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A static CGE model of the Mongolian economy

Ragchaasuren Galindev
Tsolmon Baatarzorig
Munkh-Ireedui Bayarjargal
Nasantogtokh Nyamdorj
Telmen Tur
Tuvshintugs Batdelger

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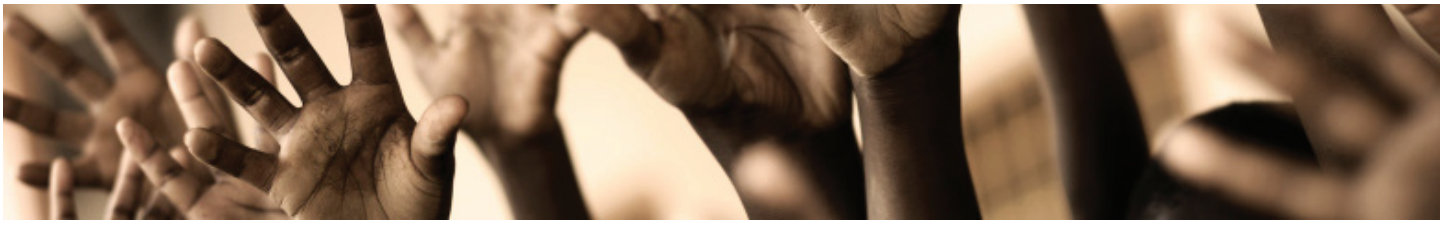

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A Static CGE Model of the Mongolian Economy

Abstract

The Mongolian economy has experienced unprecedented growth rates driven by the booming mining sector. At the same time, it has become increasingly dependent on the mining sector to the extent that movements in the international price of mining commodities could have disturbing effects on the economy. In this research, we examine the short-run effects of the developments occurring in the mining sector on the economy by calibrating a PEP standard static CGE model to a 2010 Mongolian social accounting matrix. In particular, we consider two scenarios: an increase in the stock of capital and land possessed by the coal sector and a drop in the world price of metal ores. In the former scenario, we find that the shock leads to increased value added, production, employment and exports in the coal sector, resulting in higher real GDP, exports and investment. Moreover, we do not find the associated Dutch disease effects on the other sectors. In the second scenario, we find that the effects on the productions, value added, employment, real GDP and investment are all negative while real exports and government expenditure increase slightly.

JEL: D58; Q33
Keywords: Mining boom, CGE model, Dutch disease, Mongolia

Authors

Dr. Ragchaasuren Galindev
Managing partner
Gerege Partners LLC,
Ulaanbaatar, Mongolia
ragchaasuren@geregepartners.mn

Ms Tsolmon Baatarzorig
Economic researcher/analyst
Ulaanbaatar, Mongolia
tsolmon@geregepartners.mn

Mr. Munkh-Ireedui Bayarjargal
Researcher
Economic Research Institute,
Ulaanbaatar, Mongolia
ireedui@eri.mn

Ms Nasantogtokh Nyamdorj
Head of sector
Institute For Labour Studies
Ulaanbaatar, Mongolia
nnasantogtokh@gmail.com

Mrs. Telmen Tur
Gerege Partners LLC
Ulaanbaatar, Mongolia
telmen@geregepartners.mn

Dr. Tuvshintugs Batdelger
Professor
National University of Mongolia
Ulaanbaatar, Mongolia
btuvshintugs@gmail.com

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1. Introduction

Mongolia is a fast growing yet underdeveloped country. Between 2009 and 2014, real GDP grew at an average annual rate of 11.1%. The consensus of IMF, World Bank and Oxford Economists on the Mongolian annual GDP growth is averaged at 9.5 percent until 2022. The impetus of such fast growth has been and will be the booming mining sector. There are four main channels through which the mining sector has been underlying the economic development of Mongolia. First, abundant natural resources and government policies promoting FDI increased investment and capital stocks in the mining sector. Secondly, most mining products are exported to other countries. Mining products have accounted for over 80% of total exports since 2010. Thirdly, royalties and taxes collected and government loans from mining projects have been the main source for the expansion of government expenditures. Over 20% of government revenues is directly generated by the mining sector. Fourthly, mining development, FDI in the mining sector and positive expectations about the future economic conditions have indirectly affected economic and social development in the country through the development of infrastructure, knock-on effects on other sectors and new activities in construction, agriculture, livestock farming and trade.

Although the economy is expected to grow fast, it is becoming increasingly dependent on the mining sector. The boom can negatively affect the economy, particularly when it is concentrated in a few sectors, or if the boom leads to a surge in government revenues. This negative Dutch disease effect is the result of foreign currency inflows leading to real exchange rate appreciation which reduces the competitiveness of tradable commodities (e.g., Gregory, 1976; Corden and Neary, 1982). The industries producing tradable goods such as agricultural and manufacturing commodities can be not only the engine of sustainable long-term economic growth but also the buffer of short-run volatility generated by the movements in the prices of mineral products.[1]

Dutch disease is the experience of the Netherlands in the 1960s when they discovered natural gas reserves in the North Sea. This event led to an expansion of the energy sector and a contraction of the manufacturing sector that eventually led to a recession. The main channel is that a positive shock in the natural resource sector leads to a structural change in the economy by reallocating production factors away from the industrial sector towards economic activities benefiting from this shock. At the same time, there would be a currency appreciation and a loss of international competitiveness of tradable goods. There is a body of empirical literature on Dutch disease. Rodriguez and Sachs (1999) and Sachs and Warner (2001) find a negative relationship between natural resource endowment and economic growth. Collier and Goderis (2007) find that a natural resource boom has positive effects on the level of production in the short term but negative effects in the long term. Hutchinson (1990) studies the cases of Norway, the United Kingdom and the Netherlands and reaches conclusions that the industrial sector contracts in the short term, but that there are no negative effects on growth in in the long term. Olusi and Olagunju (2005) finds the existence of Dutch disease in the Nigerian economy.

[1] See Fisher et al., (2010) for a recent literature review on the relationship between natural resources and economic development.

This paper considers the short-run effects of the mining sector on the Mongolian economy by adopting the PEP-1-1 static single country CGE model developed by Decaluwé et al. (2012) calibrated to a 2010 Mongolian social accounting matrix (SAM). Specifically, we look into two scenarios. In the first scenario, we consider the effect of an increase in the stock of capital and land possessed by the coal sector. This reflects the recently observed government policies in the form of issuing licenses to extract and export coal and subsequently increased investment in capital stock in this sector. In addition, the government is currently negotiating with investors on the operation of one of the biggest coal mines in the region. In that sense, this scenario attempts to see the effect of the operation of this project once started. In the second scenario, we consider the price effects of the mining commodities, in particular a decrease in the world price of metal ores. This is an attempt to assess the vulnerability of the economy to the changes in the external environment.

