Modeling of Economic Structural Adjustment Based on the Developed Dynamic Computable General Equilibrium Model

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Abdykappar Ashimov*
Kazakh National Research Technical University named after K. Satpayev

Yuriy Borovskiy
Kazakh National Research Technical University named after K. Satpayev

Muhit Onalbekov
Kazakh National Research Technical University named after K. Satpayev

ABSTRACT

A dynamic model was developed based on the static multi-country computable general equilibrium model (Globe1) to describe the evolution of the Kazakhstan economy and its eight major trading partners (Regions), including the Eurasian Economic Union countries. The calibrated Model was tested for practical use of the computational experiments results with parametric control theory methods. The Model was used to calculate the effects of fiscal policy measures while maintaining the currency policy practices of nine Regions at the level of 16 economy branches and 16 relevant products for 2004–2021. The selection of promising economic sectors was implemented based on the Model using the Kazakhstan example. The parametric control problem for estimating the optimal values of fiscal policy instruments, aimed at economic growth and restructuring through the stimulation of the output of selected promising sectors, was formulated and solved based on the Model.

Keywords: Global problem, Theory of parametric control of macroeconomic systems, Computable general equilibrium model.

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1. INTRODUCTION

An economic restructuring policy allows many countries that have made economic progress to develop promising industries and achieve results also called the "economic miracle." Due to the implementation of an economic restructuring policy, new growth points and incentives are created for new investments and a gradual transfer of resources (human, financial and other) to the most promising sectors is initiated. Therefore, the urgent task is to propose possible measures of a macroeconomic restructuring policy aimed at economic growth and the development of promising industries, based on the modeling effects from such measures.

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The available literature on structural adjustment modeling and public finance optimization in various regions is mostly devoted to analyzing the results of various structural adjustment programs (SAPs) (Abouharb et al. (2011), Zografakis et al. (2015), Devarajan et al. (2002), Khan (2004), Blažek et al. (2013) etc.). Most of these studies examine the effects of SAPs conducted by the International Monetary Fund (IMF), the World Bank (WB), and other international financial institutions in various developing countries around the world since the 1980s.

As an example, a past work (Abouharb et al. (2011)) developed statistical methods to determine the endogenous relationship between the decision to join SAPs and the economic growth of the recipient. Another study (Zografakis et al. (2015)) presented a static computable general equilibrium (CGE) model that reproduced the main results of the Greek economy during the implementation of the policy package adopted during the crisis.

Other examples of CGE model application for the analysis of structural adjustment problems are given in a past review (Devarajan et al. (2002)). Other CGE models that are used to evaluate the effects of trade liberalization on poverty reduction are also considered in a previous work (Khan (2004)).

Some papers analyzed the results of the implementation of national SAPs. Thus, a large-scale multi-sectoral econometric model of the Japanese economy with the input–output structure of Leontief type has been developed (Shishido et al. (1992)). They used this model to study such growth alternatives as import promotion and increased leisure in the context of induced technical progress, output, and employment.

The multiperiod real-financial CGE model of India, which determines the impact of the budget policy on the loan proposal as a possible factor limiting the effectiveness of structural adjustment programs, is considered in the paper of Naastepad (2002). Huang et al. (2013) proposed a model that combines the basic theories of international trade. They used this model to study the effects of trade liberalization, capital deepening, and technology changes.

An in-depth analysis of the available literature on the modeling of structural adjustment effects allows us to conclude that the literature mainly contains various examples of scenario analysis. However, so far, no examples of selecting a set of promising industries for the implementation of SAP policies have been presented. Moreover, no study has yet to formulate and solve extreme problems for determining the optimal values of macroeconomic policy tool for structural adjustment.

The present paper is devoted to solving this problem. On the basis of the developed and tested model for the possibility of its practical application of the dynamic CGE model (hereinafter called the “Model”), this paper demonstrates the possibilities of developing an approach to select a set of promising economic sectors. The paper also proposes a solution for one parametric control problem: evaluating the optimal values of fiscal policy tools aimed at achieving economic growth and outstripping growth of selected promising sectors of the Kazakhstan economy in the medium term.

