IMPACT OF FISCAL STABILITY LAW

Ragchaasuren Galindev[1]

The First Draft was submitted on 07 Dec 2012
The Last Draft was submitted on 06 February 2014

Abstract

This paper develops a dynamic, small open economy Computable General Equilibrium model with static expectations and a representative household for the Mongolian economy and examines the impact of the Fiscal Stability Law (FSL) which tries to stabilise government expenditure in an environment where the prices of mineral products (coal and copper) are highly volatile. It has two main parts – historical and forecast simulations. In the former, we follow a validation procedure to estimate the parameters of the model while in the latter we examine the effect of the FSL on the economy by generating artificial series for coal and copper prices until 2020. We find that the FSL reduces the volatility of most of the variables.

Keywords: Mongolian fiscal stability law, CGE modelling

[1] Email: ragchaasuren@geregepartners.mn

1. Introduction

During the economic boom between 2005 and 2008 originated from the soaring commodity prices in the world market, the government revenue increased dramatically because of increased proceeds of copper and gold mining companies.

In fact, the price of copper increased from 3675 USD/tn to 6731 USD/tn between 2005 and 2006. During the same period, the price of gold increased by about 26 percent. As a consequence, nominal government revenue excluding grants and transfers increased by 62 percent between 2005 and 2006, by 37 percent between 2006 and 2007 and by 15 percent between 2007 and 2008 according to the National Statistical Office (NSO).

On the other side of the fiscal accounting, government expenditure increased by about 61 percent between 2005 and 2006 and by about 40 percent per year in the next two years. During these boom years, real GDP grew, on average, by 10 percent per year. The crisis in 2008 hit the economy hard – the price of copper fell from around 7000 USD/tn to almost 5100 USD/tn between 2008 and 2009. The effect on the economy was direct and it shrank by 1.6 percent in 2009. It is partly due to a decrease in government spending which fell by 5.7 percent in nominal value, originated by 8.6 percent decrease in government revenue.

Given these numbers, one can conclude that contemporaneous correlation between government revenue and expenditure was high and positive over the observed business cycles. In addition, the inflation rate was 6.8 percent in 2006, 17.8 percent in 2007, 22 percent in 2008 and 4.4 percent in 2009. Mongolians learned a lesson from this experience that pro-cyclical macroeconomic policy amplifying the effect of external shocks is not a right one for our economy, especially in the current environment where the mining sector is expanding so that the economy is being more exposed to the volatility of commodity prices.

Many experts, economists and politicians suggested that we should have saved more during the boom rather than spent so as to maintain the health of the economy during the crisis – i.e., countercyclical policy. As a result in 2011, the Mongolian parliament approved a Fiscal Stability Law (FSL) which spells out the rules for the stability of the growth rate of nominal government expenditure. In addition, the parliament has recently approved the budget for 2013 which is constructed in accordance with the FSL.

In this research, we develop a dynamic and small open economy Computable General Equilibrium (CGE) model to examine the effect of the FSL on the Mongolian economy. The model parameters are estimated (validated) to replicate the main characteristics of the economy as of 2012 to be used to predict the effect of the FSL over the next few years.

The main point of the FSL is that it restricts the growth of total government expenditure. To assess the impact of the FSL, we consider three forecast scenarios – baseline, FSL and alternative. In the baseline scenario, we consider a series of prices for main mining products which are called equilibrated prices and find series of government spending that meet the requirements of the FSL. In the FSL scenario, we consider a more volatile series of prices for the main mining products and the predetermined series of government spending complying with the FSL. In the alternative scenario, we consider the same series of volatile prices but government spending is pro-cyclical. By comparing the FSL and the alternative scenarios, we assess the impact of the FSL. Overall, we find that the FSL stabilises the economy by reducing the volatility of most variables, especially the prices.

The paper is organised as follows. Section 1 discusses the structure of the CGE model. Section 2 discusses the data. Section 3 considers the method to estimate the parameters of the model and prepares the Input-Output table for 2012. Section 4 discusses the FSL and its link with the model. Section 5 has forecast simulations in different scenarios. Section 6 concludes the paper.

2. Model

Our CGE model is based on the data in Mongolian Input-Output (IO) table which is as of 2005. This is a small open economy model – i.e., the country takes the prices of all internationally traded goods and the world interest rate exogenously as given. The model is also recursive dynamic as it has capital stock and foreign debt. For simplicity, we assume that agents in the economy have static expectations about future prices and incomes as in GTEM.[2] In that sense, the model is an open economy, multi-sector extension of the Solow model. This is a single country version of the multi-region model employed to assess the "Impact of Oyu Tolgoi Copper Mine on the Mongolian Economy" (Fisher, et al. 2010)[3].

Our CGE model has the following equations in each period of time:

- ✓ Household demand for each product;
- ✓ Investment demand for each product;
- ✓ Government demand for each product;
- ✓ Export demand for each product;
- ✓ Industry demand for each product and production factor;
- ✓ Supply of each product (zero profit conditions) and production factor;
- ✓ Market equilibrium for each product and production factor;
- ✓ Production cost and purchasers' price;
- ✓ Various macroeconomic indicators such as price indices, GDP and its deflator etc;
- ✓ Exogenous technological changes;
- ✓ Capital stock, foreign debt and population dynamics.

The transactions between the industries and with the final users (households, government, investors and exporters) over products and primary factors (labour, capital, natural resources and land) are based on the decisions derived from the profit and utility maximization problems. We describe each optimization problem in the following subsections.

2.1. Demand

2.1.1. Private and government consumption

As in many CGE models, we assume that the economy is populated by many identical, infinitely lived households.[4] Households own production factors, receive their payments and make all net international income transfers. In addition, as the government is formed by households, they collect taxes and distribute transfer payments. The sources of national income are shown in (1).

$$NATIONAL\ INCOME = CAPITAL\ INCOME + LABOUR\ INCOME + LAND\ RENTAL + NATURAL\ RESOURCE\ INCOME + NET\ TAXES + NET\ FOREIGN\ INCOME \quad (1)$$

National income in (1) is the disposable income for the whole society and is divided into aggregate private consumption (C), government spending (G) and national saving ($SAVE$).

[2] GTEM stands for Global Trade and Environment Model and is used by the Australian government.
[3] The model used in the Fisher et al., (2010) is an extended version of GTEM by BAEconomics LLC.
[4] This is due to the lack of data. The drawback of this assumption is that we are unable to examine income distribution.

2.1.2. Private consumption

A representative household maximises her utility with the quantities of each product by taking their prices as given. This maximisation problem has a nested structure. The household maximises a CES (Constant Elasticity of Substitution) utility function in (2) by choosing the source-specific (either domestic or imported) quantity of N products subject to predetermined private consumption per household and prices as follows:

$$Max\ U^{(1)} = CES\left(X_1^{(1)}, X_2^{(1)}, \dots, X_N^{(1)}\right) \quad \textbf{(2)}$$

$$X_i^{(1)} = CES\left(X_{(i,s=1)}^{(1)}, X_{(i,s=2)}^{(1)}\right), \quad i = 1, \dots, N \quad \textbf{(3)}$$

$$subject\ to \quad (C/T) = \sum_{i=1}^{N}\left(P_{(i,s=1)}^{(1)}, X_{(i,s=1)}^{(1)}\right) + \sum_{i=1}^{N}\left(P_{(i,s=2)}^{(1)}, X_{(i,s=2)}^{(1)}\right) \quad \textbf{(4)}$$

where the superscript (1) indicates households, CES stands for Constant Elasticity of Substitution, $s = 1$ means domestic, $s = 2$ means imported, $P_{i,s}^{1}$ is the source-specific price of product i that households pay and T is the number of households. The solution of this maximisation problem yields household demand function for each $X_{(i,s)}^{(1)}$.

2.1.3. Government spending

The government has the same optimisation problem as the representative household subject to predetermined government spending and the source-specific prices of each product.

$$max\ U^{(2)} = CES\left(X_1^{(2)}, X_2^{(2)}, \dots, X_N^{(2)}\right) \quad \textbf{(5)}$$

$$X_i^{(2)} = CES\left(X_{(i,s=1)}^{(2)}, X_{(i,s=2)}^{(2)}\right), \quad i = 1, \dots, N \quad \textbf{(6)}$$

$$subject\ to \quad G = \sum_{i=1}^{N}\left(P_{(i,s=1)}^{(2)}, X_{(i,s=1)}^{(2)}\right) + \sum_{i=1}^{N}\left(P_{(i,s=2)}^{(2)}, X_{(i,s=2)}^{(2)}\right) \quad \textbf{(7)}$$

From this maximisation problem, we derive government demand function for each $X_{(i,s)}^{(2)}$.

2.1.4. Investment

Investment is one of the variables that generate the dynamics in this model. We consider two types of capital (c) – mining and non-mining – due to the lack of data as in Fisher et al., (2010). The both capital goods increase with investments and decrease with depreciation. The decision of investment is governed by the following equation:

$$I_c = Z_c (R_c / R^W)^{\theta_c} Y_c^{\chi_c} \quad \textbf{(8)}$$

where I_c is the quantity of investment in capital good c, R_c is the real rate of return from renting out capital good c, R^W is the exogenous world real rate of return, Y_c is the aggregate output of sectors which employ capital good c, and Z_c is an exogenous shifter. The parameters $\theta_c \geq 0$ and $\chi_c \geq 0$ are elasticities. The real rate of return, R_c, is determined as:

$$R_c = P_c / P_{I_c} - \delta_c$$

where P_c is the average rental price of capital c, P_{I_c} is the price index of investment good and $\delta_c > 0$ is the rate of depreciation. The cost of investment (INV_c) is then calculated as $\left(I_c P_{I_c}\right)$.

Once the quantity of real investment, I_c, is determined, it becomes a simple production sector (or a process) that combines the products to create the capital goods in a Leontief fashion. Investors minimise INV_c for a given set of source-specific prices subject to the process of creating I_c:

$$Min\ INV_c = \sum_{i=1}^{N}\left(P_{(c,i,s=1)}^{(3)}, X_{(c,i,s=1)}^{(3)}\right) + \sum_{i=1}^{N}\left(P_{(c,i,s=2)}^{(2)}, X_{(c,i,s=2)}^{(2)}\right) \tag{9}$$

$$subject\ to\ \ I_c = A_c \cdot Leontief\left(X_{(c,1)}^{(3)}/A_{(c,1)}, X_{(c,2)}^{(3)}/A_{(c,2)}, \ldots, X_{(c,N)}^{(3)}/A_{(c,N)}\right) \tag{10}$$

$$X_{(c,i)}^{(3)} = CES\left(X_{(c,i,s=1)}^{(3)}, X_{(c,i,s=2)}^{(3)}\right), \quad i = 1, \ldots, N \tag{11}$$

where A_c is neutral technological change in capital creation industry c and $A_{(c,i)}$ is technological change in association with using product i. Solving for this minimisation problem yields the investor-specific demand function of each $X_{(c,i,s)}^{(3)}$.

