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Building Computable General Equilibrium Model Of Croatia

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Model is largely based on EcoMod7E.

Abstract

In this paper we describe the structure of the computable general equilibrium (CGE) model and data that enables estimation of certain policy changes in Croatia. Namely, we build a 5-sector (households, firms, government, investors and foreigners) economy model while our economy is disaggregated on three highly aggregated sectors. Afterwards, we present Croatian data which enables us to simulate the model in Nadoveza, Sekur and Penava (upcoming). These data are seen as snapshot of established equilibrium in 2010 in Croatia and they represent the main input for the CGE models. Finally, we conduct the reality check of our calibrated parameters.

Key words
Computable general equilibrium model, small open economy, social accounting matrix, Croatia

JEL classification
C60, C68

Introduction

Computable general equilibrium (CGE) models are a standard tool for policy analysis in many countries. *Single-country* models are used to study the structural consequences of exogenous shocks (Breuss & Tesche, 1991). Today, most developed economies have large scale CGE models for analysis of different policies (e.g. Australian ORANI and its variants, USAGE model of the United States of America, GTAP models of the World Trade Organization etc.). Other examples of the use of CGE models include Carneiro & Arbache (2003) who investigated the impacts of trade liberalization on Brazilian labor markets or Boratyński & Borowski (2012) who assess the long-term macroeconomic effects of introducing the flat personal income tax in Poland. The first steps in building CGE model for Croatian economy (CGECRO) were made by Adelman and Šohinger (2000). The authors analyzed impacts of three ‘shocks’ to the economy: tax cut, tariff cut and the combination of the two. In 2001 Šohinger, Galinec and Harrisson provided a quantitative framework to facilitate trade policy options in World Trade Organization negotiations. The model is based on GTAP (Global Trade Analysis Project) model. Recent efforts in the construction of the CGE model for Croatia were made by Škare and Stjepanović (2011, 2013). The results of their research show that CGE models can be an important instrument for policy makers in small open economies. This paper is a contribution to the literature as we bring a detailed structure of the simple small open economy CGE model based on Croatian data. The data presented in paper are mostly derived from 2010 input-output tables for Croatia. Due to the lack of space, we examine the effects of lower tax burden on labor in Croatia and present sensitivity analysis results in Nadoveza, Sekur and Penava (upcoming).

This paper is organized in three main parts. The first part describes the structure of the model where equations for our 5-sector CGE model are presented. Next, we present the Croatian data needed for CGE estimation. In particular, we present the social accounting matrix (SAM) for Croatia and explain the predetermined parameters. Before the conclusion we provide reality check of calibrated data.

Structure of the Model

As it was mentioned in introduction we build non-monetary simple small open economy CGE model based on Croatian data as to assess the general equilibrium effects of lower labor taxes paid by producers in Nadoveza, Sekur and Penava (upcoming). In our model economy consists of five sectors: households, firms, government, investors and foreigners. The economy is disaggregated on three highly aggregated sectors: agriculture, industry and services. The model relies on few restrictive assumptions regarding the market competition and assumes market cleaning on all markets except labor market where we observe unemployed resources. We also fix nominal exchange rate due to observed stability of exchange rate in Croatia, whereas euro serves as anchor. This means that we build highly micro based macro model. However, we describe labor market with Phillips type behavioral relation. Also, balance of payment equilibrates by inflow/outflow of foreign savings since price (nominal exchange rate) is fixed. These two assumptions (unemployment and fixed exchange rate) move the model few steps away from perfect market equilibrium assumptions. All other markets clear. We also restrict policy impact on state budget by fixing government savings (which are negative in Croatia). At the same time we fix government transfers to households, which means that government adjusts its consumption after the policy change.

Households

There is representative household whose utility function is described by Stone-Geary/Linear expenditure system. Stone-Geary/Linear expenditure system is chosen because of its (budget share) flexibility relative to other possible functional forms (Burfisher, 2011). Representative household maximizes its utility function ($\mathbb{U}_h$) which is given by:

$$\mathbb{U}_h = \prod_{i=1}^{3} \left(\mathbb{C}_{h_i} - \varsigma_i\right)^{\alpha_{\mathbb{C}_{h_i}}}$$

Where $\mathbb{C}_{h_i} > \varsigma_i \geq 0\ \forall i,\ \alpha_{\mathbb{C}_{h_i}} > 0$ and $\sum_{i=1}^{3} \alpha_{\mathbb{C}_{h_i}} = 1$. $\mathbb{C}_{h_i}$ represents household's consumption of goods produced by agriculture, industry and service sectors. ς_i is a substance level of consumption. $\alpha_{\mathbb{C}_{h_i}}$ corresponds to Cobb-Douglas budget share parameters when substance level of consumption is attained.

