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Debt Management, Dollarization and Maturity Structure of Public Securities
The Experience of Bolivia

por

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Public debt profiles have improved in Bolivia recently; in particular by extending the maturity structure and increasing the proportion of debt issued in domestic currency. This paper analyzes trends in public domestic debt in Bolivia since 2000, and the role of macroeconomic fundamentals and the debt management strategy adopted by the authorities. We analyze their role using transfer function models that suggest that both were critical in improving debt profiles, in particular the strengthening of the fiscal and international reserves positions, the recent appreciation of the *Boliviano*, and new prudential regulation that promotes the use of the latter. We also compare debt profiles with other countries in Latin America, and found that there is still room for improvement, both in terms of maturity structure and currency composition.

JEL Classification Numbers: E44, E52, G18, H63
Keywords: Bolivia, debt profiles, maturity structure, currency composition

1. Background

[1] Central Bank of Bolivia and International Monetary Fund respectively. The authors thank superb research assistance from Sergio Cárdenas Rossel (Central Bank of Bolivia). Fernando Mita and Bernardo Fernández (Central Bank of Bolivia) also collaborated with the paper.

As a result of macroeconomic instability, public debt profiles worsened in Latin America during the last decades

This reflected developments in domestic financial markets; which witnessed how the maturity of financial instruments gradually lessen during the 1970s and 1980s, due to high inflation that created incentives for economic agents not to get exposed in financial systems at long maturities; a phenomenon coined "*cortoplacismo*".[2] After some Latin American economies went through hyperinflation in the late 1980s, stabilization efforts included, *inter alia*, strategies in which the role of the US dollar in domestic financial markets was promoted, in part to develop long term instruments.[3]

As in other Latin American economies, public debt in Bolivia was denominated in foreign currency and at low maturities by the late 1990s

In 1998, even more than a decade after a successful stabilization program; 86 percent of the stock of treasury paper was issued in foreign currency. Moreover, the average maturity of domestic treasury financing in Bolivia was 68 weeks only; suggesting that the introduction of foreign currency financial instruments had, at best, only partially helped to extend the maturity structure in financial markets.

Debt profiles, though, have improved in Bolivia recently; extending the maturity structure and increasing the proportion of debt issued in domestic currency

Since 1998; the stock of treasury paper in domestic currency auctioned at domestic financial markets increased from 14 percent of the total in 1998 to more than 82 percent as of September 2007. As for the maturity structure, the average maturity of bonds issued for treasury financing went from 68 weeks in 1998 to more than 240 weeks as of September 2007.[4]

Better debt profiles are the result of a complex debt management strategy; which was also aided by improving macroeconomic fundamentals

The authorities took gradual steps to favor the use of the *Boliviano* and extend the maturity of public securities, including by: (i) placing incentives to hold financial assets in *Bolivianos* (introducing, for example, marginal reserve requirements for deposits in foreign currency); (ii) introducing inflation indexed bonds at increasing maturities; (iii) paying higher yields for instruments in Bolivianos at longer maturities; and (iv) appreciating the Boliviano in the context of the crawling-peg regime. Better macroeconomic fundamentals were also critical.

[2] By the mid-1980s, in some Latin American economies, most fixed-term deposits were renewed every week; and the average maturity of financial instruments was just a few weeks. See, for example, Heymann and Liejonhufvud (1995).

[3] See Calvo (1996) and Cavallo and Cottani (1997). To review trends in financial dollarization in Latin America during the last two decades, see Rennhack and Nozaki (2005).

[4] The lengthening of the maturity structure in Bolivia began somewhat late in relation to other countries in the region; which in part may be explained by the fact that Bolivia has no access to international capital markets. Schmukler and Vesperoni (2006) show that after financial liberalization, access to international markets helped extending the debt maturity structure during the 1990s.

After going through financial stress in the early 2000s, Bolivia improved its fiscal and external balances; which helped strengthening the *Boliviano* and reducing the likelihood of financial crises.

This paper analyzes latest developments in public domestic debt in Bolivia—in particular its currency composition and maturity structure—and the role of economic fundamentals on it

We look separately to the debt issued by the central bank to conduct monetary policy, and to the debt issued by the treasury to finance its operations. We find that the debt management strategy and the improvement in macroeconomic fundamentals have both played a critical role in improving debt profiles—mainly by extending maturities and shifting the currency composition towards the domestic currency. We also compare debt profiles with other countries in Latin America, and found that there is still room for improvement, both in terms of maturity and currency composition.

The paper will be organized as follows

Section 2 reviews the literature on financial dollarization. Section 3 describes institutional arrangements to manage public domestic debt in Bolivia. Section 4 makes a review of recent trends of domestic treasury paper; both issued for monetary policy and treasury financing. Section 5 compares public debt dollarization and maturity structure in Bolivia with other Latin American countries. Section 6 shows econometric evidence on the effect of the debt management strategy and macroeconomic fundamentals on the debt profile; and section 7 concludes.