2.1.5. Exports

Export demand for product $i = 1, \ldots N$ is governed by the following equation:

$$X_{(i,s=1)}^{(4)} = B_i\left(P_{(i,s=1)}^{(4)} / (PHI \cdot P_i^W)\right)^{-\phi_i} \tag{12}$$

where $X_{(i,s=1)}^{(4)}$ is the export quantity for product i, $P_{(i,s=1)}^{(4)}$ is the FOB price received by the exporters, P_i^W is the price of product i in the international market and measured in USD, B_i is an exogenous shifter for each i, PHI is the nominal exchange rate (MNT/USD) and $\phi_i \geq 0$ is a price elasticity.

2.1.6. Industries

The model has M separate industries and each produces differentiated products. Each industry minimizes its total cost with the quantity of each product subject to the production function:

$$Min\ \sum_{s=1}^{2}\sum_{i=1}^{N}\left(P_{(j,i,s)}^{(5)} X_{(j,i,s)}^{(5)} + E_j P_{(j,E)}\right) + K_j P_{(j,K)} + L_j P_{(j,L)} + NR_j P_{(j,NR)} \tag{13}$$

$$subject\ to\ \ Y_j = A_c \cdot Leontief\left(X_{(j,1)}^{(5)}/A_{(j,1)}, X_{(j,2)}^{(5)}/A_{(j,2)}, \ldots, X_{(j,N)}^{(5)}/A_{(j,N)}, PE_j/A_{(j,PE)}\right) \tag{14}$$

$$X_{(j,i)}^{(5)} = CES\left(X_{(j,i,s=1)}^{(5)}, X_{(j,i,s=2)}^{(5)}\right), \quad i = 1, \ldots, N \tag{15}$$

where Y_j is the level of output in sector j, A_j is neutral technological change in industry j, $A_{(j,i)}$ is technological change in association with using product i in industry j, $A_{(j,PE)}$ is technological change in association with using a primary-energy (*PE*) bundle which is a CES function of a primary factor (*PF*) bundle, an energy (*ENERGY*) bundle and $(j = 1, \ldots, M)$. The *PF* bundle is a CRESH function of capital (K_j), labour (E_j), land (L_j) and natural resources (NR_j) while the *ENERGY* bundle is a CES function of various types of energy products such as petrol, coal, gas and electricity.[5]

2.2. Market equilibrium for goods and services

For each domestically produced good i, the market price, $A_{(i,s=1)}$, is determined when the total demand is equal to the total supply.

$$X_{(i,s=1)}^{(1)} + X_{(i,s=1)}^{(2)} + \sum_{c=1}^{2} X_{(c,i,s=1)}^{(3)} + X_{(i,s=1)}^{(4)} + \sum_{j=1}^{M} X_{(j,i,s=1)}^{(5)} = Y_i, \quad i = 1, \ldots, N \tag{16}$$

[5] CRESH stands for Constant Ratios of Elasticity of Substitution, Homothetic. In CRESH production functions the ratios of the elasticities of substitutions are kept constant while maintaining the homotheticity of the function. For more, see Hanoch (1971).

where $X^{(1)}_{(i,s=1)}$ is household demand, $X^{(2)}_{(i,s=1)}$ is government demand, $\sum_{c=1}^{2} X^{(3)}_{(c,i,s=1)}$ the sum of investment demand in both capitals, $X^{(4)}_{(i,s=1)}$ is export demand and $\sum_{j=1}^{M} X^{(5)}_{(j,i,s=1)}$ is the sum of demands of all M industries. Based on the market prices, the purchaser prices of all domestic products are calculated as follows:

$$P^{(1)}_{(i,s=1)} = \left(1 + t^{(1)}_{(i,s=1)}\right) P_{(i,s=1)} \quad \textbf{(17)}$$

$$P^{(2)}_{(i,s=1)} = \left(1 + t^{(2)}_{(i,s=1)}\right) P_{(i,s=1)} \quad \textbf{(18)}$$

$$P^{(3)}_{(c,i,s=1)} = \left(1 + t^{(3)}_{(c,i,s=1)}\right) P_{(i,s=1)}, \quad c = 1, 2 \quad \textbf{(19)}$$

$$P^{(4)}_{(i,s=1)} = \left(1 + t^{(4)}_{(i,s=1)}\right)\left(1 + tr^{(4)}_{(i,s=1)}\right) P_{(i,s=1)} \quad \textbf{(20)}$$

$$P^{(5)}_{(j,i,s=1)} = \left(1 + t^{(5)}_{(j,i,s=1)}\right) P_{(i,s=1)}, \quad j = 1, \dots, M \quad \textbf{(21)}$$

where $t^{(1)}_{(i,s=1)}, t^{(2)}_{(i,s=1)}, t^{(3)}_{(c,i,s=1)}, t^{(4)}_{(i,s=1)}$ and $t^{(5)}_{(j,i,s=1)}$ are household, government, investors, export and industry specific tax rates on their purchases and $tr^{(4)}_{(i,s=1)}$ is the cost of transporting product *i* to the world market which is a share of the domestic market price.

2.3. Market equilibrium for production factors

The demand for each factor is derived from industries' cost minimisation problems. The supply of each production factor is derived from maximising profits subject to CET (Constant Elasticity of Transformation) functions.

2.3.1. Capital

As mentioned earlier, there are two types of capital (c) in the economy – namely, mining and non-mining capital. The dynamics of each capital is standard – i.e., at any time t, each increases with relevant investment and decreases with relevant depreciation:

$$K_{c,t+1} = I_{c,t} + (1 - \delta_c) K_{c,t}. \quad \textbf{(22)}$$

K_c in any time period is allocated among the relevant industries in accordance with:

$$K_{(j,c)} = \tau_{(j,c)} K_c \left(P_{(j,c)}/P_c\right)^{\omega_c} \quad \textbf{(23)}$$

where $K_{(j,c)}$ is the stock of capital c supplied to industry j, $P_{(j,c)}$ is the rental price paid by industry j, P_c is the average rental price of capital c, $\omega_i \geq 0$ is the elasticity of transformation and $\tau_{(j,c)}$ is a fraction of type c capital supplied to industry j in the initial period. The equilibrium industry-specific price for each type of capital, $P_{(j,c)}$, is determined when the supply equals the demand.

2.3.2. Labour

The supply of labour, E, changes over time due to two sources – changes in labour force and changes in the rate of employment:

$$E = Employment\ rate \cdot Labour\ force$$

We assume that labour force evolves exogenously whereas the employment rate is endogenous in short-run simulations to allow for nominal rigidities but exogenous in long-run simulations to allow for full adjustments in nominal wage. We allow labour to move between industries. In particular, we consider the following nested structure as in Fisher et al., (2010). The supply of labour, E, is allocated between two broad sectors (u) – agricultural and non-agricultural in accordance with the following equation:

$$E_u = \psi_u E \cdot \left(P_{(u,E)}/P_{(E)}\right)^{\lambda} \quad \textbf{(24)}$$

where E_u is the supply of labour to sector u, $P_{(u,E)}$ is the nominal wage paid by sector u, P_E is the average nominal wage and $\lambda \geq 0$ is the elasticity of transformation and ψ_u is a fraction of labour allocated to sector u in the initial period. In respect to agricultural sector, we assume that labour is perfectly mobile among the industries within this sector. In respect to non-agricultural sector, there is another allocation process as labour cannot move freely between the industries within this sector. E_u (u = non-agriculture) is allocated further among 3 subsectors (service, mining and other) in accordance with the following equation:

$$E_{(l,u)} = \psi_{(l,u)} E_u \cdot \left(P_{(l,u,E)}/P_{(u,E)}\right)^{\lambda_u} \quad \textbf{(25)}$$

where $E_{(l,u)}$ is the supply of labour to subsector l (service, mining and other), $\lambda_u \geq 0$ is the elasticity of transformation within non-agricultural sector, $P_{(l,u,E)}$ is the nominal wage paid by subsector l and $\psi_{(l,u)}$ is a fraction of labour in subsector l in the initial period. Further, we assume that each subsector consists of a number of industries and labour within each subsector is perfectly mobile. Each $P_{(l,u,E)}$ is determined by the market clearing condition.

2.3.3. Land

Land is fixed and used only by agricultural sector. The following equation governs the allocation of land among the industries within agricultural sector:

$$L_j = \nu_j L\left(P_{(j,L)}/P_L\right)^{\pi} \quad \textbf{(26)}$$

where $P_{(j,L)}$ is the price paid by industry j in agricultural sector for using land, P_L is the average price in agricultural sector, $\pi \geq 0$ is the elasticity of transformation and ν_j is a fraction of land allocated to industry j in the initial period. The market clearing condition in each industry determines $P_{(j,L)}$.

2.3.4. Natural resources

The supply of natural resources to the industries which are based on natural resources is exogenous. In addition, we assume that natural resources supplied to an industry cannot be reallocated. This assumption implies that natural resources are differentiated and industry-specific. The payments to the owners of natural resources are determined by the market clearing conditions. This is the same assumption used in Fisher et al., (2010).

2.4. Import prices

The CIF prices of imported products, $PCIF_i$, are exogenous for $i = 1, \dots, N$. This is a common assumption used in small open economy models. The CIF prices are first converted into the domestic currency using the exchange rate, PHI, and then import tariff, $tariff_i$, is added before imposing relevant purchaser-specific sales taxes to determine purchaser prices:

$$P_{(i,s=2)} = (1 + tariff_i) \cdot PCIF_i \cdot PHI, \quad i = 1, \dots, N \quad \textbf{(27)}$$

$$P^{(1)}_{(i,s=2)} = \left(1 + t^{(1)}_{(i,s=2)}\right) P_{(i,s=2)} \quad \textbf{(28)}$$

$$P^{(2)}_{(c,i,s=2)} = \left(1 + t^{(2)}_{(c,i,s=2)}\right) P_{(i,s=2)} \quad \textbf{(29)}$$

$$P^{(3)}_{(c,i,s=2)} = \left(1 + t^{(3)}_{(c,i,s=2)}\right) P_{(i,s=2)}, \quad c = 1, 2 \quad \textbf{(30)}$$

$$P^{(5)}_{(j,i,s=2)} = \left(1 + t^{(5)}_{(j,i,s=2)}\right) P_{(i,s=2)}, \quad j = 1, \dots, M \tag{31}$$

where $t^{(1)}_{(i,s=2)}, t^{(2)}_{(i,s=2)}, t^{(3)}_{(c,i,s=2)}$ and $t^{(5)}_{(j,i,s=2)}$ are household, government, investors and industry specific tax rates on the purchase of imported products.

2.5. Zero profit and equilibrium quantity

Each producer (industry) operates in a competitive market and makes zero pure economic profit. In other words, there are no market imperfections, generating pure economic profit. Therefore total revenue equals total cost. From this condition, the equilibrium output of each domestic product is determined.

$$P^{(S)}_{(j,s=1)} Y_j = \sum_{s=1}^{2} \sum_{i=1}^{N} \left(P^{(5)}_{(j,i,s)} X^{(5)}_{(j,i,s)} + E_j P_{(j,E)} \right) + K_j P_{(j,K)} + L_j P_{(j,L)} + \\ + NR_j P_{(j,NR)}, \quad j = 1, \dots, M \tag{32}$$

$$P^{(S)}_{(j,s=1)} = \left(1 + t^{S}_{j}\right) P_{(i,s=1)} \tag{33}$$

where $P^{(S)}_{(j,s=1)}$ is a supplier price and t^{S}_{i} is the production tax rate net of transfers.

