SLOPOL, A MACROECONOMETRIC MODEL OF THE SLOVENIAN ECONOMY

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Povzetek:

Slovenija se je pridružila Evropski uniji leta 2004 in je kot prva nova članica vstopila v evrsko območje leta 2007. Ker je bila do leta 1991 del nekdanje Jugoslavije, se je njena »ekonomska zgodovina« pravzaprav začela šele takrat, kar otežuje prepoznavanje empiričnih pravil, ki bi lahko bila uporabna pri pripravi napovedi in analiz. Članek predstavlja makroekonometrični model za Slovenijo, ki se imenuje SLOPOL. Ocenili smo ga s pomočjo najnovejših četrtletnih podatkov in temelji na sodobni ekonometrični metodologiji, ki vključuje analizo stacionarnosti in kointegracije. Model se je že uspešno uporabljal za simulacije alternativnih ukrepov monetarnih in fiskalnih politik, pa tudi pri pripravi napovedi. V članku je prikazana tudi napoved ekonomskega razvoja Slovenije za leti 2011 in 2012, ki je bila pripravljena na podlagi tega modela.

Ključne besede: *Slovenija, makroekonometrični model, ekonomska napoved*

Abstract:

Slovenia entered the European Union in 2004 and was the first of the new EU Member States to enter the euro-area in 2007. As Slovenia was part of the former Yugoslavia until 1991, the economic history of the country to some extent started after that date. This causes difficulties for research into empirical regularities to be used in forecasting and policy analysis. This paper describes a macroeconometric model for Slovenia ("SLOPOL") developed despite these issues. The model uses the most recent quarterly data and is based on current econometric methodology, including stationarity and cointegration analysis. The model has already been used successfully for simulations of alternative monetary and fiscal-policy measures, as well as for forecasting. A forecast of economic development in Slovenia for 2011 and 2012, which was generated with the SLOPOL model, is also presented in this paper.

Key words: *Slovenia, Macroeconometric model, Economic forecast*

1. INTRODUCTION

Decisions about economic policies are characterised by an increasingly complex environment. Furthermore, external shocks, such as sudden movements of raw material prices, exert significant macroeconomic impacts. While the qualitative effects of demand and supply shocks, as well as of monetary and fiscal policy measures can often be derived from economic theory, their quantification requires a mathematical representation of the economy. Here, macroeconometric models containing the most important macroeconomic aggregates and markets have established a long tradition. Alongside simulations, macroeconomic models are regularly used to generate economic forecasts. Hence, a macroeconometric model that is based on both sound economic-theoretical considerations and on actual data is a useful tool for guiding economic policy-making in Slovenia. This paper describes the history and structure and an application of SLOPOL, a macroeconometric model of the Slovenian economy.

In recent years, the SLOPOL model has been used both for simulation and forecasts. Several simulations have dealt with identification and quantification of the macroeconomic effects of the introduction of the euro in Slovenia in 2007. The incorporated impacts comprised the transition from an independent monetary policy to the common monetary policy of the European Central Bank, and a positive total factor productivity shock due to saving in transaction costs and an increase of price transparency with an ensuing increase in competition. Within the model, the euro-area accession brought about temporarily higher real GDP growth, a permanently higher GDP level, more employment, temporarily lower inflation and a permanently lower price level. On the other hand, both public finances and the current account were seen to deteriorate (see, e.g. Weyerstrass 2008, Weyerstrass and Neck 2008a, 2008b).

This paper is structured as follows. In the next section, the history of the model is sketched. In the third section,

the model equations are elaborated. Section four describes a forecast performed with the model. Section 5 draws conclusions.