2. Financial Dollarization in the Literature

There is a vast literature on financial dollarization

Academic work during the last 10 years focused on the experience of several developing and emerging economies that—in the context of inflation stabilization programs—favored the use of the US dollar to lengthen the horizon of financial instruments in domestic markets. The studies on financial dollarization described below will play a role in our econometric exercise in section 6; aiding the analysis of the effects of policy measures or the impact of macroeconomic developments on debt profiles in Bolivia.

The debt strategy implemented by the Bolivian authorities was supported by recent academic work on financial dollarization

Explanations of financial dollarization range from "*original sin*" hypothesis to moral hazard, including dollarization induced by monetary and exchange rate policies. As we will see below, these explanations focus on different aspects of financial dollarization; which are not necessarily clashing, and hence support different policy instruments that can be complementary in de-dollarizing debt.

An early explanation of financial dollarization—the *"original sin"* hypothesis—points to market incompleteness

There are countries whose external liabilities are necessarily denominated in foreign exchange (especially in the long term); which implies that they are by definition unable to hedge foreign currency positions; even if agents have the foresight to match the currency structure of their liabilities.[5] Notice that the currency choice is not the result of a market equilibrium; so monetary or exchange rate policies are rather powerless in terms of de-dollarization efforts.

In contrast, the portfolio approach highlights that dollarization is the result of market equilibrium; and that agents compare the relative risk of returns of US dollar and domestic currency denominated assets

In doing so, agents target a minimum variance portfolio.[6] US dollar denominated assets will prevail if the variance of the real exchange rate is relatively lower than the one of the inflation rate.[7] Ize and Yeyati (2005) stresses that lack of credibility in the monetary regime, which may trigger sharp exchange and financial crises, would shift portfolios towards US dollar instruments. In terms of de-dollarization strategies, the portfolio approach points to

[5] Eichengreen and Hausmann (1999) and Calvo, Izquierdo and Talvi (2003) highlight the policy relevance of the mismatches caused by liability dollarization; which were in part behind the financial crisis in Argentina in 2001. Bordo (2006) highlights that the "*original sin*" was already present at the first era of globalization between 1880-1914 (with most countries having their debt denominated in gold or sterling); and that this was a key determinant in financial, banking and debt crisis at the turn of the century.

[6] See Ize and Parrado (2002); Ize and Yeyati (2003a and 2003b); Barajas and Morales (2003); Ize and Yeyati (2005); and Ize (2005).

[7] Notice that portfolio explanations may offer a rationale for cases of persistent financial dollarization after inflation stabilization; as it is possible that the latter reduce the volatility of both the exchange and the inflation rate; not affecting their relative volatilities (Ize and Yeyati, 2005).

sound macroeconomic fundamentals—to enhance credibility in the monetary regime—and a flexible exchange rate regime that does not preclude the exchange rate to move (henceforth, not explicitly reducing its variability).

Other explanations focus on policy asymmetries; in particular the ones related to exchange rate regimes

Policies that reverse overvaluations through nominal devaluations but do not correct undervaluations through nominal appreciations end up rewarding the US dollar; as it becomes a *one-side bet*.[8] This policy aggravates the *peso problem;* i.e. lenders asking for a disproportionate premium on domestic currency instruments.[9] [10] This explanation highlights that de-dollarization efforts should focus on a symmetric exchange rate policy; which does not preclude appreciations if the latter are warranted by fundamentals.

Some works focus on the existence of moral hazard; which is mainly related to expected bail outs by the government in case of a big depreciation of the domestic currency

In this case, borrowers choose to borrow in US dollars to benefit from low interest rates in tranquil times; as they expect to be bailed out in a crisis. This explanation advocates avoiding *currency-blind* prudential regulations, i.e. write regulations that place incentives to lenders to factor in risks of lending to agents that face currency mismatches. Although moral hazard is not directly relevant to the placement of public debt, well defined prudential regulation may place incentives for financial de-dollarization; which may increase demand for domestic currency treasury paper (see, for example, Ize and Yeyati 2003; Ize 2005).

3. Domestic Debt in Bolivia: Institutional Issues

Domestic debt is issued for monetary policy and treasury financing purposes

[8] See Ize and Parrado (2002); Ize and Powell (2003); and Ize and Yeyati (2003); and arguments about *fear of floating* in Calvo and Reinhart (2000).

[9] See Calvo and Guidotti (1989) results on the *peso problem* in public debt issues. Lack of credibility in the monetary regime results in high nominal rates on peso bonds that eventually force governments to inflate to reduce ex-post costs. Expectations that the government will inflate make dollar indexed debt more attractive than peso debt; as the former does not induce such adverse monetary policies. An asymmetric exchange rate policy reinforces lenders' strategies of placing US dollar debt.

[10] See also Orellana and Mollinedo (1997) for the Bolivian case.

The Central Bank of Bolivia defines an annual monetary program and sets quarterly targets for debt placements. On a weekly basis, the bank conducts analysis of financial market liquidity and places debt in Open Market Operations (OMO), mainly through competitive auctions, and occasionally through its trading desk. The treasury also places debt to finance its operations, both through financing agreements with pension funds—in which the amounts and financing conditions are pre-determined—and through auctions in domestic markets, also conducted through a committee at the central bank.

