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Trade bust, labor and wage policy in Bolivia: A CGE approach

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Abstract

In this paper, we evaluate the possible impact of the labor and wage policy in Bolivia's economy in the event of a reduction in the price of exports. For this analysis, we use a CGE model with a 2012 SAM. The Bolivian labor policy is characterized by compulsory increments in the private formal wage and an expanding labor force in the public services. A labor supply function allows migration between formality and informality and a reservation wage curve differentiates the nature of unemployment in the formal and the informal sector. The labor and wage policy does three things: 1) it promotes household consumption but reduces the GDP, decreases investment and growth, 2) it increases the rate of formality only at the expense of higher unemployment, and 3) it swells the primary sector to the detriment of the secondary sector. In the face of a decrease in commodity prices, Bolivia needs to make a correction of course in the labor and wage policy.

JEL: O17, C68, F16.
Keywords: Formal and Informal Sectors, Simulation Modeling.

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I. Introduction

Throughout its history and up until the present day, Bolivia's main exports have been minerals and natural gas. The last boom in export prices as well as responsible fiscal management and sustained wage increases are accountable for the reduction in poverty (PNUD, 2016). From 2014 onwards, the external price boom started to reverse. However, labor policy has an inertia of its own. The goal of this paper is to capture the impact of the Bolivian wage and labor policy inside a context of external downturn using the Computable General Equilibrium (CGE) methodology. To feed the CGE model we elaborate a Social Accounting Matrix (SAM) for the year 2012. We run two simulation scenarios. First we introduce modifications in the wage and labor policy. Last, we incorporate a negative variation in the prices of natural gas and minerals.

The labor market in Bolivia is portrayed by high informality and a large presence of the public sector in the formal market. Labor policy is characterized by decreed rising wages generally above inflation (see Figure 1 and 2) and a continuous increase in the labor force of public services. The share of workers in the public services is persistent (see Figure 3) even in the face of a tumbling unemployment rate and the natural growth of the labor force.

Bolivia's exports are highly concentrated in a few capital intensive raw materials, mainly natural gas. This structure begets a fiscal income dependent on extractive industries due to the government control and ownership of the gas fields. In fact, 15% of fiscal income originates in gas fields. In addition, part of that income is earmarked for infrastructure investment. When the export prices are high, the government can employ more civil servants, however, if export prices decrease, it is not easy to dismiss workers. A feature of the labor market in Bolivia is its high level of informality. For the purposes of this research, we define informality as domestic employees, non-remunerated workers, self-account workers without tax registration, and workers without long term social security or contracts. According to this definition, informality is around 80%.

The disturbing side of informality is its association with poverty (Smolka & Larangeira 2008). In the year 2012, only 4% of formal workers were poor, whereas 35%of informal workers lived in poverty. This is a result of an income distribution where formal income and years of schooling are higher in every percentile (see Figure 4 and Figure 5) than their informal counterparts. These characteristics are more relevant for vulnerable groups: single

head households, the young, indigenes, and women. Half of households headed by informal female workers live in poverty; meanwhile, just one in four households headed by formal female worker are poor. Further, activities with high levels of female hiring (sugar, miscellaneous food products, trade, restaurants and hotels, and domestic services) are also dominated by informal labor.

The evaluation of external shocks through CGE models has a short history in the analysis of the Bolivian economy (Jemio, 2003; Cicowiez, 2010; Sánchez 2009). In all past research, the government consumption and the labor in the public services have been exogenous. We depart from this characterization of the public sector and construct a CGE model where wages in the public services are also exogenous. This portrayal takes into account the different reasons behind an expansion of the government payroll (fairness, justice, rent seeking, clientelism) and the non-wage advantages of a public sector job, mainly stability.

Unlike Jemio (2003) and Sánchez (2009), migration between formality and informality is represented here via a supply function supplemented with a reservation wage curve. The segmentation of the labor market is not complete because the labor supply function allows for informal workers to migrate to formality and vice versa. We assume that hikes in the compulsory wage have a positive effect on the reservation wage. For our purposes, we model the Bolivian labor market using the framework provided by the PEP-1-1 model. Specifically, we start from an extended version developed by Cicowiez (see Section 4 and Appendix A) and then modified it to portray the workings of the Bolivian labor market.

In a context of low export prices, we conclude that the current policy lowers the level of product, reduces investment, thus hindering growth, and yet expands household consumption. Public services is intensive in skilled labor, a factor in short supply in Bolivia. Therefore, an expansion of the payroll in public services puts pressure on secondary sector activities and ultimately promotes the primarization of the economy.

II. Literature review

Characteristics, causes and size of informal labor and the informal economy are a constant subject in labor studies in Bolivia. A summary of the first two areas is in McKenzie (2009) and a comprehensive classification of causes is in Maloney (2007) who divides the primary causes into exit, or voluntary informality, and exclusion, or involuntary informality. This last dichotomy is the main question about informality (Maloney, 2007; Morales, 2016). Poverty and low productivity are common to all studies on informality.

At first the debate about informality centered on the false identification of informality with illegal activities (Casanovas, 1992), especially with cocoa production (Laserna, 1992; Blanes & Jimenez, 1989) Since the 90's, the approach to informality started to focus on activities that do not comply with all legal rules, but that are not criminal. Meyer (1996) links the gender income gap with different degrees of informality. From a financial perspective, Sethuraman (1998) shows that the informality of debtors does not necessarily represent their creditworthiness. Bolivia was pioneer to apply new lending technologies to serve informal debtors.

Later on, research on informality focuses on the proper estimation of its size. A straightforward method makes use of household survey data to identify informal workers' income and to estimate its share in the total economy (Landa, 2007). From a different perspective, Vargas (2011) estimates the size of the informal economy to be around 60% in the year 2010. He applies a first differences multiple indicators multiple causes model.

Given the importance of the informal economy in Bolivia and its association with gender and poverty, any CGE aimed to model the Bolivian labor market should include informality. Lay (2006) takes into account informality and elaborates an impact evaluation of the investment in hydrocarbons in the period from 1997 to 2003, the onset of gas exports to Brazil in 1999, and the redistributive fiscal programs dedicated to poverty reduction. His findings support the hypothesis of informalization – an increase in informality - of the economy simultaneous to a drop in poverty rate.

The CGE model in Lay (2006) assumes that some activities are entirely informal and some activities are fully formal, without considering the possibility of informal labor hired directly by formal activities. Moreover, his model does not include unemployment (above

8% in the period he studied), and it has no downward restriction in real wages, which is now a feature of the labor market in Bolivia.

Another economic feature of Bolivia is its high dependence upon mining and gas exports. This trait leads to the development of CGE models aimed at capturing the impact of external shocks on poverty and to provide suggestions about policy actions to alleviate their negative consequences. MACEPES (*Modelo de análisis de choques externos y de protección económica y* social) is an example of this kind of study. It contains a classification of labor according to formality (Sanchez, 2011). Unlike the CGE model from Lay (2006), real wage downward restrictions are part of the MACEPES model. Both Jay's model and MACEPES use constant wage differentials between types of labor to reflect lower productivity among unskilled and informal workers, a characteristic also replicated in the PEP-1-1 extended model (see Section 4 and Appendix A).

Along the same line of research, Cicowiez and Machicado (2010) simulated a decrease in export demand and prices to catch the effect of the 2008 financial crisis. Unlike Lay 2006) the authors did not distinguish formal and informal labor or activities. They applied a more complete characterization of the Bolivian export demand allowing for a drop in volume without requiring a drop in the export price. They also endogenized unemployment using a wage curve with a negative relation between wages and unemployment (Blanchflower & Oswald, 1994). This relation between unemployment deserves to be further explained.

Blanchflower (1994) concisely described the leading ideas about unemployment and wage: the Phillips curve, the Harris-Todaro migration equilibrium, the wage curve with negative slope, and unemployment caused by unequal labor demand and supply. The Phillips curve draws a negative relation between the variation of wages and the unemployment rate. Harris-Todaro portrays equilibrium as a positive relation between the level of wages and unemployment. In contrast to Harris-Todaro, Blanchflower (1994) empirically drew a wage curve where unemployment and wages have a negative relation. This positive relationship is present in dozens of countries.

Hernández (2012) used a Harris-Todaro wage gap function to model unemployment and formal-informal migration for the Colombian economy. He introduced a wage curve in the formal market and competitive equilibrium in the informal market. In this manner, unemployment occurs in the formal sector and higher wages imply higher unemployment.

Another way to model unemployment and labor migration is in Savard (2003). He used the Philippines data and assumes market segmentation and workers choice as a function of costs of entry, and a distribution of reservation wages. Microsimulations feed the model with labor supply, where each individual decides to participate in the labor market or not, and to join the formal ranks or not. A worker can either choose to stay unemployed, to be in the formal sector or to join the informal sector. He will be in the labor market if the current formal or informal salary is above his reservation wage. Changes in the level of wages generate movements among unemployment, formality and informality.

Many CGE models are developed under the neoclassical tradition. Following the structuralist tradition, the most encompassing CGE model for the Bolivian case is in Jemio (2001). His main goal is to "[put] forward an appropriate framework for the analysis of external shocks, macroeconomic adjustment and stabilization policies in less developed countries (LDCs), based on the Bolivian experience between 1970 and 1995". For this purpose, he uses separate balance accounts for different agents and different closure rules according to different periods of time and socioeconomic reforms, all inside a dynamic real financial CGE.

This dynamic versatility comes at the expense of some simplification. Similar to Lay's (2006) model, Jemio (2001) distinguishes between formal and informal activities. However, wage earners are only linked to formal activities and there are two kinds of profits. The first type accrues to formal capital owners in corporate firms; the second type belongs to households and represents income for informal workers. Moreover, there is no treatment of unemployment. In consequence, an increase of a formal activity in its participation in production is mirrored by labor migration and a higher rate of labor formality.

An adequate representation of the Bolivian labor market should take into account unemployment, informality and formal-informal migration. However, one aspect lacking in all of the models above is the role of the public services sector in the labor market, specifically in the formal sector due to its large presence on formal and skilled workers employment (between a third and a half). Gregory (1999) presupposed a qualitative difference between the motives and means in the private sector and the public sector. However, the standard CGE model does not add in differences in the form of the

production function, or the labor demand function among the economic activities in the model, whether private or public.