2. HISTORY OF THE MODEL DEVELOPMENT

This paper describes the model SLOPOL8 (SLOvenian economic POLicy model, version no. 8). Development of the model started in 1998 as part of a collaboration between the Slovenian Ministry of Economic Affairs, Verbundplan (an energy consulting company, based in Klagenfurt), the University of Klagenfurt and the Institute of Macroeconomic Analysis and Development (IMAD), Ljubljana. The model developed within this project was called SMEEM (Slovenian Macro Economic Energy Model), and combined a macroeconomic model and an energy-system model for carrying out energy-sector related analyses. Based upon this blueprint, a structural macroeconometric model of the Slovenian economy was built, called SLOPOL*i* (SLOvenian economic POLicy model, version no. *i*, with *i* denoting the version $i = 1$, 2, 8). The choice of a structural econometric model as opposed to a model of the Computable General Equilibrium (CGE) type to represent the Slovenian economy was motivated by the requirement for the model to be used for both forecasting and simulations. Due to their strong microeconomic foundation and their well defined long-run equilibrium, CGE models are very suitable for simulations, but structural models are much better suited for forecasts since they rely on a long time series of actual data of the respective economy. Thus, the choice of model type is based on the purposes for which the model is used. As it was clear that the SLOPOL model was to be applied for both simulations and forecasts, a structural model was the obvious choice. In contrast to CGE models, which are calibrated to reproduce the data of one particular year, the fact that structural models are based on time series implies that these models must be continuously updated when new data become available. In addition to incorporating the most recent data into the underlying database, the model update involves re-estimating the behavioural equations, since the parameters of the equations may have changed in the course of time. Regarding the SLOPOL model, over the years the model structure has also undergone substantial improvements. This evolution comprised both methodological and institutional issues. With the considerable progress regarding the availability of statistical data for Slovenia over the course of the country's European integration, it has been possible to improve upon the structure of the equations. Until 2005, due to the short time series used, the behavioural equations were defined in a linear form. With the availability of sufficiently long time series data, since 2006, most of the behavioural equations have been transformed to an error-correction form. In an error-correction model (ECM), behavioural equations are defined in terms of the growth rate of the respective endogenous variables; hence the equations comprise both the short-run dynamics of the endogenous variables and the long-run equilibrium between the endogenous and the explanatory variables. The specification of an ECM requires the inspection of the properties of the time series to be certain that the variables are either stationary or co integrated. Almost all variables turned out to be stationary in the first difference; hence it was decided to switch to the error-correction form. In the very few cases in which the unit root tests indicated that the first difference of the respective variable is not stationary, but economic theory and the specification tests of the estimated equation suggested including a particular variable, it was decided to give priority to theoretical considerations. This approach is motivated by the fact that the model should be usable for simulations, which require the model to be in line with economic theory. In addition, in particular for relatively short time periods, the power of the unit root tests is limited, and thus their results should be interpreted with caution. The results of the unit root and cointegration tests are not reported here, but may found in Weyerstrass and Neck (2007) for a slightly earlier model version.

3. THE SLOPOL MODEL

3.1 MODELLING APPROACH AND TIME-SERIES PROPERTIES

Although the model is used for forecasting and policy simulations, it should be noted that it is – as is every structural econometric model – subject to the famous Lucas critique. In 1976, Lucas published an influential paper (Lucas 1976), arguing that the relations between macroeconomic aggregates that form an econometric model differ depending on what macroeconomic policy regime is in place. This implies that one cannot predict the effects of a new policy regime using an empirical model based on data from previous periods when that policy regime was not in place. As Sargent (1981) argues, the Lucas critique is in part based on the notion that parameters of observed decision rules should not be viewed as structural. Instead, structural parameters in Sargent's conception are "deep parameters", such as preferences and technologies. Providing for such "deep parameters" requires a different class of macroeconomic models, namely Computable General Equilibrium (CGE) models.

One option for taking the Lucas critique into account in structural models like SLOPOL has emerged in the so-called London School of Economics tradition, initiated by Sargan (1964). According to this approach, economic theory guides the determination of the underlying long-run specification, but the dynamic adjustment

process is derived from an analysis of the time-series properties of the data series. Error-correction models combine the long-run equilibrium and the short-run adjustment mechanism. At about the same time as the developments in cointegration, Richard (1980), Engle, Hendry and Richard (1983), and Florens and Mouchard (1985) developed the concept of exogeneity. Three definitions of exogeneity may be distinguished (Ericsson, 1992): weak, strong and super exogeneity. The essential concept is weak exogeneity, which is required for efficient inference, i.e. estimation and hypothesis testing in a conditional model. Weak exogeneity of the right-hand side variables in an econometrically estimated equation means that no useful information is lost when other variables are made conditional on these without specifying their generating process. Strong exogeneity is the combination of weak exogeneity and Granger non-causality. It ensures valid conditional forecasting, i.e. valid forecasts of the endogenous variables, conditional on assumptions of the explanatory variables. Finally, super exogeneity requires weak exogeneity of the model variables and structural invariance. A conditional model is structurally invariant if all parameters are invariant for any changes in the distribution of the conditioning variables (Engle, Hendry and Richard, 1983). Super exogeneity is required for policy analyses, since the latter assume that the parameters of the model do not change when the policy regime changes.

