

Effects of the Global Financial and Economic Crisis on the Bolivian Economy: A CGE Approach[♥]

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Abstract

This paper analyses the impact of the Global Financial Crisis on the Bolivian economy. The PEP 1-1 standard model has been employed to analyze the effects of i) a reduction in world export prices of mining, agriculture and food; ii) an increase in world price of imports; iii) a reduction in world demand of textiles; iv) a reduction in foreign savings; and v) a reduction in transfers to private (remittances) and government from abroad. The model has been calibrated for a 2006 Bolivia SAM and households have been disaggregated in urban and rural as well as by income quintiles. Factors of production have been also disaggregated by skilled and unskilled labor, capital and natural resources.

Keywords: Computable General Equilibrium Model, Financial Crisis, Forecasting and Simulation

JEL Classification: C68, G01, E17

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1. Introduction

The current Global Financial Crisis (GFC) is unlike almost all the international economic crisis triggered recently in the developed world, such as the 2001-2002 or 1990-1991 crisis, only to mention the most recent ones. According to CEPAL, the World is experiencing the worst crisis since the thirties and it is becoming worst since it is affecting the real sectors of most economies around the world. Although it can be compared with the Great Depression, it has certain peculiarities that make it different and a subject that has to be analyzed with stringency.

The GFC is a financial-banking crisis that emerged in a period of an unprecedented sustained growth of the world economy. Banking crises have plagued the world for centuries. According to Cecchetti. *et.al.* (2009) while they may be quite common, financial crises also tend to be quite diverse. Initial conditions are different; industrial and institutional structures are different; levels of development are different; degrees of openness are different; policy frameworks are different; and external conditions are different.¹

The GFC has different characteristics in both its origin and consequences. It originated in the new international financial system, established from a set of new financial instruments systematically integrated: the securitization and credit deregulation, computerization of money circulation, financial globalization, financial derivatives, and new speculative investment funds, among others. All of these elements were evident in the U.S. economy and it is precisely there that it initiated with the mortgage crisis on the second half of 2008.²

The GFC and resulting economic crisis is creating widespread concern around the world. The IMF's October 2009 update of the World Economic Outlook projected a reduction in global economic growth from just under 3.5 percent in 2008 to about 0.8 percent in 2009.

¹ Reinhart and Rogoff (2008) report that, over the past two centuries, the 66 countries they study have experienced 286 banking crisis, 105 of which have come since 1945. On average, countries have been in crisis for roughly one year out of every 12.

² Interesting analyses on the origins of the crisis may be found in the articles compiled in section I of Felton and Reinhart (2008). For more recent discussions see Brunnermeier (2009), and Diamond and Rajan (2009).

Although a recovery is expected in 2010 as a result of the monetary and fiscal stimulus programs undertaken in most industrialized countries, the IMF recognizes that the current rebound will be sluggish, credit constrained and, for quite some time, jobless. Financial and corporate restructuring will continue to exert considerable downward pressure on activity, and wide output gaps will help keep inflation at low levels. Demand is likely to be dampened by the need in many advanced economies to rebuild savings. Downside risks to growth are receding gradually but remain a concern.

The GFC puts at risk the efforts developing countries are making to accelerate and maintain growth and reduce poverty as presented in the UN Millennium Development Goals. For instance, the African countries are in a difficult position to face yet another crisis after the recent increases of oil and food prices. In the Latin American region the effects of the crisis have been felt in a differentiated way, according to the relationship and level of financial integration with the industrialized economies, and the type and level of development of their economies. Mexico, for example, fully integrated into the U.S. economy entered into a recession.

The economic downturn in industrialized countries will affect developing countries differently according their initial conditions and their domestic policy responses to the crisis, through various channels of impact: trade volumes, world prices, remittances, foreign direct investment, capital flows and commercial lending, and aid flows. However, several South American countries seem more resilient and less tied to the U.S. recession. With less external debt, most South American countries, especially the ones that are rich in raw materials and/or hydrocarbon display large international reserves as a result of several years of economic expansion and high global prices for raw materials. It seems that this fact allocates these countries in a better position to face the crisis in spite of being historically and structurally disadvantaged by their reliance on commodities.

Bolivia, a landlocked country, historically poor, with severe structural economic constraints, seems to have a more favorable macroeconomic situation and a new fiscal capacity to promote measures for public investment and redistribution to dampen the crisis, at least in the short term. In fact, in 2008, Bolivia's GDP growth was 6.1 percent, one of the

highest in the region and according to the IMF the rate of growth will be 2.8 percent in 2009, the highest expected in the Western Hemisphere.

Certainly, this does not mean that the crisis has not been felt or will not be felt in the near future. Dabat (2009) and Ticehurst (2009) analyze the GFC in a broad context and mention its possible consequences for the Bolivian economy, but none of them quantify the economic effects of different shocks. Capra and Canavire (2009) use the MAMS model – a recursive dynamic CGE model – to analyze the effects of a reduction in the export prices of mining, hydrocarbons and agricultural goods; they find that the GDP will decrease in 5 percent in comparison to the base scenario. Jemio and Nina (2009) are also using a CGE model to analyze the effects of the crisis, but with a SAM for 1999. They analyzed the marginal impact (one time impact) over the real sector of external and internal shocks.

The effects of the GFC in an economy wide context have not been yet analyzed. Therefore, we assess different scenarios of shocks to the Bolivian economy through a computable general equilibrium model (CGE). In particular, we implement the PEP Standard Model for the Bolivian economy using a SAM for the year 2006. We use the model to quantify the effects of a reduction in export and import prices, reduction of the external demand (of textiles), fall in remittances transferred from abroad, and a fall in current transfers from the rest of the world to the government.

The next section describes the economic performance of the Bolivian economy in the last 5 years. Section 3 presents the methodology and data used as well as the principal characteristics of the general equilibrium model (the PEP model). Section 4 displays the results of the simulations, detailing the aggregate and sectoral effects in each case. The last section concludes and proposes policy responses to face the impact of the crisis in Bolivia.

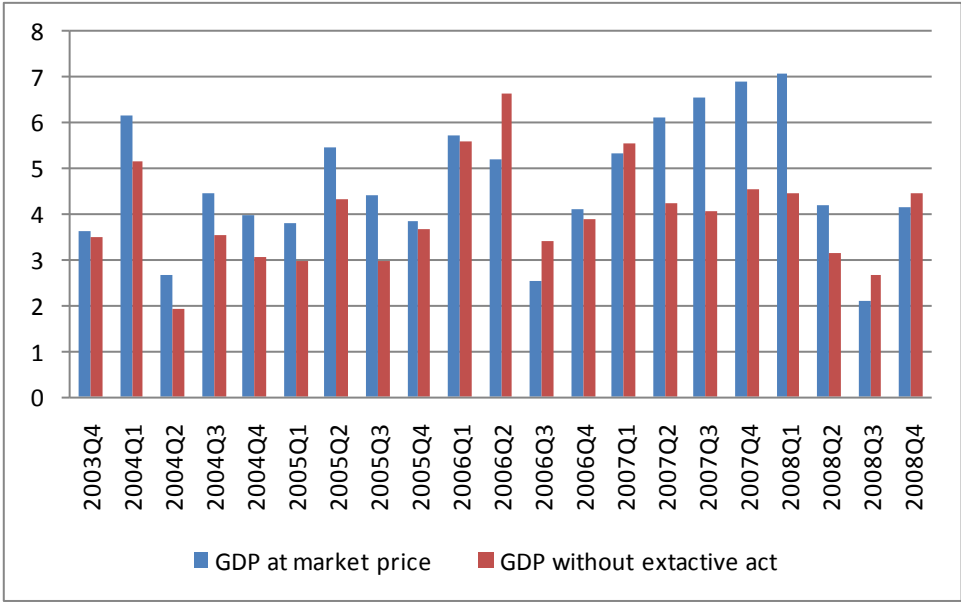
2. Economic Performance

In this section we present a short review of recent macro trends in the Bolivian economy. In particular, this section covers the last five years (period 2004-2009), which is a period characterized by the end of a deep political and social crisis that ended in 2006 with the

election of Evo Morales as the first indigenous president of Bolivia. It is also characterized by an extremely favorable external context that allowed the economy to reach important growth rates driven mainly by the extractive sectors. Finally, in the last two years, it is characterized by the occurrence of the GFC, that has affected the economy, but not with the strength that many analysts predicted.

The Bolivian economy reached its highest growth in 2008 with an annual rate of 6.15 percent. But then in 2009, the economy displayed signs of deceleration, attributed mainly to the GFC; its effects turned visible in the extractive and industrial activities for the supply side, and in the consumption for the aggregate demand side. Nevertheless, Bolivia continued being one of the countries with the best economic performance in the region.

Figure 2.1: Rates of Growth of GDP and GDP without Extractive Activities (quarterly rates)



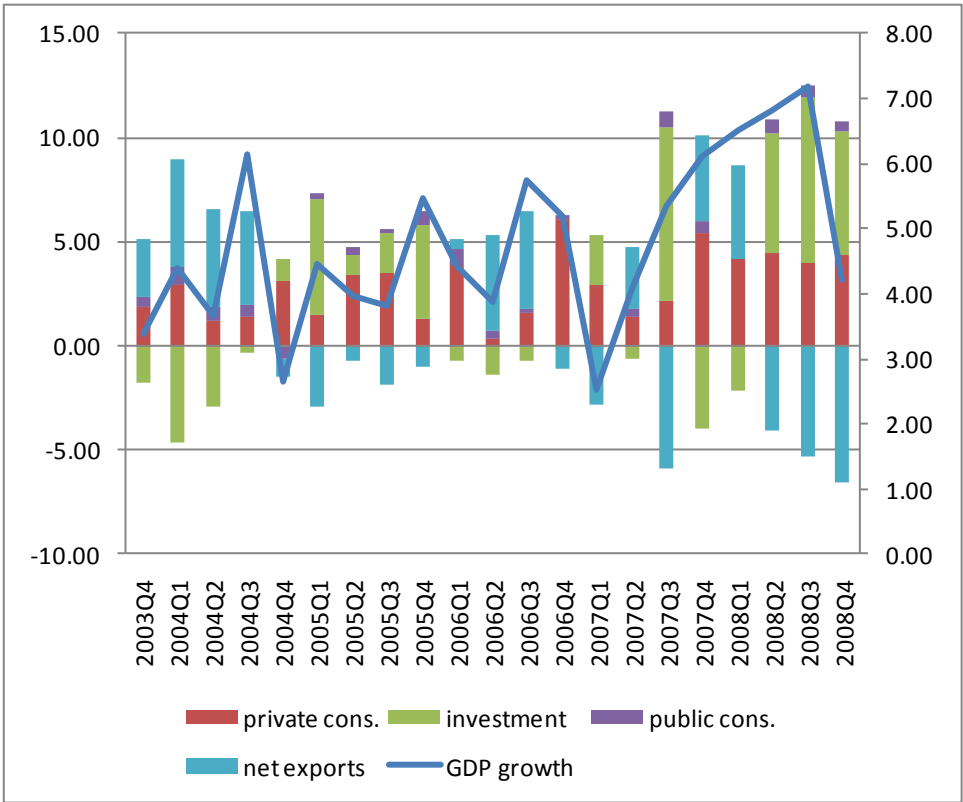
Source: Central Bank of Bolivia

The signs of slowdown of the economy appeared in the fourth quarter of 2008 when the annual rate of growth fell to 4.2 percent and then in the first quarter of 2009 when the rate of growth was 2.1 percent. Notice that in the previous quarters, growth reached rates higher than 6 percent. The production in extractive activities slowed down also but in a less

intensity. The rate of growth fell to 3.1 percent and 2.7 percent in the fourth quarter of 2008 and first quarter of 2009, respectively, but then it recovered its 2008's percentages, being above 4 percent in the second and third quarters of 2009.

