameters refers to the statistical significance of the variable at 5% level. Bold letters in parentheses represent the long-run relationships, while the parameter in front of the parentheses represents the speed of adjustment.

REAL ECONOMY

Private consumption

The model assumes that consumption follows the Classical Keynesian function, i.e. that consumption is proporcional to real disposable income of private agents. According to the Theory of permanent income (Friedman, 1957), interest rates can also affect consumption, since it depends on the income's present value of the income during the life, which then depends on interest rate. In line with this theory, we allow for interest rates[2] to affect consumption, but they do not appear statistically significant, like in De Haan et al (2001). Insignificance of the interest rates can be explained either with the absence

1. *Goal of this article is not to present details on the techniques or the texts used for the objectives indicated. Thus, details can be obtained upon request.*

2. *Real interest rate on Denar credits, credits to household and enterprises, all maturities. This is the only series available for the whole period.*
Interest rate is not presented in logarithms, thus its ratio is interpreted as semi-elasticity.

of financing of personal consumption by borrowing, or by inelasticity of consumer credits to interest rate. We believe the first explanation is more reasonable for Macedonia. If real private consumption is denoted by pc, real disposable income by di, than the behaviour of the consumption is given by the following equation:

$$\Delta pc = -0.47^* \cdot (pc(-1) - 0.97^* \cdot di(-1) - 0.23) - 0.086 \cdot \Delta pc(-1) + 0.14 \cdot \Delta pc(-2) + 0.04 \cdot \Delta di(-1) - 0.06 \cdot \Delta di(-2)$$
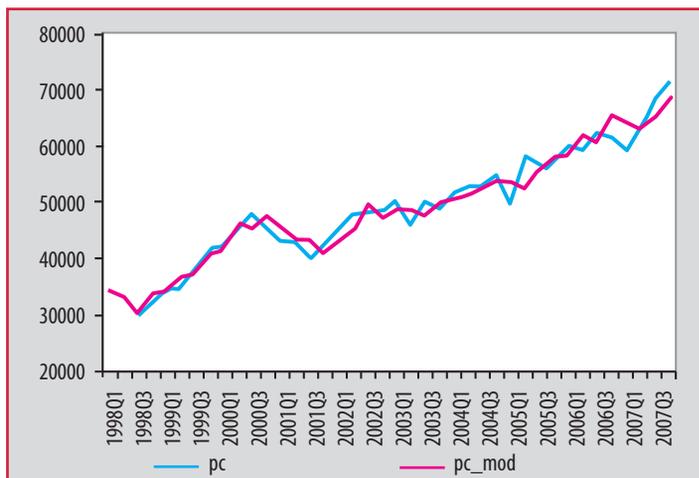

Marginal propensity to consume of 0.97 suggests that, on the long run, increase of the disposable income by one percent will cause an increase of the consumption by 0.97%. It is usual for marginal propensity to consume to be around unity, and a parameter lower than one points out to positive saving. If income is zero, consumption is still positive, however the parameter of the autonomous consumption (0.23) has no statistical significance. Disturbing the long-run relationship will cause a process of equilibrium in the short run, which lasts for about two quarters (adjustment ratio of 0.47)[3]. Estimated (model) and actual series are shown on the chart on the left, the suffix "mod" referring to the former.