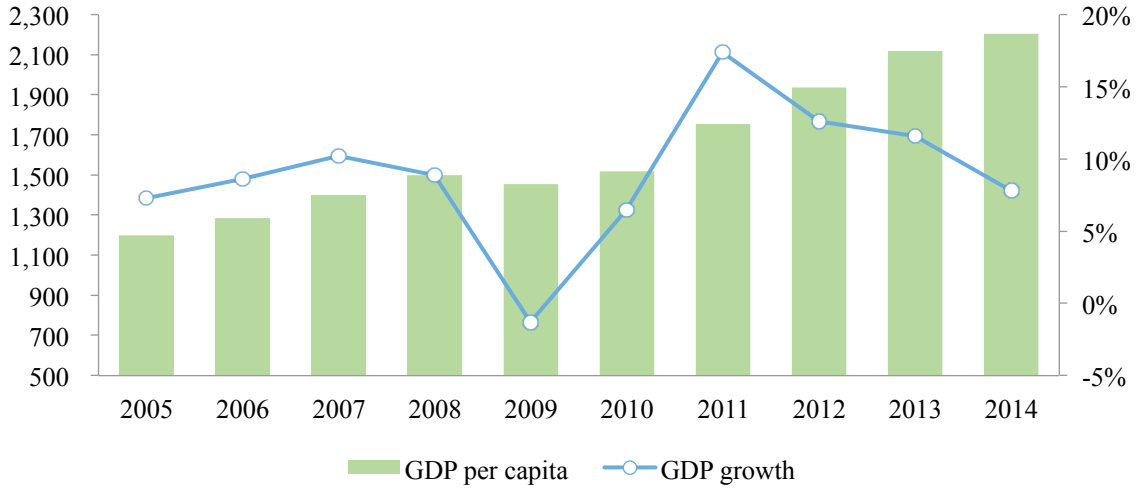
The paper is organized as follows. The next section describes the economic performance of the Mongolian economy in recent years. Section 3 presents the methodology and data used. Section 4 displays the results of the simulations, detailing the aggregate and sectoral effects in each scenario. The last section concludes and proposes policy recommendations.

2. The Mongolian economy

In this section we present a brief review of recent trends in the Mongolian economy. In particular, we focus on the last seven years (2008-2014) during which the economy experienced the consequences of the global financial crisis (2008-2009) and the recent boom (2010-2012) trigged by an extremely favorable external environment that allowed the economy to reach unprecedented growth rates driven by the mining sectors. Finally, in the last two years, it is characterized by a decrease in FDI and a fall in the prices of mining products that has negatively affected the economy.

The Mongolian economy contracted by 1.3 percent in 2009, attributed to the global financial crisis which reduced the price of copper significantly from about 9000 USD per ton to 3000 USD. But the quick recovery in the price of copper and unexpected increase in the coal price led the economy out of the recession within a year. Then, in 2011, the economy reached its highest growth with an annual rate of 17.5 percent due to massive FDI in Oyu Tolgoi copper mine and coal exports. But since then the economy has displayed signs of deceleration, attributed mainly to the reductions in FDI and the world prices of coal and copper.

Figure 2.1: Rates of GDP growth and GDP per capita (1000 MNT)



Source: Mongolian Statistical Yearbooks, National Statistical Office

Table 2.1 shows the key macroeconomic indicators for selected years (2008, 2010, 2013 and 2014). The increase in M2 money is absorbed by the increases in nominal variables such as the exchange rate, government budget indicators and inflation. The importance of the agricultural sector has decreased – the GDP share decreased from 20% to 15 percent). On the other hand, the GDP shares of the mining and trade sectors increased (see Figure 2.2).

Table 2.1: Key macroeconomic indicators

	2008	2010	2013	2014*
Population	2,665,955	2,760,968	2,930,277	2,995,459
Unemployment rate (%)	2.8	9.9	7.9	7.7
GDP, bln MNT (2005 constant price)	3,964	4,163	6,144	6,602
GDP growth (%)	8.9	6.4	11.6	7.8
GDP per capita (1000 MNT)	1499.7	1,520	2,119	2,204
Inflation	22.1	13.0	12.5	9.8
Money M2 (bln MNT)	2,270	4,680	9,451	
Annual average exchange rate (MNT/US$)	1,166	1,356	1,526	1,883
Total revenue and grants (bln MNT)	2,170	3,123	5,928	5,316
Total expenditure and net lending (bln MNT)	2,467	3,081	6,178	5,708
Budget equilibrated balance (bln MNT)	(296)	42	(250)	(393)
Total revenue and grants/GDP (%)	33.1	37.1	33.5	28.5
Total expenditure and net lending/GDP (%)	37.6	36.6	35.2	32.2
Budget overall equilibrated balance/GDP (%)	-4.5	0.5	(1.7)	(3.7)
Investment (bln MNT)	1,785	3,846	6,286	
Foreign investment (bln MNT)	835	2,443	3,503	

Exports (mln USD)	2,535	2,909	4,269	3,576
Imports (mln USD)	3,245	3,200	6,358	3,599
Foreign trade balance (mln USD)	(710)	(292)	(2,089)	(23)
Monthly average income per household	363,594	448,027	959,247	1,077,457
Monthly average expenditure per household	367,466	450,206	961,677	1,093,873

Source: Mongolian Statistical Yearbooks, National Statistical Office

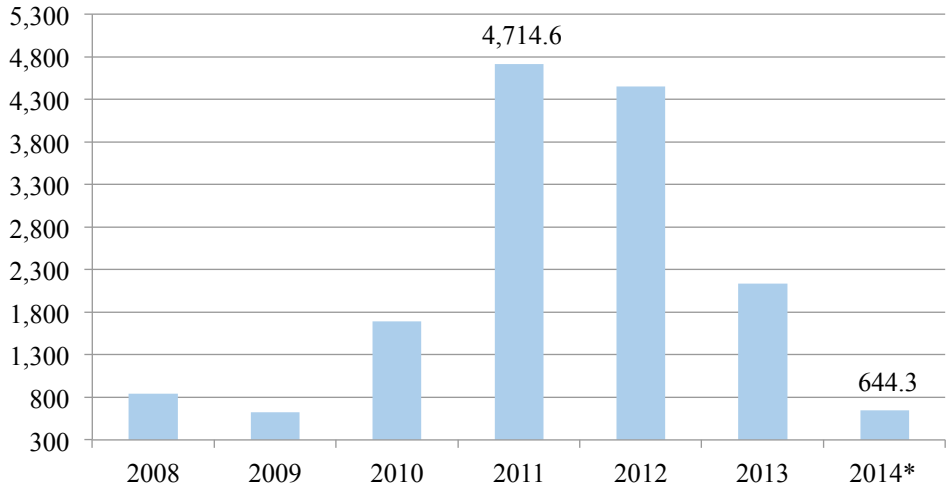
Figure 2.2: Sectoral shares in GDP in 2005 prices (%)

	2008	2009	2010	2011	2012	2013	2014*
GDP (bln MNT)	3,964	3,914	4,163	4,892	5,498	6,144	6,602
GDP (%)	100	100	100	100	100	100	100
Agriculture	19	20	16	14	15	15	17
Mining	17	18	18	16	16	17	19
Manufacturing	6	6	6	6	5	5	5
Trade	8	7	9	11	12	13	10
Transportation	11	12	12	11	11	9	11
Real estate	5	5	5	4	4	4	3
Other	34	32	35	39	38	37	36

Source: Mongolian Statistical Yearbooks, National Statistical Office

Figure 2.3 shows the dynamics of FDI. Since its peak in 2011, FDI has continuously decreased. According Invest Mongolia Agency, over 73% of all FDI since 1993 has been implemented in the mining sector.