Treasury bills and bonds are issued in foreign and domestic currency

For monetary policy purposes, the central bank places treasury bills (zero-coupon bonds issued at three, six, and 12-month maturities) and two and four-year treasury bonds, mostly in domestic currency.[11] The central bank also issues one, two and four-year inflation-indexed treasury paper, and sporadically one-month treasury bills to curb short-term excess liquidity.[12] The treasury, which in the past used to issue short-term debt, is now concentrating in longer maturities, through bonds provided of six-month coupons with a pre-determined interest rate at six, eight, and ten-year maturity.

Auctions in domestic markets are conducted once a week by the Open Market Committee (OMC) and the Treasury Paper Management Committee (TPMC)

These committees meet every Wednesday, and are composed of the president and the executive board members of the central bank, the manager for monetary operations, the deputy manager for open market operations, the chief economist, and the vice-minister of the treasury and the director of treasury debt. They place treasury bills and bonds in an auction process.[13] They also review developments in domestic and international financial markets, and in particular the liquidity conditions in the financial system to set the offer of treasury paper for the following week.

The central bank favors Open English Auctions (OEA)

The latter were introduced in August 2005, and are conducted through an interactive auction system that operates using internet protocols. Through this auction system, participants can monitor offers from other agents in real time, giving them the opportunity to increase their bidding until closing time. OEA allows participants to obtain information during the bidding process, which reduces the "winner's curse" effect and henceforth encourages more participation. The central bank and/or the treasury can also place public paper through the central bank's trading desk. In general, auction mechanisms are favored, but the authorities

[11] The central bank issues treasury bills—and not its own paper—for monetary policy purposes to avoid fractioning an already small market with different financial instruments. The proceeds from these operations are placed in a special central bank account (the *Cuenta de Regulación Monetaria,* whose proceeds belong to the treasury but can not be applied to its financing).

[12] Inflation indexed paper was introduced in 2002, to create a financial market for *Bolivianos.*

[13] Notice that decisions about treasury bills and bonds are made with full information on the yield curve for both paper issued for monetary policy and treasury financing.

may decide to offer paper through the latter if the monetary program so requires or if they intend to extend signals to market participants about interest rates.

The treasury also places long term bonds to pension funds through non-market mechanisms

The 1996 pension reform legislation grants the treasury the option to place long term bonds up to a certain share of pension funds' revenue.[14] These are bonds with annual coupons, with terms and conditions negotiated bilaterally between the treasury and pension funds. Up to 2002, the treasury placed US dollar- indexed bonds, at a 15-year maturity, with an annual interest rate of 8 percent. Starting in 2003, and consistent with the de-dollarization strategy followed by the authorities, the treasury began to place inflation-indexed bonds, with maturities between 9 and 15 years, yielding an interest rate of 5 percent. Beginning in early 2007, the treasury kept only inflation indexed bonds at 15-year maturity and coupons yielding a 4 percent interest rate.

4. Review of Recent Trends in Public Domestic Debt

This section reviews recent trends in public domestic debt

[14] A sort of call option over the pension funds' cash flow.

After a brief description of the recent trends in paper placed for monetary policy and treasury financing, section 4.1 analyzes the currency composition of public paper. Section 4.2 focuses on the maturity structure. For treasury financing, we separate the analysis of paper placed through competitive auctions in domestic markets from placements to pension funds, as financing conditions for the latter are negotiated bilaterally.

The stock of central bank paper has toned with the needs of monetary policy

As of September 2007, the stock of treasury bills—at more than US$800mn—is the highest in history, reaching 56 percent of currency issue (Figures 1 and 2). Since 1997, the stock of treasury bills and bonds have had a close correlation with the evolution of consumer price inflation, with the exception of 2003 and 2005, years in which inflation was influenced by supply shocks, both external (fuel prices) and domestic (blockades and shortages due to political instability). As the central bank acknowledges that—since early 2006—demand pressures are playing a significant role, it is likely that the stock of treasury bills will keep an upward trend.

As for treasury financing, placements in domestic markets shot up in the late 1990s (Figure 3)

While the treasury in Bolivia had traditionally financed its operations through external concessional lending—by end-1997, domestic debt reached 5¾ percent of GDP only—the last ten years have witnessed a steady growth in domestic debt, which increased by about 16 percent a year on average to reach 24 percent of GDP as of September 2007. Domestic placements include compulsory debt to pension funds and treasury bonds issued through competitive auctions. The former show the fastest growth during the last 10 years—reaching more than US$1,600 million (about 12½ percent of GDP) as of September 2007.

