ADB

Technical Assistance Consultant's Report

Project Number: 43079
September 2013

Mongolia: Updating the Energy Sector Development Plan

(Financed by the Japan Fund for Poverty Reduction)

Prepared by E. Gen Consultants Ltd. Bangladesh in association with MVV decon GmbH, Germany, and Mon-Energy Consult, Mongolia

For Ministry of Energy, Mongolia

Asian Development Bank

Updating Energy Sector Development Plan

Project Number: TA No. 7619-MON

FINAL REPORT

PART D: Volume - X of X

APPENDIX : FDI EVALUATION (MON-CGE)

Prepared for

The Asian Development Bank

and

The Mongolian Ministry of Mineral Resources and Energy

Prepared by

e.Gen Consultants Ltd.

in association with

26 July 2013

Impact Assessments of Foreign Direct Investments (FDI) with the Mon-CGE Model.

by: Martin Ehrlich and Hans Kremers

THIS VERSION: 26 July 2013

We apply an economic model of the Mongolian economy. The model is called Mon-CGE, and a detailed description can be found in Corong et al. (2011). The latter report applies the Mon-CGE model to assess the impact of increased foreign direct investments (FDI) on the Mongolian economy. Enkhbayar et al. (2010) perform some alternative simulations to assess the impact of increased foreign direct investments (FDI) but they apply their own model. Unfortunately. the report does not provide a description of the applied CGE model. The Mon-CGE model is specifically constructed for this purpose.

This report first provides a short description of the Mon-CGE model. Then it summarizes the assessments of annual shocks in Foreign Direct Investments (FDI) in two previous reports, Corong et al. (2011) and Enkhbayar et al. (2011). Notice that we are the macroeconomic part of a project in Mongolia, financed by the Asian Development Bank (ADB) under ADB TA 7619-MON, see ADB TA 7619-MON (2011). This project intends to provide the Mongolian Government with an Energy Master Plan for its rapidly developing economy, following the discovery of two large coal and copper mines, Oyu Tolgoi and Taval Tolgoi. We report on an initial attempt to assess the impact of foreign direct investments following from the Energy Master Plan using the Mon-CGE model. As such it is an alternative to the Corong et al. (2011) paper, and we hence follow the outcome report of the latter paper. We close this report by suggesting improvements that should be implemented as soon as possible. These improvements are mainly based on better connecting the Mon-CGE model to the Energy Master Plan as proposed in ADB TA 7619-MON (2013).

The Mon-CGE model.

The Mon-CGE model is a so-called recursive dynamic, single country, computable general equilibrium (CGE) model. A computable general equilibrium model is an (abstract) economic model that combines ongoing developments in input output modelling, general equilibrium theory, and the computation of economic equilibria. Contrary to the often used partial equilibrium approach, CGE models consider the interaction among multiple markets that are of importance to the economy. Contrary to the usual simulation models applied to policy problems, CGE models are based on an explicit modelling of the (micro-)economic behaviour of its consumer and producer agents with respect to their choices among the various available alternatives. The theoretical model underlying the CGE model is mainly interpreted as the benchmark model that satisfies well-known efficiency properties of a market economy, against which the existing economy is compared.

One can distinguish CGE models into multiregional and single region models. Multiregional models partition the world in several regions, while a single region model only considers the region under assessment. Mon-CGE is a single region model concentrating on the Mongolian economy. The producers in the model represent (aggregate) production sectors, each of them producing a unique output good using a technology that has the other goods as intermediate inputs, and that has among others, labour and capital as primary goods or production factors. A producer chooses the bundle of goods from his technology that maximizes his profits. Under circumstances, this profit maximization is equivalent to cost minimization per unit of output good. The producer takes the market prices as given. The Mon-CGE model contains 55 producer agents representing the essential goods in the Mongolian economy: Crops, Animals, Forestry, Fishing, Coal, Crude Natural Gas, Metal ores, Oth-

er Mining, Processed food, Dairy, Milled Grains, Other Processed Food, Beverages, Tobacco, Textiles, Wearing apparel, Leather, Wood, Pulp and Paper, Publishing, Petrol and Nuclear, Chemicals, Rubber and Plastics, Nonmetal, Base Metal, Fabricated Metal, Machines and Equipment, Office Machines, Electrical Machines, Radio TV and Communication, Medical Instruments, Motor Vehicles, Furniture, Recycling; Electricity, Gas, and Thermal Heat; Water Distribution, Construction, Trade, Hotels, Land transport, Air transport, Other transport, Post Communications, Finance, Insurance, Other Finance, Real Estate, Machine Rental, Computer Services, Residential Development, Other Business Services, Public Services, Education, Health and Society, Other Services.

The consumers in the Mon-CGE model are assumed to possess all the production factors in the economy. At current market prices, this gives them a budget or income which constrains their choice among availble alternative bundles of goods on the markets. They choose the bundle from their budget set that maximizes their welfare or utility. Also, consumers take the market prices as given. The Mon-CGE model defines 5 consumer agents: households, firms, government, China, and the Rest of the World.

The market prices and output levels of the production sectors are determined such that all markets are in equilibrium, i.e. on each market, supply satisfies demand for the good. Under well-known assumptions, we can say that the equilibrium is (Pareto) efficient. The usual CGE model is constructed in such a way that it satisfies these assumptions, and that the equilibrium exists and is unique. It is here that the CGE model functions as a benchmark model to the economy under observation.

The actual model underlying the Mon-CGE is a so-called static model. This means that time does not play a role in the model, nor are there any intertemporal decisions made. As such, the CGE model represents the Mongolian economy during a stable period around the time of its calibration. Notice that the equilibrium produces an amount of investments which can be used to update the capital stock. The way we do this is determined by what we would like to see as the next period for which to calculate an updated equilibrium in the static model. Repeating this procedure will produce a sequence of equilibria, where each equilibrium represents the Mongolian economy around the time period in the sequence with which it is associated. We call this sequential CGE model a recursive dynamic model.

The Mon-CGE model considers two categories of such ‘dynamic equations’, namely one set of statements that update variables that grow at a constant rate over time, and another set of statements that control the accumulation of capital over time. The growth of the population is a variable that belongs to the first set of equations. This growth rate also determines the growth of, among others, labour supply. The second set of equations refers to the update of the capital stock according to:

```
KD.fx(j,time)$(KDO(j) and (ord(time) eq 1))
          = KDO(j);

KD.fx(j,time)$(ord(time) gt 1)
          = KD.l(j,time-1)*(1-delta(j))+IND.l(j,time-1) + IND_FDI.l(j,time-1);
```

The latter equation shows that the capital stock of each sector j, KD(j,time) is updated according to depreciation (delta(j)), and according to the volume of private local (IND.l(j,time-1)) and foreign direct investments (IND_FDI.l(j,time-1)). These sets of update statements form assumptions on the development of the economy over time under the ‘Business-as-Usual’ (BaU) scenario.

The Modelling of Foreign Direct Investments in the Mon-CGE Model.

The Mon-CGE model contains an external implementation of the investment decisions. This means that investments are obtained from another model and the values included into the CGE.

According to Robichaud et al. (2011), the allocation of new private capital between categories and industries follows a modified version of the Jung-Thorbecke (2001) investment demand specification:

```
EQ97(bus,t)$KDO(bus)..
        IND(bus,t) =e= phi(bus)*[R(bus,t)/U(bus,t)]**sigma_INV(bus)*KD(bus,t);
```

The volume of new capital allocated to business-sector industry bus, IND(bus,t), is proportional to the existing stock of capital KD(bus,t); and the proportion varies according to the ratio of the rental rate R(bus,t) to the user cost of that capital U(bus,t).

Additionally, foreigners may invest in some specific sectors. The relationship between the volume of new capital IND_FDI (j,t) and the cost (FDI(j,t)) in sector j is described by

```
EQ98(j,t)$KDO(j)..
        IND_FDI(j,t)*PK_PRI(t) =e= e(t)*FDI(j,t);
```

The values for IND_FDI(j,t) are given in each period. Hence, the latter equation determines FDI(bus,t) in each period t. Notice that these values were not available for all sectors in the base year 2005.

FDI then returns in the following equations:

Rest-of-the-world savings

```
EQ35(t)..    SROW(t) =e= YROW(t)-SUM{agnd,e(t)*WL_ROW(agnd,t)+e(t)*RK_ROW(agnd,t)
                 +SUM[x$EXO(x,agnd),PE_FOB(x,agnd,t)*EXD(x,agnd,t)]
                 +SUM[agd,TR(agd,agnd,t)]}-e(t)*SUM[j,FDI(j,t)];
```

Total investment equals total savings

```
EQ84(t)..    IT(t) =e= SH(t)+SF(t)+SG(t)+SROW(t)+e(t)*SUM[j,FDI(j,t)];
```

Equilibrium on the private investment market

```
EQ94(t)..    IT_PRI(t) =e= PK_PRI(t)*SUM[bus$KDO(bus),IND(bus,t)]+e(t)*SUM[j,FDI(j,t)];
```

Furthermore, it is assumed that FDI will increase the output of the sectors in which it is directed. This additional production is assumed to be totally exported to China. Hence, this share of capital owned by foreigners $FDI^{RT}(x,t)$ will determine the volume of production of sector x exported to China, $EX^{FDI}(x,t)$.