Investments

Equation for investments finds theoretical basis within the neoclassical model of investments (Jorgenson, 1963), according to which investments depend on economic activity and interest rate. The model has microeconomic foundations, i.e. the equation is derived from the maximizing behaviour of economic agents, however, we are not going to elaborate it in this article. Such approach
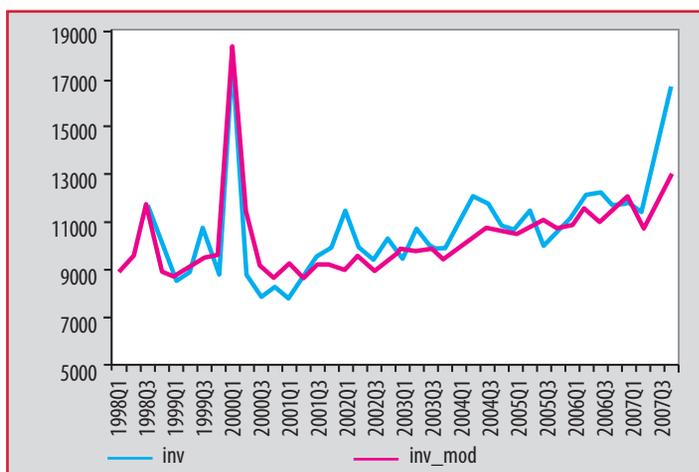
to investments is profounded within the IS-LM model as well, and an intuitive interpretation is that at higher level of economic activity, firms will invest more, as they will do when interest rate is lower, as a result of the lower cost of capital. inv stands for the real gross investments in Macedonia, y stands for real GDP, and IR stands for interest rate[4] . D0001 is a dummy variable that captures the influence of the increased investments in transportation means when anticipating the introduction of VAT. Estimated equation is presented below.

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3. Short-term parameters are statistically insignificant, but are present in regression so as to meet the assumptions of unbiasness of the estimated results.

4. Real interest rate on Denar credits, credits to household and enterprises, all maturities, like for the consumption.

$$\Delta inv = -0.95^* \cdot (inv(-1) -0.89^* \cdot y(-1) + 0.005 \cdot IR(-1) - 0.44) + 0.14 \cdot \Delta inv(-1) - 0.02 \cdot \Delta inv(-2)$$
$$+ 0.79 \cdot \Delta y(-1) + 1.50 \cdot \Delta y(-1) + 0.003 \cdot \Delta IR(-1) + 0.005 \cdot \Delta IR(-2) + 0.75^* \cdot D0001$$

On the long run, 1% increase of income implies an increase of investments by 0.89%. This parameter implies high level of acceleration between income and investments, which is in line with the theory (Mankiw, 2007), as well as with previous findings (De Haan et al., 2001, who find a unitary parameter). The interest rate has a negative sign, which implies that increase of the interest rate by 1 percentage point will result in investment reduction by 0.5%. Compared to De Haan et al. (2001), our parameter is by 2.5 times higher, pointing out that investment decisions of firms have become more sensitive to interest rates. However, the parameter is still statistically insignificant, which we explain with the small share of credits in financing investments. Parameter of the autonomous investments (0.44) is positive, but it has no statistical significance as well. Short-term disequilibrium in this relationship is adjusted quite quickly, i.e. for period a bit longer than one quarter.

LABOUR MARKET AND WAGES

Employment

When modelling employment, the starting point is the theoretical and empirical fact that, in the long run, employment is driven by the economic activity, i.e. increase of production will lead to increase of labour demand, and consequently, employment. The famous Okun's Law refers to an inverse relationship between the change in the unemployment rate and the difference between actual and potential real GDP (for further insights refer to Prachowny, 1993). In the literature, change in the unemployment rate most often refers to its deviation from the so-called non-accelerating inflation rate of unemployment (NAIRU). However, this concept is not applicable in Macedonia, due to the reasons outlined in Nikoloski (2008); hence, modelling uses the change in the variable, rather than its deviation from NAIRU. On the other hand, taking into account the objective to model employment, rather than unemployment, we can assume here that Okun's Law also applies in the reverse direction, i.e. increase in economic activity by 2% - 3% will lead to 1% increase in employment.