In the last years, the GDP growth has been driven by internal demand (see Figure 2.2). On the other hand, the net exports show a negative contribution to growth, due to a larger increase in imports than in exports. Private consumption showed an important positive contribution to growth in the last three quarters of 2008. Private investment displayed also a positive and important incidence on growth in the last three quarters of 2008, although it showed a negative incidence in the fourth quarter of 2007 and the first quarter of 2008.

Figure 2.2: GDP Components (incidence of determinants and GDP growth in percentages)



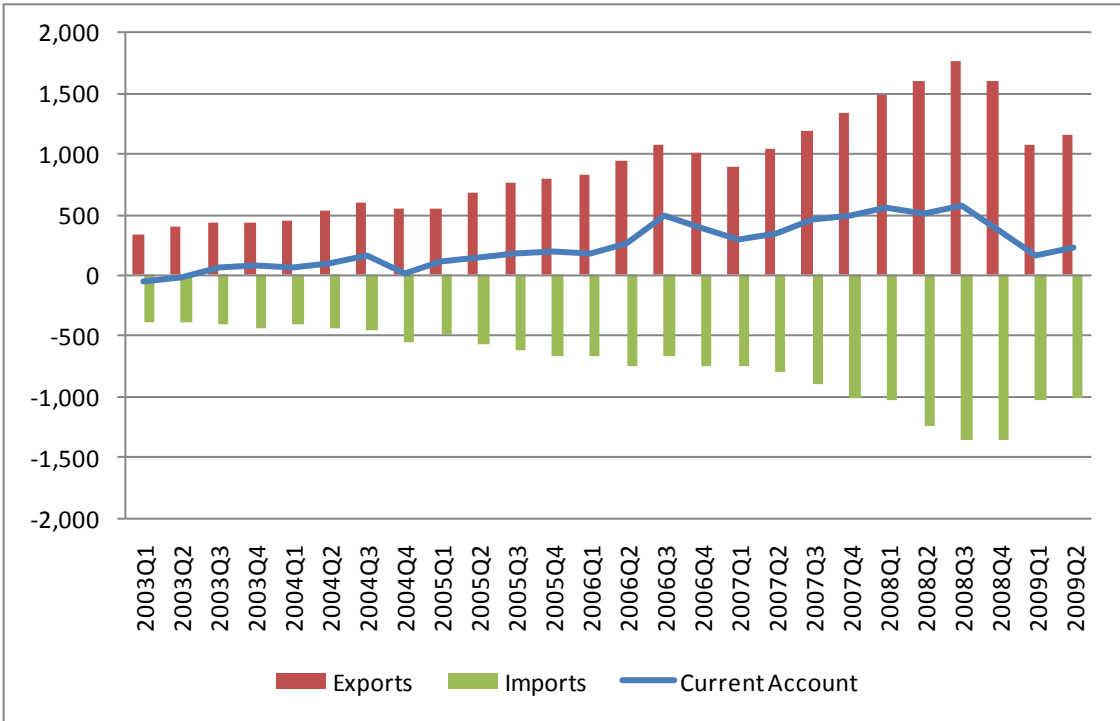
Source: National Institute of Statistics (INE)

Public consumption grew on average in 3.6 percent between 2006 and 2008, but its incidence has been small due to its lower relative weight. Private and public consumption

have been important factors in explaining GDP growth in particular in the last years. Investment recovered from the previous years. In the first quarter of 2009 it presented an annual growth of 24.1 percent, while in the same period the year before it presented an annual growth of -13.5 percent. On average it grew only by 13.77 percent between 2006 and 2008 (quarterly growth).

Bolivian economic structure is based mainly in exports of raw materials, like minerals and hydrocarbons mainly. Although the GFC reduced the external demand and lead to a decrease in the average price of exports in comparison to the exceptional elevated prices of 2008, the Current Account remained positive but with a decreasing trend, showing a slightly recover in the second quarter of 2009, as it can be seen in the following figure.

Figure 2.3: Current Account Exports and Imports (millions of USD)

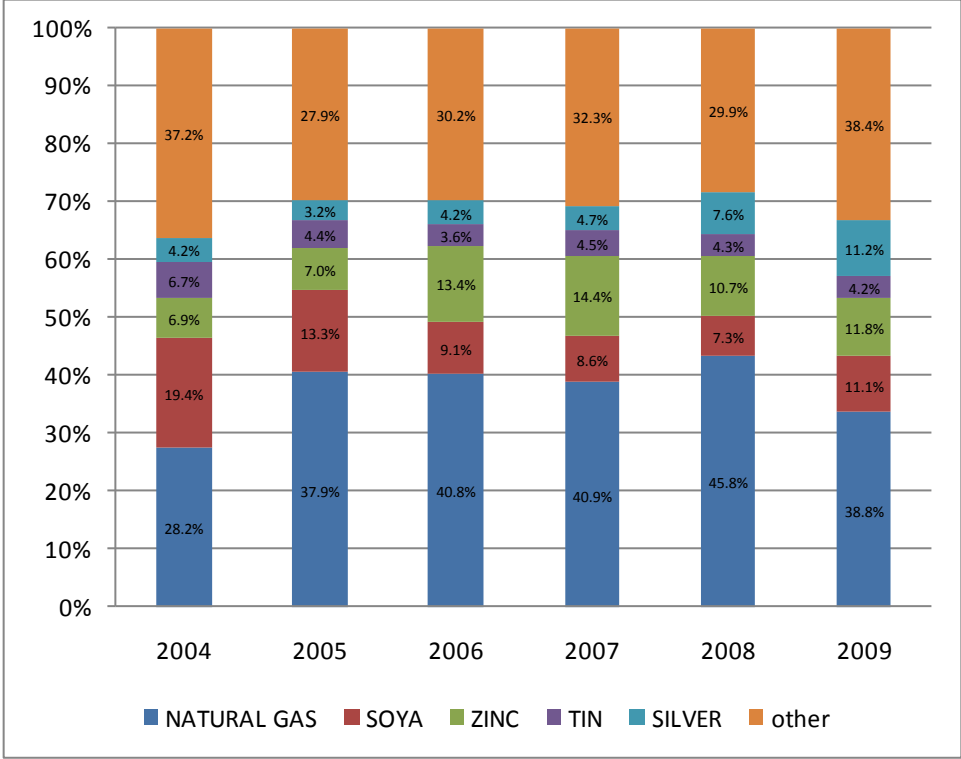


Source: Central Bank of Bolivia

With the outbreak of the GFC in 2008, external revenues have reduced, but they are still considerable high when compared with levels observed during the first half of the decade. Recall that Bolivian exports are strongly concentrated in raw materials. According to figure

2.4 five products comprise around 80 percent of total exports, these are: natural gas, zinc, tin, silver and soya.

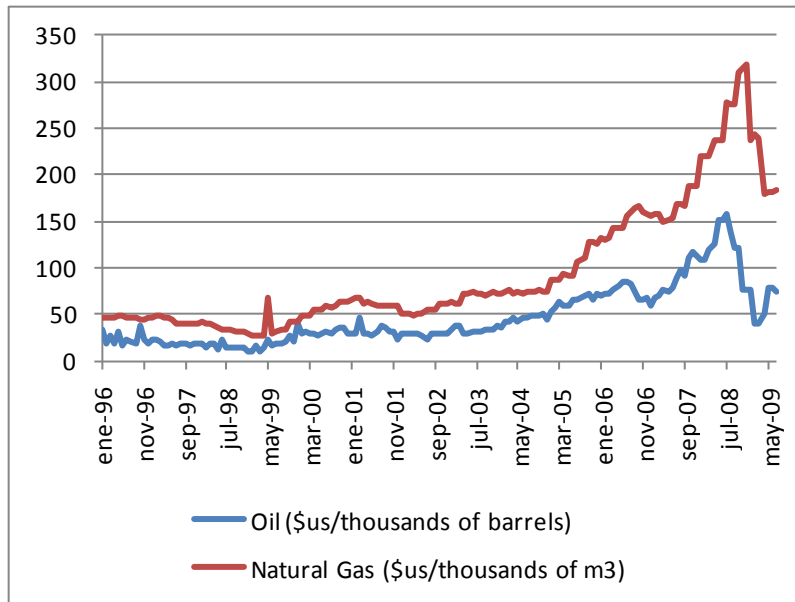
Figure 2.4: Concentration of Bolivian Exports (2004-2009)



Source: Central Bank of Bolivia

Export prices of minerals and oil experienced an unprecedented increase since 2005 as it is seen in figures 2.5 and 2.6. They reached their peaks in the first half of 2008 and then experienced a downturn in the second half of the same year. But they started to recover in the second half of 2009. Natural gas export prices have reduced—with a lag—after the price of oil went down, but they are expected to recover now that the price of oil is going up again.