A part $EX^{FDI}(x,t)$ of the output XS(x,t) of the Rest of the World are meant to be exported as foreign direct investments (FDI) into production sector x in Mongolia, at period t:

```
EQ50(x,t)..   EX_FDI(x,t) =e= FDI_RT(x,t)*XS(x,t);
```

The share parameter $FDI^{RT}(x,t)$ is determined by:

```
FDI_RT(j,time)$(ord(time) eq 1)
        = 0;
FDI_RT(j,time)$(ord(time) gt 1)
        = SUM[timej$(ord(timej) gt 1), IND_FDI.l(j,timej-1)*(1-delta(j))**(ord(timej)-2)] /KD.l(j,time);
```

where IND^{FDI} $(x,t_j\text{-}1)$ denotes the volume of foreign direct investments in sector x in the previous period.

The FDI impact assessment according to Corong et al. (2011).

Corong et al. (2011) as well as Enkhbayar et al. (2011) both used the Mon-CGE model calibrated on a Social Accounting Matrix (SAM) of Mongolia, dated 2005[1]. Due to the rapid economic development of the Mongolian economy during the last five years, - a consequence of the discovery of major resources in the Gobi Desert -, one would like to see this SAM being updated to a more recent one[2]. One simply cannot depict the Mongolian economy as being stable around 2005 anymore, given the financial crisis in the world economy around 2008 which had its impact on Mongolia around 2009.

Table 1 depicts the structure of the Mongolian Social Accounting Matrix as applied by Corong et al. (2011). The latter also provides a meticulous treatment of the symbols used in this table, and we hence refer the reader to them.

Table 1. Structure of Mongolian Social Accounting Matrix (source: Corong et al. (2011))

	Activities	Commodities	Labor	Capital	Households	Firms	Government	ROW	Direct Tax	Indirect Tax	Tariff	Savings-Investment	Stocks	Exports	Total
Activities		C1												C2	CT1
Commodities	C3				C4		C5					C6	C7		CT2
Labour	C8							C9							CT3
Capital	C10							C11							CT4
Households			C12	C13		C14	C15	C16							CT5
Firms				C17	C18			C19							CT6
Government	C20				C21			C22	C23	C24	C25			C26	CT7
ROW		C27		C28	C29	C30	C31								CT8
Direct Tax					C32	C33									CT9
Indirect Tax		C34													CT10
Tariff		C35													CT11
Savings-Investment					C36	C37	C38	C39							CT12
Stocks												C40			CT13
Exports								C41							CT14
Total	RT1	RT2	RT3	RT4	RT5	RT6	RT7	RT8	RT9	RT10	RT11	RT12	RT13	RT14	

Note: ROW – Rest of the World

We already mentioned two papers dealing with the impact of a voluminous increase in FDI in Mongolia. Corong et al. (2011) and Enkhbayar et al. (2010). Both papers apply the Mon-CGE model to assess its impact on the Mongolian economy, but they do it in their own way. Corong et al. (2011) sticks to the usual regional and sectoral resolution which we have summarized before. Enkhbayar et al. (2010) however make an explicit reference to several projects that are active with-

[1] Enkhbayar et al. (2010) actually claim to apply a SAM of 2008. I assume that this is the actual 2005 SAM. Corong et al. (2011) might have constructed the SAM for 2005 themselves, regarding the description of the procedure on how they constructed it.

[2] During visits to Ulaanbaatar in 2012, we tried to obtain the 2010 SAM of the Mongolian economy. We found out that the Statistical Office is obliged to provide a SAM each five years. However, since the 2005 SAM became available in 2008, it is expected that the 2010 SAM will become available somewhere in 2013.

in each production sector and then aggregates them to their sector level in order to obtain impacts that are significantly different from zero[3].

According to the introduction in Corong et al. (2011)[4]:

> "The simulation results suggest that increased FDI brings about changes in the economic structure arising reallocation effects, which in turn affect trade volumes, gross domestic product (GDP), production level, factor prices and ultimately employment and income. Foreign capital infusions in mining and power sectors brings about substantial benefits to Mongolia, with the GDP attaining significantly higher growth rates compared to what it would have been without FDI's contribution. More importantly, FDI results in a lasting impact overtime as GDP growth rates are further accentuated when productivity gains associated with FDI are accounted for.
>
> On aggregate, the expansion in economy-wide employment translates to higher income, consumption levels and savings for all households. However, this aggregate effect does not take into account heterogeneity of households, hence failing to capture the detailed impact on household poverty and income distribution. The government's fiscal position improves considerably due to the combined effect of higher direct tax revenues on household income and greater indirect taxes on commodities which include royalties and taxes from mining exports. This improvement in government revenue is clearly reflected on government savings which increase substantially."

In order to come to these conclusions, Corong et al. (2011) set up three alternative simulation scenarios, a baseline and two counterfactuals. The two counterfactuals refer to two scenarios where each scenario implements a particular policy on foreign direct investments. Each of these scenarios is then compared as a counterfactual to the Baseline scenario, to which we refer as a so-called 'Business-as-Usual' (BaU). Under a BaU, it is hence assumed that none of these two alternative policies are implemented and the economy develops further 'as usual'.

Business-as-Usual (BaU): No increase in FDI, contrary to the following two counterfactual scenarios. Figure 1 depicts the growth in GDP under the BaU as an index base of 100. Notice that the BAU does not follow a balanced growth path in which all prices remain constant and other variables grow at the same constant rate as the population. Mon-CGE implements this scenario as[5]:

```
IND_FDI.fx(j,time) = 0;
FDI.l(j,time)    = 0;
```

where IND_FDI(j,time) denotes the "Volume of new capital investment to industry j through FDI", and FDI(j,time), "Foreign direct investment in sector j" by the foreign country. The suffix .fx indicates that the corresponding variable has been fixed throughout the equilibrium calculations.

Scenario 1: FDI in mining and power sectors increase by 50 percent from 2012-16 relative to their baseline values. These sectors include coal, crude oil, metallic ores, other mining, and electricity, to which we will refer collectively as FDI sectors. Figure 1 depicts real GDP growth compared to BaU under Scenario 1, while Figure 2 depicts increases in real GDP with respect to the BaU scenario (100). Mon-CGE implements this scenario as[6]:

```
IND_FDI.fx(j,time) = 0;
IND_FDI.fx('coal',time)$[(time.val ge 2012) and (time.val lt 2017)]
            = 0.5*valIND('coal',time,'bau');
IND_FDI.fx('metores',time)$[(time.val ge 2012) and (time.val lt 2017)]
            = 0.5*valIND('metores',time,'bau');
IND_FDI.fx('othmining',time)$[(time.val ge 2012) and (time.val lt 2017)]
            = 0.5*valIND('othmining',time,'bau');
IND_FDI.fx('EleGasH20',time)$[(time.val ge 2012) and (time.val lt 2017)]
```

[3] Notice that the GAMS code underlying the Mon-CGE model that is currenlyt available to is is the one applied and constructed by Corong et al. (2011). The code copied into this text has been taken from this GAMS code.

[4] The paper immediately points to an important omission in the model, a heterogenous set of households is lacking. Households should be heterogenous according to income levels in order to be able to assess the impact of FDI on the poor households. This would require us to disaggregate the current one (private) household into several households according to income classes. The question is how these household income classes should be determined.

[5] See the file BAU.gms, under the implemented closures.

[6] See the file SIM1.gms: "Increased FDI corresponding to 50% of BAU investment in mining and electricity".

```
= 0.5*valIND('EleGasH20',time,'bau');
```

Scenario 2: Scenario 1 coupled with a 2 percent annual growth of total factor productivity in the FDI sectors between 2017 and 2025. Essentially, this scenario captures the favourable effects on the productivity of technology transfers arising from FDI. Figure 1 depicts real GDP growth compared to BaU under Scenario 2, while Figure 2 depicts increases in real GDP with respect to the BaU scenario (100). Mon-CGE implements this scenario by adding the following shocks[7]:

```
A(j,time)$(time.val lt 2017)
          = 1;
A('coal',time)$(time.val ge 2017)
          = A('coal',time-1)*1.02;
A('metores',time)$(time.val ge 2017)
          = A('metores',time-1)*1.02;
A('othmining',time)$(time.val ge 2017)
          = A('othmining',time-1)*1.02;
A('EleGasH20',time)$(time.val ge 2017)
          = A('EleGasH20',time-1)*1.02;
```

where A(j,time) denotes the "productivity factor".