Several studies (Hamermesh, 1998; World Bank, 2005) include the labour costs, i.e. wage taxes and contributions, as an important determinant of labour demand (employment). However, there is no credible quantitative analysis for the effect of wage taxes on employment in the empirical studies for countries like Macedonia. International studies assessing the elasticity of labour demand suggest that the possible scope of the parameter of labour costs ranges from 0.2 to 0.5, implying that 10% reduction of labour costs will lead to increase of employment by 2% to 5%. World Bank (2008) estimates the elasticity of aggregate labour demand in relation to actual the labour costs on a sample of 56 countries in the period 2000-2006, within production function with constant elasticity. It suggests that reduction of labour costs by 10% results, on average, in 2.1% increase of employment. However, this estimate has no statistical significance, and the
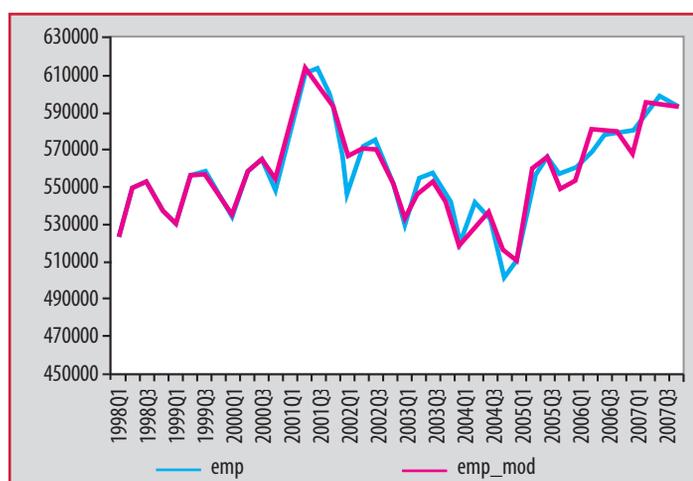
overall econometric specification is quite weak. An indicative technical specification of production function with constant elasticity is found in De Haan et al. (2001) for the Macedonian case, however, the estimated equation assumes unitary positive elasticity of labour demand to production and unitary negative elasticity to labour costs, which is not in line with other empirical findings. However, the contribution of both studies lies in the detailed elaboration of the need the employment function to also include labour costs in short-term specification. Thus, this function in MMRM, in short-run relationship, also captures the average gross wage.
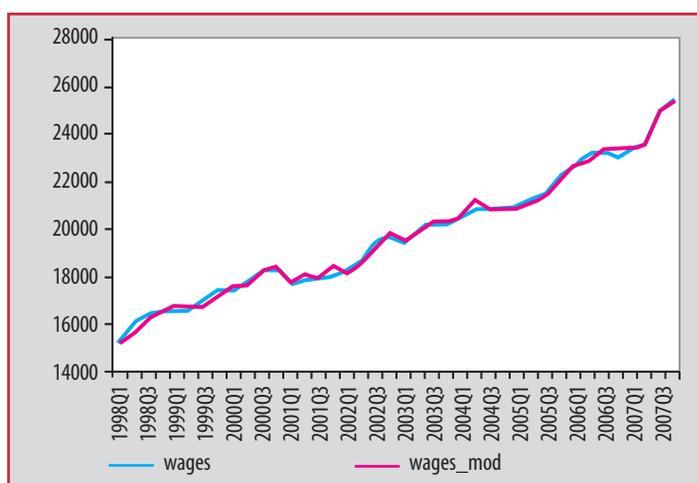
emp stands for the number of employees, y stands for the real GDP, while w stands for the real gross wage. As a result of the structural break noted in the series of employment, which is probably due to methodological changes, trend variable is included for the third quarter in 2001 to end-2004 and one dummy variable that captures an extreme value of employment in the first quarter in 2001. Thus, the equation is as follows:

$$\Delta emp = -0.25^* \cdot (emp(-1) - 0.36^* \cdot y(-1) - 9.37^*) + 0.03 \cdot \Delta emp(-1) - 0.15 \cdot \Delta emp(-2) - 0.03 \cdot \Delta emp(-3)$$
$$-0.24^* \cdot \Delta y(-1) - 0.27^* \cdot \Delta y(-2) - 0.25^* \cdot \Delta(y(-3) - 0.003^* \cdot trend - 0.31^* \cdot \Delta w + 0.05^* \cdot D0101$$

The parameter of GDP in long-run relationship indicates an increase of employment by 0.36% as a result of increase in production by 1%, being in line with the Okun's Law – increase in production by 3% to lead to increase in employment by about 1%. Parameter of gross wage in short-run relationship suggests increase of employment by 3.1% when labour costs decrease by 10%, which is within the findings and the theoretical observations above. Parameter of the speed of adjustment (-0.25) suggests relatively fast restoring of the equilibrium – for a period of one year.