2.6. Macroeconomic indicators

GDP, GNP, total export, total import, the balance of payments, CPI, foreign debt, government revenue, the terms of trade and other macroeconomic variables are calculated in the usual ways. The nominal exchange rate, PHI, is determined from the balance of payments equation:

$$INV - SAVE + PHI \cdot (EXPORT - IMPORT) - FY = 0$$

where INV is total investment, $SAVE$ is national saving and FY is net foreign transfer in MNT. Both $EXPORT$ and $IMPORT$ are expressed in USD. The sum of excess investment over $SAVE$ and total export are the supply of foreign (or demand for domestic) currencies while the sum of $IMPORT$ and FY is the demand for foreign (or supply of domestic) currencies. In other words, the exchange rate is determined from the currency market equilibrium condition.

2.7. Closing the model

Like other CGE models, the number of variables in our model is greater than the number of equations. We can divide all the variables into two groups – exogenous and endogenous. We then follow the following principle to solve for the model.

$$The\ number\ of\ equations = The\ number\ of\ endogenous\ variables$$

Normally, the following blocks of variables are considered as exogenous.

- ✓ Population and labour force growth
- ✓ Saving
- ✓ Technological changes
- ✓ Various tax rates
- ✓ CIF price of all products
- ✓ The world real rate of return
- ✓ Various shifters
- ✓ Numeraire

2.8. The method of solving the model

We use the GEMPACK software to solve for the model. Some equations in CGE models are nonlinear – for example, demand depends on the price ratio. But the following main principle is commonly used. As in Johansen (1960), all the variables are transformed into a percent change form so that the model is expressed by the following linear system of equations:

$$\boldsymbol{A}.\boldsymbol{y} + \boldsymbol{B}.\boldsymbol{x} = \boldsymbol{0}$$

where $\boldsymbol{y}$ is the vector of endogenous variables, $\boldsymbol{y}$ is the vector of exogenous variables. $\boldsymbol{A}$ and $\boldsymbol{B}$ are coefficient matrices: each row corresponds to one equation, each column corresponds to one variable. We can then find $\boldsymbol{y}$ as a function of $\boldsymbol{x}$ as follows:

$$\boldsymbol{y} = -\boldsymbol{A}^{-1}\boldsymbol{B}.\boldsymbol{x}$$

where $\boldsymbol{A}^{-1}$ is an inverse matrix of $\boldsymbol{A}$.

This linear system provides only the local solution of the original nonlinear system. So the GEMPACK software uses various extrapolation methods to find the solution for the original nonlinear problem.

3. Data

For the purpose of this study, we employ the Mongolian IO table compiled in 2005 by the National Statistical Office (NSO). This is not a Social Accounting Matrix (SAM) so that some transactions between the agents are not available. For example, it does not show the income that households receive from firms and the government (as transfers), and subsidies that firms receive from the government. It does not also show the details of government tax income as personal and corporate income taxes.

TABLE 1 STRUCTURE OF THE IO TABLE

		Users				
		Industries	Household	Investors	Government	Export
	Size	24	1	2	1	1
Domestic product	24	USE (Domestic flow, User)				
Imported product	24	USE (Imported flow, User)				
Domestic sales tax	24	Tax (Domestic sales tax, User)				
Import sales tax	24	Tax (Imported sales tax, User)				
Import tariff	24	Tariff (Imported)				
Labour	1	USE				
Capital	2	USE				
Land	1	USE				
Natural resources	1	USE				
Production taxes	1	Taxes				

Source: *Author's description.*

The IO table compiled by NSO has 55 industries and each industry produces a single commodity. We aggregate them into 24 industries and assume that each industry produces a single aggregate commodity. These industries are also considered in Fisher et al., (2010), except for Washed coal:

- ✓ **Agriculture** (Livestock, Other agriculture)
- ✓ **Mining** (Thermal coal, Coking coal, Copper, Gold, Minerals, Copper refining)
  - Copper (NonOT and OT)
  - Gold (NonOT and OT)
  - Minerals (NonOT and OT)
- ✓ **Service** (Health, Education, Public administration and defence, Other service)
- ✓ **Other** (Fishery and forest, Oil, Gas, Petroleum, Electricity, Manufacturing, Transport, Construction, Washed coal).

We divide the industries into the following subsectors for the allocation of primary factors.

- ✓ **Natural Resource Based Industries** (Mining, Oil, Gas, Fishery and forest)
- ✓ **Energy** (Thermal coal, Coking coal, Gas, Petroleum, Electricity)

The structure of the IO table used in our study is as above. As can be seen, $N = M = 24$.

4. Calibration

Since we do not have the IO table as of 2012, we cannot use the model for forecasting purposes straight away. Our objective is then to generate the IO table as of 2012 using the model and available data observed between 2005 and 2012.

This section has two main parts. In the first part, the model parameters will be calibrated (validated) using the available data between 2005 and 2011 as the data is available. In the second part, using the validated parameters, we generate the IO table for 2012 by making reasonable assumptions about the prices and output of our main export products as their values are not yet to be realised.

4.1. Calibration (2005-2011)

Our CGE model has a number of parameters characterising preferences and technologies. For simplicity and the lack of empirical findings, we make the following assumptions.

- ✓ For households and the government, the utility functions are a Cobb-Douglas which is a special case of a CES function – i.e., the elasticity of substitution of commodity groups is unity.
- ✓ The CES functions of primary factors in each industry are reduced to Cobb-Douglas functions so that the elasticity of substitution between primary factors is unity.

The most important parameters of the model are the user-specific Armington elasticities (that are, the elasticity of substitution between "$s = 1$" and "$s = 2$" for each commodity), the price elasticities of export functions, ϕ_i, the parameters of investment functions, θ_c and χ_c, and the elasticities of transformation of capital, labour and land among industries, $\omega_c, \lambda, \lambda_u$ and π, the elasticity of substitution parameters governing the *PE* and *ENERGY* bundles and the parameters specifying the CRESH function of the *PF* bundle. These parameters need to be estimated.

Econometric approaches of CGE model parameters have several problems which has prevented researchers from estimating the parameters. One of the main problems has been the lack of information, mainly in developing countries.[6] Given large number of parameters to be estimated, long time series data for numerous variables are required to provide sufficient degrees of freedom for estimation. For this reason, it is common in the literature to adjust (recalibrate) parameter values informally to meet target observed variables of the modelling economy. This is known as a "validation" procedure. In this study, we apply the following validation procedure.

4.1.1. Targets

We target GDP, its composition and the levels of output of selected industries. The values of these variables are from the NSO's statistical yearbooks and monthly bulletins between 2005 and 2011.

---

[6] See Arndt, Robinson and Tarp (2002) for a brief review of empirical research on parameter estimation for a CGE model.

4.1.1.1. Gross Domestic Product (GDP)

Between 2005 and 2011, on average, real GDP grew at 8.3 percent per year while GDP deflator increased at 14.2 percent per year. Our target nominal GDP in 2011 is then 10,899,855 million MNT. In the simulation, we allow real GDP and GDP deflator grow at these rates exogenously. In exchange, general productivity index and the nominal exchange rate are determined endogenously.

4.1.1.2. Composition of GDP

While meeting the GDP targets, we also aim to meet the composition of GDP – that are, household consumption, government spending, investment and net exports. These targets are summarised in the following table. In the simulation, we allow consumption and government spending grow exogenously at 21.24 and 26.68 percent per year respectively which are the observed averages. To meet the investment target, we allow the shifter in the mining investment function to grow at 8 percent per year while exports and imports targets are determined endogenously.

TABLE 2 GDP COMPONENTS IN 2011

Year	2011
Household consumption	50.5%
Government spending	13.9%
Investment	58.1%
Net exports	-22.5%
Exports	63.1%
Imports	85.6%

Source: *NSO's Statistical Yearbook (2005, 2011).*

4.1.1.3. Gross output of selected sector

NSO publishes data on the gross output of Livestock, Crops, Manufacturing, Mining and Electricity. Using the export data published by NSO, we consider the gross output of Copper, Gold, Oil and Coal as targets. These are summarised in the following table.

For Thermal and Coking coal, we assume that all coal sold in the domestic market is thermal as over 99 percent of coal export is coking coal. Thus, the production of Coking coal is represented by coal exports. In the process of arriving to these target values, productions and price indices experienced dramatic changes between 2005 and 2011. For example, in 2006, the price copper increased by over 90 percent. Since our objective is to generate the 2012 IO table, we assume average annual growth in production and in price indices which are summarised in the following table.[7]

[7] In the simulation, the growth rates of output are exogenous while neutral technological changes in the corresponding industries, A_j, are endogenous. Also the price changes in this table enter the simulation exogenously while the corresponding CIF price changes are determined endogenously as their historical values are unknown to us.

TABLE 3 OUTPUT OF SELECTED SECTORS (2005-2011)

Industries	Unit	2005	2011
Livestock	million MNT	609,318.0*	1,505,286.0
Crops	million MNT	137,347.0*	548,373.0
Oil	million MNT	11,187.7*	296,802.7
Manufacturing	million MNT	584.695.0*	1,991,995.0
Electricity	million MNT	174,402.0*	441,326.2
Copper	million USD	326.2	963.6
Gold	million USD	331.4	113.1
Thermal coal	million USD	49.5	342.9
Coking coal	million USD	26.6	2250.0
Washed coal	million USD	1.0	234.0

Source: *NSO's Statistical Yearbook (2005, 2011).*
Note: **These values are from the 2005 IO table. The corresponding values in 2006, 2007 and 2008 Yearbooks are different which indicates a degree of inconsistency in the data.*

Mongolia did not produce any washed or processed coal until 2009. In 2011, Mongolian Mining Corporation (MMC) produced and sold 1.5 million tons of washed coal. The 2005 IO table is modified for Washed coal sector with small (negligible) quantities using the MMC financial data and 74.58 percent annual increase in the production of Washed coal sector is targeted to meet the 2011 production.

TABLE 4 AVERAGE GROWTH RATE OF OUTPUT AND PRICE INDICES OF SELECTED INDUSTRIES

	Average output growth (%)	**Average price change** (%)
Livestock	0.84	11.61
Crops	11.48	13.02
Oil	52.74	13.42
Manufacturing	0.64	21.88
Electricity	4.37	9.37
Copper	-0.81	20.76*
Gold	-30.42	20.14*
Thermal coal	10.50	24.92
Coking coal	46.71	42.78*
Washed coal	74.58	42.78*

Source: *Author's calculation based on the data from NSO's statistical yearbooks (2005, 2011).*
Note: **These are the changes in FOB prices. For coking and washed coal, we consider the same price changes as Washed coal production started in 2011.*

4.1.2. Exogenous shocks

This section outlines the values of the exogenous variables used in the simulations between 2006 and 2020. The values used in the forecast simulation between 2012 and 2020 are assumed.

