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 a reduction in (i) the world export prices of mining and agriculture, (ii) the world demand of textiles, and (iii) transfers to households (i.e., remittances) from abroad. The model has been calibrated to a new 2006 SAM for Bolivia. The households have been disaggregated according to their location (urban and rural) and ethnicity (indigenous and non-indigenous). The factors of production have been disaggregated into skilled and unskilled labor, capital, and natural resources. Not surprisingly, our results highlight the relevance of the decrease in the export price of natural gas in explaining the negative effects of the Global Financial Crisis.

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 to 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, new speculative investment funds, among others. All of these elements were evident in the U.S. economy, and it is precisely in that country that the GFC started 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

[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).

global economic growth from just under 3.5% in 2008 to about 0.8% in 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 countries, the effects of the crisis have been different, according to their 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 to the U.S. economy, entered into a recession.

The economic downturn in industrialized countries will affect developing countries differently according to their initial conditions and 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 world prices for raw materials. This fact puts 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%, one of the highest in the region, and according to the IMF the rate of growth will be 2.8% 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 would decrease in 5% in comparison to the base scenario. Jemio and Nina (2009) used a Macroeconomic Consistency model to analyze the effects of the crisis. They analyzed the marginal impact (one time impact) over the real sector of external and internal shocks. For instance, they analyzed a 50% reduction in the world price of natural gas, a 50% fall in remittances, a 50% fall in the price of minerals, a 10% reduction in the mining activity, and a 5% decrease in public investment.

The effects of the GFC in an economy wide context have not yet been analyzed. Therefore, we assess the impact of different 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. In this study, we use the model to quantify the effects the GFC and assess different policy response alternatives.

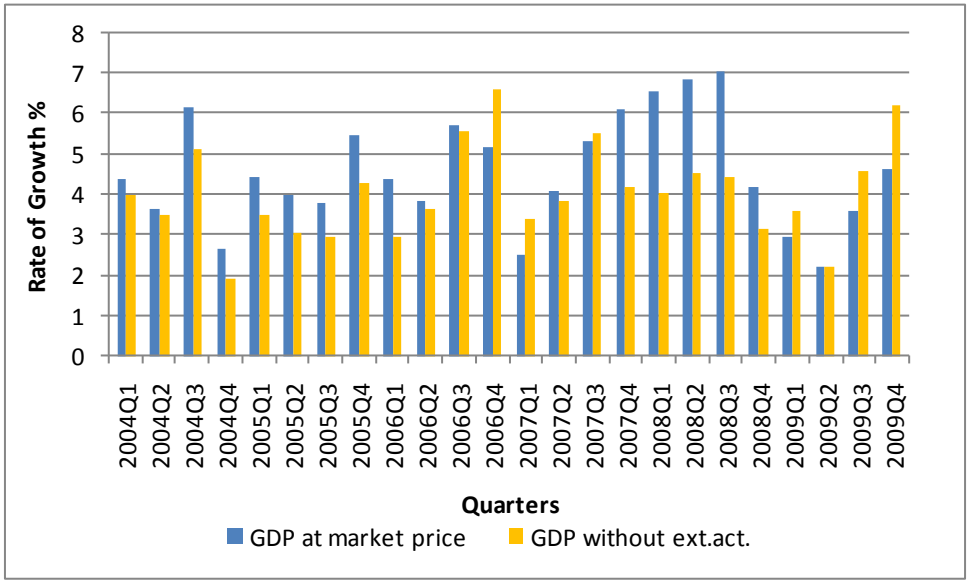
The rest of the paper is organized as follows. The next section describes the economic performance of the Bolivian economy in the last 5 years. Section 3 presents the methodology and data used as well as the principal characteristics of the computable general equilibrium model. Section 4 displays the results of the simulations, detailing the aggregate and sectoral effects. 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%. 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 on the supply side, and in consumption on the 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)

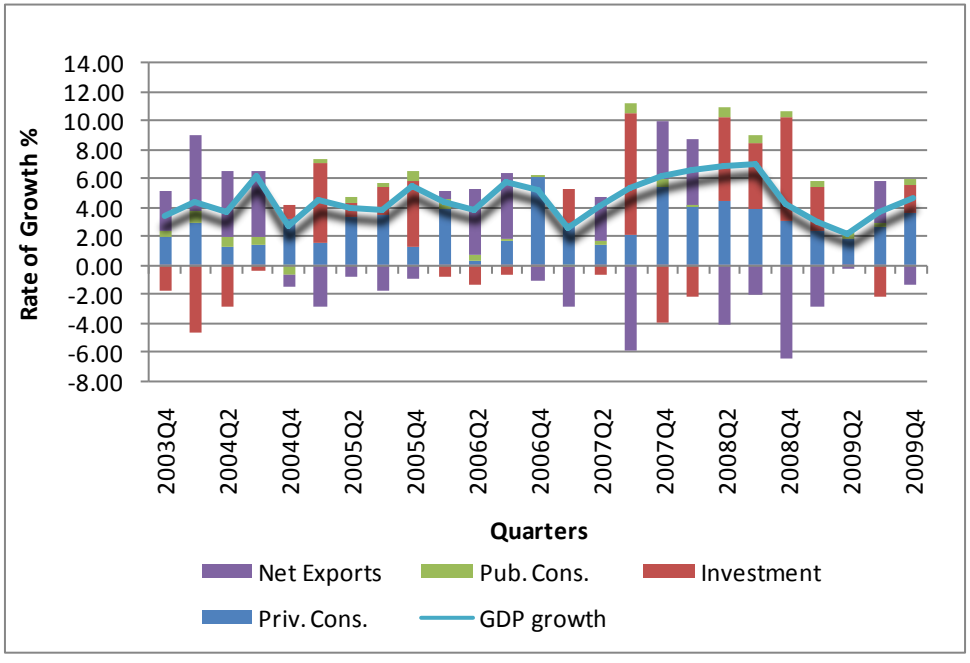


Source: Central Bank of Bolivia

The signs of slowdown of the economy appeared in the forth quarter of 2008 when the annual rate of growth fall to 4.2%, and then in the second quarter of 2009 when the rate of growth was 2.2%. Notice that in the previous quarters, growth reached rates higher than 6%. The production in extractive activities slowed down also but with less intensity. The rate of growth fell to 3.1% and 2.2% in the forth quarter of 2008 and second quarter of 2009, respectively, but then it recovered its 2008's values, being above 4% in the third and fourth quarters of 2009.

In the last five years, the GDP growth has been driven by internal demand (see Figure 2.2). On the other hand, net exports showed 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 whole period, but in particular in the last three quarters of 2008. Private investment also displayed a positive and important incidence on growth in the last three quarters of 2008, although it showed a negative incidence in the forth quarter of 2007, the first quarter of 2008 and the third quarter of 2009.

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

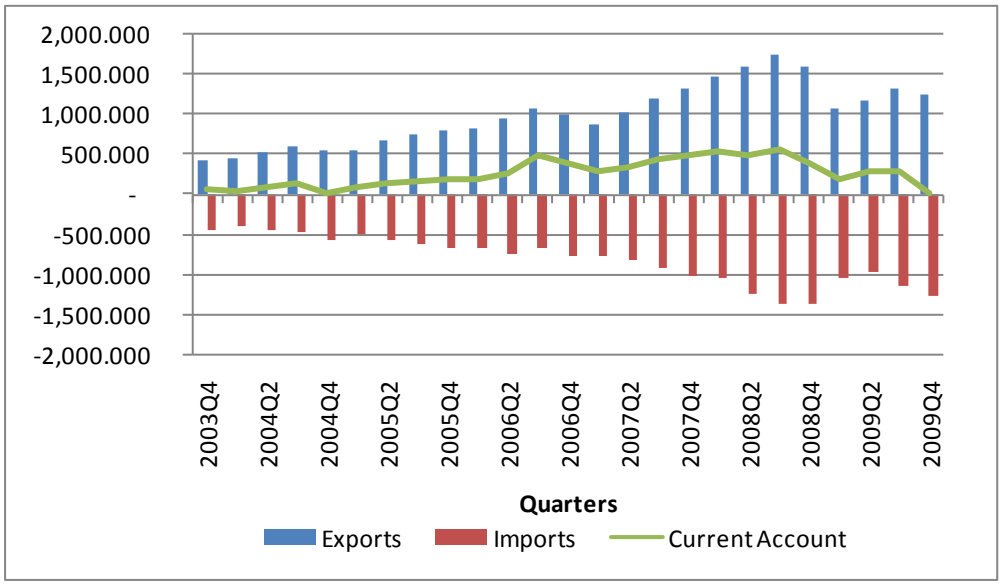


Source: National Institute of Statistics (INE)

Public consumption grew on average at 3.6% between 2006 and 2008. In fact, private and public consumption have been important factors in explaining GDP growth in particular in the last years. Investment declined in 2009. In the second quarter of 2009 it showed a negative annual growth rate of -9.64%, while in the same period the year before it showed an annual growth of 26.45%. On average, it grew only by 1.55% between 2006 and 2008 (quarterly growth).