Wages

Since wages are considered as the price of labour, in the long run and theoretically, wages behaviour is determined by the developments of labour productivity (Mankiw, 2007). MMRM does not use labour productivity in wages specification, since statistically insignificant coefficient has been determined in the long-run relationship. Theoretically, the price level could also impinge on wages, since CPI increase will lead to an upward pressure on wages[5] . However, the technical specification of the equation in MMRM does not discover a relationship between wages and price level, which could be due to the low inflation during the observed period. But, the specification utilizes unit labour costs (ulc), which are defined as a ratio between gross wage and labour productivity[6] and represent the cost made to produce a unit of output. Hence, it is logically to expect that the increase of these costs will place further upward pressure on gross wages. Unemployment benefits could also affect wages, throughout the opportunity cost of working, as well as the unemployment – usually developments of wages in the short run are related to the disequilibrium in the labour market (unemployment). However, in Macedonia, where unemployment is considerably high, the linkage between wages and unemployment is predominantly of a long-run character.

5. It is a theoretical and empirical finding that wages are less upward rigid then downward, especially in a case of strong unions.

6. Alternatively, Δulc=Δw+Δemp-Δy, according to the definitions of the variables in this study.

In other words, it is not the wage the unemployment determinant which permanently equilibrates the labour market (the concept of ineffective labour supply).

We denote gross wages per worker by w, ulc is unit labour costs as defined above, ub is the unemployment benefit, and u is the unemployment rate. Three dummy variables are used to capture extreme values of wage and to make residuals of the regression unbiased. The specification is:

$$\Delta w = -0.15 \cdot (w(-1)- 1.46^* \cdot ulc(-1) - 0.13^* \cdot ub(-1) + 0.12 \cdot u(-1) - 10.62^*) + 0.009^* + 0.356 \cdot \Delta ulc$$

$$- 0.105 \cdot \Delta u + 0.019 \cdot \Delta ub + 0.03^* \cdot D0003 - 0.04^* \cdot D0101 + 0.02 \cdot D0703$$

In the long run, an increase of ULC by 1% will lead to an increase of wages by 1,46%; an increase of the unemployment benefits presses wages upwards by 0,13%, while an increase of unemployment by 1% leads to a decrease of wage by 0,12%, which is in line with the theoretical considerations. The short-run "deviation" from such-defined equilibrium will cause a process of dynamic adjustment which is estimated to be slow, so that 1,5 to 2 years are needed for attaining full equilibrium. This could be related to the rigidity in the changes of wages even in a medium run, as well as with the structural problems of the labour market in Macedonia.

EXTERNAL SECTOR

Exports

It is usual in the literature (Goldstein and Khan, 1985), export and import to be modelled as a function of demand, i.e. as a function of income (or the activity) and prices (relative prices – the real exchange rate). This approach is used in MMRM. However, taking into account the specifics of the Macedonian economy, we believe that such an approach is not entirely appropriate. It would be a mistake to treat Macedonian export as a function of demand only and not considering the supply side. The intuition behind this consideration comes from the notion that export expansion after 2004, inter alia, is due to the restart of some production and mining capacities in Macedonia. This approach is not new in the literature, and could be met in Goldstein and Khan (1978), who argue that the production capacity is an important determinant of export.