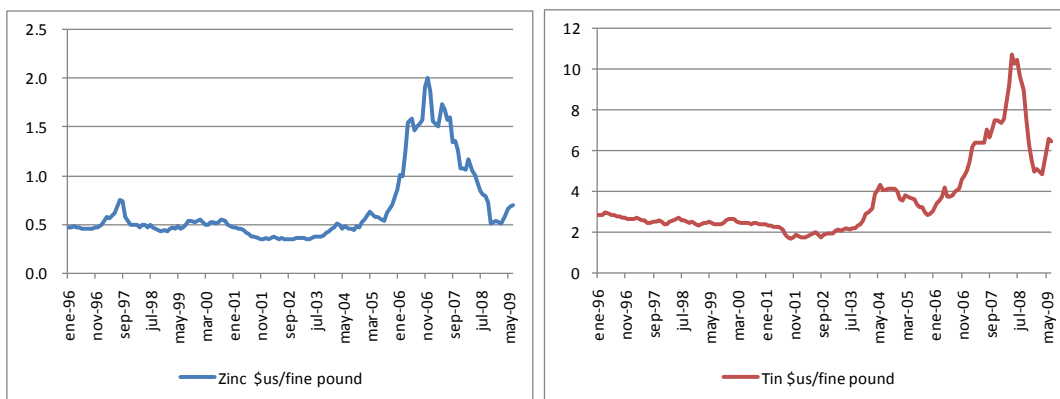
Figure 2.5: Oil and Natural Gas Export Prices

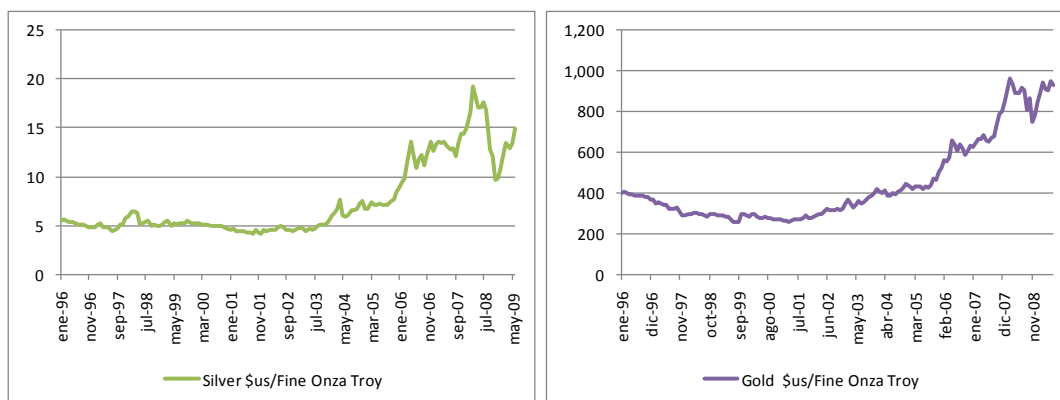


Source: Bolivian Central Bank

Prices of minerals experienced important increases in years 2006 and 2007, but then experienced sharp reductions as a result of the GFC. In particular, in year 2008, these reductions have been in the order of 52 percent for Zinc, 25 percent for Tin, 34 percent for Silver and 7 percent for Gold. Nevertheless these prices have partially recovered in year 2009. For instance, the price of zinc increased by 58 percent between January and September 2009.

Figure 2.6: Mineral Prices (Zinc, Tin, Silver and Gold)





Source: Central Bank of Bolivia

It is important to emphasize here that Bolivia's economic boom is first and foremost explained by a price effect. The economic structure remained almost the same, without productive investments and with increasing distortions in the allocation of resources, in particular in the manufacturing industry. In fact, this sector showed a decrease in its rate of growth of 3.4 percentage points in the first quarter of 2009 compared to similar period of 2008. This situation reduced its incidence on GDP to only 0.2 percent, a range well below the 0.8 percent observed in the previous year.³

The decline in industry growth is due to the contraction of activities like textiles and jewelry, due to the uncertainty that rose after the close of U.S. markets in North America by the end of the ATPDEA as well as the loss of European Union markets.⁴

The surplus of the Balance of Payments is reflected in an increase in the Net International Reserves. These Reserves as a share of GDP are the highest in the region and in the whole Bolivian economic history. This important increase in International Reserves is explained mainly by the proceeds from the sales of natural gas, along with other issues such as

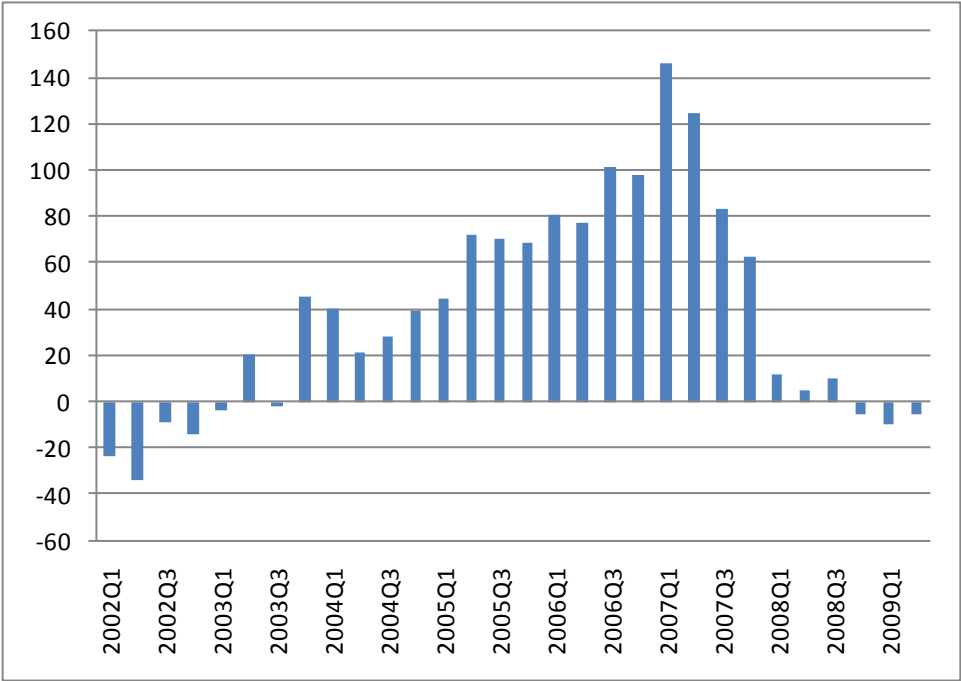
³ Distortions in the allocation of resources in the manufacturing industry have been analyzed first by Machicado and Birbuet (2009) for the market liberalization period (1988-2001).

⁴ The ATPDEA was a preferential regime granted by the US to the Andean countries to create labor alternatives that could substitute the coca plantations. It was cancelled by the US government in December 2008 as a response to the expulsion of the DEA by the Bolivian government.

remittances from Bolivians living abroad. In fact, remittances are the other factor that explains the economic boom in the last years by stimulating the aggregate demand.

Due to the GFC, remittances went down in the last quarter of 2008 and first quarter of 2009, but partially recovered in the second quarter of 2009. In particular, the monthly variations of remittances that showed slightly negative variations in the months of January, February and April, were compensated by the increases in March and May.

Figure 2.7: Evolution of Remittances (quarterly variation, in percentages)



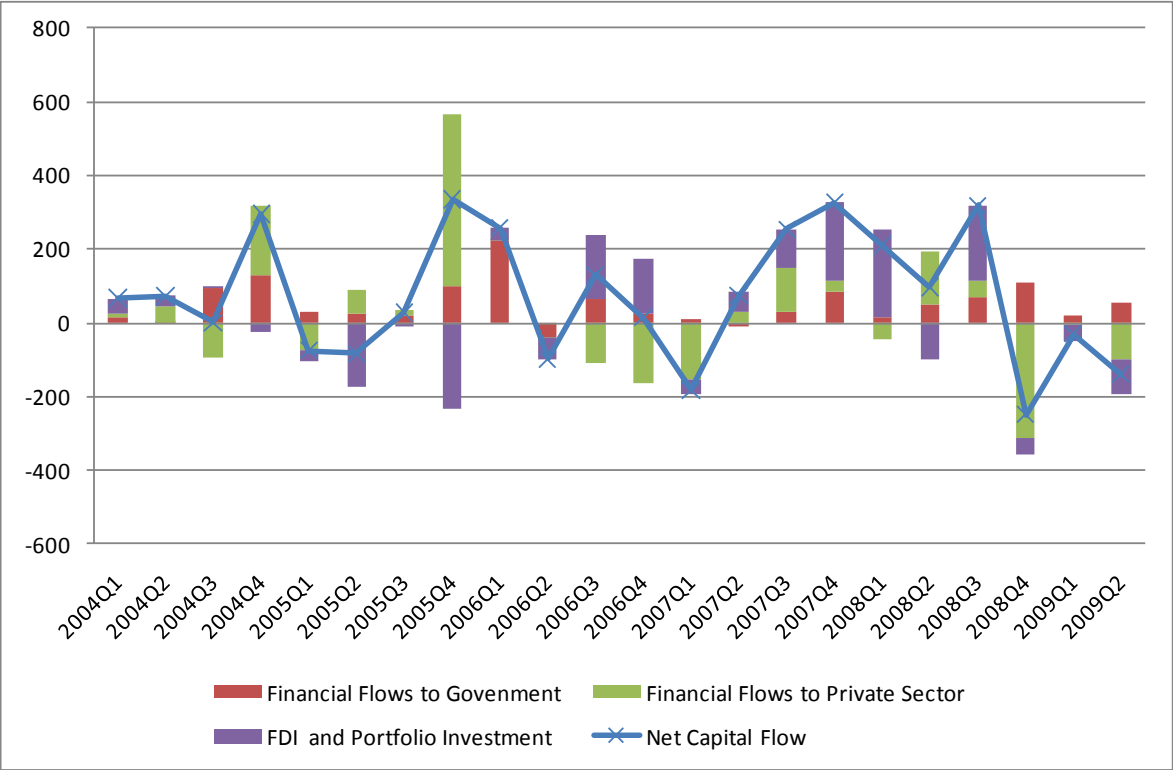
Source: Central Bank of Bolivia

In figure 2.7 we show the quarterly variation of remittances. Notice that the positive and huge variations observed between the fourth quarter of 2003 and the fourth quarter of 2007 ended in 2007. In the following quarters the variations are below 10 percent and even negative since the fourth quarter of 2008. If this pattern continues, we could expect a decrease in private consumption and a corresponding decrease in aggregate demand.

Recently, due to the GFC, net capital flows have been negative in the last quarter of 2008 and in the first and second quarters of 2009. In fact, capital flows have been very volatile as

it is seen in figure 2.8. It is noteworthy that in the last quarters only financial flows to government have been positive. Foreign Direct Investment (FDI) and financial flows to the private sector were negative. FDI is expected to remain low and even decrease as legal security is still not guaranteed, because in 2010 many new laws will be enacted to complement the new Constitution established in 2009.

Figure 2.8: Quarterly Capital Flows (Million USD)



Source: Central Bank of Bolivia

To end this review of the economy we display in table 2.1, the evolution of some poverty and inequality measures. Poverty in Bolivia reached its highest level in year 2000 (66.4 percent) and it decreased in 6.3 percentage points until 2007. In the other hand, extreme poverty decreased from 45.2 percent in 2000 to 37.7 percent in 2007. Notice that poverty is higher in rural areas than in urban areas. In rural areas it is around 75 percent while in urban areas it is around 50 percent. In addition, the estimations for 2008 seem to indicate that the GFC has not increased poverty.