Bolivian economic structure is mainly based on the exports of raw materials, like minerals and hydrocarbons. 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 slight recovery in the second quarter of 2009, but then decreasing again.

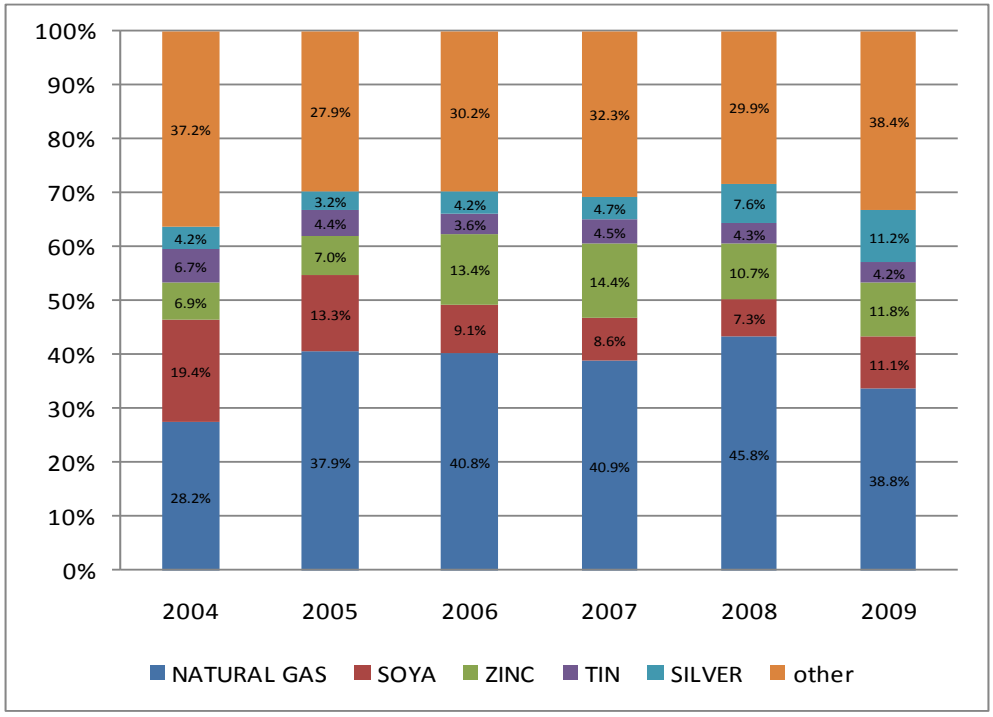
Figure 2.3: Current Account Exports and Imports (millions of USD)



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; five products comprise around 80% of total exports (natural gas, zinc, tin, silver and soya) (see Figure 2.4).

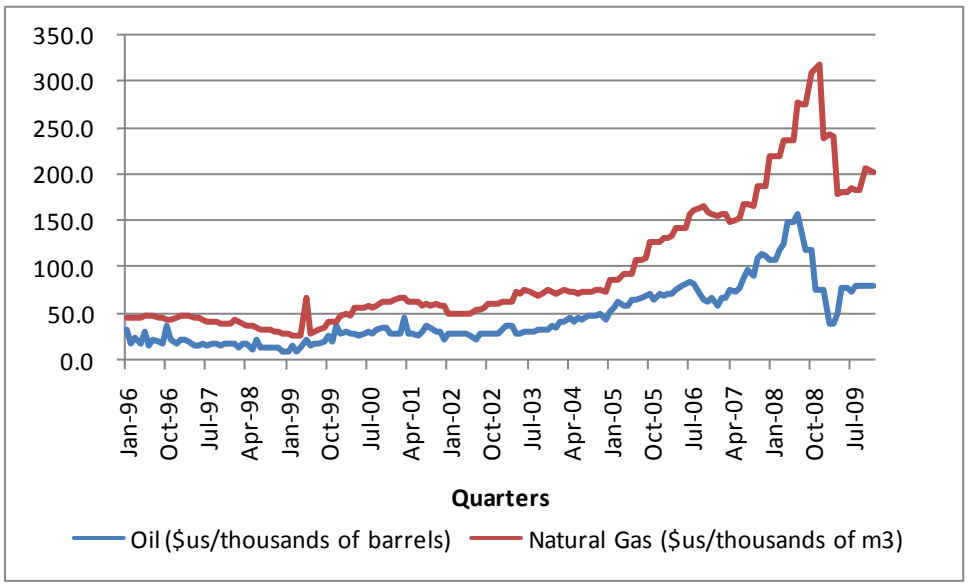
Figure 2.4: Concentration of Bolivian Exports (2004-2009)



Source: Central Bank of Bolivia

Export prices of minerals and oil experienced an unprecedented increase since 2005 (see 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 increasing again.

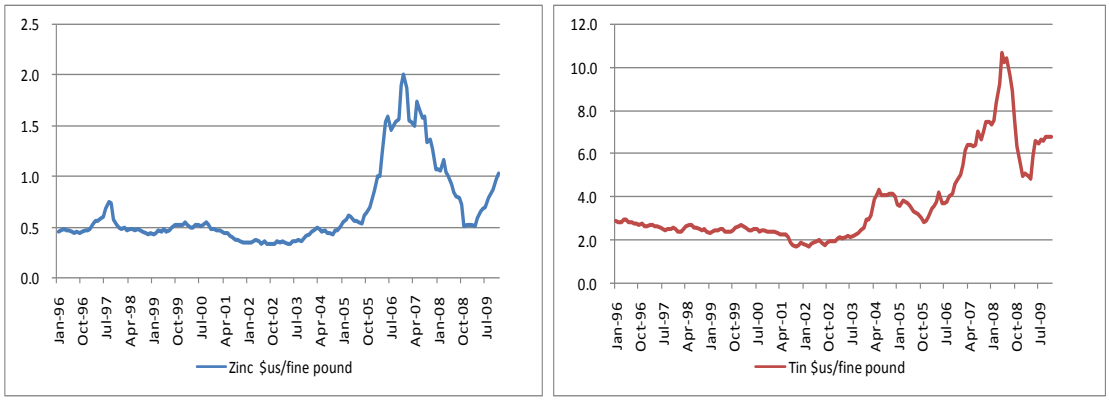
Figure 2.5: Oil and Natural Gas Export Prices

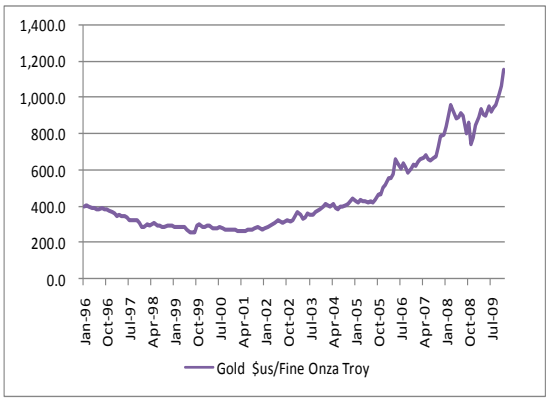


Source: Bolivian Central Bank

Prices of minerals experienced important increases in the years 2006 and 2007, but then experienced sharp reductions as a result of the GFC. In particular, in 2008, the reductions have been in the order of 52% for Zinc, 26% for Tin, 32% for Silver and 2% for Gold. Nevertheless, these prices have partially recovered in 2009. For instance, during 2009, the price of zinc and silver increased by 98% and 86%, respectively.