Figure 1. Stock of Central Bank Paper

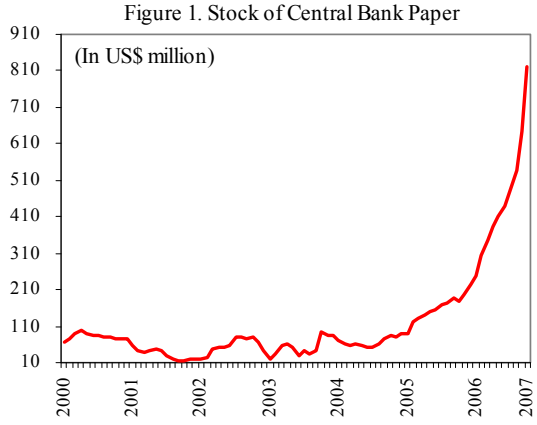


Figure 2. Inflation and Central Bank Paper

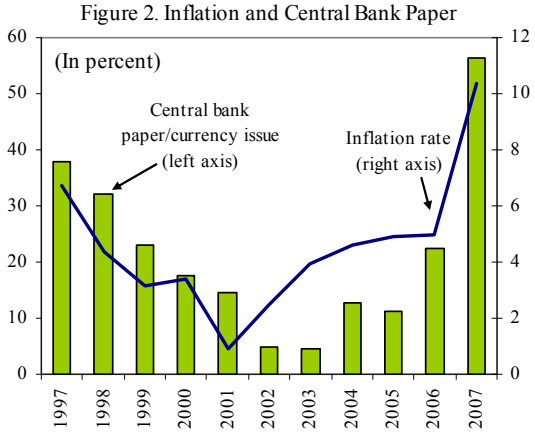
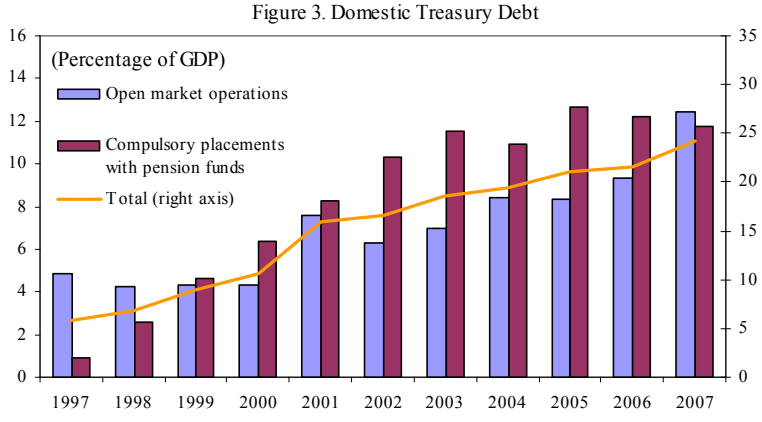


Figure 3. Domestic Treasury Debt



The financing through competitive auctions has picked up in the last five years

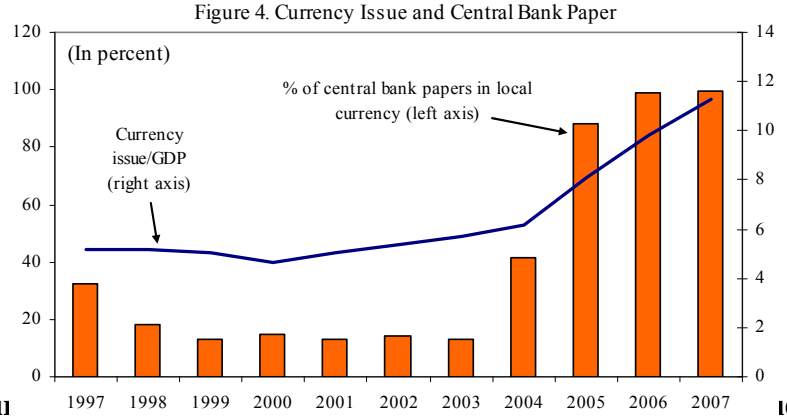
The stock of treasury bonds was stable between 1997 and 2000, at around 4 percent of GDP. The expansionary fiscal stance in the early 2000s was financed through external credit, with marginal contributions from domestic markets.[15] However, the fiscal consolidation after 2002 witnessed an increase in the contribution of domestic financing through competitive auctions.

4.1 Currency Composition of Public Debt

Consistent with the de-dollarization trend, the central bank has increasingly placed paper in domestic currency

The stock of currency issue, although at low levels if compared with international standards, has increased from its lowest in 2000 (at about 4¾ percent of GDP) to the highest in 10 years at 11 percent of GDP in 2007. Consistent with this trend, the stock of treasury bills in domestic currency, which in 1999 reached its lowest at about 13 percent of the total, has increased to represent about 99 percent of the total as of September 2007 (Figure 4).

Figure 4. Currency Issue and Central Bank Paper

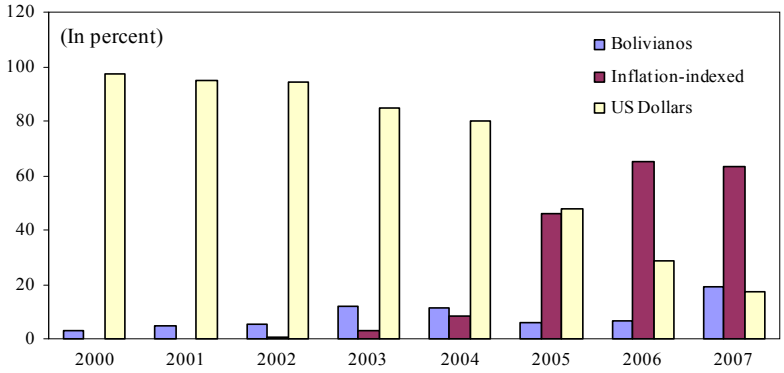


As for treasu ıed in US dollars until 2004 (Figure 5)

As a consequence, the stock of US dollar domestic debt represented 95 percent of the total by end-2000; and still 80 percent by end-2004. This financing structure was similar to the one of credit to the private sector by the financial system—as of end-2003, US dollar credit to the private sector represented 97 percent of total credit.