1) Population growth – we assume that population grows gradually. More specifically, the following growth rates are used.

TABLE 5 POPULATION GROWTH RATE

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Growth	1.23	1.18	1.14	1.13	1.13	1.13	1.13	1.12	1.10	1.08	1.06	1.04	1.01	0.98	0.96

Source: *NSO's statistical yearbooks (2006, 2011) for the period of 2006 and 2011 and author's assumption for the remaining periods.*

2) Labour force growth – in 2005, labour force was 1,307,453 and is assumed to grow at the following rates since then.

TABLE 6 LABOUR FORCE GROWTH RATE

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Growth	2.64	2.28	1.92	1.83	2.04	2.71	2.48	2.31	2.19	2.08	2.00	1.89	1.78	1.73	1.68

Source: *NSO's statistical yearbooks (2006, 2011) for the period of 2006 and 2011 and author's assumption for the remaining periods.*

3) The employment and unemployment rates – we assume that the unemployment rate falls continuously to 7 percent in 2015. However, depending on simulations, this assumption can be changed. For example, the unemployment rate can be endogenous in short-run simulations to allow for nominal rigidities while is exogenous in long-run simulations to allow for full adjustments in nominal wages. In this study, we consider the long-run simulations.

TABLE 7 EMPLOYMENT RATES

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Emp. rate	0.86	0.87	0.87	0.87	0.82	0.87	0.91	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.93

Source: *NSO statistical yearbooks (2006, 2011) for the period of 2006 and 2011 and author's assumption for the remaining periods.*

4) The CIF prices of selected products – these are all percentage changes. NSO does not calculate import and export price indices in the composite sectors that we are considering. Thus these are all assumed values.[8]

TABLE 8 CIF PRICE CHANGES

Year	2006	2007	2008	2009	2010	2011
Construction	10	10	10	10	10	10
Petroleum	10	10	10	10	10	10
Transport	6	6	6	6	6	6
Education/Health	4	4	4	4	4	4
Other mineral	10	10	10	10	10	10
Service	4	4	4	4	4	4

Source: *Author's assumption.*

4.1.3. Parameter estimates

We firstly swap the target variables with originally exogenous variables. For example, some domestic price indices are exogenous while the corresponding CIF prices are endogenous. GDP growth is now exogenous so that general productivity growth becomes endogenous. The growth rates of production in the selected sectors are swapped by neutral technological progress in the corresponding sectors to be exogenous.

Given the exogenous variables (including the targets) and the information in the IO table, we simulate the model for some initial parameter values which are mostly borrowed from the GTAP model and Fisher et al., (2010). We then adjust the parameter values until the values of the endogenous variables do not show overly strange behaviour and the model works without any terminating errors throughout the simulation period. We admit that there is no formal way of measuring the overall goodness of fit of the model.

[8] With regard to the assumed values of the variables and some parameters which are not based on rigorous microeconomic studies, it is common to do sensitivity analyses in the literature. In this study, however, the number of such analyses is excessive as it is the first on this scale. We believe that more studies like this will be undertaken on the Mongolian economy so that more discussions and debates will be undertaken.

We assume, for simplicity, that each user has the same Armington elasticities – i.e., the elasticity of substitution for "$s = 1$" and "$s = 2$" for each commodity and find the following values. Except for Livestock, these values are approximated by those in the GTAP model. For the price elasticities of export functions, ϕ_i, we estimate the following values. As you can see, the export price elasticities are much higher for the mining products than less internationally-traded goods such as Service, Health and Education.[9]

TABLE 9 SIMULATED PARAMETER VALUES

Products	Armington elasticity	ϕ_i
Livestock	5.00	10.000
Other agriculture	3.25	6.500
Fishery and forest	2.00	0.010
Oil	5.20	10.400
Coking/Washed/Thermal coal	3.05	10.000
Copper	3.75	10.000
Gold	2.90	10.000
Copper refinery	3.50	7.000
Minerals	2.90	5.800
Petroleum	2.10	0.001
Electricity	2.80	0.001
Manufacturing	3.00	1.500
Transport	1.90	3.800
Construction	1.90	0.100
Health/Education/Pub admin.	1.90	0.001
Service	1.90	0.200

Source: *Author's calculation.*

The following parameter values are more or less the same as those used in Fisher et al., (2010). The parameters of the investment functions are chosen as $\theta_c = 10$ and $\chi_c = 1$ for both investment goods. We also assume $\omega_{mining} = 0.2, \omega_{non-mining} = 1, \lambda = 2.5, \lambda_u = 5$ and $\pi = 0.1$. In addition, the elasticity of substitution between the *ENERGY* and *PF* bundles is assumed to be zero for *MINING* and 0.04 for non-mining industries, the elasticity of substitution within the *ENERGY* bundle is assumed to be 0.4. Low or zero values of the elasticity of substitution between *ENERGY* and *PF* imply almost or a perfect Leontief structure. The parameters specifying the CRESH function of the *PF* bundle are assumed to be uniformly 0.44 for land and 1.0 for the other primary factors. According to these, mining capital and land are far less mobile than non-mining capital while labour is a more mobile factor within non-agricultural sector. All the elasticity parameters of the CRESH function being equal to unity imply a Cobb-Douglas function. In that sense, we are assuming Cobb-Douglas functions for the *PF* bundles for non-agricultural sectors.

[9] We know that these parameter values are subject to a sensitivity analysis. As mentioned earlier, however, it is a quite time and space consuming job. In addition, bear in mind that we find these values after a number of simulations for different set of values some of which lead to undesired results while some result in a crash of the simulation. Basically, for these parameter values, the model runs well while giving us the target values. However, we cannot claim that there would not be better values.

4.1.4. Results

Given the above parameter values, the values of the exogenous variables and the target values of the chosen variables, the model solves for all the endogenous variables in each period. We accept the fact that these endogenous variables may not be the same as those observed in reality. However, bear in mind that we do not have data for all the variables. We are looking at certain target variables to see the overall fitness of the model with the economy. In addition to the targets, we consider the value-added in some sectors to show how the model is performing.

4.1.4.1. Gross Domestic Product

The target values of both real and nominal GDP are obviously met as their growth rates are exogenous in the simulations. General productivity growth swapped by real GDP growth is, on average, 3.7 percent per year. We will discuss the nominal exchange rate swapped by the GDP deflator more below.

4.1.4.2. Composition of GDP

TABLE 10 RESULTS (GDP COMPOSITION)

	Targets	Simulated
Household consumption	50.5%	51%
Government spending	13.9%	14%
Investment	58.1%	42%
Net exports	-22.5%	-6%
Exports	63.1%	71%
Imports	85.6%	81%

Source: *Author's calculation.*

As can be seen from the above table, the targets for household consumption and government spending are met as their growth rates are exogenous. However, the simulated results are different from the targets for investment and net exports. Note that these are based on the nominal values. Let us see the composition of them in terms of real and price changes.

TABLE 11 RESULTS (REAL AND PRICE CHANGES OF GDP COMPONENTS)

	Targets	Simulated
Real household consumption growth	7.05	8.45
Price index of household consumption	8.91	11.80
Real government spending growth	9.09	17.56
Price index of government spending	16.07	7.90
Real investment growth	15.87	17.37
Price index of investment	14.21	13.19
Real export growth	17.70	5.53
Price index of export	11.25	24.08
Real import growth	19.17	12.92
Price index of import	9.24	20.03

Source: *Author's calculation.*

As can be seen, although the nominal value of government spending meet the target, its real value exceeds the observed and the price index did not increase enough. The reason is the model is not generating enough inflation in Health, Education, and Public Administration and Defence which are the main components of government spending.

4.1.4.3. Output of selected sectors

The model-generated values for gross output of the selected sectors are given in comparison with the targets in the following table. According to this, the comparison looks good. The reason is that these observed values are used as exogenous shocks to the model instead of some originally exogenous shocks (neutral technological progress). However, we are interested in how the model performs in the other areas.

TABLE 12 RESULTS (OUTPUT GROWTH OF SELECTED INDUSTRIES)

Industries	Unit	2011 targets	Simulated
Livestock	million MNT	1,505,286.0	1,613,705.0
Other agriculture	million MNT	548,373.0	548,999.0
Oil	million MNT	296,802.7	302,324.0
Manufacturing	million MNT	1,991,995.0	2,043,429.0
Electricity	million MNT	441,326.2	384,093.0
Copper	million USD	963.6	960.0
Gold	million USD	113.1	102.0
Thermal coal	million USD	342.9	280.7
Coking coal	million USD	2250.0	2308.2
Washed coal	million USD	234.0	237.3

Source: *Author's calculation.*

In the table below, the value-added of some sectors generated endogenously by the model are compared with the observed.

TABLE 13 SIMULATION RESULTS(VALUE-ADDED OF SELECTED INDUSTRIES)

Sectors	**Observed** increase (in folds)	**Simulated** increase (in folds)
Transportation	3.4	3.17
Construction	2.3	5.36
Health	5.1	3.32
Education	5.1	3.83
Public admin. and defence	5.6	4.68

Source: *Author's calculation.*

Although the model does not generate close enough increase in the value-added of the sectors (except for Transportation), one could say that the directions are correct at least.

Above we saw that the model is doing a reasonably good job in generating data for some endogenous variables while meeting the targets of the selected variables. For the chosen parameter values, however, some other variables are misbehaving. The most volatile variable is the nominal exchange rate, especially in 2011 as opposed to roughly 1300 in reality. The following table shows the model generated values for the exchange rate.

TABLE 14 SIMULATION RESULTS (NOMINAL EXCHANGE RATE)

Nominal exchange rate	2005	2006	2007	2008	2009	2010	2011
MNT/USD	1205	1500	1694	1704	1498	1173	803

Source: *Author's calculation.*

The following table has the model-generated export growth of some commodities which seem untrue, especially Livestock in 2009, 2010 and 2011.

TABLE 15 SIMULATION RESULTS (EXPORT GROWTH OF SELECTED INDUSTRIES)

Export growth (%)	2006	2007	2008	2009	2010	2011
Livestock	47.83	26.66	4.76	-21.09	-58.5	-90.06
Manufacturing	-1.85	-2.36	-3.07	-3.30	-7.13	-8.43
Service	4.73	2.35	-0.52	-3.85	-6.68	-9.95

Source: *Author's calculation.*

Before we simulate the IO table for 2012, it is worthwhile mentioning the difficulties that we face in validating the parameter values. Having simulated the model many times for different set of parameter values, we find that our method of estimating the parameter values is inefficient (time consuming) as we enter the parameter values manually for each simulation and there is no systematic approach (such as formal econometric tests) to the validity of the parameter values. In our mind, there should be a method (a solver software) that chooses all the parameter values from pre-specified grid points (intervals) simultaneously while minimising the Sum of Differences between Targeted and Simulated variables. Unfortunately, we have learned that the GEMPACK program does not have this facility.[10]

In addition, we should not forget the hidden impact of informal sector on the economy and the observed data. Some estimates suggest that the size of the informal sector in Mongolia is about 40 percent of GDP (e.g., NSO). We firmly believe that the informal sector activities are the one of the reasons why some model-generated variables are misbehaving due to the inconsistencies in the data. We also think that the model specification may not be a right representation of the IO table in 2005. Alternatively the IO table data may not be the equilibrium outcome of the CGE model.