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





Source: Central Bank of Bolivia

It is important to emphasize 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 the same period of 2008. This situation reduced its share of GDP to only 0.2%, a value well below the 0.8% 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 arose 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]

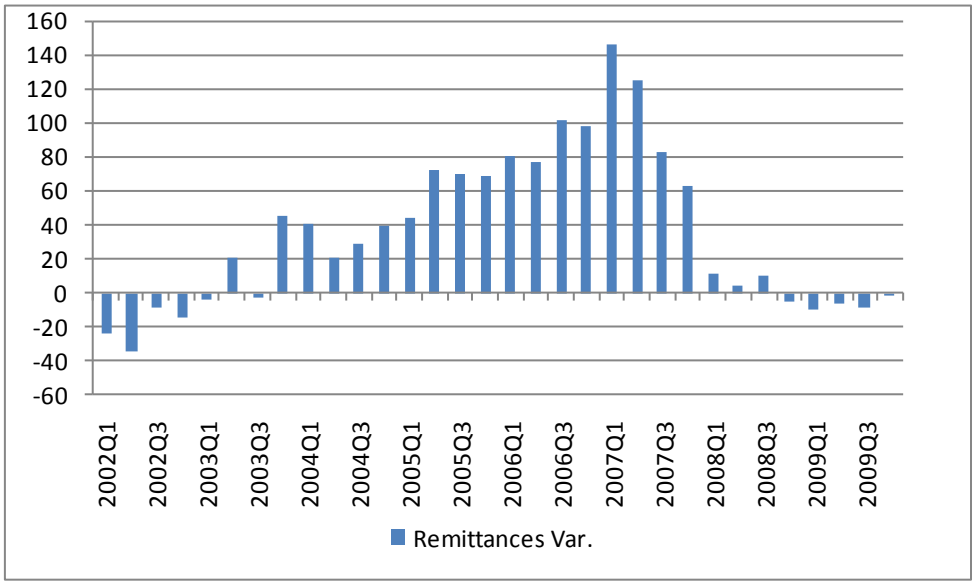
The surplus of the balance of payments is reflected in an increase in the net international reserves. These reserves as a share of GDP are the highest in the region and in the whole Bolivian economic history. According to Canavire and Mariscal (2010), the Current Account surplus is not only explained by the proceeds from exports (mainly sales of natural gas), but also by other factors such as remittances from Bolivians living abroad and a reduction in the service of external debt (interests). Gross International Reserves grew from USD 1798.4 million in 2005 to USD 7722.2 million in 2008.

[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.

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 %ages)



Source: Central Bank of Bolivia

In figure 2.7 we show the quarterly variation of remittances. Notice that the positive and large 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% 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.

To end this brief review of the economy, we show the evolution of poverty and inequality (see Table 2.1).[5] Poverty in Bolivia reached its highest level in the year 2000 (66.4%) and it decreased in 6.3 percentage points until 2007. On the other hand, extreme poverty

[5] Official poverty estimates in Bolivia use a national extreme poverty line based on the cost of a basic food bundle, and a moderate poverty line computed from the extreme line using the Engel/Orchansky ratio of food expenditures.

decreased from 45.2% in 2000 to 37.7% in 2007. Notice that poverty is higher in rural areas than in urban areas. In rural areas it is around 75% while in urban areas it is around 50%. In addition, the estimations for 2008 seem to indicate that the GFC has not increased poverty.

Table 2.1: Poverty and Inequality Indicators

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

According to the Gini coefficient, inequality has decreases 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 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), and
- volatile and less prominent capital flows

There is the thought that the GFC will impact negatively the economy 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 a Social Accounting Matrix (SAM), and production and consumption elasticities.

3.1 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 are the Input-Output tables for Bolivia in 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, value added, and taxes on activities and commodities. 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 gas 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 distinction between indigenous and non-indigenous households is relevant in the Bolivian case, as more than 60 percent of the population is reported as indigenous and most of them are poor. 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, the SAM identifies savings, private and public investment, and a stock change accounts.

Table 3.1: Bolivia SAM 2006 Accounts

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

Table A.1 in Appendix A shows the estimated macro-sam. Bolivia GDP reached 89,157,704 million bolivianos in 2006 (see Table 3.2). In 2006, the government current

account surplus was around 11% of GDP and government current and capital demand was 14.7 and 6.4 per cent of GDP, respectively. The sectoral composition of private and public investment demand is different. For private (public) investment, construction represents 32% (71%) of total investment demand.

Table 3.2: Bolivia GDP 2006 (billions bolivianos)

indicator	LCU	shr% GDP
Household consumption	56,429	63.3
Fixed investment -- private	5,762	6.5
Fixed investment -- public	5,721	6.4
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 3.3 and 3.4, respectively. Columns (i) and (ii) of Table 3.4 show the share of each sector in total exports and imports, respectively. Columns (iii) and (iv) of Table 3.4 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 total 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 A.2 in Appendix A; total tax revenue reached 28% of GDP in 2006, while taxes on mining represented 38% of total tax revenue. The distribution of income and consumption between our four representative households can be found in Table A.3 in Appendix A.

Table 3.3: Production Structure Bolivia 2006 (%)

sector	act shr in VA	factor share in value added					
		f-lab-unsk	f-lab-sk	f-cap	f-land	f-natres	Total
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 tobbaco	1.8	16.3	12.0	71.7			100.0
Textiles	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 3.4: Trade Structure of Bolivia 2006 (%)

sector	exports% (i)	imports% (ii)	ex intensity (iii)	im intensity (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 tobbaco	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.				

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

Table 3.5: Income Composition of Households Bolivia 2006 (%)

income source	h-urb-noindig	h-urb-indig	h-rur-noindig	h-rur-indig
Unskilled labor	19.8	30.5	57.4	50.8
Skilled labor	28.0	21.3	10.3	10.1
Capital	36.3	31.5	17.6	15.2
Land	2.2	1.9	1.1	0.9
Natural resource	3.3	2.9	1.6	1.4
Transfers	10.4	11.9	12.0	21.6
Total	100.0	100.0	100.0	100.0
Source: Bolivia SAM 2006.				

3.2 Model

As explained, we implemented the Static Single-Country PEP Standard Model, a relatively standard applied trade-focused computable general equilibrium model.[6] However, we introduced some changes in order to better reflect the Bolivian economy. Specifically, we adapted the model in order to reflect that Bolivia is a 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 tangency condition for export and domestic sales. Additionally, we have modified the functioning of the government sector: (1) we assume that government consumption of each commodity is fixed in real terms, instead of assuming that total government spending in commodities is fixed, and (2) we differentiate between private and public investment. Consequently, we can simulate increases in government current and capital spending. Finally, we introduced a wage curve (see Blanchflower and Oswald, 1994) to endogenize unemployment; it establishes a

[6] See Robinson (1989) for a survey and van der Mensbrugghe (2005) and Lofgren et al. (2002) for other standard applied models in the tradition of Dervis et al. (1982). Other applications of the CGE methodology to Bolivia include Lay et al. (2008a), Lay et al. (2008b), and Klassen et al. (2007).

negative relationship between the levels of unemployment and wages.[7] The wage curve was calibrated using the 2006 Bolivian Household Survey. The initial levels of unemployment for unskilled and skilled workers are 3.9 and 10.5%, respectively. A more detailed presentation of the changes to the PEP Standard Model can be found in Appendix B.

As usual in the CGE context, we need to specify the equilibrating mechanism for three macroeconomic balances: 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 investment spending and all tax rates are fixed. The real private 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 private investment. 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 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.

4.1 Scenarios

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

(1) world prices of main export products (i.e., mining and agriculture),

(2) export demand of textiles, and

[7] 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".

(3) remittances from abroad (e.g., Spain, Argentina and the United States).