The super-exogeneity condition may be investigated using a test for weak exogeneity combined with a test for parameter invariance (Ericsson, 1992). Hence, a recursive stability analysis may be performed for the equations of a macroeconomic model to test for parameter invariance. The CUSUM test and a Chow breakpoint test, based on N-step forecasts, were performed to test the SLOPOL model for parameter stability. The CUSUM test (Brown, Durbin, and Evans, 1975) is based on the cumulative sum of the recursive residuals. An equation is estimated using the observations until time period t-1. The resulting coefficients are then used to generate a forecast of the endogenous variable for time period t. The difference between the actual observation and the forecast value for time period t is called recursive residual. In general, the Chow forecast test (Chow, 1960) estimates and compares two models, one using the full set of data, and the other using only a sub-period. Differences between the results for the two estimated models cast doubts on the stability of the estimated relation over the sample period. The parameter stability test is based on N-step forecasts. In particular, this test uses recursive calculations to carry out a sequence of Chow forecast tests. This test starts with the smallest possible sample size for estimating the forecasting equation and then adds one observation at a time. For almost all of the 25 behavioural equations, the tests indicate that the parameters have been stable over time.[1] Exceptions are the equations for short-term and long-term interest rates, for tax payments by companies, and for remaining government revenues. The Granger causality tests indicate that in almost all equations, the right-hand side variables, i.e. the explanatory variables, are indeed not directly influenced by the left-hand side, i.e. the endogenous variables. An exception is the wage-price system, in which wages are influenced by prices, while at the same time wages are an important cost factor and hence a determinant of prices. Therefore, estimating the wage-price system by three-stage least squares (3SLS) or Full Information Maximum Likelihood (FIML) instead of OLS may have been preferable from an econometric-theoretical point of view. However, the OLS estimation rendered "better" results from a statistical and theoretical point of view, as estimation with 3SLS or FIML resulted in a number of insignificant coefficients or coefficients with signs in contrast to those expected from economic theory.[2] Therefore, all equations were estimated with OLS.

Based on the Granger causality and parameter stability tests, the model can be viewed as being appropriate for both forecasting and policy analysis, although it cannot be excluded that future changes in the policy regimes might induce private agents to change their behaviour in a different way than they did in the past.

3.2 THE BLOCKS AND EQUATIONS OF THE MODEL

The following describes the most recent version of the SLOPOL model, SLOPOL8. SLOPOL is a medium-sized macroeconometric model of the small open economy of Slovenia. It consists of 62 equations, of which 25 are behavioural equations and 37 are identities. In addition to the 62 endogenous variables that are determined in the equations, the model contains 27 exogenous variables. The latter comprise totally exogenous variables, which are outside the influence of Slovenian policy-makers, policy instruments and some dummy variables. Totally exogenous variables cover international aggregates (oil price, world trade, euro-area interest rates) and Slovenian variables that are not under control by the government (population). Policy instruments comprise public consumption and investment, transfer payments to private households, as well as tax rates and social-security contribution rates. A full list of all endogenous and exogenous variables is provided in Table 1. The behavioural equations were estimated by ordinary

[1] For the sake of brevity, the results are not reported here, but are available from the author upon request.

[2] In empirical work, it sometimes happens that, econometrically, relations do not match economic theory. This may have various causes. It is sometimes difficult to identify those variables in reality that match their theoretical counterparts. For example, in reality, a large number of interest rates exist in the economy, while models only contain a very limited selection. In addition, macroeconomic time series are subject to revisions and re-classifications over time.

least squares (OLS), using quarterly data for the period 1995q1 until 2009q4. Over time, Slovenian data were gradually adjusted to meet the EU criteria and definitions (e.g. ESA95 for national accounts). In so far as not all of the time series have been revised backward, this gives rise to a number of structural breaks in the time series. Therefore, it seems appropriate not to use data before 1995 for econometric estimations for Slovenia. For the period since 1995, such structural breaks do not seem to be omnipresent in the Slovenian data. Data for Slovenia were taken from databases and publications by the Slovenian Statistical Office, the Bank of Slovenia, and Eurostat. Euro-area data were taken from the Eurostat database, while the oil price was taken from a database provided by the Energy Information Administration (EIA) of the US Department of Energy, and world trade comes from the OECD Main Economic Indicators.

