

The 1999-2004 Sudden Stop in Bolivia: Was it important? *

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April, 2012

(First Draft)

Abstract

In this paper, the economic crisis of 1999-2004 is analyzed for the first time in the context of a Sudden Stop by using a general equilibrium model (the neoclassical growth model) under the Great Depressions methodology. First, we focus on the stylized facts that accompany a Sudden Stop paying special attention to the current account reversal, the increase in country risk premium, the real exchange rate depreciation and the evolution of output vis-à-vis total factor productivity (TFP). Second, we show that the Great Depressions methodology could not be applied in strict rigor to analyze the Sudden Stop in Bolivia, nevertheless it is a useful tool. Third, by applying a growth accounting exercise we prove that most of output fluctuations are due to changes in TFP, therefore a theory for explaining TFP is needed. In fact, a simple neoclassical growth model with frictions into capital accumulation can match fairly well the data. Finally we sketch out the elements of a theory that ascribes the evolution of TFP. We find that the link between capital flows with institutional volatility, foreign direct investment, internal absorption and fiscal policy can explain most of the changes in TFP. In terms of monetary policy, the real exchange depreciation plays also a crucial role in explaining the shift in production from nontraded to traded sectors.

Keywords: Capital flows, Sudden Stop, Neoclassical Growth Model, Total Factor Productivity

JEL Classification: F21, F32, E13, O47

* I am indebted to Joaquin Mayorga for able research assistant. The usual disclaimer applies.

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1. Introduction

Bolivia suffered in 1998-99 what is known as Sudden Stop. Sudden Stop episodes are characterized by a drop in net capital flows, being accompanied by a current account reversal, a fall in Gross Domestic Product (GDP), a collapse in asset prices, and an increase in the country risk premium just at the hit of the crisis. Furthermore, as pointed out by Calvo *et. al.* (2006), most episodes of Sudden Stops are characterized by a drop (increase) in TFP during the crisis (recovery) period, a relatively constant capital stock during the whole crisis-recovery period, a collapse in credit in the crisis but creditless recovery just at the hit of the crisis.¹

During the 1990s, Bolivia experienced a massive inflow of external resources which produced an over-expansion of bank credit while the economy was growing in a stable manner. Nevertheless, by the end of the decade there was a reversion of these capital inflows which caused an economic contraction that imposed important costs in terms of income and employment losses. According to Mercado *et.al* (2005) there was a negative shock that affected severely economic growth in Bolivia during the first quarter of 1999. This negative shock was explained by the fall in the capital inflows to the Bolivian economy and the international economic context, in particular of the neighbor countries Brazil and Argentina.

Chavez and Muriel (2004) attribute the crises of the late 90's also to the forced eradication of coca crops by the State, the currency crisis of trading partners (Argentina and Brazil), the deteriorating terms of trade (mainly mineral prices) and the (relative) decline of Foreign Direct Investment (FDI). All of this led to a severe economic downturn. The rate of GDP growth reached only 0.4 percent between 1998 and 1999. In addition, the socio-political conflicts that started in 2002 and ended in 2005 limited the growth in the first half of the decade of 2000 causing GDP to grow only at an average rate of 2.5 percent. In this scenario, the fiscal deficit tended to increase, with an annual average of 6.3 percent of GDP, the gross investment rate decreased to 13.8 percent of GDP and the current account displayed negative values until 2002 (see Muriel and Jemio, 2008).

Jemio (2000) is the first to mention that one of the main consequences of the economic downturn of 1998-99 was a domestic credit crunch. Part of the credit crunch was due to the contagion effects of the international financial crisis on the Bolivian economy. The international financial crisis spread into the Bolivian economy through lower capital flows, lower trade flows and anti-cyclical policies followed by other countries. The contraction in international demand reduced prices of major export products, affecting the incomes of Bolivian exporters, and deteriorating their cash flows and their capacity to service debts. Additionally, the economy was affected by lower availability of external financing. In 1998-99 there was an outflow of resources, especially the capital that was intermediated by the financial system. This resulted in a decline in international reserves and a contraction in the money supply. The lack of liquidity accentuated the

¹ The expression “Sudden Stop” was first suggested by Dornbusch, Goldfajn and Valdes (1995) and it refers mainly to a sudden stop in the capital flows to emerging economies.

fall in the pace of economic activity. Furthermore, the devaluation of the Brazilian Real represented a loss of competitiveness of the tradable sector, and put pressure on the exchange rate.

Calvo (2006) also emphasizes that Bolivia's sudden drop in GDP growth in 1999 had external causes that translated in a higher cost of and limited availability of credit, forcing indebted firms to slowdown production and default on their bank loans. Bolivia's GDP growth dropped from an average of 4.5 percent during 1992-1998 to around 2 percent in 1999. Morales (2007) also states that GDP per capita was below its trend during the crisis that started with the devaluation of the Brazilian Real in 1998. During the slowdown, as credit became costlier and scarcer, surviving firms used retained earnings to sustain working capital at the expense of investment, thus leading to a drop in investment (World Bank, 2004). It is possible to think that this led also to a fall in productivity.²

In order to understand the evolution of the Bolivian economy and the consequences of the economic downturn of 1998-99, it is important to distinguish between the proportion of the economic activity that is due to the production factors, capital and labor, and the proportion that is due to the efficiency of those factors. Therefore, we develop a growth accounting exercise that shows that Total Factor Productivity (TFP) mimics the behavior of output: it falls sharply during the collapse phase and recovers swiftly afterwards. There is no correspondingly sharp collapse or recovery in either physical capital or labor force. We show that variations in TFP account for the variation in output throughout the collapse and recovery processes.

In this paper it is also the first time that the 1998-99 Bolivia's economic downturn or crisis is given the name of a Sudden Stop. A sudden stop of capital flows into a developing country tends to be followed by a switch from trade deficits to surpluses, a depreciation of the real exchange rate, and decreases in output and total factor productivity. Additionally, substantial reallocation takes place from the nontraded sector to the traded sector. Although data availability inhibits a more profound analysis, it is worthwhile to analyze this Sudden Stop and to hypothesize about its causes. This paper does so using the "Great Depressions" methodology suggested by Kehoe and Prescott (2007). This methodology employs a simple dynamic applied general equilibrium model, based on the neoclassical growth model, to account for the fluctuations in factor inputs that are induced by changes in TFP.

It is suitable to employ the Great Depressions methodology to analyse the Sudden Stop of 1998-99, because it is a diagnostic tool that indicates what issues need to be studied further. Perhaps not surprisingly, this methodology indicates that, when searching for causes of the Sudden Stop in Bolivia, we should examine government policies. For instance, Jemio (2000) states that the fiscal and monetary policies played a pro-cyclical role regarding external shocks. Fiscal policy restricted public investment as a way to reduce the fiscal deficit, but amplified the real effects of the shocks.

² This phenomenon was not unique to Bolivia; the whole Latin America region was affected by this systemic shock (see Galindo and Schiantarelli, 2003).

There could be also institutional factors that could have played an amplification role of the crisis, like the new prudential norm applied by the banking regulation agency in order to prevent a financial crisis.

The paper is organized as follows. Section 2 briefly describes the main characteristics of a sudden stop in Bolivia. Section 3 explains the application of the Great Depression methodology for Bolivia. Then in section 4 we present the growth-accounting exercise. In section 5 we describe the results obtained by the application of the general equilibrium model and section 6 presents several explanations beyond TFP changes during this period. Finally in section 7 we present the conclusions.

2. Main Characteristics of the Sudden Stop in Bolivia

A growing number of empirical studies document the stylized facts of Sudden Stops³. Based on the main findings from these studies on Sudden Stop phenomenon, we analyze if also the Bolivian economy experienced a Sudden Stop during the period 1998-99. Therefore, this section focuses on providing a detailed analysis and stylized evidence of the magnitude of Bolivia's Sudden Stop.

Sudden Stops are characterized by large capital flows reversals and a sudden loss of access to international capital markets. Furthermore, the following main empirical regularities are observed during the sudden stops episodes: (i) a large reversal of the trade deficit to trade surplus, (ii) high bond spreads implying high interest rates, (iii) a depreciation of the real exchange rate, (iv) a drop in the domestic production followed by rapid recovery of output, where most of the drop in output (and its quick recovery) is due to TFP.

Next we test if these stylized facts of a Sudden Stop are observed during the Bolivia's economic downturn of 1998-99.

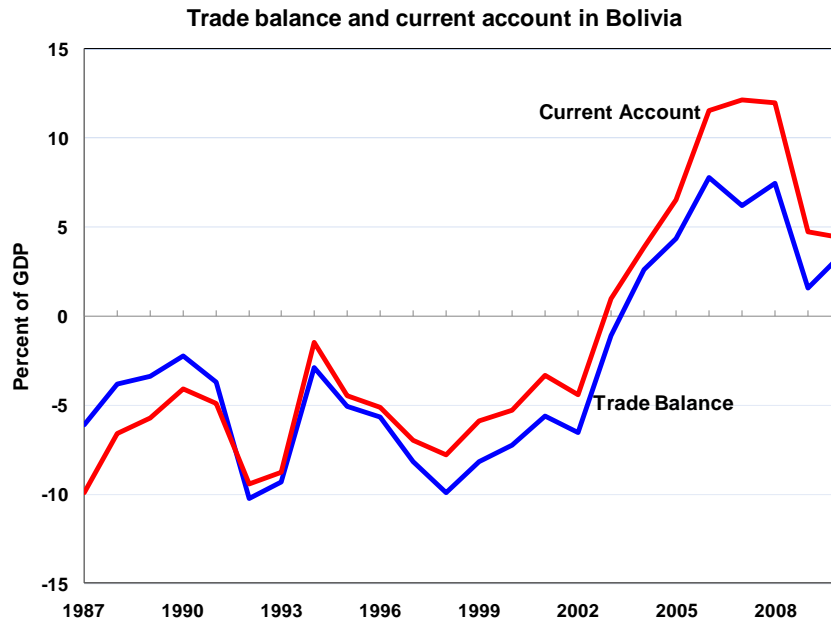
2.1. Current Account Reversal

Sudden Stops are by definition large reversals in the capital inflows that a country receives. A decrease in net capital inflows can be approximated through the Current Account reversals. Figure 1 presents the Trade Balance and Current Account as a share of GDP to illustrate the magnitude of the cutback in external financing during the economic downturn in Bolivia. The country showed Current Account deficits since 1987, with peaks in 1992 (9.45 percent of GDP) and 1998 (7.83 percent of GDP). The difference between these two episodes is that even though the Current Account deficit of 1992 dropped to 1.5 percent of GDP in 1994, it increased again until 1998, while the Current Account deficit of 1998 decreased until 2002 and then became a Current Account surplus. The same occurs with the trade balance. In 1998 the trade deficit was 9.94 percent and in

³ Calvo and Reinhart (1999), Calvo, Izquierdo and Loo-Kang (2006), Kehoe and Ruhl (2009) and Mendoza (2010) among others.