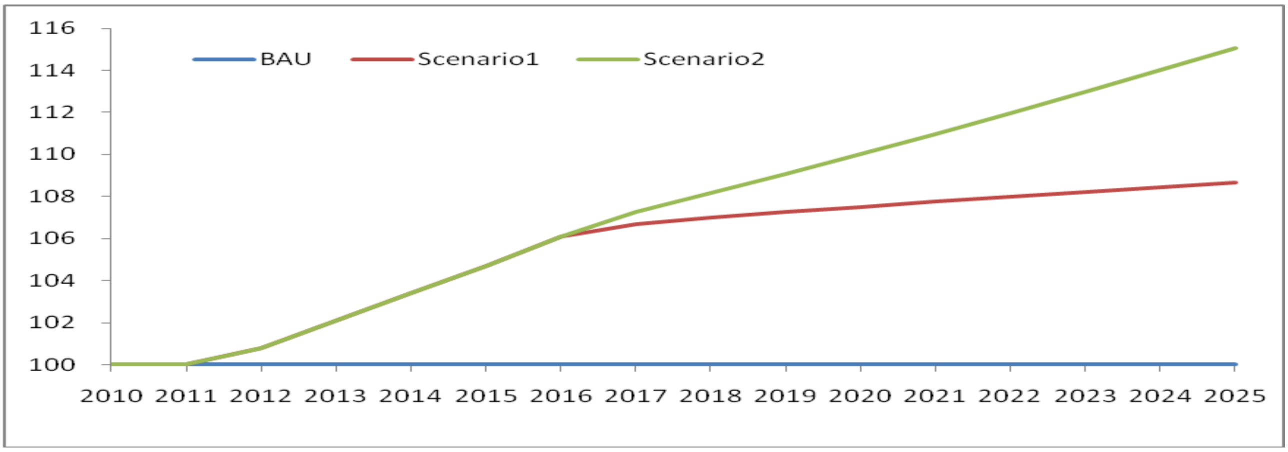

Figure 1: Real GDP growth with respect to the BAU scenario. Notes: BAU-Business As Usual; Base=100. (Source: Authors' calculation based on simulation results.)

Additionally, Corong et al. (2011) make the following assumptions in the Mon-CGE model underlying their simulations:

- the nominal exchange rate is the numéraire
- world prices of products exported or imported are exogenous
- a number of transfers from abroad (return on capital and labour) are exogenous and growing at the growth rate of population as do the current public spending or investment
- The current account balance is a fixed proportion of GDP, implying that as GDP grows, foreign savings rise proportionally to the rate of domestic economic growth
- Given the need for state funding to cover ongoing expenses and investment, private investment is determined by taking into account the savings-investment constraint.
- Similarly, we account for unemployment in Mongolia by postulating that some segments of the work force are underutilized. In modeling parlance, this translates into an assumption of wage

[7] See the file SIM2.gms: "Increased FDI corresponding to 50% of BAU investment in mining and electricity. Increased productivity in these sectors of 2% per year starting in 2018".

rigidity with the possibility of creating additional employment whenever demand for labor increases.

The simulation results shown below are presented as a variable's percentage change relative to the Business As Usual (BAU) scenario. In order to obtain the real value of the variables, we should obtain the real values during the base year, here 2005. Although we present results for all years of simulation, we pay particular attention to analyzing results for the years 2017 and 2025, which respectively corresponds to the end of increased foreign direct investment in the FDI sectors and end of the simulation period. The simulation results are presented with respect to the impact on the following variables: GDP, Mongolian exports, labour in Mongolia, and Mongolian household consumption.

Impact on GDP:

Figure 1 describes the growth in real GDP under the two scenarios, in comparison to the BaU scenario. The increase in FDI under both counterfactual scenarios is shown to have a significant impact on real GDP growth in comparison to BaU. When we add technological improvements in the form of improvements of certain productivity parameters, as in Scenario 2 from period 2017 on, growth in real GDP will be even stronger.

	BaU		Scenario 1		Scenario 2	
	Real GDP	GDP Deflator	Real GDP	GDP Deflator	Real GDP	GDP Deflator
2010	100	1.00	100.0	1.00	100.0	1.00
2011	100	1.00	100.0	1.00	100.0	1.00
2012	100	1.00	100.8	1.02	100.8	1.02
2013	100	1.00	102.1	1.02	102.1	1.02
2014	100	1.00	103.4	1.02	103.4	1.02
2015	100	1.00	104.7	1.02	104.7	1.02
2016	100	1.00	106.1	1.02	106.1	1.02
2017	100	1.00	106.7	1.00	107.3	1.00
2018	100	1.00	107.0	1.00	108.2	1.00
2019	100	1.00	107.2	0.99	109.1	0.98
2020	100	1.00	107.5	0.99	110.0	0.98
2021	100	1.00	107.7	0.99	111.0	0.97
2022	100	1.00	108.0	0.99	111.9	0.96
2023	100	1.00	108.2	0.98	113.0	0.96
2024	100	1.00	108.4	0.98	114.0	0.95
2025	100	1.00	108.6	0.98	115.1	0.94

Table 2: GDP, Price Index and Real GDP. Note: BAU-Business As Usual; GDP deflator is the inverse of the real exchange rate. (Source: Corong et al. (2011)'s calculation based on simulation results)

Comparing Scenario 1 and 2 indicates a high sensitivity of GDP growth to changes in productivity in the FDI sectors.

Table 2 adds the evolution of the GDP deflator, which is the inverse of the real exchange rate. A higher FDI does lead to an appreciation of the real exchange rate by roughly 2 percent from 2012-2017, but this increase is not sufficient to dampen mining export earnings and fear for a 'Dutch disease'.

Impacts on the structure of the Mongolian Economy:

The immediate impact of a higher stock of productive capital from abroad is a significant expansion in output among the FDI sectors. This output expansion then results in a higher demand for intermediate inputs, thereby creating a spillover effect to the rest of the economy as other sectors also increase their output to meet higher demand for their products. As a result, employment increases as well as the returns to capital, especially for capital invested in the FDI sectors. This higher return to capital creates a snowball effect, as greater profitability in the FDI sectors attract further investments.

The combined effect of higher stock of productive capital from abroad and the real exchange rate appreciation until 2017 is to boost the demand for investment goods, particularly construction, production of capital equipment, as well as services associated with the delivery of these investment goods. Nonetheless, this mechanism of expansion ends with the cessation of FDI in 2016.

	Scenario 1			Scenario 2	
	BaU	2017	2025	2017	2025
FDI sectors	25.16	26.45	26.03	26.34	25.18
Agriculture	22.00	21.58	21.59	21.59	21.57
Manufacturing	9.81	9.71	9.77	9.74	9.98
Services	43.03	42.26	42.61	42.33	43.27

Table 3: Relative shares (percent) in GDP. (Source: Corong et al. (2011)’s calculation based on simulation results)

Table 3 shows that the FDI sectors (mining sector and electricity) represent almost 25 percent of GDP, with agriculture, manufacturing and services sectors respectively accounting for 22, 10 and 43 percent of total GDP respectively. Increased FDI in the mining and electricity sectors raises the contribution to total GDP made by the FDI sectors by roughly 1 percent (Scenario 1), while the services sector reduce its contributions marginally.

In contrast, under Scenario 2, the share of FDI sectors to total GDP only rises marginally relative to the BAU, while it is the share of services that increase significantly. This is expected since higher productivity in the FDI sectors (2017-2025) allows it to employ relatively less labour and capital per unit of output. Both the manufacturing and services sector take advantage of this situation by employing much needed labourers that were released by the FDI sectors to support their own output expansion. This is especially so for services whose output expansion is anchored on facilitating complementary services to all expanding sectors in the economy.

We could conclude from Table 3 that the ‘beneficial’ treatment of the FDI sectors in comparison to the other sectors, has only marginal influence on their share in the economy’s GDP. Increases in GDP following increases in FDI can be contributed relatively equal to each sector in the Mongolian economy as before.

Impacts on Mongolian exports:

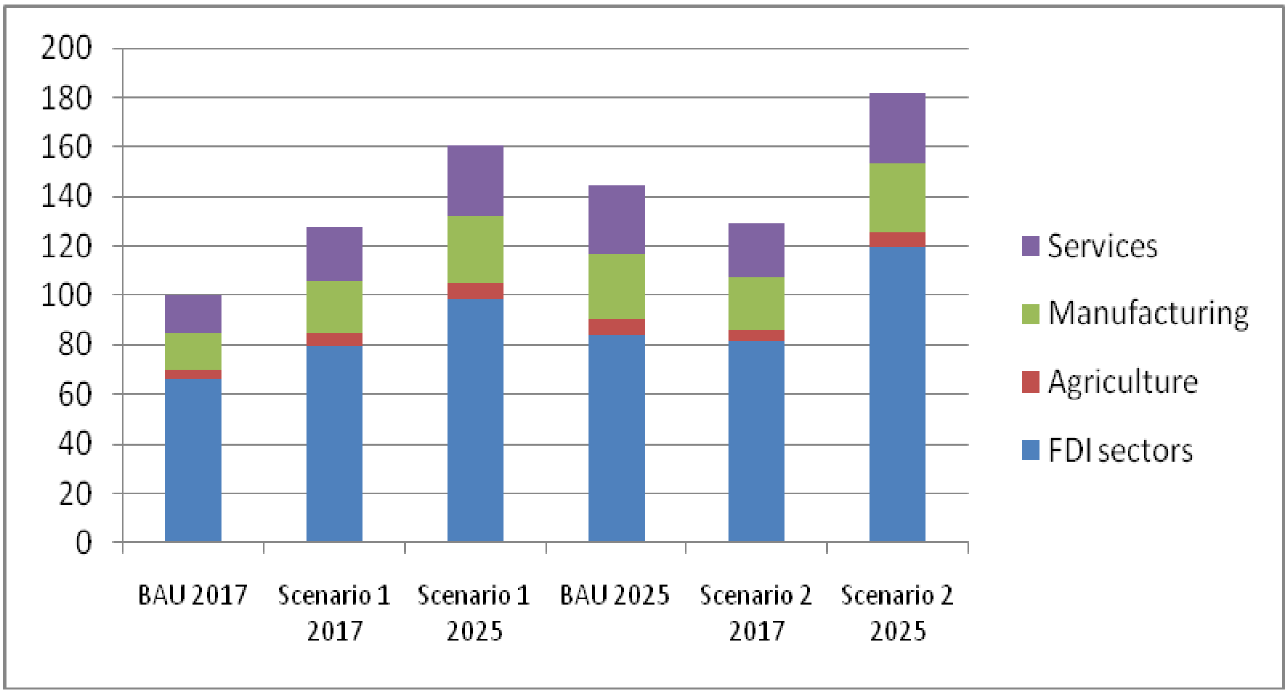

Figure 2: Structure and evolution of total exports (Volume). Note: BAU-Business As Usual; BAU 2017 is used as the index of exports (Base=100) . (Source: Corong et al. (2011)'s calculation based on simulation results)

Figure 2 shows the structure and evolution of the total volume of exports in Mongolia. The sectors where the FDI is taking place, mining and extraction, benefit most with respect to exports but this also holds, in a lesser way, for manufacturing and services. Notice that, under Scenario 2, agricultural exports are also significantly increased, since productivity gains are added to the FDI boost. In part, the higher increase in exports is boosted by the real exchange rate depreciation between 2017 and 2025, resulting in Mongolian exports becoming relatively cheaper abroad.