The model contains behavioural equations and identities for several markets and sectors (the goods market, the labour market, the foreign-exchange market, the money market and the government sector), and various rigidities (wages and prices). It combines Keynesian and neoclassical elements. The former determine the short- and medium-run solutions in the sense that the model is demand-driven and persistent disequilibria in the goods and labour markets are possible. The supply side incorporates neoclassical features. Most of the behavioural equations contain lagged dependent variables, reflecting adaptive expectations and costs of adjustment. In this paper, the behavioural equations are described verbally. For more details, including the parameters of the behavioural equations, see Neck et al. (2004); a more detailed description of an earlier version of the model can also be found in Weyerstrass et al. (2001).

Turning first to the supply side, potential output is determined by a Cobb-Douglas production function with constant returns to scale. This depends on trend employment, the capital stock, and autonomous technical progress. Trend employment is defined as the labour force minus natural unemployment, defined via the non-accelerating inflation rate of unemployment (NAIRU). In line with the literature on production functions, as well as international practice in macroeconometric modelling, the elasticities of labour and capital were set at 0.65 and 0.35, respectively. These elasticities correspond approximately to the shares of wages and profits, respectively, in national income. The NAIRU, which approximates structural unemployment, is estimated by applying the Hodrick-Prescott (HP) filter to the actual unemployment rate. For forecasts and simulations, the structural unemployment rate is then extrapolated with an autoregressive (AR) process. The determination of technical progress requires several steps. First, ex post total factor productivity (TFP) is calculated as the Solow residual, i.e. that part of the change in GDP that is not attributable to changing production factors, labour and capital, weighted with their respective production elasticities. In a second step, the trend of technical progress is determined by applying the HP filter, similar to the procedure used for the NAIRU. Finally, as with the structural unemployment rate, for forecasting purposes an AR process is applied to the TFP trend. The third production factor, i.e. the capital stock, enters the determination of potential GDP not with its trend, but with its actual level.

On the demand side, consumption of private households is explained by a combination of Keynesian elements and elements from the permanent income hypothesis and the life-cycle hypothesis. Thus, private consumption depends on current disposable income and on lagged consumption (in accordance with the habit-persistence hypothesis). In addition, the long-term interest rate enters the consumption equation with a negative sign to capture wealth effects, consistent with both Milton Friedman's permanent-income hypothesis and Franco Modigliani's life-cycle hypothesis. Investment is derived from profit maximisation of firms. Hence, real gross fixed capital formation is influenced by the change of total domestic demand (in accordance with the accelerator hypothesis) and by the user cost of capital, where the latter is defined as the real interest rate plus the depreciation rate of the capital stock. In the current model version, changes in inventories are explained in an autoregressive equation; hence, they depend on their own past development. Alternatively, as in many macroeconomic models in use around the world, they could be treated as exogenous in the SLOPOL model. Real exports of goods and services are a function of the real exchange rate and of foreign demand for Slovenian goods and services. Foreign demand is approximated by world trade. The real exchange rate captures the competitiveness of Slovenian companies on the world market. Real imports of goods and services depend on domestic final demand and on the real exchange rate. Real appreciation of the Slovenian currency (the tolar until the end of 2006, the euro since Slovenia's euro-area integration on 1 January 2007) makes Slovenian goods and services more expensive on the world market. On the other hand, foreign products become relatively cheaper; hence domestic production is substituted by imports. Hence real appreciation stimulates imports, while it also exerts a negative effect on exports. After joining the euro-area, the Slovenian real exchange rate can appreciate or depreciate not only versus other currencies but also versus other euro-area countries due to inflation differentials.