2. MODEL BUILDING

The dynamic Model is built by developing and binding to the data of the static CGE model Globe1 (GLOBE CGE Model, 2016) following the basic steps enumerated below.

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1. Building a conceptual description of the world economy.
2. Building the Model in the GAMS environment (GAMS (2016)) based on the built conceptual description and the Globe1 model.
3. Selection of the composition of the Regions and economic sectors as well as the historical and forecasting periods of the Model calculation.
4. Building the database of the Model's initial data (matrices of social accounts, coefficients of elasticity of substitution, and so on).
5. Binding the Model to the initial data.

Further in this section, we present some results of the implementation of these steps.

2.1 Conceptual description of the world economy for Model building

Before we proceed, we first list some background information for the conceptual description. The world economy is represented by the functions of interacting agents of selected Regions of the world economy. These agents are following:

- Producers (industries) of the Region (consisting of identical elementary agents or firms) during the production stage, industries use two production factors belonging to the households of their Region: labor and capital;
- Households of the Region (consisting of identical elementary agents -households);
- The states of the Region (wherein a consumer consists of identical elementary agents - state structures); and
- Agent-Region Globe imports transporting services and exporting them to all other regions when each type of good is imported from each region to another.

We list below the main functions of these agents-price-takers.

The producer agent in its annual activities:

- produces one type of product, corresponding to the name of the Industry and type of production subject to the condition of cost reduction;
- produces gross value added (GVA) by using such factors as the labor and the capital of the households;
- exports a part of the production (subject to the condition of profit maximization);
- imports intermediate products from other Regions and consumes such products;
- pays net tax payments to their Government.

Producer agent solves two pairs of nested optimization problems:

- minimization costs for the purchase of the intermediate production and GVA costs for a given production output;
- minimization costs for the purchase of the production factors at the given output of the final production;
- profit maximization from sales within the Region and beyond at the given production output; and
- profit maximization from exports to various Regions at the given level of production exports.

Household agent in its annual activities:

- receives income from producers based on the demand for its specific factors from the producers of their Region;

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- consumes the production outputs from all the Regions (according to the solution of the problem of maximizing their utility functions under budgetary constraints);
- achieves savings in the form of investment products based on their income and consumption; and
- pays net tax payments to their Government.

The Government of each Region in its annual activities:

- determines the effective tax rates and receives income in the form of net tax revenue (including revenue from customs duties);
- consumes the final products (government spending); and
- achieves savings in the form of investment products based on its income and expenses.

Industry, Household, and Government Agents jointly solve the following optimization problems annually:

- determination of the optimal share of imports in the consumption of each type of product, subject to the minimum costs of the domestic and imported components of production; and
- determination of the optimal regional structure of each type of imported product subject to the minimum costs of this type of imported production.

The conceptual description of the "world economy" contains the statements of the abovementioned optimization problems with the corresponding first-order conditions, other equations describing the functions of the agents, balance ratios for prices and quantities (real indicators, measured in the prices of the producer), the internal balances in the accounts of the government, and the external balances of trade accounts.

The conceptual description uses the system of composite endogenous prices for all types of productions in each Region, including the prices of the buyers and sellers, the prices of the exporter and importer, and so on. The values of prices ensure the performance of the annual balance sheet ratios, while providing for the following:

- the equilibrium in factor (Labor and Capital) markets;
- the equilibrium in the markets for each type of production;
- bilateral current account balances for each pair of Regions; and
- the equilibrium of savings (Households, Governments) and their investments in the respective Regions' industries.

The proposed Model, in comparison with the basic version of Globe1 (GLOBE CGE Model (2016)), is developed as follows. The static model of Globe1 is developed into a dynamic Model by describing the following variables using dynamic equations: the technological coefficients of the production functions for the GVA of all the Regions' industries and the supply of Factors (Labor and Capital) by all Households in the Regions.