The imposition of restrictions in the economy by the government generates rent seeking opportunities (Krueger, 1974). Labor demand in the public sector is an example of that. The government could either allow competition for rents with social groups struggling to be part of the payroll, or restrict competition favoring a specific social group. Rent seeking behavior in the allocation of public employment puts pressure on increasing public labor demand and reduces the overall efficiency. In general, government surplus labor could be explained by a combination of cognitive myopia in the public and private sphere, leverage of non-state actors favoring anti-growth policies and institutional weakness (Ross, 1999).

The public sector has different reasons and follows different constraints in hiring than the private sector. Behind the distribution of wages in the public sector there are goals of equity and fairness. Also, the public sector needs to portray itself as a model employer and avoid paying low wages or wages higher than the private sector. (Blaise Melly, 2005).

Taking a step aside of the usual CGE modelling of the public sector as a neoclassical activity with salaries equal to the value of the marginal product of labor, Gelb (1991) addressed government employment portraying a Harris-Todaro equilibrium in the urban (modern) and rural labor markets. In this model, government employment is divided into unproductive and productive labor. In this paper, we assume that an increase in public sector labor has a null influence in the level of production of public services. Behind this machinery there is an unfavorable view of public current expenditure[1].

In short, there are two differing approaches in the modelling the public sector. One could either treat it like any other sector under the ruling of the first order conditions inside a competitive market, or one could only state political or social goals. CGE literature on Bolivia tends to follow the first approach.

[1] Nevertheless, Devarajan (1996) presented empirical evidence sustaining the opposite: a bigger current expenditure share is associated with a higher growth rate; meanwhile, an increase in capital expenditure generates a lower per capita GDP. Thus, as is common in economics, there are no definitive answers.

Informality incorporation into a CGE framework and the evaluation of external shocks on the Bolivian economy is not novel. However, since 2006, the labor policy landscape has gained new elements (mandatory wage increments), and consequently there is a need to reexamine the comprehensive treatment of unemployment and formal-informal migration. Also, it is important to specifically take into account the public administration because its payroll covers between a third to a half of total formal workers.

III. Data

3.1 SAM construction

For the purpose of this paper, we construct a Social Accounting Matrix (SAM) using 2012 data. The last similar array was constructed in 2006 by government officials. A SAM is a representation of the circular flow in the economy: each column is associated to expenses and each row to income sources. Thereby, every cell represents a transaction between agents (for example, the rest of world sells food to a goods account) and not necessarily does every cell have to be filled (Round, 2003). The sources used for the elaboration of the matrix are the Supply and Use Table (SUT) and the Household Survey (HS), both from the National Institute of Statistics, and the Balance of Payments, from the Central Bank.

Income, expenses, transfers, and other variables are calculated using the HS and are not equal to the totals in the SUT. Therefore, the totals are extracted from the SUT and the shares come from the HS. The classification of activities in the HS follows the *Código de Clasificación de Actividades Económicas Bolivianas* (CAEB) which has 99 activities. Since both the CAEB and the SUT are based on the International Standard Industrial Classification of all Economic Activities, we link the HS and the SUT accordingly.

The elaborated SAM is a square matrix with 103 rows and columns. With the exception of elaborated tobacco, chemical products, non-mineral metallic products and basic metal products, all the activities from the SUT are taken into account. The reason for the exclusion is the absence of information about factor remuneration in tobacco because the HS sample does not cover any worker in such activities. As a result, we incorporate elaborated tobacco to industrial agriculture. The rest of the excluded activities are

aggregated in order to avoid having negative domestic production (their stocks' variation is high for the base year). There are 29 activities in total and the same number of goods and services.

The SAM divides labor into 12 categories classified by gender, level of skill, formality and sector (private or public). There are 4 types of households according to poverty and the urban-rural division. The government is a single agent. There is one account representing the rest of the world[2].

3.2 Factor intensity

Agricultural activities are highly dependent on informal unskilled male labor (see Table 2). On the opposite side of the spectrum, crude oil & natural gas is intensive on capital and does not hire informal labor. Electricity and financial services follow a similar pattern and are concentrated on the formal labor market. From the HS we find a slight level of informality in the public sector, around 3%. This number could be explained by consultants unaffiliated to long term social insurance or with contracts in the making. Due to its insignificant level, for the SAM calibration we combine the informal public labor categories with their formal counterparts. Besides agriculture, informality is also concentrated in construction and transportation. Activities with high levels of female hiring (sugar, miscellaneous food products, trade, restaurants and hotels, and domestic services) are also dominated by informal labor.

3.3 Value added and export, import intensity

Natural gas and minerals generate 20% of the added value and they are two of the most export oriented activities (see Table 3). In fact, exports from other sectors are inconsequential as a result of their low participation in the gross output. Therefore, Bolivia is a developing economy highly concentrated in the primary sector. As a consequence, the supply of manufacture products and between a tenth and a quarter of the food products

[2] All the data and files are available upon request.

come from abroad. For example, other manufactured goods account for less than 1% of the total domestic supply. However, imports of other manufacturers are more than 13 times the value of the domestic supply.

3.4 Factor income and household participation

Households' main sources of income present a typical structure (see Table 4). The leading source of income for non-poor urban households comes from capital ownership and formal skilled male labor. Meanwhile, the rest of household categories earn most of their income from informal unskilled labor. Female labor represents the second source of income only for poor rural households. Around 75% of the government payroll is allocated to non-poor urban households because public services are intensive in skilled labor (see Table 5). This implies that a simulation of an increase in labor demand for public services impacts skilled labor.

3.5 Labor by activity and unemployment

The equations in the model section are in terms of volume of labor. For this reason, the SAM has an auxiliary matrix with the number of people allocated to each activity. Table 6 portrays labor in percentages. Industrial agriculture, livestock and trade are the activities with the greatest number of workers and comprise of 41% of the total labor (almost 5 million workers in the year 2012). Public services is the fourth largest category with 7.9% of the total employment. The intensity of each activity by labor type is similar to the factor intensity by total payment.

The unemployment rate for female labor (4.5%) is higher than the unemployment rate among male labor (2.2%). Also, as expected, skilled labor has a higher rate (4.7%) than unskilled labor (2.4%). This pattern repeats itself when labor is classified into four categories by gender and level of skill (see Table 7). The division between formal and informal unemployment follows the proportions suggested in Fernandez (2016), assigning approximately two thirds of the rate of unemployment to high productivity (formal) workers.

3.6 Demand elasticities and other parameters

A CGE model is composed of a set of identities and equations which in turn contain variables and parameters. Calibration of a CGE model is the determination of values for the equations' parameters that are consistent with the initial equilibrium. The information condensed in the SAM is not sufficient to estimate the elasticities of substitution, transformation or expenditure. For the case of expenditure elasticities, parameter values are drawn from the author's econometric estimation (see Appendix B). The elasticity of transformation ψ between formal and informal labor expresses the ease of movement between formality and informality. A more complete description the role of ψ is in the next section. The other remaining production and trade elasticities come from Annabi (2006) and the authors' criteria.

IV. The model

Here we present a stylized labor market model for the Bolivian economy in the context of a CGE model. We start from an extended version of the PEP-1-1 standard model[3] to portray the workings of public services, the relationship between unemployment and wages for the formal and informal sector, and the migration of labor from formality to informality and vice versa.

The standard PEP-1-1 model is a single country static model that assumes a nested production structure with several types of factors. Output is a Leontief function of intermediate input and value added. One level down, value added is a Constant Elasticity of Substitution (CES) function of labor and capital. Activities can produce more than one product and factors can be fixed or mobile. A Stone-Geary utility function models demand for households. The final demand price encompasses trade and transport margins. Finally, government consumption is fixed.

[3] Martin Cicowiez is the author of the extended version. Up to this date, his work is unpublished. We thank him for his support and valuable comments. For further questions or requests, please contact him at martin@depeco.econo.unlp.edu.ar or us at rolando.morales.anaya,46@gmail.com or erick.gomez.soto@gmail.com.

The PEP-1-1 extended version follows the same structure except on two issues. First, wages are not normalized as we explain below. The model takes into account the actual number of workers. Second, wages are not equal throughout all labor types and activities, but differ by type of activity and labor[4].

In the PEP-1-1 standard model, w_l wages are normalized, therefore the wage rate paid by industry j for type l labor, including payroll taxes $t_{l,j}$, is equal to

$$wt_{l,j} = w_l(1 + t_{l,j})$$

Where w_l is the normalized wage and $t_{l,j}$ is the tax rate. In contrast, the extended version does not use an arbitrary labor unit to achieve normalization. The wage w_l is the average wage for l and equal to:

$$w_l = \frac{Total\ payment_l}{Number\ of\ workers_l}$$

The activity-specific wage wa_l is the payment received by each type of labor in each activity. The wage distortion wd_l is a parameter defined as wa_l the divided by the average wage w_l .

$$wd_l = \frac{wa_l}{w_l}$$

Using wd_l, the extended model defines the wage rate paid by industry j for type l labor $wt_{l,j}$ as:

$$wt_{l,j} = w_l \cdot wd_{l,j}(1 + t_{l,j})$$

In this manner, the extended model introduces a wedge among wages in different activities for a specific type of labor. This functional form is appropriate for our purposes because it reflects the structural factors that underlay the wage distribution across activities. Specifically, average formal wages are greater than the informal ones.

Starting from the PEP-1-1 extended model, we introduce new equations regarding the labor market and the public sector services. The CGE model assembled here has the following features:

[4] The selection of closures and simulation scenarios is available using an excel spreadsheet. The extended version incorporates several files listed in Appendix A.

- Downward restriction to real wages.
- Wage curve.
- Labor supply derived from a CET (constant elasticity of transformation) that preserves additivity.
- Exogenous public services wage.
- Exogenous public services labor demand, met before any other demand.
- Constant public services production.