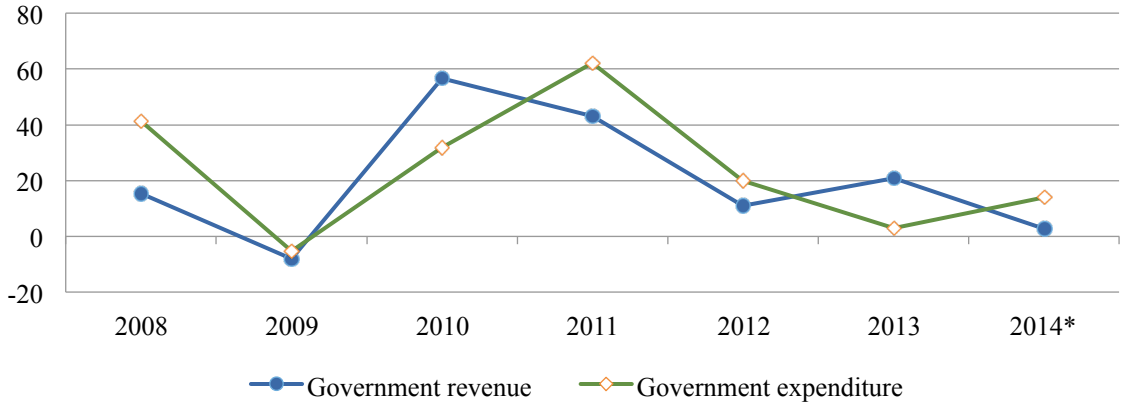
Figure 2.3: Foreign direct investments (mln US$)



Source: Mongol Bank

As shown in Table 2.1, total government revenues and expenditures are over 30% of GDP. In addition, the fiscal policy has been highly procyclical, amplifying the effect of external shocks. Figure 2.4 shows the growth rates of total government revenue and expenditure.

Figure 2.4: Growth rates of government revenue and expenditure (%)



Source: Mongolian Statistical Yearbooks, National Statistical Office

3. Methodology and data

In this paper we implement the PEP-1-1 single-country static CGE model developed by Decaluwé et al. (2012) calibrated to a 2010 Mongolian social accounting matrix (SAM). The main data requirement is to calibrate the CGE model to the SAM.

We needed a social accounting matrix (SAM) to build the CGE model, but there is no existing SAM for the Mongolian economy. This led us to build a Mongolian SAM from a variety of data sources. The main source of information for the construction of the SAM is the Input Output table for Mongolia 2010 (latest available) constructed by the National Statistical Office (NSO). They present information on production, intermediate consumption, final demand (e.g., aggregate household and government consumption, gross fixed capital formations and exports), labor and capital income by industries and taxes on products. Additionally, information from the balance of payments is an important input to build the external accounts of the SAM. To build the government account, data for 2010 from the statistical yearbook provides what was required. To disaggregate labor payments and households, we used the Mongolian Household Socio-Economic Survey (HSES) and Labor Force Survey (LFS) conducted by the NSO for 2010.

In building the 2010 SAM for Mongolia we followed the procedure proposed by Pyatt and Round (1985). The process has a top-down structure, containing the following steps: (i) construction of an aggregate SAM (hereafter, macro-sam), (ii) disaggregation of the macro-sam into a matrix with a relatively large sectoral breakdown (hereafter, micro-sam), and (iii) balancing of the micro-SAM to make it suitable for the calibration of the PEP-1-1 model. Data limitations forced us to make some assumptions in order to build the SAM. The data came from a number of different sources, so manual adjustments were required to balance the SAM.

Table 3.1: Mongolian 2010 SAM Accounts

Sectors – Commodities (22)	Institutions (5)
Agriculture	Households
Coal	Poor households (HP)
Metal ore	Rich households (HR)
Other mining	Firm
Mining service	Government (GVT)
Manufacturing	Rest of the world (ROW)
Electricity	**Taxes (4)**
Water supply	Income taxes
Construction	Import taxes
Trade	Taxes on commodities
Transportation	Other taxes on production
Accommodation	**Factors (4)**
Information	Labor
Finance	Skilled labor (SK)
Real estate	Unskilled labor (USK)
Professional	Capital (CAP)
Administrative	Land (LND)
Public administration	**Savings-Investment (2)**
Education	Savings-Investment (Saving)
Health	Stock change (Stock)
Entertainment	
Other services	

Table 3.1 shows the accounts in the Mongolian SAM. The productive activities are split into 22 sectors and commodities. The SAM has two types of labor: those classified as "elementary workers" in 2010 LFS (unskilled) and those falling in the other classifications (skilled).[2] The remaining production factors are the capital stock and land used in agricultural and mining sectors. The institutional accounts include two representative (poor and rich) households and a representative firm. The other institutions are the government and the rest of the world. The tax accounts have been disaggregated into four taxes as shown in Table 3.1. Lastly, there is one consolidated savings-investment and a stock change accounts. Table 3.2 shows a macroeconomic SAM that is an aggregation of the detailed and balanced SAM. Mongolian GDP was 9,757 billion MNT in 2010 (see Table 3.3). In 2010, the current account deficit was around 10% of GDP and government consumption was 12.7% of GDP.

[2] We follow ISCO-08 which classifies cleaners and helpers; street and related sales and service workers; refuse workers and other elementary workers; food preparation assistants; agricultural, forestry and fishery laborers; laborers in mining, construction, transport and manufacturing as "elementary occupation".

Table 3.2: Mongolian MACROSAM 2010 (billion MNT)

	Value added	Household	Firm	GVT	ROW	Sectors	Commodities	Saving	Stock	**Total**
Value added						8,739				**8,739**
Household	6,664			804	307					**7,775**
Firm	1,308			388						**1,696**
GVT	8	335	1,644		102	19	998			**3,106**
ROW	760	169		38			5,315			**6,281**
Sectors							17,943			**17,943**
Commodities		5,396		1,238	4,331	9,185		3,498	608	**24,256**
Saving		1,875	51	638	1,542					**4,106**
Stock								608		**608**
Total	**8,739**	**7,775**	**1,696**	**3,106**	**6,281**	**17,943**	**24,256**	**4,106**	**608**	

Table 3.3: Mongolian GDP 2010 (billion MNT)

	LCU	GDP share (%)
Poor household consumption	788	8.1
Non-poor household consumption	4,608	47.2
Government consumption	1,238	12.7
Investment	3,498	35.9
Stock variation	608	6.2
Exports	4,331	44.4
Imports	5,315	54.5
GDP at factor cost	8,758	89.8
Net taxes on products	998	10.2
GDP market price	**9,757**	**100.0**

The production structure of Mongolia is shown by Table 3.4. Columns (i)-(iv) show the share of each sector in the economy's skilled labor income, unskilled labor income, composite capital income and value added, respectively. In terms of skilled labor, those employed by the public administration and education sectors receive nearly 30 percent of total skilled labor income in the economy. In terms of unskilled labor, those employed by the metal ores, trade and education sectors receive the highest shares of unskilled labor income (17.5, 15.7 and 12.3 percent respectively). For capital and land income, the agriculture, metal ores, trade and real estate sectors account jointly for nearly 50 percent. The agriculture, metal ores and trade sectors account for the highest shares of value added in the economy, namely 13.1, 11.8 and 13.7 percent respectively. The manufacture sector produces 7.6 percent of value added. Column (v) shows the share of value added in the sum of value added and expenditure on intermediate consumption.