4.1.5. General government budget

The 2005 IO table has a column which shows that purchases made by the government on the products produced by domestic industries as well as imported. The sum of the purchases is recorded as government spending which accounts for about 12 percent of GDP in 2005. In addition, we showed above that government spending increased significantly over the 2006-2010 period but it did not exceed 14 percent of GDP. The question is then what the total expenditure expected to be 42.2 percent of GDP in 2013 mean. The reason is that government spending recorded for GDP calculations is only a part of the total expenditure on goods and services. More specifically, it is[11]

$$Government\ spending = Total\ expenditure - capital\ expenditure - revenue\ from\ primary\ and\ non-primary\ activities =$$

[10] In GAMS, however, an approach gaining popularity in the literature is known as a Maximum Entropy Approach by Arndt, Robinson and Tarp (2002). They apply information theory to estimating a system of nonlinear simultaneous equations. We will consider this approach in our future work.

[11] "The Method of Calculating GDP and GNP", NSO (2007).

$$Current\ expenditure - revenue\ from\ primary\ and\ non-primary\ activities.$$

Our model is not based on a SAM (Social Accounting Matrix) which is an extended version of an IO table, showing the transactions of all participants. For example, a SAM shows the income allocated to households so that one can calculate their disposable income. On the other hand, the 2005 IO table does not have any information about household income including transfers from the government. There is no a SAM for Mongolia. Consequently, it is impossible for the model to account for all the transactions. For example, we are unable to see the effects of the remaining part of the total expenditure on the economy explicitly as capital expenditure is a part of total investment in the economy. Looking at the government budget in 2005, we believe that government spending recorded for the GDP calculation is the expenditure on goods and services, 356,201 million MNT, as being quite close to the figure in the IO table which is 344,488 million. In the simulation, we target the total government expenditure as of 2011 which is about 4.7 trillion MNT. In doing so, we generate a variable in the model code which accounts for the remaining government expenditure and grows at an exogenous rate to meet the target.

The 2005 IO table has information on production taxes, domestic sale taxes, imported sale taxes, import tariff and export taxes. The sum of these taxes is used in the calculation GDP. On the other hand, general government budget details every source of its revenue such as tax revenue from businesses, population and windfall etc. Tax revenue from the IO table is about 406,582 million MNT in 2005 while the net tax revenue (tax revenue (583,119) – subsidies and transfers (160,428)) is about 423,771 million MNT (Yearbook 2005, NSO). In the government budget, subsidies and transfers are recorded on the government spending side. In that respect, tax revenue in the model is understood as a representative of the net tax revenue despite the small difference. Again, we target the total government revenue as of 2011 which is about 4.4 trillion MNT. In doing so, we create a variable representing the remaining government revenue which then grows as an exogenous rate to meet the target. As a consequence, we generate the exact value for the government budget deficit as of 2011. This value becomes the initial value for the forecast simulations.

4.2. Simulation (2012)

In the previous subsection, we use the data observed between 2005 and 2011 to estimate the parameter values. In this subsection, we use those parameter values together with the prices and quantities of main export commodities such as copper and coal to predict the year-end values of the endogenous variables in the model. In doing so, the model generates the IO table for 2012 which will be used in our main analysis with the FSL.

4.2.1. Exogenous shocks

Between October 2011 and October 2012, the following changes happened in the price of our main export commodities (October 2012 bulletin, NSO).

TABLE 16 COMMODITY PRICES

Price	Unit	2011 I-X	2012 I-X
Coal	USD/tn	102.0	98.0
Copper (concentrate)	USD/tn	1744.0	1453.0

Source: *October 2012 bulletin, NSO.*

According to this, the price of copper and coal decreased by 16 and 3 percent respectively. The following table shows how the export quantities changed over the same period.

TABLE 17 EXPORT QUANTITIES OF COAL AND COPPER

Quantities	Unit	2011 I-X	2012 I-X
Coal	million tonnes	15.96	16.55
Copper (concentrate)	thousand tonnes	475.00	479.00

Source: *October 2012 bulletin, NSO.*

For the actual simulation between 2011 and 2012, we use more moderate changes than those in the above table since there are still two months until the end of the year and the market conditions are improving in both coal and copper markets. In addition, we understand that Oyu Tolgoi copper mine has started its operation so that we assume the following productions of copper and gold for 2012.

TABLE 18 ASSUMED PRICES OF COPPER AND COAL USED IN THE SIMULATION

Price	Unit	2011	2012
Coking coal	USD/tn	106.0	106.0
Copper (concentrate)	USD/tn	1682.0	1531.0
Washed coal	USD/tn	156.0	156.0

Source: *Author's assumption.*

Between October 2011 and October 2012, the export of crude oil increased by 41.7 percent. Thus we assume that the same increase can happen in 2012.

TABLE 19 ASSUMED QUANTITIES OF SELECTED MINING PRODUCTS USED IN THE SIMULATION

Quantities	Unit	2011	2012
Coking coal	million tonnes	19.5	19.5
NonOT Copper (concentrate)	thousand tonnes	575.9	575.9
Washed coal	million tonnes	1.5	3.0
Oil	thousand barrel	2553.7	3618.5
OT Copper (concentrate)	thousand tonnes	0.0	28.9
OT Gold	thousand ounce	0.0	27.8

Source: *Author's assumption.*

In addition to these shocks, we assume the following changes.

- ✓ Nominal government spending increases at 25 percent.
- ✓ Nominal private consumption increases at 25 percent so national saving is endogenous.
- ✓ The nominal exchange rate, *PHI*, appreciates at 2 percent.
- ✓ General productivity growth is 3 percent.
- ✓ Shifters in the two investment functions increased uniformly by 20 percent.
- ✓ The CIF prices of some products are changed as follows:

TABLE 20 ASSUMED CIF PRICES OF SELECTED INDUSTRIES

	CIF prices (%)
Manufacturing	10.0
Transportation	6.0
Construction	10.0
Health	4.0
Education	4.0
Service	4.0
Livestock	0.0
Other agriculture	0.0
Petroleum	4.6

Source: *Author's assumption.*

4.2.2. Results

Using 2011 as a base year and the exogenous shocks outlined above, the model solves for all the endogenous variables for 2012. The results given below are the expected outcomes generated by the model for 2012. For example, we expect that inflation will be around 11.45 percent, real GDP will grow by about 11 percent and Construction sector will expand most rapidly at 21 percent.

TABLE 21 SIMULATION RESULTS (MACROECONOMIC VARIABLES AND OUTPUT OF SELECTED INDUSTRIES)

Macroeconomic variables (%)		Output growth of selected sectors (%)	
Price index of private consumption	11.45	Livestock	3.69
Real export	7.04	Other agriculture	-0.29
Real GDP	10.64	Electricity	8.11
Real imports	18.36	Manufacturing	8.77
GDP deflator	8.98	Transportation	10.05
Tax revenue	23.34	Construction	21.05
Mining sector output	6.56	Health	5.94
Non-mining sector output	10.38	Education	5.38
Real wage	10.42	Public administration and defence	8.27
Nominal government spending	25.00	Service	9.34

Source: *Author's calculation.*

The composition of nominal GDP is expected to be as follows:

TABLE 22 SIMULATION RESULTS (GDP COMPONENTS)

	Million MNT	Share of GDP (%)
Nominal GDP	15829.01	100.0
Private consumption	8295.25	52.0
Government spending	2285.20	14.0
Investment	7563.03	48.0
Net exports	-2309.39	-15.0
Export	7112.52	45.0

Import	9422.38	60.0

Source: *Author's calculation.*

These figures can be compared with the actual ones once the data becomes available. In addition, the actual values will be used to re-simulate the model for this purpose.

5. Fiscal Stability Law and the CGE model

We now discuss the FSL and its connection with our CGE model. 2013 is the year that the government budget is approved by the parliament on the basis of the FSL in its full extent. We now outline the main characteristics of the FSL and the government's recently-approved 2013 budget.

5.1. The Fiscal Stability Law

According to Section 6 of the FSL, the government budget must meet the following four requirements:

- **6.1.1.** Total budget revenue must be calculated with the equilibrated method.
- **6.1.2.** The budget deficit derived from the equilibrated method must not exceed 2 percent of GDP in the same year or must become surplus.
- **6.1.3.** The growth rate of total expenditure must not exceed the maximum of the growth rate of non-mining GDP in the same year and the average growth rate of non-mining GDP in the previous 12 years.
- **6.1.4.** The present value of government debt must not exceed 40 percent of GDP of the budget year.

The equilibrated method is a method that uses the "equilibrated" prices of main mining products.[12] The definition of the equilibrated prices is spelled out in Section 11.1.3 of the FSL. According to this, one must first calculate the average price of last 12 years for each main mining product as well as the average price of subsequent three years (including the current year) predicted by the government approved international agency. The equilibrated price is the average of these two average prices.[13]

According to the FSL, if the actual prices of the main mining products are higher than the equilibrated counterparts, the actual total revenue exceeds its predicted and hence the surplus must be saved in a Fiscal Stability Fund (FSF). The government aims to increase the FSF over time and maintain it to at least 5 percent of GDP thereafter. The fund will be used when the actual prices of the main mining products are realised to be less than the equilibrated prices to maintain the stability of fiscal positions. Any fund above 10 percent of GDP can be invested in specified economic activities such that it does not affect the stability of the economy, especially inflation.

5.2. Government budget plan – 2013

It is a special year that the government budget approved by the parliament for 2013 is based on the FSL. The fiscal authorities have issued a 354-page-document. We, however, focus on the details relevant to our study.

According to this document:

[12] The definition of main mining products is that they contribute at least 3 percent of total government revenue.
[13] 2013 budget document shows how it is calculated.

- ✓ Copper and coal are defined as the main mining products as the income from these sectors contribute to more than 3 percent of total government revenue.
- ✓ The equilibrated prices of the main mining products in 2013 are given in the following table.

TABLE 23 EQUILIBRATED PRICES OF MAIN MINING PRODUCTS (2013)

Copper (99%)	USD/tn	6328.9
Processed (washed) coal	USD/tn	131.5
Coking coal (5500+ kcal)	USD/tn	80.2
Bituminous coal (4000-5500 kcal)	USD/tn	65.5

Source: *2013 Government Budget Plan.*

- ✓ The equilibrated revenue is expected to be 7,088.3 billion MNT which is 40.2 percent of expected GDP. This meets the requirement in Section 6.1.1 of the FSL.
- ✓ The total expenditure is expected to be 7,449.2 billion MNT which is 42.2 percent of expected GDP. In their calculation, the average growth rate of GDP from non-mining sectors over 2001-2012 is 22.4 percent while the growth rate of GDP from non-mining sector in 2012 is expected to be 16.5 percent. As the total expenditure is expected to increase by 18 percent in 2013, it meets the requirement in Section 6.1.3 of the FSL – i.e., less than $22.4 = max(22.4, 16.5)$.
- ✓ The equilibrated budget deficit is expected to be 360.9 billion which is less than 2 percent of expected GDP. This meets the requirement in Section 6.1.2 of the FSL.
- ✓ Any revenue exceeding the equilibrated revenue will be accumulated in the FSF.