2004 a trade surplus of 2.63 percent is observed. Contrary to what happened in Mexico, as documented by Kehoe and Ruhl (2009), the Bolivian economy did not return to a deficit.

Figure No. 1

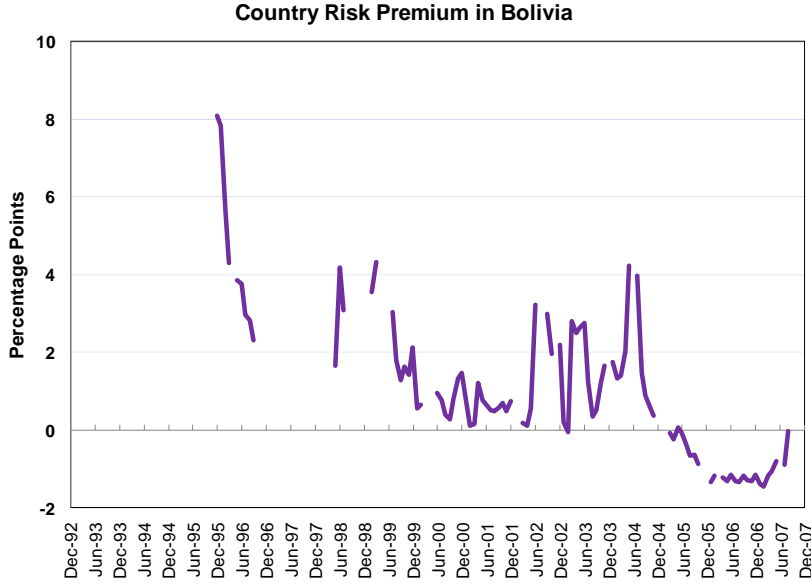


Source: World Development Indicators

2.2. Increase in the Country Risk Premium

Another feature observed during the Sudden Stops episodes in most countries is the increase in the country risk premium. Figure 2 shows the difference of the Bolivian 3-month Treasury Bill and the U.S. 3-month Treasury Bill. This spread reflects the country risk premium of the Bolivian economy and it can be seen that it increased since 2001. This means that the interest rates did not increase at the beginning of the Sudden Stop. The highest spread is seen in May 2004 with a value of 4.24. Since then the spread decreased attaining negative values in 2005 and 2006.

Figure No. 2



Source: IFS and Central Bank of Bolivia

2.3. Real Exchange Depreciation

The Sudden Stop was accompanied by large depreciation of the real exchange rate. We define the real exchange rate for Bolivia vis-à-vis the United States following Kehoe and Ruhl (2009):

$$RER_{BOL,US,t} = NER_{BOL,US,t} \frac{P_{US,t}}{P_{BOL,t}} \quad (1)$$

where NER is Bolivian nominal exchange rate, and P_j is the price level in country j , as measured using gross output deflators. We plot the natural logarithm of the real exchange rate for Bolivia in figure 3. Observe that the real exchange rate was fairly constant until 1998 when the Sudden Stop began. The real exchange rate depreciated by 21 percent between 1998 and 2005, and appreciated afterwards approaching its 1988 level in 2009.

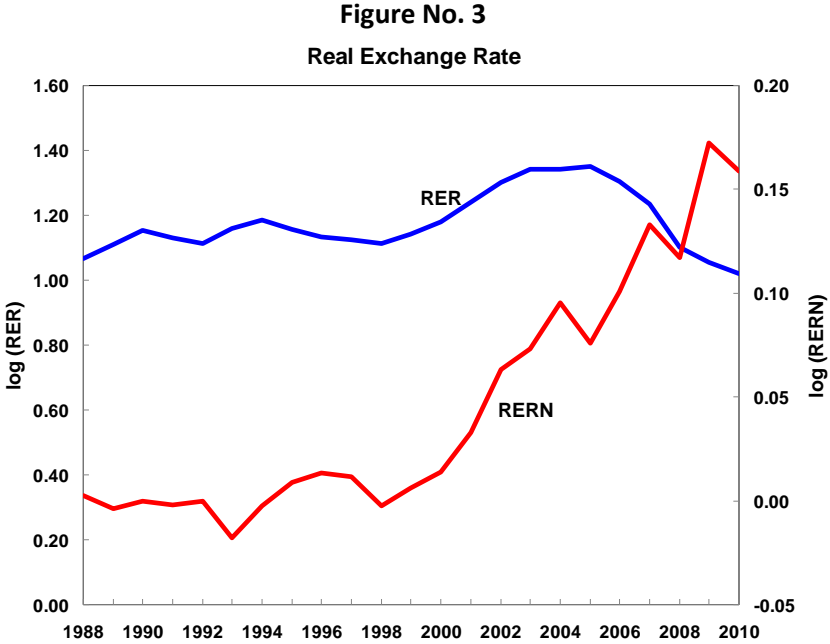
To decompose the movements of the real exchange rate into sectoral components, we follow Stockman and Tesar (1995) and Betts and Kehoe (2001) in defining agriculture, mining, and manufacturing as the traded goods sector and construction and services as the nontraded goods sector. We rewrite (1) as

$$RER_{BOL,US,t} = \left(NER_{BOL,US,t} \frac{P_{US,t}^T}{P_{BOL,t}^T} \right) \left(\frac{P_{BOL,t}^T / P_{BOL,t}}{P_{US,t}^T / P_{US,t}} \right) = RER_{BOL,US,t}^T \times RER_{BOL,US,t}^N \quad (2)$$

where the price of traded goods, P^T , is the gross output deflator for agriculture, mining, and manufacturing. The first term in the decomposition measures the traded good real exchange rate.

The second term in the decomposition is the price of nontraded goods in the United States relative to that in Bolivia.⁴

We plot the log of RERN in figure 3 also. Notice that the real exchange rate of the nontraded goods displayed also a constant trend until 1988 when the Sudden Stop began. After 1988 there is a significant depreciation of the real exchange rate of the nontraded goods as a reflection of the decrease in the price of the nontraded goods. This decreasing trend of the nontradable goods relative to the tradable goods did not stop even after 2005 when the real exchange rate of the whole economy started to appreciate.



Source: IFS and INE

2.4. Output and Total Factor Productivity (TFP)

We plot real GDP per working age (age 15–64) person and total factor productivity in figure 4. The figure shows a contraction of output during the first year of the Sudden Stop (1999) and its recovery since the last year of the Sudden Stop (2004). Real GDP per working age person fell by 1.9 percent in 1999. To measure TFP we use a typical Cobb-Douglas production function.

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha} \quad (3)$$

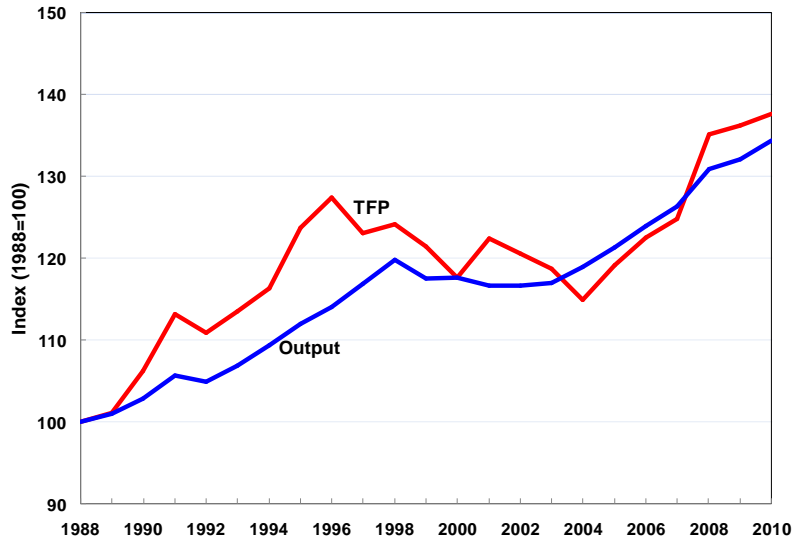
where Y_t is real GDP, A_t is total factor productivity, K_t is capital, and L_t is hours worked in period t . We employed the capital share of $\alpha = 0.4$, in line with the estimates provided in the appendix. Using equation (3), TFP is computed as:

⁴ The traded goods sector includes agriculture, forestry, fishing, mining, hydrocarbons and manufacturing. The nontraded goods sector includes all the remaining sectors.

$$A_t = \frac{Y_t}{K_t^\alpha L_t^{1-\alpha}} \quad (4)$$

The capital stock is constructed from investment data using the perpetual inventory method, and labor is measured as total hours worked. TFP fell by 2.1 percent in 1999, almost matching the decline in output. Notice also that TFP started to decrease in 1996, two years before of the beginning of the Sudden Stop. In fact, TFP decreased sharper than output, but recovered at the same pace. The correlation between output and TFP has been of 0.9 during the period 1988-2010.

Figure No. 4
Output and TFP



Source: Author's calculation based on data of the IFS, CEPAL, WDI and UN

3. The Great Depressions Methodology

The book edited by Kehoe and Prescott (2007) presents various examples of the application of the Great Depressions Methodology which is a fairly new methodology. Cole and Ohanian (1999) first applied the neoclassical growth model to study the Great Depression of the 1930s in the United States. This successful application led to the study of depressions across the world using this method.⁵

The Great Depressions methodology focuses on the growth of a country's real GDP per working-age-person relative to a trend. In analyzing growth it is more appropriate to concentrate on GDP per-working-age person instead of GDP per-capita, because this indicator is consistent with a theoretical economy in which the entire working-age population is capable of working.