[15] External credit was mainly granted by multilateral agencies and bilateral donors; on concessional terms.

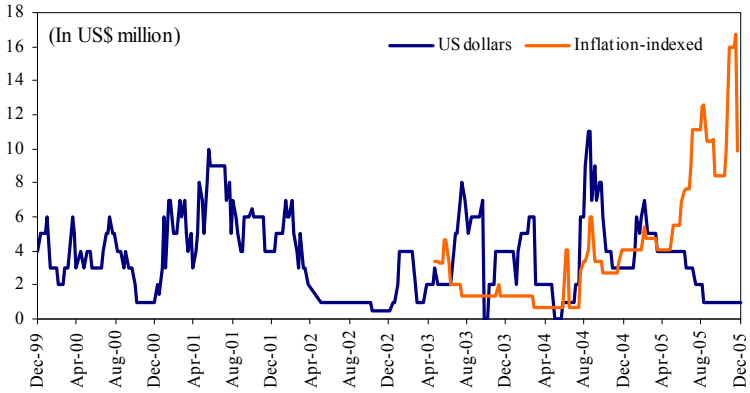
Figure 5. Auctioned Treasury Paper by Currency



In 2005, the issue of inflation indexed bonds picked up, gradually replacing US dollar denominated paper (see Figure 5)

The treasury stepped up its offers of inflation indexed bonds (Figure 6) aiming at de-dollarizing domestic debt. On the demand side, as explained in the introduction, more appetite for instruments in *Bolivianos* seems to be related to positive macroeconomic developments and several policy measures favoring the use of domestic currency, like the increase in reserve requirements for US dollar deposits, a tax on financial transactions in US dollars, a larger exchange rate bid-ask spread, and a gradual appreciation of the *Boliviano* (see section 6).

Figure 6. Weekly Supply of Auctioned Treasury Paper



Starting in 2006, aiming at reducing indexation, the treasury has also favored non-indexed instruments in *Bolivianos*

In 2006, the treasury opted for reducing its offer of 2 and 4-year inflation-indexed bonds in favor of non-indexed treasury bonds in *Bolivianos.*[16] The latter—which have been offered for the first time in history—were well received by the market, as substantiated by the increasing placements at decreasing yields during the last months. In 2007, the treasury introduced 6, 8 and 10-year non-indexed bonds in *Bolivianos,* with nominal annual yields between 9 and 11 percent.[17]

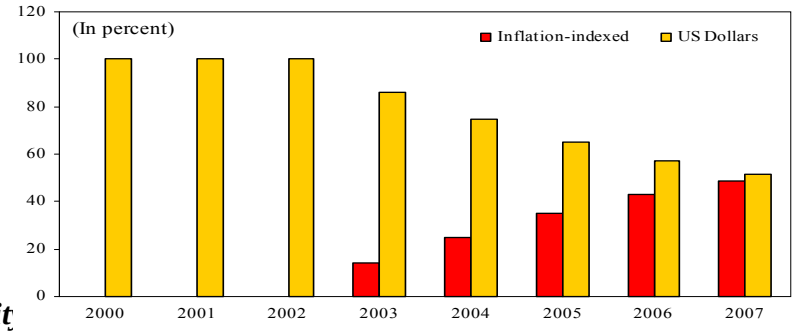
Then, as a consequence of recent debt management policies, US dollar treasury paper auctioned in domestic markets fell to less than 20 percent of the total by September 2007

US dollar treasury paper fell steadily since 2003; from about 85 percent of open market paper to 17 percent in 2007 (see Figure 5). This was basically replaced by both inflation indexed bonds and nominal paper in *Bolivianos*, which add up to more than US$650mn as of September 2007, representing 64 and 19 percent of total auctioned paper respectively.[18]

Treasury placements to pension funds—which started in 1997—shifted from US dollar-indexed treasury bonds to inflation-indexed bonds in 2003

Pension fund financing to the treasury started with 15-year US dollars indexed bonds. In 2003, the original legislation on pension reform was amended, to index pension payments to inflation—these payments were previously indexed to the US dollar. At that time, the treasury and pension funds renegotiated the original agreement; replacing US dollar indexed debt by inflation indexed bonds. This agreement allowed the government to de-dollarize treasury debt, while pension fund companies got to hedge against future pension payments.

