

Is Fiscal Policy Alone Enough for Growth? A Simulation Analysis for Bolivia[♥]

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Abstract

In the last years there has been a renewed interest in fiscal policy as a tool to promote economic growth, and this has increased the use of quantitative models to evaluate the macroeconomic effects of changing taxes, increasing government expenditures and/or public investment. This paper develops a DSGE model for Bolivian economy with five sectors: Non-tradable, importable, hydrocarbons, mining and agriculture. We find that solely the fiscal policy is unable to generate the appropriate rates of growth to reduce poverty. It has to be accompanied by an efficient provision of public capital and productivity boosts in the economic sectors. This short-run and long-run analysis is relevant for the Bolivian economy, because the government is using fiscal policy as one of its main tools to attack poverty and aims to put public investment as the foremost instruments to promote growth and welfare.

Keywords: Fiscal Policy, Infrastructure, Multisector Growth Model

JEL Classification: E62, H54, O41

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1. INTRODUCTION

During the early nineties there was a boom of papers in the economic literature analyzing expansionary fiscal policies based on tax cuts or spending increases. In particular most of them were aimed to analyze the fiscal adjustments in a context of economic crisis. Giavazzi and Pagano (1990) were the first to argue that fiscal adjustments (deficit reductions) large, decisive and on the spending side could be expansionary. Alesina and Perotti (1997) investigate various episodes of fiscal adjustments arriving at the conclusion that fiscal stimuli based upon tax cuts are more likely to increase growth than those based upon spending increases.¹

Recently there has been a revival of this literature, in particular in the developed countries and mainly in the United States, due to the Financial Crisis of 2007-2009 and the recovery plans that have been implemented which are based mainly in fiscal policy responses. Feldstein (2009) indicates that although in the past there was a widespread consensus among economists that fiscal policy was not useful as a countercyclical instrument, now governments in Washington and around the world are developing massive fiscal stimulus packages, supported by a wide range of economists in universities, governments, and businesses. There has been a revival of the so called Fiscal Policy Multipliers.²

In Latin America and in Developing Countries the recently literature has concentrated mainly in verifying the idea that fiscal policy is procyclical, which is a puzzle that has sparked a growing theoretical literature that tries to explain it. Gavin and Perotti (1997) were the first to call attention to the fact, Talvi and Vegh (2005) claimed that procyclical fiscal policy seemed to be the rule in all the developing world and recently Ilizetki and Vegh (2008) using a battery of econometric tests, find overwhelming evidence to support the idea that procyclical fiscal policy in developing countries is in fact a truth and not a fiction.

¹ There is quite a rich literature that studies the determinants and economic outcomes of large fiscal adjustments. A non exhaustive-list includes Ardagna (2004), Giavazzi, Jappelli and Pagano (2000), Lambertini and Tavares (2000), McDermott and Wescott (1996), Von Hagen and Strauch (2001), Von Hagen, Hughes, and Strauch (2002), among others.

² See Maunford and Uhlig (2008), Alesina and Ardagna (2009), Cogan, et.al. (2009), Ramey (2009), and Romer and Romer (2010), among others.

The common thing in all this literature is the fact that all the analysis has concentrated in tax and expenditure policies and has left aside public investment policies, in particular those policies based on public investment in infrastructure. Infrastructure becomes an important source of growth as shown by Aschauer (1989a, 1989b). These works concentrated on the estimation of the production elasticities of government expenditure, using aggregated data for countries, mainly the U.S.³ There are also cross-country studies that emphasize the role of infrastructure for a country's growth.⁴

Papers in this literature have typically used regression analysis on either "growth accounting" or steady state equations. While these papers have been useful in pointing out the importance of infrastructure, their methodology does not allow for the analysis of important general equilibrium feedback effects among key macroeconomic variables and welfare.

In this sense, this paper examines the impact of fiscal policy on output, consumption, investment and foreign trade, using a Dynamic Stochastic General Equilibrium (DSGE) model for a small open economy with five sectors and with the new feature that firms in each sector employ public capital or infrastructure as a factor of production. These sectors which are the non-tradable sector (services), the importable sector (manufacturing), hydrocarbons, mining and agriculture are representative of the Bolivian economy. In particular the hydrocarbons sector, which is intensive in capital, is conceived by the government as a strategic sector that will generate resources necessary to attack poverty and underdevelopment.

In the paper, first we analyze the macroeconomic and sectoral impact of a change in government expenditures, tax structure and public investment in infrastructure on output, consumption, investment, trade balance and welfare, i.e. the macroeconomic impacts of fiscal policy. Second, we identify the combination of fiscal policy instruments that allow sustaining a social policy based on government transfers to households, and third we show that a fiscal policy solely is unable to generate the appropriate rates of output growth and welfare gains to reduce the poverty levels. A combination of an effective provision of public capital with an increase in productivity (TFP) is needed. In all the simulations we

³ Munnell (1990) and García-Milá, McGuire and Porter (1993) use Panel Data to estimate production elasticities.

⁴ See Easterly and Rebelo (1993), Ford and Poret (1991), Hulten (1996) and Canning (1998) among others.

provide quantitative calculations for the long-run as well as the dynamic transitions for selected cases.

The DSGE model is based on Chumacero, Fuentes, & Schmidt-Hebbel (2004) but modified to include public investment in infrastructure in a way similar to Rioja (2003) and sector division for the exportable sector as in Estrada (2006). We calibrated the model for the Bolivian economy and solved it using the second-order-approximation technique developed by Schmitt-Grohé and Uribe (2004). The advantage in using this perturbation method is that it allows considering second-order effects, which arise as important features in an economy with high levels of uncertainty.

An important aspect is that the model allows us to extract precise quantitative implications, because we examine the effects of a range of different scenarios on real output and welfare, as well as on other macroeconomic variables like consumption, investment and on output of the different five sectors. Model simulation results are reported first, for steady-state effects and then for the dynamic effects on the composition of these variables. This is important if we consider that in the last years, the Bolivian government has based its policy to attack poverty in transfers to households through bonuses, and aims to put public investment as the foremost instrument to promote growth and welfare. Certainly, quantitative measures of the impact of these policies are needed to guide the policymakers.

The paper is organized as follows. Section 2 briefly describes fiscal policy in Bolivia. Section 3 describes the dynamic general equilibrium model and its calibration for the Bolivian economy. Then in section 4 we present the simulation results for steady-state effects as well for the dynamic effects on selected macroeconomic and sectoral variables. Section 5 concludes.

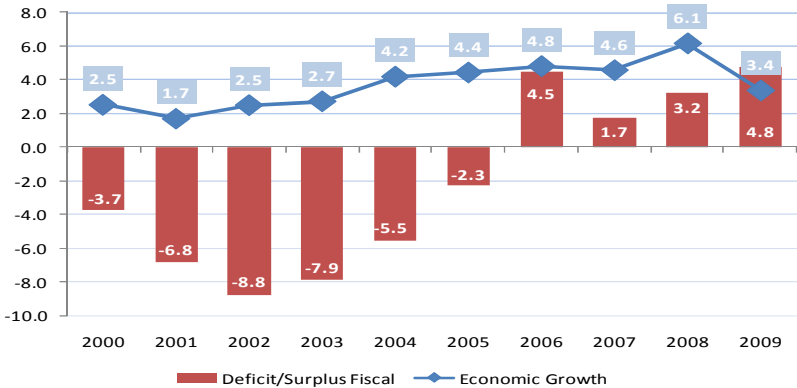
2. FISCAL POLICY IN BOLIVIA

Since 2006 the Bolivian economy has recorded a fiscal surplus, explained mainly by the international economic boom, translated into high export prices of the products that the country exports, more revenues from the Direct Tax on Hydrocarbons and from royalties which increased public sector revenues in an important manner. Between 2004 and 2008

government revenues increased from 28.5 percent of GDP to 48.4 percent of GDP. This increase of almost 20 percentage points of GDP is huge in terms of GDP.⁵

The following figure shows how these events affected the path of the fiscal deficit as a percentage of GDP and its close relationship with the rate of growth of the economy. Since 2002 the trend of the fiscal deficit was decreasing until turning into a surplus in 2006. The fiscal surplus was 4.5 percent of GDP, the highest in recent years, and the fiscal balance remained positive until 2009 inclusive.

Figure 1: Fiscal Surplus and Economic Growth (in percentages)



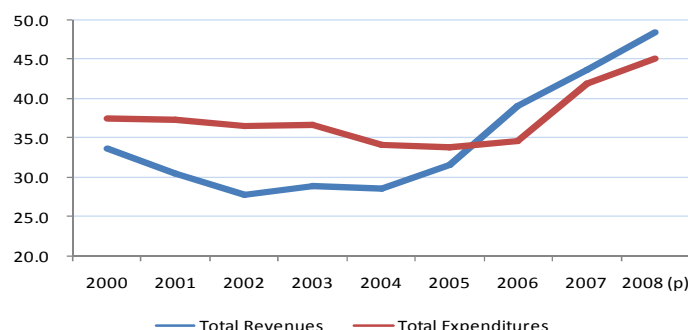
Source: Central Bank of Bolivia

The growth rate of the economy has been steadily growing since 2002 until 2008 and it is positively correlated with the public sector fiscal results. In the period 2004 - 2008 the average growth rate of the economy was 4.8 percent and in 2008 it was 6.1 percent, the highest rate of growth since 1975. In that sense, the economy experienced an unprecedented scenario with relatively important rates of growth and fiscal surpluses. This opens up a first question: Can these revenues be used to sustain economic growth?

On the other hand, government expenditures as a share of GDP remained constant until 2006 with a slightly decrease in 2003, but then they grew in the last 2 years. They represented 36 percent of GDP on average between 2000 and 2006 and then increased up to 42 percent and 45 percent of GDP in the years 2008 and 2009 respectively. In the following figure it can be seen that in the last years government expenditures grew but revenues grew in a larger magnitude.

⁵ For comparison, the fiscal revenues of the U.S. federal government increased by 18.7 percent of GDP in the last 40 years (U.S. Congressional Budget Office, 2009).

Figure 2: Total Expenditures and Revenues for the Non-Financial Public Sector (% of GDP)



Source: Central Bank of Bolivia

One explanation for the increase in government revenues lies in the continuous increase in tax revenues. Total tax revenues increased by 27.82 percent (average between 2005 and 2008). The principal taxes are the Value Added Tax (IVA) and the Direct Tax on Hydrocarbons (IDH), which together represent 50 percent of total tax revenues. In particular the Direct Tax on Hydrocarbon's, which is a tax on the export of hydrocarbons, displays the largest increase (52 percent on average), and this increase has been important in year 2006 which has been the year of the nationalization of the oil company (YPFB).