As shown in Table 4.1, the first scenario is a 25% reduction in the export price of mining (see scenario pwe-min), in accordance with the export price index computed by the Central Bank of Bolivia.[8] The second scenario (i.e., pwe-agr) simulates a 16% reduction in the export price of agriculture, that corresponds to the highest monthly variation registered between September and October of 2008. The 40% decrease in the world export demand of textiles (see scenario edem-txt) matches the fall in exports that the textile sector experienced between 2008 and 2009. This simulation is meant to capture, along with the effects of the GFC, the elimination of the tariff preferences that the USA granted to Bolivia under the ATPDEA (for its initials in Spanish). The ATPDEA included import duties preferences for several products, but the main products that Bolivia exported under these preferences were textiles. According to Jemio and Nina (2009), a 50% decrease in remittances would cause a 2.8% decrease in GDP. In the remit scenario this hypothesis is evaluated by simulating a 17% reduction in transfers from the rest of the world to households. The size of the shock corresponds to the decrease in remittances observed between the fourth quarter of 2007 and the first quarter of 2009. Finally, we simulate a combined scenario (combi) in which all previous shocks are considered together; this corresponds to our "crisis" scenario.

[8] Notice that the mining sector in the SAM contains the hydrocarbon sector. The price index computed by the Central Bank of Bolivia shows a 22% reduction between 2006 and 2008.

Table 4.1: Simulated Scenarios

name	description
External shocks	
pwe-min	25% reduction in world export price of mining
pwe-agr	16% reduction in world export price of agriculture
edem-txt	40% reduction in world export demand of textiles
remit	17% reduction in remittances to all households
combi	all previous scenarios combined
External shocks + Policy shocks	
combi-trnsfr	combi + 10% increase in transfers from gov to hhd
combi-spnd	combi + 5% increase in government consumption
	+ 9% increase in government investment

Source: Authors' elaboration.

4.2 Results

In this subsection, we describe and analyze the macroeconomic and sectoral results obtained from the CGE simulations. As explained before, the starting point for our simulations is a picture of the Bolivian economy in the year 2006.

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

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

indicator	base LCU	pwe-min	pwe-agr	edem-txt	remit	combi	combi-trnsfr	combi-spnd
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
National accounts (chg%)								
Household consumption	56,429	-4.9	-0.2	-0.1	-1.3	-6.7	-6.3	-6.1
Fixed investment	11,482	-46.3	-0.1	-0.1	-3.0	-49.9	-51.7	-56.9
Government consumption	13,140	0.0	0.0	0.0	0.0	0.0	0.0	5.0
Exports	37,943	-3.7	-0.1	-0.5	1.2	-2.7	-2.9	-3.6
Imports	-29,118	-20.6	-0.5	-0.7	-2.0	-23.4	-23.6	-24.6
GDP market price	89,158	-3.9	0.0	0.0	-0.1	-4.2	-4.2	-4.0
Net indirect taxes	19,425	-13.1	0.1	-0.1	-0.1	-13.7	-13.7	-14.1
GDP factor cost	69,733	-1.3	-0.1	0.0	-0.1	-1.5	-1.5	-1.2
Price indices (100=base)								
Consumer price index	100.0	92.3	99.6	99.5	99.0	90.5	90.7	91.2
Domestic price index (*)	100.0	90.5	99.6	99.5	98.9	88.6	88.7	89.2
Terms of trade (pe/pm)	100.0	84.5	99.6	100.0	100.0	84.1	84.1	84.1
World price index (**)	100.0	84.5	99.6	100.0	100.0	84.1	84.1	84.1
Real exchange rate	100.0	100.8	100.2	100.5	101.1	102.7	102.6	102.0
Unemployment (%)								
Unskilled labor	3.9	4.6	4.1	4.0	3.9	4.9	4.9	4.9
Skilled labor	10.5	12.9	10.6	10.6	10.7	13.2	13.1	11.8
Total	7.0	8.4	7.1	7.1	7.1	8.8	8.8	8.1
Fiscal (shr% GDP)								
Government savings	11.0	7.6	11.1	11.1	11.0	7.8	7.4	6.5
Tax revenue	28.1	26.2	28.2	28.2	28.1	26.4	26.4	26.1
Government consumption	14.7	15.9	14.7	14.7	14.7	15.9	15.9	16.9
Government investment	6.4	6.8	6.4	6.4	6.4	6.8	6.8	7.3
note: the nominal exchange rate is the numeraire								
(*) = non-tradables								
(**) = tradables								
Source: Authors' calculations.								

Not surprisingly, the largest impact on real GDP at factor cost appears when there is a reduction in the export price of mining, GDP decreases by 1.3%. This result is due to the large share of the mining sector in total exports (i.e., 61%; see Table 3.4) and total value added (14%).[9] The other non-combined scenarios show negative but small effects on real GDP at factor cost.

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

In terms of total household consumption, it decreases by 4.9% and 0.2% in the pwe-min and pwe-agr scenarios, respectively. Again, this is a reflection of the importance of the mining sector as a source of income, In terms of the four representative households identified in the SAM, the largest impact is observed for the urban indigenous and non-indigenous households, who are the main recipients of income from the mining sector (see Table C.1 in Appendix C). The decline in remittances (remit scenario) also has a negative impact on total private consumption; it is reduced by 1.3% when remittances fall by 17%, although the impact on GDP is relatively small (-0.1%).

According to macroeconomic data, 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). In the pwe-min scenario, fixed investment falls by -46.3%. There are two main channels that explain this outcome. First, a reduction in the export price of mining leads to a decrease in the production of mining with the corresponding reduction in revenues from indirect taxes imposed on this sector -- as said before, mining (particularly, natural gas) is a highly taxed sector. Therefore, fiscal surplus shrinks and government savings decreases from 11% to 7.6% as a share of GDP – see the last four rows of Table 4.2. In fact, the GDP share of tax revenues reduces from 28.1% to 26.2% in the pwe-min scenario.[10] Second, unemployment increases from 7% to 8.4%, affecting wages negatively. As a consequence, households' income and savings also go down. These two channels reduce the available savings and -- consequently – private investment.

As expected, exports drop when there is a decrease in the price of mining. This, in turn, generates a depreciation of the real exchange rate that, ceteris paribus, increases exports of non-mining products and decreases imports (-20.6%) in order to keep foreign savings fixed; recall that foreign savings are fixed as part of the model macro closure rule for the external sector (see above). The real exchange rate depreciation is similar but less strong in the pwe-agr and edem-txt scenarios.

[10] Notice that government income from hydrocarbons increased from 5.6% of GDP in 2004 to 25.7% of GDP in the last quarter of 2008.

The decrease in remittances has a negative impact on households and government income and savings (see scenario remit). Again, less savings translates into less investment (-3%) due to the selected savings-investment closure rule. The income effect of a reduction in remittances differs among our four household categories, being the indigenous urban households the most affected -- their consumption decreases by 2.9% --, while indigenous rural households are the least affected -- their consumption decreases by -1.9%. This result is explained by the fact that urban households are more dependent on remittances than rural households.

Table 4.3 presents changes in the sectoral volumes of 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 (viii) show the percentage change with respect to the base scenario. Table C.2 in Appendix C presents the same set of results but with a greater sector disaggregation.

Table 4.3: Sectoral Results (change% w.r.t. base scenario)
Aggregated Sectors

indicator	base LCU	pwe-min	pwe-agr	edem-txt	remit	combi	combi-trnsfr	combi-spnd
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Value added								
Agriculture	9,750	2.5	-1.6	0.2	-0.1	0.6	0.7	0.3
Mining	11,346	-12.9	0.4	0.3	0.6	-11.4	-11.5	-12.1
Food	4,939	3.2	0.2	0.2	-0.1	3.7	3.8	3.6
Other manufactures	3,866	6.7	0.6	-2.5	0.5	5.6	5.4	4.4
Services	39,832	-0.3	0.0	0.0	-0.3	-0.5	-0.5	0.5
Exports								
Agriculture	1,021	19.7	-25.9	1.3	1.8	-8.5	-8.7	-9.7
Mining	23,536	-19.9	0.4	0.4	0.8	-18.3	-18.4	-18.6
Food	4,492	21.4	1.0	1.3	2.0	27.1	26.7	25.3
Other manufactures	5,514	27.3	1.1	-7.1	1.4	25.0	24.4	22.3
Services	3,380	18.4	1.0	0.9	1.9	23.3	23.0	21.4
Imports								
Agriculture	866	-11.8	-0.8	-0.8	-2.1	-15.0	-14.6	-14.1
Mining	2,240	-15.9	-0.2	-0.2	-1.1	-17.1	-17.0	-17.2
Food	1,485	-16.1	-1.0	-0.9	-2.8	-20.1	-19.6	-18.8
Other manufactures	19,057	-22.7	-0.3	-0.7	-1.9	-25.3	-25.8	-27.7
Services	5,470	-17.6	-1.0	-0.8	-2.7	-21.5	-21.1	-20.0

Source: Authors' calculations.