Table 2.1: Poverty and Inequality Indicators (Poverty Line Method)

Geographic area and indicators	1996	1997	1999	2000	2001	2002	2003-2004	2005	2006	2007 (p)	2008 (e)
Bolivia											
Poverty incidence (%)	64.8	63.6	63.5	66.4	63.1	63.3	63.1	60.6	59.9	60.1	59.3
Extreme poverty incidence (%)	41.2	38.1	40.7	45.2	38.8	39.5	34.5	38.2	37.7	37.7	32.7
Gini index	0.6	0.6	0.58	0.62	0.59	0.60	n.d.	0.60	0.59	0.56	n.d.
Urban area											
Poverty incidence (%)	51.9	54.5	51.4	54.5	54.3	53.9	54.4	51.1	50.3	50.9	51.2
Extreme poverty incidence (%)	23.7	24.9	23.5	27.9	26.2	25.7	22.9	24.3	23.4	23.7	22.0
Gini index	0.51	0.52	0.49	0.53	0.53	0.54	n.d.	0.54	0.53	0.51	n.d.
Capital cities (1)											
Poverty incidence (%)	48.4	50.7	46.4	52.0	50.5	51.0	52.8	47.5	46.0	48.0	n.d.
Extreme poverty incidence (%)	20.9	21.3	20.7	25.7	22.3	23.9	21.7	21.8	21.1	21.9	n.d.
Rural area											
Poverty incidence (%)	84.4	78.0	84.0	87.0	77.7	78.8	77.7	77.6	76.5	77.3	74.3
Extreme poverty incidence (%)	67.8	59.0	69.9	75.0	59.7	62.3	53.7	62.9	62.2	63.9	53.3
Gini index	0.61	0.63	0.64	0.69	0.64	0.63	n.d.	0.66	0.64	0.64	n.d.

Source: UDAPE, (p) preliminary, (e) based on estimations, (1) includes El Alto

The Gini index is used to measure inequality. The closer it is to 1 the larger is the inequality. Inequality has decreased slightly in the last three years (2005-2007) from 0.60 to 0.56. In urban areas it decreased by 0.03 percentage points and in rural areas by 0.02 percentage points. Nevertheless, poverty and inequality remain very high.

In sum, in the last 5 years, the Bolivian economy has been characterized by an extremely favorable external context, that allowed maintaining macroeconomic stability and boost growth, but it remains the question if this growth is stable and can help to reduce poverty. From this external context three elements are key as identified by Jemio and Nina (2009):

- Much higher revenues of hydrocarbons and minerals, due to a price effect
- Larger remittances from Bolivians that live and work abroad (USA, Spain and Argentina)
- Volatile and less prominent capital flows

The effects of the GFC will be triggered certainly by a combination of these three factors and will affect not only the macroeconomic variables, but also sectoral variables and social indicators.

3. Methodology and Data

In this paper we implement the PEP Standard (CGE) Model calibrated to a 2006 Bolivian SAM. The CGE model mathematical structure is extensively documented in Decaluwé et

al. (2009). The main data requirements to calibrate the CGE model are (1) a Social Accounting Matrix (SAM), and (2) production and consumption elasticities.

3.1 The Data

This section presents a short explanation of the steps followed in building the 2006 SAM for Bolivia and further adapting it for the PEP-1-1 Standard Model; for details see the Appendix.

The main source of information for the construction of a new Bolivian SAM is the Input-Output tables for Bolivia 2006 (latest available) constructed by the National Institute of Statistics (INE, 2006). They present information on production, intermediate consumption, final demand (i.e., households and government consumption), exports, aggregate added value, and taxes on products. Besides, information from the balance of payments is the most important input to build the external accounts of the SAM. To build the government account, data for 2006 from INE provides what was required. To disaggregate labor payments and households, we used the Bolivian Household Survey (Encuesta Continua de Hogares) for the years 2005, 2006 and 2007.

In building the 2006 SAM for Bolivia we followed the procedure proposed in Reinert and Roland-Holst (1997). The process has a top-down structure, entailing 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 Standard Model; note that the imbalances were related to rounding errors.

Table 3.1 shows the accounts in the SAM. The productive sector is split in 19 activities and commodities: 4 primary, 7 manufactures, and 8 services. This sectoral disaggregation allows us to isolate the main productive sectors in Bolivia. The SAM identifies two types of labor: those with 12 or less years of education (unskilled), and those with 13 or more years of education (skilled). The remaining productive factors are the capital stock, land used in agricultural activities, and a natural resource factor used in the oil extraction and mining sectors. The institutional accounts include four representative households (i.e, the private

domestic institutions): (1) urban non-indigenous, (2) urban indigenous, (3) rural non-indigenous and (4) rural indigenous. The other institutions are the government and the rest of the world. The tax accounts have been disaggregated into four taxes showed in Table 3.1. Lastly, there is one consolidated savings-investment and a stock change accounts.

Table 3.1: Bolivia SAM 2006 Accounts

Sectors (19)	Sectors (19) -- cont.	Institutions (6)
<i>Primary</i>	<i>Services</i>	<i>Households</i>
Agriculture	Electricity, gas and water	Urban non-indigenous
Livestock	Construction	Urban indigenous
Other primary	Trade	Rural non-indigenous
Mining	Transport	Rural indigenous
	Communications	Government
<i>Manufactures</i>	Restaurants and hotels	Rest of the world
Meat	Public administration	
Other food	Other services	Taxes (4)
Beverages and tobacco		Commodity taxes
Textiles	Factors (5)	Activity taxes
Petroleum refinery	Unskilled labor	Tariffs
Metal and metal products	Skilled labor	Income taxes
Other manufactures	Capital	
	Land	Savings-Investment (2)
	Natural resource	Savings-Investment
		Stock change
Source: Authors' calculations.		

Table 3.2 shows a macroeconomic SAM that is an aggregation of the detailed SAM. Bolivia GDP reached 89,157,704 million bolivianos in 2006 (see Table 3.3). In 2006, the government current account surplus was around 11% of GDP and government consumption was 14.7% of GDP.

Table 3.2: Bolivia MACROSAM 2006 (billions bolivianos)

	act	com	f-lab	f-cap	hhd	gov	row	t-act	t-com	t-iva	t-imp	t-dir	s-i	dstk	total
act		144,720													144,720
com	74,721				56,635	13,170	37,997						11,505	-718	193,309
f-lab	24,061						270								24,331
f-cap	45,938						1,491								47,429
hhd			24,271	41,786		2,940	6,084								75,081
gov					156		703	12,981	5,597	852	5,673				25,962
row		29,159	60	5,643	497	90									35,450
t-act															0
t-com		12,981													12,981
t-iva		5,597													5,597
t-imp		852													852
t-dir					5,673										5,673
s-i					12,120	9,762	-11,096								10,787
dstk													-718		-718
total	144,720	193,309	24,331	47,429	75,081	25,962	35,450	0	12,981	5,597	852	5,673	10,787	-718	

Source: Bolivia SAM 2006.

Table 3.3: Bolivia GDP 2006 (billions bolivianos)

indicator	LCU	shr% GDP
Household consumption	56,429	63.3
Fixed investment	11,482	12.9
Stock change	-718	-0.8
Government consumption	13,140	14.7
Exports	37,943	42.6
Imports	-29,118	-32.7
GDP market price	89,158	100.0
Net indirect taxes	19,425	21.8
GDP at factor cost	69,733	78.2

Source: Bolivia SAM 2006.

The production and trade structure of Bolivia is reflected in tables 3.4 and 3.5, respectively. Columns (i) and (ii) of Table 3.5 show the share of each sector in total exports and imports, respectively. Columns (iii) and (iv) of Table 3.5 present, for each sector, the share of exports in production and the share of imports in consumption, respectively. While the mining (particularly, gas) products represent a significant share of export revenue (around 61%), their share in the economy value added is about 14%. The Bolivian 2006 SAM reports taxes paid by institutions, commodity sales, activities, and tariffs. The different tax instruments and their share in total revenue are summarized in Table 3.6.

Table 3.4: Production Structure Bolivia 2006 (%)

sector	act shr in VA	factor share in value added					Total
		f-lab-uns	f-lab-sk	f-cap	f-land	f-natres	
Agriculture	9.5	61.1	7.3	18.3	13.2		100.0
Livestock	3.5	56.2	6.7	18.9	18.1		100.0
Other primary	1.0	45.0	5.4	28.9	20.7		100.0
Mining	14.2	19.2	11.9	46.9		22.1	100.0
Meat	1.9	19.4	14.3	66.3			100.0
Other food	3.4	24.7	18.1	57.2			100.0
Beverages and tobacco	1.8	16.3	12.0	71.7			100.0
Textil	1.4	41.5	11.4	47.1			100.0
Oil refining	2.1	22.7	14.0	63.3			100.0
Metal and metal products	0.2	43.7	20.6	35.7			100.0
Other manufactures	3.9	38.3	13.4	48.4			100.0
Electricity, gas and water	3.0	5.8	19.7	74.5			100.0
Construction	2.3	36.2	15.2	48.5			100.0
Trade	8.1	40.6	16.3	43.1			100.0
Transport	11.0	48.3	9.7	42.0			100.0
Communications	2.1	2.0	6.7	91.3			100.0
Restaurants and hotels	3.3	35.4	10.5	54.1			100.0
Public administration	14.4	14.7	64.7	20.6			100.0
Other services	13.1	17.0	52.7	30.4			100.0
Total	100.0	30.2	24.8	39.8	2.1	3.1	100.0

Source: Bolivia SAM 2006

Table 3.5: Trade Structure of Bolivia 2006 (%)

sector	exports%	imports%	ex intensity	im intensity
	(i)	(ii)	(iii)	(iv)
Agriculture	2.1	2.8	7.3	7.3
Livestock	0.3	0.1	2.8	1.0
Other primary	0.3	0.1	7.9	1.8
Mining	60.9	0.1	76.6	0.3
Meat	0.1	0.2	0.6	1.0
Other food	11.1	3.8	30.4	9.8
Beverages and tobacco	0.6	1.0	5.7	6.5
Textil	2.9	4.6	32.4	33.9
Oil refining	1.1	7.6	8.1	21.4
Metal and metal products	6.2	37.1	45.7	72.9
Other manufactures	5.4	23.7	26.7	51.2
Transport	4.5	8.8	11.8	16.5
Communications	1.0	0.6	13.3	6.2
Restaurants and hotels	2.1	3.0	15.8	15.5
Other services	1.2	6.3	2.7	9.3
Total	100.0	100.0	28.7	22.0
References:				
Exports% = share of each sector in total exports				
Imports% = share of each sector in total imports				
EX intensity = share of exports in production				
IM intensity = share of imports in consumption				
Source: Bolivia SAM 2006.				

Table 3.6: Taxes Included in the CGE Model

tax instrument	tax-rev\$	shr-tax-rev	shr-gdp
Income taxes	564.8	22.5	6.3
Activity taxes	961.5	38.4	10.8
Commodity taxes	893.0	35.6	10.0
Tariffs	87.9	3.5	1.0
Total	2,507.2	100.0	28.1
References:			
tax-rev\$ = tax revenue in LCU			
shr-tax-rev = share of tax revenue in total tax revenue			
shr-GDP = share of tax revenue in GDP			
Source: Bolivia SAM 2006.			

Apart from the SAM, our CGE model database includes production, trade, and consumption elasticities; the values were drawn from own estimations, and Annabi et al. (2006) and Decaluwé 2009 (see the Appendix).