Table 1: Tax Revenues 2004-2009 (% variation)

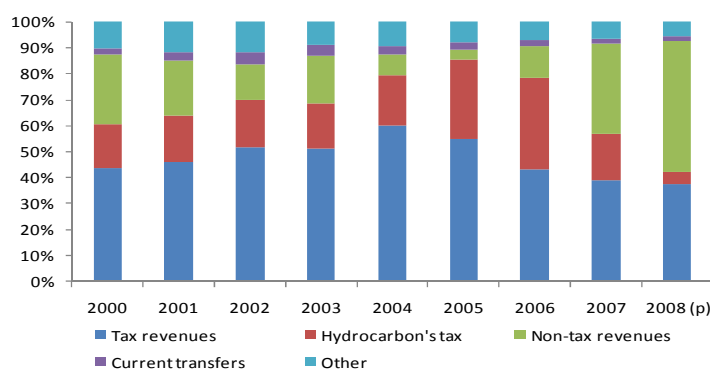
	2005	2006	2007	2008	2009 (p)	Average 2005-2008	Average 2005-2009
Value-added tax (IVA)	19.27%	21.75%	21.08%	23.24%	-7.31%	21.33%	15.61%
Transactions tax (IT)	8.77%	6.32%	14.87%	23.02%	-15.40%	13.25%	7.52%
Firm's profits tax (IUE)	41.75%	38.05%	6.49%	47.18%	59.30%	33.37%	38.56%
Specific consumption tax (ICE)	18.72%	18.08%	18.87%	19.64%	5.28%	18.82%	16.12%
Complementary regime-value-added tax (RC-IVA)	10.65%	1.23%	0.72%	18.83%	11.54%	7.86%	8.59%
Hydrocarbon's special tax (IEHD)	64.44%	6.04%	19.15%	6.18%	-29.20%	23.95%	13.32%
Financial transactions tax (ITF)	101.67%	-29.49%	-27.45%	5.15%	-0.48%	12.47%	9.88%
Others	-65.32%	8.90%	52.11%	32.29%	64.10%	6.99%	18.41%
Total Domestic Taxes	20.68%	16.63%	16.10%	24.79%	6.36%	19.55%	16.91%
Direct tax on Hydrocarbons (IDH)		136.12%	8.32%	11.57%	-2.68%	52.00%	38.33%
Import tariff (GA)	18.38%	15.74%	21.31%	25.99%	-16.22%	20.35%	13.04%
Total Domestic Taxes + IDH + GA	41.25%	34.10%	14.32%	21.61%	3.26%	27.82%	22.91%

Source: SIN-ANB

(p) preliminary information until September 2009

Regarding the composition of current revenues of the Non-financial public sector, it can be seen in figure 3 that tax revenues remain the main source of income, although non-tax revenues increased their participation due to the nationalization of the oil company (YPFB) in year 2006. Notice that the hydrocarbon's tax was an important source of revenues in years 2005 and 2006. In 2007 and 2008 non-tax revenues replaced the hydrocarbon's tax revenues. Therefore, it seems that it is not clear at all that the nationalization of the oil company represented an additional source of revenues as most people argue. Furthermore, non-tax revenues also include the sales (domestic and foreign) of other public companies that have been nationalized or have been created.⁶

Figure 3: Composition of Current Revenues of the Non-Financial Public Sector (% of total)



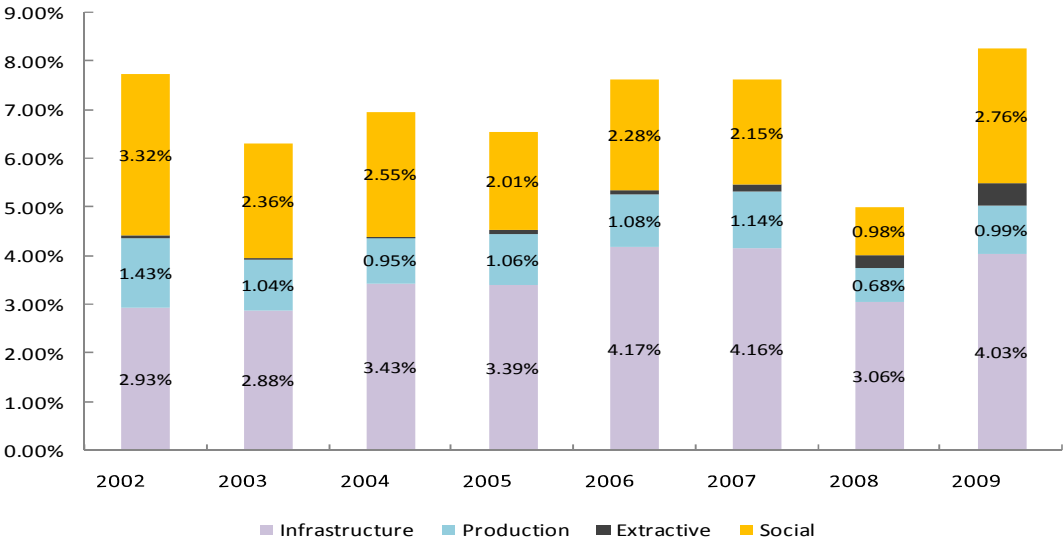
Source: UDAPE

Public investment was around 8 percent of GDP in 2006 and 2007. It decreased to 5 percent in 2008 and it increased again up to 8.5 percent of GDP in 2009. Figure 4 shows that public investment is mainly concentrated in infrastructure; the government invested on average 3.8 percent of GDP in infrastructure in the last 5 years. Social investment which comprises investment in health, education, sanitation and urbanization is in second place with an average of 2 percent of GDP in the last 5 years. It seems that public investment in infrastructure increased in line with the growth of the economy, but social investment remained almost unchanged. In recent years, government's capital spending has focused

⁶ Here we can mention the nationalization of Entel-the telecom company- in 2008, the creation of BOA –an aviation company- in 2008 and the reactivation of Comibol –the mining company- in 2009.

on road infrastructure and water resources, however since 2005 investment to support productive activities has again increased but not up to the levels reported in 2002. Certainly, investment in infrastructure plays a crucial role in any development strategy for Bolivia, since transport costs are very high, about 20 times higher than in Brazil, according to Weisbrot et al. (2009).

Figure 4: Public Investment (percentage of GDP)

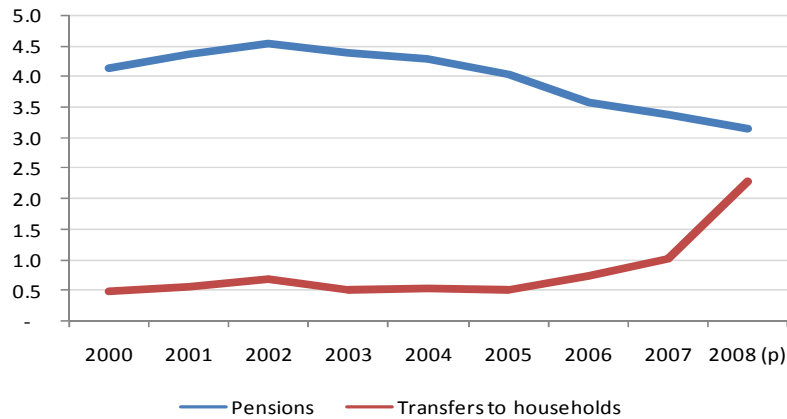


Source: Central Bank of Bolivia and Ministry of Economy and Public Financing

Bolivia’s poverty reduction strategy is based solely in the conditional transfers that the government gives to households. The amount transferred to households as a share of GDP has increased in the last 2 years. In fact, they increased from 0.7 percent of GDP in 2006 to 2.3 percent of GDP in 2008. In figure 5, we display also the pensions that the government had to transfer to households due to the change in the pension system from a pay-as-you-go system to a fully-funded system that occurred in 1996. In any case, it is important to have in mind that these transfers represent an important pressure for the fiscal budget and need to be managed efficiently.⁷

⁷ There are currently three types of conditional transfers: Renta Dignidad (for persons over 60 years of age), bono Juancito Pinto (for students in primary school) and bono Juana Azurduy (for mothers during and after pregnancy).

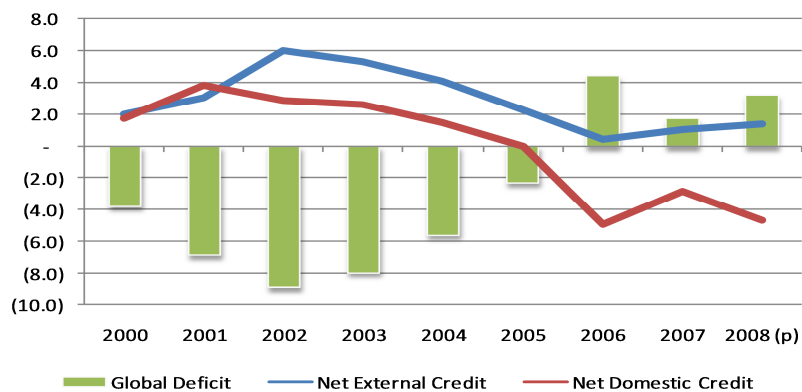
Figure 5: Current Transfers of the Non-Financial Public Sector (% of GDP)



Source: Central Bank of Bolivia

Finally, figure 6 shows the financing of the fiscal deficit in the last years. As it is common in budget accounting we observe the net external credit and the net domestic credit. During the years of a fiscal deficit (2000-2005) we observe an increase in the net external credit until 2002, but then it decreased continuously until 2006. The net domestic credit decreased also steadily from 2002 until 2006 and here it is important to mention that there has been a substitution between foreign and domestic debt, with domestic debt becoming more important than foreign debt since 2006. Most of the domestic debt is with the so called AFP's (Pension Funds Administrators) and with the Central Bank. However, the government has been able to reduce its debt with the Central Bank, due to the fiscal surpluses experienced in the last years. Therefore we observe negative values for the net domestic credit since 2006.

Figure 6: Financing of the Fiscal Deficit (% of GDP)



Source: Central Bank of Bolivia

In sum, there is a new scenario for the fiscal policy in Bolivia, with increasing revenues but also with new responsibilities for the public sector not only in terms of the State Owned Enterprises (SOE's), but also in terms of the social policy that the government is committed to sustain to reduce the poverty levels in Bolivia. Of course this fiscal policy should be compatible with a sustainable growth and improving levels of welfare for people. These issues will be analyzed in the following sections.

3. MODELLING AND CALIBRATION

3.1 THE BASIC MODEL

The model is based on Chumacero, Fuentes, & Schmidt-Hebbel (2004) and modified in order to address the issue of public investment in infrastructure as in Rioja (2003) and expanded for a multisector economy as in Estrada (2006).

3.1.1 The Households

The economy is inhabited by infinitely-lived individuals who derive utility from consumption of importable goods ($c_{m,t}$), consumption of non-tradable goods ($c_{n,t}$) and government consumption (g_t) which is basically a public good that does not suffer from congestion. Therefore, a representative agent maximizes the expected value of lifetime utility as given by

$$E_t \sum_{t=0}^{\infty} \beta^t u(c_{m,t}, c_{n,t}, g_t) \quad (1)$$

The other goods that are produced in the economy are exportable goods which we denote x_h as the hydrocarbon good (natural gas), x_m as the mineral good (zinc, gold, silver or tin) and x_a as the agricultural good (soya, Brazilian nuts or quinoa).

Each household receives interest income rk , lump-sum transfers from the government Γ , profits from the importable, non-tradable, hydrocarbons, mineral and agricultural firms π_m ,

π_n , π_{xh} , π_{xm} and π_{xa} respectively⁸ and can also contract foreign debt abroad, b . The household's budget constraint is

$$(1 + \tau_m)(1 + \tau_c)c_{m,t} + (1 + \tau_c)p_{n,t}c_{n,t} + (1 + \tau_m)(1 + \tau_c)i_t + (1 + \tilde{r}_t)b_t \leq (1 - \tau_k)r_t k_t + \pi_{xh,t} + \pi_{xm,t} + \pi_{xa,t} + \pi_{m,t} + \pi_{n,t} + b_{t+1} + \Gamma_t \quad (2)$$

where τ_m is an import tariff, τ_k is the tax rate on capital income, τ_c represents the tax rate on consumption of importables and non-tradables, p_n is the relative price on the non-tradable good in terms of the importable good (used as numeraire) and \tilde{r} is the (net) interest rate paid on foreign debt. Private investment, which we denote by i , follows the standard law of motion for private capital:

$$k_{t+1} = i_t + (1 - \delta)k_t \quad (3)$$

where δ is the depreciation rate of private capital stock and k_t is the capital stock.