The production of the mining sector drops by 13% in the pwe-min scenario. In contrast, all other sectors, and in particular other manufactures, are positively affected. For instance, the food industry increases its production by 3.2%. Two are the main mechanisms that explain this result. First, the real exchange rate appreciation favors exports and production of the non-mining sector. Second, there are positive input-output effects for the activities that use mining products as intermediate inputs.

At the sectoral level, the decrease in investment described above translates into a decrease in construction. According to the SAM, 96% of construction output is demanded for investment purposes. Thus, the positive correlation between the output of mining and construction reflects the relationship between lower mining world export prices, less savings, less investment, and less demand for construction. Furthermore, construction is a

non-tradable sector which decreases its production due to the depreciation of the real exchange rate.

The pwe-agr scenario shows similar effects for the agricultural and non-agricultural sectors. In fact, agricultural exports decrease by 26%. In a recent study, Birbuet and Machicado (2009) highlight the high sensitivity of agricultural exports to variations in world export prices.[11] In fact, the recent growth in agriculture is largely explained by the high international prices of quinoa, Brazilian nuts, soya, rice and vegetable oil.

In the edem-txt scenario, production of textiles decreases by 12.6%. The resulting real exchange rate depreciation – necessary to maintain a fixed current account balance – has a positive effect on the production and exports of other sectors. As expected, imports decrease for all products.

The drop in remittances (see remit scenario) has a direct negative impact on the consumption and production of agriculture, food and services. On the other hand, production of mining and other manufactures (i.e., the more export-intensive sectors) increase. At the same time, as a consequence of the real exchange rate depreciation, exports of all sectors increase and imports of all sectors decrease.

Table C.3 of Appendix C presents the changes in sectoral labor demand. As expected, sectoral employment is positively correlated with sectoral production. Moreover, demand of skilled and unskilled workers moves in similar magnitudes, which reflect our assumption of complementarity between both labor categories.[12]

As was shown, a 40% reduction in the foreign demand of textiles does not have a significant impact on GDP. However, there is an important reallocation of workers among sectors. In fact, with the ending of the ATPDEA, the demand of both labor categories in the textile sector decreases by around 20%. This is close to what was recently observed; labor

[11] The authors focus in the quinoa sector, which has been one of the growing agricultural sectors in recent years.
[12] Specifically, we assume that the elasticity of substitution between different types of labor is 0.8.

demand in the textile sector decreased in the cities of La Paz and El Alto, but without remarkable effects on aggregate output.[13]

Table 4.4: Factor Returns
(index base=1)

scenario	f-lab-unsk	f-lab-sk	f-cap	f-land	f-natres
base	1.000	1.000	1.000	1.000	1.000
pwe-min	0.907	0.903	0.858	0.933	0.522
pwe-agr	0.991	0.995	0.996	0.969	1.007
edem-txt	0.993	0.995	0.994	0.996	1.006
remit	0.990	0.988	0.989	0.987	1.012
combi	0.882	0.883	0.839	0.883	0.541
combi-trnsfr	0.883	0.885	0.840	0.886	0.539
combi-spnd	0.888	0.901	0.846	0.886	0.532
Source: Authors' calculations.					

Finally, Table 4.4 presents the changes in factor returns. In the pwe-min scenario, capital and particularly natural resources are the most negatively affected factors. The average return to capital decreases by almost 14%, and the return to natural resources decreases by almost 50%. This result is associated with the fact that the mining sector is intensive in capital and natural resources, which are treated as sector-specific factors. In the other simulations, the fall in the return to unskilled and skilled labor, capital and land, is less than 2%, except for land in the pwe-agr scenario. As explained below, the changes in factor returns help to explain our poverty results of section 4.5.

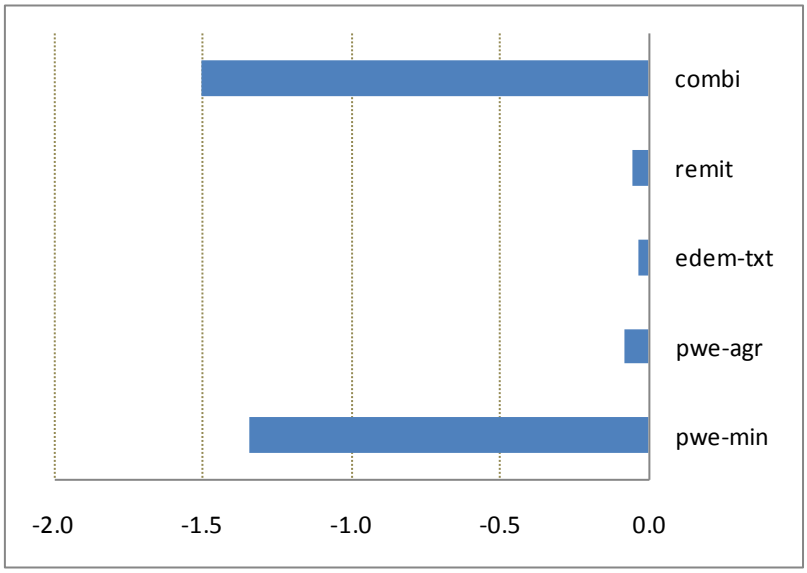
4.3 Combined Scenario

As already mentioned, our combined scenario allows us to assess the impact of all previous shocks simulated together. Not surprisingly, Figure 4.1 clearly shows that the main driver of the combined scenario results is the drop in the world price of mining. As shown in Table 4.2, real GDP declines by 1.5%, while investment and private consumption decrease by 50% and 7%, respectively. The drop in the foreign currency inflow -- due to the

[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).

combination of the three external shocks -- induces a real exchange rate depreciation that, in turn, decreases imports by 23%. The unemployment rate is strongly affected in this scenario; it rises from 7% to 9%, being the skilled labor the most affected (see Table 4.2).

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



4.4 Policy Response Scenarios

In this subsection, two policy response scenarios are considered. Our aim is to assess if the government is capable of compensating 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 production of the natural gas sector. In our model, this mechanism is captured through a high activity tax on mining.

Therefore, we have simulated expansive fiscal policies along with the combined (crisis) scenario; i.e., when there is a combination of all the external shocks. First, we consider our combined scenario complemented with a 10% increase in transfers from the government to households (combi-trnsfr), and second, we consider our combined scenario together with a 5% increase in government consumption plus a 9% increase in government investment

(combi-spnd). The size of these two policy responses is in line with what was observed during 2009. The results of the simulations are shown in the last columns of all the tables above. In what follows, the policy response scenarios are compared to the combined (crisis) scenario.

Our results show that in simulation combi-trnsfr the GDP does not change, while in simulation combi-spnd the GDP decrease in somewhat smaller. This is striking because one would have expected a better performance of the economy, since the government is applying counter cyclical policies. The key to explain these results lies on how the government is financing these expansive policies.

First, observe that there is a crowding out effect: investment decreases 2 and 7 percentage points more in the combi-trnsfr and combi-spnd scenarios than in the combi scenario, respectively. The reason for the crowding out effect lies in the need to finance the increase in government spending using domestic resources. In fact, government surplus is reduced 0.4 (scenario combi-trnsfr) and 1.3 (scenario combi-spnd) percentage points more than in the crisis (combi) scenario. On the other hand, there is a positive effect on household consumption, which shows a smaller decrease; i.e., compare -6.7% with -6.3% and -6.1%.

Second, unemployment of unskilled workers is not reduced with any of the two policy response measures. In contrast, unemployment of skilled workers is reduced, particularly when the government increases its current and capital consumption. In fact, Table C.2 shows an increase in the production of government services, which is intensive in skilled labor.

In sum, the high government dependence on the mining (particularly, natural gas) sector as a source of financing could constrain its capacity to respond to the negative effects of external shocks.