4.1 Wage curve and downward restriction

The real wage wr_l is the wage the w_l wage divided by the consumer price index PI. The real wage is always equal or greater than the reservation wage wrr_l. The wage curve (Blanchflower & Oswald, 1994) here is a reservation wage curve because it portrays the relation between wrr_l and unemployment u_l. The real wage in the base period wro_l is a parameter in the specification of the wage curve. The base period unemployment uo_l is also a parameter. The unemployment elasticity of the real wage is negative $\omega_l < 0$. This elasticity shows the responsiveness of the real wage to changes in u_l.

$$wrr_l = wro_l \left(\frac{u_l}{uo_l}\right)^{\omega_l}$$

$$wr_l > wrr_l$$

The estimation of the wage curve is an ongoing effort in developing countries where there are mayor differences between formal and informal workers. Baltagi (2013) and Ramos (2012) agree in a higher ω_l for informal workers in developing countries. We assume $\omega_i = -0.2$ for informal workers. In contrast, we assume $\omega_f = 0$ in the formal market. Therefore, changes in the real wage of formal workers and unemployment are independent (i.e. the neoclassical case).

The real wage for any type of labor cannot be lower than its reservation wage. Since $\omega_f = 0$ means that for all formal categories of labor the wage curve is horizontal, the formal real wage is always above the base level. In other words, there is a downward restriction to formal real wages:

$$wr_f > wro_f$$

In regards of the informal labor a higher unemployment u_l reduces the reservation wage and, thus, the real wage is lower than the base period level. This feature represents an economy with indexed formal salaries.

The equality between labor supply and demand implies zero unemployment. If we move equilibrium wage upwards, unemployment will rise. This movement draws an implicit function between the level of unemployment and wages with a positive slope. Meanwhile, the wage curve draws the same relationship with negative slope in the informal labor market and a horizontal line in the formal labor market. For analytic purposes, this implicit function and the wage curve should be considered jointly and their intersection establishes the final equilibrium point[5].

We assume that wage and labor policy (compulsory rises in formal wages and in the minimum wage) impact the workers' reservation wage shifting the wage curve upwards. In the formal markets, the rise in the reservation wages causes a higher level of wages and of unemployment. In the informal markets, this movement causes both a rise in wages and unemployment that is relatively lower than in the formal cases.

4.2 Labor supply

The SAM contains 12 types of labor and there are also 12 types of labor demands. The labor supply consists of four types of workers: male, female, skilled and unskilled. They can work in the private sector as formal or informal workers, and in the government services, or be unemployed. The government sector hires only formal workers. Therefore, there are 12 ways to be hired. We assume short term scenarios, thus the level of skill is not mutable. Any worker can either be part of the formal private sector, work informally, be on the government's payroll or be unemployed. The index set $lagg$ is defined by:

$$lagg = \{sm, um, sf, uf\}$$

sm : skilled male; um: unskilled male

sf: skilled female; uf: unskilled female

[5] Here, equilibrium means: supply + unemployment = demand

The index laggs identifies 4 idiosyncratic characteristics of workers. This is related to the labor supply. We define 4 types of labor: formal, informal, private and government sectors. This is related to labor demand. Therefore, there are 4x4 configurations of the labor market. Nevertheless, given that public sector does not hire informal workers, there are only 4x4-4=12 possible market contracts. We introduce the following aggregation of workers based on their labor allocation (that means private/public, formal/informal) following their level of skill:

a) Skilled male: index set **sm**

fsm: formal skilled male;

ism: informal skilled male

spsm: skilled male allocated to the public services activity

b) Unskilled male: index set **um**

fum: formal unskilled male; ium: informal unskilled male

fsf: formal skilled female; isf: informal skilled female

spuf: unskilled male allocated to the public services activity

c) Skilled females: index set: **sf**

fsf: formal skilled female;

isf: informal skilled female

spsf: skilled female allocated to the public services activity

d) Unskilled females: index set: **uf**

fuf: formal unskilled female;

iuf: informal unskilled female

spuf: unskilled female allocated to the public services activity

Therefore, we have:

$sm = \{fsm, ism, sp_{sm}\}$; $sf = \{fsf, isf, sp_{sf}\}$; $um = \{fum, ium, sp_{um}\}$; $uf = \{fuf, iuf, sp_{uf}\}$

The index l refers to these 12 configurations of the labor market. We postulate that workers, independently of their idiosyncratic category, chose to offer their work in the formal or informal labor market. Labor supply for each formal or informal category (not in the public sector) is defined (for categories included in $lagg$) from the first order condition of

a volume preserving CET formulation (Mensbrugghe, 2016). The labor supply ls_l for each type *l* of labor is equal to:

$$ls_l = lst_{lagg} \cdot \delta_l^{\psi_{lagg}+1} \left(\frac{w_l(1-u_l)}{wt_{lagg}}\right)^{\psi_{lagg}}$$

lst_{lagg} is the total supply in each idiosyncratic category of workers $lagg$, and it is exogenous. The distribution parameter is δ_l. The elasticity of transformation is ψ_{lagg}. Composite wage is denoted by wt_{lagg}. This function presumes an artificial agent in charge of the allocation of labor to the formal or informal markets that takes into account the relative wages and unemployment. A change in the wage curve generates a different mapping of wages and unemployment, thus increasing (or reducing) the level of unemployment and reducing (or increasing) the available number of workers to allocate as formal or informal. The role of labor allocated in the production of public services is explained further below. Finally, note that:

$$lst_{lagg} = \sum_l ls_l$$

4.3 Formal-informal migration

The elasticity ψ_{lagg} represents the ease of movement between the formal and the informal sector for each idiosyncratic group of labor. For instance, the higher ψ_{uf} (the elasticity among unskilled female workers) then the bigger movement of labor from informality to formality (or vice versa) given a change in the relative wages of unskilled formal and unskilled informal women workers. When we talk about labor migration, we refer to a movement inside the 4 idiosyncratic labor categories because it is possible, for example, to have a formal unskilled male worker turn to the informal sector, but it is not possible for him to acquire a higher skill level, at least not in the short term.

We postulate that there is an order of values for the idiosyncratic groups. This ordering gives greater mobility to unskilled than to skilled workers, and also greater mobility to female than to male workers. Since ψ_{lagg} can be interpreted as summarizing the preferences for the formal or informal sector, we assume that female workers are more likely to join the informal ranks since the flexible schedule in an informal job makes it easier to

balance work and family. We also presume that skilled workers have submitted themselves to years of schooling precisely because they know formal jobs usually require formal education and consequently they possess a higher preference for formality. However, the results of the model could change in function of the assumed values for ψ_{lagg}. We confront this issue by analysing the sensibility of the model to ψ_{lagg}.

$$\psi_{skilled\ male} < \psi_{skilled\ female} < 1 < \psi_{unskilled\ male} < \psi_{unskilled\ female}$$

4.4 Public services: labor demand and wages

Here we make three modelling decisions concerning the Public Services: labor demand is exogenous, wage is exogenous and real government consumption is constant. These three statements imply that the government can increase employment without elevating the level of production. That means that in this case, labor productivity decreases.

The model has 16 labor factors, 8 of which relate to the public services activity. The introduction of an exogenous labor demand and real wages in the public services is straightforward:

ld_l is exogenous for $l = \{spsm, spum, spsf, spuf\}$

wr_l is exogenous for $l = \{spsm, spum, spsf, spuf\}$

This mechanism allows us to easily fix the level of public labor and wages. For the base scenario, labor and wages in public services are equal to the registered levels in 2012. Note that for informal workers, the value of ld and wr are defined as zero exogenously.

4.5 Public services: production

Labor demand for each type of labor l and for all activities j, with the exception of labor employed in public services, follows the first order condition of a CES production function. For labor demand in public services, γ represents the endogenous efficiency of the public services CES production function. An increase of labor allocated to the public services production will reduce the labor supplied to the formal and informal markets and will impact the level of efficiency γ in the public services. Consequently the level of

production in the public services activity remains unchanged. The demand of composite labor in the public services activity with endogenous efficiency γ is:

$$ldc_{sp} = \gamma_{sp} \cdot B_{sp} \sum_{l} \left[\beta_l \cdot ld_l^{-\rho_{sp}}\right]^{\frac{-1}{\rho_{sp}}}$$

ldc_{sp}: Labor demand composite
γ_{sp}: Endogenous Total Factor Productivity
B_{sp}: Scale factor
β_l : Share parameter
ld_l: Labor demand
ρ_{sp}: Elasticity parameter (CES - composite labor)

All 4 public sector labor categories are exogenous. The simulation allows for specific changes in any single one of them without considering substitution or complementarity, since γ_{sp} adjusts itself to keep constant the volume of production regardless of the composition of labor. However, in the section focused in the simulation, we assume an equal increase rate in the labor demand of all public services categories.

Unlike Gelb (1991), we prefer not to call a public services activity with demand derived from a CES production function neoclassical and a demand with a different derivation non-neoclassical. Suffice to bear in mind the different reasons behind hiring in the public services.

4.6 Labor market clearing: supply equals demand

Labor market clearing states that total labor supply of a type of labor ls_l (adjusted for the rate of unemployment) is equal to the sum of sectorial demands for each labor type $ld_{l,j}$. With the exception of labor allocated in public services, wages adjust to achieve equilibrium through movement between formality, informality and unemployment. Labor allocated to public services is exogenous and is satisfied first. Labor demand for any other labor type different from the public services categories is the result of cost minimization of a CES production function in each type of activity and depends on the wage $wt_{l,j}$, the composite wage and the usual parameters.

$$ls_l(1 - u_l) = \sum_{j} ld_{l,j} = ld_l$$

4.7 Macroclosure

General equilibrium has an all-encompassing spirit but, like every economic model, needs to draw the line between what is inside and outside; that is, the endogenous and exogenous variables. Macroclosure rules state the exogenous variables and ensure that the model reaches the equilibrium. Also, a closure decision implies an assumption of causality. To specify the model, it is usual to introduce three closure rules related to the government budget, savings-investment equilibrium and the external balance. The extended model is capable of handling all possible combinations of these balances and letting the capital move freely with the use of an excel spreadsheet. We assume that the government balances the budget via variation in savings. In this manner, we mirror the usual government strategy for dealing with a drop in fiscal income.

The model is savings-driven, which means investment follows the existing savings. Historically, Bolivian savings have been low and external savings supplement them. The export price boom reversed this situation and allowed an increase in investment. Foreign savings are fixed. A glut in imports has to be counterbalanced with a boost in exports. This assumption is adequate for mirroring external financing restrictions.

In all instances we assume a short term movement. Therefore we fix the volume of capital used in each activity. In the short term the volume of unskilled labor is also fixed, without having the possibility of seeing the impact of schooling on the level of skilled labor. Finally, this is a real model and there is homogeneity in prices, consequently the choice of the numeraire does not affect the results.