Household make choices of $c_{m,t}$, $c_{n,t}$, b_{t+1} and k_{t+1} , i.e the problem of the representative consumer can be summarized by the following Bellman equation:

$$v(k_t, b_t) = \beta v(k_{t+1}, b_{t+1}) + u(c_{m,t}, c_{n,t}, g_t) - \lambda_t \left[\begin{aligned} &(1 + \tau_m)(1 + \tau_c)c_{m,t} + (1 + \tau_c)p_{n,t}c_{n,t} + \\ &(1 + \tau_m)(1 + \tau_c)(k_{t+1} - (1 - \delta)k_t) + (1 + \tilde{r}_t)b_t - \\ &(1 - \tau_k)r_t k_t - \pi_{xh,t} - \pi_{xm,t} - \pi_{xa,t} - \pi_{m,t} - \pi_{n,t} - \\ &b_{t+1} - \Gamma_t \end{aligned} \right] \quad (4)$$

The first-order conditions are:

$$p_{n,t} = \frac{u'_{cn,t}}{u'_{cm,t}}(1 + \tau_m) \quad (5)$$

$$1 = \beta E_t \left[\frac{u'_{cm,t+1}}{u'_{cm,t}}(1 + \tilde{r}_{t+1}) \right] \quad (6)$$

⁸ Profits can be interpreted also as the retribution to the labor factor, since we are assuming that labor is sector specific.

$$1 = \beta E_t \left[\frac{u'_{cm,t+1}}{u'_{cm,t}} \left(\frac{(1-\tau_k)}{(1+\tau_m)(1+\tau_c)} r_{t+1} + 1 - \delta \right) \right] \quad (7)$$

Equation (5) states that the relative price between importables and non-tradables must equate the ratio of marginal utilities between both goods. The next two intertemporal conditions are the standard Euler equations that indicate that the marginal rate of substitution between consumption today and tomorrow, must equate their relative price, evaluated at the cost of foreign borrowing and the rate of return of capital investment, respectively.

3.1.2 The Firms

This economy is represented by five sectors which are: importables (manufacturing), non-tradables (services), hydrocarbons, mining and agriculture. In each sector there is an equal number of representative firms that require private capital k and public capital k_g to produce their goods. Firms do not directly own capital, they simply rent k_t each period from households at the domestic market rental rate of capital r_t . Public capital is provided freely by the government. We assume that labor is sector specific, which means that labor cannot move across sectors. The importable sector is in fact a domestic sector that produces import substitutes.⁹

The reason why public capital is included in the production functions of all sectors of the Bolivian economy is that Bolivia is a small and poor economy, therefore any productive activity requires, in one or another way, the support of the government. An appropriate way of capturing this is assuming that the government involvement in productive activities is reflected in the provision of infrastructure or public capital.

The firm's problem is static in this framework and sectoral profits are given by the following equations:

$$\pi_{m,t} = (1+\tau_m) f(z_{m,t}, k_{m,t}, k_t^*) - r_t k_{m,t} \quad (8)$$

$$\pi_{n,t} = p_{n,t} f(z_{n,t}, k_{n,t}, k_t^*) - r_t k_{n,t} \quad (9)$$

⁹ Imports and import substitutes are perfect substitutes, this means that they should be sold at the same price, therefore the domestic price of $y_{m,t}$ is equal to $(1+\tau_m)$.

$$\pi_{xh,t} = (1 - \tau_{xh})q_{xh,t}f(z_{xh,t}, k_{xh,t}, k_t^*) - r_t k_{xh,t} \quad (10)$$

$$\pi_{xm,t} = q_{xm,t}f(z_{xm,t}, k_{xm,t}, k_t^*) - r_t k_{xm,t} \quad (11)$$

$$\pi_{xa,t} = q_{xa,t}f(z_{xa,t}, k_{xa,t}, k_t^*) - r_t k_{xa,t} \quad (12)$$

where π_i are the profits of each sector i , z_i is a productive shock in sector i , k_i is the amount of private capital demanded in sector i and q_i is the relative price of good i in terms of the importable good. Public capital is the same for all sectors. The only difference is the intensity of usage of public capital in each sector. There is also a tax on the production of hydrocarbons which is denoted by τ_{xh} .

By maximizing the above profits directly with respect to the relevant capital stock we obtain the following first-order conditions:

$$(1 + \tau_m)f'_{km}(z_{m,t}, k_{m,t}, k_t^*) = r_t \quad (13)$$

$$p_{n,t}f'_{kn}(z_{n,t}, k_{n,t}, k_t^*) = r_t \quad (14)$$

$$(1 - \tau_{xh})q_{xh,t}f'_{xh}(z_{xh,t}, k_{xh,t}, k_t^*) = r_t \quad (15)$$

$$q_{xm,t}f'_{xm}(z_{xm,t}, k_{xm,t}, k_t^*) = r_t \quad (16)$$

$$q_{xa,t}f'_{xa}(z_{xa,t}, k_{xa,t}, k_t^*) = r_t \quad (17)$$

These equations describe the demand for capital services by firms of each production sector of the economy.

3.1.3 The Government

The government invests in infrastructure I , has current expenditure consumption g and provides lump-sum transfers to households Γ . The Government has the following budget constraint:

$$g_t + \Gamma_t + I_t = \tau_c(c_{m,t} + p_{n,t}c_{n,t} + i_t) + \tau_m(1 + \tau_c)(c_{m,t} + i_t) - \tau_m y_{m,t} + \tau_k r_t k_t + \tau_{xh} q_{xh,t} y_{xh,t} \quad (18)$$

where $y_{m,t}$ is the production of import substitutes (from the importables' sector). In fact the spending of imports ($c_{m,t}+i_t-y_{m,t}$) is what is being taxed by the tariff τ_m .

Public capital evolves according to

$$k_{g,t+1} = I_t + (1 - \delta_g)k_{g,t} \quad (19)$$

where $0 \leq \delta_g \leq 1$ is a constant depreciation rate of public capital.

As in Rioja (2003) we assume that only the effective measure of the stock of public capital k_g is useful for private production. That is,

$$k_t^* = \theta k_{g,t} \quad (20)$$

where $0 < \theta < 1$ is an infrastructure effectiveness index. The closer θ is to 1, the more effective the public capital stock, and the larger the benefit that firms get.

As usual, the government does not optimize any explicit objective function but instead its current expenditure follows the rule:

$$g_{t+1} = (1 - \rho_g)\bar{g} + \rho_g g_t + v_{g,t+1} \quad v_{g,t+1} \sim N(0, \sigma_g^2) \quad (21)$$

3.1.4 The Foreign Sector

An open economy has different properties than a closed economy. The main difference is that, if it is possible to import goods and capital, the economy having a low initial capital stock would prefer to run a current account deficit in the first periods, sustain a high level of consumption and pay later the rest of the world with a current account surplus. This is something that certainly does not happen in reality and makes the solution of the model difficult, because it induces multiple equilibrium for each different path of debt, and non-stationarity of the variables.¹⁰

Schmitt-Grohé and Uribe (2003) suggest five modifications to the standard small open economy model with incomplete asset markets to induce stationarity. We use the

¹⁰ See Fernandez de Cordoba and Kehoe (2000) for an application for Spain.

modification that employs a debt-elastic interest-rate premium, which has been used also by Bhandari et. al. (1990), Turnovsky (1997), and Osang and Turnovsky (2000).¹¹

Therefore we assume that the country faces an upward-sloping supply schedule for debt, reflecting the degree of risk associated with lending to the economy. This is expressed by assuming that the borrowing rate \tilde{r}_{t+1} , charged on foreign debt is of the form:

$$\tilde{r}_{t+1} = (1 - \rho_r)r^* + (1 - \rho_r)\varphi\left(\frac{b_t}{y_t}\right)^\omega + \rho_r\tilde{r}_t + v_{r,t+1} \quad \omega' > 0, \omega'' > 0 \quad (22)$$

where r^* is the exogenously given world interest rate and $\varphi(b_t/y_t)^\omega$ is the country-specific risk premium that increases with the stock of debt as a share of output. Two elements are fundamental in this specification. First, the convexity of the function is a convenient way of incorporating the ceiling on borrowing suggested by Eaton and Gersovitz (1981). Second, the type of AR(1) specification that incorporates uncertainty explains why we need to employ a stochastic model. Otherwise, by using a non-stochastic specification the model still presents the failure mentioned by Fernandez de Cordoba and Kehoe (2000).

The relative prices of the exportable goods in terms of the importables, i.e. the terms of trade are assumed to have the following law of motion:

$$q_{xi,t+1} = (1 - \rho_{qxi})\bar{q}_{xi} + \rho_{qxi}q_{xi,t} + v_{qxi,t+1} \quad v_{qxi,t+1} \sim N(0, \sigma_{qxi}^2) \quad (23)$$

where \bar{q}_{xi} is the unconditional expectation of the terms of trade and $i=xh, xm$ and xa .

3.1.5 Market-Clearing Conditions

We define the production function of any of the sectors by:

$$y_{i,t} = f(z_{i,t}, k_{i,t}, k_t^*) \quad (24)$$

where i again represent each of the five sectors. Remark that the public capital k^* is the same for all the sectors, which means that infrastructure will benefit all the sectors in the same manner. Public capital is a non-rival good.

¹¹ Other modifications imply a model with an endogenous discount factor, with convex portfolio adjustment costs, with complete asset markets, and without stationarity-inducing features.

Equations (24) and (25) represent the market clearing conditions. The first equation describes the equilibrium in the importable good market, which shows that the current account (CA) balance must be compensated by the capital account balance. The second equation is the typical equilibrium condition in the non-tradable good market.

$$CA \equiv -(b_{t+1} - b_t) = q_{xh,t}y_{xh,t} + q_{xm,t}y_{xm,t} + q_{xa,t}y_{xa,t} + y_{m,t} - c_{m,t} - g_t - i_t - I_t - \tilde{r}_t b_t \quad (24)$$

and

$$P_{n,t}y_{n,t} = P_{n,t}c_{n,t} \quad (25)$$

3.1.6 Competitive Equilibrium

A competitive equilibrium is a set of allocation rules $c_m=C_m(s)$, $c_n=C_n(s)$, $k_{+1}=K(s)$, $b_{+1}=B(s)$, $k_{+1}^*=K^*(s)$, $k_{xh,+1}=K_{xh}(s)$, $k_{xm,+1}=K_{xm}(s)$, $k_{xa,+1}=K_{xa}(s)$, $k_{m,+1}=K_m(s)$, $k_{n,+1}=K_n(s)$; a set of pricing functions $r=R(s)$, and $p_n=P_n(s)$; and the laws of motion of the exogenous state variables $s_{+1}=S(s)$, such that:

- Households solve the problem (4) taking as given s and the form of the functions $R(s)$, $P_n(s)$, and $S(s)$, with the equilibrium solution to this problem satisfying $c_m=C_m(s)$, $c_n=C_n(s)$, $k_{+1}=K(s)$, and $b_{+1}=B(s)$.
- Firms of the hydrocarbons, mining, agriculture, importable and non-tradable sectors maximize profits (13)-(17) taking as given s and the form of the functions $R(s)$, $P_n(s)$, and $S(s)$, with the equilibrium solutions to these problems satisfying $k_{xh,+1}=K_{xh}(s)$, $k_{xm,+1}=K_{xm}(s)$, $k_{xa,+1}=K_{xa}(s)$, $k_{m,+1}=K_m(s)$, $k_{n,+1}=K_n(s)$ and $k_{+1}^*=K^*(s)$.
- The economy-wide resource constraints (24) and (25) hold each period, and the factor market clears:

$$K_{xh}(s) + K_{xm}(s) + K_{xa}(s) + K_m(s) + K_n(s) = K(s)$$

3.2 FUNCTIONAL FORMS AND CALIBRATION

The model which is clearly non-linear, is difficult to solve analytically. The alternative is to use numerical methods. Therefore, we adopt functional forms for the utility and

productions functions and give values to the parameters of the model to match the Bolivian macroeconomic context in year 2006.