Table 3.7: Consumption and Income Distribution Bolivia 2006 (%)

	households				total
	h-urb- noindig	h-urb- indig	h-rur- noindig	h-rur- indig	
Consumption	35.2	24.5	21.5	18.8	100.0
Agriculture	28.9	27.5	11.1	32.5	100.0
Livestock	28.9	27.5	11.1	32.5	100.0
Other primary	28.9	27.5	11.1	32.5	100.0
Mining					
Meat	28.9	27.5	11.1	32.5	100.0
Other food	28.9	27.5	11.1	32.5	100.0
Beverages and tobacco	28.9	27.5	11.1	32.5	100.0
Textiles	45.1	29.1	8.1	17.7	100.0
Oil refining	47.0	1.6	0.3	51.2	100.0
Metal and metal products	22.9	29.3	36.8	11.0	100.0
Other manufactures	22.9	29.3	36.8	11.0	100.0
Electricity, gas and water	37.8	17.7	42.5	2.0	100.0
Construction					
Trade					
Transport	44.1	38.9	5.2	11.7	100.0
Communications	48.4	25.8	13.0	12.8	100.0
Restaurants and hotels	37.8	17.7	42.5	2.0	100.0
Public administration	37.8	17.7	42.5	2.0	100.0
Other services	37.8	17.7	42.5	2.0	100.0
Income	52.0	33.3	4.8	9.9	100.0
Unskilled labor	36.4	35.9	9.7	17.9	100.0
Skilled labor	63.0	30.6	2.1	4.3	100.0
Capital	59.5	33.1	2.6	4.8	100.0
Land	59.5	33.1	2.6	4.8	100.0
Natural resource	59.5	33.1	2.6	4.8	100.0
Transfers	44.7	32.9	4.7	17.7	100.0
Source: Bolivia SAM 2006.					

3.2 The Model

As explained, we implemented the PEP Standard Model. However, we introduced some changes in order to better reflect the Bolivian economy. Specifically, we changed the model in order to reflect that Bolivia is price taker in world markets; producers can always sell as much as they wish on the world market at the (exogenous) current price; alternatively, we introduced the “pure” form of the small-country hypothesis. In some cases (see below the “edem-txt” scenario), we want to simulate a decrease in world export demand without altering the world export price. This is achieved by making selected export quantities exogenous and deleting the CET for export and domestic sales tangency condition. We also modified the functioning of the government sector; we assume that government consumption of each commodity is fixed in real terms, instead of assuming that total government spending in commodities is fixed. Finally, we introduced a wage curve (see Blanchflower and Oswald, 1994) to endogenize unemployment; it establishes a negative relationship between the levels of unemployment and wages.⁵ The wage curve was calibrated using the 2006 Bolivian Household Survey. A more detailed presentation of the changes can be found in the Appendix.

As usual in the CGE context, we need to specify the three macroeconomic balances that are present in a CGE model: i) external balance, ii) savings-investment, and iii) government budget. The model allows for alternative closure rules for these balances. We assume that the government current account is equilibrated through changes in government savings; real government consumption and all tax rates are fixed. The real investment is endogenous and follows the available savings (i.e., the model is savings-driven); thus, a change in the households income will be reflected in a change in investment, and the same for the government savings. The foreign savings (i.e., the negative of the current account balance) are fixed in the base scenario value, being the real exchange rate the variable that

⁵ According to David Blanchflower and Andrew Oswald, the wage curve summarizes the fact that “A worker who is employed in an area of high unemployment earns less than an identical individual who works in a region with low joblessness”.

equilibrates the inflows and outflows of foreign currency. Finally, the model numeraire is the (nominal) exchange rate.

4. Simulations

In this section we use the modified PEP Standard Model to perform counterfactual simulations. Two sets of scenarios are considered: in the first, we run simulations related to external shocks intended to analyze the impact of the GFC in the Bolivian economy; in the second, we assess the impact of some policy responses. Besides, we consider two sets of external shocks: a severe crisis scenario, and a medium crisis scenario.

4.1 Scenarios

As explained in Section 2, we simulate scenarios related to the following variables:

1. world prices of main export products, mining and agriculture (natural gas, zinc, silver, gold, lead, tin and soya),
2. export demand of textiles,
3. foreign savings and foreign direct investment, and
4. remittances from abroad (Spain, Argentina and the United States).

Table 4.1 describes the percentage change in the variables used for the simulations. In general, we are considering a reduction of 25% in export prices of mining and agriculture. This reduction is in accordance with the export price index computed by the Central Bank, which displays a reduction of 21.6% between 2006 and 2008.⁶

⁶ Recall that in the mining sector we are considering also the hydrocarbon sector.

Table 4.1: Simulated Scenarios

name	description
external shocks	
pwe-min	25% reduction in world export price of mining
pwe-agr	25% reduction in world export price of agriculture
edem-txt	40% reduction in world export demand of textiles
curacc	25% reduction in foreign savings
remit	30% reduction in remittances to all households
combi	all previous scenarios combined
combi-cut	similar to combi but shocks are cut by 50%
policy shocks	
combi + trnsfr-hhd	combi + 10% increase in transfers from gov to hhd
combi + govcon	combi + 2.5% increase in government consumption

Source: Author's calculation.

We also simulate a 40% reduction in the world export demand of textiles. This simulation is meant to capture not only the effects of the GFC in this sector, but also the elimination of the tariff preferences that Bolivia had with the USA, called the ATPDEA (for its initials in Spanish). Although these preferences included various articles of the manufacturing sector, it is considered that textiles are the main sector that has been affected.⁷

The 25% reduction of foreign savings can be interpreted as an improvement in the current account balance, since Bolivia had a surplus in current account in year 2006. With this simulation we aim to capture the pressure for the Bolivian economy to generate a larger surplus in order to maintain the level of International Reserves or to pay external debt. The fall in foreign savings can be attributed to a fall in FDI. In fact, FDI has been falling constantly in the last two years. In 2008 it represented 3% of GDP and in 2009 it represented 2.9% of GDP.

It is thought that a fall in remittances could have an important impact in the economy. We evaluate this hypothesis by simulating a 30% reduction in remittances to households. The

⁷ The ATPDEA included import duties preferences for several products, but the main products that Bolivia exported under these preferences were textiles, jewelry and wood products.

reduction that we are simulating is larger than what it is observed in the data, but recall that we are simulating a severe impact scenario.⁸

Finally, we simulate a combined scenario (combi) where we include all the shocks together. This is our severe crisis scenario. We also simulate a medium crisis scenario (combi-cut) where we feature again the same changes in variables together but shocks are cut by 50%.

4.2 Results

In this subsection, we describe and analyze the results obtained with the CGE simulations. Recall that our base scenario is a picture of the Bolivian economy in year 2006, and we consider the existence of unemployment in both labor markets (i.e., skilled and unskilled workers). We are interested in the changes of the main macroeconomic variables as well as of the sectoral variables.

Table 4.2 shows the percentage change of all the main (real) macroeconomic variables. In particular, we present the results for the aggregate demand, price indices, unemployment, and fiscal variables. Column (i) shows the GDP components expressed in billions of bolivianos (local currency unit) for year 2006. In columns (ii)-(x), we display the percentage change with respect to the base scenario. The last two columns refer to the policy response scenarios that will be explained later.

⁸ Actually, remittances fell in 9.3% in the last months and they have slightly recovered also.

Table 4.2: Real Macro Indicators (change% w.r.t. base scenario)

indicator	base LCU (i)	pwe-min (ii)	pwe-agr (iii)	edem- txt (iv)	curacc (v)	remit (vi)	combi (vii)	combi- cut (viii)	combi- trnsfr- (ix)	combi- govcon (x)
national accounts (chg%)										
household consumption	56,429	-5.0	-0.4	-0.1	-0.3	-2.5	-8.3	-4.2	-7.8	-8.1
fixed investment	11,482	-49.8	0.6	0.2	-25.1	-4.0	-85.3	-40.0	-88.3	-89.1
government consumption	13,140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
exports	37,943	-4.9	0.0	-0.4	2.2	2.4	-0.4	0.1	-0.6	-0.8
imports	-29,118	-21.2	-0.5	-0.6	-6.7	-3.1	-32.1	-16.6	-32.5	-32.7
GDP market price	89,158	-4.7	0.0	0.0	-0.3	-0.1	-5.9	-2.4	-6.0	-5.9
net indirect taxes	19,425	-15.9	0.2	0.0	-0.9	0.1	-18.9	-7.7	-19.1	-19.2
GDP factor cost	69,733	-1.6	-0.1	0.0	-0.1	-0.1	-2.3	-0.9	-2.4	-2.2
price indices (100=base)										
consumer price index	100.0	91.6	99.5	99.6	98.9	98.4	88.1	93.6	88.3	88.3
domestic price index (*)	100.0	89.6	99.5	99.5	98.4	98.3	85.2	92.3	85.3	85.3
terms of trade (pe/pm)	100.0	84.5	99.4	100.0	100.0	100.0	83.9	91.9	83.9	83.9
world price index (**)	100.0	91.2	99.7	100.0	100.0	100.0	90.9	95.4	90.9	90.9
real exchange rate	100.0	101.8	100.2	100.5	101.6	101.8	106.7	103.4	106.6	106.5
unemployment (%)										
unskilled labor	3.9	4.6	4.2	4.0	4.1	3.9	5.0	4.6	5.0	5.1
skilled labor	10.5	13.3	10.6	10.6	10.7	10.9	13.8	12.3	13.7	13.1
total	7.0	8.7	7.2	7.0	7.2	7.2	9.1	8.2	9.1	8.8
fiscal (shr% GDP)										
government savings	11.0	7.3	11.1	11.1	10.9	11.0	7.2	9.4	6.8	6.6
tax revenue	28.1	26.0	28.3	28.2	28.1	28.2	26.0	27.3	26.0	25.8
government consumption	14.7	16.0	14.7	14.7	14.8	14.7	16.0	15.3	16.0	16.5
note: the nominal exchange rate is the numeraire										
(*) = non-tradables										
(**) = tradables										
Source: Authors' calculations.										

Notice that in neither of the simulations there is a change in government consumption, because it is considered an exogenous variable – recall the model closure rule explained in Section 3. Looking at GDP at factor cost, it can be seen that the largest effects appear when there is a reduction in the export price of mining, GDP decreases by -1.6%. This happens because mining is the main export product (61%); besides, its share in value added is 14%.⁹

In terms of household consumption, it decreases by -5% when there is a reduction in mining export prices and it decreases by -0.4% when there is a reduction in the export price of agricultural products, reflecting the importance of mining in the incomes of the economy. Household consumption falls because the income of all type of households falls.

⁹ The rates of GDP growth above 6% experienced in 2008 were explained mainly by the boost in the mining sector.

Remittances have also a considerable impact on consumption; it is reduced by -2.5% when remittances fall by 30%. Nevertheless, the impact on GDP is relatively low (-0.1%).

A structural problem of the Bolivian economy is certainly the high volatility of investment, which is reflected in our assumption that investment is savings-driven (see above). The fall in fixed investment is noteworthy; it falls by almost -50% when the price of mining decreases and by -85.3% in the severe and combined scenario. There are two main channels that explain the fall in investment. First, a reduction in the export price of mining leads to a decrease in the production of mining with the corresponding reduction on revenues from taxes of this sector -- remember that mining is a highly taxed sector. Therefore, fiscal surplus reduces and government savings decreases from 11% to 7.3% as a share of GDP. Second, a 25% reduction in export prices of mining, increases unemployment from 7% to 8.7%, affecting negatively to wages, which fall in -10% and also households' income. As a consequence households' savings also fall. These two channels reduce savings in the economy with the corresponding reduction in investment.