2.2 Model building in the GAMS environment

The mathematical Model, which is built based on its conceptual description, is obtained by combining into one system the equations describing the first-order conditions of all agents' optimization tasks and other rules of agent activity (behavior), including those describing the dynamics of the technological coefficients of production functions and supply of factors (Labor and Capital). Balance and auxiliary equations are also included in the mathematical model. Next, the closure of the model was completed by dividing

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all variables into two classes: endogenous and exogenous. The exchange rates of all Regions' currencies were then considered as endogenous (i.e., floating).

All equations of the mathematical Model were loaded into the GAMS environment as part of the main module of the Model. This module allows for the solution of the Model by finding the values of all endogenous variables of the Model for the given values of its exogenous variables.

The developed calibration module enables the calculation of all values of the exogenous variables of the Model based on the generated database by means of special expressions. The calibration phase was carried out every time the Model was initiated.

The solution of the Model's calibrated system of equations (Model Calculation) was performed through the software implemented in the GAMS integrated development environment using the built-in problem solver (PATH) (Ferris et al. (2016)).

2.3 Selection of the composition of the Regions and economic sectors and the historical and forecasting periods of the Model calculation

The composition of the Model’s Regions is determined by the composition of the tasks to be performed and focuses primarily on the Kazakhstan economy. The developed Model describes the dynamics of the interacting economies in the following Regions: Kazakhstan, other members of the Eurasian Economic Union (Russia, Belarus, Armenia, Kyrgyzstan), and the main trade partners of Kazakhstan, namely, the European Union (in one country), the USA, China, and the Rest of the World (in one country).

The economy of the Model of each Region is described by the following production sectors, which are the most significant ones within the Kazakhstan economy:

1. Mining operations (except oil and gas) - ming
2. Mining of crude oil and gas - crog
3. Metalworking production and mechanical engineering - mepe
4. Metallurgical production - mind
5. Education, Health service, public administration - ehas
6. Production and transmission of electricity, gas and hot water - pegw
7. Manufacture of food products, beverages and tobacco - fpin
8. Professional, scientific and technical activities - psta
9. Other industries - otis
10. Other services - oths
11. Agriculture, forestry and fisheries - agff
12. Construction industry - buil
13. Production of textiles, clothing, leather and related products - mtal
14. Financial service - fins
15. Chemical and petrochemical industry - chpp
16. Transport - tser

The Model calculation period (2004–2021) is determined by the available values of the SAM matrices from the GTAP database (2004, 2007, 2011) and the horizon for the projections of the main macroeconomic indicators provided by the IMF (2021).

2.4 Database of the initial data and its link to the Model

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The core of the Model's database consists of the sets of matched SAMs of the Regions for each year under consideration (2004–2021). The SAMs indicate how product flows (in monetary terms) and financial flows among the Sectors, Households, the State, and the importers and exporters are distributed. The mentioned SAM sets for 2004, 2007, and 2011 were extracted using a special converter from the GTAP database (GTAP Data Base (2015)). Given that no data for the remaining years of the considered historical period 2004–2014 can be found in this database, the required SAM sets for the years 2005, 2006, 2008–2010 and 2012–2014 were calculated using the developed algorithm (algorithm 1). This developed algorithm was derived based on the available statistical sources containing the input–output tables (see, e.g., World Input–Output Database (2016)) and indicators of mutual trade (World Integrated Trade Solution (2016)), using the base ratios calculated with the help of the known SAMs for the most recent year (2004, 2007 or 2011). For the forecast period (2015–2021), algorithm 2 was used to calculate these SAM sets based on the following forecast indicators of the regions provided by the World Economic Outlook Databases (2016): GDP, total investment, import volume, the volume of import of services, the volume of exports of goods, the volume of exports of services, general government revenues, and general government expenditure. In doing so, we used the baseline ratios calculated with the help of the obtained SAM for 2014.