4.8 Simulations

The aim of this section is to analyze the impact of further pursuing the wage and labor policy inside a context of a decrease in the prices of exports. This exercise lights the path of policy making in times of dwindling external resources. We start with a 2012 dataset that already has labor and wage policies implemented in the past in place. Then, we simulate the impact of (a) further increasing unproductive public sector employment, (b) further increasing the real minimum wage, and c) dropping the prices of exports. Another two scenarios are the result of combining the above (see Table 7). In ldpub1-inc the 6% increase

in public sector labor corresponds to the yearly average growth rate of public servants for the past five years. To capture the influence of the permanent increase of formal salaries in wmin-inc, we focus the attention on the compulsory growth rate of the formal private wage, on average equal to 3%. The comb-labpol scenario aggregates the last two scenarios and evaluates the labor policy.

There are two main characteristics of the external shock associated with the end of the commodity prices boom. Hid-dec relates to the first characteristic by reducing the oil price by 24%, which is the gap between the expected price in the government budget and the actual price for the first trimester in 2016. The natural gas price in Bolivia is calculated via a formula that takes as the international price of WTI oil the main input. The goal is to reduce gas price volatility and take advantage of the export market dependence (Brazil and Argentina) on Bolivian supply. The second characteristic is the drop in the international price of minerals. We mirror this movement with a 7% reduction in the export price of minerals equal to the decrease in the index price of exported minerals.

Finally, comb1 merges the labor and wage policy scenarios with the external shock. In this manner, we assess the impact of the labor and wage policy and also the influence of the external shock through the comparison of key macroeconomic variables (GDP growth, household consumption, investment, unemployment, etc.), wages and the rate of informality.

Table 1 Simulated scenarios

Name	Description
Labor Policy	
1) ldpub-inc	Public labor demand increase of 6%
2) wmin-inc	Formal wage increase of 3%
3) comb-labpol	Policy scenarios combined
External shock	
4) ex-shock	Oil price decrease of 24%, price of minerals decrease of 7%
Labor policy and external shock	
5) comb1	Comb-labpol + exshock

V. Results

This section reports the interpretation of the results. The percentage change in macroeconomic variables from the different scenarios with respect to the base setup is in Table 8. The second column from the left shows the base level value and the rest of the columns compare the percentage change with the base line scenario. The first half of the table contains macroeconomic variables. Prices, real wages relative increments are at the lower second part of the table. Although some scenarios present an increase in labor for the public sector, real government consumption is constant through all the scenarios. The reason for this absence of variation is the endogenous scale parameter in the public sector composite labor demand, which accounts for a relative loss of efficiency and maintains the real public sector output unchanged. In other words, we allocate all new government employment as non-productive.

The external shock scenario assumes a 24% drop in the oil price (see Table 1). The natural gas price variation is slightly below 4%. This gap arises due to a downward slope demand curve for hydrocarbons. In this way, we portray the role of the formula used to calculate the price of oil; that is, the reduction of price volatility.

From an increase of public services demand of labor, we record a rise in household consumption due to higher wages. This provokes the reduction of the GDP. The construction sector accounts for 7% of the value added and suffers the biggest drop in this scenario, almost 4%. Household demand cannot be held responsible for this drop because households do not consume goods coming from this activity. Taking into account that the closure rule for the savings and investment equilibrium is savings driven, or in other words the level of investment follows the available savings, the drop comes from a lower investment due to lower government savings. Higher labor demand in public services means a lower level of government savings. Moreover, the drop in government savings –to balance the budget- has an adverse impact on investment that ultimately would drag down the GDP, were this a dynamic model[6].

The interconnection between sectors of the labor market is evident in wage and

[6] In the year 2012, 60% of the GDP came from final household demand and 19% from gross fixed capital.

unemployment rate changes (see Table 8 and Table 9). Public services provision is intensive in female skilled labor and this type of labor displays the highest increase in wages regarding the informal sector. A higher labor demand in public services reduces the pool of labor for the rest of the activities. Capital is fixed, thus the private sector has to settle with the amount of capital already allocated and cannot substitute capital for labor. A lower supply of labor combined with higher household demand reduces the rate of unemployment, most of all among skilled women which is also due to having a public services activity intensive in this type of labor. Nevertheless, unemployment in formal skilled and unskilled males increases due to the drop in the construction sector (highly intensive in male labor).

The 3% raise in formal wages ultimately has a negative influence on household consumption. Labor supply, faced with higher wages in the formal sector, chooses to migrate to formality. However, formal labor demand decreases because of higher costs. As a result, unemployment rises, counterbalancing the effect of higher wages on household consumption. We should expect a higher general level of wages in the informal sector: firms increase their informal payroll substituting formal for informal labor increasing pressure on informal wages. Ultimately, the economic contraction caused by a raise in formal wages diminishes the level of wages in the informal sector.

The Bolivian GDP is adversely influenced by the labor policy in its two components (real formal wage increase and public labor demand increase). When combined, the labor policy has an almost 1% negative impact on GDP (see Figure 6). Nevertheless, the combined labor policy has a mixed effect on informal wages: higher informal wages in the case of a surge in demand of labor in public services, and lower informal wages in the case of a mandatory increase in formal wages. At the end of the day, lower informal wages dominate the scenario, except for skilled females, who are the main beneficiaries of public sector openings.

Bolivia's dependency on natural resources and raw material exports is evident in the large negative effect of a drop in the price of natural gas on the economy. The biggest danger is the drop in investment: less government income translates into less investment. The dynamic effects of a reduction of nearly a quarter of the investment is not captured by a static model. However, it should not be neglected. Also, the real exchange depreciation

allows the economy to sustain the level of exports. The 3.2% reduction in household consumption, along with the drop in investment, are the source of a fall in imports.

Even though the total the rigidity in formal wages shields formal workers form a negative effect of a drop in export prices on their income, the jump in the unemployment rate is larger in the formal than in the informal sector (see Table 9). In this sense, the model displays the usual different behavior of informal versus formal workers, even in the case of a drop in wages, they tend to stay working in comparison to their formal pears.

In general, the drop in the export price of minerals has the same effects of the drop in natural gas price. Therefore, the combined effect of both negative external shocks is essentially a simple sum of them[7].

Household consumption increases because of the labor policy, but at the expense of the primarization of the economy. Skilled labor is in short supply in Bolivia, an increase of formal wages and labor demand in public services puts pressure on the secondary sector. Exports from the secondary sector of the economy fall and imports of services increase, generating an export substitution effect.

The primarization (see Table 10) of the economy originated in the labor policy is accompanied by an apparent formalization (see Table 11). In other words, there is an increase in the rate of formal employment. Nevertheless, once we consider the jump in the unemployment rate, the gains in formalization are to the detriment of labor demand.

VI. Sensitivity analysis

The results of the CGE model could change drastically upon the choice of parameter values. To ensure robustness, it is advisable to run the model with different parameter values. As stated above, part of the parameters in the model come from the usual criteria

[7] We also conduct a combined external boost with the same impact and of nearly the same length, but in a positive direction, as the pooled negative external scenario. This arithmetic of impacts serves to cover the negative effect of the labor policy during an external price boom and to amplify the elevation of household consumption.

and part from econometric estimation. However, the elasticity of transformation ψ for each aggregated labor category comes from the authors' assumptions and thus, its influence on GDP variation, household consumption and unemployment should be put to test. In Table 12, we select 6 sets of values for ψ. The second set contains the values used to obtain the general results. We conclude that although the magnitude of change varies, the sign of the changes does not. Hence, the results are robust to changes in the values of ψ (see Figure 7 to Figure 10).

VII. Conclusions and policy implications

The CGE methodology allows us to isolate the influence of the current labor policy: an adverse effect in aggregated production and a positive effect on household consumption, while pushing for the primarization and an apparent formalization of the economy. The negative effects are mimicked by the larger impact of surging export prices in natural gas and minerals while the positive effect on household consumption is at the cost of less investment. Therefore, the success of the last decade of economic policy does not arise from the expanding public sector or the swelling formal wages.

An adverse external shock deepens the undesirable effects of labor policy. Depending on the extent to which the current labor policy continues, the fiscal reserves and the possible sources of funding will be depleted. Therefore, a correction of course in labor and wage policy depending on the external market conditions is needed.

It is not advisable to have permanent increments above the rate of inflation in wages, without considering the external context. Also, informal workers should be part of the debate on salary increments because they are indirectly affected through changes in household consumption and unemployment.

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Tables and Figures

Table 2 Labor and capital participation in the nominal payroll by activity (percentage)[8]

	(1) Formal SM	(2) Formal SF	(3) Formal UM	(4) Formal UF	(5) Informal SM	(6) Informal SF	(7) Informal UM	(8) Informal UF	(9) Capital	(10) Total
Agricultural nonindustrial	12	1	8	1	14	0	53	10	0	100
Agricultural industrial	0	0	0	0	1	0	5	1	94	100
Coca	0	0	1	0	10	5	57	24	4	100
Livestock	5	2	2	0	17	2	51	17	4	100
Forestry, hunting and fishing	5	0	51	2	7	0	29	2	4	100
Crude Oil and Natural Gas	6	3	1	0	0	0	0	0	90	100
Non- and metallic minerals	9	3	12	1	3	0	9	1	63	100
Fresh and Processed Meat	9	5	5	2	6	0	7	3	63	100
Dairy products	13	6	7	4	2	1	2	2	63	100
Mill Products and Bakery	11	3	11	0	4	1	2	5	63	100
Sugar and Confectionery	3	2	1	0	6	5	7	13	63	100
Miscellaneous food products	0	0	0	0	0	14	15	8	63	100
Drinks	18	3	10	1	1	0	2	2	63	100
Other Manufacturing	9	2	2	0	7	4	10	3	63	100
Wood And Wood Products	7	0	0	0	1	0	1	1	90	100
Paper and Paper Products	10	2	7	0	6	2	9	1	63	100
Miscellaneous Manufactures	7	2	2	0	12	0	12	1	63	100
Electricity, Gas and Water	30	9	10	4	2	0	9	0	36	100
Construction	8	2	3	0	14	0	37	0	36	100
Trade	10	5	2	1	7	12	7	19	36	100
Transportation and Storage	7	1	3	0	22	1	30	1	36	100
Communications	31	12	1	1	11	4	2	1	36	100
Financial Services	37	25	0	0	1	1	0	0	36	100
Services for Business	26	10	2	0	14	6	4	1	36	100
Ownership of Housing	16	21	2	0	18	7	0	1	36	100
Community services	12	11	2	1	12	5	11	4	43	100
Restaurants and Hotels	5	3	4	2	4	10	5	31	36	100
Domestic Services	0	0	0	0	2	31	3	63	0	100
Public Administration	48	44	3	2	1	1	0	0	0	100

Source: Authors' elaboration based on HS and SUT

[8] S: skilled, M: male, U: unskilled, F: female.