As expected, exports fall sharply when there is a decrease in the price of mining. They fall in -4.9% because the share of mining in Bolivian total exports is the largest (60%). The decrease in the world price of mining generates a depreciation of the real exchange rate that, *ceteris paribus*, increases exports of non-mining products and decreases imports (-21%), in order to keep foreign savings fixed; remember that foreign savings are fixed as part of the model macro closure rule for the external sector (see above). The effect is similar but less strong in the pwe-agr and edem-txt scenarios.

A reduction in foreign savings has a strong effect on investment, which falls by -25.1% in the curracc scenario. This result is explained by the selected closure rule for the rest of the world (i.e., exogenous foreign savings) and for the savings-investment balance (i.e., the model is savings-driven). The decrease in remittances also has a negative impact on investment (see scenario remit), reducing it by -4% due to a decrease in income that translates into a decrease in savings. It is interesting to note that the income effect of a reduction in remittances is different according to the type of household that is being considered.

Table 4.3: Transfer Income of Households (change% w.r.t. base scenario)

RH	base LCU	pwe-min	pwe-agr	edem- txt	curacc	remit	combi	combi- cut	combi- trnsfr-	combi- govcon
h-urb-noindig	402.7	-8.4	-0.5	-0.4	-1.1	-23.0	-31.1	-14.8	-28.5	-30.9
h-urb-indig	296.2	-8.4	-0.5	-0.4	-1.1	-23.4	-31.4	-15.0	-28.9	-31.2
h-rur-noindig	42.7	-8.4	-0.5	-0.4	-1.1	-19.5	-27.9	-13.4	-24.3	-27.7
h-rur-indig	159.8	-8.4	-0.5	-0.4	-1.1	-14.9	-23.8	-11.6	-18.8	-23.6

Source: Authors' calculations.

In table 4.3 it can be seen that indigenous urban households are the most affected by a reduction in remittances, transfer incomes decrease by -23.4%, while indigenous rural households are the least affected, and their income falls by -14.9%. This result shows that urban households are more dependent on remittances than rural households.

In the last three rows of table 4.2 we analyze the impact on some key fiscal indicators, as government savings, government consumption and tax revenues. In particular, the results highlight the importance of the mining sector (particularly, hydrocarbons) as a source of revenues for the government. Consequently, public savings and investment also depend on the revenues from the mining sectors.¹⁰

The government surplus expressed as a share of GDP is (significantly) reduced only when the export prices of mining decrease (see scenario pwe-min). On the other hand, government consumption expressed as a share of GDP increases (+1.2 percent point), as consequence of a decrease in domestic prices and a decrease in GDP – recall that we assume government consumption is fixed in real terms as part of our government closure rule. In the pwe-agr and edem-txt scenarios, the simulated shocks have a minor fiscal impact. In the curacc and remit scenarios, the adjustment is attained through a reduction in investment.

Second, the share of tax revenues reduces from 28.1% to 26% when the export price of mining reduces in 25%, because the production in the mining sector falls. The opposite happens when there is a reduction in the export price of agriculture, tax revenues share raises up to 28.3%. The reason of these opposite effects is that taxes on mining represent

¹⁰ Public income from hydrocarbons increased from 5.6% as a share of GDP in 2004 to 25.7% as a share of GDP in the last quarter of 2008.

almost 40% of total government income; therefore, when mining production falls, tax income also falls. On the other hand, when the export price of agricultural goods decreases, tax revenues increases because the production of other sectors that pay taxes increases. Certainly this positive effect is not so important as the decrease in government revenues due to a decrease in pwe-min.

Finally, a 25% reduction in foreign savings traduces into a reduction in government savings share by 0.1% with respect to the base scenario, while government consumption rises by the same magnitude (0.1%). Recall that government savings is an endogenous variable and it moves always to balance the government budget constraint.

Then, in table 4.4 we present the sectoral results. In particular, we analyze the impact of the simulations on production (value added), exports and imports. To facilitate the presentation of results, we concentrate on five aggregated sectors: mining, agriculture, food, manufactures and services. Columns (ii) to (x) show the percentage change with respect to the base scenario.¹¹

¹¹ In the appendix we show the same results for all the 19 (disaggregated) sectors.

**Table 4.4: Sectoral Results (change% w.r.t. base scenario)
Aggregated Sectors**

indicator	base LCU (i)	pwe-min (ii)	pwe-agr (iii)	edem- txt (iv)	curacc (v)	remit (vi)	combi (vii)	combi- cut (viii)	combi- trnsfr- (ix)	combi- govcon (x)
Value added										
Agriculture	9,750	3.9	-2.4	0.2	0.3	-0.4	0.9	0.5	1.1	0.8
Mining	11,346	-16.2	0.8	0.5	1.2	1.5	-13.2	-5.8	-13.4	-13.5
Food	4,939	4.5	0.1	0.2	0.7	-0.5	6.1	2.8	6.3	6.0
Other manufactures	3,866	9.3	1.0	-2.7	-0.2	1.0	9.0	4.5	8.6	8.3
Services	39,832	-0.6	0.1	0.0	-0.7	-0.5	-2.1	-0.9	-2.2	-1.8
Exports										
Agriculture	1,021	24.3	-39.2	1.2	3.1	2.8	-19.4	-8.1	-19.6	-19.8
Mining	23,536	-24.7	0.9	0.5	2.3	2.0	-20.1	-8.8	-20.1	-20.2
Food	4,492	27.8	1.0	1.3	3.5	3.3	41.2	19.5	40.7	40.4
Other manufactures	5,514	31.6	1.7	-7.0	0.2	2.8	33.8	14.4	32.7	32.3
Services	3,380	21.2	1.4	0.9	2.6	3.0	31.7	15.5	31.3	31.0
Imports										
Agriculture	866	-12.9	-0.6	-0.8	-2.0	-3.7	-17.8	-10.4	-17.3	-17.6
Mining	2,240	-16.0	-0.3	-0.2	-1.8	-1.9	-19.9	-10.4	-19.8	-20.0
Food	1,485	-18.7	-1.2	-0.9	-2.5	-5.0	-26.7	-14.8	-26.0	-26.2
Other manufactures	19,057	-23.1	-0.2	-0.5	-9.2	-2.7	-36.2	-18.3	-37.0	-37.3
Services	5,470	-18.9	-1.4	-0.8	-2.2	-4.4	-26.4	-14.5	-26.0	-26.0
Source: Authors' calculations.										

Production in the mining sector falls by -16.2% when the export price of mining reduces by 25%. In contrast, all the other sectors and in particular other manufactures are affected positively by a reduction in the price of mining. For instance, other manufactures increase their production by 9.3%. There is certainly a reallocation of resources, like an inverse Dutch Disease – the sectors that increase the most are relatively more export-oriented. When the price of mining - the main economic sector- decreases, production is cut in this sector and resources move to other sectors.

The fall in remittances causes a reduction in agriculture, food and services value added by -0.4% and -0.5%. On the other hand, remittances boost mining and other manufactures production by 1.5% and 1% respectively. The fall in remittances puts pressure on the real exchange rate, which should depreciate to comply with the restriction of fixed savings from the rest of the world. Then, the depreciation of the real exchange rate stimulates the exports of the more tradable sectors - with a ratio exports/production higher (see Table 3.5).

Exports behave in a similar way than production, but of course with different magnitudes. It is remarkable the reduction in agriculture exports due to a reduction in its world price (-

39.2%). This fact highlights the high sensibility of agriculture exports to variations in world export prices. Birbuet and Machicado (2009) demonstrate this fact in a case study elaborated for the quinoa sector, which has been one of the growing agricultural sectors in the last years. The growing of the sector is explained mainly by the high international prices of quinoa and the same occurs with other commodities as Brazilian nuts, soya, rice and vegetable oil.

A reduction in the world export price of mining boosts exports of all the other sectors, because the real exchange rate depreciates. This is also clearly seen in imports; all sectors reduce their imports due to the depreciation of the exchange rate. In particular, other manufactures are highly influenced, because their share in total imports is 23.7% (see table 3.5).

A 25% reduction in foreign savings imposes the necessity to generate more foreign resources. Therefore exports increase in most of the sectors by more than 2%, with the only exception of other manufactures that increases its exports only by 0.2%. Again, all sectors increase their exports as a response to the depreciation of the real exchange rate. Certainly, when there is a real depreciation, imports also fall as it is seen in table 4.4.

When the foreign demand of textiles reduces by 40%, exports of this sector decrease by -40% and value added decreases by -12.35%. This strong reduction is compensated by the expansions experienced by other sectors included in other manufactures, such as metal and metal products and light manufactures.

It is important to analyze also the effects on labor variables, like labor demand and wages, since Bolivia is a poor country and poverty is mainly explained by a lack of labor opportunities. It is true that unemployment problems are somehow compensated by informal employment and underemployment, but it is also true that labor demand is highly sensible to macroeconomic shocks.

The following table displays the labor demand changes (again with respect to the base scenario) under our 5 different shocks and the combined scenarios. We show the impact on skilled and unskilled labor demand for agriculture, mining, textiles, construction and trade.

We have included construction and trade since those are the sectors that absorb an important amount of labor.

**Table 4.5: Labor Demand (change% w.r.t. base scenario)
Selected Sectors**

	base LCU	pwe-min	pwe-agr	edem- txt	curacc	remit	combi	combi- cut	combi- trnsfr-	combi- govcon
Unskilled labor										
Agriculture	404.5	9.6	-4.6	0.4	1.3	-0.3	5.2	2.6	5.5	5.1
Mining	189.1	-52.1	3.1	1.7	4.0	5.4	-44.6	-21.1	-45.1	-45.3
Textiles	41.5	9.5	1.0	-22.4	1.6	0.4	-13.5	-5.5	-13.4	-13.3
Construction	57.2	-72.9	1.4	0.6	-40.2	-6.7	-99.4	-60.7	-99.8	-99.9
Trade	228.8	13.0	0.1	-0.8	0.1	0.5	13.9	6.6	13.6	13.2
Skilled labor										
Agriculture	48.4	10.2	-5.1	0.3	1.1	0.0	5.3	2.4	5.6	4.7
Mining	117.1	-51.8	2.5	1.6	3.7	5.7	-44.5	-21.3	-45.1	-45.6
Textiles	11.4	10.1	0.5	-22.5	1.4	0.6	-13.4	-5.7	-13.3	-13.7
Construction	24.1	-72.7	0.9	0.4	-40.3	-6.4	-99.4	-60.8	-99.8	-99.9
Trade	91.5	13.7	-0.4	-0.9	-0.1	0.8	14.0	6.4	13.7	12.7
Source: Authors' calculations.										