3.2.1 Functional Forms

The generic model presented above suggests the following functional form for preferences:

$$u(c_{m,t}, c_{n,t}, g_t) = \theta_m \ln(c_{m,t}) + \theta_n \ln(c_{n,t} + \mu g_t)$$

with $\theta_m, \theta_n > 0$ and $\theta_m + \theta_n = 1$. The parameter μ measures how a typical individual values public consumption relatively to private consumption. The specification for the relationship between private consumption of non-tradable goods and public consumption follows Aschauer (1985), Barro (1981) and Christiano and Eichenbaum (1992). We are assuming that consumption of public goods can be substituted (depending on the value of μ) with consumption of non-tradable goods and vice versa.¹²

For the production functions we employ the following specification:

$$f(z_{i,t}, k_{i,t}, k_t^*) = z_{i,t} k_{i,t}^{\alpha_i} (k_t^*)^{\phi_i}$$

where $\alpha_i + \phi_i < 1$ since both types of capital are fixed factors.

The parameter α_i is the compensation for capital as a share of output of sector $i = xh, xm, xa, m$ and n and ϕ_i is the coefficient of public capital in the production function that reflects the importance of infrastructure in each of the different five sectors of the economy.

The productivity shocks z_i follow standard AR(1) processes of the form:

$$z_{i,t+1} = (1 - \rho_i) \bar{z} + \rho_i z_{i,t} + v_{i,t+1} \quad v_{i,t+1} \sim N(0, \sigma_i^2)$$

3.2.2 Calibration

Once the laws of motion are specified, we accurately calibrate the model so that it can display the main characteristics of the Bolivian economy. We are considering 2006 as our

¹² It is reasonable to think that when individuals want to increase their consumption of health for example, they will sacrifice consumption of non-tradables like haircuts.

base year and the data used is quarterly. In table 2, we display the parameters of the model, which we assume, for now, that are invariant to changes in economic policies.

The first column of table 2 shows the deep parameters of preferences. The subjective discount factor β was set to make it consistent with a 10.66 percent annual rate at which Bolivians can borrow (\tilde{r} in our model). The parameters θ_m and θ_n are calibrated so as to reproduce the share of total consumption over GDP in steady state, where we define total consumption as consumption in importables plus consumption in non-tradables times its relative price. We set $\mu=0.5$ as a benchmark, implying there is imperfect substitution between private and public consumption.

Table 2: Parameters

Preferences	Prod. Functions	Technology Shocks	Fiscal Variables	Exogenous Prices
$\beta=0.975$	$\delta=0.028$ (yearly)	$\rho_{xh}=0.72$	$g=0.18$	$q_{xh}=0.174$
$\theta_m=0.4585$	$\alpha_{xh}=0.66$	$\rho_{xm}=0.53$	$\rho_g=-0.083$	$q_{xm}=0.14$
$\theta_n=0.5415$	$\alpha_{xm}=0.25$	$\rho_{xa}=0.45$	$\sigma_g=0.01$	$q_{xa}=0.19$
$\mu=0.5$	$\alpha_{xa}=0.19$	$\rho_m=0.4$	$\delta_g=2*\delta$	$\rho_{qxh}=0.87$
	$\alpha_m=0.58$	$\rho_n=0.51$	$\theta=0.613$	$\rho_{qxm}=0.91$
	$\alpha_n=0.38$	$\sigma_{xh}=0.014$	$\tau_m=0.1$	$\rho_{qxa}=0.86$
	$\phi_{xh}=0.25$	$\sigma_{xm}=0.009$	$\tau_c=0.13$	$\sigma_{qxh}=0.017$
	$\phi_{xm}=0.14$	$\sigma_{xa}=0.011$	$\tau_k=0.13$	$\sigma_{qxm}=0.01$
	$\phi_{xa}=0.12$	$\sigma_m=0.017$	$\tau_{xh}=0.32$	$\sigma_{qxa}=0.11$
	$\phi_m=0.07$	$\sigma_n=0.03$		$\phi=0.248$
	$\phi_n=0.25$	$z_{xh}=0.53$		$\rho_r=0.6576$
		$z_{xm}=0.72$		$\sigma_r=0.01146$
		$z_{xa}=0.57$		$\tilde{r}=0.048$
		$z_m=0.15$		$\omega=1.2$
		$z_n=0.75$		

Source: Author's calculations

The second column describes the deep parameters of the production functions. The depreciation rate of private capital δ has been set to 2.8 percent per year, which was obtained by calibrating the private investment. The output-factor elasticities α in each sector were obtained in the following manner: We have reduced the 35 sectors that represent the Bolivian economy in the 2006 input-output matrix, to 6 sectors that represent agriculture, hydrocarbons, mining, importables, non-tradables and infrastructure. In particular, we are considering as infrastructure sectors: i) energy, gas and water, ii) transport and storage and iii) communications. Then, we have used the value-added decomposition in factor payments for 1996 (the only year available) and imputed these

shares for our sectoral value-added of 2006. The corresponding calculations are shown in table A.1 of the appendix.

Key parameters are the infrastructure shares in each sector. We have used also our input-output matrix disaggregation, but here we employed the intermediate consumption of infrastructure in each of the five sectors of the model. In other words, we have calculated the ϕ 's as the share of intermediate consumption of infrastructure in agriculture, mining, hydrocarbons, importables and non-tradables. Recall that public capital is conceived assumed to be a free good in the model, therefore it seems strange to calibrate the share parameters of each sector using intermediate consumption which is expenditure. We have solved this concern by assuming that the government is giving subsidies to the private sector in order to produce the public goods. Although the government is providing the public capital, it is being produced by the private sector and in some manner its usage is being also paid by the firms. The corresponding calculations are shown in table A.2 of the appendix.¹³

The third column contains the TFP parameters. These parameters have been calibrated to match the closer as possible the share of output of each sector over GDP. The autorregressive coefficients and volatilities of the shocks were set so as to match the autocorrelation of output and standard deviations of residuals of AR(1) regressions for the sectoral outputs.¹⁴

The forth column shows the government parameters and fiscal variables. The parameters of the government expenditure AR(1) process have been obtained by performing a simple OLS regression, but the parameter g has been calibrated in order to match the government expenditure over GDP. The rate of depreciation of public capital δ_g has been estimated by the World Bank to be about twice as high as the rate of depreciation of private capital. The benchmark effectiveness parameter θ is estimated here based on data of the so called "Loss Indicators." In particular we have employed loss indicators of power, telecom, roads and water. Then, the Bolivian loss index across infrastructure types is calculated by taking a weighted loss and comparing it with the weighted average of

¹³ In fact a more correct specification of the production function should be:

$$f(z_{i,t}, k_{i,t}, k_t^*) = z_{i,t} k_{i,t}^{\alpha_i} (x k_t^*)^{\phi_i} \text{ where } x \text{ represents private intermediate consumption}$$

¹⁴ This parameter values are important to adjust the speed of convergence to the steady state.

industrialized countries. The calculations are shown in table A.3 of the appendix. According to these calculations, Bolivia has a level of effectiveness of 61.3 which means that infrastructure in Bolivia is 39 percent less effective than in the developing countries.¹⁵

The tax rates describe the Bolivian tax system. The consumption tax τ_c is approximated by the Value Added tax (IVA) which is 13%. The tax on capital income τ_k corresponds to the Complementary Regime Value Added tax (RC-IVA) which has also a rate of 13%. The tax on hydrocarbons τ_{xh} has a rate of 32%, which corresponds to the Direct Tax on Hydrocarbons (IDH for its initials in Spanish). Finally, the import tariff τ_m represents the average tariff for all the imported products; it has a value of 10%.

Finally in column 5 of table 3 we display the so called exogenous prices. All of them follow standard laws of motion and most of their parameters were estimated using OLS regressions. We calibrated the constant terms of the AR(1) specifications of these relative prices using the respective index prices calculated by the Bolivian Central Bank. Finally, we calibrated φ equal to 0.248 to match a ratio of external debt over GDP equal to 0.3790, which is consistent with the capital account balance in steady state. This value for φ combined with a value of ω equal to 1.2 gives a country risk value equal to 0.05857.

4. RESULTS

In this section we perform different simulations with key parameters of the model to quantify the effects of fiscal policy on several macroeconomic variables like output, consumption, investment, among others. We distinguish the long run effects from the short run dynamics. The long run effects are obtained by comparing the steady states of the model under the baseline scenario and under the simulations scenario. The short run dynamic effects require that we impose initial conditions, solve the model (find the policy functions of the control variables and the laws of motion of the endogenous state variables), and characterize the transition to the new steady state.¹⁶

¹⁵ We use the same weights as in Rioja (2003), this means 0.40, 0.10, 0.25, 0.25 for power, telecom, paved roads and water systems respectively. In developing countries the effectiveness index θ is normalized to 1, which means that infrastructure is highly effective.

¹⁶ According to our specification, the policy functions of the control variables cannot be obtained analytically and we have to resort to numerical methods. We used the Schmitt-Grohé and Uribe (2004)

4.1 STEADY STATE COMPARISONS

In this sub-section we present long run effects results or steady state changes in: consumption of each good (c_m, c_n), physical production in each sector ($Y_{xh}, Y_{xa}, Y_{xm}, Y_m, Y_n$), the reciprocal of the exchange rate (p_n), government lump sum transfers as a fraction of output (Γ , as a proxy for additional pressures on the government budget), private investment (i), public investment (l), total real consumption (C), total real output (Y) and welfare compensation (TU).¹⁷

Recall that the aim of this paper is to find out the optimal fiscal policy in terms of growth, and social transfers, therefore we have ordered the long run analysis of the results in the following manner:

4.1.1 Tax Policy

We analyze a fiscal policy based solely in changes of the tax rates for the four taxes considered in our model. By reducing and increasing the import tariff, we analyze a more or less opened economy. For instance 0 percent tariff can be interpreted as a fully opened economy, while a 20 percent tariff can be translated into a less world linked economy. In the Value-Added tax simulation we simulate an increase in the tax rate up to the Latin America's average. According to Otalora (2009) the Latin America's average is 14.05 percent. In the capital and hydrocarbon's tax simulations we perform a 10 percent increase and decrease of these tax rates. Table 3 displays the results of the tax policy simulations.

Table 3: Change in Steady State Values from a Tax Policy (in percentages)

Variables	$\nabla\tau_m$	$\Delta\tau_m$	$\Delta\tau_c$	$\nabla\tau_k$	$\Delta\tau_k$	$\nabla\tau_{xh}$	$\Delta\tau_{xh}$	$\nabla\tau_m,$ $\Delta\tau_c$	$\nabla\tau_k,$ $\Delta\tau_c$	$\Delta\tau_{xh},$ $\Delta\tau_c$
Simulated Value	0	0.2	0.1405	0.117	0.143	0.288	0.352	0, 0.1348	0.117, 0.1322	0.352, 0.1380
c_m	6.49	-5.55	-0.51	2.28	-2.32	3.55	-3.39	6.32	2.19	-3.78

second-order approximation technique. This perturbation method has been proven superior to the traditional linear-quadratic approximations.