Taking into account that large part of Macedonian export is placed on EU-15 markets (about 53%), as a variable for the foreign income serves the GDP of these countries (y_eu15). This variable is not ideal because a big part of Macedonian export in these countries is then directed to other markets (emerging markets); however, the participation of emerging markets into Macedonian export is marginal (about 1%). Since the official data for the export prices are scarce, the real effective exchange rate (rer) serves as a variable for the relative prices (the exchange rate is defined so that an increase represents appreciation). The equation includes the domestic industrial production as well (ind), as a
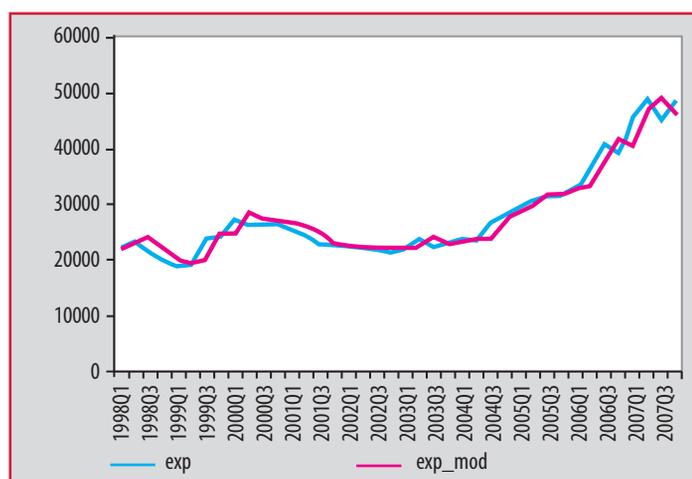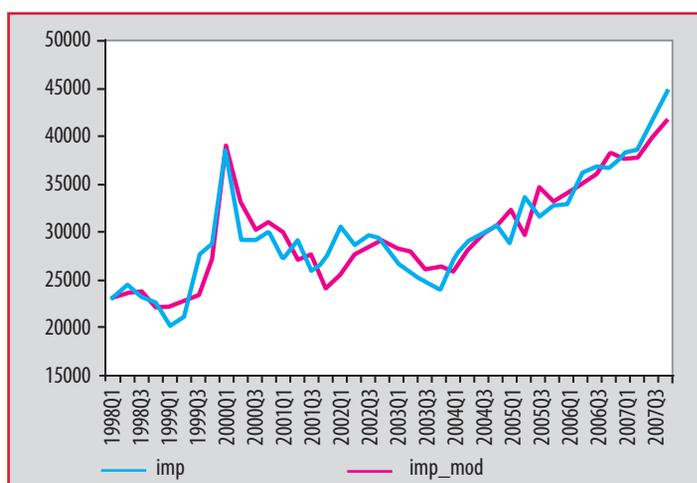
variable that captures supply, i.e. the production capacity. In this specification this variable could incorporate some other effects as well; for instance, the growth of emerging markets, which are not included into the income variable, or the prices of metals.

$$\Delta exp = -0.11^* \cdot (exp(-1) - 4.72^* \cdot y\_eu15(-1) - 3.05^* \cdot ind(-1) + 1.45 \cdot rer(-1) + 71.24^*)$$

High and statistically significant coefficient of the industrial production stands in favour of the thesis that Macedonian export is supply-driven. Export appears highly sensitive to foreign-demand changes (an increase of export by 4,7% when foreign income grows by 1%) and moderately sensitive to relative-prices changes (a decrease of export by 1,45% when the exchange rate appreciates by 1%). Income elasticity of export appears high, compared to other studies for Macedonia (for instance, Jovanovik (2007) finds elasticity of about 1,5, the same as Kadievska-Vojnovik and Unevska (2007), while De Haan et al (2001) assume unit elasticity). These differences are justified with the different data for the foreign demand – the average quarterly growth rate of the foreign demand in Jovanovik (2007) is 2,6 times the one in this study, almost the same as the magnitude of the coefficient in this study compared to the coefficient in Jovanovik (2007)[7] . As for the price elasticity, the obtained coefficient of -1,45 is between the one obtained by Kadievska-Vojnovik and Unevska (2007) of -0,7 and Jovanovik (2007) of -2,2. Considering the expectation that Macedonian export is highly price-sensitive, because of the high participation of products with a low level of finalisation, we believe the obtained elasticity to be reasonable. The adjustment coefficient is relatively low, which points to the slow restoring of the equilibrium condition – for more than two years.