Household has to satisfy its budget constraint given by:

$$I_h \geq \mathbb{S}_{\mathrm{h}} + t_{\mathrm{I}} I_h + \sum_{i=1}^{3} \left(1 + t_{\mathbb{C}_i}\right) \mathbb{P}_i \mathbb{C}_{h_i}$$

Where I_h represents household income, $\mathbb{S}_{\mathrm{h}}$ stands for household savings, $\mathbb{P}_i$ are prices of final goods while t_{I} and $t_{\mathbb{C}_i}$ represent income and consumption taxes respectively. Household's demand for goods is then given by

$$\mathbb{C}_{h_i} = \left[\left(1 + t_{\mathbb{C}_i}\right)\mathbb{P}_i \varsigma_i + \alpha_{\mathbb{C}_{h_i}} \mathbb{P}_i ((1 - t_{\mathrm{I}}) I_h - \mathbb{S}_h - \sum_{i=1}^{3} \left(1 + t_{\mathbb{C}_i}\right)\mathbb{P}_i \varsigma_i)\right] / \left[\left(1 + t_{\mathbb{C}_i}\right)\mathbb{P}_i\right]$$

Firms

We assume that three firms produce three homogenous domestic goods (agricultural, industrial and service sector goods) with three factors of production: capital ($\mathbb{K}_i$), labor ($\mathbb{L}_i$) and intermediate inputs ($\mathbb{Y}_{D_{i,j}}$). We also assume that capital and labor are perfectly mobile across sectors and exogenously given. Firms maximize their profits and are constrained by 2-level nested production function. At first level, firms combine factors of production (capital and labor) and intermediates in Leontief fashion to produce domestic goods. At second level, firms minimize their costs subject to CES production function ($\mathbb{VA}_i$) and choose their intermediates using input-output technical coefficients which form the Leontief matrix ($\mathbb{Y}_{D_{i,j}}$). At 1st level:

$$\mathbb{Y}_{D_i} = f(\mathbb{K}_i, \mathbb{L}_i, \mathbb{Y}_{D_{i,j}})$$

Firms choose the combination of capital and labor which minimizes its costs subject to CES production function to form its value added.

$$\mathbb{VA}_i = f(\mathbb{K}_i, \mathbb{L}_i)$$
$$\min \mathbb{K}_i (1 + t_{\mathbb{k}})\mathbb{r} + \mathbb{L}_i (1 + t_{\mathbb{l}})\,\mathbb{w}$$

ST

$$\mathbb{Y}_{D_i} = \mathbb{A}_{\mathbb{S}_{D_i}} (\gamma_{\mathbb{VA}_i} \mathbb{K}_i{}^{-\rho_{\mathbb{VA}_i}} + \left(1 - \gamma_{\mathbb{VA}_i}\right) \mathbb{L}_i{}^{-\rho_{\mathbb{VA}_i}})^{-1/\rho_{\mathbb{VA}_i}}$$

Optimization leads to derived capital and labor demand:

$$\mathbb{K}_i = \left(\frac{\mathbb{Y}_{D_i}}{\mathbb{A}_{\mathbb{S}_{D_i}}}\right) \{(\gamma^{\mathbb{VA}_i})^{\sigma_{\mathbb{VA}_i}} (1 + t_{\mathbb{k}}) \mathbb{r}^{-\sigma_{\mathbb{VA}_i}} \left[\left(\gamma^{\mathbb{VA}_i}\right)^{\sigma_{\mathbb{VA}_i}} (1 + t_{\mathbb{k}}) \mathbb{r}^{1-\sigma_{\mathbb{VA}_i}} + \left(1 - \gamma^{\mathbb{VA}_i}\right)^{\sigma_{\mathbb{VA}_i}} (1 + t_{\mathbb{l}}) \mathbb{w}^{1-\sigma_{\mathbb{VA}_i}}\right]^{\frac{\sigma_{\mathbb{VA}_i}}{(1-\sigma_{\mathbb{VA}_i})}}\}$$