⁵ See the different papers contained in the book of Kehoe and Prescott (2007)

The analysis employs the same specification of the production function given by equation (3). When TFP grows at a constant (that is, when TFP is $A_t = \bar{A}g^{(1-\alpha)t}$), the neoclassical growth model implies a unique balanced-growth path in which output and capital per worker grow at the same constant rate, $g-1$. It is relative to this trend growth rate that we measure a country's performance.

In many chapters Kehoe and Prescott (2007) argue that this trend growth represents the world stock of usable production knowledge growing smoothly over time and that this knowledge is not country specific, therefore they define the trend growth rate to be 2 percent per year, corresponding to the growth rate of GDP per working-age person for the United States over the period 1900-2000. This growth rate of 2 percent per year is considered by Kehoe and Prescott (2007) as common to all countries in the world (in a balanced growth path) and it is basic for the following definition of a great depression.⁶

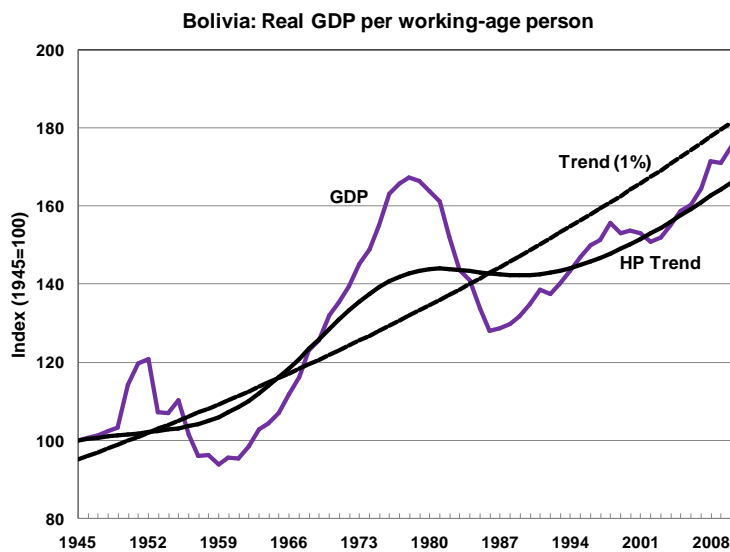
Definition: A period of economic growth below trend is defined as a *great depression* if it meets the following three conditions:

1. There is no significant recovery during the period in the sense that there is no subperiod of a decade or longer in which the growth of output per-working-age person returns to rates of 2 percent or better.
2. There is at least one year in which output per working-age person is at least 20 percent below trend.
3. There is at least one year in the first decade of the great depression in which output per working-age person is at least 15 percent below trend.

These conditions are motivated by the U.S. experience during 1929-39 (the Great Depression) and they can be found also in many other countries during different periods, but they cannot be verified with this rigor in the Bolivian case, figure 5 shows why.

Figure No. 5

⁶ Below I discuss why this 2 percent rate of growth could not apply to all countries in particular in the Bolivian case.



Source: IFS and Cepal

In the figure, it is possible to identify four well marked periods in Bolivia's modern economic history (1952-2010). The first period starts in 1952, with the National Revolution, and runs until 1957. This was a period of recession and high inflation. The second period starts in 1958 and runs until 1978. This was a period of economic growth and stabilization. The third period runs from 1978 to 1985. This was a period of economic crisis with extraordinary proportions and hyperinflation. And finally, in 1985, the fourth period starts and lasts to our days. This period is characterized by slow economic growth. In figure 5 we plot also two trends: A typical Hodrick-Prescott (HP) trend and a 1 percent growth trend.⁷

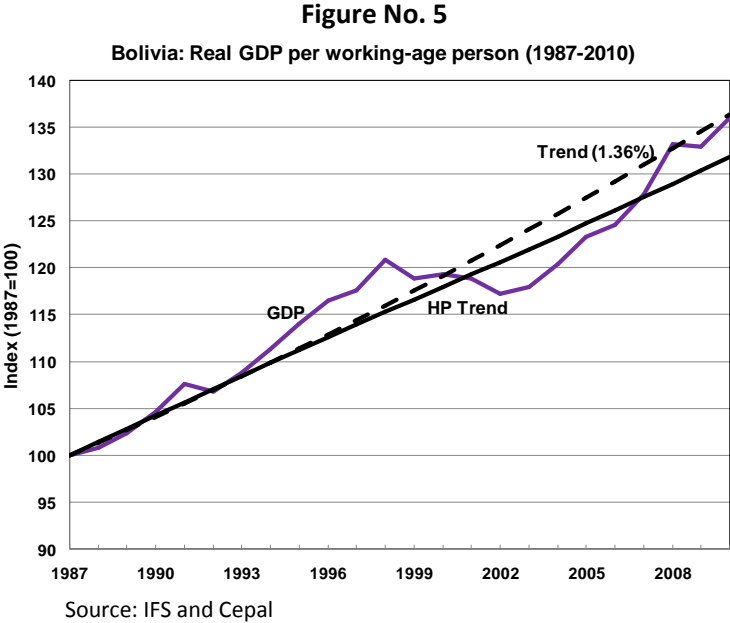
If we consider the HP trend, we verify that the periods of recession (GDP per working-age-person below trend) has been 1956-1969, 1983-1994 and 2002-2004. Real output-per-working-age person fell by more than 13 percent in 1959 and 1961 compared to the HP trend and those are the largest falls in the whole period. If we consider the 1 percent growth trend, Bolivia experienced only two periods of recession: 1956-1967 and 1985-2010. This means that according to this trend, nowadays we are still living a recession. Therefore we claim that the application of the 2 percent growth trend could not be suitable for all countries and Bolivia is an example.

There is also another reason why the 2 percent growth trend could not be suitable. In the Bolivian case neither with the HP trend, nor with the 1 percent trend, real output per-working-age person fell by more than 20 percent compared to the trend. With the 1 percent trend we can see that the falls are larger, 16.6 percent and 16.9 percent for 1959 and 1961, but during the hyperinflation the

⁷ The 1 percent growth trend was chosen to match the periods of important growth (second period) and stabilized growth (fourth period). A 2 percent growth trend would have over-estimated the fourth period.

falls are not as large as expected, more than 12 percent only. This could not be true, since the hyperinflation has been one of the worst depressions that Bolivia experienced.⁸

Even though, we cannot apply the great depression definition in strict rigor, we think that it can be used to analyze the two periods of crisis of Bolivia’s economic history and also the Sudden Stop of 1999-2004. Figure 6 shows that output-per-working-age person started to fall in 1998 until 2002 and started to recover in 2003, but still remained below trend until 2007. Because the deviation from trend was relatively large and occurred quickly, we can apply the great depression methodology to analyze Bolivia’s Sudden Stop.



4. Growth Accounting Exercise

In this section we perform a growth accounting exercise following Hayashi and Prescott (2002). Our aim here is to see how much of the output drop was due to changes in inputs, capital or labor, and how much to changes in productivity (TFP). We have seen already that the dynamics of the TFP mimics the pattern observed for the GDP per working-age-person, it falls sharply during the collapse phase and only recovers shifty afterwards.

Our growth accounting exercise rewrites the production function (3) as

$$\frac{Y_t}{N_t} = A_t^{\frac{1}{1-\alpha}} \left(\frac{K_t}{Y_t} \right)^{\frac{\alpha}{1-\alpha}} \left(\frac{L_t}{N_t} \right) \quad (5)$$

⁸ See all the chapters devoted to the Bolivia case study in Sachs (1990).

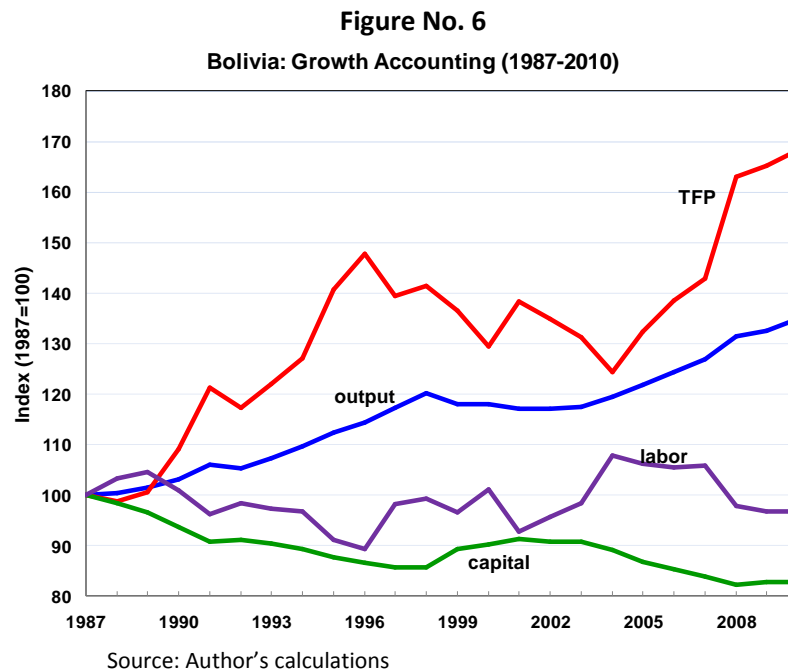
where N_t is the number of working age (15–64 years) person. The advantage of this growth accounting is that, in a balanced growth path, $(K_t / Y_t)^{\alpha/(1-\alpha)}$ and L_t / N_t are constant, and growth in Y_t / N_t is driven by growth in $A_t^{1/(1-\alpha)}$.

The data used to perform this growth accounting come from different sources. The national account data were obtained from the CEPAL. The population data was extracted from the IMF International Financial Statistics (IFS) and the data on employment was extracted from Maddison. To compute the working age population, we used data from the World Bank (World Development Indicators) which divides the population between ages. As this information is only available every five years, we extrapolate with the population data to obtain a series for each year. Data on working hours are only available since 1988 and the only source is the Unity of Analysis of Economic Policies (UDAPE).

The capital stock series were calculated using the perpetual inventory method, based in the law of motion for capital.

$$K_{t+1} = (1 - \delta)K_t + I_t \quad (6)$$

where δ is the depreciation rate which we assume it is equal to 0.05. We assumed also a value of 0.4 for the capital share in the production function (α) as calculated using the model presented in the appendix. Figure 6 displays the growth accounting exercise for the period 1987-2010.