Table 3 Value added, gross output and export/import intensity (percentage)[9]

(1) ACTIVITIES	(2) Value Added (shr% GDP)	(3) Gross Output at Basic Prices (shr%)	(4) Exports (shr% Gross Output)	(5) GOODS	(6) Domestic supply (shr% total domestic supply)	(7) Imports over domestic supply (%)
Agricultural nonindustrial	6	3	11	Agricultural nonindustrial	4	5
Agricultural industrial	3	2	13	Agricultural industrial	3	4
Coca	1	0	4	Coca	0	0
Livestock	3	2	1	Livestock	3	2
Forestry, hunting and fishing	1	1	3	Forestry, hunting and fishing	1	1
Crude Oil and Natural Gas	10	15	88	Crude Oil and Natural Gas	2	0
Non-metallic and metallic minerals	10	7	68	Non-metallic and metallic minerals	3	5
Fresh and Processed Meat	2	3	1	Fresh and Processed Meat	5	2
Dairy products	1	1	5	Dairy products	1	10
Mill Products and Bakery	1	2	16	Mill Products and Bakery	3	16
Sugar and Confectionery	0	1	6	Sugar and Confectionery	1	19
Miscellaneous food products	1	3	54	Miscellaneous food products	2	23
Drinks	2	3	4	Drinks	4	17
Other Manufacturing	3	5	78	Other Manufacturing	1	1347
Wood And Wood Products	1	2	3	Wood And Wood Products	2	167
Paper and Paper Products	2	2	1	Paper and Paper Products	3	18
Miscellaneous Manufactures Products	0	0	94	Miscellaneous Manufactures Products	0	6346
Electricity, Gas and Water	2	2	0	Electricity, Gas and Water	2	0
Construction	3	5	0	Construction	6	0
Trade	9	7	0	Trade	10	0
Transportation and Storage	9	8	9	Transportation and Storage	11	21
Communications	1	1	19	Communications	1	9
Financial Services	0	4	2	Financial Services	5	6
Services for Business	3	2	5	Services for Business	3	46
Ownership of Housing	3	2	0	Ownership of Housing	2	0
Community, social and personal services	4	3	2	Community, social and personal services	4	4
Restaurants and Hotels	3	3	20	Restaurants and Hotels	3	19
Domestic Services	1	0	0	Domestic Services	0	0
Services of Public Administration	15	10	1	Services of Public Administration	13	0
TOTAL	100	100			100	

Source: Authors' elaboration based on HS and SUT

[9] The following serves to link the data portrayed here with the PEP-1-1 model. For a further documentation please visit https://www.pep-net.org/pep-1-1-single-country-static-version.

Value added of activity j: $PVAO_j \cdot \frac{PVAO_j \cdot VAO_j}{\sum_j (PVAO_j \cdot VAO_j)}$

Gross output at basic prices of activity j: $\frac{PTO_j \cdot XSTO_j}{\sum_j (PTO_j \cdot XSTO_j)}$

Exports of activity j over its gross output: $\frac{\sum_i (PEO_i \cdot EXO_{j,i})}{PTO_j \cdot XSTO_j}$

Domestic supply i: $\frac{\sum_j PL_i DS_{j,i}}{\sum_i \sum_j PL_i DS_{j,i}}$

Imports of good i over domestic supply: $\frac{ePWM_i IM_i}{\sum_j PL_i DS_{j,i}}$

Table 4 Factor participation in household income (percentage)

Households	(1) Formal SM	(2) Formal SF	(3) Formal UM	(4) Formal UF	(5) Informal SM	(6) Informal SF	(7) Informal UM	(8) Informal UF	(9) Public Adm SM	(10) Public Adm SF	(11) Public Adm UM	(12) Public Adm UF	(13) Capital	Total
Non Poor Urban	14.6	6.4	5.9	0.7	9.9	4.1	11.8	5.9	10.5	10.0	0.5	0.5	19	100
Poor Urban	6.6	2.1	4.4	1.1	11.9	3.8	24.2	9.0	6.4	4.4	1.6	0.6	24	100
Non Poor Rural	3.2	0.3	6.2	0.6	8.1	1.5	35.2	9.2	12.3	11.1	1.0	0.5	11	100
Poor Rural	1.4	0.2	3.6	0.5	7.6	1.3	60.8	10.2	3.0	1.2	2.2	1.5	7	100
Factor (shr% Income)	11.9	5.0	9.8	3.6	5.7	0.7	17.6	6.7	10.1	9.3	0.8	0.5	18.3	100

Source: Authors' elaboration based on HS and SUT

Table 5 Household participation in factor income (percentage)

Households	(1) Formal SM	(2) Formal SF	(3) Formal UM	(4) Formal UF	(5) Informal SM	(6) Informal SF	(7) Informal UM	(8) Informal UF	(9) Public Adm SM	(10) Public Adm SF	(11) Public Adm UM	(12) Public Adm UF	(13) Capital	Household (shr% Factor Income)
Non Poor Urban	90.5	94.7	76.1	71.5	74.5	83.1	49.6	64.2	76.9	79.3	52.4	66.8	77.9	74
Poor Urban	5.7	4.3	8.1	15.6	12.5	10.8	14.3	13.8	6.6	4.9	21.6	11.9	13.5	10
Non Poor Rural	3.5	0.8	13.9	10.8	10.6	5.1	25.7	17.4	15.6	15.3	17.5	12.1	7.5	13
Poor Rural	0.3	0.1	1.9	2.1	2.3	1.1	10.5	4.6	0.9	0.4	8.5	9.2	1.1	3
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Authors' elaboration based on HS and SUT

Table 6 Percentage of the labor force allocated by activity

	Agricultural nonindustrial	Agricultural industrial	Coca	Livestock	Forestry, hunting and fishing	Crude Oil and Natural Gas	Non-metallic and metallic minerals	Fresh and Processed Meat	Dairy products	Mill Products and Bakery
Formal skilled male labor	0.10	0.01	0.00	0.09	0.02	0.19	0.42	0.03	0.13	0.03
Formal skilled women labor	0.01	0.00	0.00	0.06	0.00	0.06	0.04	0.03	0.05	0.01
Informal skilled male labor	0.14	0.87	0.35	0.75	0.04	0.01	0.15	0.02	0.02	0.02
Informal skilled women labor	0.00	0.33	0.15	0.37	0.00	0.01	0.01	0.00	0.01	0.01
Formal unskilled male labor	0.07	0.00	0.01	0.05	0.03	0.05	0.53	0.02	0.06	0.04
Formal unskilled women labor	0.01	0.00	0.00	0.01	0.03	0.00	0.09	0.01	0.02	0.00
Informal unskilled male labor	0.62	8.11	1.04	4.53	0.16	0.01	0.52	0.02	0.04	0.03
Informal unskilled women labor	0.17	5.64	0.97	5.81	0.09	0.00	0.07	0.04	0.05	0.00
Total	1.13	14.97	2.53	11.66	0.38	0.32	1.83	0.17	0.38	0.13

	Sugar and Confectionery	Miscellaneous food products	Drinks	Other Manufacturing	Wood And Wood Products	Paper and Paper Products	Miscellaneous Manufactures Products	Electricity, Gas and Water	Construction	Trade
Formal skilled male labor	0.08	0.00	0.14	0.11	0.04	0.12	0.55	0.18	0.59	1.34
Formal skilled women labor	0.06	0.00	0.01	0.08	0.00	0.05	0.19	0.07	0.15	0.97
Informal skilled male labor	0.19	0.00	0.02	0.46	0.11	0.07	0.92	0.02	1.66	1.41
Informal skilled women labor	0.35	0.02	0.00	0.66	0.00	0.10	0.10	0.01	0.07	3.23
Formal unskilled male labor	0.06	0.00	0.06	0.02	0.02	0.01	0.21	0.09	0.34	0.29
Formal unskilled women labor	0.02	0.00	0.03	0.02	0.00	0.00	0.00	0.03	0.00	0.33
Informal unskilled male labor	0.21	0.01	0.05	0.57	0.24	0.02	1.19	0.05	4.27	1.91
Informal unskilled women labor	0.58	0.01	0.06	1.09	0.00	0.01	0.22	0.00	0.07	5.41
Total	1.54	0.05	0.37	3.00	0.42	0.39	3.38	0.45	7.16	14.90

	Transportation and Storage	Communications	Financial Services	Services for Business	Ownership of Housing	Community, social and personal services	Restaurants and Hotels	Domestic Services		Services of Public Administration
Formal skilled male labor	0.43	0.35	0.40	1.08	0.03	1.15	0.25	0.00		3.34
Formal skilled women labor	0.13	0.15	0.34	0.65	0.04	1.16	0.25	0.00		3.50
Informal skilled male labor	2.25	0.28	0.03	0.68	0.02	1.61	0.34	0.04		0.11
Informal skilled women labor	0.09	0.17	0.03	0.69	0.02	0.87	1.03	0.75		0.15
Formal unskilled male labor	0.27	0.02	0.00	0.12	0.01	0.21	0.12	0.00		0.36
Formal unskilled women labor	0.01	0.03	0.01	0.06	0.00	0.10	0.13	0.00		0.31
Informal unskilled male labor	2.66	0.08	0.00	0.27	0.00	1.44	0.59	0.05		0.07
Informal unskilled women labor	0.09	0.06	0.00	0.16	0.01	0.67	2.84	1.64		0.05
Total	5.92	1.14	0.81	3.71	0.12	7.21	5.56	2.48		7.87

Source: Authors' elaboration based on HS.

Table 7 Base level unemployment in the year 2012

	Unemployment rate
Female	4.49
Male	2.22
Unskilled	2.45
Skilled	4.67
Skilled male	3.78
Unskilled male	1.39
Skilled female	5.70
Unskilled female	3.78

Source: Authors' elaboration based on HS.