Import

Similar approach has been followed for the import equation. The modification here refers to the inclusion of export (exp) as determinant of import, since a big part of the import refers to goods for reproduction (about 65%), i.e. products which are later manufactured further and exported[8]. A significant part of the import refers to consumer goods (about 25%), hence private consumption (pc) is used as a variable for income, and not GDP. A trial has been made to include investment into the specification, but it appeared insignificant. This modelling could be seen as a decomposition of import on separate components – for export, for consumption and for investment, and its advantage over including one variable for economic activity only (GDP) is seen through the observation of which GDP components drives import.

The real effective exchange rate was used as a variable for relative prices, but it was found insignificant and was ultimately excluded from the specification. This finding is not surprising and points that the import is not price elastic, which sounds reasonable taking into consideration the high import

7. *Since coefficients represent elasticities, i.e. changes of the dependent variable caused by a unit change of the independent variable, than higher rates of growth of the independent variable represent lower elasticity.*

8. *Something similar appears in De Haan et al (2001), who, in the export equation incorporate import. We believe that the relationship between export and import is more accurately to be modeled as in MMRM, i.e. we believe that the increase of export generates an increase of import of goods for reproduction, and not the vice versa.*

dependence of the Macedonian economy. As an argument towards this thesis, the import-goods price (oil, electricity, food) in 2008 significantly increased, while import volume did not decrease. Similar results are obtained in other studies: De Haan et al (2001) assume low elasticity of -0,4 (but the coefficient is calibrated rather than estimated), while Jovanovik (2007) once finds insignificant coefficient and than marginally significant coefficient.

$$\Delta imp = -0.74^* \cdot (imp(-1) - 0.35^* \cdot exp(-1) - 1.06^* \cdot pc(-1) + 4.43) + 0.009 + 0.31^* \cdot D0001$$

The obtained coefficient in front of the private consumption points to almost unit income elasticity of import, which is relatively low compared to other studies (Jovanovik, 2007, finds income elasticity of import of 2,1 and 2,5, while Kadievska-Vojnovik and Unevska, 2007, of 3,5). However, it should be noted that growth rates of the nominal private consumption, the variable which is used in this study, are significantly higher compared to the growth rates of the real GDP, the variable used in the other studies, which contributes for the lower coefficient (the reverse for export). Despite that, a part of the income elasticity is captured here through the export, which, as expected, appears as a significant factor for import developments. The higher coefficient and the higher growth rates of the private consumption compared to export, point out that the increase of import is by more driven by the private consumption. The high coefficient of adjustment of -0,7 points the very fast restoring of the equilibrium – for less than a half-year.

4. CONCLUSION

The aim of this paper was to explain the basic estimated regressions which form the basis of the macroeconomic model of the Republic of Macedonia (MMRM). The study interprets the estimated coefficients by considering economic theory and logic, and by utilizing a technique which separates the long-run dynamics from the short-run adjustment mechanism. The study is a small contribution towards the whole documentation of MMRM by the Ministry of Finance. The study does not present the estimated equations for the unemployment benefits and for pensions, which are less important, as well as the equations for prices and import prices which ask for further quantitative analysis. In addition, the study did not aim at describing how MMRM works.

Challenge for the forthcoming period is the ambition to accomplish higher explanatory power of regressions, to endogenize more macroeconomic variables, to incorporate new variables in the model and to estimate additional economic relationships. Especially important in the medium term is the modelling of prices (inflation), whereby the specification of these could be obtained from other, estimated or calibrated, more sophisticated and more complex models, which are often developed within the central-bank modelling. Narrowly related to this is a specification/description of the transmission mechanism of the monetary policy, the monetary rules and so on, which implies that in a short- to medium run, the inclusion of the monetary sector in the model should be strengthened. This would be the range of the next version of the model, which could be a basis for new studies as this one.

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