At least four features are worth noting. First, Bolivia has not reached a balanced growth path because the capital and labor factors are not constant over time. Second, the capital-output ratio,

K/Y goes down until 1998, it recovers until 2001 and then it falls again. Third, hours worked per working-age person, L/N displays an irregular pattern, going up and down with high volatility. Finally, output growth is driven by TFP, although TFP shows an irregular pattern, while output changes more smoothly. The beauty of this growth accounting is that we can identify the deviations from the balanced growth. In general it is seen that output deviations are explained by deviations in TFP.

Taking logarithms to equation (5) we can decompose the change in real GDP per working-age person from period t to period t+s in changes in capital and labor inputs and changes in TFP. We rearrange the terms to obtain the following expression:

$$\begin{aligned} \left[\log\left(\frac{Y_{t+s}}{N_{t+s}}\right) - \log\left(\frac{Y_t}{N_t}\right) \right] / s &= \frac{1}{1-\alpha} [\log A_{t+s} - \log A_t] / s \\ + \frac{\alpha}{1-\alpha} \left[\log\left(\frac{K_{t+s}}{Y_{t+s}}\right) - \log\left(\frac{K_t}{Y_t}\right) \right] / s &+ \left[\log\left(\frac{L_{t+s}}{N_{t+s}}\right) - \log\left(\frac{L_t}{N_t}\right) \right] / s \end{aligned} \quad (7)$$

The first term on the right hand side is the contribution to growth of changes in TFP, the second term is the contribution of changes in the capital-output ratio, and the third term is the contribution of changes in hours worked per-working-age person. Table 1 presents the growth accounting for Bolivia during the periods 1987-2010, 1998-2003 (the Sudden Stop), 2003-2005 and 2006-2010. These results confirm the impression given by figure 6: most of the economic fluctuations in output per working-age person Y_t/N_t are due to changes in total factor productivity A_t , rather than to changes in the capital-output ratio K_t/Y_t or in the hours per working-age person L_t/N_t , in particular during the period of the Sudden Stop.

5. Applied General Equilibrium Model

Although growth accounting indicates that most of the changes in output in Bolivia over the period 1987-2010 were due to changes in TFP, the contributions of changes in the capital-output ratio and of changes in hours worked per working-age person were not negligible. How much of these changes can we account for as equilibrium responses to the observed productivity shocks in a growth model? To answer this question, we calibrate a simple applied general equilibrium model, based on the neoclassical growth model, of a closed economy in which consumers have perfect foresight over the sequence of TFP shocks.

The model features a representative household that chooses paths of consumption, leisure, and investment in order to maximize utility. The household maximizes the utility function

$$\sum_{t=T_0}^{\infty} \beta^t (\gamma \log C_t + (1-\gamma) \log(\bar{h}N_t - L_t)) \quad (8)$$

subject to a sequence of budget constraints,

$$C_t + K_{t+1} = w_t L_t + (1 - \delta + r_t) K_t \quad (9)$$

nonnegativity constraints on C_t , the law of movement of capital (equation 6) and a constraint on the initial stock of capital, K_{T_0} . In the utility function, the parameter β , $0 < \beta < 1$, is a discount factor and the parameter γ , $0 < \gamma < 1$, is a consumption share. C_t is consumption, K_t is the capital stock, L_t is hours worked, w_t is the wage rate, r_t is the rental rate, and δ , $0 < \delta < 1$, is the depreciation rate. The total number of hours available for work is $\bar{h} N_t$, where N_t is the working-age population and \bar{h} is the number of hours available for market work. We specify \bar{h} as 100 per week. One period of time is one year.

Firms operate in a perfectly competitive market, using a constant returns to scale technology, which we assume to be Cobb-Douglas:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha} \quad (10)$$

where Y_t denotes total output, A_t is total factor productivity (TFP), and α , $0 < \alpha < 1$, is the capital share. The conditions that firms earn zero profits and minimize costs provide expressions for the factor prices:

$$w_t = (1 - \alpha) A_t K_t^\alpha L_t^{-\alpha} \quad (11)$$

$$r_t = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} \quad (12)$$

The current period's output is divided between consumption and investment. The feasibility constraint is

$$C_t + K_{t+1} - (1 - \delta) K_t = A_t K_t^\alpha L_t^{1-\alpha} \quad (13)$$

Here we include government spending and net exports in consumption. To run numerical experiments, we need to calibrate values for the parameters β and γ in the consumer's utility function. Using the first-order conditions for the maximization problem of the representative consumer in our model economy, we obtain

$$\beta = \frac{C_{t+1}}{C_t (1 - \delta + r_{t+1})} \quad (14)$$

$$\gamma = \frac{C_t}{C_t + w_t (\bar{h} N_t - L_t)} \quad (15)$$

Using data for the period 1950-87, we estimate $\beta=0.8966$ and $\gamma=0.3722$.

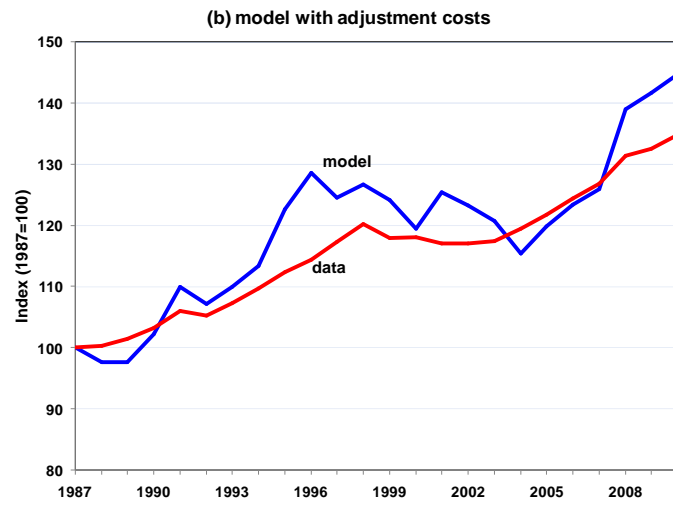
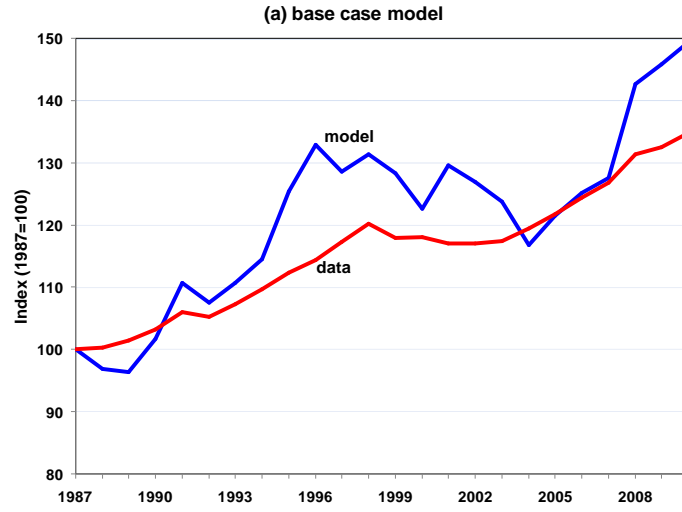
Table 1: Growth accounting: Decomposition of average annual changes in real output per working-age person (%)

	Base Case		Adjustment Costs	
	Data	Model	Data	Model
1987-2010				
change in Y/N	1.30	1.75	1.30	1.61
due to TFP	2.26	2.26	2.25	2.25
due to K/Y	-0.82	-1.03	-0.81	-0.94
due to L/N	-0.14	0.51	-0.14	0.30
1998-2003				
change in Y/N	-0.48	-1.19	-0.48	-0.96
due to TFP	-1.49	-1.49	-1.47	-1.47
due to K/Y	1.17	1.35	1.15	1.12
due to L/N	-0.16	-1.05	-0.16	-0.60
2003-2005				
change in Y/N	1.84	-0.92	1.84	-0.36
due to TFP	0.36	0.36	0.32	0.32
due to K/Y	-2.30	-0.81	-2.26	-0.42
due to L/N	3.79	-0.47	3.79	-0.26
2006-2010				
change in Y/N	2.01	4.42	2.01	3.99
due to TFP	4.87	4.87	4.88	4.88
due to K/Y	-0.72	-1.61	-0.73	-1.64
due to L/N	-2.14	1.16	-2.14	0.75

Source: Author's calculations

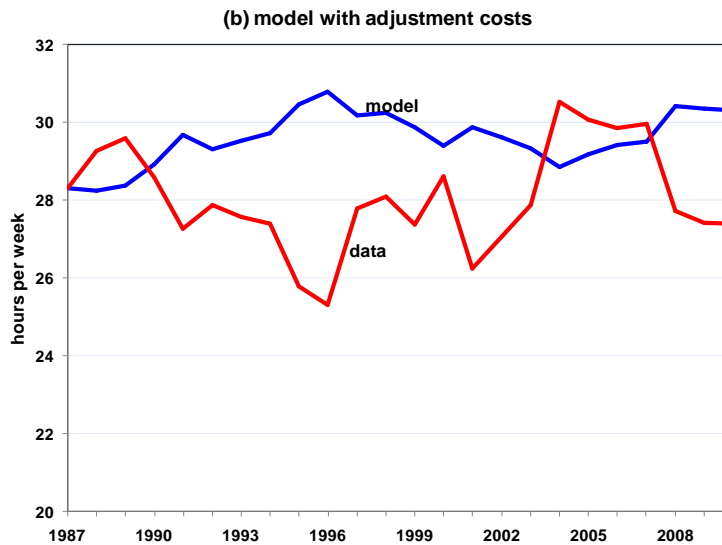
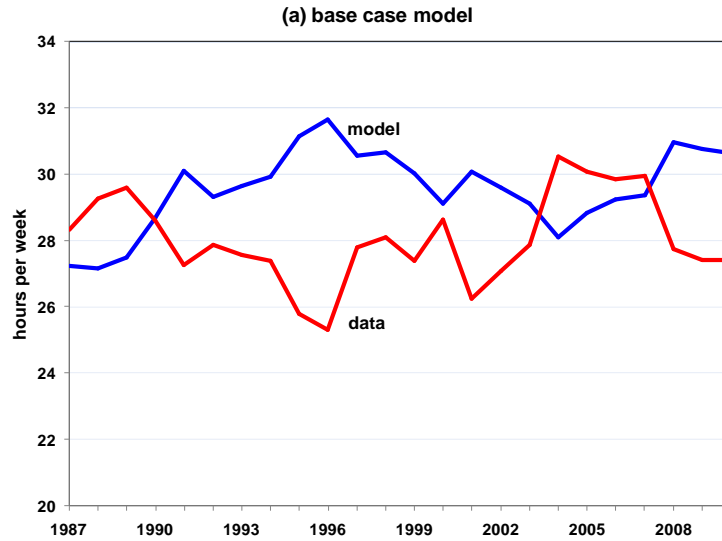
The second column in Table 1 and the (a) graphs in Figures 7, 8, 9 and 10 report the results of our base case numerical experiment. We set K_{1987} equal to its observed value in 1987 and compute the perfect foresight equilibrium path, where the sequence of TFP, $A_{1987}, A_{1988}, \dots, A_{2010}$, is given by data and TFP after 2010 is assumed to grow at the same average rate as it did over the period 1950-2010. The model is truncated by assuming that the equilibrium converges to a balanced-growth path by 2038. Notice that although the model captures the timing of ups and downs in Bolivia fairly well, fluctuations are too large compared to the data. This shows up especially in fluctuations in hours worked in Figure 8 where the model does exactly the opposite than the data. For example, in 1996 the data shows an increase in hours worked, while the model shows a decrease.