Figure 7. Stock of Placements to Pension Funds by Currency



4.2 Maturit

The maturity structure of central bank paper, concentrated in the short term, responds to the needs of monetary policy

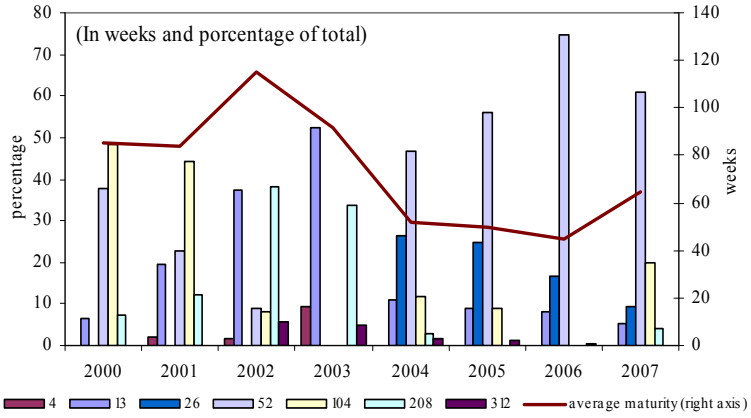
[16] The market for indexed paper in *Bolivianos* played a critical role as a reference market for the introduction of nominal bonds, in particular because it reduced the risk that the treasury deflates domestic currency debt through an acceleration of inflation.

[17] These are relative low yields, compared with the expected yield obtained by an investment in inflation indexed paper, which includes the coupon paid by the paper plus the expected inflation rate, proxied by the median of inflation projected in the central bank monthly survey.

[18] Incidentally, a side effect of the financing policy that shifted towards (longer term, see below) inflation-indexed instruments is that it has to some extent aligned the ministry of finance with the central bank on anti-inflationary policies.

The Central Bank of Bolivia issued treasury bills at 2, 4 and 6-year maturity in the early 2000s, not only aiming at monetary policy operations, but also at developing long term markets.[19] However, it has been increasingly concentrating in short term paper in the last three years (Figure 8). As a result, almost two-thirds of placements were at 1-year maturity as of September 2007, with the other third mainly distributed in 3, 6 and 24-month maturities.[20]

Figure 8. Central Bank Paper: Maturity Structure



In contrast, the treasury has pursued a strategy to lengthen the maturity structure of paper placed in competitive auctions

Since early 2004, the treasury has favored the placement of 2 and 4-year treasury bonds. On average, the maturity at issuance of auctioned treasury paper has been raised by almost 2 years between 2004 and September 2007 (from 140 weeks to 241 weeks, Figure 9a). The average remaining maturity has also increased from 70 weeks in 2004 to 151 weeks as of September 2007 (Figure 9b). As a consequence, more than 70 percent of auctioned paper is coming due in more than a year. Between 2008 and 2012, treasury debt coming due averages 14 percent of the total stock, peaking at 18 percent in 2009 (Figure 9c).

Figure 9a. Auctioned Tresury Paper: Remaining Maturity

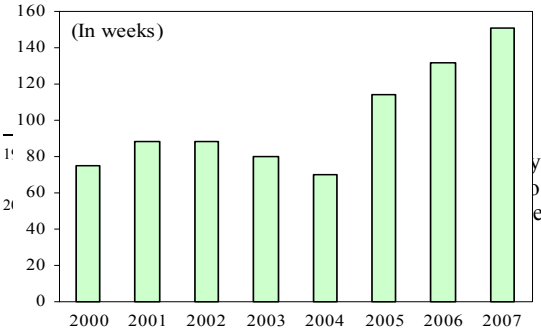


Figure 9b. Auctioned Treasury Paper: Maturity at Issuance

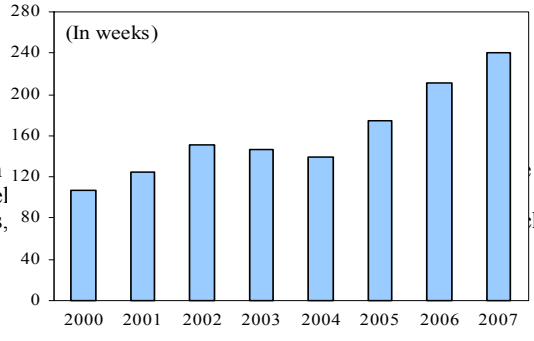
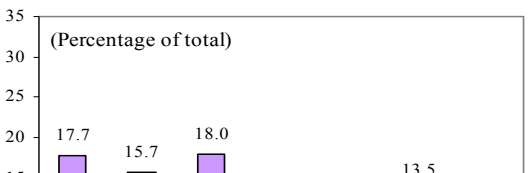


Figure 9c. Auctioned Treasury Paper: Amortization Schedule



Treasury placements to pension funds have historically involved long term paper

While the initial financing agreement with pension funds involved only 15-year treasury bonds; the subsequent renegotiation involved the issuance of treasury bonds at 9 and 15-year maturity, giving place to an average 13-year maturity at issuance. The average remaining maturity has then fallen throughout the period, and reached about 11 years as of end-2006 (Figure 10a). In early 2007, the treasury and the pension funds agreed to stop placements of 9-year maturity bonds, so the maturity structure of those instruments is shifting towards longer maturities again.