Impact on labour:

	2017			2025		
	BaU	Scenario 1	Scenario 2	BaU	Scenario 1	Scenario 2
FDI sectors	100	111.8	110.8	100	109.8	103.5
Agriculture	100	104.9	105.2	100	102.8	105.2
Manufacturing	100	105.3	106.0	100	105.8	111.2
Services	100	104.2	104.5	100	104.2	107.6

Table 4: Impact on employment. Note: BAU-Business As Usual; Base=100. (Source: Corong et al (2011)'s calculation based on simulation results)

There is a significantly positive effect of increased FDI on employment in all Mongolian production sectors. This effect is highest in the mining sectors, which benefit most from FDI. Notice that this effect decreases under Scenario 2 where productivity gains are included. The positive employment effects in the other (non-FDI) sectors are a consequence of increased demand for the necessary inputs by the FDI sectors, hence increased production in these sectors. Table 4 provides data on the impact on employment in the sectors.

Impact on household consumption:

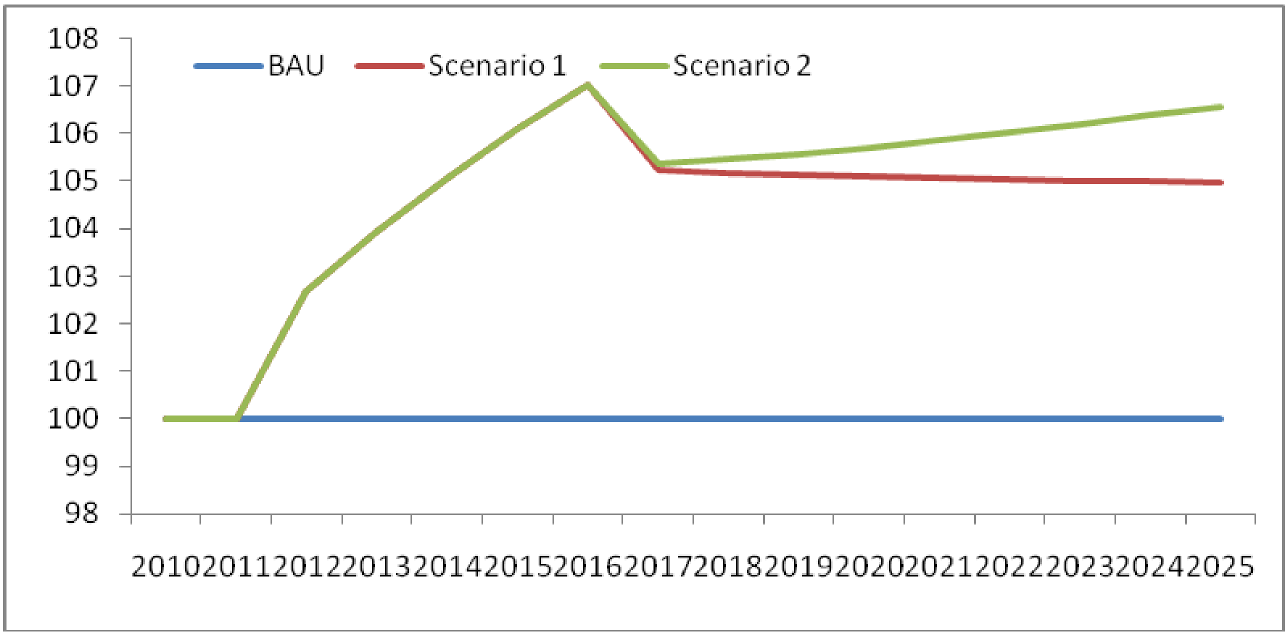

Figure 3: Evolution of household consumption. Notes: BAU- Business As Usual; BASE=100. (Source: Authors' calculation based on simulation results)

As expected, the expansion in economy-wide employment allows households to earn more income and enjoy higher consumption levels (Figure 3). Regardless of the scenario, household consumption increases significantly, registering more than 7 percentage points above the BAU in 2016. This then drops to roughly 5 percentage points above the BAU in 2017 as inward FDI in mining and power sectors terminate. While household consumption stabilizes at 5 percent under scenario 1, it rises once again to 7 percent by 2025 under scenario 2 as productivity gains associated with FDI bring about additional employment, hence improvement to household earnings (see Table 5).

	BaU	Scenario 1	%	Scenario 2	%
2012	121	124	2.7	124	2.7
2017	140	148	5.2	148	5.2
2025	178	186	5	189	6.6

Table 5: Household savings. (Source: Corong et al (2011)'s calculation based on simulation results.)

The FDI impact assessment of Enkbatyar et al. (2011).

The other paper, Enkbatyar et al. (2011), takes a much more detailed view on assessing the impact of a significantly increased FDI following the discovery of the two mines. This recent discovery shows the necessity for Mongolian government to prepare for a long term transition of Mongolia from a predominately rural, subsistence society to a modern, diversified, higher income country. They explicitly refer to the importance of spillover effects to the rest of the economy:

> "The extent to which the country's considerable potential can be realized will depend not only on successful extraction and marketing of resources, but also on the extent to which these targeted activities and revenues generate net-positive spillovers for the rest of the economy, enhancing the basis for market oriented entrepreneurship, higher labor productivity, and sustainable increases in living standards for the majority of Mongolians."

Enkbatyar et al. (2011) assess 26 of the country's highest priority development projects. They defend the implementation of a CGE analysis by mentioning that the results

> "suggest that each of these can make an important contribution to the national development agenda, but they differ in important ways in both the scope and timing of their impacts. Because of their scale, these projects are very pervasive in their effects across the economy, and many different stakeholders will be

> implicated by them and have their livelihoods and opportunities affected directly and indirectly. By using scenario analysis such as that undertaken in this study, it is hoped the Government of Mongolia can more clearly identify both beneficiaries and those who will face adjustment challenges."[8]

The report does not apply the aforementioned Mon-CGE model but a CGE model developed by David Roland-Holst[9]. This model is calibrated on exogenous growth rates of population, labour force, and GDP. In the Baseline scenario, the dynamics are calibrated in each region by imposing the assumption of a balanced growth path, i.e. the ratio between labour and capital (in efficiency units) is held constant over time. When alternative scenarios around the baseline are simulated, the technical efficiency parameters are held constant, and the growth of capital is endogenously determined by the saving/investment relation.

The second paper considers the following five scenarios in comparison to the Baseline scenario:

- Mining: Primary mining and mineral resource development. It is assumed to contribute 5% per annum to the target sector's total productivity of production factors labour and capital.
- Energy: Energy sector development. Contributes 5% per annum to target sector TFP.
- AgFood: AgroFood development. Contributes 5% per annum to agrofood TFP.
- Infra: Infrastructure development. Assumed to increase infrastructure dependent sectors TFP by 5% per annum.
- TED: Technology and education investment. Assumed to increase skill intensive sector TFP by 5% per annum.

Notice that each scenario is a composite with very substantial amounts of investment by a group of large scale projects announced for priority implementation by the Government of Mongolia. Table 6 provides an explicit concordance between these investment projects and the 5 scenarios.

[8] In order to identify "beneficiaries and challenged", I would expect a more elaborate distinction among households too. Again heterogeneity of households with respect to income classes should be added to the original Mon-CGE model. Did Enkbayar et al. (2011) consider an extension of the Mon-CGE model to incorporating heterogenous households?

[9] Notice that Enkbayar et al. (2011) do not describe the model that they are applying. They just refer to another report, Enkbayar et al. (....). We currently do not have the underlying GAMS model and the data used.

	Scenario				
Project	Mining	Energy	Infra	AgFood	TED
Oyu	Oyu				
Tavan	Tavan				
Copper	Copper				
Steel	Steel				
Coke		Coke			
OilRef		OilRef			
Coal		Coal			
Const			Const		
Food				Food	
Irri				Irri	
AgFood				AgFood	
HiTech					HiTech
TTPower		TTPower			
Railway			Railway		
GobiH2O				GobiH2O	
Satellite					Satellite
UBRoad			UBRoad		
MonRoad			MonRoad		
Expway			Expway		
5thPower		5thPower			
Housing			Housing		
BioErg		BioErg			
ITT					ITT
STown					STown
KKXIII					KKXIII
Eco			Eco		

Table 6: Concordance between Investment Projects and Scenarios (source: Enkbayar et al. (2011)).