Figure 7: Real GDP per working-age-person



Source: Author's calculations

Figure 8: Hours worked per working-age-person

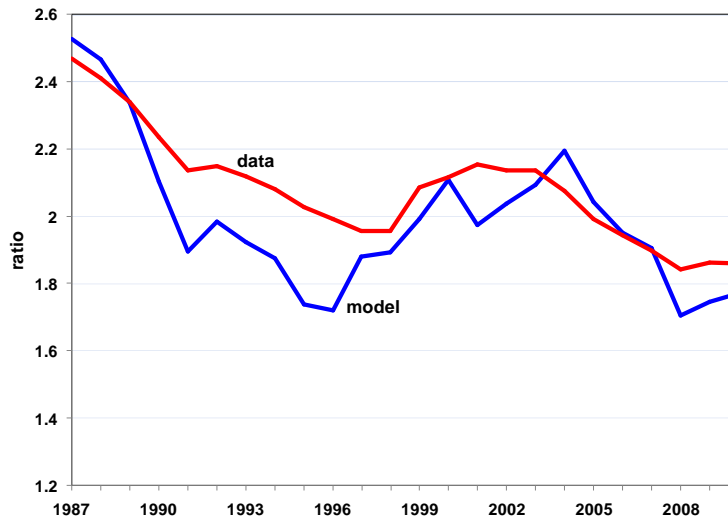


Source: Author's calculations

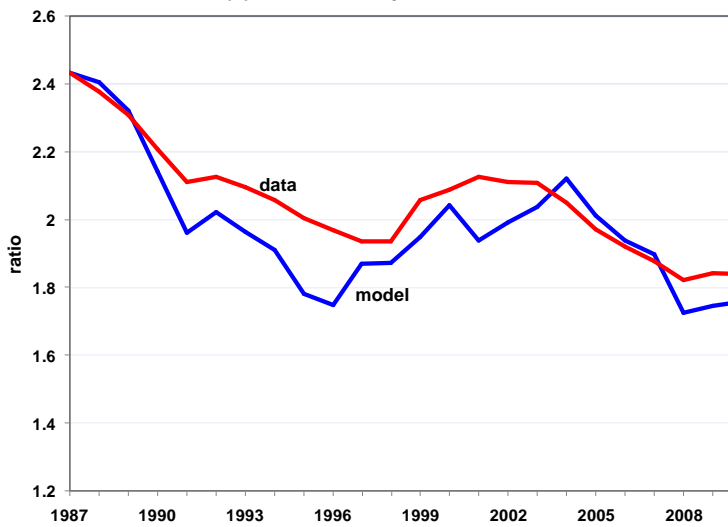
There are a number of reasons why our model may predict more volatile swings in hours worked than seen in the data. The assumption of perfect foresight, for example, may be too strong. Notice, for example, that in the model the upturn and the subsequent downturn associated with the Sudden Stop occurs in 1996-1997 rather than in 1998-1999, as it does in the data. A model with uncertainty and rational expectations would tend to produce a less volatile path for investment than that in figure 10, and a smoother capital accumulation would tend to induce a smoother labor input than that in figure 8. Rigidities on the Bolivian labor market, on the other hand, may have caused hours worked to fluctuate less than in the frictionless labor market in our model, causing hours worked to fluctuate less than in figure 8. These obviously are topics that need to be studied more.

Figure 9: Capital-output ratio

(a) base case model

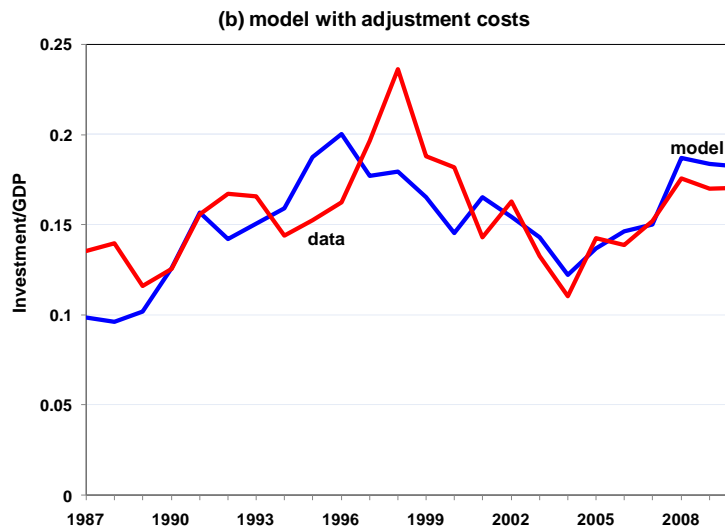
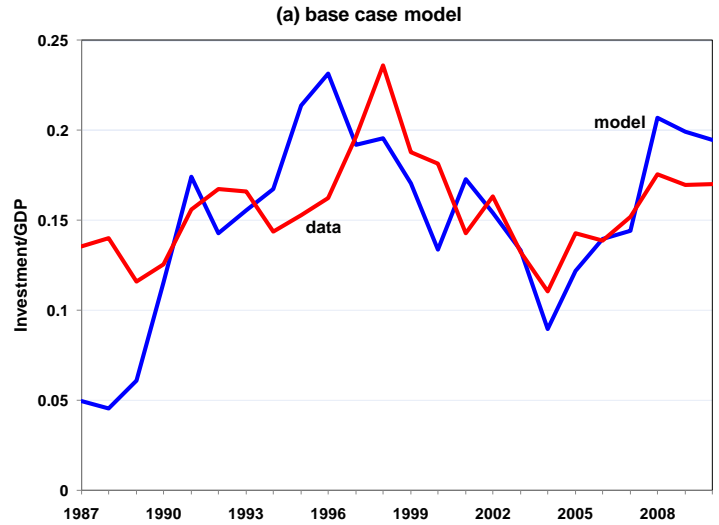


(b) Model with adjustment costs



Source: Author's calculations

Figure 10: Investment rate



Source: Authors' calculations

To show that introducing frictions into the model can result in far more accurate results, we introduce the simplest possible friction into capital accumulation. The third and fourth columns in table 1 and the (b) graphs in figures 7, 8, 9 and 10 report the results of numerical experiments in which there are constant-returns-to-scale adjustment costs of the capital stock as in the work of Lucas and Prescott (1971):

$$K_{t+1} = (1 - \delta)K_t + \phi \left(\frac{I_t}{K_t} \right) K_t \quad (16)$$

where

$$\phi\left(\frac{I}{K}\right) = \left[\delta^{1-\eta} \left(\frac{I}{K}\right)^\eta + (\eta-1)\delta \right] / \eta \quad (17)$$

where $1 \geq \eta > 0$ is the curvature parameter for adjustment costs. The model without adjustment costs corresponds to $\eta=1$. Somewhat arbitrarily, we set $\eta=0.9$, as in the work of Kehoe (2003).⁹

Since capital accumulation is now governed by equation (17), rather than by equation (6), we need to recalculate our capital stock series and our TFP series. The third column of table 1 reports the growth accounting. The calibration of γ stays the same, and we recalibrate $\beta=0.8990$. The results of the numerical experiment are reported in the fourth column in table 1 and the (b) graphs in figures 7, 8, 9 and 10. Notice that the primary determinant of changes in GDP is still changes in TFP. As King and Rebelo (1999) have noted, putting rigidities into a dynamic general equilibrium model does not diminish the role played by TFP shocks.

The model now does a more accurate job of accounting for fluctuations in Bolivia. Notice, in particular, that the smoother investment series in figure 10, which is the direct result of the adjustment costs, induces a smoother series for hours worked in figure 8. There are still significant deviations of the model's results from the data that are worth studying. Hours worked in Bolivia during the Sudden Stop (1998-2003) actually rose between 1999 and 2000, for example, rather than fell as in the model. The model also fails to account for the sharp increase in hours worked during 2001-2004. We obviously need to identify the factors that caused this sort of deviations between the data and the model's predictions. We also need to do a better job of specifying and calibrating the frictions that we impose either in the labor market or in capital accumulation. Nevertheless, examining the results of our numerical experiments in table 1 and figures 7, 8, 9 and 10 indicates that a model that takes the series for TFP as given can account for most of the boom in Bolivia between 1987 and 1997, the Sudden Stop between 1998 and 2004 and the boom of 2005 onwards. Consequently, to explain what has happened in Bolivia, we need to be able to explain the performance of TFP.

6. Explaining TFP

In attempting to account for cross-country levels of output per capita, Prescott (1998) concludes that only TFP can account for cross-country differences, and not capital or labor inputs. Consequently, we need to understand TFP to explain both the cross-country distribution of per capita output, and the large movements of output within a specific country. Prescott (1998) calls for a theory of TFP and outlines a theory that involves a country's resistance to the adoption of more efficient technologies.