5.3. The FSL in the CGE model

In the following section, we simulate the model-economy between 2013 and 2020 under three different scenarios to assess the impact of the FSL. In the first scenario, we assume that the government has established a series of equilibrated prices of the main mining products (copper and coal) until 2020. Given the series of the prices, the government determines a series of its total expenditure such that it satisfies the requirements of the FSL. It is an iteration procedure in a sense that we first simulate the model until 2020 for a random series of government expenditure and see if the requirements of the FSL are satisfied. If not, we adjust the government expenditure in years where the requirements are not met and simulate the model repeatedly until the requirements are met. As a result, we generate a predetermined series of the government total expenditure which satisfy the FSL. In the second scenario, we consider a much more volatile series of prices of the main mining products together with the series of government expenditure determined in the first scenario. This is an environment in which the FSL is in action – i.e., the government total expenditure follows a predetermined process based on the equilibrated method regardless of actual economic conditions. The effect of the FSL is reflected by various indicators such as real and nominal GDP, price indices and output of different sectors. The Fiscal Stability Fund is then determined by the difference between total government revenue and the predetermined government expenditure. In the last scenario, we simulate the model with the same volatile prices of the main mining products but government expenditure is endogenous – in particular, it follows GNP. This is an environment in which the FSL is not in action. We consider this scenario to determine the marginal difference that the FSL makes to the economy. In doing so, we measure the same indicators as in the second scenario and compare them to access the impact of the FSL. Specifically, we measure and compare the average growth rates and the standard deviation of chosen variables as well as illustrate graphically the model generated changes of those variables.

In Section 3, we saw that the total government revenue grew faster than tax revenue while the total expenditure grew faster than government spending on goods and services. In the simulations between 2013 and 2020, however, we assume that the total government revenue growth at the same rate as tax revenue while the total government expenditure grows at the same rate of government spending on goods and services. In this way, the share of tax revenue in the total revenue and the share of government spending in the total expenditure remain stable. While the tax revenue is endogenous, government spending on goods and services is either exogenous or endogenous depending on the scenarios. Consequently, the model generates a series of budget deficit.

In our model, the market for loanable fund operates as follows. National saving $(SAVE)$ has two parts – private $\left(S_{private}\right)$ and public saving $\left(S_{public}\right)$:

$$SAVE = S_{private} + S_{public}$$

$$SAVE = (Y - C - T) + (T - G) = Y - C - G$$

where Y is national income (GNP), C is private consumption, T is tax revenue and G is government spending. As we saw earlier, investment (INV) is an endogenous variable and depends on the relative rate of return and output. If $SAVE > INV$, the excess saving will be invested abroad and will earn the world rate of return. Otherwise, national saving will not be sufficient to finance the desired investment and hence foreign investment will fill up the gap.

Our model does not make any specific assumption about how government budget deficit is financed and who receives the interest payment of government borrowing as not being based on a full SAM. However, it is implicitly assumed that budget deficit is financed by borrowing from the loanable fund market. In the case of budget surplus, the surplus will increase the loanable fund $(SAVE)$ and will earn the market rate of return. The interest payment is calculated at the aggregate level and affects the national income as described in (1).

6. Simulation

In this section, we simulate the model between 2013 and 2020 in the following three scenarios.

- ✓ Baseline scenario
- ✓ FSL scenario
- ✓ Alternative (without FSL) scenario

6.1. Baseline scenario

As mentioned earlier, in this scenario, we assume that the government has established a series of equilibrated prices of copper and coking (both raw and washed) coal in accordance with the FSL until 2020. More specifically, the prices of copper and coal grow at constant 7 percent from their 2013 (actually equilibrated) values which are given in the following table.

This implies that the prices of copper, coking coal and washed coal are falling by 15.7, 25.9 and 15.7 percent from their 2012 levels respectively, but then start growing at 7 percent annually in the following years. As a result, the prices will be 60 percent higher in 2020 than their 2013 levels.

TABLE 24 EQUILIBRATED PRICES OF THE MAIN MINING PRODUCTS USED IN THE SIMULATION

Equilibrated price	Unit	2013
Copper (99%)	USD/tn	6328.9
Washed coal	USD/tn	131.5
Coking coal	USD/tn	80.2

Source: *2013 Government Budget Plan.*

In 2013, the production of Oyu Tolgoi copper mine will be dramatically high. According to the government and Oyu Tolgoi company, they have the following plan.

TABLE 25 OT PRODUCTION PLAN

Quantities	Unit	2013	2014	2015	2016	2017	2018	2019	2020
OT Copper (concentrate)	1000 tn	50	179	179	279	415	601	761	783
OT Gold	1000 oz	119	796	796	620	560	530	1063	753

Source: *Fisher et al. (2010).*

According to the 2013-budget-document, coking coal export will increase by 50 percent in 2013 due to increased production of Tavan Tolgoi coal mine. We also assume that the production of washed coal will also increase by 80 percent. This means that the country will be exporting about 30 million tonnes of raw coking coal and 5.4 million tonnes of washed coal in 2013. The series of production projections are summarised in the following table.

TABLE 26 COAL PRODUCTION PLAN

Quantities	Unit	2013	2014	2015	2016	2017	2018	2019	2020
Coking coal	mill.tn	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Washed coal	mill.tn	5.4	8.1	9.4	10.8	12.1	13.5	13.5	13.5

Source: *Author's assumption.*

In addition to these, we assume that general productivity of the economy increases at 3 percent per year, the exchange rate of USD appreciates at 2 percent a year and the CIF prices increase at the same rates as in 2012.

Unlike the historical simulation in the previous section, nominal household consumption is endogenous and follows GNP so that national saving is exogenous.

Given these shocks, we simulate the model for a random series of government spending shocks. The model generates series of the budget deficit and its share in GDP and the growth rate of non-mining sector output. As we know from 6.1.2 of the FSL, the budget deficit cannot exceed 2 percent of GDP in the same year.

As of 6.1.3 of the FSL, we take the following steps. We take the sum of the growth rate of output in non-mining sector and GDP deflator as a proxy for the growth rate of GDP in this sector. Since we do not have actual data for the growth rate of GDP in non-mining sector in last 12 years, we use the model generated values from 2006. Specifically, we use the previous 8-year, 9-year, 10-year and 11-year averages for 2013, 2014, 2015 and 2016 respectively and finally the 12-year average for the remaining four periods. These average values of the growth rate of GDP in non-mining sector are to be compared with the corresponding growth rate of GDP in non-mining sector in the same year and we take their maximum. As we know, the growth rate of government expenditure must not exceed the corresponding maximum value in each year.

We adjust the growth rate of government spending in each year such that it meets the requirements 6.1.2 and 6.1.3 of the FSL.

Given the shocks and procedure outlined above, we find the following series of the growth rate of government spending which meet the requirements of the FSL.

TABLE 27 RESULTS (CONSISTENT WITH THE FSL)

	%	2013	2014	2015	2016	2017	2018	2019	2020
1	Government spending growth	18.0	12.0	7.0	8.0	6.0	7.0	8.0	8.0
2	GDP growth in non-mining sector	17.6	24.7	-6.5	10.5	2.9	7.6	14.7	4.2
3	Proxy for previous 12-year average of GDP growth in non-mining sector	21.0	21.4	18.6	17.8	16.6	15.2	14.4	12.8
4	Maximum of 2 and 3	21.0	24.7	18.6	17.8	16.6	15.2	14.7	12.8
5	Budget deficit to GDP ratio	-0.5	5.4	-1.8	-0.1	-1.8	-1.3	2.9	1.4

Source: *Author's calculation.*

It is clear that we have chosen a stable series of government spending growth. In particular, we find that the mean rate of growth is 9.3 percent and its standard deviation is 4.0 percent.

6.2. FSL scenario

In this scenario, we assume that the government is committed to maintain the growth rate of its spending determined in the baseline scenario regardless of economic conditions. However, the actual prices of copper and coal behave very differently from their equilibrated values. We assume that the prices will grow by 60 percent between 2013 and 2020 overall which is the same as in the baseline scenario. Interim, the prices behave as described in the following table rather than 7 percent constant growth as in the baseline scenario.

TABLE 28 ASSUMED VOLATILE PRICES OF THE MAIN MINING PRODUCTS (2013-2020)

Actual price change (%)	2013	2014	2015	2016	2017	2018	2019	2020
Coking coal	-25.9	5.0	30.0	5.0	-10.0	10.0	25.0	-10.0
Washed coal	-15.7	5.0	30.0	5.0	-10.0	10.0	25.0	-10.0
Copper	-15.2	5.0	30.0	5.0	-10.0	10.0	25.0	-10.0

Source: *Author's assumption.*

As you can see, we have chosen a quite dramatic case with quite high degree of volatility and perfect contemporaneous correlation between the prices. Such high degree of volatility can be justified by recent historical records of the prices which have been derived by the author using statistical yearbook data from NSO.

TABLE 29 PRICES OF THE MAIN MINING PRODUCTS (2006-2011)

Price change (%)	2006	2007	2008	2009	2010	2011
Copper	96.1	28.6	3.7	-40.1	53.5	29.0
Coking coal	47.7	91.4	24.6	-2.8	22.5	102.2

Source: *Author's calculation based on the data from NSO's statistical yearbook (2006, 2011).*

The rest of the details are the same as those in the baseline scenario.

6.2.1. Results

The results are presented in the following tables.

TABLE 30 RESULTS (MACROECONOMIC VARIABLES)

Macroeconomic variables (%)	2013	2014	2015	2016	2017	2018	2019	2020
Price index of private consumption	13.3	11.9	-1.9	0.7	-7.9	4.0	12.9	-6.4
Real export	29.8	22.6	6.8	15.7	13.9	7.9	11.2	12.9
Real GDP	19.8	16.2	4.8	9.1	3.4	6.2	13.3	3.1
Real imports	21.4	21.5	-4.9	0.3	-14.3	2.6	21.0	-11.2
Tax revenue	28.2	28.7	2.6	7.0	-8.9	11.0	29.6	-5.2
Mining sector output	36.2	25.5	0.0	11.6	1.1	3.2	18.9	0.4
Non-mining sector output	10.8	10.6	7.1	7.8	5.9	6.3	7.8	5.9
Real wage	11.7	11.4	-1.3	1.0	-6.1	1.8	9.1	-5.1
Terms of trade	-14.7	-1.6	1.9	-5.8	-14.9	-3.0	6.0	-14.1
Nominal national saving	26.9	21.4	1.4	1.2	-14.9	7.6	23.5	-14.8

Source: *Author's calculation.*

These results are mere forecasts and cumbersome to explain how they have been achieved. Therefore we will compare and contrast them with those from the scenario without FSL and discuss the underlying mechanism for the differences in a later subsection.