Table 3.5 shows the allocation of value added among the production factors for each sector. The agriculture, coal, metal ores, other mining, mining services, manufacturing, trade, transportation, information and real estate sectors have a relatively high degree of capital intensity as their combined capital and land income shares are above 70 percent. The remaining sectors are relatively more labor intensive. The public

administration, education, health, professional and entertainment sectors are mostly financed by the government and are relatively more labor intensive.

Table 3.4: Production structure of Mongolia 2010 (%)

Sectors	SK_i	USK_i	$CAP_i + LND_i$	VA_i/VA	$VA_i/(VA_i + CI_i)$
	(i)	(ii)	(iii)	(iv)	(v)
Agriculture	2.2	0.5	16.8	13.1	66.0
Coal	1.7	5.7	7.6	6.3	58.7
Metal ores	5.2	17.5	13.6	11.8	61.1
Other mining	0.8	2.6	1.2	1.1	36.5
Mining service	1.8	6.1	5.7	4.8	34.2
Manufacturing	6.1	2.8	8.2	7.6	29.1
Electricity	4.2	1.7	1.6	2.2	31.4
Water supply	0.6	3.8	0.2	0.4	28.9
Construction	4.8	3.7	2.2	2.9	18.9
Trade	11.2	15.7	14.3	13.7	59.6
Transportation	6.6	6.8	8.1	7.7	46.1
Accommodation	1.4	1.4	0.3	0.6	21.9
Information	3.3	1.2	2.9	2.9	52.7
Finance	4.5	1.9	2.2	2.7	64.5
Real estate	0.7	0.0	10.3	7.9	75.8
Professional	4.8	2.0	0.5	1.5	39.7
Administrative	1.8	2.0	0.6	0.9	45.7
Public admin	14.7	7.5	1.8	4.9	59.4
Education	14.9	12.1	0.9	4.3	67.2
Health	6.5	3.0	0.5	1.9	54.5
Entertainment	1.1	1.1	0.1	0.4	54.5
Other services	1.0	1.2	0.3	0.5	50.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	

Notes: SK and USK refer to skilled and unskilled labor, CAP and LND refer to capital and land while VA and CI refer to value added and intermediate consumption.

Table 3.5: Value added structure of Mongolia in 2010 (%)

Sectors	SK_i	USK_i	$CAP_i + LND_i$	VA_i
Agriculture	3.8	0.1	96.0	**100.0**
Coal	6.1	2.4	91.5	**100.0**
Metal ores	9.8	4.0	86.2	**100.0**
Other mining	15.5	6.2	78.3	**100.0**
Mining service	8.4	3.4	88.2	**100.0**
Manufacturing	18.1	1.0	80.9	**100.0**
Electricity	43.5	2.1	54.4	**100.0**
Water supply	39.0	28.4	32.6	**100.0**
Construction	37.9	3.5	58.6	**100.0**
Trade	18.4	3.1	78.5	**100.0**
Transportation	19.2	2.3	78.4	**100.0**
Accommodation	52.9	6.2	40.9	**100.0**
Information	25.4	1.1	73.4	**100.0**
Finance	36.7	1.8	61.5	**100.0**
Real estate	2.0	0.0	98.0	**100.0**
Professional	71.2	3.5	25.3	**100.0**
Administrative	44.9	5.7	49.4	**100.0**

Public administration	68.2	4.1	27.7	**100.0**
Education	77.2	7.4	15.4	**100.0**
Health	76.6	4.1	19.3	**100.0**
Entertainment	70.0	8.3	21.7	**100.0**
Other services	45.8	6.2	48.0	**100.0**

The trade structure of Mongolia is reflected in Table 3.6. Columns (i) and (ii) of Table 3.6 show the share of each sector in total exports and imports, respectively. Columns (iii) and (iv) of Table 3.6 present, for each sector, the share of exports in production and the share of imports in consumption, respectively. While the mining (particularly, coal and metal ores) commodities account for roughly 60 percent of export revenues, manufacturing products represent the highest share of imports (around 86%). According to column (iii), most of the mining commodities (i.e., coal, metal ores and other mining) produced is exported (over 90%) while other commodities are mostly consumed domestically. According to column (iv), most of the manufacturing commodities consumed by the domestic economy is imported (around 67%).

Table 3.6: Trade structure of Mongolia 2010 (%)

Sectors-commodities	**exports%**	**imports%**	**ex intensity**	**im intensity**
	(i)	(ii)	(iii)	(iv)
Agriculture	3.4	1.4	8.4	4.0
Coal	21.9	0.0	99.2	0.0
Metal ores	38.3	0.0	98.0	0.0
Other mining	5.6	0.1	91.3	1.6
Mining service	0.2	0.9	0.7	6.8
Manufacturing	6.8	86.0	12.8	66.6
Electricity	0.0	0.3	0.1	2.6
Water supply	0.0	0.0	0.4	0.9
Construction	0.1	0.2	0.3	0.5
Trade	13.3	0.0	28.7	0.0
Transportation	6.0	3.7	17.7	11.7
Accommodation	2.6	1.7	47.3	27.8
Information	0.3	0.8	2.5	10.2
Finance	0.4	1.0	5.2	12.8
Real estate	0.0	0.0	0.0	0.0
Professional	0.9	2.1	11.7	24.7
Administrative	0.1	0.5	3.3	12.7
Public administration	0.0	0.0	0.0	0.0
Education	0.1	1.2	1.0	10.2
Health	0.0	0.1	0.1	1.7
Entertainment	0.0	0.0	0.0	0.0
Other services	0.0	0.0	0.0	0.0
Total	**100.0**	**100.0**		

The Mongolian 2010 SAM reports the sources of government revenue which includes taxes paid by institutions, commodity sales, sectors, and tariffs and various transfer payments (see Table 3.7). According to this, most of (over 75%) its income comes from direct taxes (which are personal income taxes and corporate taxes) and import duties.