While there is no broadly accepted theory of TFP, a country's institutions likely play a large role in the evolution of its TFP. Institutions that may be important include a country's openness to foreign

⁹ We could have calibrated this parameter to attain an accurate matching of the model with the data, however the value assigned is similar to the value assigned for Argentina in a similar period.

competition, the strength of monopoly rights, the prevalence of labor unions, government regulation of industry, and price controls. To understand the boom of the 1990s and the Sudden Stop that started in 1998 in Bolivia, we need to identify changes in the institutional structure that took place during the boom of the mid 90's and the beginning of the Sudden Stop. We need not go far in searching for obvious candidates. During the 90's, the abundant inflow of external resources generated an over-expansion of bank credit and a stable period of growth. However, at the end of the decade, the reversal of capital flows caused an economic downturn, which had very high costs in terms of loss of income and employment.

6.1 What Happened to TFP in Bolivia?

The analysis of the previous sections leaves us with the challenge of identifying the ways in which external volatility and policy changes led to the fluctuations in TFP depicted in figure 4. This section sketches out the elements of a theory that ascribes the spurt in growth in TFP in the early 1990s to an over-expansion of the internal credit due to the large inflow of external resources, and ascribes the fall in TFP since 1998 to the reversal of these flows that caused the contraction of the internal credit. In this theory, the time consistency problem associated with coordinating monetary and fiscal policy and the structural restrictions that they confronted play a crucial role. It will be worthwhile to expand this sketch of a theory into a formal model.¹⁰

6.1.1 Institutional volatility

According to Antelo (2000), the structural reforms implemented in Bolivia since the mid 80's were framed in line with the Washington Consensus. These reforms included the liberalization of the financial system and contemplated fundamental aspects such as: i) the elimination of controls on bank credit, ii) deregulation of interest rates, iii) free entry to the banking sector, or more generally to the financial services industry; iv) autonomy of banks to manage their own businesses; v) private ownership of banks only, and vi) liberalization of international capital flows.

The financial liberalization promoted the financial deepening. The ratio of financial assets to GDP increased from 21.6 percent in 1990 to 58.3 percent in 2001. However, the liberalization process also increased the risks of occurrence of episodes of financial crises. For this reason, financial liberalization was accompanied by a reform process aimed at developing a regulatory framework and prudential supervision. The Supreme Decree (S.D.) 21060 (August 1985) laid the foundation for the development of a new regulatory and supervisory framework for a liberalized financial system based on prudential and effective supervision. Subsequently, the S.D. 21660 (July 1987) consolidated key aspects of the prudential regulation system, as it is the case of capital adequacy, prudential supervision and reporting requirements on the state of the portfolio of banks. This

¹⁰ Meza and Quintin (2005) state that quantitative studies of the real impact of financial crises should take the behavior of TFP into account.

decree also restored all the powers and regulatory and supervisory functions for the Superintendence of Banks and Financial Entities (SBEF).¹¹

During the 90's, additional reforms were done to put the Bolivian financial system in line with the basic principles for effective banking supervision agreed in Basel. To this end, the Law of Banks and Financial Institutions was enacted in April 1993, the Rules for the Evaluation and Qualification of Portfolio by SBEF were approved on February 1994 and the Law of the Central Bank was enacted in October 1995. However, during this period some changes to the legislation also introduced ambiguity and uncertainty regarding the roles and responsibilities of the SBEF to issue regulations and to exercise supervision. For example, the Law of the Central Bank gave some regulatory powers to the Central Bank. The Pensions Law (November 1996) established a parallel Financial Regulatory System called SIREFI and the Law of Participation and Popular Credit (1997) created the CONFIP which was a committee responsible for the approval of the prudential rules regarding the financial system.¹²

By the end of 1998, the bank's portfolio had grown by 15 percent (in real terms) between 1993 and 1998, reaching USD 4200 million. However, this expansion was not accompanied by an equivalent growth in the creation of provisions for bank's loan losses, so the risk of the banking system increased significantly. To overcome the problems of deficiency in provisions, the SBEF issued new regulations for evaluation and qualification of the loan portfolios in November 1998. These regulations established a new approach for the assessment of credit risk and how the provisions for doubtful accounts should be established. This new approach gave priority to the payment capacity of the client and not to the ability to offer collateral. In addition, the percentages of provisions for the different risk categories were adjusted, and it was established that the provisions should be incorporated without discounting guarantees.

According to Jemio (2006), this new regulation generated a lot of controversy at that time, because it was blamed for the sharp "credit crunch" that began in the financial system in 1999. In fact the Sudden Stop that began in 1998 had this "credit crunch" as one of its more visible features. This is not surprising, as Calvo, *et.al.* (2003) points out, the severity of crises hits the financial sector and, as a result, banks become more cautious and cut their loans, especially to small-and-medium-sized firms. Until late 2004 the banking portfolio reduced to USD 1700 million. As a counterpart to this contraction, banks reduced deposit-taking by lowering the interest rates, increased their liquidity, repay their external financing lines and increased their investments in foreign assets.

In order to reactivate the credit for the production sectors, since 1999 the governments issued a series of economic stimulus programs including rules and decrees designed to ease the prudential

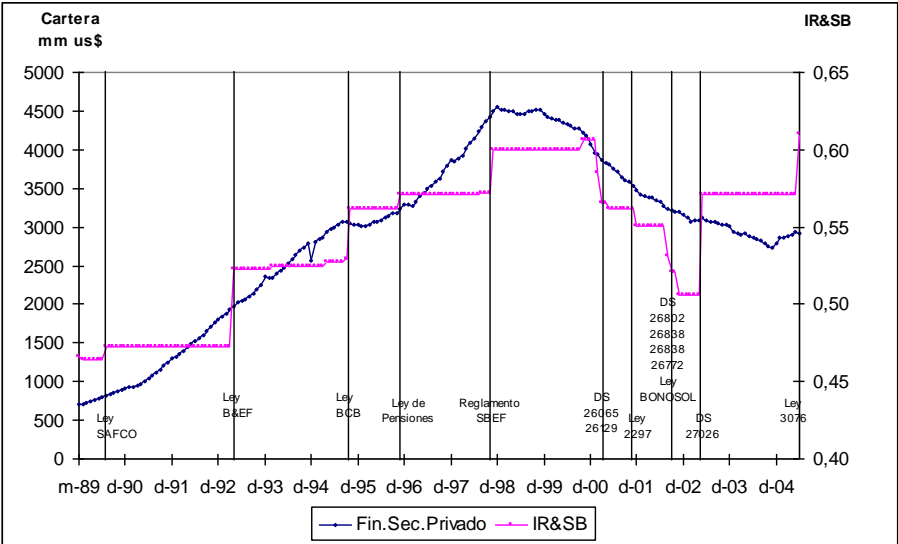
¹¹ Later, the S.D. 22203 (May 1989) put into effect the Constitution of the SBEF consolidating its regulatory role.

¹² This committee was composed by the President of the Central Bank, the Superintendent of Banks and Financial Institutions, the Superintendent of Pensions, Securities and Insurance and a deputy of the Ministry of Finance.

regulation. First, this relaxation restricted the autonomy and powers of the SBEF in the supervisory and regulatory areas, and second it relaxed the rules relating to the qualification of portfolio requirements to build up provisions for bad debts. In this manner, the S.D. 26753 and S.D. 26772 created the Ministry of Financial Issues and gave to it (officially) all the powers to regulate the financial system, taking or limiting these functions for the SBEF. Additionally, since 2000 several supreme decrees were enacted to dictate new rules regarding evaluation, qualification and provisions for commercial loans and rescheduled credits.¹³

Despite the easing of prudential regulation, and the implementation of various programs to induce the reactivation of the bank credit, in particular to the production sectors, banks continued their policy of trimming credit. Therefore, in May 2004 the government issued the S.D. 27026, which restores the exclusive jurisdiction of the SBEF to issue prudential regulations, control and supervise the activities, persons and entities involved in financial intermediation and auxiliary financial services.

Figure 11: Banking Portfolio and the Regulation and Supervision Index



Source: Extracted from Jemio (2006)

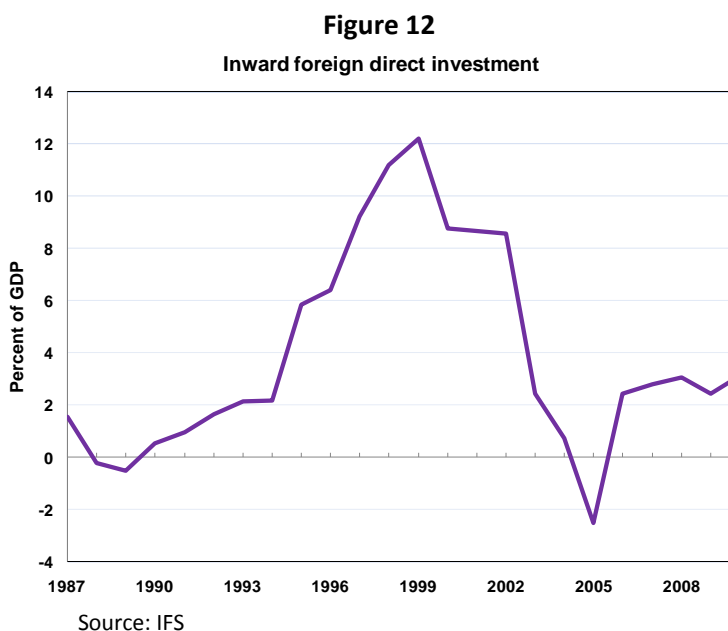
Comparing figure 4 with figure 11 presents us with the challenge of modeling the link between changes in TFP and changes in the legal and institutional framework governing the operations of the financial system in Bolivia. The results of the numerical experiments with our general equilibrium model impose some discipline on any potential theory. In particular, the impact of changes in the institutional framework would have to show up primarily in TFP. Notice that figure 11 shows the progress and setbacks made in Bolivia to create a regulatory framework that could enable the smooth functioning of financial intermediaries. These institutional changes correlate with TFP.

¹³ The numbers of the supreme decrees are: S.D. 25961, S.D. 25979, S.D. 26065, S.D. 26129, S.D. 26195, S.D. 26204, S.D. 26802 and S.D. 26838.

6.1.2 Foreign Investment

After the structural reforms implemented since 1985, the Bolivian economy became one of the most open economies, and therefore one of the most sensitive to external shocks. Therefore, the observed behavior of international financial flows in the 1990s and 2000s had a significant impact on the performance of the Bolivian economy as a whole, and on the financial system in particular. The financial flows reactivated in the 1990's, after a period of acute shortage of foreign capital during the 1980s. Capital inflows tended to increase over the 1990s, fueled by a climate of economic and political stability and by the structural reforms implemented during this period. However, since 1998 the economy started to experience the negative effects of the international financial crisis, showing a slowdown in economic growth and a reversal in external financial flows, especially those intermediated by the financial sector.