The following table shows what is happening to output growth in a set of selected industries.

TABLE 31 RESULTS (GROWTH RATES OFOUTPUT OF SELECTED INDUSTRIES)

Growth rate of gross output (%)	2013	2014	2015	2016	2017	2018	2019	2020
Livestock	2.7	3.4	7.0	6.4	8.0	5.0	3.7	7.5
Other agriculture	-1.2	-0.2	9.3	6.4	12.3	4.2	-1.1	11.0
Electricity	9.0	5.7	8.6	7.7	7.8	5.7	4.8	6.7
Manufacturing	7.7	8.4	16.1	13.9	21.6	12.5	5.0	23.9
Transportation	20.5	17.9	5.7	10.3	2.8	6.1	15.4	2.5
Construction	23.3	25.6	-5.6	2.2	-16.9	1.5	28.8	-16.2
Health	-0.1	-2.8	12.5	7.9	15.8	3.4	-3.9	13.0
Education	-1.2	-3.7	14.7	10.0	22.2	5.1	-5.4	20.2
Public admin. and defence	0.2	-3.5	13.1	9.3	21.0	3.8	-6.1	19.2
Service	9.6	9.2	5.8	4.5	-1.9	4.2	9.9	-3.7

Source: *Author's calculation.*

6.3. Alternative (without FSL) scenario

To access how much stabilisation the FSL is creating, we consider the case in which the government spending is endogenous and follows GNP – i.e., procyclical. In this subsection, we merely report the results. In the following subsection, however, we compare the results from the two scenarios and discuss the costs and benefits of the FSL and its underlying mechanism.

The following table has the results for the selected macroeconomic variables.

TABLE 32 RESULTS (MACROECONOMIC VARIABLES)

Macroeconomic variables (%)	2013	2014	2015	2016	2017	2018	2019	2020
Price index of private consumption	13.8	12.5	-2.5	0.4	-8.6	4.2	13.4	-7.0
Real export	29.6	22.4	7.0	15.8	14.2	7.8	11.0	13.3
Real GDP	19.8	16.2	4.8	9.1	3.4	6.1	13.3	3.1
Real imports	21.7	21.9	-5.4	0.2	-14.4	2.7	21.1	-11.2
Tax revenue	28.0	28.9	2.1	7.1	-8.1	11.1	28.9	-4.1
Mining sector output	36.2	25.5	0.0	11.6	1.1	3.2	18.9	0.4
Non-mining sector output	11.1	10.9	6.8	7.5	5.1	6.3	8.2	5.3
Real wage	13.3	13.2	-2.4	-0.3	-10.2	2.0	12.1	-9.4
Terms of trade	-14.6	-1.4	1.6	-5.9	-15.1	-3.0	6.2	-14.3
Nominal national saving	27.8	22.7	0.3	0.6	-16.2	7.8	24.6	-16.0

Source: *Author's calculation.*

The table below shows what is happening to output growth in the same selected industries.

TABLE 33 RESULTS (OUTPUT GROWTH OF SELECTED INDUSTRIES)

Growth rate of gross output (%)	2013	2014	2015	2016	2017	2018	2019	2020
Livestock	2.1	2.8	7.5	6.9	9.8	4.9	2.6	9.5
Other agriculture	-1.6	-0.9	9.9	6.8	13.5	4.1	-1.7	12.1
Electricity	8.3	5.0	9.3	8.4	9.8	5.6	3.6	8.7
Manufacturing	6.8	7.4	17.0	14.8	24.5	12.2	3.5	26.6
Transportation	20.0	17.6	6.0	10.7	4.1	6.0	14.5	3.8
Construction	23.7	25.9	-6.0	2.0	-17.5	1.6	29.5	-16.8
Health	3.7	1.2	9.7	4.4	2.3	3.6	3.8	-2.1
Education	2.8	0.7	11.4	6.1	8.0	5.3	2.0	4.9
Public admin. and defence	6.8	3.7	7.8	3.2	-0.3	4.3	5.7	-3.4
Service	9.0	8.6	6.1	5.1	0.1	4.1	8.5	-1.6

Source: *Author's calculation.*

For these results to emerge, the following series of growth rate of government spending are determined endogenously.

TABLE 34 RESULTS (GOVERNMENT SPENDING GROWTH)

	2013	2014	2015	2016	2017	2018	2019	2020
Government spending growth (%)	27.8	22.7	0.3	0.6	-16.2	7.8	24.6	-16.0

Source: *Author's calculation.*

In comparison to those in the FSL scenario, the mean rate of growth for the government spending is 6.4 percent and its standard deviation is 17.5 percent as opposed to 9.3 percent and 4.0 percent respectively. In other words, government spending is much more volatile and procyclical compared to the FSL scenario.

6.4. Comparing the scenarios

We now compare and contrast the results from the FSL scenario with those in the alternative scenario. The following two tables show the mean and the standard deviation of the above selected variables.

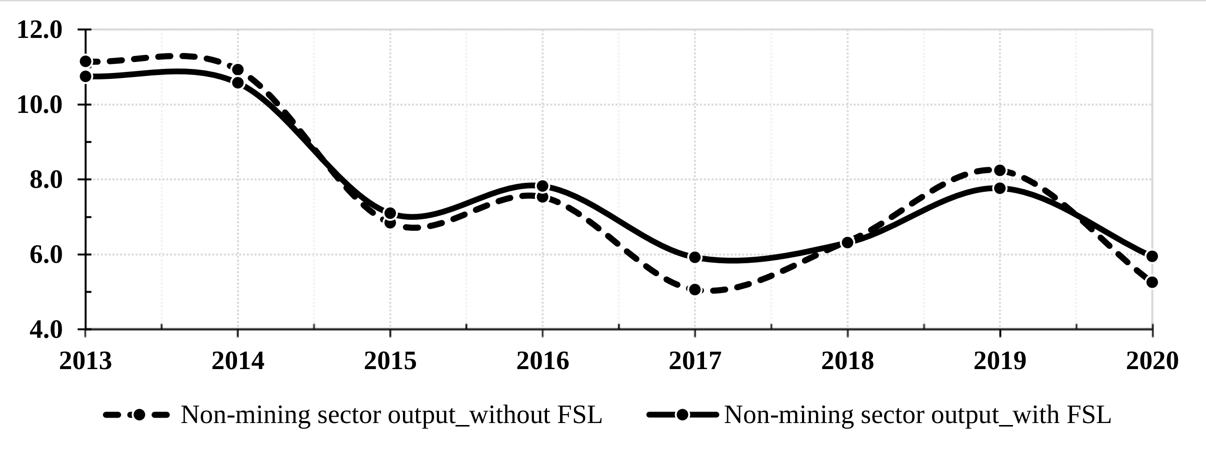
According to these macroeconomic variables, the mean growth rates are more or less the same across the scenarios while the standard deviations tend to be smaller in the FSL scenario except for tax revenue and real exports. The magnitude of the volatility of real wage and the output of non-mining sector are substantially lower in the FSL scenario. The graphs below show the model generated values for these two variables. You can clearly see how these variables are being stabilised under the FSL.

TABLE 35 COMPARING THE SIMULATION RESULTS (MACROECONOMIC VARIABLES)

Macroeconomic variables (%)	Mean		Standard deviation	
	FSL	Alternative	FSL	Alternative
Price index of household consumption	3.3	3.3	8.6	9.2
Real export	15.1	15.2	7.7	7.6
Real GDP	9.5	9.5	6.3	6.3
Real import	4.5	4.6	14.9	15.1
Tax revenue	11.6	11.7	15.6	15.2
Mining sector output	12.1	12.1	13.6	13.6
Non-mining sector output	7.8	7.7	1.9	2.3
Real wage	2.8	2.3	7.1	9.7
Terms of trade	-5.8	-5.8	8.1	8.1
Nominal national saving	6.5	6.4	16.5	17.5

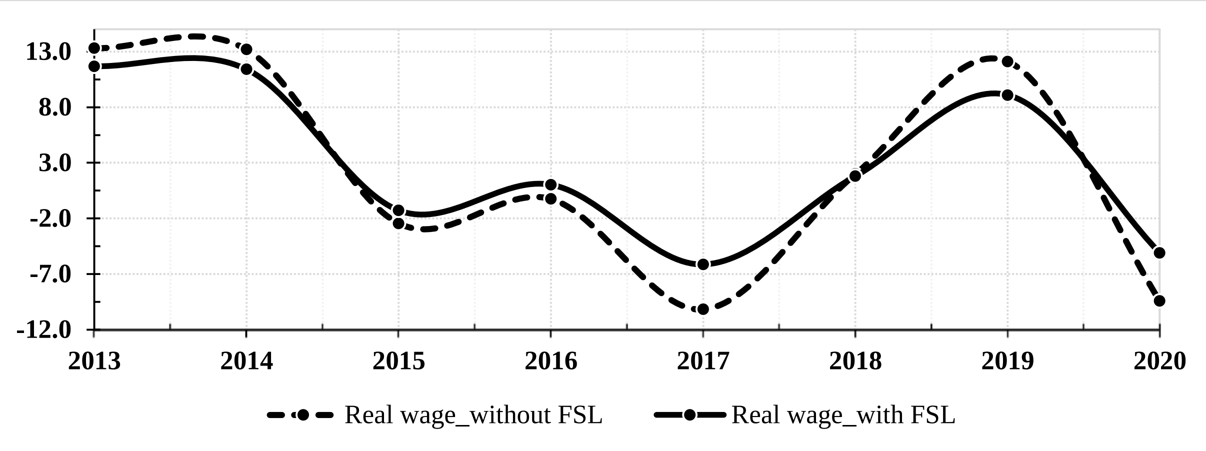
Source: *Author's calculation.*

FIGURE 1 COMPARING THE SIMULATION RESULTS (OUTPUT GROWTH OF NON-MINING SECTOR)



Source: *Author's calculation.*

FIGURE 2 COMPARING THE SIMULATION RESULTS (REAL WAGES)



Source: *Author's calculation.*

The above two graphs are the examples of the case where the volatilities are significantly reduced by the FSL. In most cases, however, we see little or no visible reductions in the volatility if we present their graphs. We will try to explain the underlying mechanism of the policy in reducing the volatility in the following subsection.

The following table shows the mean and standard deviation of the growth rates of output for the selected sectors.

TABLE 36 COMPARING THE SIMULATION RESULTS (OUTPUT GROWTH OF SELECTED INDUSTRIES)

Growth rate of gross output (%)	Mean		Standard deviation	
	FSL	Alternative	FSL	Alternative
Livestock	5.5	5.8	2.0	3.1
Other agriculture	5.1	5.3	5.5	6.3
Electricity	7.0	7.3	1.5	2.3
Manufacturing	13.6	14.1	6.7	8.3
Transportation	10.2	10.3	7.0	6.3
Construction	5.3	5.3	18.5	18.9
Health	5.7	3.3	7.7	3.3
Education	7.7	5.1	10.7	3.5
Public admin. and defence	7.1	3.5	10.2	3.7
Service	4.7	5.0	5.2	4.0

Source: *Author's calculation.*

Except for Health, Education and Public Administration and Defence, the magnitude of the volatility in the sectors have decreased to induce the overall decrease in the volatility of output in non-mining sector. The reason why the above three sectors exhibit more volatile growth under the FSL is the following. We find that the price indices of government spending in the both scenarios follow roughly the same pattern but the volatility in the FSL scenario is slightly smaller. Consequently, real government spending is much more volatile in the FSL scenario as the nominal government expenditure is very stable. Since the output of these three sectors is mainly purchased by the government, they follow the radical behaviour of real government spending.