$$\mathbb{L}_i = \left(\frac{\mathbb{Y}_{D_i}}{\mathbb{A}_{\mathbb{S}_{D_i}}}\right) \{\left(1 - \gamma^{\mathbb{VA}_i}\right)^{\sigma_{\mathbb{VA}_i}} (1 + t_{\mathbb{l}}) \mathbb{w}^{-\sigma_{\mathbb{VA}_i}} \left[\left(\gamma^{\mathbb{VA}_i}\right)^{\sigma_{\mathbb{VA}_i}} (1 + t_{\mathbb{k}}) \mathbb{r}^{1-\sigma_{\mathbb{VA}_i}} + \left(1 - \gamma^{\mathbb{VA}_i}\right)^{\sigma_{\mathbb{VA}_i}} (1 + t_{\mathbb{l}}) \mathbb{w}^{1-\sigma_{\mathbb{VA}_i}}\right]^{\frac{\sigma_{\mathbb{VA}_i}}{(1-\sigma_{\mathbb{VA}_i})}}\}$$

Where payments to capital and labor are represented by $\mathbb{r}$ and $\mathbb{w}$, parameter $\mathbb{A}_{\mathbb{S}_{D_i}}$ is shift parameter and is equal to reverse value of value added share in total production of domestic good ($\mathbb{Y}_{D_i}$), $\sigma_{\mathbb{VA}_i} = 1/(1 + \rho_{\mathbb{VA}_i})$, represents elasticity of substitution between factors, $t_{\mathbb{k}}$ and $t_{\mathbb{l}}$ are taxes on capital and labor respectively.

Intermediate inputs demand of i's sector for j's products (where $i = j$) is simply given by:

$$\mathbb{Y}_{D_{i,j}} = \mathbb{A}\mathbb{Y}_{D_i}$$

Where $\mathbb{A}$ is the matrix of technical coefficients.

From zero-profit constraint we get firms implicit supply of domestic goods:

$$\mathbb{Y}_{D_i}\mathbb{P}_{D_i} = (1+t_{\mathbb{k}})\mathbb{r}\mathbb{K}_i + (1+t_{\mathbb{l}})\mathbb{w}\mathbb{L}_i + \sum_{j=1}^{3}\mathbb{A}\mathbb{Y}_{D_i}\mathbb{P}_{D_j}$$

Government

Government allocates its resources (revenues collected from taxes on consumption, labor, capital, import and household income) by maximizing its Cobb Douglas type utility function constrained by its budget constraint:

$$\mathbb{U}_g = \prod_{i=1}^{3}\left(\mathbb{C}_{g_i}\right)^{\beta_{\mathbb{C}_{g_i}}}$$

Where $\mathbb{C}_{g_i} \geq 0\ \forall i$, $\beta_{\mathbb{C}_{g_i}} > 0$ and $\sum_{i=1}^{3}\beta_{\mathbb{C}_{g_i}} = 1$

ST

$$\mathbb{R} \geq \sum_{i=1}^{3}\left(\mathbb{P}_i\mathbb{C}_{g_i}\right) + \mathbb{TR} + \mathbb{S}_g\mathbb{P}^{index}$$

Where $\mathbb{R}$ stands for government revenues, $\mathbb{TR}$ represents government expenditures on unemployment and other transfers to households, while $\mathbb{S}_g$ stands for government savings which can be negative in the case of budget deficit and positive otherwise. Government consumption is then given by:

$$\mathbb{C}_{g_i} = \left[\beta_{\mathbb{C}_{g_i}}(\mathbb{R} - \mathbb{TR} - \mathbb{S}_g\mathbb{P}^{index})\right]/\mathbb{P}_i$$

Investment bank

In similar way investment bank allocates investments ($\mathbb{I}_i$) subject to savings constraint ($\mathbb{S}_T = \mathbb{S}_h + \mathbb{S}_g + \mathbb{S}_f$):

$$\mathbb{U}_i = \prod_{i=1}^{3}(\mathbb{I}_i)^{\delta_{\mathbb{I}_i}}$$

Where $\mathbb{I}_i \geq 0\ \forall i$, $\delta_{\mathbb{I}_i} > 0$ and $\sum_{i=1}^{3}\delta_{\mathbb{I}_i} = 1$