Table 8 Macroeconomic indicators, prices and government performance

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	base (LCU)	ldpub-inc (Percentage)	wmin-inc (Percentage)	comb-labpol (Percentage)	comb-exsho (Percentage)	comb1 (Percentage)
Agents & GDP						
Household consumption	1109	1.2	-0.2	0.7	-3.9	-3.5
Fixed investment	296	-3.8	-1.7	-5.6	-25.0	-30.6
Government consumption	252	0.0	0.0	0.0	0.0	0.0
GDP basic price	1421	-0.2	-0.8	-1.0	-2.0	-3.0
Balance of trade						
Exports	883	-0.5	-0.8	-1.2	-11.3	-12.6
Imports	707	-0.2	-0.7	-0.9	-2.8	-3.8
Taxes						
Direct taxes from enterprises	109	-0.7	-1.2	-1.8	-12.3	-13.9
Inderect taxes	428	-0.7	-0.8	-1.5	-13.0	-14.3
End scale par.Pub.Sec.%chg						
Prices						
Natural gas %var	1	-4.1	-1.8	-5.9	-10.6	-17.8
Real exchange rate %var	1	-1.2	-0.5	-1.7	5.8	4.1
Wages						
Formal Skilled Male		- 0.00	3.00	3.00	- 0.00	3.00
Formal Skilled Female		- 0.00	3.00	3.00	0.00	3.00
Formal Unskilled Male		0.00	3.00	3.00	- 0.00	3.00
Formal Unskilled Female		- 0.00	3.00	3.00	0.00	3.00
Informal Skilled Male		0.08	- 0.25	- 0.18	- 0.97	- 1.10
Informal Skilled Female		0.46	- 0.18	0.25	- 0.53	- 0.34
Informal Unskilled Male		- 0.24	- 0.23	- 0.45	- 0.86	- 1.20
Informal Unskilled Female		0.02	- 0.16	- 0.14	- 0.12	- 0.27
Investment shr%GDP	18.2	17.6	18.0	17.4	14.1	13.1
Gov. Income shr%GDP	41.0	40.8	41.0	40.8	36.7	36.5
Gov. Savings shr%GDP	15.8	14.6	15.5	14.3	10.8	9.4

*Variation relative to the base, **Only as a percentage of GDP according to the scenario

Source: Author's elaboration

Table 9 Unemployment rate (Percentage variation from base line scenario)

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	ldpub-inc (Percentage)	wmin-inc (Percentage)	comb-labpol	comb-exsho	comb1 (Percentage)
Formal					
Formal Skilled Male	-9.1	100.1	91.4	96.8	185.5
Formal Skilled Female	-33.7	94.5	62.1	67.1	128.4
Formal Unskilled Male	18.9	97.2	115.5	99.9	211.6
Formal Unskilled Female	-1.2	89.0	87.7	27.5	115.0
Informal					
Informal Skilled Male	-2.9	9.8	6.8	58.9	67.1
Informal Skilled Female	-20.3	7.0	-13.9	24.7	10.4
Informal Unskilled Male	12.7	11.8	25.0	53.2	81.5
Informal Unskilled Female	-0.8	8.1	7.3	6.1	13.9

Source: Author's elaboration

Table 10 Value added, exports and imports by scenario

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Base (LCU)	**ldpub-inc** (percentage)	**wmin-inc** (percentage)	**comb-labpol** (percentage)	**comb-exsho** (percentage)	**comb1** (percentage)
Value added						
Primary	1848	0.16	-0.38	-0.22	-1.45	-1.69
Secondary	605	-0.36	-0.84	-1.20	3.05	1.86
Terciary	3004	-0.41	-0.87	-1.28	-3.77	-5.12
	5457	-0.21	-0.70	-0.92	-2.23	-3.18
Exports						
Primary	561	-0.15	-0.55	-0.69	-4.89	-5.61
Secondary	195	-0.87	-1.05	-1.93	8.57	6.63
Terciary	54	-1.49	-1.79	-3.26	8.01	4.47
	811	-0.41	-0.75	-1.16	-0.78	-1.99
Imports						
Primary	11	0.48	-0.08	0.41	-6.57	-6.22
Secondary	593	-0.75	-0.92	-1.68	-11.90	-13.56
Terciary	102	1.12	0.05	1.18	-8.48	-7.43
	707	-0.46	-0.77	-1.23	-11.32	-12.56

Source: Authors' calculation

Table 11 Rate of formality and informality

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	base (LCU)	ldpub-inc (Percentage)	wmin-inc (Percentage)	comb-labpol	comb-exsho	comb1 (Percentage)
Formal	23.7	24.0	23.6	23.9	23.5	23.7
Formal Private	16.1	16.0	16.0	15.9	15.9	15.7
Formal Public	7.6	8.0	7.6	8.0	7.6	8.0
Informal	76.3	76.0	76.4	76.1	76.5	76.3

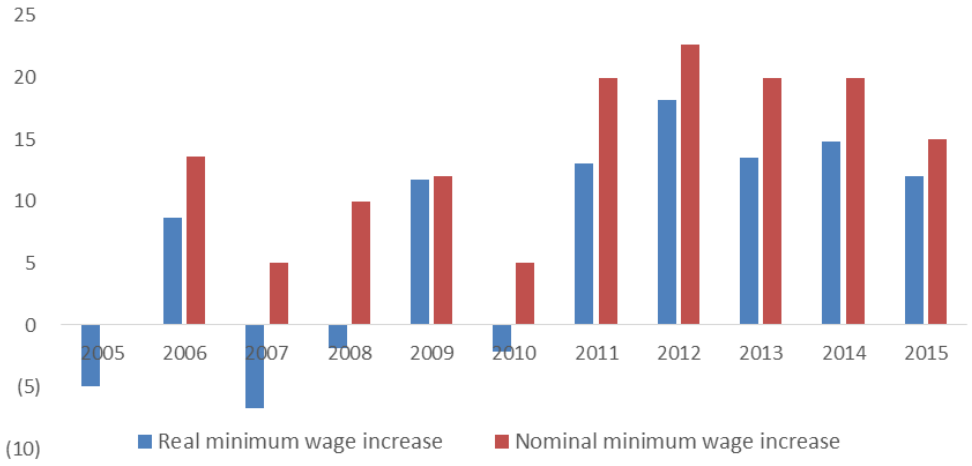
Source: Author's elaboration

Table 12 $Elasticity\ of\ transformation\ \psi$ values

	1st	2th	3th	4th	5th	6th	7th
Formal Skilled Male	8	0.4	1	0.1	0.1	2	0.01
Formal Skilled Female	8	0.6	1	0.1	0.1	2	0.01
Formal Unskilled Male	8	1.5	1	0.1	8	2	0.01
Formal Unskilled Female	8	2	1	0.1	8	2	0.01

Source: Author's elaboration

Figure 1 Minimum wage increments



Source: UDAPE

Figure 2 Private formal wage compulsory increments

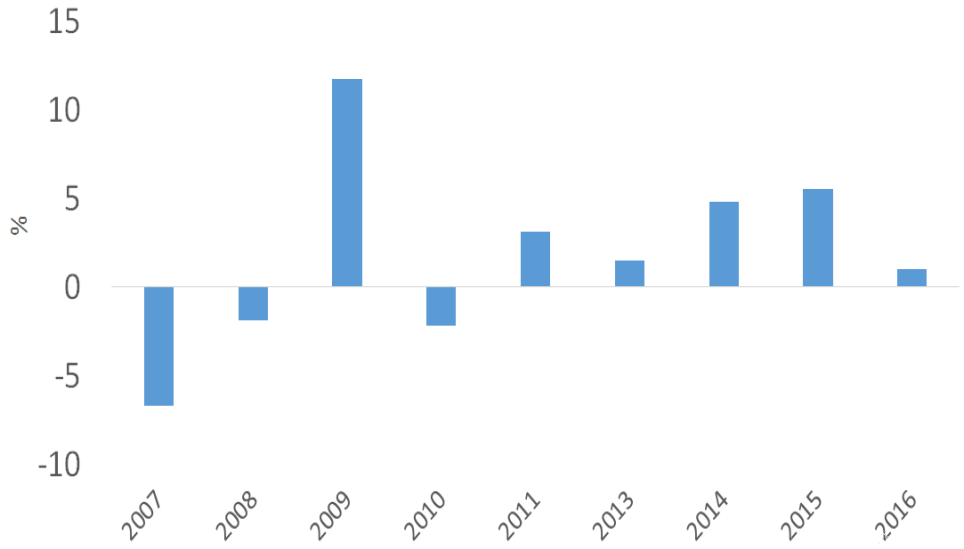
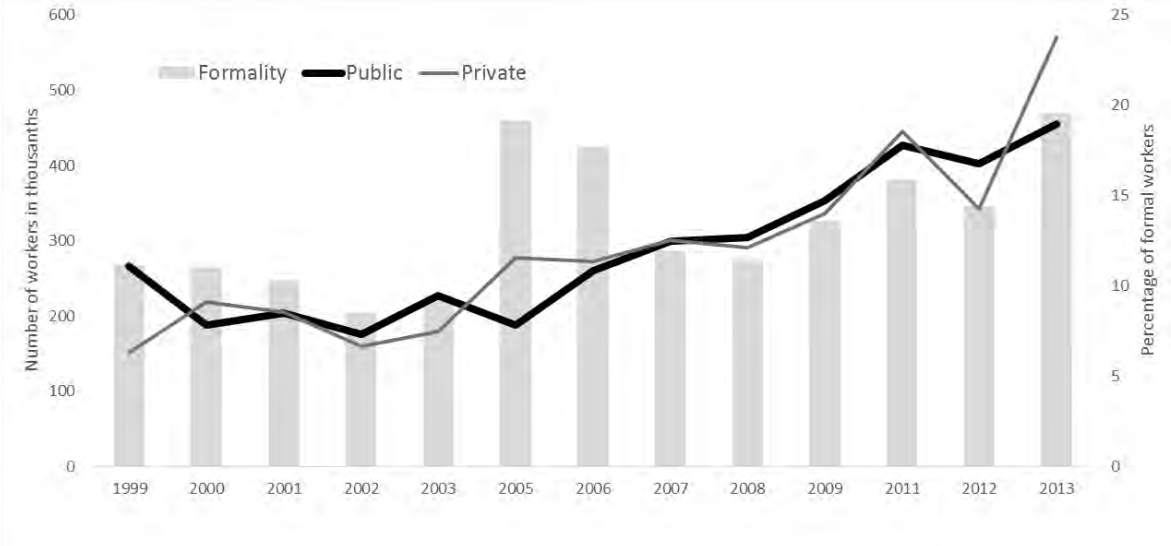
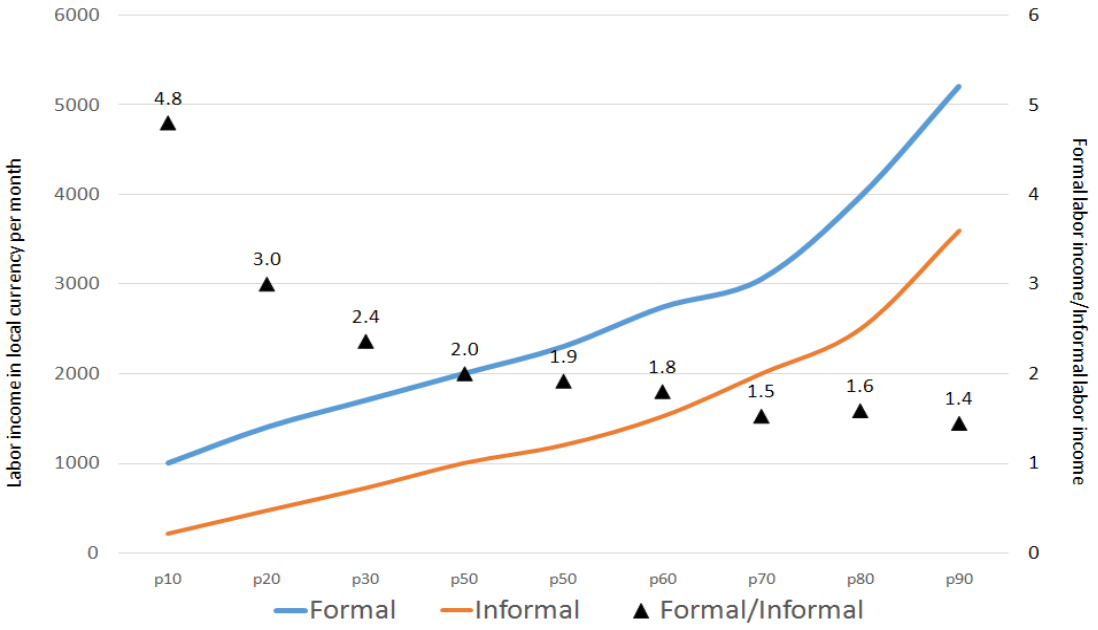