On the money market, the short-term interest rate is linked to its euro-area counterpart to capture Slovenia's euro-area membership and the resulting gradual adjustment of interest rates in Slovenia towards the euro-area average. From 2007 onwards, the 3-months

EURIBOR has been used.[3] In the same vein, the long-term euro-area interest rate is included in the equation determining the long-term interest rate in Slovenia (which is approximated by the yield on 10-year government bonds). In addition, the long-term interest rate is linked to the short-term rate as a representation of the term structure of interest rates. The foreign-exchange market is represented by the real effective exchange rate against a group of 41 countries. Since the time series on which the estimations of the behavioural equations are based include the period before Slovenia's euro-area accession in 2007, the bilateral exchange rate between the Slovenian tolar and the euro is included as one of the explanatory variables in the effective exchange rate equation. In addition, the exchange rate between the euro and the US dollar is considered. As the real exchange rate takes nominal exchange rate and price developments into account, the CPI in Slovenia (in the long-run relationship between the levels of the variables) and the inflation rate, respectively, (in the part of the equation capturing the short-run dynamics) is included as a further explanatory variable.

Turning to the labour market, labour demand of companies (i.e. actual employment) is influenced by final demand for goods and services and by unit labour costs, the latter being defined as the nominal gross wage divided by labour productivity. Labour productivity in turn is calculated as real GDP per employee. Labour supply by private households is defined as the participation rate, i.e. the labour force (employed plus unemployed persons) divided by the working-age population (the population aged 15 to 64 years). The participation rate depends positively on the real net wage.

In the wage-price system, gross wages, the consumer price index (CPI) and various deflators are determined. The gross wage rate depends on the price level, labour productivity and the difference between the actual unemployment rate and the natural rate of unemployment (or the NAIRU). The last relationship ensures that in the long run the output gap is closed, i.e. actual output converges towards potential GDP. If actual production exceeds its long-run sustainable level, actual unemployment will be lower than structural unemployment. In such a situation, trade unions have a stronger position in wage negotiations and enforce higher wage increases. These higher wages are higher costs for companies, and these either depress their investment activity or are passed on to consumers in the form of price increases. In either case, real effective demand is reduced, thus pushing actual towards potential production. In the case of a negative output gap, i.e. if actual output falls behind its long-run level, the unemployment rate exceeds the NAIRU and the adjustment process goes in the opposite direction via lower prices and costs and ultimately higher real demand. Consumer prices depend on domestic and international factors. The former comprise unit labour costs and the capacity utilisation rate. In addition, Slovenian prices depend on the oil price, converted into domestic currency. The inclusion of the capacity utilisation rate in the price equation represents a second channel for closing an output gap by increasing prices in the case of over-utilisation of capacities, and lower price increases if actual production falls behind potential GDP. The GDP deflator and the deflators of private and public consumption are linked to consumer prices. The export deflator depends on unit labour costs in Slovenia and on world trade. The former assumes that Slovenian companies try to pass increases in domestic costs on to output prices, provided that international competition allows to do so. The inclusion of world trade follows the notion that world market prices are to a large extent determined by the international economic situation. Hence, in a situation of a large increase in world trade, international inflation is also higher than in a world-wide recession. Finally, the import deflator is influenced by the oil price in euro as a proxy for international raw material prices, which constitute an important determinant of prices in a small open economy such as Slovenia's.

In the government sector of the model, the most important expenditure and revenue items of the Slovenian budget are determined. Social-security contributions by employees are calculated by multiplying the average social-security contribution rate by the gross wage rate and the number of employees. In the same vein, income-tax payments by employees are determined by multiplying the average income-tax rate by the gross wage rate and the number of employees. In a behavioural equation, social-security payments by companies are linked to social-security contributions by employees. Profit tax payments by companies are explained by nominal GDP as an indicator for the economic situation, taking account of the fact that profits and hence profit tax payments behave strongly pro-cyclically. Value-added tax revenues depend on the value-added tax rate and private consumption. Finally, the remaining government revenues are explained by nominal GDP, considering that they are also pro-cyclical. On the expenditure side of the budget, interest payments depend on the stock of public debt and on the long-term interest rate. Public consumption according to fiscal statistics is linked to public consumption according to national accounts, since these are very closely related but not identical due to some differences in the statistical definitions. Finally, the remaining government expenditures are, as in the case of revenues, determined by nominal GDP as an indicator of the economic situation. The budget balance is given by the difference between total government revenues and expenditures. The public debt level is extrapolated with the budget balance.

[3] Hence, because of Slovenia's euro-area membership, there is no difference between short-term interest rates in Slovenia and in the euro-area. In contrast, long-term interest rates may differ considerably also within the euro-area, as the financial crisis in 2007–08 and the sovereign debt crisis in 2010 have clearly demonstrated.