Assuming equal disbursement of estimated budgets over the next decades, the corresponding investment outlays are depicted in Table 7.

	Mining	Energy	AgFood	Infra	Ted
2011	580	362	79	740	190
2012	690	362	79	740	190
2013	690	362	79	740	190
2014	690	362	79	740	190
2015	690	362	79	740	190
2016	690	362	79	740	190
2017	690	362	79	740	190
2018	690	362	79	740	190
2019	690	362	79	740	190
2020	690	362	79	740	190
Total	6,790	3,620	790	7,400	1,900

Table 7: Annual Assumed Investment Outlays by Project Group (in millions of 2010 USD, source: Enkbayar et al. (2011))

Mongolia negotiates external finance for these projects that is amortized at 5 percent over 30 years, which nearly equalizes net external capital flows by 2020. For the first eleven years, the flows are expressed in Table 7, in terms of one dollar of inbound project FDI for each of the years 2010-2020.

Scenarios are all carried forward to 2030 to capture project net impacts after most of primary cash flows have stabilized. This allows for “relaxation” of real exchange rate pressures, transient wealth effects, and resource pulls that may arise from these.

The simulation results are presented with respect to the impact on the following (macroeconomic) variables: GDP, output, trade, private consumption, labour, and capital. Table 8 summarizes the macroeconomic results of the 5 simulations defined above.

	Mining	Energy	AgFood	Infra	Ted
Output	38%	11%	33%	43%	80%
GDP	38%	11%	28%	48%	85%
HH Income	14%	8%	21%	33%	43%
Consumption	18%	12%	19%	36%	59%
Exports	41%	8%	43%	51%	96%
Imports	22%	6%	23%	35%	54%
CPI	-1%	-3%	4%	-4%	-10%
Wage	8%	0%	13%	11%	5%
Rental	-10%	4%	4%	6%	8%

Table 8: Macroeconomic Results (Cumulative percent change in real 2010 PPP values, 2010-2030, source: Enkbayar et al. (2011))

Impact on GDP:

These can be found in Table 8. They show dramatic growth effects, in double digits. The five scenarios exhibit significant differences in the way they contribute to economic growth in Mongolia, as is shown in Figure 4,

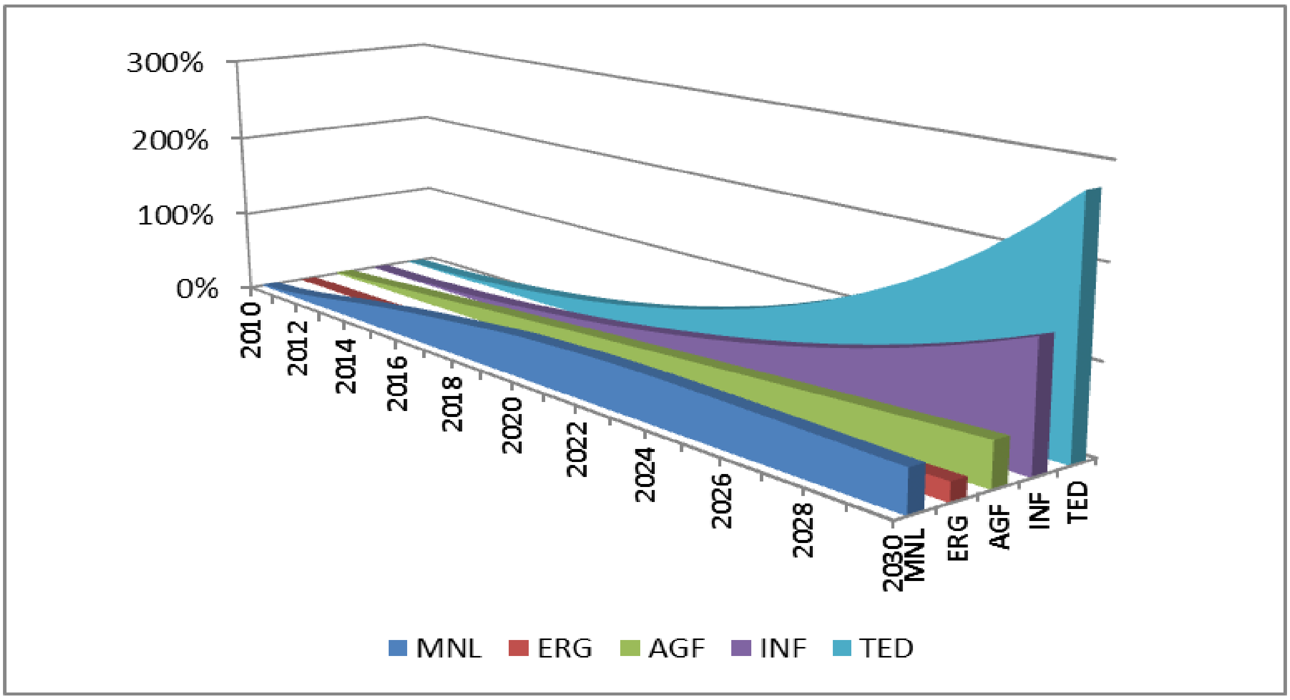

Figure 4: Trend GDP Impacts of Investment by Project Group (Percent change from Baseline in each year, source: Enkbayar et al. (2011))

which shows real GDP differences from the Baseline trend annually:

- The Mining group of projects makes early contributions to GDP, but then stabilizes.
- The TED scenarios, which represent investments in economywide productivity and efficiency, begin to yield returns that are low in the beginning, but continue growing long after the direct resource investment projects have plateaued. The TED scenario yields the most dramatic long term expansion, in terms of domestic output, income, and competitiveness (exports).

"51. Herein lies an essential lesson for policy makers. All these projects are attractive in terms of total return over the period considered, but some offer much more attractive long term gains. To avoid the resource boom syndrome that has plagued many emerging economies since the 19th century, Mongolia needs to secure its investments in long term systemic efficiency and productivity growth. Only these commitments will secure the basis for market forces and entrepreneurial initiative to do its part in building and diversifying the economy. This in turn is a necessary condition for transition to a modern, self-sustaining consumer society."

Impact on output:

Table 8 also provides the outcomes of the 5 scenarios on total output levels of the particular sectors that are targeted under these scenarios. These output levels follow a similar growth as GDP is doing. Table 9 distinguishes cumulative output growth over the various production sectors. One notices that growth is mainly associated with the sectors involved in the particular scenarios, but there is a significant side effect on the other sectors. Notice that this effect can be associated with the fact that general equilibrium models consider more than one market and can therefore look at indirect effects too.

	Mining	Energy	AgFood	Infra	Ted
AgroFood	24%	9%	65%	28%	61%
Mining	232%	9%	9%	53%	80%
Energy	25%	236%	5%	103%	168%
Manufactures	9%	10%	3%	91%	152%
MetMin Products	48%	17%	0%	53%	101%
Construction	40%	12%	9%	61%	77%
Utilities	31%	45%	21%	55%	90%
Trade	24%	10%	20%	69%	109%
TransComm	31%	2%	22%	109%	170%
Other Services	14%	6%	9%	21%	58%
Total	38%	11%	33%	43%	80%

Table 9: Output Changes by Sector and Project (cumulative percent change, 2010-30, source: Enkbayar et al. (2011))

Impact on trade:

Table 10 depicts changes in exports by sector and project under the five scenarios. These outcomes show that there may be a similar dynamics expected as what was underlying the 'Asian Miracle' of the so-called 'Tiger economies'. The impuls originating from these external demand effects on the Mongolian economy is also behind the construction of the stimulus packages.

	Mining	Energy	AgFood	Infra	Ted
AgroFood	23%	10%	82%	21%	56%
Mining	4764%	-4%	-10%	217%	254%
Energy	5%	1038%	-9%	103%	151%
Manufactures	2%	7%	-10%	84%	131%
MetMin Products	52%	20%	-8%	45%	87%
Construction	47%	8%	-4%	51%	81%
Utilities	12%	302%	-2%	30%	93%
Trade	7%	4%	-7%	107%	161%
TransComm	31%	2%	-22%	109%	170%
Other Services	9%	5%	-7%	0%	89%
Total	41%	8%	43%	51%	96%

Table 10: Export Changes by Sector and Project (cumulative percent change, 2010-30, source: Enkbayar et al. (2011))

- for primary sectors (Mining and Energy), it can lower costs for others and propagate export competitiveness (and attendant growth) across the economy.
- When the target of investment is infrastructure or factor productivity (TED), the diffusion of competitiveness benefits is even more widespread.
- The result for AgroFood investment, by contrast, is relatively isolated, but this finding is strongly biased by initial conditions, where the data describe a large subsistence enclave and agricultural exports dominated by relatively unrefined primary products. If investments in Mongolian agrofood in-

stead facilitate the development of higher value products, especially including domestic supply chains with higher food processing value added, this sector will contribute to growth across the entire economy.

Impact on private consumption:

Personal consumption growth mirrors or exceeds real income, in some cases exceeding it because productivity gains lower domestic resource costs (CPI) and increase household purchasing power. See Table 8.