4.5 Poverty Results

In combination with the PEP Standard Model, different alternatives for conducting distributional analysis can be implemented. In our case, 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. Consequently, our approach is based on the assumption that the distribution of income within the population represented by each representative household does not change accross simulations.[14] 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 two shocks that drive the poverty results in the crisis (combi) scenario are the drop in the world export price of mining (pwe-min) and the decline in remittances (remit). The other two external shocks have a negligible – although negative – effect on poverty. The national moderate (extreme) poverty headcount ratio increases 2.9 (2.3) percentage points in the crisis scenario. The increase in moderate and extreme poverty is larger for the urban indigenous and non-indigenous households, consistent with the changes in consumption described above. The policy response scenarios combi-trnsfr and combi-spnd show a slight decrease in poverty compared to the crisis scenario.

[14] Alternatively, poverty results could be generated using a more elaborated microsimulation model (see Bourguignon et al., 2008; Bussolo and Cockburn, 2010), either top-down, feeding CGE simulation results to a separate household model, or integrated, with the household model built directly into the CGE model.

Table 4.5: Poverty Impact of Simulations
(headcount ratio -- official poverty lines)

indicator	base	pwe-min	pwe-agr	edem-txt	remit	combi	combi-trnsfr	combi-spnd
Poverty								
national	60.0	62.3	60.0	60.0	60.7	62.9	62.9	62.7
h-urb-noindig	47.2	49.9	47.2	47.2	47.8	50.5	50.5	50.3
h-urb-indig	54.4	58.1	54.5	54.4	55.9	59.0	58.8	58.6
h-rur-noindig	76.9	78.0	76.9	76.9	76.9	78.8	78.8	78.8
h-rur-indig	77.4	78.2	77.4	77.4	77.8	78.4	78.3	78.4
Extreme poverty								
national	37.5	39.3	37.5	37.5	37.8	39.8	39.7	39.7
h-urb-noindig	18.8	21.3	18.8	18.8	19.4	21.7	21.7	21.7
h-urb-indig	28.5	30.4	28.5	28.5	28.7	31.4	31.4	31.3
h-rur-noindig	54.2	56.1	54.2	54.2	54.2	56.1	56.1	56.1
h-rur-indig	67.7	68.1	67.7	67.7	67.8	68.3	68.2	68.3

Source: Authors' calculations.

As explained, the results obtained from our CGE model are based on a set of assumptions. Specifically, we have run all the simulations assigning certain values to the supply and demand elasticities. In Appendix D we present a sensitivity analysis of model results with respect to the values chosen for the different elasticities.

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 allocated the Bolivian economy with the highest rate of growth in the western hemisphere.

However, 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 quantitatively analyzed the impact of the GFC on the main macroeconomic variables and on sectoral variables as production,

exports, and imports. In general, we have found that the GFC could have mild effects on the Bolivian economy, except when there is a drop 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. The results showed that total investment will fall by -50% in the crisis scenario. Undoubtedly, the 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 decline. Government savings fell to 7.6% of GDP when there is a fall in the export price of mining. We claim that, 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 17% 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 0.7 percentage points and extreme poverty by 0.3 percentage points.

Finally, it seems that the policy response of the government to the crisis, based on increasing transfers and/or increasing government consumption and investment, has not the counter-cyclical effects that would have been expected. Nevertheless, we have not explored non-domestic sources of financing for those transfers and consumption 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.

References

Andersen, Lykke, Beatriz Muriel and Horacio Valencia (2009). Non-agricultural Labor from Rural Farmers in Bolivia: An Analysis of Determinants and Effects. *Development Research Working Paper* 01/2009. INESAD, La Paz – Bolivia.

Annabi, Nabil, John Cockburn and Bernard Decaluwé (2006). Functional Forms and Parameterization of CGE Models. *PEP MPIA Working Paper* 2006-04.

Birbuet, Juan Cristobal and Carlos Gustavo Machicado (2009). Technological Progress and Productivity in the Quinoa Sector. *Development Research Working Paper* 07/2009. INESAD, La Paz – Bolivia.

Blanchflower, David G. and Andrew J. Oswald (1994). *The Wage Curve*. Cambridge: The MIT Press.

Blanchflower, David G. and Andrew J. Oswald (2005). The Wage Curve Reloaded. *NBER Working Paper* 11338.

Bourguignon, François, Maurizio Bussolo and Luiz Awazu Pereira da Silva (2008). Introduction: Evaluating the Impact of Macroeconomic Policies on Poverty and Income Distribution. In Bourguignon, F., Maurizio B. and L. A. Pereira da Silva (eds.). *The Impact of Macroeconomic Policies on Poverty and Income Distribution: Macro-Micro Evaluation Techniques and Tools*. World Bank and Palgrave Macmillan.

Brunnermeier, M.K. (2009). Deciphering the Liquidity and Credit Crunch 2007-08. *Journal of Economic Perspectives* 23 (1): 77-100.

Bussolo, Maurizio and John Cockburn (eds.) (2010). Macro-Micro Analytics: A Guide to Combining Computable General Equilibrium and Microsimulation Modelling Frameworks. *International Journal of Microsimulation* Special Issue 3 (1).

Canavire, Gustavo and Mirna Mariscal (2010). Políticas Macroeconómicas, Choques Externos y Protección Social en Bolivia. UDAPE, La Paz-Bolivia.

Canavire, Gustavo, Wilson Jimenez and Mirna Mariscal (2007). Políticas para Alcanzar los Objetivos de Desarrollo del Milenio en Bolivia: Costos y Escenarios de Financiamiento bajo un Modelo de Equilibrio General Computable y Microsimulaciones. UDAPE, La Paz – Bolivia. (mimeo).

Capra, Katherina and Gustavo Canavire (2009). El Impacto de la Crisis Financiera Internacional en los Sectores Productivos Bolivianos. In Seoane, A. and E. Jimenez (coordinadores). *Debates sobre el Desarrollo e Inserción Internacional*. CIDES-UMSA, La Paz – Bolivia.

Cecchetti, Stephen, Marion Kohler and Christian Upper (2009). Financial Crises and Economic Activity. *NBER Working Paper* 15379.

Dabat, Alejandro (2009). Estados Unidos, la Crisis Financieras y sus Consecuencias Internacionales. In Seoane, A. and E. Jimenez (coordinadores). *Debates sobre el Desarrollo e Inserción Internacional*. CIDES-UMSA, La Paz – Bolivia.

Decaluwé, Bernard, André Lemelin, Hélène Maisonnave and Véronique Robichaud (2009). The PEP Standard Computable General Equilibrium Model: Single-Country, Static Version.

Dervis, Kemal, Jaime de Melo and Sherman Robinson (1982). General Equilibrium Models for Development Policy. World Bank Research Publication. Cambridge University Press and World Bank.

Diamond, D.W. and R. Rajan (2009). The Credit Crisis: Conjectures about Causes and Remedies. *NBER Working Paper* 14739.

Felton, A. and C. Reinhart (2008). The First Global Financial Crisis of the 21st Century. CEPR-voxeu.org.

Harrison, Glenn W and H. D. Vinod (1992). The Sensitivity Analysis of Applied General Equilibrium Models: Completely Randomized Factorial Sampling Designs. *Review of Economics and Statistics* 74 (2): 357-62.

Jemio, Luis Carlos and Osvaldo Nina (2009). Global Financial Crisis: Effects on Bolivia. *Development Research Working Paper* No. 03/2009. INESAD, La Paz – Bolivia.

Klasen, Stephan, Melanie Grosse, Jann Lay, Julius Spatz, Rainer Thiele and Manfred Wiebelt (2007). Analyzing Pro-Poor Growth in Bolivia: Adressing Data Gaps and Modeling Policy Choices. In Grimm, M., A. MsKay and S. Klasen (eds). *Determinants of Pro-Poor Growth: Analytical Issues and Findings from 14 Country Case Studies*. Palgrave-McMillan.

Lay, Jann, Rainer Thiele and Manfred Wiebelt (2008a). Resource Booms, Inequality, and Poverty: The Case of Gas in Bolivia. *Review of Income and Wealth* 54 (3): 407-437.

Lay, Jann, Rainer. Thiele and Manfred Wiebelt (2008b). Shocks, Policy Reforms, and pro-Poor Growth in Bolivia: A Simulation Analysis. *Review of Development Economics* 12 (1): 37-56.