The model is closed by a number of identities and definition equations.

4. ECONOMIC FORECAST FOR SLOVENIA

In past years, the SLOPOL model has been used both for simulation and forecasts. Several simulations have dealt with the identification and quantification of macroeconomic effects of the introduction of the euro in Slovenia in 2007. The transition from an independent monetary policy to the common monetary policy of the European Central Bank and a positive total factor productivity shock due to reduced transaction costs and an increase of price transparency are seen in the model to bring about temporarily higher real GDP growth, a permanently higher GDP level, more employment, temporarily lower inflation and a permanently lower price level. On the other hand, both public finances and the current account deteriorate (see e.g. Weyerstrass 2008, Weyerstrass and Neck 2008a, 2008b).

For this paper, the SLOPOL model has been applied to generate an economic forecast for Slovenia. Assumptions on the most important exogenous variables can be found in Table 2. For the forecast it is assumed that world trade increases by 5.7% in 2011 and by 7% in 2012. During the world-wide economic crisis in 2009, it had plummeted by 13%, followed by a remarkable recovery in 2010. Driven in particular by high import demand from emerging markets in Asia and Latin America, world trade expanded by 13.6%. For the exchange rate between the euro and the US dollar, a constant value of 1.36 dollar per euro for both years was assumed. Regarding fiscal policies, it was assumed that in the forecast period, public consumption and investment will grow less than in 2008 and 2009, when the Slovenian government conducted an expansionary fiscal policy in its efforts to combat the economic crisis.

The forecast results are summarised in Table 3. The model predicts a continuation of the gradual recovery from the sharp recession of 2009 when real GDP in Slovenia contracted by 8%, mainly as the result of a sharp drop of exports and investment. In 2010, driven by higher exports, by a turn in the inventory cycle, as well as by fiscal and monetary policy stimuli, real GDP recorded a slight growth rate of about 1%.[4] For 2011 and 2012, the forecast predicts real GDP growth rates of 2.2% and 2.6%, respectively. This recovery is driven by the improvement of exports, which recover in line with world trade. However, since in many countries fiscal policies are becoming more and more restrictive in an effort to combat increased public debt, the growth rate of world trade will likely abate and hence normalise in the coming years. In addition to international demand, gross fixed capital formation is expected to grow once more, though the high growth rates observed in the past will not be reached over the forecast period, mainly due to the still low utilisation of existing production capacities. Inflation will gradually pick up. Due to the slow GDP growth, employment will record only small growth in 2011. In 2012, employment growth will accelerate somewhat. As a result, the unemployment rate will stay at an elevated level for an extended period. Finally, due to an expansionary fiscal policy and the operation of automatic stabilisers (lower tax revenues and higher payments of unemployment benefits), the budget balance deteriorated sharply during the economic crisis. Hence, in the future the Slovenian government – like governments in almost all EU Member States – will be forced to implement a more restrictive fiscal policy.

Compared with the latest official IMAD forecast from autumn 2010 (IMAD 2010), the model-based forecast presented in this section is slightly less optimistic (table 4). For 2011 and 2012, the IMAD forecast of real GDP growth is one quarter and one percentage point higher, respectively. While the SLOPOL forecast predicts a faster expansion of consumption, exports and imports in both years, the IMAD forecast implies higher growth rates of investment. The inflation forecast of IMAD is considerably higher, particularly so in 2011. This might be explained by information about planned increases in taxes or administered prices, which was available to IMAD experts when generating the forecast. According to the IMAD forecast, employment will grow less than in the model-based forecast. On the other hand, unemployment is lower according to IMAD's forecast. Obviously, the SLOPOL model predicts a faster increase of labour supply in reaction to the economic recovery. Overall, the model-based forecast differs in some details from the IMAD autumn 2010 projection, but the overall assessment of the economic prospects for Slovenia are quite similar.

The economic forecast described in this section is intended in particular to illustrate the opportunities offered by the SLOPOL model. It must be stated that a macroeconomic forecast should not be based on the outcome of a macroeconomic model alone, since a model cannot capture future changes in the economic system, such as announced changes to tax rates, nor can it fully take account of the impacts of extreme events such as the severe recession of 2009, which have rarely, if at all, occurred in the past, and which are thus not sufficiently represented in the time series the model is based on.