Figure 3 Public and private sector workers



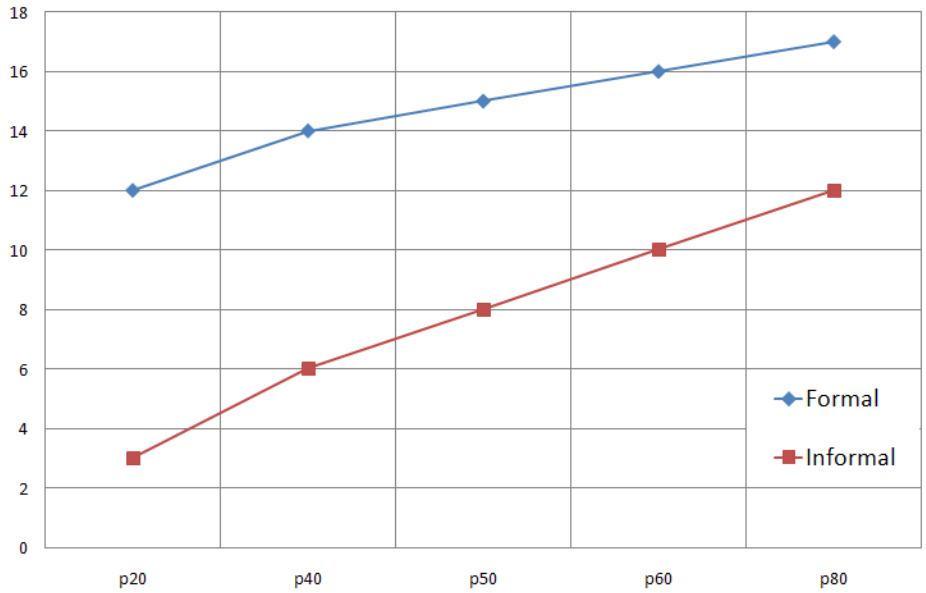
Source: Author's elaboration based on HS

Figure 4 Formal and informal income



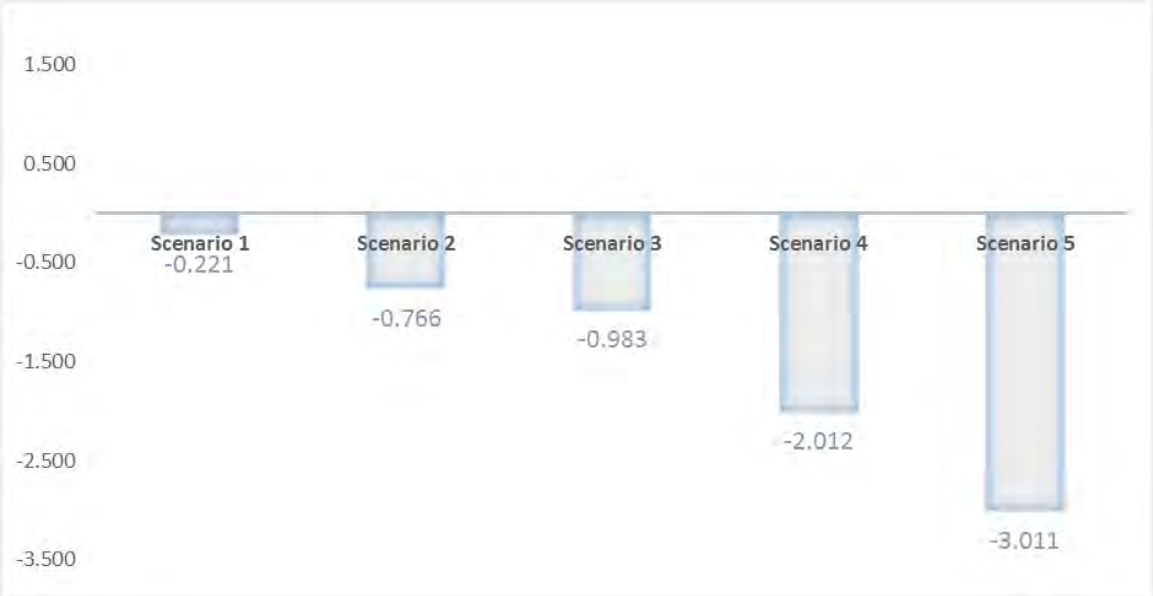
Source: Author's elaboration based on HS

Figure 5 Formal and informal years of schooling



Source: Author's elaboration based on HS

Figure 6 GDP percentage variation in different scenarios

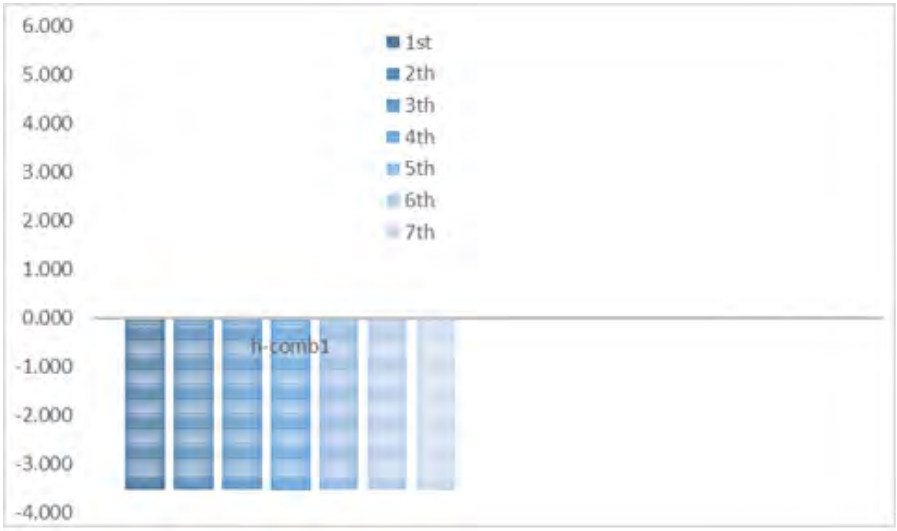


Source: Own calculation

Figure 7 Sensitivity analysis of the elasticity of transformation ψ on GDP

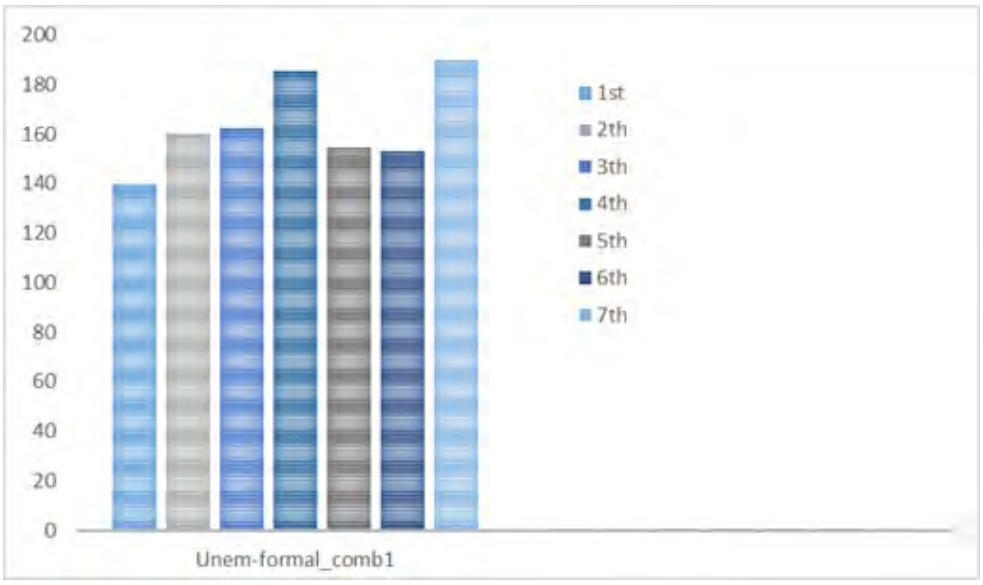
Source: Author's elaboration

Figure 8 Sensitivity analysis of the elasticity of transformation ψ on household consumption