Table 3.7: Sources of government income

	Values from the SAM	Shares (%)
Capital income	7,989	0.3
Transfers from firms	362,295	11.7
Direct taxes	1,616,784	52.1
Import duties	800,281	25.8
Taxes on commodity sales	197,891	6.4
Taxes on production	18,958	0.6
Taxes on exports	190	0.0
Transfers from ROW	101,523	3.3
Total	**3,105,911**	**100.0**

The structure of government expenditures in the SAM is reflected in Table 3.8. The government spends nearly 40 percent of its income on goods and services which accounts for about 13 percent of GDP. Although it is not presented here, most of its spending is on education, public administration and health commodities. It also spends about 20 percent of its income on savings which accounts for 15.5 percent of investment undertaken in the economy (Table 3.13). The government transfers 8.5 and 17.4 percent of its income to poor and rich households respectively which are from the social security fund, social assistance fund, reimbursement, repression reimbursement and other current transfers appearing in government expenditures. According to Table 3.10 below, the government transfers account for 30.9 and 7.8 percent of poor and rich household income, respectively (Table 3.10).

Table 3.8: Structure of government expenditure

	Values from the SAM	Shares (%)
Transfers to poor households	263,760	8.5
Transfers to rich households	540,387	17.4
Transfers to firms	387,711	12.5
Transfers to ROW	37,709	1.2
Spending on commodities	1,237,928	39.9
Public savings	638,416	20.6
Total	**3,105,911**	**100.0**

Tables 3.9-3.12 present the private sector accounts. Households are divided into poor and rich households based on the 2010 poverty line. According to National Statistical Office, 39.2 percent of households were recorded as poor in 2010. The representative poor and rich households allocate 92.5 and 66.6 percent of their income to consumption which account for 8.1 and 47.2 percent of GDP respectively (Table 3.3). They save 3.5 and 26.7 percent of their income which account for 0.7 and 44.9 percent of total investment, respectively (Table 3.13).

Table 3.9: Structure of representative household spending (mln MNT, %)

	Values from the SAM		Shares (%)	
	HP	HR	HP	HR
Direct taxes	34,806	299,870	4.1	4.3
Consumption	788,349	4,607,814	92.5	66.6
Transfer to ROW	-	169,486	0.0	2.4
Savings	29,505	1,845,464	3.5	26.7
Total	**852,661**	**6,922,633**	**100.0**	**100.0**

Notes: HP and HR refer to representative poor and rich households; ROW refers to the rest of the world.

Table 3.10: Structure of representative household's income (mln MNT, %)

	Values from the SAM		Shares (%)	
	HP	HR	HP	HR
SK labor income	202,785	1,762,333	23.8	25.5
USK labor income	24,155	209,927	2.8	3.0
Capital income	223,847	3,506,939	26.3	50.6
Land income	44,020	689,647	5.2	10.0
Transfers from GVT	263,760	540,387	30.9	7.8
Transfers from ROW	94,093	213,401	11.0	3.1
Total	**852,661**	**6,922,633**	**100.0**	**100.0**

According to Table 3.10, poor households receive the highest share of their income from the government as transfers (roughly 31%) while rich households receive their highest share of income from capital and land ownership (roughly 60%). For both types of households, labor income account for less than 30 percent of income.

The structure of representative firm's spending is given by Table 3.11. Direct taxes account for 75.61 percent of its expenditures which includes elements appearing in government revenues such as corporate taxes, price increase taxes on some products, social security contributions, stamp duties, royalties, land payments, etc. Transfers to the government (GVT) includes elements such as dividends, interest and fines, rent, navigation fees, revenues of budget entities, etc., which are considered as revenue for the government. Table 3.12 shows the sources of the representative firm's income. The firm receives 77.1 percent of its income from its capital and land ownership which we assume to account for 20 percent of total combined capital and labor income as there is no information. Transfers from the government accounts for the remaining 22.9 percent of its income which is sourced from the government budget expenditure.

Table 3.11: Structure of a representative firm's spending (mln MNT and %)

	Transfers to GVT	Direct Taxes	Savings	Total
From SAM	362,295	1,282,108	51,322	**1,695,725**
Shares (%)	21.37	75.61	3.03	**100.00**

Table 3.12: Structure of a representative firm's income (mln MNT and %)

	Capital income	Transfers from GVT	Total
From SAM	1,308,014	387,711	**1,695,725**
Shares (%)	77.1	22.9	**100.0**

The following table shows the sources of investment. According to this, the savings by rich households and foreigners accounted for 80% of investment undertaken in 2010. To balance the 2010 Mongolian SAM, we adjust the savings by households, firms, government and the rest of world. In 2010, about 4,106 billion MNT of investment was implemented in the economy which accounted for roughly 42 percent of GDP (Table 3.3). Although it is not presented here, spending on construction, manufacture and mining service commodities accounts for nearly 90 percent of consumption for investment purposes (roughly 38%, 36% and 16% respectively).

Table 3.13: Savings to investment (mln MNT and %)

	Savings	shares%
Poor households	29,505	0.7
Rich households	1,845,464	44.9
Firms	51,322	1.2
GVT	638,416	15.5
ROW	1,541,545	37.5
Total	**4,106,251**	**100.0**

4. Experiments

In this section, we consider the short-run effects of two separate scenarios on the economy by using the comparative-static PEP-1-1 model calibrated to the 2010 Mongolian SAM introduced in the previous section.

- The first shock that we consider is a 30-percent increase in the stock of capital and land in the coal sector. This represents an increase in land used for mining and capital stock due to investments during and after 2010 which is the base year for the SAM.[3]
- The second shock is a decrease in the world price of metal ores commodity which is mainly copper concentrate and iron ore.

These shocks are very relevant to the Mongolian economy as the government is currently negotiating with investors on the operation of one of the biggest coal mines in the world, Tavan Tolgoi, and the international price of copper is historically very volatile.

In the short-run in these scenarios the stock of capital and land are fixed for all sectors (except for the coal sector in the first scenario) and nominal wages are constant so that the model features the elements of Keynesian economics – i.e., aggregate labor

[3] We consider the typical values for the elasticities of substitution between capital and land for almost all sectors (0.25) in the literature (e.g., the PEP-1-1 model).

supply is elastic or there exists slack in the labor market. Relaxing this assumption would significantly alter the results below. For example, one could consider either an upward sloping labor supply (i.e., a wage curve) or a full employment condition with a flexible nominal wage.

We consider a closure rule for the PEP-1-1 model in which capital and land are immobile between sectors and nominal government spending, the current account balance, various tax rates, the world prices of all commodities, the parameters of households' savings and transfer functions and the nominal exchange rate (the numeraire) are fixed. Given that both the current account balance and the nominal exchange rate are fixed, the equilibrium of foreign trade is reached through the flexibility of domestic prices and resulting adjustments in the real exchange rate.

4.1. Simulation results: An increase in the stock of capital and land in the coal sector

Macro effects

The 30-percent increase in capital and land used by the coal sector leads to a 2.7 and 3.4 percent increase in employment of skilled and unskilled labor respectively through its direct, indirect and induced effects which contributes to the 2.3 percent increase in real GDP (Table 4.1). Since the coal sector produces mostly coal, 99 percent of which is exported and the exports share of coal is roughly 22 percent, overall exports could potentially increase by over 6 percent if domestic prices remained the same. However, overall exports increase by 4.5 percent due to the increase in the domestic prices which is reflected by 0.5 percent increase in GDP deflator and 0.9 percent increase in consumer prices. The increase in the domestic price implies that consumers substitute for relatively cheaper imports, with overall imports increasing by 3.2 percent. The level of income for poor and rich households increases by 2 and 2.7 percent respectively due to the increase in GDP leading to the same increase in their consumption and savings. Total investment increases by 3.1 percent indicating that overall savings increase by the same amount. Government savings increase by 11.9 percent reflecting an increase in government revenue as government spending is assumed to be fixed.