In addition to the obtained SAM sets, the database of the initial data of the Model included the values of the elasticity coefficients of the substitution of various factors in the production functions of the industries; the values of the replacement rates of various types of products in the functions of output industries; the aggregation functions that describe the consumption of agents; the parameter values of household utility functions; and the initial values of the dynamic equations of the corresponding model.

These coefficients and parameters were obtained from the GTAP database for 2004, 2007, and 2011 and then extrapolated to the remaining years of the Model calculation period (2004–2021).

Within the 5th step in the GAMS environment, the Model is already linked to the selected regions, to economic sectors, to the calculation period, to the formed SAM database, and other values of the replacement rates and parameters indicated above. The results of calculating the obtained base scenario of the calibrated Model accurately reproduce the statistical and forecast data to be used in constructing the SAM sets for the model database of the initial data.

3. MODEL VERIFICATION (TESTING ON THE POSSIBILITY OF PRACTICAL APPLICATION)

The verification of the calibrated Model was performed following three methods, the first two of which were proposed by the authors within the framework of the development of parametric control theory.

3.1 Assessing the stability of smooth mappings defined by the Model

The availability of the stability properties of mapping $f: A \rightarrow B$, which transfers the values of the exogenous parameters $p \in A$ into the solutions (the values of endogenous variables), suggests preserving the qualitative properties with small (in some sense)

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changes of such a mapping. To assess the stability of the smooth mapping of the specified type, the authors proposed the corresponding set of numerical algorithms for the cases of immersion, submersion, and submersion with a fold on the basis of the numerical evaluation of the fulfillment of its conditions (Ashimov et al. (2014)).

In the experiments, basic mappings of types $f: A \rightarrow B$ with $dimA = 5$ and $dimB = 9$ were considered, whereas the arguments of f took the value-added tax rates of the five EAEU countries (Kazakhstan, Russia, Belarus, Armenia, and Kyrgyzstan) for 2015. The output variables of f took the values GDP in all the nine Regions of the Model for 2021. A five-dimensional box A, with the center at point $p = (p_1, \ldots, p_5)$, corresponding to the baseline values of the specified tax rate and with boundaries distanced from the value p_i to the value of $0.5p_i$. The time to calculate the implemented mapping stability algorithms increases exponentially with the increase in the dimension of area A. This limits the use of such an approach. Thus, to obtain a reasonable calculation time, the set of the most important factors used in the solution was selected based on the model of specific problems for macroeconomic analysis and parametric control.

The results of the specified numerical experiments demonstrated the absence of singular points of the f mapping in the A box and the stability of this immersion.

3.2 Estimation of the stability indicators of mappings defined by the Model

The $\beta_f(p, \alpha)$ stability indicator is defined by the Model mapping $f: A \rightarrow B_t$ at the $p \in A$ point and for the selected positive α, the value is the diameter of the image (when f mapping) of the ball with its radius α and with its center at the point p (in relative terms). If the numerical assessment of the $\beta_f(p) = \lim_{\alpha \to 0} \beta_f(p, \alpha)$ value is uniformly close to zero for all the $p \in A$, then the f mapping defined by the tested model is assessed on the A set as being continuously dependent on the exogenous values.

In the Model experiments (as A set), a parallelepiped was centered at the point p corresponding to the baseline values of all the tax rates in all the Regions in the year 2004, whereas the endogenous variables B_t sets include the GDP, exports, and imports of all the Regions of the Model for the fixed computational year t (from 2004 to 2021). Table 1 shows the calculated values of the Model stability indicators (in percentage) for the base point p and $\alpha = 0.01$.

Table 1. Values of the stability indicators for the basic calculation of the Model

Year	2004	2005	2006	2007	2008-2021
$\beta_f(p, 0.01)$	0.4536	0.0813	0.0097	0.006	0.0

All the specified values of the stability indicators do not exceed 0.4536, indicating that the stability of the Model for calculations up to 2021 is sufficiently high. Specifically, the acquired 2004 value of the $\beta_f(p, 0.01)$ indicator means that the image of a sphere is centered at the point p (corresponding to the basic values of all the 2004 tax rates) and has the radius of 0.01 (in relative terms) in the calculation of the Model, and is transformed into a set with the diameter of 0.4536 (in relative terms) for the output variables values (GDP, exports, and imports of all the Regions in 2021). Various

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options of the calculated values of the limit indicators $\beta_f(p)$ are close enough to zero at α = 0.0001, which demonstrates that the tested mapping as a continuous one in A box.