ST

$$\mathbb{S}_T \geq \sum_{i=1}^{3}\left(\mathbb{I}_i\mathbb{P}_{i_i}\right)$$

Investments are given by:

$$\mathbb{I}_i = \left[\delta_{\mathbb{I}_i}\mathbb{S}_T\right]/\mathbb{P}_i$$

Foreign sector

We assume small open economy model which simply means that Croatia can't impact world export ($\mathbb{P}_{ex_i}$) and import prices ($\mathbb{P}_{im_i}$) and it takes them as given. In CGE models, we assume substitution between import and domestic goods and between exports and domestic goods in a pairwise matter. The assumption about imperfect substitution between imports ($\mathbb{IM}_i$) and domestic goods ($\mathbb{Y}_{D_i}$) is called Armington assumption (Hosoe, Gasawa, & Hashimoto, 2010). Firm chooses between selling its domestic products ($\mathbb{Y}_{D_i}$) on domestic market ($\mathbb{Y}_{DD_i}$) priced at priced at $\mathbb{P}_{DD_i}$ and foreign markets ($\mathbb{EX}_i$) priced at world price of exports. It maximizes its profits while facing constant elasticity of transformation (CET) function type constraint:

$$\max \mathbb{P}_{DD_i}\mathbb{Y}_{DD_i} + \mathbb{P}_{ex_i}\mathbb{er}_i\mathbb{EX}_i - \mathbb{P}_{D_i}\mathbb{Y}_{D_i}$$

ST

$$\mathbb{Y}_{D_i} = A_{T_i}(\gamma_{T_i}\mathbb{EX}_i{}^{-\rho_{T_i}} + \left(1-\gamma_{T_i}\right)\mathbb{Y}_{DD_i}{}^{-\rho_{T_i}})^{-1/\rho_{T_i}}$$

Solution leads to domestic and export supply of domestic goods. A_{T_i} is scale parameter of CET function, while $\mathbb{er}_i$ stands for nominal exchange rate.

$$\mathbb{Y}_{DD_i} = \left(\frac{\mathbb{Y}_{D_i}}{A_{T_i}}\right)\{(1-\gamma^{T_i})^{\sigma_{T_i}}\mathbb{P}_{DD_i}{}^{-\sigma_{T_i}}\left[(\gamma^{T_i})^{\sigma_{T_i}}(\mathbb{P}_{Wex_i}\mathbb{er}_i)^{1-\sigma_{T_i}} + (1-\gamma^{T_i})^{\sigma_{T_i}}\mathbb{P}_{DD_i}{}^{1-\sigma_{T_i}}\right]^{\frac{\sigma_{T_i}}{(1-\sigma_{T_i})}}\}$$

$$\mathbb{EX}_i = \left(\frac{\mathbb{Y}_{D_i}}{A_{T_i}}\right)\{(\gamma^{T_i})^{\sigma_{T_i}}(\mathbb{P}_{Wex_i}\mathbb{er}_i)^{-\sigma_{T_i}}\left[(\gamma^{T_i})^{\sigma_{T_i}}(\mathbb{P}_{Wex_i}\mathbb{er}_i)^{1-\sigma_{T_i}} + (1-\gamma^{T_i})^{\sigma_{T_i}}\mathbb{P}_{DD_i}{}^{1-\sigma_{T_i}}\right]^{\frac{\sigma_{T_i}}{(1-\sigma_{T_i})}}\}$$

Where $\sigma_{T_i} = 1/(1+\rho_{T_i})$, stands for elasticity of transformation parameter. Above mentioned Armington assumption assumes that consumers and firms consume composite good - $\mathbb{Y}_i$ (not domestic or foreign variant but the combination of the two). In order to choose the combination of domestic and foreign variant of goods to produce final goods ($\mathbb{Y}_i$) firm maximizes its profits from final goods sale priced at $\mathbb{P}_i$ subject to constant elasticity of substitution (CES) production function.

$$\max \mathbb{Y}_i\mathbb{P}_i - ((1+t_{\mathbb{IM}_i})\mathbb{P}_{im_i}\mathbb{er}_i\mathbb{IM}_i + \mathbb{P}_{DD_i}\mathbb{Y}_{DD_i})$$