Table 4.1: Change in macroeconomic variables (%), simulation 1

Real GDP at basic price	2.3
Nominal GDP at market price	2.9
Consumer prices	0.9
GDP deflator	0.5
Public expenditure price index	0.3
Total investment	3.1
Overall exports	4.5
Overall imports	3.2
Exports prices	-0.7
Consumption/savings of poor households	2.0
Consumption/savings of rich households	2.7
Gross fixed capital formation	3.4
Employment of skilled labor	2.7
Employment of unskilled labor	3.4
Government savings	11.9
Firms' savings	1.0

Sectoral effects

The increase in capital and land used by the coal sector has different effects on the other sectors. Table 4.2 shows the percentage changes in employment, total output and the price of value added for each sector. Except for the metal ores and other mining sectors, total output and employment for most sectors increase at various rates. The price of value added in the coal, metal ores and other mining sectors decreases while in the remaining sectors it increases.

Table 4.2: Changes in sectoral production (%), simulation 1

	Employment	Total output	Price of value added
Agriculture	0.2	0.0	0.8
Coal	27.4	29.8	-8.8
Metal ores	-0.0	-0.0	-0.2
Other mining	-0.1	-0.0	-0.5
Mining service	0.6	0.1	2.5
Manufacturing	2.3	0.4	1.3
Electricity	3.8	1.7	1.3
Water supply	0.5	0.3	0.1
Construction	8.2	3.3	3.1
Trade	3.1	0.7	1.6
Transportation	3.8	0.8	2.0
Accommodation	1.6	0.9	0.4
Information	2.4	0.6	1.2
Financial activities	2.6	1.0	1.1
Real estate	5.5	0.1	3.6
Professional	2.9	2.2	0.5
Administrative	7.2	3.6	2.3
Public administration	0.6	0.5	0.1
Education	1.2	1.0	0.1
Health	0.8	0.7	0.1
Entertainment	1.2	0.9	0.2
Other services	4.4	2.3	1.4

Table 4.3 shows the percentage changes in the domestic price, export prices, domestic demand, the demand for exports and imports of each commodity. Except for coal, the domestic and hence export fob price of each commodity increases which explains the decrease in exports and the increase in imports of each commodity given that the world prices and the nominal exchange rate remain fixed. In other words, domestic commodities lose their relative competitive advantage in the international market.

Table 4.3: Change in prices and international trade (%), simulation 1

	Domestic price	FOB price	Domestic demand	Exports	Imports
Agriculture	0.8	0.8	0.3	-3.8	2.3
Coal	-5.0	-5.0	119.0	29.3	109.1
Metal ores	0.1	0.1	6.8	-0.3	6.8
Other mining	0.1	0.1	2.0	-0.3	2.1
Mining service	1.9	1.9	1.4	-3.7	3.1
Manufacturing	0.8	0.8	0.8	-1.6	3.3
Electricity	0.0	0.0	1.6	-0.1	1.7
Water supply	0.5	0.5	0.7	-1.0	2.2
Construction	0.9	0.9	1.9	-1.9	3.8

Trade	1.2	1.2	2.0	-2.4	-
Transportation	1.2	1.2	1.5	-2.4	4.1
Accommodation	0.4	0.4	2.1	-0.8	3.0
Information	1.2	1.2	1.0	-2.3	3.3
Financial activities	1.0	1.0	1.2	-2.0	3.2
Real estate	3.1	-	0.7	-	-
Professional	0.4	0.4	1.5	-0.7	2.2
Administrative	1.1	1.1	2.6	-2.2	4.9
Public administration	0.3	-	0.5	-	-
Education	0.2	0.2	1.0	-0.4	1.4
Health	0.2	0.2	0.6	-0.5	1.1
Entertainment	0.3	-	0.9	-	-
Other services	1.0	-	2.2	-	-

The coal sector experiences the biggest changes. Given the low degree of substitutability among the primary factors, the increase in capital and land increases the labor demand by 27.4 percent and decreases the overall price of value added by 8.8 percent, and this happens due to the decrease in the rental price of composite capital by 9.6 percent. As a result, total output increases by 29.8 percent. The decrease in the price of value added leads to a 5-percent decrease in the local price of coal. Since the elasticity of substitution between domestic supply and exports is sufficiently high (i.e., perfect substitutes) for all goods, export prices follow the pattern of domestic prices. As a result, exports of coal increase by 29.3 percent. The decrease in the price of coal also results in an increase of over 100 percent in the demand for imports and domestic demand – however, their values in the SAM are insignificantly small.

An increase in the intermediate consumption generated by the coal sector growth increases the demand for all commodities. Consequently, output of less export-oriented sectors increase – total output of the construction, professional, administrative and other service sectors increase noticeably (3.3%, 2.2, 3.6% and 2.3%, respectively). Employment in these sectors increases by 8.2, 2.9, 7.2 and 4.4 percent respectively. The growth generated in these sectors also increases the price of value added by 3.1, 0.5, 2.3 and 1.4 percent, respectively through an increase in rental prices of capital and land. Although the main commodities produced by these sectors do not account for significant shares in the coal sector's expenditure, the increase in household consumption and investment can explain the growth in these sectors. For example, construction takes the largest share of investment expenditures.

For the metal ores and other mining sectors, changes are small in terms of employment, output, prices and exports. Although domestic demand and imports for metal ores and other mining commodities increase noticeably, their values in the SAM are small.

The prices of public administration, education, health and entertainment commodities do not increase by significant amounts because their main consumer is the government and its nominal spending is assumed to stay fixed in this simulation. In fact, the government price index is 0.3, implying a decrease in real government spending and hence a decrease in the demand for these commodities. In this case, however, the positive effects on the demand for these commodities due to higher

household and intermediate consumption and investment dominates the negative impact of the decreased real government spending. Consequently, all the domestic prices except for that of coal increase. The increase in domestic prices also explains why the imports of each commodity increase since both international prices of all goods and the nominal exchange rate are fixed.

Summary

The growth in the coal sector increases real GDP, real investment, real consumption, employment, government revenues and relative price levels. It does not create a Dutch disease effect on the other sectors. The reason can be the underlying short-run assumption that the supply of labor is elastic at a fixed nominal wage – i.e., there is slack in the labor market. Consequently, the increase in the aggregate demand for labor triggered by the growth in the coal sector (through its direct and indirect effects such as higher intermediate consumption of domestic goods) does not increase the cost of labor and hence the cost of production for all sectors.[4] Although the price levels increase in the economy, they are not sufficiently strong to reduce the level of output of the sectors producing tradable commodities. Instead, labor demand increases in all sectors, except for the metal ores and other mining (i.e., highly export-oriented sectors). As mentioned before, the level of employment of skilled and unskilled labor increase by 2.7 and 3.4 percent, respectively. We admit that these results obtained in this simulation may not hold under different assumptions such as a full employment condition with a flexible nominal wage.