3.3 Implementation of the counterfactual and forecast scenarios

According to the well-known macroeconomic theory, the reduction of taxes levied on producers and consumers as well as the increased state demand for consumer products increase the country's output and GDP. Here, the Model counterfactual and forecast scenarios were calculated to assess the implementation of the provision of the theory. Specifically, the scenario was performed featuring a 10% decrease in the effective tax rates of value added tax and tax on the producers' income, and a 10% increase in government consumption in each EAEU country. The results of the demonstrated changes in the GVA in each sector in the relevant country (ranging from –3.85% to 6.16%) led to a GDP increase in each Region ranging from 0.0279% in 2009 for global economy to 0.7715% in 2012 for EAEU, compared with the observed data.

The above results of the three test methods demonstrate the successful verification of the tested Model.

4. STRUCTURAL ADJUSTMENT PROBLEM SOLUTION USING THE EXAMPLE OF THE KAZAKHSTAN ECONOMY

Within the framework of developing optimal measures of fiscal policy to ensure the economic growth and structural adjustment of the Kazakhstan economy at the sectoral level, the following steps were proposed:

1) choose a set of the most promising sectors of Kazakhstan economy, for which it is desirable to have an outstripping growth of output; and

2) solve the dynamic optimization problem which is aimed at economic growth and accelerated growth of output of each of the selected promising industries in Kazakhstan.

4.1 Selection of the promising industries

The marginal cost of public funds for taxes from this industry (*MCFi*) for 2015 is proposed as an indicator characterizing the prospects of each i-th industry of Kazakhstan (see also Devarajan et al. (2002)). In this paper, the amount of change in the country's GDP resulting from an increase in tax collections from the *i*-th industry by 1 tenge (the monetary unit of Kazakhstan) is adopted as the *MCFi*. This indicator characterizes the significance of the industry, such that increasing its taxation leads to the increase in the country's GDP. The results of the calculation of *MCFi* indicator based on the Model are shown in Table 2.

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Table 2. MCF_i indicators for 2015

i	1	2	3	4	5	6	7	8
Industry	ming	crog	mepe	mind	ehas	pegw	fpin	psta
MCF_i	**0.548**	–0.035	–0.161	**0.573**	**0.118**	–0.195	–0.940	0.048
i	9	10	11	12	13	14	15	16
Industry	otis	oths	agff	buil	mtal	fins	chpp	tesr
MCF_i	–0.420	–0.692	–0.666	**0.530**	–1.517	–0.017	**0.162**	**0.170**

Based on the analysis of the values shown in Table 2, the following set of six industries corresponding to the largest MCF_i indicators was determined:

(1) Mining operations (except oil and gas) - ming;
(4) Metallurgical production - mind;
(5) Education, Health service, public administration - ehas;
(12) Construction industry - buil;
(15) Chemical and petrochemical industry - chpp; and
(16) Transport - tser.

The set of numbers i of the selected industries is denoted by $I = \{1; 4; 5; 12; 15; 16\}$.

4.2 Setting and solving the parametric control problem

The problem of dynamic optimization (i.e., the *SP* problem of parametric control) was considered in solving the problem of economic growth and accelerated growth in the output of selected industries in Kazakhstan in 2015–2021 via fiscal policy measures.

Statement of the *SP* problem. The problem deals with the identification of the values of the control parameters $u(t)$ (effective rates of seven types of taxes and customs duties differentiated by 16 types of products and the share of government spending in the total consumption of the Republic of Kazakhstan) that provide the maximum value of the *K* (3) criterion with constraints on the control instruments of $u(t) \in U(t)$ type and constraints (1)–(2) for some of the endogenous variables.