ST

$$\mathbb{Y}_i = A_{A_i}(\gamma_{A_i}\mathbb{IM}_i{}^{-\rho_{A_i}} + (1-\gamma_{A_i})\mathbb{Y}_{DD_i}{}^{-\rho_{A_i}})^{-1/\rho_{A_i}}$$

$$\mathbb{IM}_i = \left(\frac{\mathbb{Y}_i}{A_{A_i}}\right)\{(\gamma^{A_i})^{\sigma_{A_i}}((1+t_{\mathbb{IM}_i})\mathbb{er}_i\mathbb{P}_{im_i})^{-\sigma_{A_i}}\left[(\gamma^{A_i})^{\sigma_{A_i}}((1+t_{\mathbb{IM}_i})\mathbb{er}_i\mathbb{P}_{im_i})^{1-\sigma_{A_i}} + (1-\gamma^{A_i})^{\sigma_{A_i}}\mathbb{P}_{DD_i}{}^{1-\sigma_{A_i}}\right]^{\frac{\sigma_{A_i}}{(1-\sigma_{A_i})}}\}$$

$$\mathbb{Y}_i = \left(\frac{\mathbb{Y}_i}{A_{A_i}}\right)\{(1-\gamma^{A_i})^{\sigma_{A_i}}\mathbb{P}_{DD_i}{}^{-\sigma_{A_i}}\left[(\gamma^{A_i})^{\sigma_{A_i}}((1+t_{\mathbb{IM}_i})\mathbb{er}_i\mathbb{P}_{im_i})^{1-\sigma_{A_i}} + (1-\gamma^{A_i})^{\sigma_{A_i}}\mathbb{P}_{DD_i}{}^{1-\sigma_{A_i}}\right]^{\frac{\sigma_{A_i}}{(1-\sigma_{A_i})}}\}$$

Where $\sigma_{A_i} = 1/(1+\rho_{A_i})$ represents elasticity of substitution parameter.
Balance of payments equilibrium condition requires that:

$$\sum_{i=1}^{3}\mathbb{P}_{im_i}\mathbb{er}_i\mathbb{IM}_i = \sum_{i=1}^{3}\mathbb{P}_{ex_i}\mathbb{er}_i\mathbb{EX}_i + \mathbb{S}_f$$

Unemployment ($\mathbb{U}$) is generated in the following (adjusted) Phillips curve style:

$$[(\mathbb{w}^1/\mathbb{P}^{index_0})/(\mathbb{w}^0/\mathbb{P}^{index_0}) - 1] = \alpha[(\mathbb{U}^1/\mathbb{L}_S{}^1)/(\mathbb{U}^0/\mathbb{L}_S{}^0) - 1]$$

Where Phillips parameter equals α. $\mathbb{P}^{index}$ stands for Laspeyres price index of domestic goods prices.
Market cleaning conditions require equilibrium on all markets (labor, capital, goods):

$\sum_{i=1}^{3}\mathbb{L}_i = \mathbb{L}_S - \mathbb{U}$,

$\sum_{i=1}^{3}\mathbb{K}_i = \mathbb{K}_S$ and

$\mathbb{Y}_i = \mathbb{C}_{h_i} + \mathbb{I}_i + \mathbb{C}_{g_i} + \sum_{j=1}^{3}\mathbb{AY}_{D_{i\,j,i}}$.

Data

CGE models largely relay on input-output tables. The input-output tables are then used for construction of Social accounting matrix (SAM) of an economy. SAM's rows record economic agents expenditures, while data in columns track agents' sources of income. Even if SAM is largely based on I-O tables, there are data which have to be collected from other data sources. SAM entries sometimes differ from realized and published values. The reason is that data which enter in SAM usually have to be modified since SAM is a square matrix in which the corresponding row and column sums have to be equal. Data from different sources usually don't satisfy this condition. In this paper we present Croatian Social accounting matrix on which we base our simulations presented in Nadoveza, Sekur and Penava (upcoming). Our SAM is based on 2010 Croatian I-O tables which are assembled and published by Croatian Bureau of Statistics (CBS). According to stated requirements of SAM, data presented in Table 1 are seen as snapshot of established equilibrium in 2010 in Croatia.