Foreign direct investment (FDI) probably played a significant role in both the 1990s boom and the Sudden Stop (1998-2004). Calvo, *et.al.* (2003) defines the Argentinean collapse of 2000 as a situation in which foreign investment, which had mostly poured into the non traded goods sector, suddenly stopped. Figure 12 shows the evolution of FDI in Bolivia. Notice that Bolivia also experienced a sudden stop in FDI since 1999. FDI was 12.2 percent of GDP in 1999 and fell to -2.5 percent of GDP in 2005. It fell around 4 percentage points between 1999 and 2000, but the largest fall is observed between 2002 and 2003 (around 6 percentage points).



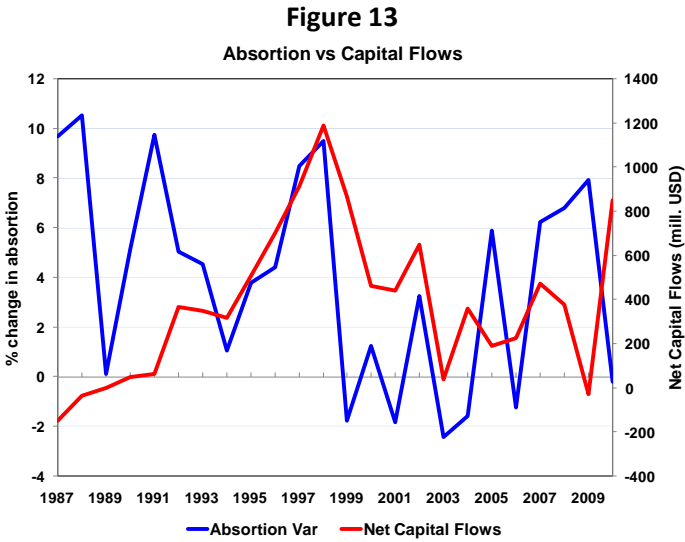
The Sudden Stop that started in 1998 resulted later in a time of high political and social instability that had an impact on external financial flows, especially FDI.

6.1.3 Internal Absorption

According to Jemio (2006) the cyclical nature of financial flows, in general, have undesirable macroeconomic effects. An increase in capital flows tends to produce an increase in domestic

absorption through, among other things, a high credit growth. This results in inflationary pressures, appreciation of the real exchange rate, with the consequent loss of competitiveness, and the deterioration of the current account of the balance of payments. The reversion of external flows due to the perception of international investors that they have committed an over-exposure to risk, produces an inverse effect: credit and domestic absorption shrank. As domestic prices are rigid (downwards), economic activity decreases and unemployment rises.

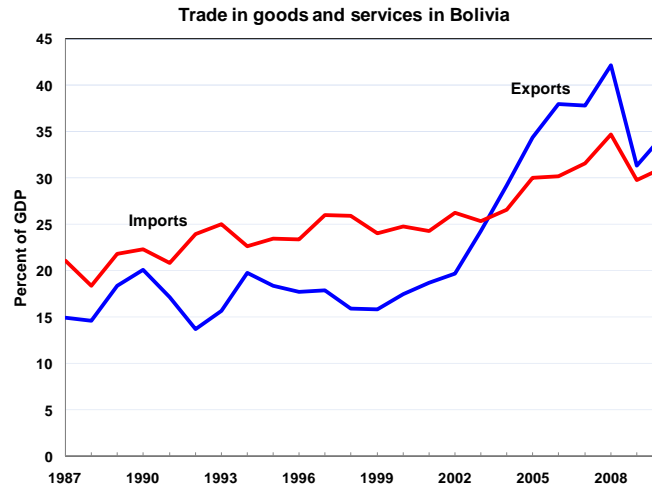
As shown in figure 13, the volatility in capital flows has had a direct effect on the growth of domestic absorption during the 90s. Observe that there is a high correlation between net capital flows and the variation in absorption between 1993 and 2004 coinciding exactly with the period of the Sudden Stop. During the period of high net external financing (1992-1998), the absorption tended to grow at an average rate above 5 percent in real terms, especially during the years of 1997 and 1998, it grew at 8.5 percent and 9.5 percent respectively. In contrast, during the exit of foreign capital, the growth rate of domestic absorption substantially reduced, being negative in 1999, 2001, 2003 and 2004. In 2002 there was an increase in absorption, explained by the increase in capital flows but also by the high export growth that occurred that year, which resulted in revenue growth, and in turn affected positively the rate of growth of absorption.



Source: CEPAL

Since 2004 Bolivia experienced a positive trade balance. The exports grew more than the imports as a result of a favorable international context. In particular, international prices of Bolivia’s export commodities like minerals started to increase. Figure 14 shows that no theory that places the blame for the Sudden Stop on a drop in the trade balance can match the data.

Figure 14



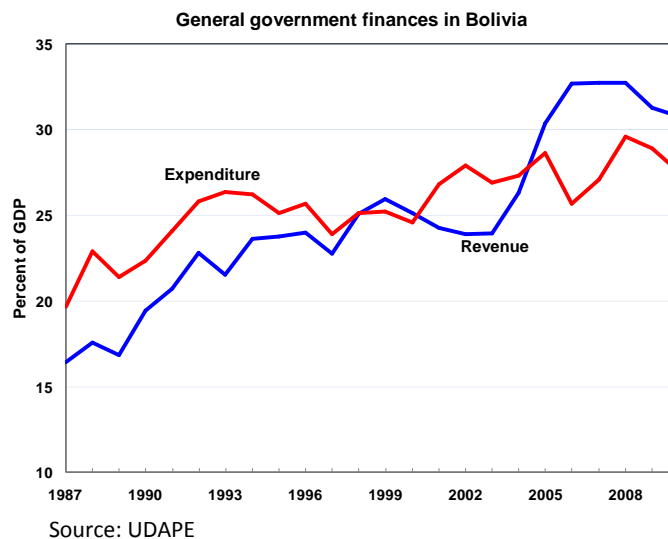
Source: World Development Indicators (WDI)

6.1.4 Fiscal Policy and the Financial Sector

The government's actions had a major influence on the performance of the economy and on the financial system in particular. First, fiscal policy tended to have a cyclical behavior induced by volatile capital flows. As shown in Figure 15, general government expenditures represented on average 26 percent of GDP between 1999 and 2004 and they remained relatively constant around this percentage value. This means that the behavior of public expenditures was therefore procyclical and helped to accentuate the business cycle caused by external and internal shocks. In other words, government expenditures contributed to expand aggregate demand during the inflow of external resources, and to shrink aggregate demand during periods of reversal of external financial flows.

Second, the economic cycle impacted also on fiscal revenues. They decreased from 25.11 percent of GDP in 1998 to 23.94 percent of GDP in 2004. This means that during the Sudden Stop, which was a period of economic contraction, fiscal revenues decreased, thereby increasing the fiscal deficit and putting pressure on public debt.

Figure 15

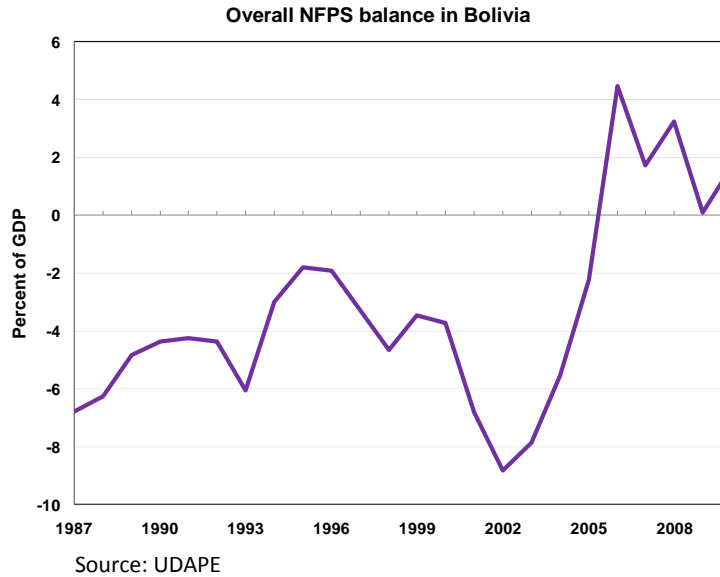


In the first half of the 90's, the government was in the stage of consolidating the macroeconomic stabilization program initiated in 1985. The deepening of the 1st Generation Reforms that goes from 1987 to 1993 and the implementation of the 2nd Generation Reforms from 1993 to 1997 implied an important effort of the public sector that translated into an increase in the Non-Financial Public Sector (NFPS) deficit. During the period 1990-1994, the NFPS deficit was on average 4.4 percent of GDP, with its peak in 1993 (6 percent of GDP). This deficit was mostly covered with external financing and less with credits from the central bank and the placement of government securities through open market operations.¹⁴

In the period 1995-1998, the government pursued a policy of fiscal adjustment, succeeding in reducing the deficit below 2 percent of GDP in 1995 and 1996. These deficits were the lowest recorded during the 90's as it is seen in figure 16. During the period 1995-1998 the fiscal deficit as a share of GDP averaged 2.9 percent. Despite the low levels of deficit, the government maintained external financial flows observed in previous years and it even increased the placement of bonds and treasury bills in the private financial sector. This measure aimed to reduce the internal credit of the Central Bank to the NFPS.

Figure 16

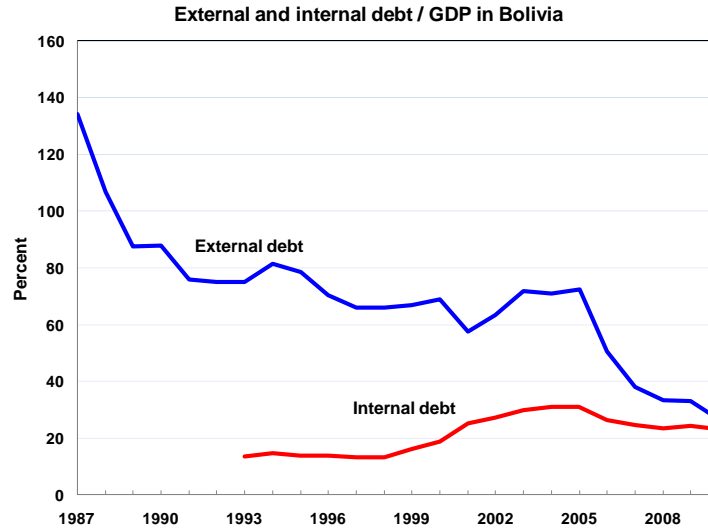
¹⁴ See Barja (2000) for a detailed review of these reforms.