Here, $t = 2015, \dots, 2021 -$ time in years, and $U(t)$ – is a box with the center at the point of base values $u(t)$ and boundaries spaced at ±30% of the baseline values.

The restrictions of the *SP* problem for the endogenous variables of the Model are given by

$$\boldsymbol{QVAP}(\boldsymbol{t}) \geq \overline{\boldsymbol{QVAP}}(\boldsymbol{t}), \quad (1)$$

$$\boldsymbol{QXA_j}(\boldsymbol{t}) \geq \overline{\boldsymbol{QXA_j}}(\boldsymbol{t}), \quad (2)$$

where $\boldsymbol{j = 1, \dots, 16}$, $\boldsymbol{t = 2015, \dots, 2021}$; $\boldsymbol{QVAP}(\boldsymbol{t})$ is the GDP per capita in Kazakhstan; $\boldsymbol{QXA_j}(\boldsymbol{t})$ is the output of industry j per capita; and the sign "$\overline{\ }$" corresponds to the base values of the corresponding indicator.

K criterion characterizes the growth of GDP in the Republic of Kazakhstan and

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the growth in the output of the selected six industries from 2015–2021 (with the corresponding weight coefficients $\alpha_i = 0.1$). *K* is expressed as

$$K = \sum_{t=2015}^{2021}(TQVA(t) + \sum_{i \in I} \alpha_i TQX_i(t)), \quad (3)$$

where $TQVA(t)$ is the GDP per capita rate and $TQX_i(t)$ is the rate of output of industry *i* per capita in Kazakhstan in the year *t* (in current USD).

In this problem, the values of all unmanaged exogenous variables in Kazakhstan and all exogenous variables of the remaining Regions correspond to the base forecast of the corresponding variables.

The formulated *SP* problem can be solved numerically by using the iterative optimization algorithm provided by GAMS (NLPEC (2016)). The increase in the output of the selected promising industries in 2015–2021 (in percentage) compared with the baseline forecast are presented Table 3.

Table 3. The average growth in output of the promising industries compared with the baseline forecast in 2015–2021.

i	1	2	3	4	5	6	7	8
Industry	ming	crog	mepe	mind	ehas	pegw	fpin	psta
Growth	**2.99**	2.94	2.49	**3.18**	**3.41**	5.66	4.34	2.48
i	9	10	11	12	13	14	15	16
Industry	otis	oths	agff	buil	mtal	fins	chpp	tesr
Growth	3.28	2.97	1.31	**3.77**	4.73	2.93	**3.99**	**6.88**

The results of the calculations presented in Table 3 show that the average growth in the output of the six selected promising industries is 4.04% compared with the baseline forecast.

In addition, the stimulation of these promising industries has also attracted growth in other industries that supply products for intermediate consumption to the stimulated industries. The output of such major suppliers of intermediate products as Transport increased at an average of 6.88%. In addition, the increase in cash received by households also increased the output growth of the manufacture of food products, beverages and tobacco at an average rate of 4.34%; production of textiles, clothing, leather and related products by 4.73%; and a 2.93% increase in the output of the financial services industry.

At the same time, the average growth of selected promising sectors (3.31%) turned out to be greater than the average growth of ten other sectors. Compared with the baseline scenario, the average GDP growth per capita for the period 2015–2021 is 1.03%, and the average output growth in all sectors per capita is 3.58% as a result of the SP problem solving. Forecast growth with parametric control of GDP per capita for the period 2015–2021 is 37.35%, and the maximum growth in the output of the industry

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Metalworking production and mechanical engineering is 54.46% per capita for the same period.

The analysis of the presented results of the *SP* problem solutions and the results of the corresponding tests show the high capabilities of the parametric control approach for developing recommendations on the optimal state economic policies aimed at economic growth and structural reorganization.