Predetermined parameters include income elasticity of consumption, Frisch parameter and unemployment benefits expressed as share of income from labor. The latter is set at 0.5 and is close to approximated official share as can be seen from the official data in Table 4. From the Table 2 we can see that income elasticity is low for agricultural products, while services enjoy the highest income elasticity. Frisch parameter is calculated from Muhammad, et al. (2011) and is defined as the substitution parameter which measures the sensitivity of the marginal utility of income to income/total expenditures. The Frisch parameter establishes a relationship between own-price and income elasticities (Nganou, 2005).

Table 1: Social Accounting Matrix for Croatia (2010)

SAM		Goods			Sector			Factors		Households	State	Net taxes on goods	Labor taxes	Capital taxes	Customs	Income tax	Investments	Ro
		Agriculture	Industry	Services	Agriculture	Industry	Services	Labor	Capital l									
Goods	Agriculture				4359	7919	2751			8713	0						1912	
	Industry				4578	70850	47977			74816	0						55973	
	Services				3165	42916	81768			122721	69585						10138	
Sector	Agriculture	25702																193
	Industry		250055															437
	Services			323292														259
Factors	Labor				2611	41935	114679											
	Capital				9699	12688	81621											
Households								159225	104008		29970							
State												10746	2456	645	344	35962		
Net taxes on goods		-48	4011	6783														
Labor taxes					27	522	1907											
Capital taxes					7	137	501											
Customs		-2	128	217														
Income tax										35962								
Savings										50991	- 49401							664
RoW					3188	116805	17997											
Total		25653	254195	330292	27633	293773	349201	159225	104008	293203	50154	10746	2456	645	344	35962	68022	137

Source: author calculations based on CBS (2014), CBS (2016), CBS (2015), CNB (2015), MFin (2016), Urban (2009), Babić (2008), ZABA (2012), HZZ (2016)

The critical assumption, as it is shown in Nadoveza, Sekur and Penava (upcoming), is assumed Phillips type relationship between price and unemployment. It is estimated in Blanchflower (2001) that Phillips parameter ranges between -0,3 and 0,1 in countries which share some mutual characteristics with Croatia. Since Botrić (2012), Družić, et al., (2006), Krznar (2011) and Šergo, et al. (2012) couldn't prove the existence of Phillips curve in Croatia we stretched it from -0.1 to -1 in Nadoveza, Sekur and Penava (upcoming). Results show mild sensitivity to this parameter. It seems that any future work regarding CGE model for Croatia should start with the revision of the Phillips curve (existence) assumption.

Table 2: Predetermined parameters

Households	Income elasticity	Agriculture	0,627	Muhammad, et al. (2011)
		Industry	1,026	
		Services	1,198	
	Frisch parameter		-1,36	Calculated from Muhammad, et al. (2011) as income elasticity/own price Frisch elasticity
	Unemployment benefits		0,5	
Firms	CES (σ_{VA_i})	Agriculture	0,56	Jomini, et al. (1991), table 4.3. (calculated as simple average of subsectors)
		Industry	1,22	
		Services	5,46	
	CET (σ_{T_i})	Agriculture	2,43	
		Industry	2,84	
		Services	1,9	
	Armington (σ_{A_i})	Agriculture	4,85	
		Industry	5,69	
		Services	3,8	
Labor market	Phillips curve parameter		From -0,3 to -0,1	Blanchflower (2001)

In accordance with above explained predetermined parameters we have calibrated other relevant parameters and data. The results are shown in Table 3. Calibrated data seem to be reasonable and we don't see major problems.

Table 3: Calibrated parameters

Households (LES)	Savings		12%
	Income tax		20%
	Budget shares ($\alpha_{\mathbb{C}_{h_i}}$)	Agriculture	0,0
		Industry	0,3
		Services	0,6
	Minimal requirements (ς_i)	Agriculture	5109,4
		Industry	22747,1
		Services	24070,1
Investment bank (C-D)	Budget shares ($\delta_{\mathbb{I}_i}$)	Agriculture	0,03
		Industry	0,82
		Services	0,15
State (C-D)	Budget shares ($\beta_{\mathbb{C}_{g_i}}$)	Agriculture	0,0000028
		Industry	0,0000000
		Services	0,9999972
Firms (CES)	Distribution parameter ($\gamma^{\mathbb{VA}_i}$)	Agriculture	0,9
		Industry	0,3
		Services	0,5
	Shift parameter ($\mathbb{A}_{\mathbb{S}_{D_i}}$)	Agriculture	3,0
		Industry	5,7
		Services	3,4