Since 1997, the downward trend is reversed and the deficit increased until 4.7 percent of GDP in 1998. The 2nd Generation Reforms implemented between 1993 and 1997 represented an incremental cost to the Treasury. These costs originated mainly in the Pensions Reform (1996), the payment of compensation to officers of the capitalized (privatized) State Owned Enterprises, the Educational Reform, and transfers to municipalities and prefectures as part of the Decentralization and Popular Participation reforms. In addition, between 1997 and 2000 the external financing flows to the public sector tended to decline, although the government benefited from the debt relief program HIPC I. For this reason, since 1998 the government started to place treasury bonds (BTs) in the Pensions Funds, in order to finance primarily the costs of the Pensions Reform. The placement of BTs in the Pensions Funds reached an average of USD 140 million per year.

The fiscal balance of the NFPS deteriorated sharply until 2002, reaching 8.8 percent of GDP. To finance this deficit, the government increased significantly the use of external financing flows, the placement of LTs and BTs through open market operations and, after many years, it used again the liquidity credits from the Central Bank. In 2002, the placement of government securities in the Pensions Funds and through open market operations amounted 4.6 percent of GDP. The Central Bank funding amounted to USD 131 million, equivalent to 1.6 percent of GDP. The high levels of deficits increased public debt, mainly the internal debt as it is seen in figure 16.

Figure 16



Source: UDAPE and WDI

6.2 Lessons for Models of Monetary Policy

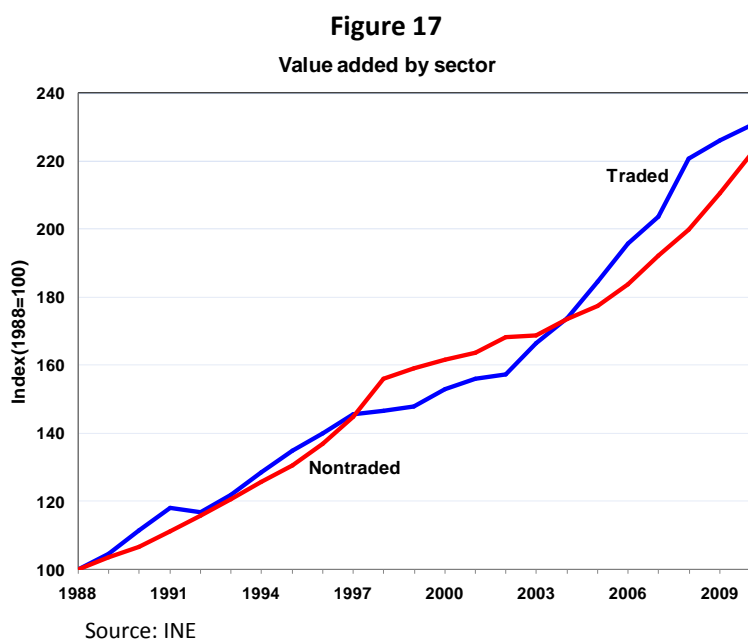
According to Jemio (2006), the possibility of response of the Bolivian economy to encounter the Sudden Stop faced serious limitations. For instance, the room for maneuver of the monetary policy was constrained by the external opening to capitals and the existence of a managed exchange rate. In fact, the exchange rate policy also faced restrictions, especially due to the high dollarization of the economy and in the financial system.

6.2.1 Real Exchange Rates and Domestic Relative Prices

Kehoe and Ruhl (2009) state, that it is important to analyze the effects of a Sudden Stop on the disaggregated economy. By documenting the Mexican economy (1994-1995) they find that when credit is restricted, traded output falls by less than nontraded output and that labor and investment move from the nontraded sector to the traded sector, as is also emphasized by Tornell and Westermann (2002). They also find that the movement in the relative price of nontraded to traded goods accounts for about 20 percent of the movement in real exchange rates. These findings are in line with Burstein, *et.al.* (2005) and Mendoza (2005), who study the real exchange rate depreciations that accompany sudden stops and also find that nontraded goods prices play a large role in these depreciations.

In figure 3 above, we have seen that the depreciation of the real exchange rate of the nontraded goods was a reflection of the decrease in the price of the nontraded goods. We observed also that the Sudden Stop in Bolivia was accompanied by a decline in output. The sectoral data allow us to say more. In figure 17, we plot real value added for the traded and nontraded sectors in Bolivia. During the Sudden Stop, value added in the traded and nontraded sectors showed similar rates of growth even though the prices in the nontraded sector fell more than the prices in the traded sector. But after the Sudden Stop, value added in the traded sector grew more than in the nontraded sector. This shift in production should be the focus of a sectoral analysis of the Sudden

Stop. As Kehoe and Ruhl indicate, in response to a Sudden Stop, the relative price of traded to nontraded goods increased, leading to a shift of resources away from the nontraded sector and into the traded sector.



Loza (2001) emphasizes also that shocks in prices of export commodities have not been given the importance that they deserve in a context of a financial crisis. Even though the Bolivian exports during 1998-1999 were not concentrated in few products and were not dependent of a particular sector, the external vulnerability could not be reduced, because the cyclical effects of the prices could not be attenuated and price volatility of exports could not be reduced.

7. Concluding Remarks

In this paper we analyze the real effects of the crisis or economic downturn that Bolivia experienced between 1998 and 2004. First of all we demonstrate that this crisis can be clearly defined as a Sudden Stop, because the trade deficit during the crisis is followed by a trade surplus, there is an increase in the country-risk premium, the real exchange rate depreciates and there is a drop in domestic production followed by a rapid recovery.

Then by applying the “Great Depressions” methodology we decompose the changes in economic growth rates into the parts due to capital accumulation and inputs of labor and the part due to the efficiency with which factors are used, measured as TFP. Through this growth accounting analysis we conclude that, as in other economies, the fall and recovery of GDP before, during and after the Sudden Stop is mostly explained by the TFP.

Also as part of the “Great Depressions” methodology we employ the standard neoclassical growth model to simulate the evolution of output per-working-age person, the capital to output ratio, the

hours worked per working-age person and the investment rate. We conclude that a model with adjustment costs is better to match the data. The model allows us also to affirm that to analyze the Sudden Stop and the characteristics that accompanied this episode we have to pay special attention on what are the factors that explain TFP. Perhaps not surprisingly, we find that when searching for causes of the Sudden Stop in Bolivia, we should examine the institutional volatility in particular the changes in the institutions of the financial system. We have to examine also the dynamics of foreign investment, foreign trade and the lack of fiscal discipline, in particular the procyclicality of fiscal policy. Regarding monetary policy we have to pay special attention to the real exchange rate and the relative price of tradable over nontradable goods.

Perhaps, the main contribution of this paper is that we have put the seeds for the construction of a more sophisticated model that should address all these issues at the same time. The results of our analysis impose also some discipline on our search: a successful theory of the Sudden Stop in Bolivia needs to have the crucial link between government policy and TFP, rather than between government policy and investment or between government policy and employment, at least up until the recovery that started in 2005. Furthermore, when we talk about government policy we do not refer only to fiscal and monetary policy (economic policies), we refer also to the institutional policy (laws, decrees and norms that were enacted).

Finally, we have to indicate that there are other variables that we have not mentioned that some authors attribute to them the economic downturn of 1998-2004. For instance, Chavez and Muriel (2004) indicate that among other things, the forced eradication of coca crops by the State contributed to the appearance of the crisis. Marconi and Mosley (2005) claim that the Sudden Stop in Bolivia showed the national significance which microfinance occupies in the economy. This are certainly issues that need to be studied further.

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APPENDIX

Appendix: Estimation of deep parameters

To estimate the parameters α and ρ that represent the share of capital on GDP and the persistence of the technology shock we employ the same AR(2) estimation of Chumacero and Fuentes (2001). The authors employ a stochastic exogenous growth model to arrive to the following compact representation of the Data Generating Process (DGP) of per capita GDP.

$$\ln y_t = B + Dt + (\alpha + \rho) \ln y_{t-1} - \alpha \rho \ln y_{t-2} + \varepsilon_t \quad (\text{A.1})$$

or equivalently

$$(1 - \alpha L)(1 - \rho L) \ln y_t = B + Dt + \varepsilon_t \quad (\text{A.2})$$

where L denotes the lag operator and B and D are constants.

By estimating equation (A.1) by Non-Linear Least Squares (NLLS), we recover the parameters α and ρ . The results of such estimation, along with statistics that summarize key properties of the model and the resulting residuals are reported on table A.1.

Table A.1: Results of Univariate Time Series Regressions on GDP per working age-person (1950-2010)

GDP per working age-person	
D	0.0002 (0.0002)
α	0.4024 (0.1199)
ρ	0.9992 (0.0015)
R^2	0.961
DW	2.017
Q	0.013
Q^2	0.012
JB	0.000

Nota: R^2 =Adjusted R^2 . DW=Durbin-Watson statistic. Q=Minimum p-value of the Ljung-Box test for white noise residuals. Q^2 =Minimum p-value of the Ljung-Box for White noise on the squared residuals. JB=P-value of the Jarque-Bera normality test. Standard errors in parenthesis

In general, the results suggest that a representation such as (A.1) provides a good statistical representation of the univariate time series properties of GDP per working-age person. In particular the model is able to induce white noise residuals. Regarding the estimated parameters,

it can be seen that the parameter α has a value of 0.4. This value over-estimates the value of 0.35 obtained by Humérez and Dorado (2006), but it also under-estimates the value of 0.69 estimated by Jemio (2008).

In addition, by employing the National Accounts, it can be seen that the average gross operating surplus (*Excedente Bruto de Explotación*) which constitutes the retribution to the capital factor has a value of 0.47 for the period 1988-2005 (the only data available). Therefore our estimated value of 0.4 seems to be a good estimation of the share of capital in Bolivia. Regarding the parameter ρ , it has a value of 0.99, which is consistent with a stationary process.