5. CONCLUSIONS

1. The dynamic CGE Model describing the interaction of the economies of nine regions of the planet from 2004–2021 has been designed and built.
2. Sets of SAM of the Model's regions for historical and forecast periods have been formed.
3. Using the methods of parametric control theory, the possibility of transferring the results of computational experiments based on the Model to the subject domain has been estimated.
4. The effectiveness of methods for selecting the promising industries and the solution of the parametric control problem aimed at economic growth and structural restructuring has been demonstrated.

REFERENCES

[1] Abouharb, R. & Duchesne, E. (2011), "World Bank Structural Adjustment Programs and their Impact on Economic Growth: A Selection Corrected Analysis", *The 4th Annual Conference on The Political Economy of International Organizations*, http://wp.peio.me/wp-content/uploads/2014/04/Conf4_Abouharb-Duchesne-30.09.2010.pdf Accessed 7 January 2017.

[2] Ashimov, A., Adilov, Zh., Alshanov, R., Borovskiy, Yu. & Sultanov, B. (2014), "The Theory of Parametric Control of Macroeconomic Systems and Its Applications (I)", *Advances in Systems Science and Application*, 14(1), 1-21.

[3] Blažek, P. & Šandor, M. (2013), "Public Finance Optimization – Current Trends", *Review of Integrative Business and Economics Research*, 2(2), 547-554.

[4] Devarajan, S. & Robinson, S. (2002), "The Impact of Computable General Equilibrium Models on Policy", *Conference on Frontiers in Applied General Equilibrium Modeling*, https://www.pep-net.org/sites/pep-net.org/files/typo3doc/pdf/DevarajanRobinson.pdf Accessed 7 January 2017.

[5] Ferris, M. & Munson, T. (2016), PATH 4.7 http://www.gams.com/latest/docs/solvers/path/index.html Accessed 7 January 2017.

[6] GAMS. (2016), www.gams.com Accessed 7 January 2017.

[7] GLOBE CGE Model. (2016), www.cgemod.org.uk/globe1.html Accessed 7 January 2017.

[8] GTAP Data Base. (2015), www.gtap.agecon.purdue.edu/databases/default.asp Accessed 7 January 2017.

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ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

[9] Huang, H., Ju, J. & Yue, V.Z. (2013), "A Unified Model of Structural Adjustments and International Trade: Theory and Evidence from China", *Meeting Papers from Society for Economic Dynamics*, No 859, https://economicdynamics.org/meetpapers/2013/paper_859.pdf Accessed 7 January 2017.

[10] Khan, H.A. (2004), "Using Macroeconomic Computable General Equilibrium Models for Assessing Poverty Impact of Structural Adjustment Policies", *ADB Institute Discussion Paper*, No.12, https://think-asia.org/bitstream/handle/11540/3600/2004.07.dp12.macroeconomic.equilibrium.models.poverty.pdf?sequence=1 Accessed 7 January 2017.

[11] Naastepad, C.W.M. (2002), "Effective supply failures and structural adjustment: a real–financial model with reference to India", *Cambridge J Econ*, 26(5), 637-657.

[12] NLPEC. (2016), http://www.gams.com/latest/docs/solvers/nlpec/index.html Accessed 7 January 2017.

[13] Shishido, S. & Nakamura, O. (1992), "Induced Technical Progress and Structural Adjustment: A Multi-Sectoral Model Approach to Japan's Growth Alternatives", *Journal of Applied Input-Output Analysis*, (1)1, 1-23.

[14] World Economic Outlook Databases. (2016), http://www.imf.org/external/ns/cs.aspx?id=28 Accessed 7 January 2017.

[15] World Input-Output Database. (2016), http://www.wiod.org/home Accessed 7 January 2017.

[16] World Integrated Trade Solution. (2016), http://wits.worldbank.org Accessed 7 January 2017.

[17] Zografakis, S. & Sarris, A. (2015), "A multisectoral computable general equilibrium model for the analysis of the distributional consequences of the economic crisis in Greece", *14th Conference on Research on Economic Theory and Econometrics*. http://www2.aueb.gr/conferences/Crete2015/Papers/Sarris.pdf Accessed 7 January 2017.

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