Impact on labour:

According to Table 8, wages rise in all cases, particularly those associated with the largest investments and labor-intensive investment.

Impact on capital:

According to Table 8, the rental rate rises except in the mineral scenario, which targets sectors with the highest prior capital constraints.

An FDI impact assessment of the Electricity Master Plan

The outcome of the project “Updating the Energy Sector Development Plan”[10] is an Electricity Master Plan (EMP) for the Mongolian economy. The expected results of the Electricity Master Plan will be a number of strategies with respect to:

- Electricity demand forecast
- A proposed investment schedule (over a period of 20 years). This implies proposed annual investments in:
  - Electricity generation
  - Electricity transmission lines
  - Electricity distribution
  - Capacity building and know-how transfer in the Mongolian electricity industry
- For each investment, the EMP determines whether it is of foreign (FDI) or domestic origin
- The EMP provides a split in the underlying financing strategy with respect to:
  - Consumer contribution – an overview of imposed tariffs with respect to different consumer groups (‘tariff study’)
  - Local loan financing
  - International loan financing
  - Local grants financing
  - International grants financing[11]

For the Mongolian government, the main issue will be to assess the impact of implementation of the Energy Master Plan on the Mongolian economy.

- What are the impacts of the EMP on the labour market?
- How will the Mongolian economy improve?

Computable general equilibrium (CGE) models turn out to be particularly well-suited to address such questions. It is rather peculiar that, given their popularity among policy makers, that these type

[10] Project nr. ADB TA 7619-MON submitted to the Asian Development Bank by e.GEN Consultants Ltd., Dhaka, Bangladesh, on January 31, 2011
[11] We actually assume no grants. We assume 6% WACC as a blended financing rate for local and international inputs.

of models have not often been applied to assess the impact of implementing an Electricity Master Plan on the economy. One of the main advantages of applying these models is that they take account of the direct as well as the indirect effects of any policy measure implementation. This is due to their focus on multiple markets and their interactions.

The base year for the Social Accounting Matrix (SAM) will be 2005 underlying the current calibration of the Mon-CGE model. The Mon-CGE model has been applied in a recursive dynamic way so that it is able to generate different scenarios. As such, we calibrate the model to generate a benchmark scenario that refers to a 'Business-as-Usual' (BaU) situation. Let us take the existing BaU scenario underlying the current calibration of the Mon-CGE model to this end. The implementation of the EMP into the Mon-CGE model results in an alternative or counterfactual scenario. This scenario is implemented next to the existing two counterfactual scenarios described above and in Corong et al. (2011). Comparing the latter scenarios with the BaU scenario allows us to assess the impact of implementing the EMP on the economy, and compare these outcomes with the outcomes of the existing counterfactuals.

We define the two scenarios in the following way. The Business-as-Usual, as its name indicates, leaves everything as it is and ever was. This Business-as-Usual scenario is compared with three scenarios from the ADB-MON-7619 Energy Master Plan (EMP) with respect to GDP, structure of the Mongolian economy, exports, labour, and household consumption, following Robichaud et al. (2011). The EMP postulates the following three scenarios, to which we add the necessary data:

SCENARIO 1 (ADB-MON-7619 EMP 1)[12]: This scenario is based on increased FDI according to a Coal-Based Expansion scenario.

In Table 11, the first column depicts a time series of total investments in the EleGasH2O production sector. The original series obtained from the Energy Master Plan was in millions of US$, hence we translated them into millions of Tugruk (mMNT) using the exchange rate of 1US$ = 1.435 MNT as used in the Energy Master Plan. From these total investments, depicted with T, we compute the part of foreign direct investments (FDI) and investments from domestic origin using an allocation of 90% of T being FDI and 10% of T being domestic investments.

Scenario	ADB MON-7619 EMP 1: Coal-based expansion			
T = total investments	T (in mMNT) = 1.435*T (in US$m)	FDI (90% * T)	Domestic (10% * T)	INDfactor x valIND(*)
2013	162.7	146.4	16.3	8.8
2014	438.0	394.2	43.8	22.9
2015	669.9	602.9	67.0	34.1
2016	978.2	880.4	97.8	48.3
2017	872.4	785.2	87.2	41.8
2018	346.7	312.0	34.7	16.1
2019	292.6	263.3	29.3	13.2
2020	682.6	614.4	68.3	30.0
2021	621.8	559.6	62.2	26.5
2022	642.0	577.8	64.2	26.6
2023	0.0	0.0	0.0	0.0
2024	917.2	825.5	91.7	35.8

Table 11: Total investments, FDI, Domestic investments, and the calculated INDfactor in the EleGasH2O production sector, for the ADB MON-7619 EMP 1 scenario.

[12] The GAMS file ADB-MON-7619_EMP1.gms contains the Coal-Based expansion scenario.

Notice that Robichaud et al. (2011) implement the FDI shocks as a multiple, 0.5, of valIND(EleGasH20',time,'bau') in the BaU scenario. We introduce a factor, INDfactor in Table 11, which denotes this multiple, and it is computed in such a way that the value FDI obtained in the Energy Masterplan according to Table 11, equals INDfactor times this valIND(EleGasH20',time,'bau') for each period 'time'. Column 4 enumerates the values obtained for INDfactor for each period from 2013 until 2024.

SCENARIO 2 (ADB-MON-7619 EMP 2)[13]: This scenario is based on increased FDI according to a Mixed Hydro-Wind Expansion scenario.

In Table 12, the first column depicts a time series of total investments in the EleGasH2O production sector. The original series obtained from the Energy Master Plan was in millions of US$, hence we translated them into millions of Tugruk (mMNT) using the exchange rate of 1US$ = 1.435 MNT as used in the Energy Master Plan. From these total investments, depicted with T, we compute the part of foreign direct investments (FDI) and investments from domestic origin using an allocation of 90% of T being FDI and 10% of T being domestic investments.

Notice that Robichaud et al. (2011) implement the FDI shocks as a multiple, 0.5, of valIND(EleGasH20',time,'bau') in the BaU scenario. We introduce a factor, INDfactor in Table 12, which denotes this multiple, and it is computed in such a way that the value FDI obtained in the Energy Masterplan according to Table 12, equals INDfactor times this valIND(EleGasH20',time,'bau') for each period 'time'. Column 4 enumerates the values obtained for INDfactor for each period from 2013 until 2024.

Scenario	ADB MON-7619 EMP 2: Mixed hydro-wind expansion			
T = total investments	T (in mMNT) = 1.435*T (in US$m)	FDI (90% * T)	Domestic (10% * T)	INDfactor x valIND(*)
2013	162.7	146.4	16.3	8.8
2014	438.0	394.2	43.8	22.9
2015	731.7	658.5	73.2	34.1
2016	1077.1	969.4	107.7	48.3
2017	1107.5	996.7	110.7	41.8
2018	668.3	601.5	66.8	16.1
2019	800.9	720.8	80.1	13.2
2020	905.3	814.8	90.5	30.0
2021	380.9	342.8	38.1	26.5
2022	642.0	577.8	64.2	26.6
2023	346.7	312.0	34.7	0.0
2024	1340.1	1206.1	134.0	35.8

Table 12: Total investments, FDI, Domestic investments, and the calculated INDfactor in the EleGasH2O production sector, for the ADB MON-7619 EMP 2 scenario.

SCENARIO 3 (ADB-MON-7619 EMP 3)[14]: This scenario is based on increased FDI according to a Heavy Renewables Expansion scenario.

[13] The GAMS file ADB-MON-7619_EMP2.gms contains the Mixed Hydro-Wind expansion scenario.
[14] The GAMS file ADB-MON-7619_EMP3.gms contains the Heavy Renewables expansion scenario.

Scenario	ADB MON-7619 EMP 3: Heavy Renewables expansion			
T = total investments	T (in mMNT) = 1.435*T (in US$m)	FDI (90% * T)	Domestic (10% * T)	INDfactor x valIND(*)
2013	162.7	146.4	16.3	8.8
2014	438.0	394.2	43.8	22.9
2015	669.9	602.9	67.0	34.1
2016	978.2	880.4	97.8	48.3
2017	872.4	785.2	87.2	41.8
2018	473.6	426.2	47.4	22.0
2019	715.5	644.0	71.6	32.3
2020	1105.6	995.0	110.6	48.5
2021	1044.8	940.3	104.5	44.5
2022	1065.0	958.5	106.5	44.0
2023	296.1	266.5	29.6	11.9
2024	917.2	825.5	91.7	35.8

Table 13: Total investments, FDI, Domestic investments, and the calculated INDfactor in the EleGasH2O production sector, for the ADB MON-7619 EMP 3 scenario.

In Table 13, the first column depicts a time series of total investments in the EleGasH2O production sector. The original series obtained from the Energy Master Plan was in millions of US$, hence we translated them into millions of Tugruk (mMNT) using the exchange rate of 1US$ = 1.435 MNT as used in the Energy Master Plan. From these total investments, depicted with T, we compute the part of foreign direct investments (FDI) and investments from domestic origin using an allocation of 90% of T being FDI and 10% of T being domestic investments.

Notice that Robichaud et al. (2011) implement the FDI shocks as a multiple, 0.5, of valIND(EleGasH20',time,'bau') in the BaU scenario. We introduce a factor, INDfactor in Table 13, which denotes this multiple, and it is computed in such a way that the value FDI obtained in the Energy Masterplan according to Table 13, equals INDfactor times this valIND(EleGasH20',time,'bau') for each period ‘time’. Column 4 enumerates the values obtained for INDfactor for each period from 2013 until 2024.