Notice that when the export price of mining decreases, labor demand in mining decreases (-52.1%) as a consequence of a decrease in production. But also labor demand of skilled (-72.7%) and unskilled (-72.9%) workers decreases in the mining and construction sectors respectively. According to the model, employment in construction falls because investment falls and the investment demand is basically a construction demand. Furthermore, construction is a non-tradable sector which decreases its production due to the depreciation of the real exchange rate. This is consistent with what is typically observed in the mining Departments of Potosi and Oruro, when the labor demand in the mining sector increases, the labor demand in construction also increases and vice versa. This was very evident in terms of unskilled workers, but our model results show that this is true also for skilled workers.

It is also noteworthy how an improvement in the current account or in other words a 25% reduction in foreign savings affects labor demand mainly in the sectors of construction and metal mechanic (not shown). This is certainly, because these sectors concentrate a highly proportion of investment, therefore when investment falls, labor demand in these sectors

also fall. On the other hand, when there is a reduction in foreign savings the country needs to generate foreign resources in order to maintain the level of foreign reserves or pay external debt, therefore, the real exchange rate depreciates and this affects all sectors that demand this type of goods as intermediate inputs. In particular, the sector of metal mechanic is an important input for mining, construction, beverages and tobacco among others.¹²

There are opposite effects in mining and construction when remittances fall. Labor demand of skilled labor increases in mining by 5.7% while it decreases in construction by -6.4%. Again, the country needs to generate foreign resources, therefore value added and labor demand in the sector that is export intensive increases, while the sector that does not export reduces its value added and its labor demand. This is interesting and explains why unskilled unemployment does not change as a consequence of a fall in remittances, while unemployment of skilled workers increases to 10.9%. Certainly the mining sector cannot absorb the skilled workers released from the construction sector.

Although, we have seen that a 40% reduction in the external demand of textiles does not have an important effect on GDP, it has an important effect on labor demand. The demand of both types of labor decreases by more than 22% in that sector. This has been certainly what we have observed in the economy. Labor demand has decreased in particular in the cities of La Paz and El Alto but without remarkable effects on aggregate output.¹³

There are no important differences in labor demand changes between skilled and unskilled labor. Both change in a similar magnitude, which reflect our assumption of complementarity between both labor types.¹⁴ Exceptions are the increase of unskilled labor demand and the decrease in skilled labor demand in trade when there is a 25% reduction in export price of agriculture. Unskilled labor demand increases by 0.1% and skilled labor

¹² Now that the government has adopted a fixed exchange rate policy, the pressure to maintain reserves is larger.

¹³ In 2005, La Paz and El Alto represented 43% of total Bolivian exports to the US, under the ATPDEA and these exports were mainly textiles (UDAPE, 2006).

¹⁴ Specifically, we assume that the elasticity of substitution between different types of labor is 0.8.

demand decreases by -0.4%. In table 3.4 it can be seen that 61.1% of agriculture value added represents unskilled labor, while only 7.3% represents skilled labor.

Finally, in table 4.6 we display the impact of the different shocks on labor income for each type of household, where we have divided households by geographical location (urban and rural) and if their members are indigenous or not.

Table 4.6: Labor Income by Type of Household (change% w.r.t. base scenario)

RH	base LCU	pwe-min	pwe-agr	edem- txt	curacc	remit	combi	combi- cut	combi- trnsfr-	combi- govcon
h-urb-noindig	1,854.9	-12.4	-1.0	-0.5	-1.5	-2.0	-16.8	-9.4	-16.6	-16.0
h-urb-indig	1,284.8	-11.9	-1.1	-0.6	-1.6	-1.9	-16.4	-9.2	-16.2	-15.8
h-rur-noindig	240.7	-11.2	-1.3	-0.6	-1.6	-1.7	-15.9	-9.0	-15.7	-15.6
h-rur-indig	452.0	-11.3	-1.3	-0.6	-1.6	-1.7	-15.9	-9.0	-15.7	-15.6

Source: Authors' calculations.

The results in terms of labor income are powerful. In all the cases, there is a decrease in labor income in each type of household. The strongest effects are seen when the export prices of mining decrease by 25%. Non-indigenous' income decreases by -12.4% for urban households and by -11.2% for rural households. This result reinforces our preceding analysis where we have seen that first, a reduction on prices of mining affects production in that sector, because the share of exports in production is 76.6%, therefore wages and income are affected. Second, as income in all type of households is affected, savings of all type of households are also negatively affected, decreasing in this way investment of the whole economy.¹⁵

Regarding income and consumption distribution, the model predicts minor changes among the different shocks. The urban non-indigenous households hold more than 50% of the incomes, while urban indigenous households hold 33% of the income. In terms of consumption, urban non-indigenous households represent 35%, urban and indigenous represent 24% and rural and non-indigenous represent 21-22%. These percentages do not change due to the GFC.

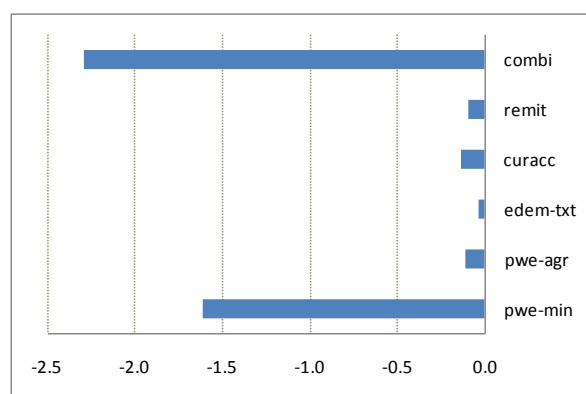
¹⁵ We have to mention that according to the household surveys used in the micro sam, only urban households save in the economy.

4.3 Combined Scenarios

We already mentioned and reported our two combined scenarios, but we have not analyzed the results yet. In this section we discuss these results emphasizing the fact that the combi scenario is a severe impact scenario and the combi-cut is a weak impact scenario for the Bolivian economy.

It is clear that the main effects observed in both scenarios are mainly attributed to the reduction in the export price of mining (see Figure 4.1). Fixed investment, which is affected not only by a reduction in government savings but also in households savings, decreases only by -40% in the weak crisis scenario. Imports are also reduced by -16.6% and this is explained mainly by the depreciation of the real exchange rate. Real exchange rate always move to equilibrate the in and out flows of foreign resources.

Figure 4.1: Change in GDP (change% w.r.t. base scenario)



There is a difference of 0.9% in total unemployment between the weak and severe scenarios and this difference is larger for skilled labor (1.5%). In the weak scenario labor demand is also depressed in all sectors except in agriculture and trade, but labor demand in construction is depressed only by -60.7% for unskilled workers and -60.8% for skilled workers. Here we observe again a combination of a fall in labor demand caused by the high correlation of labor demand between mining and construction, and also a fall in labor demand due to a reallocation of resources between sectors that are export intensive and less import dependent.

In the weak scenario exports of food, other manufactures and service sectors boost in a magnitude that is almost the half than what we observe in the severe scenario. Tax revenues and government savings decrease in the weak scenario but in a smaller proportion of GDP. Recall that government savings is the variable that moves to balance the fiscal budget. Tax revenues reduces only to 27.3% as a share of GDP in the weak scenario and this is explained mainly by the fall in production of activities that pay taxes, in particular mining and natural gas extractive activities.

4.4 Policy Response Scenarios

We have included also two policy response scenarios to see if the government is capable to neutralize or reduce the negative effects of the GFC. According to Weisbrot, Ray and Johnston (2009), the Bolivian government has used fiscal policy to effectively encounter the effects of the world recession. They claim that this would not have been possible without the control that the government obtained of the incomes and the production of natural gas.

Therefore, we simulate expansive fiscal policies in a context where the worst case scenario occurs; i.e., when there is a combination of all the external shocks and they are severe. First, we have our combined scenario complemented with a 10% increase in transfers from the government to households (combi+trnsfr-hhd), and second, we have our combined scenario with a 2.5% increase in government consumption (combi+govcon). The results of the simulations are shown in the last columns of all the tables above.

According to the model, we find that in both simulations GDP decreases in a larger magnitude. In rhetorical “the remedy is worst than the illness”. This is striking because one would have expected a better performance of the economy, since the government is applying counter cyclical policies. But there is a key point that has to be considered, and it is related to how the government is financing these policies.

First, observe that there is a crowding out effect. When the government increases its transfers to households by 10%, fixed investment falls by -88.3% and when it increases its consumption by 2.5%, investment falls by -89.1%. What is happening is that government

savings are falling and therefore investment is falling too. It happens also that households, in this severe crisis episode, use the transfers from the government to consume. Notice that without this compensatory measure, household consumption reduces by -8.3% while it reduces only by -7.8% when government increase transfers by 10%.

Second, these results although appear to be counterintuitive, they are not. Recall that the main source of income for the government is taxes collected from the mining and in particular from the hydrocarbons sector (mining in the model). We have demonstrated already that this sector is the main economic sector, so when the export price of mining decreases there is a severe economic contraction and reduction in government incomes. Then, the government has no other alternative to finance these expansive fiscal policies with debt, scarifying its savings and investment in the economy.

In both policy response scenarios, exports in mining and agriculture decreases, but exports of the other sectors increase due to the depreciation of the real exchange rate that accompanies the reduction in foreign savings. This reduction in foreign savings has to be considered also as a pressure for the government to maintain the current account balance fixed.

Finally, in terms of labor demand the outstanding impact from the mining sector is noticeable. Again, there is a reduction in labor demand of unskilled workers by approximately -45% and the “contagion” effect on construction reduces labor demand in -100%. Again, this happens because the mining sector unleashes a huge amount of unskilled workers and they turn into an important supply of unskilled workers in construction. Unemployment rate remains constant when government increases transfers to households by 10%, but it reduces to 8.8% when it increases government consumption.¹⁶

In conclusion, the high dependence of the government on the mining (hydrocarbons) sector and in particular on its international prices, constrain the capacity of the government to respond to the negative effects from the GFC.

¹⁶ Recall that “contagion” is explained (see above) by a decrease in investment which is mainly construction demand.

4.5 Poverty Results

The results in terms of poverty at the micro level are calculated by linking the CGE model to a simple microsimulation technique – clearly, these are rough poverty estimates. The two are used in a sequential “top-down” fashion: the CGE communicates with the microsimulation model by generating a vector of changes in the real income for each representative household. The Encuesta Continua de Hogares (ECH), the main household survey in Bolivia, is used to build the microsimulation model. At the micro level, a counterfactual household per cápita income distribution is generated; the change in the real income of each representative household is applied to the corresponding individuals in the household survey. Subsequently, we estimate new poverty indicators.

The poverty results show that, at the national level, there is an increase in poverty by 2.4 percentage points and 1.1 percentage points, when there is a 25% reduction in world export price of mining and a 30% reduction in remittances, respectively. Indigenous urban households are the most affected by a reduction in the price of mining, their poverty increases by 3.7 percentage points. In the severe impact scenario (combi) poverty increases up to 63.5% and poverty among indigenous urban households increases up to 59.9%. (see table 4.7).