¹⁷ To abstract from changes in relative prices, total consumption (C) and total output (Y) are measured at the initial baseline prices. TU is defined as the subsidy (tax if negative) in terms of consumption of importables, non tradables and public services that would be needed to compensate (take from) the consumer in order for him to be indifferent between the situation before and after the change is made.

c_n	2.05	-2.15	0.42	1.34	-1.41	2.25	-2.23	2.30	1.46	-1.93
Y_{xh}	18.03	-	1.02	2.47	-2.57	11.61	-	18.65	2.74	-10.21
		14.85					10.90			
Y_{xa}	2.03	-2.00	0.36	0.29	-0.30	0.51	-0.52	2.20	0.37	-0.27
Y_{xm}	2.92	-2.84	0.40	0.41	-0.45	0.63	-0.69	3.13	0.50	-0.37
Y_m	-0.26	0.02	-0.63	2.00	-2.00	0.57	-0.59	-0.53	1.88	-1.09
Y_n	2.05	-2.15	0.42	1.34	-1.41	2.25	-2.23	2.30	1.46	-1.93
p_n	-5.05	5.20	-0.90	0.98	-0.99	1.38	-1.28	-5.42	0.79	-1.98
Γ/GDP	-8.10	1.54	17.60	-3.83	3.26	11.96	-	0.00	0.00	0.00
							13.28			
i	6.57	-5.26	-1.23	3.58	-3.55	3.57	-3.31	6.03	3.33	-4.25
I	-1.56	0.12	3.89	-0.44	0.27	3.48	-3.57	0.27	0.43	-0.72
C	4.03	-3.67	0.01	1.76	-1.81	2.83	-2.75	4.09	1.79	-2.75
Y	3.30	-3.02	0.13	1.56	-1.60	2.59	-2.51	3.41	1.61	-2.43
TU	3.86	-3.82	-0.02	1.71	-1.83	2.71	-2.79	3.91	1.73	-2.81

Source: Author's calculation.

Notice that a fully opened economy (column 1) allows the economy to grow by 3.3 percent, with welfare increasing by 3.86 percent. The reduction in the price of the capital good (importable) raises the value of the marginal productivity in the exportable and non-tradable sectors, while keeping it constant in the importable sector. Therefore Y_{xh} , Y_{xa} , Y_{xm} and Y_n increase and Y_m decreases by -0.26 percent. Consistent with the tariff reduction, the real exchange rate depreciates by -5 percent. The opposite effects occur when there is an increase in the import tariff (second column). Indeed, most of the results are in the same magnitude but with negative sign, except in transfers as a share of GDP. By opening the economy, transfers are reduced by -8.1 percent, as a result of the decrease in government revenues, but by closing the economy transfers increase only by 1.54 percent.

An increase in the value-added tax (third column), although very beneficial for transfers as a share of GDP, which increase by 17.6 percent, is not so good in terms of output. Total real output increases only by 0.13 percent and all the sectors' output increase by less than 1 percent with the exception of hydrocarbons which grows by 1 percent and importables which decreases by -0.63 percent. Despite the endogenous increase in the lump sum transfer, the net welfare effect is almost null (-0.02 percent) which is explained mainly by the decrease in consumption of importables (-0.51 percent). Private invested is adversely affected also, it decreases by -1.23 percent, but certainly public investment is largely benefited, it can be increased by 3.89 percent.

The literature on optimal fiscal policy states that capital taxes should be zero. Here, a reduction in the capital tax promotes aggregate capital accumulation and this increases

the amount of capital used in each sector, and thus output in each sector. The sector that most benefits from a reduction in capital tax is the hydrocarbon sector, its output increases by 2.47 percent. Certainly, this happens because the hydrocarbon sector is intensive in capital (α larger than 0.5). The other sector that is intensive in capital which is manufacturing (importables) grows by 2 percent. Notice that the effects of an increase or a decrease in capital tax are almost linear. When capital tax increases by 10 percent, aggregate output decreases by -1.6 percent while it increases by 1.56 percent when capital tax decreases by 10 percent.¹⁸

Production in the hydrocarbon sector is highly sensitive to variations in the tax on the production of this sector. Notice that a 10 percent decrease in this tax, increases output in this sector by 11.61 percent, while in the opposite simulation, it decreases by -10.9 percent. What is interesting from this simulation is precisely that government revenues are increased, because output in the hydrocarbon sector increases a lot. Even though the tax rate is reduced (column 6), transfers over GDP are increased by 11.96 percent, which is a magnitude similar to the increase in output of the hydrocarbons' sector. Consumption of tradable and non-tradable goods is also positively affected, which allows the government to collect more revenues through the consumption tax.

Finally, in the last three columns of table 4, we simulated three combined scenarios, where transfers over GDP remain constant in comparison to the baseline scenario. This is to analyze the needed increase in consumption or value-added tax to compensate the negative effects of those tax policies that showed negative effects on transfers over GDP.

Among the three combined scenarios, the best is the scenario that combines a fully opened economy ($\tau_m=0$) with a 3.72 percent increase in the value-added tax. The scenario that combines a decrease in the capital tax with an increase in the value-added tax is also good in the sense that the impact on all variables is positive although low, whereas the scenario that combines an increase in the hydrocarbons tax with an increase in the value added tax is bad, because the impact on all variables is negative.

From these simulations, we can conclude that the best Bolivia can do in terms of a tax policy is to liberalize the economy by reducing the tariffs. This policy allows the economy to grow by 3.3 percent and to experience welfare gains of 3.86 percent. If in addition, the

¹⁸ See Chamley (1986) and Chari, Christiano and Kehoe (1994) for references on optimal fiscal policy.

government wants to maintain its social policy based on transfers to households, it should increase the value-added tax. This combined policy allows the economy to grow by 3.41 percent and to experience welfare gains of 3.91 percent.

4.1.2 Expenditure and Investment Policy

Next, we analyze a fiscal policy based solely in public expenditures and public investment. Recall that in our setting, public consumption includes everything that is not investment; this means that health and education expenditure is considered in this variable among other expenditures like wages and benefits for public workers. First, we simulate a 10 percent increase in public expenditure. Second, we simulate an increase in public investment as a share of total government revenues. We simulate an increase of this share equal to the average of years 2007 and 2008. Finally, we combine a 10 percent increase in public expenditure with a 10 percent increase in public investment.

Table 4: Change in Steady State Values from an Expenditure and Investment Policy
(in percentages)

Variables	Δg	Δ/Y_g	$\Delta g, \Delta/Y_g$
Simulated Value	0.198	0.2756	0.198, 0.2936
c_m	-4.36	1.31	-0.41
c_n	-2.92	1.80	2.52
Y_{xh}	-2.95	3.68	8.22
Y_{xa}	-0.61	0.76	1.66
Y_{xm}	-0.79	0.95	2.09
Y_m	-0.69	0.85	1.86
Y_n	-2.92	1.80	2.52
p_n	-2.06	-0.41	-3.17
Γ/GDP	-51.55	1.49	-45.02
i	-2.38	1.37	1.76
I	-4.12	5.19	11.69
C	-3.56	1.58	1.21
Y	-1.86	1.58	2.90
TU	-3.38	1.51	1.33

Source: Author's calculation.

People always expect to find a positive effect on output from an increase in government expenditure or public investment. Cross-country empirical studies have generally found that public infrastructure has positive effects on a country's productive performance (e.g, Easterly and Rebelo (1993), Canning and Fay (1993), Canning (1999)) and this is indeed

the case of Bolivia. An increase in public investment as a share of government revenues by 3.26 percent (average of the last two years) increases output and public investment by 1.58 percent and 5.19 percent respectively. However, the opposite happens when the government increases its current expenditures. An increase by 10 percent of government expenditures decreases output by -1.86 percent and consumption by -3.56 percent. Certainly, an increase in government expenditure represents an important pressure for fiscal balance, since transfers as a share of GDP have to be reduced by -51.55 percent.

The combined scenario allows us to identify that transfers to households are very sensitive to an increase in government expenditures; they remain high and negative, whereas aggregate output, consumption and investment show positive signs. In particular public investment shows an important increase (11.69 percent). Notice also that in the first and third columns the real exchange rate depreciates, however only in the combined scenario this depreciation has a positive effect on outputs of the exportable sectors. In the case where only government expenditure increases, the negative sign on all sectoral outputs is explained by the reduction in public investment, which affects public capital and therefore output in all sectors.

In conclusion, between a public expenditure policy and a public investment policy, the government should choose the latter. This result opens another question: If we are considering that education and health is included in the variable g , does this mean that it is bad for the government to increase these expenditures? This question will be answered in the next exercises.

4.1.3 Tax and Expenditure Policy

Let's start answering the question stated above by combining the 10 percent increase in government expenditures with an increase in the two main taxes that are available for the Bolivian government, the value-added tax and the hydrocarbon's tax. In particular we aim to calculate the needed variation in tax rates in order to compensate for the negative effect of government expenditures on transfers to households.

Table 5: Change in Steady State Values from a Tax and Expenditure Policy (in percentages)

Variables	$\Delta g, \Delta \tau_c$	$\Delta g, \Delta \tau_c$ and $\nabla \tau_{xh}$
Simulated Value	0.198, 0.1627	0.198, 0.1405 and 0.2328
C_m	-6.14	5.12
C_n	-2.00	3.68
Y_{xh}	-0.50	30.88
Y_{xa}	0.34	1.08
Y_{xm}	0.30	1.32
Y_m	-2.77	0.18
Y_n	-2.00	3.68
p_n	-4.75	1.11
I/GDP	0.00	0.00
i	-6.29	6.53
I	6.95	9.09
C	-3.85	4.32
Y	-1.74	5.48
TU	-3.77	4.30

Source: Author's calculation.

The results in table 5 indicate that to compensate the negative effect on transfers as a share of GDP from a 10 percent increase in government expenditures an increase of 25 percent in the consumption tax is needed. This is certainly a huge increase and it is reflected in the negative effects on growth, consumption, private investment and welfare. In fact, only public investment displays a positive reaction by increasing by 6.95 percent.

Therefore, in the second column we combine the 10 percent increase in government expenditures, with an increase in the value added tax up to the Latin America's average and with a decrease in the hydrocarbon's tax. We find out that this is indeed a better policy, since all the variables display a positive reaction. In particular notice that output in the long run grows by 5.48 percent, which is the best rate of growth observed in all the simulations performed until now. Certainly this important impact is driven by the 30.88 percent increase in hydrocarbon's output, which is the main sector of the Bolivian economy.

4.1.4 Fiscal Policy complemented with Efficiency and Productivity

In this subsection we analyze fiscal policy combined with two variables that are not directly related to fiscal policy, but the government can in some manner provide the incentives to promote them. They are first efficiency, which is related to an improvement in the way

public investment (in infrastructure) is provided, and second productivity, which is related to an improvement in Total Factor Productivity in all the sectors.

According to the National Development Plan (PND for its initials in Spanish) in the period 2006-2011, Bolivia should have reached an average annual growth in output of 6.3 percent. To attain this overall rate of growth, the sectors should have grown (annually) by 3.1 percent (agriculture), 6.8 percent (importables), 18.8 percent (non-tradables), 13.2 percent (hydrocarbons) and 10.4 percent (mining). We have re-calibrated the TFP parameters in each sector in order to attain these rates of growth in each of the sectors. As we are using quarterly data, the TFP parameters have been calibrated for quarterly rates of growth.¹⁹

Rioja (2003), shows that raising effectiveness has sizable positive effects on private investment, consumption and welfare. We simulated a 5 percent increase in the level of effectiveness of the existing infrastructure network, i.e. the value of θ increased up to 0.644. The first two columns in table 6 show the effects of increasing TFP and θ , while the next columns show five combined exercises where we found out which should be the best fiscal policy the government should follow in Bolivia.