We have repeated the simulations of Robichaud et al. (2011) with respect to the three scenarios defined in the Energy Master Plan, ADB MON-7619. Hence, we now present the results comparable to the latter study.

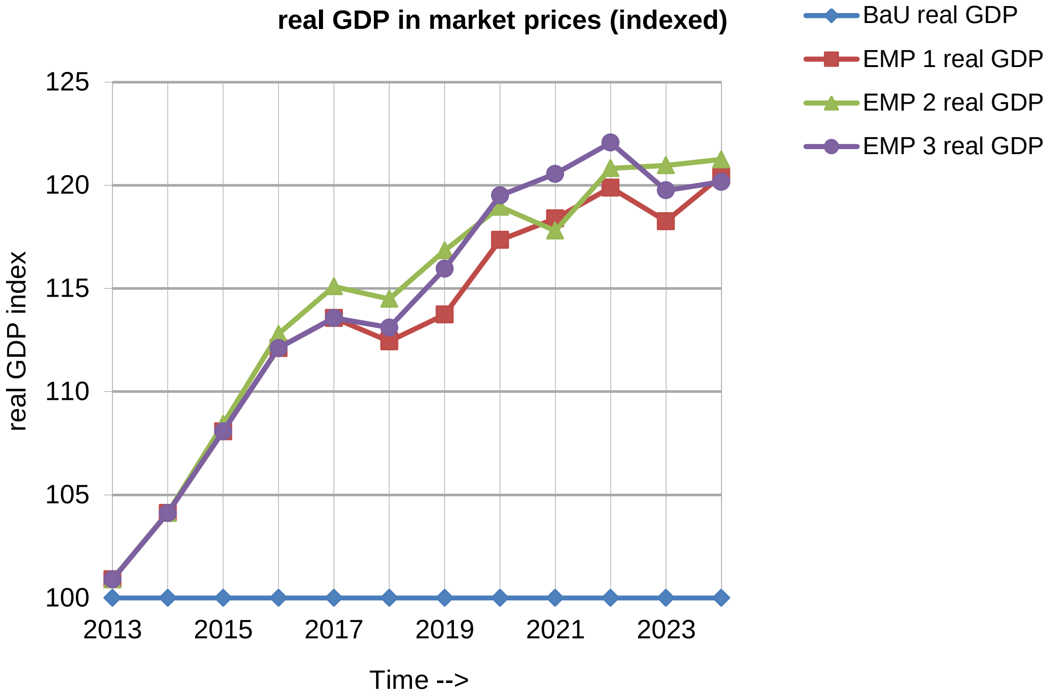

Figure 5: GDP in market prices (indexed) growth with respect to the BAU scenario. Notes: BAU-Business As Usual; Base=100. (Source: Authors' calculation based on simulation results.)

Impact on GDP

Figure 5 depicts the growth in GDP at market prices, indexed with respect to the BaU levels (100) in each time period, while Table 14 provides the underlying data in each scenario. As expected, increased FDI leads to a significant growth in GDP, similar to Robichaud et al. (2011). Here, though, since the ADB MON-7619 Energy Master Plan provides annual increases in FDI that can be very different over the years, depicted GDP growth is seen to increasingly diverge among the different scenarios from 2016 on.

	BaU		EMP 1		EMP 2		EMP 3	
	real GDP	GDP Deflator	real GDP	GDP Deflator	real GDP	GDP Deflator	real GDP	GDP Deflator
2013	100.00	1.00	100.91	1.02	100.91	1.02	100.91	1.02
2014	100.00	1.00	104.12	1.07	104.12	1.07	104.12	1.07
2015	100.00	1.00	108.08	1.10	108.43	1.10	108.08	1.10
2016	100.00	1.00	112.11	1.12	112.79	1.13	112.11	1.12
2017	100.00	1.00	113.57	1.08	115.10	1.10	113.57	1.08
2018	100.00	1.00	112.44	1.00	114.49	1.03	113.11	1.01
2019	100.00	1.00	113.74	0.99	116.84	1.03	115.96	1.03
2020	100.00	1.00	117.35	1.03	118.96	1.02	119.50	1.05
2021	100.00	1.00	118.39	1.01	117.80	0.96	120.55	1.03
2022	100.00	1.00	119.89	1.00	120.82	0.98	122.07	1.01
2023	100.00	1.00	118.25	0.93	120.96	0.95	119.75	0.93
2024	100.00	1.00	120.46	0.94	121.25	0.92	120.16	0.91

Table 14: Real GDP (= GDP at market prices / GDP Price deflator), and GDP Price deflator. Note: BAU-Business As Usual; GDP deflator is the inverse of the real exchange rate, calculated as a Fisher Price Index. (Source: Authors' calculation based on simulation results)

Table 14 also adds the evolution of the GDP deflator, which is the inverse of the real exchange rate. A higher FDI does lead to an initial appreciation of the real exchange rate by maximally 12-13 percent around 2016 for all scenarios. But in the end, there is a significant depreciation visible of around 6-9 percent. This is not that different from the results in Robichaud et al. (2011) given the much longer period of, significantly varying, levels of investments under the EMP simulations.

Impacts on the structure of the Mongolian Economy:

Table 15 shows the impact on the structure of the Mongolian economy within the four production categories that make up this structure. The impact is indexed on the BaU level (100). We depict the impact in 2013, where each EMP scenario undergoes the same level of investments in the EleGasH2O sector. We depict the impact at the end of the investment stream, in 2025, for each EMP scenario.

The table depicts the shares of the FDI sectors compared to the shares of the Agriculture (Primary), Manufacturing (Secondary), and Services (Tertiairy) sectors in the Mongolian economy, at various points in time between 2013 and 2025. We depict 2013 since then investments in the EleGasH2O sector starts, and 2025, since it is the last period. Investments have stopped at that time. Notice that the sector shares under the BaU scenario are the same in every period, equal to Robichaud et al. (2011).

The immediate impact of a higher stock of productive capital from abroad is a significant expansion in output among the FDI sectors. This output expansion then results in a higher demand for intermediate inputs, thereby creating a spillover effect to the rest of the economy as other sectors also increase their output to meet higher demand for their products. Table 15 shows that this increase in the share of FDI sectors in the Mongolian economy when compared to its BaU share holds in the end for the first two EMP scenarios. Scenario EMP3 though shows a decrease in its share.

Under Scenario EMP3, one may notice that it is mainly the services sector whose 2025 end of period share in the Mongolian economy profits from the preceding flow of investments. The services sector share also profits, though to a lesser extent under the other two EMP scenarios.

Notice that, at the start of the investment flow, at 2013, the share of the FDI sectors and the share of the Services sectors fall, in favour of the share of the traditional agriculture and manufacturing sectors.

			EMP 1	EMP 2	EMP 3
	BaU	2013	2025	2025	2025
FDI sectors	25.16	24.42	26.13	25.53	24.91
Agriculture	22.00	22.51	21.04	21.01	21.04
Manufacturing	9.81	10.35	9.70	9.71	9.68
Services	43.03	42.72	43.13	43.75	44.37

Table 15: Relative shares (percent) in GDP. (Source: Authors' calculation based on simulation results)

Impacts on Mongolian exports

Impact of the EMP on total exports

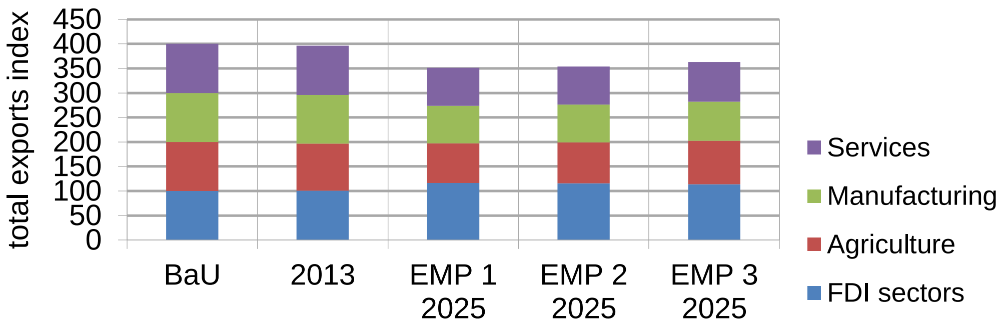

Figure 6: Structure and evolution of total exports (Volume). Note: BAU-Business As Usual; BAU 2017 is used as the index of exports (Base=100) . (Source: Authors' calculation based on simulation results)

Figure 6 shows the structure and evolution of the total volume of exports in Mongolia. The sector where the FDI is taking place, EleGasH2O, benefits most with respect to exports while exports decrease in other sectors (contrary to Robichaud et al. (2011), where Manufacturing did profit too, though in a lesser way).

Impact on labour

Table 16 shows the impact on employment within the four production categories. The impact is indexed on the BaU level (100). We depict the impact in 2013, where each EMP scenario undergoes the same level of investments in the EleGasH2O sector. We depict the impact at the end of the investment stream, in 2025, for each EMP scenario.