**Table 4.7: Poverty Impact of Simulations
(headcount ratio -- official poverty lines)**

indicator	base	pwe-min	pwe-agr	edem- txt	curacc	remit	combi	combi- cut	combi- trnsfr-	combi- govcon
poverty										
national	60.0	62.4	60.0	60.0	60.0	61.1	63.5	62.1	63.3	63.4
h-urb-noindig	47.2	50.0	47.3	47.2	47.3	48.0	51.3	49.4	51.1	51.1
h-urb-indig	54.4	58.1	54.5	54.4	54.5	56.7	59.9	57.8	59.7	59.8
h-rur-noindig	76.9	78.0	76.9	76.9	76.9	77.0	78.8	78.0	78.8	78.8
h-rur-indig	77.4	78.3	77.4	77.4	77.4	78.1	78.4	78.3	78.4	78.4
extreme poverty										
national	37.5	39.5	37.5	37.5	37.5	38.1	40.2	39.1	40.1	40.1
h-urb-noindig	18.8	21.6	18.8	18.8	18.8	19.6	22.1	20.8	22.0	22.0
h-urb-indig	28.5	30.8	28.5	28.5	28.5	28.9	32.1	30.3	32.1	32.1
h-rur-noindig	54.2	56.1	54.2	54.2	54.2	54.6	56.1	56.1	56.1	56.1
h-rur-indig	67.7	68.1	67.7	67.7	67.7	68.0	68.5	68.1	68.3	68.5

Source: Authors' calculations.

The results are similar in terms of extreme poverty. In the severe impact scenario, extreme poverty increases by 2.7 percentage points and in the weak impact scenario (combi-cut) it increases by 1.6 percentage points.

Notice that poverty and extreme poverty are not affected when there is a 40% reduction in the world export demand of textiles. Extreme poverty among any type of households is also not affected when there is a 25% reduction in the world export price of agriculture and a 25% reduction in foreign savings. But in these cases, poverty increases by 0.1% in urban households. In fact, urban households are the owners of the land and it is this factor that absorbs the fall in the price of agriculture.¹⁷

Finally, notice that in the policy response scenarios, poverty and extreme poverty increase in a sizable magnitude. Poverty increases by more than 3% and extreme poverty by 2.5%. This happens again, because the negative impact on poverty of a reduction in public savings and therefore in investment is stronger than the positive impact of a transfer or expenditure policy.

5. Concluding Remarks

Bolivia has experienced in recent years an important commodity price boom, which has significantly increased its external revenues. This export boom has permitted the country to reverse chronic fiscal and external deficits, and accumulate foreign exchange reserves up to a level never seen before. In addition, the growth forecasts for 2009 allocate the Bolivian economy with the highest rate of growth in the western hemisphere.

With the outbreak of the GFC, export revenues fell as a consequence of the reduction in world export prices of mining, agriculture and food commodities, but they are still at historically high levels. In this paper we have analyzed quantitatively the impact of the GFC on the main macroeconomic variables and on sectoral variables like value added, exports and imports. In general, we have found that the GFC could have mild effects on the

¹⁷ This is an assumption made due to lack of information. The assignment of land across different households was made in the same manner as capital.

Bolivian economy, except when there is a 25% reduction in the world export price of mining.

It seems that the boom occurred in previous years had furnished the Bolivian economy with a greater capacity to undertake counter-cyclical policies to ameliorate the future negative effects of the GFC. However there are some important risks that the economy will face in the future, some related to the GFC and some not.

First, investment rates, in particular private investment will continue to be at very low levels, undermining future growth and employment creation. Undoubtedly, FDI necessary to obtain capital and technology will not flow to Bolivia, impeding the adequate exploitation of natural resources and promoting growth in other sectors, in particular in the manufacturing ones. Bolivia will continue exporting raw materials.

Second, the fiscal surplus experienced in these years has ended and long term fiscal sustainability is in risk as it depends on hydrocarbons revenues. Due to the GFC and to low investments in this sector, hydrocarbon reserves and production and fiscal revenues are expected to go down. Therefore external revenues will fall not only due to the GFC, but also due to a supply constraint in Bolivia's production.

Third, remittances will not recover their growing performance and in the best case they will remain stable. By simulating a reduction of 30% in remittances we have shown that not only consumption, but also investment will be affected. This will reduce aggregate demand and income with negative consequences for poverty. In fact, poverty will increase by 1.1 percentage points and extreme poverty by 0.6 percentage points.

Finally, it seems that the policy response of the government to the crisis, based on increasing transfers and/or increasing government consumption, has not the counter-cyclical effects that people would expect. Nevertheless, remark that we have not explored the mechanisms of financing these transfers or expenditures. It is possible, for example, that these transfers could be financed by progressive taxes or by external debt. In these cases, the effects on poverty will be certainly different. We leave this type of simulations for a further version of the paper or for another paper.

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Appendix: Changes to the PEP Standard Model

International Trade

In the PEP 1-1 Standard Model, the world demand for exports of product x is

$$EXD_x = EXDO_x \left(\frac{e.PWX_x}{PE_x^{FOB}} \right)^{\sigma_x^{XD}} \quad (64)$$

In case $\sigma_x^{XD} = \infty$, equation (64) simplifies to

$$e.PWX_x = PE_x^{FOB} \quad (64')$$

which represents the “pure” form of the small-country hypothesis; producers can always sell as much as they wish on the world market at the (exogenous) current price, PWX_x .

To simulate a change in the world export demand of a given commodity exported by a given industry keeping the small country assumption (see scenario edem-txt), we introduce the following changes to the model: (1) again, replace equation (64) by (64'), and (2) replace equation (63) (i.e., the relative supply of exports and local commodity) by equation (63') for the selected commodity and industry pair(s),

$$EX_{j,x} = EXO_{j,x} \quad (63')$$

Government Consumption

In the PEP Standard Model, government consumption of commodity i is determined by the following equation (see equation (56) in Decaluwé et al. (2009)).

$$PC_i CG_i = \gamma_i^{GVT} G \quad (56)$$

with g (i.e., current government expenditures on goods and services) fixed and equal to its initial value (i.e., $G = GO$). As an alternative, we modified the government behavior assuming that the real government spending is fixed (i.e., all the CG_i variables) while G is

endogenous. Specifically, we dropped equation (56) from the model and added equations (56') and (56''),

$$CG_i = CGO_i \quad (56')$$

$$G = \sum_i PC_i CG_i \quad (56'')$$

Wage Curve

The PEP Standard Model assumes full employment of the labor force. As explained above, we introduced endogenous unemployment by means of a wage curve. Specifically, we add to the model equation (WC) and the endogenous variable UERAT (unemployment rate). The value of the phillips parameter (i.e., the wage curve elasticity) was set at 0.10 based on international evidence documented in Blanchflower and Oswald (2005).

$$\frac{\frac{W_t}{PIXCON}}{\frac{WO_t}{PIXCONO}} - 1 = phillips_t \left(\frac{UERAT_t}{UERATO_t} - 1 \right) \quad (WC)$$

Elasticities

The income elasticities and Frisch parameters were estimated using the 2007 Bolivian Household Survey; it records income and consumption data. We estimated logarithmic commodity-wise expenditure demand function was estimated using the OLS method,

$$\log(con_{ih}) = \beta_0 + \beta_1 \log(gastot_{ih}) + \beta_2 cantmiem_h + \varepsilon_{ih} \quad (A.1)$$

where con(i,h) is consumption of commodity i in household h, gastot(i,h) is total consumption expenditure of household h, cantmiem(h) is the household size, epsilon is a random term, and b1 is the parameter of interest.

The LES functions in the CGE model assume that total household consumption takes place within an income/expenditure (budget) constraint; total household consumption expenditure is equal to total household income after taxes and savings. This adding-up restriction was

imposed by means of computing the *gastot* variable as the sum of all household consumption expenditures recorded in the household survey. Equation (A.1) was estimated for seven commodities, using two samples of 2,626 and 1,274 urban and rural households, respectively.¹⁸ The estimation results are presented in Table A.1, where all the expenditure elasticities of demand are positive and statistically different from zero at 5 percent or lower significance levels. We found that income elasticities are relatively lower for food and textiles, and higher for other manufactures and other services. Table A.2 shows the estimated Frisch parameters.¹⁹

Table A.1a: Income Elasticities Urban Households

	(1)	(3)	(5)	(7)	(9)	(11)	(13)
VARIABLES	food	comunic	othmnf	othsvc	oilref	textil	transp
<i>lgastot</i>	0.483 *** (0.0263)	0.526 *** (0.0493)	1.107 *** (0.0248)	1.559 *** (0.0446)	0.707 *** (0.0992)	0.768 *** (0.0339)	0.505 *** (0.0355)
<i>cantmiem</i>	0.0956 *** (0.00841)	-0.0462 ** (0.0211)	-0.000662 (0.00921)	-0.0469 *** (0.0165)	-0.0691 ** (0.0306)	-0.000718 (0.0121)	0.0252 ** (0.0115)
Constant	1.929 *** (0.188)	0.125 (0.351)	-2.414 *** (0.167)	-6.061 *** (0.311)	-0.410 (0.669)	-0.206 (0.237)	0.585 ** (0.251)
Observations	2,626	776	2,621	2,128	391	1,722	2,122
R-squared	0.355	0.148	0.530	0.430	0.218	0.306	0.154
Robust standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							
Source: Authors' calculations.							

¹⁸ Then, these seven commodities were mapped to the 19 commodities in the CGE model.

¹⁹ The Frisch parameters measure the household-specific elasticity of the marginal utility of income with respect to income. The available evidence suggests that the Frisch parameter varies systematically with the level of per-capita income (see Lluch, Powell and Williams, 1977).

Table A.1b: Income Elasticities Rural Households

	(2)	(4)	(6)	(8)	(10)	(12)	(14)
VARIABLES	food	comunic	othmnf	othsvc	oilref	textil	transp
lgastot	0.663 *** (0.0273)	0.553 *** (0.118)	1.116 *** (0.0561)	1.423 *** (0.106)	0.628 ** (0.245)	0.773 *** (0.0691)	0.486 *** (0.0530)
cantmiem	0.0262 ** (0.0113)	-0.0555 (0.0383)	0.0424 ** (0.0184)	-0.113 ** (0.0443)	0.0562 (0.0679)	-0.0452 * (0.0265)	0.00715 (0.0206)
Constant	1.448 *** (0.165)	-0.464 (0.786)	-3.308 *** (0.367)	-5.527 *** (0.698)	-0.593 (1.874)	-0.166 (0.494)	0.233 (0.356)
Observations	1,274	335	1,247	605	72	700	839
R-squared	0.532	0.135	0.407	0.313	0.217	0.233	0.184
Robust standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							
Source: Authors' calculations.							

Table A.2: Frisch Parameter

hosehold	frisch
Urban non-indigenous	-4.3
Urban indigenous	-5.1
Rural non-indigenous	-5.8
Rural indigenous	-6.9
Source: Authors' calculations.	