Table 6: Change in Steady State Values from a complemented Fiscal Policy (in percentages)

Variables	ΔTFP	$\Delta\theta$	$\Delta g,$ ΔTFP	$\Delta g,$ ΔTFP and $\Delta\theta$	$\Delta g,$ ΔTFP and $\Delta\theta$	$\Delta g,$ $\Delta\theta$	$\Delta g, \Delta I/Y_g$ and $\Delta\theta$
Simulated Value	(*)	0.644	0.198, (*)	0.198, (*) and 0.644	0.198, (*) and 0.69	0.198, 0.721	0.198, 0.2936 and 0.7
C_m	3.29	3.04	-1.06	2.08	6.76	6.33	9.54
C_n	6.67	3.40	3.67	7.29	12.67	9.00	13.70
Y_{xh}	4.75	6.35	1.76	8.31	18.38	19.72	30.50
Y_{xa}	1.27	1.29	0.68	1.98	3.88	3.81	5.69
Y_{xm}	3.10	1.61	2.32	4.01	6.45	4.82	7.21
Y_m	2.04	1.46	1.36	2.85	5.00	4.29	6.43
Y_n	6.67	3.40	3.67	7.29	12.67	9.00	13.70
p_n	-2.89	-0.20	-4.82	-4.96	-5.15	-2.49	-3.51
Γ/GDP	13.06	13.80	-36.61	-21.42	0.00	0.00	0.00
I	2.90	2.63	0.52	3.22	7.25	6.82	10.42

¹⁹ The PND expresses the economic and planning strategy that the government will follow in the next years to consolidate the process of transformation of the economy.

I	3.70	3.80	-0.42	3.50	9.42	9.32	25.75
C	5.16	3.24	1.56	4.96	10.03	7.81	11.84
Y	4.23	2.83	2.34	5.30	9.71	8.05	12.27
TU	4.72	3.06	1.60	4.70	8.97	7.23	10.46

Source: Author's calculation.

Note: (*) The percentage increases (in percentages) are: 0.6 (tradables), 4.3 (non-tradables), 0.71 (hydrocarbons), 1.8 (mining) and 0.6 (agriculture).

By comparing columns 1 and 2, we can see that both changes have a positive impact in the economy. There are similar variations in public and private investment, although consumption increases in a larger magnitude when there is an increase in TFP, therefore output shows a larger increase (5.16 percent). The favorable productivity boost raises output in the non-tradable sector by 6.67 percent, while the increase in effectiveness has its larger impact in hydrocarbon's output, it rises by 6.35 percent. Welfare gains are also larger in the TFP simulation than in the effectiveness simulation and transfers as a share of GDP increase in similar magnitudes in both scenarios. A first conclusion would be that productivity and effectiveness are important sources of growth, but need to be accompanied by fiscal policy to reach larger rates of growth.

In the third and four columns we combine productivity and effectiveness with government expenditures. We combine a 10 percent increase in government expenditures with an increase in TFP in all sectors. The results show that now an expansive fiscal policy based in current expenditure can increase output by only 2.34 percent, but what is worse is that transfers as a share of GDP decrease by -36.61 percent. If we add a 5 percent increase in θ , we still observe that transfers over GDP decrease by -21.42 percent, but output rises by 5.3 percent which is a much better rate of growth. These results indicate that by increasing the effectiveness of public infrastructure we can enhance growth. The question is how much should the effectiveness index increase, if the government wants to break the trade-off between transfers (social policy) and growth.²⁰

The fifth column shows that the effectiveness index should increase up to a value of 0.69, i.e. a 12.47 percent increase, in order to maintain the social policy inalterable. Furthermore, output grows by 9.71 percent, which is an appropriate rate of growth for a country that needs to reduce its poverty levels. Private and public investment are also strongly benefited, they increase by 7.25 percent and 9.42 percent respectively. Welfare

²⁰ We are not considering a larger increase in TFP, because this is certainly something more difficult to achieve. It is a variable related to many things in the economy, it is not directly to fiscal policy and takes time to improve.

also rises by 8.97 percent, which is explained mainly by the 12.67 percent increase in consumption of non-tradable goods.

Important and sizable effects but in a smaller magnitude can be seen when we drop out the increase in TFP. Total real output increases by 8.05 percent, welfare gains are in the order of 7.23 percent and total real consumption rises by 7.81 percent. Lump sum transfers remain constant, since the effectiveness index has increased by 17.7 percent. Unfortunately, a metric to infer if this magnitude is big or small is not available. Rioja (2003) computes a value for θ equal to 0.74, which is the average for seven Latin American countries. If we consider this value as a benchmark, we can say that if Bolivia manages to approximate to this value, the country will be able to develop a fiscal policy based on public expenditures, without affecting growth and its social policy. This is something new, because it shows a link between effectiveness in the provision of public infrastructure, public expenditures (health and education) and social policy (transfers to households).

In the last column, we add a 10 percent increase in public investment as a share of government revenues. This allows reducing the needed increase in effectiveness and presents the best case scenario for Bolivia. All the main macroeconomic variables boost in magnitudes larger than 10 percent. In particular public investment is largely improved, rising by 25.75 percent. This result shows the importance of public investment, but accompanied with effectiveness as stressed by Rioja (2003).

Those Latin American countries that have experienced an increase in TFP are the ones that have been able to reduce their growth gap with developing countries like the US or UK. Our model demonstrates that this could be the Bolivian case also, if the country begins to dismantle all the restrictions and distortions that impede a productivity expansion. But, it is not only TFP that could promote the development of the country, because certainly an output increase of 4 percent in the long run is still not sufficient to reduce poverty. Therefore, we can state that there is room for government policies based on public investment in infrastructure or public expenditures, but with effectiveness. This combination will certainly help in reducing poverty and the economic sectors will grow in

an important magnitude solving also other problems like unemployment and reduced usage of installed capacity.²¹

4.2 IMPACT AND DYNAMIC TRANSITION EFFECTS

In the long run, we model fiscal policy and non-fiscal policy variations as permanent changes in the levels of tax rates levied on different sectors or as multiplicative shocks on their production functions. Thus, to quantify the long run level effects of these policies we concentrated on comparisons between two steady states.

Three issues are overlooked in the long run analysis: First, because of their nature fiscal policy produces gradual and not instantaneous changes in the macroeconomic variables. Second, potential costs and benefits of policy changes have to be evaluated considering the period in which they go into effect (initial conditions are very different from steady-state conditions). Finally, the structure of the economy determinates the speed of convergence to the new steady state and the transitional dynamics.

Let s_0 be the values of the state variables in the initial period (that we calibrated to replicate the Bolivian economy in the year 2006). Let $G_i(\cdot)$ be the policy functions of the control variables and $S_i(\cdot)$ the implied laws of motion of the state variables for the baseline scenario B and the comparisons scenarios C1 and C2. Using the policy functions, laws of motion, and initial conditions, dynamic simulations are carried out for all variables of interest, where we determine the time it takes to reach the percentage changes obtained by increasing government expenditures and public investment as a share of government revenues by 10 percent and combining it with a 15.44 percent increase in the effectiveness of public capital (last column of table 6). In fact, this is our scenario C1 presented in the following table and in figure B1 in the appendix.

²¹ See Restuccia (2008) for a nice explanation of the low GDP per worker in Latin America based on a low and declining relative TFP.

Table 7: Dynamic Transition – Expansive Fiscal Policy + Effectiveness of Public Capital

Variable	Years							
	1	5	10	20	40	80	160	SS
Output	3.0%	3.8%	4.8%	6.6%	9.1%	11.3%	12.2%	12.3%
Consumption	0.7%	1.6%	2.7%	4.7%	7.8%	10.6%	11.7%	11.8%
Priv. Investment	1.5%	4.2%	6.5%	9.0%	10.4%	10.5%	10.4%	10.4%
Pub. Investment	20.3%	20.4%	20.7%	21.6%	23.3%	25.0%	25.7%	25.7%
Welfare	0.8%	1.6%	2.6%	4.5%	7.1%	9.5%	10.4%	10.5%

Sector	Years							
	1	5	10	20	40	80	160	SS
Hydrocarbons	9.6%	11.9%	14.4%	18.5%	23.8%	28.5%	30.3%	30.5%
Agriculture	2.1%	2.6%	3.1%	3.8%	4.7%	5.4%	5.7%	5.7%
Mining	2.6%	3.2%	3.8%	4.8%	5.9%	6.8%	7.2%	7.2%
Importables	1.2%	1.4%	1.7%	2.6%	4.1%	5.7%	6.3%	6.4%
Non-tradables	2.7%	3.8%	5.1%	7.2%	10.0%	12.6%	13.6%	13.7%

Source: Author's calculation

Recall that in the previous section we concluded that the best the Bolivian government can do is to increase government expenditures and public investment, but accompanied by an increase in the effectiveness of public capital, in order to compensate the negative effects on transfers to households, which result from increasing current expenditures mainly. The percentage changes were noteworthy, output, consumption and welfare increase by more than 10 percent. But, those percentage changes were changes in the long-run which we don't know how long it would take to reach it.

The results in table 7 show that after 160 years, the macroeconomic variables and sectoral outputs will be close to their steady state values. That is too much and the results can be even more disappointing if we consider that after 20 years output will grow only by 6.6 percent and welfare will improve only by 4.5 percent. After 5 years, Bolivia will be growing at its historical levels, around 4 percent.

These disappointing results lead us to analyze the scenario C2 where we added the productivity boost according to the PND goals. This increase in overall TFP will generate huge rates of growth in the steady-state, but appropriate rates of growth in the short-run as it is shown in the following table and in figure B2 in the appendix.²²

²² By appropriate rates of growth, we mean rates of growth able to reduce the poverty levels.

Table 8: Dynamic Transition – Expansive Fiscal Policy + Effectiveness of Public Capital + TFP Improvement

Variable	Years							
	1	5	10	20	40	80	160	SS
Output	5.3%	6.4%	7.7%	10.0%	13.2%	16.0%	17.1%	17.2%
Consumption	3.1%	4.5%	6.0%	8.7%	12.6%	16.3%	17.7%	17.8%
Priv. Investment	3.5%	7.2%	9.7%	12.4%	13.8%	13.9%	13.8%	13.8%
Pub. Investment	23.5%	23.7%	24.2%	25.4%	27.6%	29.7%	30.6%	30.7%
Welfare	2.9%	4.2%	5.5%	7.8%	10.9%	13.7%	14.7%	14.8%

Sector	Years							
	1	5	10	20	40	80	160	SS
Hydrocarbons	10.4%	13.5%	16.6%	21.7%	28.5%	34.4%	36.7%	36.9%
Agriculture	2.7%	3.3%	3.9%	4.8%	5.8%	6.7%	7.0%	7.1%
Mining	4.8%	5.6%	6.4%	7.5%	9.0%	10.1%	10.5%	10.6%
Importables	1.8%	2.1%	2.6%	3.8%	5.8%	7.8%	8.5%	8.6%
Non-tradables	7.2%	8.6%	10.2%	13.0%	16.7%	20.0%	21.3%	21.4%

Source: Authors' calculations

In table 8 it can be seen, that after 5 years the Bolivian economy can reach important rates of growth for output and private investment, 6.4 percent and 7.2 percent respectively. After 10 years the performance is even better and after 20 years it is the best. What is important here is to see that a moderate increase in TFP, as the one simulated by the PND goals, can have important consequences in the medium run in terms of growth and welfare. But if we want to increase the impact in the short run, a larger boost in TFP is needed.