Lluch, Constantino, Alan A. Powell and Ross A. Williams (1977). *Patterns in Household Demand and Savings*. London: Oxford University Press.

Lofgren, Hans, Rebecca Lee Harris and Sherman Robinson (2002). A Standard Computable General Equilibrium (CGE) Model in GAMS. IFPRI Microcomputers in Policy Research 5.

Machicado, Carlos Gustavo and Juan Cristobal Birbuet (2009). Misallocation and Manufacturing TFP in the Market Liberalization Period of Bolivia. *Development Research Working Paper* 06/2009. INESAD, La Paz – Bolivia..

Reinert, K. A. and D. W. Roland-Holst (1997). Social Accounting Matrices. In Francois, J. F. and Reinert, K. A. (eds.). *Applied Methods for Trade Policy Analysis: A Handbook*. Cambridge University Press.

Reinhart, Carmen and Keneth Rogoff (2008). Banking Crises: An Equal Opportunity Menace. *NBER Working Paper* 14587.

Robinson Sherman (1989). Multisectoral Models. In Chenery, H. and T. N. Srinivasan (eds.). Handbook of Development Economics. Amsterdam: Elsevier.

Ticehurst, Simón (2009). La Integración Sudamericana como Salida Regional a la Crisis Económica Financiera Mundial. In Seoane, A. and E. Jimenez (coordinadores). *Debates sobre el Desarrollo e Inserción Internacional*. CIDES-UMSA, La Paz – Bolivia.

van der Mensbrugghe, Dominique (2005). "Prototype model for a single country real computable general equilibrium model". World Bank Development Prospects Group.

Appendix A: SAM and Elasticities

Table A.1: 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 A.2: 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.			

Table A.3: 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 tobbaco	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.					

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 using the OLS method,

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

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.[15] The estimation results are presented in Table A.4, where all the expenditure elasticities of demand are positive and statistically different from zero at 5 % 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.5 shows the estimated Frisch parameters.[16]

Table A.4a: Income Elasticities Urban Households

	(1)		(3)		(5)		(7)		(9)		(11)		(13)	
VARIABLES	food		comunic		othmnf		othsvc		oilref		textil		transp	
lgastot	0.483	***	0.526	***	1.107	***	1.559	***	0.707	***	0.768	***	0.505	***
	(0.0263)		(0.0493)		(0.0248)		(0.0446)		(0.0992)		(0.0339)		(0.0355)	
cantmiem	0.0956	***	-0.0462	**	-0.000662		-0.0469	***	-0.0691	**	-0.000718		0.0252	**
	(0.00841)		(0.0211)		(0.00921)		(0.0165)		(0.0306)		(0.0121)		(0.0115)	
Constant	1.929	***	0.125		-2.414	***	-6.061	***	-0.410		-0.206		0.585	**
	(0.188)		(0.351)		(0.167)		(0.311)		(0.669)		(0.237)		(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.

[15] Then, these seven commodities were mapped to the 19 commodities in the CGE model.

[16] 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.4b: Income Elasticities Rural Households

	(2)		(4)		(6)		(8)		(10)		(12)		(14)	
VARIABLES	food		comunic		othmnf		othsvc		oilref		textil		transp	
lgastot	0.663	***	0.553	***	1.116	***	1.423	***	0.628	**	0.773	***	0.486	***
	(0.0273)		(0.118)		(0.0561)		(0.106)		(0.245)		(0.0691)		(0.0530)	
cantmiem	0.0262	**	-0.0555		0.0424	**	-0.113	**	0.0562		-0.0452	*	0.00715	
	(0.0113)		(0.0383)		(0.0184)		(0.0443)		(0.0679)		(0.0265)		(0.0206)	
Constant	1.448	***	-0.464		-3.308	***	-5.527	***	-0.593		-0.166		0.233	
	(0.165)		(0.786)		(0.367)		(0.698)		(1.874)		(0.494)		(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.5: 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.	

In the PEP Standard Model household savings are a linear function of disposable income; this allows for the marginal propensity to save, to be different from the average propensity (see equation (16) in Decaluwe et al (2009)). In our case, rural households show negative savings. As consequence, for those households the intercept is negative, while the slope (the marginal propensity) is positive. The marginal propensity to save was estimated at the national level using savings and income data for the period 1970-2008. The estimated value is 0.231.

Appendix B: Changes to the PEP Standard Model

International Trade

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

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

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

$$e.PWX_x = PE_x^{FOB} \tag{64'}$$

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),

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

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)).

$$PC_i CG_i = \gamma_i^{GVT} G \tag{56}$$

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''),

$$CG_i = CGO_i \tag{56'}$$

$$G = \sum_i PC_i CG_i \tag{56''}$$

Private and Public Investment

The PEP Standard Model does not make a difference between private and public investment. Consequently, it does not allow simulating the impact of an increase in public investment when the model is savings-driven. In order to model public investment as different from private investment, we have modified equations 54, 55, 89, 92, 98 and WALRAS in the original model. In addition, we have added equations (INVG1)-(INVG4) and the variables

$INVG_i$	public investment demand of commodity i,
$INVTOT_i$	total investment demand of commodity i (private + public),
$ITPUB$	total public investment expenditures, and
$ITTOT$	total investment expenditures.

Notice that the original model variable IT now refers to total private investment expenditures. In equation (89') i1 is a subset of i, including all commodities but the one in iref (see equation (WALRAS')).

$$GFCF = ITTOT - \sum_i PC_i VSTK_i \tag{54'}$$

$$PC_i INV_i = \gamma_i^{INV} IT \tag{55'}$$

$$\begin{aligned} Q_{i1} &= \sum_h C_{i1,h} + CG_{i1} + INVTOT_{i1} \\ &+ VSTK_{i1} + DIT_{i1} + MRGN_{i1} \end{aligned} \tag{89'}$$

$$ITTOT = \sum_h SH_h + \sum_f SF_f + SG + SROW \tag{92'}$$

$$GDP^{FD} = \sum_i PC_i \left(\sum_h C_{i,h} + CG_i + INVTOT_i + VSTK_i \right) + \sum_x PE_x^{FOB} EXD_x + e \sum_m PWM_m IM_m \quad (98')$$

$$LEON = Q_{iref} - \sum_h C_{iref,h} - CG_{iref} - INVTOT_{iref} - VSTK_{iref} - DIT_{iref} - MRGN_{iref} \quad (\text{WALRAS'})$$

Equation (INVG1) calculates the quantity of commodity i for public investment demand. It is assumed that the commodity composition of public investment does not change; if public investment increases (i.e., an increase in invgadj), the public investment demand of every commodity is increased by the same proportion. Equation (INVG2) computes total investment demand of commodity i. Equation (INVG3) compute the total government investment expenditure. From equation (INVG4), the total private investment expenditure (IT) is computed.

$$INVG_i = \overline{invg}_i invgadj \quad (\text{INVG1})$$

$$INVTOT_i = INV_i + INVG_i \quad (\text{INVG2})$$

$$ITPUB = \sum_i PC_i INVG_i \quad (\text{INVG3})$$

$$ITTOT = IT + ITPUB + \sum_i PC_i VSTK_i \quad (\text{INVG4})$$

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).

$$\frac{\frac{W_l}{PIXCON}}{\frac{WO_l}{PIXCONO}} - 1 = phillips_l\left(\frac{UERAT_l}{UERATO_l} - 1\right) \qquad \text{(WC)}$$

Appendix C: Additional Results

Table C.1: Consumption Results (change% w.r.t. base scenario)

representative household	base	pwe-min	pwe-agr	edem-txt	remit	combi	combi-trnsfr	combi-spnd
h-urb-noindig	1,984	-15.0	-0.7	-0.6	-2.8	-18.8	-18.3	-17.2
h-urb-indig	1,385	-13.8	-0.8	-0.6	-2.9	-17.8	-17.3	-16.5
h-rur-noindig	1,216	-8.4	-0.5	-0.5	-1.3	-10.6	-10.3	-9.9
h-rur-indig	1,059	-9.3	-0.6	-0.5	-1.9	-12.1	-11.4	-11.4
Source: Authors' calculations.								