6.5. Discussion

Given the results displayed in the previous subsections, it can be claimed that the FSL tends to reduce the volatility of most variables. In this subsection, we try to explain the underlying mechanism of the FSL in reducing the volatility of the variables. Unlike partial equilibrium models, it is hard to explain the final effect of any policy in a multi-sector general equilibrium models as there could be many conflicting forces in the form of direct, indirect and induced effects in the presence of many resource constraints so that we only see the net effects.

In copper, coking and washed coal industries, their value added reflects the relevant price changes since the production quantities are given exogenously. In both scenarios, this is inevitable. As a consequence, both GDP and GNP change in both quantities and price indices according to the national accounting system. Private consumption, national saving and government spending follow nominal GNP in the scenario without FSL. On the other hand, the first two follow nominal GNP but government spending follows the predetermined growth rates so that partially reduces the volatility of aggregate demand. As a consequence, the volatility of price levels in the form of CPI, government spending price index, GDP deflator and GNP deflator is reduced. As mentioned earlier, real government spending becomes more volatile in the FSL scenario as nominal spending is stable while its price index is slightly less volatile in the FSL scenario. As a result, the demand for Health, Education and Public Administration and Defence and consequently the output growth in these sectors is more volatile which is transmitted through the economy in their own channels. The results presented in the previous subsections are the net (or general equilibrium) effects of the policy. We observe that in the FSL scenario, real GDP is equally volatile, real GNP is less volatile, real aggregate investment is slightly less volatile, both real aggregate export and import are equally volatile and the overall output growth in non-mining sector is much less volatile despite much more volatility in Health, Education, Public Administration and Defence and Transportation sectors as the other non-mining sectors grow at much more stable rates.

Other benefits of the FSL can be looked at the terminal values of some variables. As we saw earlier, real GDP growth is the same as that in the alternative scenario. We also find that real GNP growth is the same in both scenarios, averaging around 1.6 percent. In addition, the accumulated government budget surplus by 2020 is 2.6 trillion MNT in the FSL scenario while it is 6.1 trillion MNT in the alternative scenario. In other words, despite the assumption that government spending is procyclical in the alternative scenario, the undiscounted sum of budget surplus is higher in the alternative scenario. This is also reflected in annual government budget surplus to GDP ratio – the average is 1.4 percent in a year in the FSL scenario while 3.1 percent in the alternative scenario. The reason why the budget surplus in the alternative scenario is higher than that in the FSL scenario is that the average growth rate of government expenditure is 6.4 percent as opposed to 9.3 percent in the FSL scenario.

The following table has the simulated FSF in million MNT under the FSL.

TABLE 37 RESULTS (FSF)

	2013	2014	2015	2016	2017	2018	2019	2020	Total
FSF	0.0	-142.6	1101.0	729.8	-308.7	-106.4	866.0	-287.1	1852.0

Source: *Author's calculation.*

It shows that the FSF will sum up to 1.852 billion MNT by 2020 without gaining interest. The main cost of the FSL is that real private consumption, the growth rate of output in Health, Education and Public Administration and Defence sectors are more volatile. In addition, the average growth rate of real private consumption 1.7 percent in the FSL scenario as opposed to

2.5 percent in the alternative scenario. Since real GDP, investment, export and import have more or less the same magnitude of volatility, the volatility in real government spending is absorbed by real private consumption on the expenditure side of the GDP calculation (see the graph below). The standard deviation of private consumption is 11.7 percent in the FSL scenario while 8.2 percent in the alternative scenario. This trade-off can be seen from the following table.

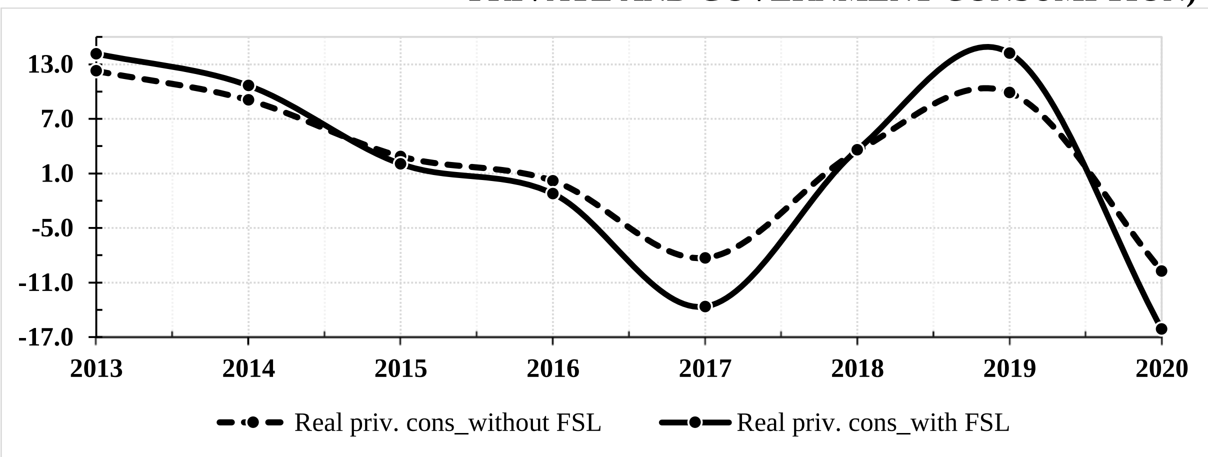
TABLE 38 SIMULATION RESULTS (REAL PRIVATE AND GOVERNMENT CONSUMPTION)

%	Mean		Standard deviation	
	FSL	Alternative	FSL	Alternative
Real private consumption	1.7	2.5	11.7	8.2
Real government spending	7.1	4.7	7.9	5.5

Source: *Author's calculation.*

Overall, we find that some price indices such as government spending price index, GDP and GNP deflators and investment goods price index are slightly higher on average in the FSL scenario despite having smaller volatilities. For example, the average GDP deflator in the FSL scenario is 1.7 percent as opposed to 1.6 percent in the alternative scenario.

FIGURE 3 COMPARING THE SIMULATION RESULTS (REAL PRIVATE AND GOVERNMENT CONSUMPTION)



Source: *Author's calculation*

7. Conclusion

In this research, we have examined the impact of the FSL on the Mongolian economy by developing a dynamic CSE model. In essence, our work can be summarised in three folds. Firstly, we simulated the model between 2006 and 2011 to estimate some parameter values by imposing certain targets for some observed variables during the period – i.e., the validation procedure. We also borrowed many other parameter values from Fisher et al., (2010) and the GTAP model. The results suggest that the model needs to improve in certain areas as some variables act quite differently from their observed values. This will certainly be the focus of our future research. In this direction, we will study the Maximum Entropy (ME) approach to estimate the parameters of the model. Using the model parameters and some predictions about the prices and quantities of the main mining products, we secondly forecasted the economy for 2012. As a by-product, the model created the IO table for 2012 which was then used to simulate the model for the period between 2013 and 2020. Taking the actual government budget deficit in 2011 as the initial value, we assumed that total government revenue would grow at the same rate as tax revenue and total government expenditure would grow at the same rate as government spending on goods and services in the forecast simulation. The forecast simulation had three parts. First, we simulated the model for a given series of equilibrated prices of the main mining products (copper and coal). From this simulation, we found a series of government spending values that would meet the all the requirements of the FSL. This was our baseline scenario. Second, we generated a series of the prices of the main mining products which was much more volatile than the equilibrated prices but would end up with the same levels by 2020 – 60 percent higher than their 2013 levels. Given the series of volatile prices, we simulated the model with the predetermined series of the government spending obtained from the baseline scenario. This was our FSL scenario. To access the impact of the FSL, we considered another scenario with the same set of volatile prices in which, however, government spending is procyclical in the sense it would follow GNP. This was our alternative (without FSL) scenario.

We found that the volatility of most variables tended to be lower because of the FSL. The most reduced ones were real wages and the output growth of non-mining sectors. For the other variables, the reduction in the volatility was marginal. Some variables such as output of Health, Education, Public Administration and Defence were more volatile because of the volatility in real government spending. Price indices were found to be more stable in the FSL scenario. Overall, we believe that the FSL is doing its job by stabilising the economy. Moreover, the terminal values as of 2020 suggested that real GDP and GNP would be the same in the both scenarios while government debt would be much higher in the alternative scenario. Alongside the benefits of the FSL, there were some costs. We found that the volatility of government spending in the alternative scenario was transmitted to the volatility of private consumption in the FSL scenario. In other words, real private consumption was more volatile in the FSL scenario. In addition, the volatility of output of Health, Education, Public Administration and Defence sectors were more volatile and the price indices were growing slightly faster on average.

We understand that there is a room for improving the model’s performance, especially for the period between 2005 and 2011 by choosing better values for the parameters. However, we are not concluding that the model is not good enough. As an equilibrium model, it is doing a reasonably good job as simulating the economy until 2015 without terminating errors. There are over 11000 variables and over 8000 equations in the model. About 2000 of them are exogenous variables so that their values supposed to be entered in every simulation. It is, however, not practical as we simply do not know the values of the exogenous variables in each period. Overall, the performance of the model depends on the usual suspects that are the quality of the data and the structure (or specification) of the model. Ideally, we want a method which can choose the values of the parameters and the exogenous variables simultaneously in the process of minimising the difference around the targets such as the Maximum Entropy (ME) Approach. We are unaware that if we can apply the ME approach in GEMPACK programme. We know that the ME approach has been used in GAMS environment. We will leave the ME approach to the Mongolian CGE model for the future work.

8. References

Arndt, C, S Robinson, and F Tarp. 2002. "Parameter estimation for a computable general equilibrium model: maximum entropy approach." *Economic modelling 19(3)* 375-398.

Fisher, B, T Batdelger, M Begg, B Buyantsogt, B Chadraabal, R Galindev, A Gurney, and E Lkhanaajav. 2010. *The Development of the OyuTolgoi Copper Mine: an assessment of the macroeconomic consequences for Mongolia.* Canberra: BAE Report.

Hanoch, G. 1971. "CRESH production functions." *Econometrica, 39(5)* 695-712.

National Statistical Office. 2007. "Method of Calculating GDP an GNP." Ulaanbaatar.

National Statistical Office of Mongolia. 2006-2012. *Monthly Bulletin.* Ulaanbaatar: NSO.

National Statistical Office of Mongolia. 2007. *The Method of Calculating GDP and GNP*. Ulaanbaatar: NSO.

National Statistical Office. 2005-2011. *Statistical Year Book.* Ulaanbaatar: NSO.