In conclusion, fiscal policy by itself can help improving the economic performance, but if we really want to attain rates of growth on output (sectoral and total) and on other macroeconomic variables that could allocate Bolivia in a poverty reduction path, the help from an efficient provision of public capital and in particular from an important increase in productivity is needed.²³

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 allowed the country to reverse chronic fiscal and external deficits, and accumulate foreign exchange reserves up to a level never seen before (USD 7.7 billion in 2008 and USD 8.5 billion in 2009). In

²³ In appendix C we performed also a sensitivity analysis for the relative prices and the valuation of public consumption.

addition in the last four years, the Bolivian economy has grown more than in the last three decades, with an average of 5.2 percent, which positions the country in good shape to reduce poverty. Furthermore, since 2004 the government revenues have increased almost 20 percentage points of GDP. A large proportion of this increase is due to the increase of the revenues from hydrocarbons, and this occurred because royalties' payment increased, the government renationalized the industry and the international market experienced highest international oil prices. This unprecedented scenario allowed the government to push forward fiscal policy (expenditure and investment policy) and to put in place several transfer programs for poor people.

This paper has simulated the macroeconomic and sectoral impact of different fiscal policy scenarios by setting up a five-sector dynamic general equilibrium model for a small open economy, inhabited by representative infinitely-lived agents that face an upward sloping supply of foreign capital, reflecting an endogenous country risk premium. We included also public capital as a factor of production for firms, which allowed us to analyze the impact of public investment in infrastructure on sectoral outputs. Public capital displays non-rivalry and we have shown that its effective measure is useful to enhance growth and welfare. The model has been calibrated to match the national account ratios and sectoral output of the Bolivian economy for the base year 2006.

Simulation results for steady state comparisons indicate that the best fiscal policy based solely on tax changes is the one that combines a fully opened economy with a 3.71 percent increase in the value-added tax. This policy allows the economy to grow by 3.41 percent and sustain the social policy based on transfers to households. Then, we have analyzed a fiscal policy based on increases on government expenditures and on public investment. The results are noteworthy, government expenditures have negative effects on the economy, because it affects strongly the transfers that households receive. This negative effect reduces consumption of tradables and non-tradables and therefore the aggregate demand depresses. But public investment has positive effects, because it reinforces production in all sectors, although the growth and welfare gains are low.

These results are certainly controversial, first because they indicate that the economy cannot experience rates of growth above 6 percent which is the minimum growth required to reduce poverty and second, because it seems that public expenditure policies are bad. Therefore we have analyzed several combined scenarios and found that the

macroeconomic effects improve when we combine a 10 percent increase in government expenditures, an increase the value-added tax up to the Latin American average and a decrease in the hydrocarbons tax of -27.2 percent. In this setting the economy grows by 5.48 percent and the main push comes precisely from the hydrocarbon sector which grows by 30.9 percent.

Nevertheless, the results are still poor if we consider that we are analyzing the steady-state or in other words the long-run effects. So, we have introduced in the analysis productivity boosts through TFP increases in all sectors and an efficient provision of public capital, and we have found the best combination of fiscal policy instruments: If there is a 10 percent increase in government expenditures and in public investment but there is also a 15.4 percent increase in the effectiveness index of public capital, the government is able to sustain its social policy of transfers and the economy can grow by 12.3 percent. In addition if there is an increase in TFP according to the PND (National Development Plan) goals, the economy can grow by 17.2 percent and transfers can be increased by 13.7 percent. Finally, we simulated the dynamic transition paths for these two remarkable scenarios, because there is another important question: How long does it take the economy to reach these steady states. It takes more than 100 years, but even in the medium-run there are important effects, in particular when productivity increases. In 5 years, output can grow by 6.4 percent, consumption rises by 6 percent and private investment increases by 9.7 percent. After 10 years output grows by 7.7 percent and after 20 years it grows by 10 percent. In conclusion, larger productivity boosts are needed to promote growth and welfare in the short-run.

The paper has analyzed fiscal policy in Bolivia and has tried to guide the decisions that a government will have to take if it wants to put fiscal policy as the main tool to promote development and structural transformations of the Bolivian economy. The results should come as no surprise. Fiscal policy alone is unable to generate the appropriate rates of growth to reduce poverty, it has to be accompanied by productivity boosts in all sectors and also public capital should be provided with more efficiency. Certainly TFP enhancement is out of the scope of fiscal policy, or maybe there is something the government can do, in particular in removing distortions for the production sector. In any case TFP responds to the health of the whole macroeconomic context of an economy.

REFERENCES

- Alesina A., and R. Perotti (1997) "The Welfare State and Competitiveness," *American Economic Review*, 87, pp. 921-939.
- Alesina A., and S. Ardagna (2009) "Large changes in fiscal policy: taxes versus spending," paper prepared for Tax Policy and the Economy 2009, mimeo.
- Ardagna Silvia (2004), "Fiscal Stabilizations: When Do They Work and Why", *European Economic Review*, vol. 48, No. 5, October 2004, pp. 1047-1074.
- Aschauer, D. (1985) "Fiscal Policy and Aggregate Demand," *American Economic Review*, v.75, pp. 117-127.
- Aschauer, D.A. (1989a) "Is Public Expenditure Productive?" *Journal of Monetary Economics*, Vol. 23, pp: 177-200.
- Aschauer, D.A. (1989b) "Public Investment and Productivity Growth in the Group of Seven," *Economic Perspectives*, Federal Reserve Bank of Chicago, 13.
- Barja, G, J. Monterrey and S. Villarroel (2005) "The Elasticity of Substitution in Demand for Non-Tradable Goods in Bolivia. IADB (mimeo).
- Barro, R. (1981) "Output Effect of Government Purchases," *Journal of Political Economy*, v.89, pp. 1086-1121.
- Bhandari, J., N. Haque, and S. Turnovsky (1990) "Growth, External debt, and Sovereign Risk in a Small Open Economy," *IMF Staff Papers* 37, pp: 388-417.
- Canning, D. (1998) "A Database of World Infrastructure Stocks, 1950-1995," Policy research working paper, No 1929, Washington, D.C., World Bank.
- Canning, David (1999) "Infrastructure Contribution to Aggregate Output," World Bank Policy Research working paper 2246.
- Canning, David and Marianne Fay (1993) "The Effect of Transportation Networks on Economic Growth," manuscript, Columbia University.
- Cavalcanti, P. and L. Goncalves do Nascimento (2006) "Welfare and Growth Effects of Alternative Fiscal Rules for Infrastructure Investment in Brazil," Fundacao Getulio Vargas (mimeo).
- Chamley, C. (1986) "Optimal Taxation of Capital Income in General Equilibrium with Infinite Lives," *Econometrica*, Vol.54 (3), pp: 607-622.
- Chari, V.V., Lawrence Christiano and Patrick Kehoe (1994) "Optimal Fiscal Policy in a Business Cycle Model," *Journal of Political Economy*, Vol.102 (4), pp: 617-652.
- Christiano, L. and M. Eichenbaum (1992) "Current Real Business Cycle Theories and Aggregate Labor Markets Fluctuations," *American Economic Review*, v.82, pp: 430-450.
- Chumacero, R., Rodrigo Fuentes and Klaus Schmidt-Hebbel (2004) "Chile's Free Trade Agreements: How Big is the Deal?," Working Paper No. 264, Central Bank of Chile.
- Cogan, J, T. Cwik, J. Taylor and V. Wieland (2009) "New Keynesian versus Old Keynesian Government Spending Multipliers," mimeo.
- Easterly, W. and S. Rebelo (1993) "Fiscal Policy and Economic Growth: An Empirical Investigation," *Journal of Monetary Economics*, 32, pp: 417-458.
- Eaton, J. and M. Gersovitz (1981) "Debt with Potential Repudiation: Theoretical and Empirical Analysis," *Review of Economic Studies*, 48, pp: 289-309.
- Estrada, P. (2006) "Economía Pequeña, Abierta, Exportadora de Gas y Soya, con Shocks Internos y Externos: Cambios que Bolivia no esperaba", Universidad de Chile.
- Evans, P. and G. Karras (1996) "Private and Government Consumption with Liquidity Constraints," *Journal of International Money and Finance*, v.15, pp: 255-266.
- Feldstein, Martin (2009) "Rethinking the Role of Fiscal Policy," NBER Working Paper 14684.
- Fernandez de Cordoba, G. and T. Kehoe (2000) "Capital Flows and Real Exchange Rate Fluctuations Following Spain's Entry into the European Community," *Journal of International Economics*, 51, pp: 49-78.
- Ford, R. and P. Poret (1991) "Infrastructure and Private Sector Productivity," OECD Working Paper, 91.
- García-Milá, T., T. McGuire y R.M. Porter (1993) "The Effect of Public Capital in State- Level Production Functions Reconsidered," *The Review of Economics and Statistics*, Vol.LXXVIII, pp: 162-180.

- Gavin, Michael and Roberto Perotti (1997) "Fiscal Policy in Latin America," NBER Macroeconomics Annual.
- Giavazzi F., and M. Pagano (1990) "Can Severe Fiscal Contractions Be Expansionary? Tales of Two Small European Countries," NBER Macroeconomics Annual, MIT Press, (Cambridge, MA), pp. 95-122.
- Giavazzi, F., T. Jappelli, and M. Pagano (2000) "Searching for Non-Linear Effects of Fiscal Policy: Evidence from Industrial and Developing Countries," *European Economic Review*, 2000, vol. 44, n.7, 1259-1289.
- Hulten, C.R. (1996) "Infrastructure Capital and Economic Growth: How Well You Use It May Be More Important Than How Much You Have," NBER Working Paper 5847.
- Ilzetzki and Vegh (2008) "Procyclical Fiscal Policy in Developing Countries: Truth or Fiction?" NBER Working Paper 14191.
- Lambertini L., and J. Tavares (2001), Exchange Rates and Fiscal Adjustments: Evidence from the ECD and Implications for EMU.
- Mountford, Andrew and Uhlig, Harald (2008) "What Are the Effects of Fiscal Policy Shocks?" NBER Working Paper No. 14551, National Bureau of Economic Research, (December).
- McDermott J., and R. Wescott (1996) "An Empirical Analysis of Fiscal Adjustments," *IMF Staff papers*, vol. 43, n.4, 723-753.
- Ministry of Economy and Public Financing (2009) "Fiscal Memory". La Paz, Bolivia.
- Munnell, A. (1990) "How Does Public Infrastructure Affect Regional Economic Performance?" *New England Economic Review*, (September/October), pp: 11- 32.
- Osang, T. and S. Turnovsky (2000) "Differential Tariffs, Growth and Welfare in a Small Open Economy," *Journal of Development Economics*, 62, pp. 315-342.
- Otalora, Carlos (2009) *Economía Fiscal*, primera edición, Plural Editores, La Paz, Bolivia.
- Ramey, Valerie. "Identifying Government Spending Shocks: It's All in the Timing." Working paper, University of California at San Diego; NBER Working Paper No. 15464, National Bureau of Economic Research, October 2009.
- Restuccia, Diego (2008) "The Latin American Development Problem," Working Paper 318, University of Toronto, Department of Economics.
- Rioja, F.K. (2003) "The Penalties of Inefficient Infrastructure," *Review of Development Economics*, 7(1), pp: 127-137.
- Romer, C. and D. Romer (2010) "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks," *American Economic Review*, 100, pp.763-801. (June)
- Schmitt-Grohé S. and M. Uribe (2003) "Closing small open economy models," *Journal of International Economics*, 61, pp: 163-185.
- Schmitt-Grohé S. and M. Uribe (2004) "Solving dynamic general equilibrium models using a second-order approximation to the policy function," *Journal of Economic Dynamics and Control*, 28, pp: 755-775.
- Talvi, Ernesto, and Carlos A. Végh (2005) "Tax Base Variability and Pro-cyclical Fiscal Policy in Developing Countries", *Journal of Development Economics* 78, pp.156-190.
- Turnovsky, S. (1997) "Equilibrium Growth in a Small Economy Facing an Imperfect World Capital Market", *Review of Development Economics*, 1, pp: 1-22.
- Von Hagen J., A. H. Hallett, R. Strauch, (2002), "Budgetary Consolidation in Europe: Quality, Economic Conditions, and Persistence", *Journal of the Japanese and International Economics*, vol. 16, pp. 512-535.
- Von Hagen J., R. Strauch, (2001), "Fiscal Consolidations: Quality, Economic Conditions, and Success, Public Choice, vol. 109, no.3-4, pp 327-346
- Weisbrot, M., R. Ray and J. Johnston (2009) "Bolivia: La economía bajo el gobierno de Morales," Center of Economic and Policy Research, mimeo.