Table C.2: Sectoral Results (change% w.r.t. base scenario)

indicator	base LCU	pwe-min	pwe-agr	edem-txt	remit	combi	combi-trnsfr	combi-spnd
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Value added								
Agriculture	661.8	4.6	-2.1	0.3	0.0	2.4	2.5	2.2
Livestock	243.8	-2.2	-0.8	-0.1	-0.6	-4.0	-3.9	-4.2
Other primary	69.3	-1.6	0.4	0.1	0.2	-0.6	-0.9	-1.7
Mining	986.8	-15.1	0.4	0.4	0.7	-13.6	-13.7	-14.3
Meat	133.8	-2.0	-0.1	-0.2	-0.7	-3.1	-2.8	-2.7
Other food	235.8	7.5	0.3	0.5	0.3	9.2	9.2	8.7
Beverages and tobbaco	124.2	0.7	0.1	0.1	-0.3	0.6	0.7	0.7
Textiles	100.0	3.7	0.3	-11.4	0.1	-8.3	-8.2	-8.2
Oil refining	147.8	2.0	0.2	0.2	0.2	2.6	2.7	2.6
Metal and metal products	13.2	53.8	1.3	1.5	0.9	62.0	60.0	53.4
Other manufactures	273.4	5.6	0.7	0.6	0.6	8.0	7.7	6.6
Electricity, gas and water	210.9	-2.6	-0.1	-0.1	-0.7	-3.6	-3.4	-3.2
Construction	157.9	-26.9	0.0	0.0	-1.6	-29.1	-30.3	-30.2
Trade	563.0	5.7	0.0	-0.4	0.2	5.8	5.7	4.9
Transport	764.5	3.0	0.2	0.2	0.1	3.7	3.7	3.3
Communications	144.5	0.4	0.1	0.0	0.0	0.6	0.6	0.5
Restaurants and hotels	226.8	0.4	0.1	0.2	-0.5	0.3	0.4	0.4
Public administration	1,001.6	-0.3	0.0	0.0	-0.1	-0.4	-0.4	4.3
Other services	914.1	-2.0	0.0	0.1	-0.7	-2.7	-2.6	-2.6
Exports								
Agriculture	80.0	20.3	-29.0	1.3	1.9	-11.7	-11.9	-12.9
Livestock	11.8	17.0	-28.6	1.1	1.7	-14.0	-14.2	-15.1
Other primary	10.3	18.0	1.3	1.1	1.7	23.2	22.9	21.9
Mining	2,310.1	-19.8	0.4	0.4	0.8	-18.2	-18.2	-18.5
Meat	3.9	18.9	1.1	1.2	2.1	24.3	24.0	22.7
Other food	422.9	21.7	1.0	1.3	2.0	27.4	27.1	25.6
Beverages and tobbaco	22.3	16.6	0.9	0.8	2.0	21.1	20.7	19.5
Textiles	111.8	0.0	0.0	-40.0	0.0	-40.0	-40.0	-40.0
Oil refining	43.5	-27.0	0.6	0.6	1.3	-25.1	-25.1	-25.2
Metal and metal products	234.5	47.3	1.4	1.5	1.9	56.2	55.0	51.2
Other manufactures	205.1	19.4	1.2	1.1	1.7	24.8	24.5	23.2
Transport	172.6	18.8	1.1	0.9	1.6	23.6	23.3	22.1
Communications	38.1	14.8	0.4	0.5	2.3	18.3	17.8	16.5
Restaurants and hotels	81.1	19.3	1.2	1.0	2.3	25.1	24.6	23.1
Other services	46.2	18.6	1.0	1.0	1.8	23.3	23.0	20.3
Imports								
Agriculture	80.1	-11.2	-0.8	-0.8	-2.1	-14.3	-13.9	-13.4
Livestock	4.2	-19.7	-1.1	-1.3	-3.0	-24.2	-23.8	-23.5
Other primary	2.2	-20.7	-0.8	-0.9	-1.4	-23.1	-23.2	-23.9
Mining	2.3	-31.3	0.5	0.5	-0.4	-30.2	-30.8	-33.0
Meat	6.9	-19.5	-1.3	-1.5	-3.5	-24.9	-24.2	-23.3
Other food	111.1	-16.3	-1.0	-1.0	-2.7	-20.4	-19.8	-19.0
Beverages and tobbaco	30.5	-14.5	-0.8	-0.7	-2.8	-18.3	-17.8	-16.9
Textiles	134.3	-13.1	-0.9	-6.7	-2.3	-20.4	-20.0	-18.9
Oil refining	221.8	-15.8	-0.2	-0.2	-1.1	-17.0	-16.8	-17.0
Metal and metal products	1,080.7	-31.9	-0.2	-0.1	-2.2	-34.2	-35.1	-38.3
Other manufactures	690.6	-10.3	-0.4	-0.5	-1.3	-12.3	-12.3	-12.7
Transport	257.7	-14.5	-0.9	-0.8	-1.7	-17.5	-17.3	-17.0
Communications	18.1	-16.1	-0.5	-0.5	-3.0	-19.3	-18.8	-17.7
Restaurants and hotels	87.8	-21.7	-1.3	-1.0	-4.3	-27.4	-26.7	-25.2
Other services	183.3	-20.0	-1.0	-0.9	-3.3	-24.5	-24.0	-22.1

Source: Authors' calculations.

Table C.3: Labor Demand (change% w.r.t. base scenario)
Selected Sectors

	base LCU	pwe-min	pwe-agr	edem-txt	remit	combi	combi-trnsfr	combi-spnd
Unskilled labor								
Agriculture	404.5	6.8	-3.0	0.5	0.0	3.5	3.7	3.3
Mining	189.1	-40.8	1.5	1.2	2.1	-37.2	-37.5	-38.6
Textiles	41.5	6.9	0.7	-20.4	0.2	-15.1	-15.0	-14.7
Construction	57.2	-45.4	0.1	0.0	-3.1	-48.4	-50.0	-49.7
Trade	228.8	10.1	0.1	-0.7	0.3	10.4	10.2	9.1
Skilled labor								
Agriculture	48.4	7.2	-3.3	0.3	0.2	3.5	3.6	2.1
Mining	117.1	-40.6	1.2	1.1	2.3	-37.2	-37.5	-39.3
Textiles	11.4	7.3	0.4	-20.5	0.4	-15.1	-15.1	-15.7
Construction	24.1	-45.2	-0.3	-0.1	-3.0	-48.5	-50.1	-50.3
Trade	91.5	10.5	-0.3	-0.8	0.4	10.3	10.1	7.9

Source: Authors' calculations.

Appendix D: Sensitivity Analysis with respect to Elasticities

In our sensitivity analysis we follow the methodology proposed by Vinod and Harrison (1992), which comprises the following steps:

1. we assume that each elasticity is uniformly distributed in the interval [-0.8 central value,+0.8 central value],
2. randomly select the value for each elasticity,
3. calibrate the model using the selected elasticities,
4. simulate counterfactual scenarios – repeat steps (2)-(3) 500 times by performing a sampling with replacement of the elasticity values, and
5. analyze the results

The results of the sensitivity analysis confirm that the main messages presented in this paper hold irrespective of the values assigned to the different model elasticities. In Table D.1 the confidence intervals for each macro result are presented; similar results for other variables are available from the authors upon request.

Table D.1: Sensitivity Analysis Results
combi (crisis) scenario

indicator	mean	sd	lim-inf	lim-sup
	(i)	(ii)	(iii)	(iv)
National accounts (chg%)				
Household consumption	-6.977	0.657	-7.039	-6.916
Fixed investment	-49.351	3.517	-49.680	-49.023
Government consumption	0.000	0.000	0.000	0.000
Exports	-1.752	2.269	-1.964	-1.540
Imports	-22.606	2.244	-22.815	-22.396
GDP market price	-4.134	0.951	-4.223	-4.046
Net indirect taxes	-13.197	2.744	-13.453	-12.940
GDP factor cost	-1.610	0.530	-1.660	-1.561
Price indices (100=base)				
Consumer price index	89.565	1.371	89.437	89.694
Domestic price index (*)	87.747	1.412	87.615	87.879
Terms of trade (pe/pm)	84.105	0.000	84.105	84.105
World price index (**)	91.007	0.000	91.007	91.007
Real exchange rate	103.742	1.676	103.586	103.899
Unemployment (%)				
Total	8.778	0.783	8.705	8.852

Source: Authors' calculations.