4.2. Simulation results: A decrease in the international price of metal ores

As mentioned earlier, the international price of metal ores (especially, copper concentrate and iron ore) is highly volatile. In addition, metal ores accounts for over 38 percent of total exports of Mongolia (Table 3.6) and almost 12 percent of country's value added is generated by this sector (Table 3.4). Given the degree of volatility of the price, its frequency and magnitude, one may suggest to consider the effect of these movements on the Mongolian economy. In this scenario, we consider the short-run effect of a 20-percent decrease in the world price of metal ores.

Macro effects

The 20-percent reduction in the international (both imports and exports) price of metal ores has the following a short-run effects on the macroeconomic variables (Table 4.4). Real GDP decreases by 1.2 percent which is caused by the decrease in investment (4.6%), the decrease in real consumption of poor and rich households (1% and 4.9%, respectively), the increase in real government spending (0.6%), the increase in real exports (0.9%) and the decrease in real imports (5.1%).[5] All the price levels decrease – for example, the GDP deflator decreases by 6.1 percent and consumer prices decrease by 1.8 percent indicating that domestic prices fall significantly as the import

[4] We also consider a long-run simulation in which nominal wage is flexible and aggregate labor supply is fixed and we find that the Dutch disease effect is more pronounced. For example, real GDP in basic price increases by 1.6 percent and the GDP deflator increases by 1.2 percent compared to 2.3 percent and 0.5 percent in the short-run simulation respectively (see Appendix for more results).

[5] The changes in the real variables are the differences between the nominal percentage changes and the price indices. The imports price index is zero as the import share of metal ores is insignificant.

prices of all commodities (except for metal ores) remain fixed. On the production side, the decrease in real GDP is reflected by the decrease in employment (4.8% and 5.2% for skilled and unskilled labor, respectively). The decrease in total investment (7.1%) is explained by the decreases in government savings (25.2%), household savings (4.6% for the poor and 6.4% for the rich) and firms' savings (2.4%).

Table 4.4: Change in macroeconomic indicators (%), simulation 2

Real GDP at basic price	-1.2
Nominal GDP at market price	-6.9
Consumer prices	-1.8
GDP deflator	-6.1
Public expenditure price index	-0.6
Investment price index	-2.5
Total investment	-7.1
Overall exports	-7.6
Overall imports	-5.1
Exports prices	-8.5
Consumption/savings of poor households	-4.6
Consumption/savings of rich households	-6.4
Gross fixed capital formation	-8.6
Employment of skilled labor	-4.8
Employment of unskilled labor	-5.2
Government savings	-25.2
Firms' savings	-2.4

Sectoral effects

The 20-percent reduction in the world price of metal ores has various effects on the sectors (Table 4.5). Except for the coal and other mining (highly export-oriented) sectors, total output and the price of value added of each sector fall at different rates. Consequently, the level of employment follows the pattern in total output at various rates reflecting the labor intensity of each sector.

Table 4.5: Change in sectoral production (%), simulation 2

	Employment	Total output	Price of value added
Agriculture	-0.4	-0.0	-1.9
Coal	0.1	0.0	0.5
Metal ores	-8.3	-1.4	-30.6
Other mining	0.1	0.0	0.2
Mining service	-1.5	-0.2	-6.3
Manufacturing	-4.3	-0.8	-2.3
Electricity	-6.5	-3.0	-2.4
Water supply	-9.0	-6.1	-2.1
Construction	-19.7	-8.5	-8.3
Trade	-5.6	-1.2	-3.0
Transportation	-5.0	-1.1	-2.7
Accommodation	-2.2	-1.3	-0.6

Information	-4.5	-1.2	-2.2
Financial activities	-5.0	-1.9	-2.1
Real estate	-13.5	-0.3	-9.0
Professional	-5.7	-4.3	-1.0
Administrative	-11.0	-5.7	-3.8
Public administration	-0.9	-0.7	-0.2
Education	-2.9	-2.4	-0.3
Health	-2.0	-1.6	-0.3
Entertainment	-2.7	-2.1	-0.4
Other services	-9.8	-5.2	-3.3

Table 4.6 shows the percentage changes in the prices and demands for each commodity. All the domestic prices and hence fob prices decline which can be explained by the decrease in domestic demand for all the commodities (except for metal ores). However, the decrease in domestic prices explains the increase in domestic demand for metal ores, the increase in exports and the decrease in imports of all the commodities (except for metal ores).

Table 4.6: Change in prices and international trade (%), simulation 2

	Domestic price	FOB price	Domestic demand	Exports	Imports
Agriculture	-1.7	-1.7	-0.8	9.0	-4.9
Coal	-0.0	-0.0	-34.9	0.2	-34.9
Metal ores	-19.4	-19.4	26.6	-3.7	27.5
Other mining	-0.3	-0.3	-5.2	1.6	-5.5
Mining service	-4.6	-4.6	-3.5	9.8	-7.4
Manufacturing	-1.4	-1.4	-1.0	2.9	-5.1
Electricity	-1.5	-1.5	-2.5	3.1	-6.6
Water supply	-1.5	-1.5	-4.4	3.1	-8.4
Construction	-2.3	-2.3	-5.0	4.8	-9.2
Trade	-2.3	-2.3	-3.6	4.7	-
Transportation	-1.8	-1.8	-2.1	3.6	-5.5
Accommodation	-0.9	-0.9	-3.1	1.8	-4.8
Information	-2.5	-2.5	-2.1	5.1	-6.8
Financial activities	-2.0	-2.0	-2.3	4.2	-6.2
Real estate	-7.8	-	-1.6	-	-
Professional	-0.5	-0.5	-2.3	1.0	-3.3
Administrative	-1.5	-1.4	-2.4	3.0	-5.3
Public administration	-0.5	-	-0.7	-	-
Education	-0.5	-0.5	-2.4	1.1	-3.5
Health	-0.6	-0.6	-1.4	1.3	-2.7
Entertainment	-0.8	-	-2.0	-	-
Other services	-2.5	-	-5.3	-	-

The metal ores sector experiences the largest fall in the price of value added (30.6%). Given that output decreases by 1.4 percent and the nominal wage is fixed, the decrease in nominal revenue is reflected by the decrease in rental prices of capital and land. Indeed, the price of composite capital for the metal ores sector decreases by 35 percent.[6] Since the metal ores sectors accounts for a significant share of value added

[6] The price of composite capital for all the sectors (except for the coal and other mining sectors) decreases at various rates.

in the economy (roughly 12%), the economic agents (households, firm and the government) experience considerable losses in their income. Consequently, the demand for all the commodities fall and generates the results shown in Tables 4.5 and 4.6. Some industries are hit harder than others. For example, the production of the construction sector decreases by over 8.5 percent and consequently the level of employment in the sector decreases by nearly 20 percent. The reason is the decrease in real investment (about 6%) and the decrease in total intermediate consumption which accounts for consumption shares of 51 and 49 percent of the construction commodity respectively. The construction sector is relatively capital intensive (the labor share of value added is about 41%), so employment decreases by nearly 20 percent to absorb the decline in output. The other two sectors to experience the largest declines in employment are the real estate and administrative sectors which produce 8.9 and 0.9 percent of total value added in the economy, respectively. The output of these sectors fall by 0.3 and 5.7 percent, respectively. The real estate sector is highly capital intensive (the capital income share is 98%) which explains why employment in this sector decreases by 13.5 percent and the domestic price of the real estate commodity decreases by the highest amount (7.8%).[7] The capital income share of the administrative sector is about 50 percent so that the decline of 11 percent in employment in this sector is mostly explained by the decrease in output.