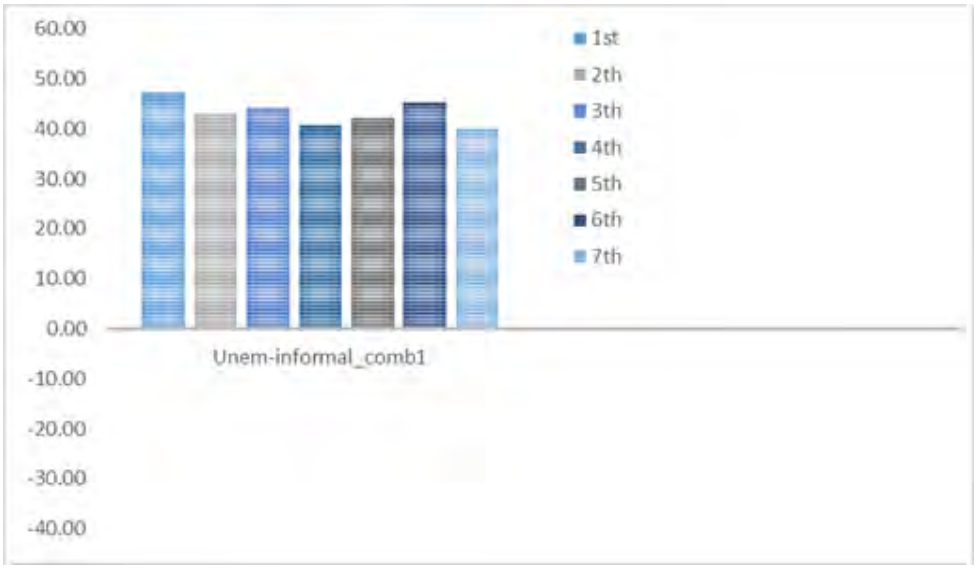
Source: Author's elaboration

Figure 9 Sensitivity analysis of the elasticity of transformation ψ on formal unemployment



Source: Author's elaboration

Figure 10 Omega sensitivity analysis on informal unemployment



Source: Author's elaboration

Appendices

Appendix A

The extended PEP-1-1 CGE model includes features to ease the selection of macroclosure rules and the configuration of the simulation scenarios. These features are possible thanks to a set of files that complement the original model. In the table there is a brief explanation of the purpose of each additional file.

Code files	Description
mod.gms	Contains the CGE model and calls for subroutines in the other files and a loop to run different simulation scenarios. Overall, the model is run in pieces using the save and restart command.
bol2012-data.inc	The mod.gms file runs a GDX routine to read the sets, SAM and parameters from the bol2012-data.xls file.
bol2012-sim.inc	The sim.gms file runs a GDX routine to read data about macroclosure rules and parameters from the bol2012-sim.xls.
sim.gms	Different macroclosure rules and different values of parameters can be chosen for the simulation scenarios. The sim.gms file uses the output from the mod.gms file.
repsetup.inc	Declares the variable results for each scenario
varinit.inc	Renames the level variables in the model solution to the initial base values later used to compute the report.
macclos.inc	Contains the possible Macroclosure rules in the form of If conditions over the value of choice parameters in the boldatsim.xls. The If conditions either assign unrestricted limits to a variable (making it endogenous) or fix the value to the calibrated one.
par-defn-sim.inc	The fixed values in macclos.inc are subject to variation according to the information rendered in the boldatasim.xls file. The par-defn-sim.inc multiplies the calibrated values of the exogenous variables by parameter values that describe the nature of the simulation.

reploop.inc	Generates a level variable for each solution of the simulated scenarios.
diagnostics-sol.inc	Checks if each iteration of the loop arrives to a solution and if the Leon variable is undistinguishable equal to zero.
rep.gms	Calls the repperc-base.inc and reploop.inc
repperc-base.inc	Computes the percentage change in comparison to the base solution.
reploop.inc	Assigns the solution of each variable and simulation to a different set of variables.
Auxiliary excel files	
Bol2012-data.xls	Contains the sets, SAM and parameters in excel formal.
Bol2o12-sim.xls	Comprises the names of the simulation scenarios, their associated Macroclosure rules and exogenous changes in excel format.

Appendix B

Elasticities of household final demand

The household micro data used in for this estimation is provided by the Instituto Nacional de Estadística (INE) in the 2012 household surveys conducted inside the MECOVI program. The survey for this year contains data from 31,935 individuals. This data set contains information about household consumption according to the type of goods they consume. The SAM built for 2012 for Bolivia has 29 goods. In the following regression, the household expenses are in logarithmic terms

$$\ln(\text{hexpen}_{activity_i}) = \beta_0 + \beta_1 \ln(\text{totalexpen}) + \beta_2 totper + \varepsilon_i$$

$$i = 1, 2, \ldots, 29$$

Where,

$\text{hexpen}_{\text{activity}}$ i: Household expenditure by economic activity.

totalexpen: Total expenditure of household types.

totper: Represents the number of household members.

The estimated elasticities and their associated p-values of the type household consumption can be seen in Table 13. The parameter estimates are mostly statistically significant.

Table 13 Estimation of elasticities of final demand of households

		Poor rural households			Nonpoor rural households			Poor urban households			Nonpoor urban households		
	Goods	totalexpen***	totper***	constant***	totalexpen***	totper***	constant***	totalexpen***	totper***	constant***	totalexpen***	totper***	constant***
1	Agricultural nonindustrial	0.961	- 0.053	- 0.995	0.851	0.008	- 0.294	0.967	0.014	- 1.573	0.701	0.100	0.705
2	Agricultural industrial	0.814	- 0.052	- 2.719	0.719	- 0.029	- 1.939	0.876	- 0.036	- 3.800	0.794	- 0.009	- 3.059
3	Coca	0.728	- 0.058	- 0.517	0.580	- 0.102	0.674	0.657	- 0.106	- 1.233	0.471	- 0.019	0.367
4	Livestock	0.806	- 0.006	- 2.230	0.767	- 0.009	- 1.853	0.898	0.007	- 3.521	0.651	0.063	- 1.258
5	Forestry, hunting and fishing	0.638	- 0.150	0.001	0.206	- 0.066	4.048	0.688	- 0.148	- 0.377	0.701	- 0.051	- 1.385
6	Crude Oil and Natural Gas												
7	Non-metallic and metallic minerals												
8	Fresh and Processed Meat	1.215	- 0.057	- 3.997	0.919	0.023	- 1.470	1.015	- 0.021	- 2.231	0.723	0.071	0.353
9	Dairy products	0.968	- 0.007	- 3.186	0.968	- 0.034	- 3.038	0.905	- 0.022	- 2.542	0.755	0.016	- 1.071
10	Mill Products and Bakery	0.779	- 0.046	- 1.708	0.637	- 0.042	- 0.504	0.799	- 0.022	- 3.233	0.816	- 0.060	- 3.185
11	Sugar and Confectionery	0.747	0.025	- 1.235	0.783	0.008	- 1.656	0.965	- 0.002	- 3.616	0.778	0.050	- 2.013
12	Miscellaneous food products	0.880	0.078	- 2.224	0.748	0.132	- 1.297	0.939	0.150	- 3.406	0.646	0.255	- 0.912
13	Drinks	1.134	- 0.027	- 4.266	0.966	- 0.031	- 2.608	1.058	- 0.005	- 3.797	0.932	- 0.021	- 2.384
14	Other Manufacturing	0.832	0.079	- 1.742	0.745	0.028	- 0.535	0.918	0.037	- 2.944	0.900	- 0.016	- 2.418
15	Wood And Wood Products	1.032	- 0.061	- 4.032	0.734**	- 0.050	- 1.000	1.099	- 0.076	- 4.397	0.892	- 0.072	- 2.243
16	Paper and Paper Products	0.857	0.078	- 2.879	0.879	0.081	- 3.259	0.934	0.107	- 3.718	0.748	0.125**	- 1.797
17	Miscellaneous Manufactures Products												
18	Electricity, Gas and Water	0.796	- 0.066	- 0.989	0.926	- 0.039	-2.392**	0.915	- 0.036	- 1.987	1.011	- 0.019	- 3.062
19	Construction												
20	Trade												
21	Transportation and Storage	0.882	- 0.036	- 1.845	0.979	- 0.105	- 2.670	0.957	0.018	- 2.673	0.856	0.041	- 1.629
22	Communications	0.956	- 0.049	- 2.887	1.029	- 0.089	- 3.508	0.974	- 0.003	- 3.156	1.226	- 0.056	- 5.398
23	Financial Services	0.516	- 0.074	1.644	0.492	- 0.019	2.062	0.883	0.124	- 3.215	1.037	- 0.007	- 4.010
24	Services for Business	1.177	0.049	- 6.384	1.945	- 0.217	- 13.734	1.074	- 0.162	- 4.452	1.259	- 0.138	- 6.715
25	Ownership of Housing	1.068	- 0.036	- 3.218	0.904	0.010	- 1.740	0.951	- 0.046	- 1.438	1.180	- 0.123	- 3.544
26	Community, social and personal services	0.950	- 0.050	- 3.649	0.936	- 0.007	- 3.545	1.162	- 0.109	- 4.958	1.219	0.028	-6.145**
27	Restaurants and Hotels	0.976	- 0.051	- 2.585	1.119	- 0.078	- 3.897	1.010	- 0.041	- 2.714	0.984	- 0.117	- 1.912
28	Domestic Services	0.868	- 0.132	- 1.213	1.264	0.082	- 5.502	1.079	- 0.285	- 2.373	1.088	0.023	- 3.673
29	Services of Public Administration	0.910	- 0.024	- 4.711	1.036	- 0.154	- 5.169	0.960	- 0.066	- 4.628	1.254	- 0.140	- 7.200

Notes: *,**,*** statistically significant at the 10%, 5% and 1% levels, respectively.

Source: Authors' elaboration