More than half of the stock of debt issued to pension funds is coming due after 2017 (Figure 10b)

The first amortizations of pension fund's treasury paper, corresponding to initial placements at the inception of the reform in 1996, will take place in 2011. Debt amortizations will average about 11 percent of total debt between 2012 and 2015. About 54 percent of total pension fund treasury paper will come due after 2017.

Figure 10a. Stock of Placements to Pension Funds Bonds: Remaining Maturity

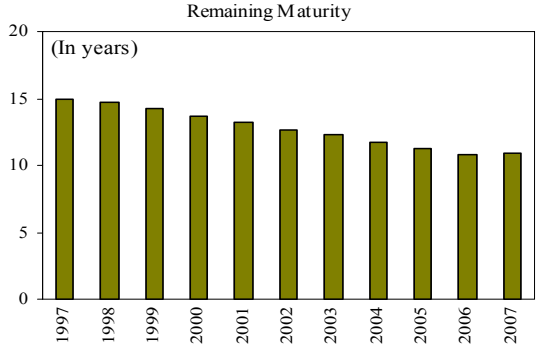
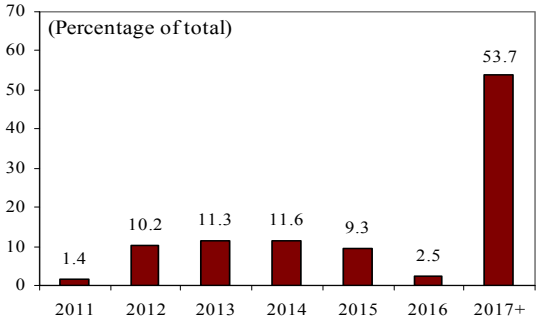


Figure 10b. Stock of Placements to Pension Funds Bonds: Amortization Schedule



5. Bolivia in Perspective: Treasury Paper in Latin America[21]

[21] This section focus on domestic debt issued for treasury financing; and in particular to debt issued through open market operations.

As a result of the increase in treasury placements during the last years; the stock of public domestic debt in Bolivia is high compared with other countries in the region

Excluding Brazil, Bolivia presents one of the highest debt ratios in the region at about 20 percent of GDP, similar to Costa Rica and Colombia (Table 1). In part, this is related to the fact that Bolivia—like Colombia—makes compulsory debt placements to pension funds; which secures a large debt market.[22] As a consequence, these placements account for two-thirds of total placements.

In terms of maturity structure—despite significant recent improvements—a comparison of Bolivia with Latin America shows that there is room for lengthening maturities

Bolivia's debt maturity looks high in relation to the average for Latin America (see Table 1); but this is in part related to treasury compulsory placements to pension funds; which are made at 15-year maturity. Excluding these placements; the average remaining maturity in Bolivia—at 2½ years—is about half the average in the region (excluding Bolivia and Colombia). However, average maturity at issuance is higher in Bolivia than in any other country of the sample, with the exception of Peru. This suggests that Bolivia is gradually aligning with the rest of the region in terms of remaining maturity.

Excluding compulsory debt to pension funds; the dollarization of treasury placements is similar to the region's average

More than 70 percent of domestic debt is denominated in *Bolivianos*, slightly higher than the average in the region (see Table 1).[23] De-dollarization of domestic debt will likely continue in coming years; which would allow Bolivia to align the currency denomination of domestic debt with other countries that made faster progress in replacing US dollar denominated debt.

[22] Placements in this market will be reduced as pension funds are allowed to increase investments abroad.

[23] Treasury paper issued to pension funds comprises a higher proportion of foreign currency denominated debt because only US dollar bonds were issued immediately after the pension reform was implemented, in part because pensions were indexed to the US dollar until 2003. Pensions are now tied to inflation, and only inflation indexed paper has been issued to pension funds after 2003. The share of foreign currency denominated debt will continue to fall, especially after 2011, when US dollar debt will begin to come due.

Table 1
Latin America: Domestic Treasury Debt 1/

Country	Treasury Debt / GDP	Average Maturity at Issuance (in years)	Average Remaining Maturity (in years)	Currency Composition 2/
Bolivia 3/	20.2	9.5	7.8	53.4
Excluding compulsory placements to pension fund	7.4	4.1	2.5	71.4
Brazil	65.8	3.0	2.6	98.7
Chile 4/	3.2	...	12.2	100.0
Colombia 5/	21.6	3.9	3.4	99.6
Costa Rica	23.3	3.5	3.8	84.4
Ecuador	7.8	...	3.7	0.0
Mexico	15.8	3.3	4.3	...
Paraguay	2.4	...	...	25.0
Peru	7.0	9.5	5.1	83.5
Uruguay 6/	5.8	…	3.0	62.0
Average (excluding Bolivia)	17.0	4.6	4.8	69.2
Average (excluding Bolivia and Colombia)	16.4	6.0	4.9	64.8

Source: IMF staff estimates.