APPENDIX

A. Calibrations

Table A.1: Calibration of α

	1	2	3	4	5	24	27	28	
VA (in thousands of Bs. Of 1990)	Agriculture (1-5)	Hydrocarbons (6 y 19)	Mining (7, 20, 21 y 22)	Importables (8-18 y 23)	Non-tradables (25, 26 y 29-35)	Electricity, gas and water	Transport and storage	Communications	TOTAL
f-lab	6,444,261	798,415	3,384,730	3,270,488	19,476,173	535,857	4,447,022	120,588	38,477,535
f-cap	1,873,349	4,834,479	1,295,147	4,440,511	11,971,380	1,579,682	3,220,626	1,324,170	30,539,342
f-land	1,459,264	0	0	0	0	0	0	0	1,459,264
f-natres	0	1,670,433	511,687	0	0	0	0	0	2,182,120
total	9,776,874	7,303,326	5,191,564	7,711,000	31,447,553	2,115,539	7,667,648	1,444,758	72,658,262
in%									
f-lab	0.66	0.11	0.65	0.42	0.62	0.25	0.58	0.08	0.53
f-cap	0.19	0.66	0.25	0.58	0.38	0.75	0.42	0.92	0.42
f-land	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
f-natres	0.00	0.23	0.10	0.00	0.00	0.00	0.00	0.00	0.03
total	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Source: Input-output matrix (2006)

Table A.2: Calibration of ϕ

	1	2	3	4	5
Sectors					
Intermediate Consumption (thousands of Bs. Of 1990)	Agriculture (1-5)	Hydrocarbons (6 y 19)	Mining (7, 20, 21 y 22)	Importables (8-18 y 23)	Non-tradables (25, 26 y 29-35)
Agriculture	673,280	1,903	16,516	3,633,472	196,011
Hydrocarbons	37,740	1,171,274	106,898	154,590	187,431
Mining	31,698	162,272	585,708	574,910	1,022,309
Importables	528,444	88,162	257,327	2,823,865	2,331,561
Non-tradables	128,294	369,308	57,827	260,887	1,008,874
Electricity, gas and wáter	322	52,109	50,813	89,587	169,092
Transport and storage	186,842	534,921	102,381	403,240	1,161,924
Communications	1,781	3,935	18,218	66,670	235,227
Total	1,588,400	2,383,885	1,195,688	8,007,221	6,312,428
Infrastructure	188,944	590,965	171,412	559,497	1,566,243
Phis	0.12	0.25	0.14	0.07	0.25

Source: Input-output matrix (2006)

Table A.3. Calibration of θ

Year	Power (i)	Telecom (ii)	Paved Roads (iii)	Water (iv)
1995	11.56	n.a.	94.50	n.a.
1996	11.49	n.a.	94.50	n.a.
1997	11.61	n.a.	94.30	n.a.
1998	11.99	n.a.	94.00	n.a.
1999	11.41	n.a.	93.60	n.a.
2000	10.18	n.a.	93.40	n.a.
2001	12.40	n.a.	93.30	n.a.
2002	13.07	n.a.	93.30	n.a.
2003	14.35	n.a.	93.00	n.a.
2004	13.61	n.a.	93.00	n.a.
2005	13.95	n.a.	n.a.	n.a.
2006	14.36	n.a.	n.a.	37.03
2007	n.a.	17.76	n.a.	31.97
2008	n.a.	n.a.	n.a.	32.87

(i) Electric power transmission and distribution losses (% of output)

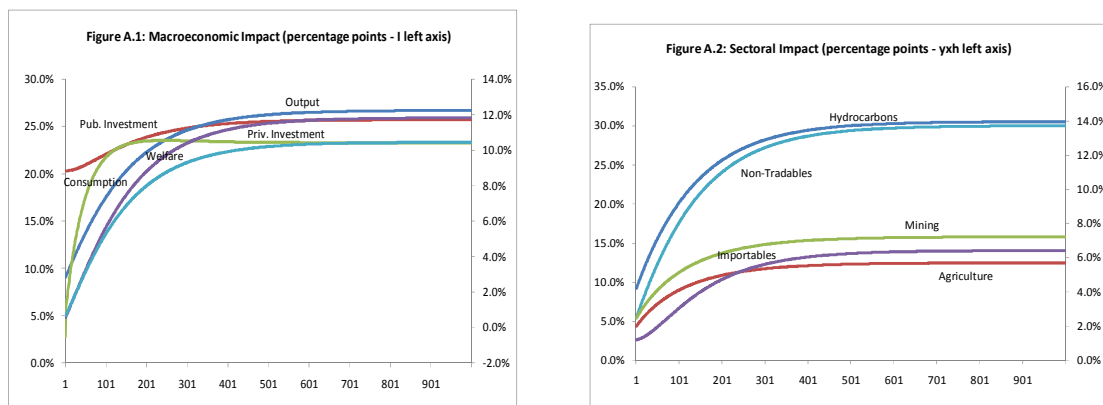
(ii) Faults (per 100 mainlines per year)

(iii) Roads, not paved (% of total roads)

(iv) Losses (% of total water provision)

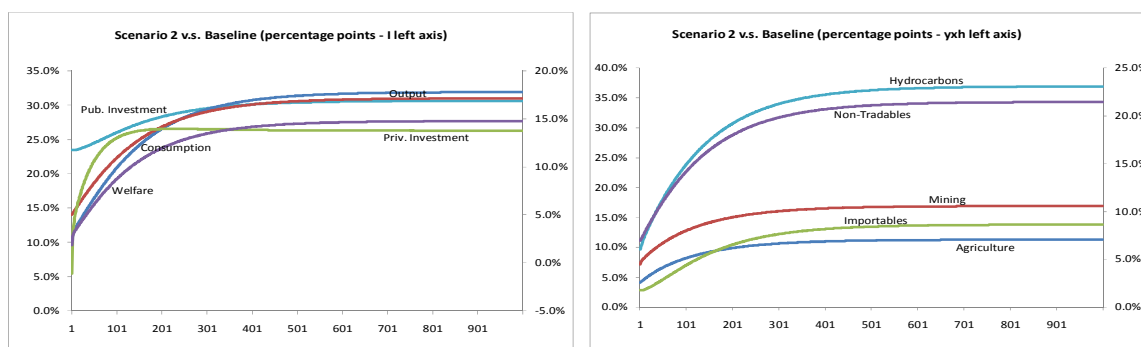
B. Dynamic Transitions

Figure B1: Baseline Scenario vs C1



Source: Authors' calculations

Figure B.2: Baseline Scenario vs C2



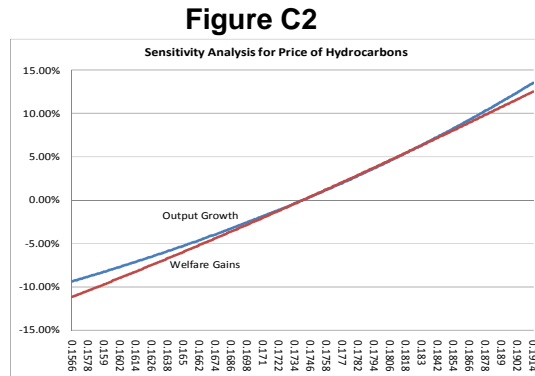
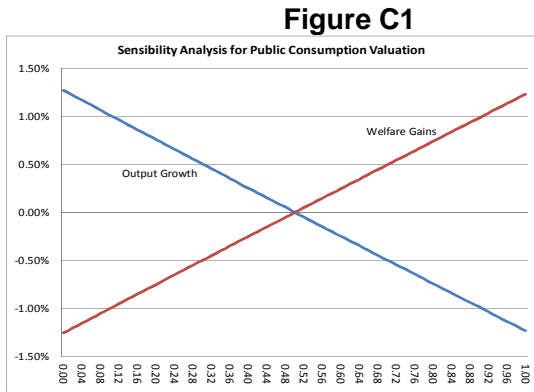
Source: Authors' calculations

C. Sensitivity Analysis

In this appendix we analyze how sensitive are the main results of the model to changes in the public consumption valuation and on relative prices. In particular, we simulate the effects on output growth and welfare gains by:

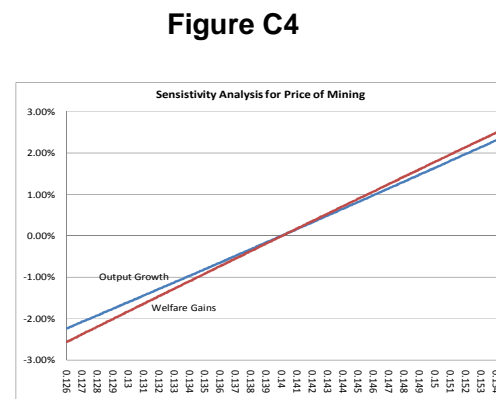
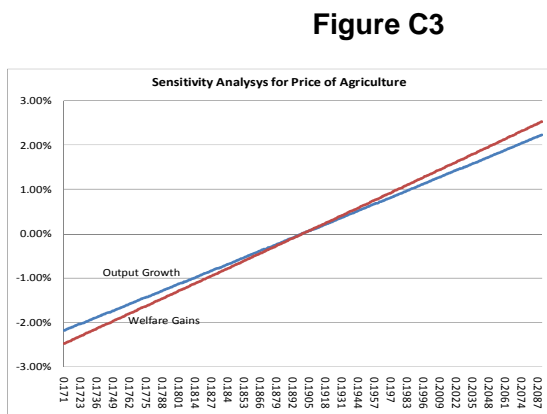
- Change in public consumption valuation. Public consumption is related to non-tradables' consumption by the parameter μ . We simulate an increase in μ to 1 which represents a situation where consumers weight public and private consumption equally and a decrease in μ to 0, where public consumption is pure waste.
- Change in relative prices (q_{xh} , q_{xa} and q_{xm}). The Bolivian Central Bank has computed these relative prices for the basic exportable products of Bolivia. According to these calculations, we simulate a 10 percent increase and decrease in the three prices.

The following figures display the results:



Source: Authors' calculations

Cavalcanti and Goncalvez (2006) perform also a sensitivity analysis and find that there is no problem to use values for μ between 0 and 1, although Evans and Karras (1996) have estimated a value of μ equal to 1.14 using a GMM estimator. We observe that when public consumption is pure waste ($\mu=0$) the rate of growth of output is above 1 percent, but welfare gains are negative. As we increase the parameter value up to 1 the rate of growth tends to decrease and welfare gains tends to increase. It is interesting to observe also that when public consumption is equally valued to private consumption, the welfare gains are sizable, and this happens because we are considering that public consumption is part of the utility function. Recall again that in public consumption we are considering the government expenditures in health and education. So another way to interpret this last results is that if human capital were more prized in Bolivia (through health and education), the economy would benefit from positive welfare gains, although the rate of growth of output will be deprived.



Source: Authors' calculations

The results of the exercises with commodity prices (relative prices) show that output and welfare are positively correlated with those prices. In particular it can be observed a high sensitivity with the price of hydrocarbons. A 10 percent increase (starting in the baseline value) can contribute to an almost 15 percent output growth and welfare gains. Change in agriculture and mining prices has similar effects on growth and welfare.