			EMP 1	EMP 2	EMP 3
	BaU	2013	2025	2025	2025
FDI sectors	100.00	97.19	106.99	96.86	87.58
Agriculture	100.00	103.15	94.24	94.38	94.36
Manufacturing	100.00	109.21	98.56	98.79	98.09
Services	100.00	98.77	98.75	101.53	104.26

Table 16: Impact (indexed) on employment. Note: BAU-Business As Usual; Base=100. (Source: Authors' calculation based on simulation results)

In the end, in period 2025, the FDI sectors only experience a positive effect on employment under the EMP 1 scenario. Services seems to provide more employment in 2025 under the other two scenarios.

Impact on household consumption

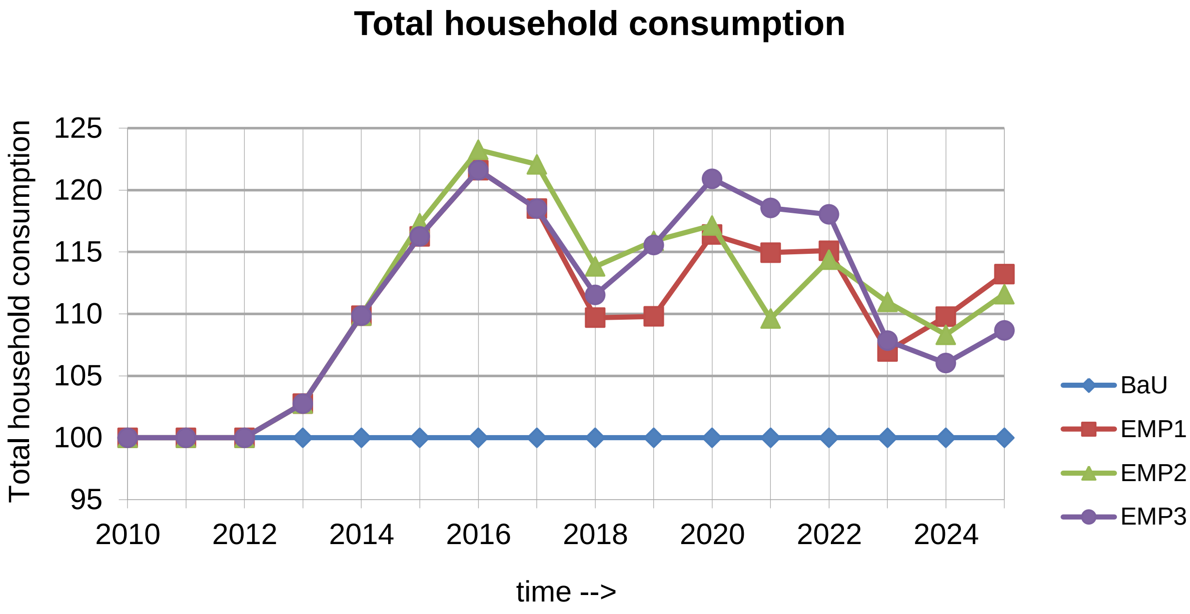

Figure 7: Evolution of household consumption. Notes: BAU- Business As Usual; BASE=100. (Source: Authors' calculation based on simulation results)

As expected, the expansion in economy-wide employment until 2016 allows households to earn more income and enjoy higher consumption levels (Figure 7). Regardless of the scenario, household consumption increases significantly during this period of investments, registering more than 20 percentage points above the BAU in 2016. This then drops to roughly 10 percentage points above the BAU in 2025 as inward FDI in the EleGasH2O sector terminates. Table 17 then shows household savings.

	BaU	EMP 1	%	EMP 2	%	EMP 3	%
2013	125	128	2.76	128	2.76	128	2.76
2025	178	201	13.0	198	11	193	8.48

Table 17: Household savings. (Source: Authors' calculation based on simulation results.)

Proposals for improvements.

The outcome of the project "Updating the Energy Sector Development Plan" is an Energy Master Plan (EMP) for the Mongolian economy. The expected results of the Electricity Master Plan will be a number of strategies with respect to:

- Electricity demand forecast
- A proposed investment schedule (over a period of 20 years). This implies proposed annual investments in:
  - Coal mining
  - Electricity generation
  - Electricity transmission lines
  - Electricity distribution
  - Electricity metering
  - Capacity building and know-how transfer in the Mongolian electricity industry

- For each investment, the EMP determines whether it is of foreign (FDI) or domestic origin
- The EMP provides a split in the underlying financing strategy with respect to:
  - Consumer contribution – an overview of imposed tariffs with respect to different consumer groups (‘tariff study’)
  - Local loan financing
  - International loan financing
  - Local grants financing
  - International grants financing
- Future electricity prices: The tariff study determines in which way the consumer will contribute to the financing of the investments
  - Future electricity tariff scenarios by consumer group: Industry – commercial – public services – residential sector

For the Mongolian government, the main issue will be to assess the impact of implementation of the Energy Master Plan on the Mongolian economy. The objectives of the impact assessment with the Mon-CGE model can be summarized in the following points:

- Proof that the EMP is “feasible” under macro-economic considerations
  - There are not inconsistencies between the EMP and the expected macro-economic development
  - The EMP has positive macro-economic impact
- Identification the EMP positive macro-economic impacts upon the Mongolian Economy:
  - How will the further development of the Mongolian economy improve? Higher economic development and increase of welfare
  - What are the impacts of the EMP have on the labour market? Increased employment
- Discussion of a number of impacts which are difficult to analyse:
  - More competitive industry in form of lower production costs for certain products
  - Impacts of improved electricity supply

The main issue with any impact assessment of the implementation of this EMP is therefore whether and to what extent the welfare of Mongolia benefits in comparison to its neighbouring countries.

We think that Computable general equilibrium (CGE) models (see Ginsburgh and Keyzer (1997) and Shoven and Whalley (1992)) turn out to be particularly well-suited to address such questions. It is rather peculiar that, given their popularity among policy makers, that these type of models have not often been applied to assess the impact of implementing an Energy Master Plan on the economy. One of the main advantages of applying these models is that they take account of the direct as well as the indirect effects of any policy measure implementation. This is due to their focus on multiple markets and their interactions.

The Mon-CGE model could be applied to assess the impact of implementing the Energy Master Plan resulting from the project “Updating the Energy Sector Development Plan” on the Mongolian economy, with respect to its impacts on the Mongolian labour market, to the further development of the Mongolian economy in terms of GDP, the impact on Mongolian welfare, and its impact on trade.

As a starting point, this report only took three particular scenarios from the Energy Master Plan, and applied the associated annual time series of investments from 2013 until 2024 to compute an annual shock to FDI in the EleGasH2O production sector. Some improvements can already be thought of: an update of the calibration of the Mon-CGE model to 2010 as the new base year, as soon as the new SAM for 2010 becomes available. We also should incorporate more specific characteristics of the applied scenarios into the Mon-CGE model. The first scenario is based on an extension of coal, the second scenario on mixed hydro-wind, while the third scenario is heavily based on the use of renewable energy. Hence, we should extend the Mon-CGE model with such renewables. But are data on the use of these renewables available? Furthermore, these extra investments into the EleGasH2O production sector should provide some technical improvements in the sense that future productivity of certain inputs is improved. Corong et al. (2011) take this into account in their second scenario where certain productivity paramaters in the FDI sectors are improved in the near future.

We take the ‘Business-as-Usual’ scenario from the original application of Mon-CGE, but we should build in a 'bottleneck' in the electricity supply since this is what the EMP is trying to overcome. There will be no rationing modelled into the Mon-CGE model hence we have to concentrate on a rather artificial way of including such a bottleneck. The proposal is to calibrate the Mon-CGE model in such a way as to keep the output of the electricity sector in the CGE model at the same level in every period. Under the assumption that electricity supply forms a limiting factor, we increase the price of electricity in such a way that it equals demand to supply on the electricity market.

The EMP counterfactual scenario then differs from the BaU scenario in that it implements the details of the EMP as far as possible and consequentially lets electricity sector output adjust. Thereby, the EMP is seen to remove the imposed bottleneck. We can then compare the counterfactual with the BaU with respect to its impact on welfare (Hicksian Equivalent Variation), unemployment, trade effects etc.

The EMP contains directions to what part of the investments into the electricity sector are domestic and what part is foreign (FDI). Then we can compare the various outcomes of the EMP impact assessment under different assumptions with respect to the allocation over foreign and domestic investments.

References

ADB TA 7619 – MON (July, 2013). Updating Energy Sector Development Plan. Monthly Progress Report: For the Month of June, 2013. Submitted to: P. Tovuudorj, Director General, Energy Policy Department Ministry of Mineral Resources and Energy, Government of Mongolia

Project nr. ADB TA 7619-MON submitted to the Asian Development Bank by e.GEN Consultants Ltd., Dhaka, Bangladesh, on January 31, 2011

Corong, E., B. Decaluwe, and V. Robichaud (March, 2011), "Assessing the Impact of Increased Foreign Direct Investment in Mongolia: A Computable General Equilibrium (CGE) Approach", Report.

Ginsburgh, V., and M. Keyzer (1997), The Structure of Applied General Equilibrium Models, The MIT Press, Cambridge, Massachusetts, London, England.

Enkhbayar, S., D. Roland-Holst, T. Oi, and G. Sugiyarto (February, 2011), "Mongolia's Investment Priorities from a National Development Perspective", Report.

Shoven, J. and J. Whalley (1992), Applying General Equilibrium, New York: Cambridge University Press