5. CONCLUSIONS

Decisions about monetary and fiscal policy measures should be based on sound theoretical, but also empirically validated knowledge, rather than on expert

[4] According to EU Commission estimates in its 2010 autumn forecast.

judgement alone. In addition to policy makers, decision-makers in companies are interested in economic forecasts, as well as assessments of the quantitative impacts of international economic events on the domestic economy. A macroeconometric model such as SLOPOL that represents the most important markets of the Slovenian economy and that is based on sound economic theory and on actual data is a useful tool for these tasks, i.e. forecasting and simulation. Simulations of the model (both static and dynamic) with historical values of exogenous variables over the period of estimation gave rise to a reasonable tracking quality for most variables with respect to trends and turning points. This may be seen as an encouragement to use the model for policy analysis. Nevertheless, it should be mentioned that the SLOPOL model is – as with every structural econometric model – subject to the Lucas critique.

A forecast that was generated with the model was in line with official forecasts created with other methods. It points to a gradual recovery of the Slovenian economy after the severe recession observed in 2009.

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Appendix:

Table 1: **Variables of the SLOPOL model**

Endogenous variables	
AGWN	Average gross wage per employee, nominal
AGWR	Average gross wage per employee, real
ALANCEGDP	Budget balance in relation to GDP
BALANCEN	Budget balance
CAGDP	Current account balance in percent of GDP
CAN	Current account balance
CAPR	Capital stock, real
CDEF	Private consumption deflator
CN	Private consumption, nominal
CPI	HICP for Slovenia
CR	Private consumption, real
DEBT	Public debt
DEBTGDP	Debt level in relation to GDP
DEMAND	Final demand, real
EMP	Employed persons
EXPDEF	Export deflator
EXPREST	Remaining government expenditures
EXR	Exports, real
GDEF	Public consumption deflator
GDPDEF	GDP deflator
GDPN	GDP, nominal, Mio. euro
GDPR	GDP, real, Mio euro, chained volumes, reference year 2000
GINVR	Real government investment
GNFIN	Government consumption, fiscal statistics
GOV10Y	Yield of 10-year government bonds
GOV10YR	Real government bond yield
GR	Government consumption, real
GRGDPR	Real GDP growth rate
GRYPOT	Growth rate of potential GDP
IMPDEF	Import deflator
IMPR	Imports, real
INCOME	Disposable income of private households, nominal
INCOMER	Disposable income of private households, real
INCTAX	Total income-tax revenues
NCTAXCORP	Corporate taxes on income and profit
INCTAXPERS	Individual taxes on income and profit
INFL	Inflation rate
INTEREST	Interest payments
INVENTR	Change in inventories (+ statistical discrepancy), real
INVR	Gross fixed capital formation, real
LFORCE	Labour force
NAIRU	Non-accelerating inflation rate of unemployment
NETWAGEN	Gross wage minus income taxes and social-security contributions, nominal
NETWAGER	Gross wage minus income taxes and social-security contributions, real
OILEUR	Oil price in euro
PRINVR	Real private investment
PROD	Labour productivity
REER	Real effective exchange rate
REVREST	Remaining government revenues
SITBOR3M	Interest rate for 3 months, from 2007 on EURIBOR
SOCCOMP	Social-security contributions by companies
SOCEMP	Employees' social-security contributions
SOCTOTAL	Social-security contributions by employers and employees
TRENDEMP	Trend of employment
TRENDTFP	Trend of total factor productivity
UCC	User cost of capital
ULC	Unit labour cost
UN	Unemployed persons
UR	Unemployment rate
UTIL	Capacity utilisation rate
VAT	Value-added and sales tax revenues
WEDGE	Tax wedge, i.e. difference between gross and net wage
YPOT	Potential output

Exogenous variables	
DUM001	Dummy variable, 1 in 2000q1
DUM002	Dummy variable, 1 in 2000q2
DUM004	Dummy variable, 1 in 2000q4
DUM011	Dummy variable, 1 in 2001q1
DUM021	Dummy variable, 1 in 2002q1
DUM031	Dummy variable, 1 in 2003q1
DUM032	Dummy variable, 1 in 2003q2
DUM051	Dummy variable, 1 in 2005q1
DUM052	Dummy variable, 1 in 2005q2
DUM062	Dummy variable, 1 in 2006q2
DUM992	Dummy variable, 1 in 1999q2
EUR10Y	10-year government bond yield – euro-area average
EUR3M	3-months EURIBOR
EURUSD	Exchange rate USD per EUR
GINVN	Government investment, nominal