Summary

The decrease in the world price of the metal ores commodity decreases real GDP, real investment, real consumption and government revenues and the price levels. It does not induce a sufficiently large decline in the domestic and hence fob prices to increase exports and hence output of traded sectors. The reason is again the underlying short-run assumption that the supply of labor is elastic at a fixed nominal wage. Consequently, the production cost does not fall sufficiently to generate a relative competitive advantage for the domestically traded commodities in the international markets. We again admit that the simulation results may not hold under different assumptions under which the nominal wage adjusts to some degree.

It is worthwhile to emphasize that fixing government spending on goods and services seems to act as a countercyclical mechanism against the negative shock. Given the decreased domestic prices, government demand for goods actually increases as its real spending increases by 0.6 percent. However, it may not be wise to conclude that increasing government spending will do better for the economy as it will decrease government savings and hence investment. Eventually, there may not be any real effect due to the crowding out effect. The only way to act without reducing investment is to borrow from abroad (in the form of transfers from the rest of the world) and increase its spending.

[7] From the SAM, we find that the main consumers of the administrative commodity are households and the agriculture, trade and transportation sectors – their combined share accounts for over 60 percent of the revenue generated for this commodity.

5. Conclusions and policy recommendations

We have now arrived at the point where we can draw conclusions from the simulation results. Our main objective in this paper is to attempt to assess the impact of the mining sector on the Mongolian economy using a CGE model calibrated to the 2010 SAM in order to provide policy recommendations on how to mitigate the negative impacts of the dominant and volatile mining sector. Although it is possible to consider many different scenarios, we focus on two cases in this work. In both cases, we assume that nominal wage remains constant and that labor supply is elastic to capture the short-run effects.

First, we simulate the model with a 30-percent increase in the stock of capital and land possessed by the coal industry. This reflects the government policies of promoting FDI in the coal industry during and after 2010 and the current situation to operate the biggest coal mines in Mongolia, Tavan Tolgoi. We find that the rapid expansion in this sector has positive impacts on real GDP, real exports and real investment, employment and real household consumption. Moreover, it has insignificant Dutch disease effects on the production of the other sectors and small negative effects on the exports of other commodities through real appreciation of the domestic currency. The reason is that we consider the short-run effects with fixed nominal wage and elastic labor supply. In this scenario, nominal government spending on goods and services also remains fixed. This may not be consistent with what we observe in Mongolia where the government spending and transfers have been procyclical. If the government borrowed from foreigners and increased its spending and transfers to households in response to the expansion in the coal sector, the effects of the shock could be amplified and we could find more profound Dutch disease effects.

In the second scenario, we simulate the effects of 20-percent decrease in the international price of metal ores. Given its dependence on the mining sector, that the Mongolian economy is always under constant threat of frequent and sometimes very violent price shocks. The objective of this scenario is to show the effects of negative price shocks and hence derive some policy recommendations. We find that the shock has negative effects on the production and employment of almost all sectors, resulting in a decrease in value added, real GDP, investment and household consumption while there are small positive effects on real exports and real government spending. Again in this scenario, nominal government spending remains constant. Given the procyclicality of the fiscal policy observed in Mongolia, government spending would decrease in response to the shock which would amplify the effect of the shock.

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Appendix

This appendix has the simulation results generated for the case where nominal wages are flexible and aggregate labor supply is fixed (see footnote 4).

A.1. Change in macroeconomic variables (%), simulation 1

Real GDP at basic price	1.6
Nominal GDP at market price	2.9
Consumer prices	1.2
GDP deflator	1.2
Public expenditure price index	1.9
Total investment	2.9
Overall exports	4.3
Overall imports	3.1
Exports prices	-0.6
Consumption/savings of poor households	2.2
Consumption/savings of rich households	2.7
Gross fixed capital formation	3.2
Wage rate of skilled labor	2.8
Wage rate of unskilled labor	4.5
Government savings	10.8
Firms' savings	1.3

A.2. Change in sectoral production (%), simulation 1

	Employment	Total output	Price of value added
Agriculture	-0.5	0.0	0.2
Coal	26.4	29.7	-9.0
Metal ores	-0.8	-0.1	-0.4
Other mining	-1.0	-0.2	-0.9
Mining service	-0.1	0.0	3.0
Manufacturing	-1.7	-0.3	2.0
Electricity	1.3	0.6	3.4
Water supply	-4.1	-2.7	2.6
Construction	5.4	2.2	5.1
Trade	-1.1	-0.2	2.4
Transportation	-0.2	0.0	2.9
Accommodation	-0.9	-0.5	2.7
Information	-1.0	-0.3	2.4
Financial activities	-0.6	-0.2	2.6
Real estate	1.2	0.0	3.6
Professional	-0.8	-0.6	2.7

Administrative	2.8	1.4	3.9
Public administration	-1.6	-1.1	2.6
Education	-1.3	-1.1	2.8
Health	-1.2	-1.0	2.7
Entertainment	-1.1	-0.9	2.8
Other services	1.5	0.8	3.5

A.3. Change in prices and international trade (%), simulation 1

	Domestic price	FOB price	Domestic demand	Exports	Imports
Agriculture	0.4	0.4	0.1	-1.8	1.0
Coal	-5.0	-5.0	109.6	29.3	100.1
Metal ores	0.1	0.1	6.3	-0.4	6.4
Other mining	0.1	0.1	1.1	-0.5	1.2
Mining service	2.3	2.3	0.8	-4.5	3.0
Manufacturing	1.0	1.0	-0.1	-2.0	3.0
Electricity	1.2	1.2	0.4	-2.4	3.9
Water supply	2.4	2.4	-1.5	-4.7	5.4
Construction	1.6	1.6	1.3	-3.1	4.3
Trade	2.0	2.0	1.3	-3.8	-
Transportation	1.9	1.9	0.8	-3.7	4.6
Accommodation	1.2	1.2	0.8	-2.4	3.3
Information	2.0	2.0	0.0	-3.9	4.0
Financial activities	2.2	2.2	0.0	-4.3	4.5
Real estate	3.2	-	0.3	-	-
Professional	1.7	1.7	-0.3	-3.4	3.1
Administrative	2.4	2.4	1.4	-4.6	6.2
Public administration	2.0	-	-1.1	-	-
Education	2.2	2.2	-1.0	-4.2	3.3
Health	1.9	1.9	-1.0	-3.7	2.8
Entertainment	2.1	-	-0.8	-	-
Other services	2.5	-	1.0	-	-