RoW (CES, Armington)	Distribution parameter (γ^{A_i})	Agriculture	0,4
		Industry	0,5
		Services	0,3
	Shift parameter (A_{A_i})	Agriculture	1,8
		Industry	2,0
		Services	1,7
Firms – composite good (CET)	Distribution parameter (γ^{T_i})	Agriculture	0,7
		Industry	0,6
		Services	0,8
	Shift parameter (A_{T_i})	Agriculture	2,6
		Industry	2,1
		Services	2,8

Reality Check

In Table 4 calibrated data and data adjusted to fit SAM's requirements are confronted with official data from various sources. Some SAM entries do not have official counterparts available in official databases. In this case official source column is filled with N.A. Some data have their counterparts, but the methodologies differ. In this case column official data reports non comparable. As it can be seen from the Table 4, official and calibrated data do not show any major differences. What worries us are the non-comparable data. As it is shown in Table 4 net taxes on goods (taxes-subsidies) represent relatively small share of total budget revenues in SAM. On the other hand gross taxes on goods and services are major component of budget revenues. Any future research should be able to explain these differences within model in detail.

Table 4: Calibrated vs official data

Indicator	***SAM***	***Official data***	***Source***
Unemployment rate	20%	17,4	CBS (2016b)
Savings households (share in GDP)	8,36%	10%	ZABA (2012) (savings-credits-% GDP)
Transfers to households (% of GDP)	5%	5%	Babić (2008)
Unemployment benefit (% wage)	50%	≈ 44%	HZZ (2016)
Personal income tax (% of total.)	12%	N.A.	
Personal income tax (labor)	23%	24,6%	Urban (2009:8)
Labor taxes (employer,% of wages)	1,30%	N.A.	
Capital taxes (employer)	0,60%	N.A.	
Agriculture in GVA	4%	4%	CBS (2014)
Industry in GVA	42%	36%	CBS (2014)
Services in GVA	54%	60%	CBS (2014)
Agriculture in employment	2%	3%	CBS (2016a)
Industry in employment	26%	24%	CBS (2016a)
Services in employment	72%	63%	CBS (2016a)
Agriculture in the capital use	9%	N.A.	
Industry in the capital use	12%	N.A.	
Services in the capital use	78%	N.A.	
Consumption (% of GDP)	82%	79%	CBS (2014)
State (% of GDP)	14%	20%	CBS (2014)
Investments (% of GDP)	17%	21%	CBS (2014)
Exports (% of GDP)	34%	38%	CBS (2014)
Imports (% of GDP)	34%	38%	CBS (2014)
Foreign savings (% of GDP)	8%	5%	CBS, CNB (ESA 2010)
Net consumption taxes in household consumption - agriculture	-0,50%	N.A.	
Net consumption taxes in household consumption - Industry	6%	N.A.	
Net consumption taxes in household consumption - services	6%	N.A.	

Net taxes on goods -% government revenue	21%	non comparable	
Taxes on labor -% government revenue	5%	non comparable	
Taxes on capital - % government revenue	1%	non comparable	
Income Tax -% government revenue	72%	non comparable	
Customs duties -% government revenue	1%	non comparable	
The state budget deficit	-7%	-6%	MFin (2016)

Concluding Remarks

In this paper we presented a structure of the small open economy computable general equilibrium (CGE) model and the social accounting matrix (SAM) for Croatia. Potential applications of this model are various. Depending on the problem the model can be extended to solve specific policy challenges. Based on model derived here, we model the effects of lower tax burden on labor in Croatia in Nadoveza, Sekur and Penava (upcoming). However, it should bear in mind two main drawbacks that could improve the effectiveness of this CGE model. First, as it was shown, the Phillips curve (existence) assumption should be tested. And second, the lack of some data and few restrictive assumptions decrease the accuracy of the model itself. However, we find this kind of models to be very useful for the estimation of the effects of economic policy changes.

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