GN	Government consumption, nominal
NCTAXRATE	Average personal income-tax rate
OIL	Oil price, USD per barrel Brent
POP1564	Population aged 15 to 64
SITEUR	Exchange rate euro per 100 tolar

OCEMPRATE	Average social-security contribution rate, employees
RANSFERSN	Total transfers to households and individuals
VATAXRATE	Value-added tax rate
WTRADE	World Trade; Source: OECD Main Economic Indicators

Table 2: **Assumptions about the international environment**

	2009	2010	2011	2012
World trade volume (growth rate)	-13.0	13.6	5.7	7.0
Oil price (US dollar per barrel Brent)	61.3	79.4	82.0	82.0
Exchange rate (US dollar per euro)	1.39	1.33	1.36	1.36
3-months interest rate EURIBOR	1.2	0.8	1.7	2.0
10-year government bond rate euro-area	3.8	3.6	4.5	4.5
Public investment (growth rate)	2.6	16.0	-0.6	-10.4

Sources: EUROSTAT; Oesterreichische Nationalbank; own assumptions

Table 3: **Economic forecast for Slovenia**

	2008	2009	2010	2011f	2012f
	Real growth rates				
Private consumption	2.9	-0.8	-0.5	2.0	2.1
Public consumption	6.2	3.0	0.9	1.2	2.1
Gross fixed capital formation	8.5	-21.6	-4.4	2.7	1.7
Exports	3.3	-17.7	8.1	8.0	9.4
Imports	3.8	-19.7	6.3	7.6	8.6
GDP	3.7	-8.1	1.1	2.2	2.6
	Growth rates				
Consumer prices (CPI)	5.5	0.9	2.1	1.9	1.9
Average gross wage	8.3	3.5	3.6	0.1	0.7
Unit labour cost	5.9	8.5	-0.4	-1.7	-0.6
Employment	2.8	-1.9	-2.3	0.5	1.2
	Levels				
Unemployment rate	4.4	5.9	7.2	8.2	7.3
Budget balance (% of GDP)	-1.8	-5.8	-5.8	-6.6	-5.7
	Contributions to GDP growth (percentage points)				
Private consumption	1.6	-0.4	-0.3	1.1	1.1
Public consumption	1.1	0.5	0.2	0.2	0.4
Gross fixed capital formation	2.4	-6.5	-1.1	0.7	0.5
Change in inventories	2.5	-13.1	5.4	-0.1	-0.1
Exports	-3.0	15.3	-4.2	5.6	6.9
Imports	-0.8	-4.0	1.2	-5.2	-6.2
GDP	3.7	-8.1	1.1	2.2	2.6

Sources: Statistical Office of the Republic of Slovenia, Eurostat; 2011–2012: own forecast

Table 4: **Comparison with IMAD autumn 2010 forecast**

	Own forecast		IMAD	
	2011	**2012**	**2011**	**2012**
	Real growth rates			
Private consumption	2.0	2.1	1.0	2.0
Public consumption	1.2	2.1	-0.8	1.4
Gross fixed capital formation	2.7	1.7	4.0	4.3
Exports	8.0	9.4	5.9	7.0
Imports	7.6	8.6	4.5	5.9
GDP	2.2	2.6	2.5	3.1
	Growth rates			
Consumer prices (CPI)	1.9	1.9	2.7	2.2
Average gross wage per employee	0.1	0.7	0.2	1.3
Unit labour cost	-1.7	-0.6	-0.5	n. a.
Employment	0.5	1.2	-0.3	0.2
	Levels			
Unemployment rate	8.2	7.3	7.1	6.9
Budget balance (% of GDP)	-6.6	-5.7	n. a.	n. a.
	Assumptions			
World trade volume (growth rate)	5.7	7.0	n. a.	n. a.
GDP in EU (growth rate)	n. a.	n. a.	1.5	2.0
Oil price (USD per barrel Brent)	82.0	82.0	82.0	85.0
Exchange rate (US dollar per euro)	1.36	1.36	1.29	1.29
3-months interest rate EURIBOR	1.7	2.0	n. a.	n. a.

Sources: Own forecast; IMAD Autumn 2010 forecast.

Note: n. a.: not available