1/ Data for end-2006; unless otherwise indicated.
2/ Domestic currency denominated paper; as share of total.
3/ Includes compulsory placements to pension funds.
4/ All placements made through competitive auctions.
5/ Includes compulsory placements to public sector agencies financed by the central government.
6/ As of February 2007.

6. Currency Composition and Debt Maturity: Debt Management and Economic Fundamentals[24]

As in the rest of Latin America, macroeconomic instability in Bolivia played a critical role in public debt profiles during the last decades

High inflation shortened agents' planning horizons; which resulted in a shift in the maturity structure of financial instruments towards the short run. Policies that facilitated the dollarization of financial instruments helped extending the maturity structure somewhat. However, by the late 1990s, Bolivia still presented a short maturity structure and high dollarization of its financial instruments; and in particular of its public domestic debt.

In light of this, we test the role of macroeconomic fundamentals on domestic debt profiles in Bolivia

We emphasize the role of: (i) the fiscal stance; as reducing fiscal dominance may induce economic agents to expand their planning horizons and shift their portfolios to domestic currency (consistent with the portfolio approach to financial dollarization); (ii) the external position; as a solid international reserves position strengthen the domestic currency (i.e. the monetary regime, also in line with the portfolio approach); (iii) the exchange rate policy; to test the arguments of the one-sided bet against the domestic currency described before.

Together with macroeconomic issues, we also assess the impact of policy measures to promote the use of the *Boliviano*

Among these measures, we focus on the introduction of inflation indexed paper and the financial transactions tax on dollar deposits. We also assess the impact of changes to the prudential regulation framework, and in particular the increase in marginal reserves requirements on US dollar portfolios; which is in line with recommendations from the moral hazard approach to financial dollarization issues.

In the spirit of transfer function models; we combine structural and time series analysis[25]

To do so, we first construct a structural regression model and then develop a time series model for the regression residuals (the unexplained noise). Thus, the general form of the models estimated can be written as

$$y_t = \omega(B)\, x_t + \phi^{-1}(B)\, \theta(B)\, \eta_t \quad (1)$$

where x_t is a vector of independent variables (corresponding to the structural analysis) and $\omega(B)$ is the lag polynomial associated with them. $\Phi^{-1}(B)$ and $\theta(B)$ are polynomials associated with autoregressive and moving average components, i.e. the time series analysis.

[24] This section focus on domestic debt issued for treasury financing, placed through competitive auctions.
[25] Details on the stochastic properties of the data, cointegration relations; and diagnostic tests for the regressions are illustrated in the technical appendix.

The estimates in Table 2 analyze dollarization of treasury paper[26]

They use monthly data between 2000 and 2006; expressed in first differences. The dependent variable is defined as the share of US dollar denominated paper over the total. Fiscal balance is defined as the 12-month fiscal balance as percentage of GDP. Net international reserves are also defined in terms of GDP. The rate of crawling is defined as the monthly depreciation (appreciation) of the *Boliviano*. The yield differential captures the difference between US dollar and *Boliviano* denominated assets (which captures, in the short term, measures like the wedge introduced by the financial transaction tax in US dollar portfolios). The US dollar reserve requirement is the effective reserve requirement on US dollar deposits (and captures the marginal reserve requirement imposed on US dollar deposits since 2005).

The evidence suggests that macroeconomic fundamentals have played a significant role in de-dollarization; especially the fiscal stance and the exchange rate policy

Changes in economic fundamentals had an impact in the degree of dollarization. Improvements in the fiscal balance and appreciations of the *Boliviano* are statistically significant; and have the largest effects, reducing the dollarization ratio. The international reserve position—which signals strength of the domestic currency—also is statistically significant and has a negative effect on dollarization. Finally, the estimates also show that a higher relative yield of a portfolio in *Bolivianos* is also statistically significant in explaining the evolution of dollarization; as well as the reserve requirement on US dollar deposits, which reduces dollarization of public debt.[27]

Table 2
Dollarization of open market operations
(All Variables in First Difference)

Dependent Variable: USD Paper/Total

[26] We focus on debt auctioned in domestic markets in this section because it reflects both policy decisions and market reactions to the latter.

[27] As noted earlier, the link between public debt dollarization and reserve requirements on US dollar deposits is an indirect one. Higher reserve requirements may place incentives for banks to capture liquidity in *Bolivianos*, which may increase demand for public paper in *Bolivianos as* well.

Explanatory Variables	Coefficients
USD Paper/Total (-1)	0.572609***
	[7.241238]
Fiscal Balance (-12)	-0.392786**
	[2.189123]
Net International Reserves	-0.345494***
	[2.808580]
Rate of Crawling	0.633769*
	[1.879026]
Yield Differential (-1)	0.178793*
	[1.822459]
USD Reserve Requirement (-3)	-1.021202**
	[2.377128]
Constant	-0.002242**
	[2.059970]
Adjusted R^2	0.670309
Number of observations	71
Mean of dependent variable	-0.009592
Durbin-Watson statistic	1.957125
Serial Correlation LM Test (4 lags)	0.256727
	(0.904439)
F-statistic	24.71998
	(0.000000)

The table reports OLS estimation for the first difference of the ratio of USD paper/total, which stands for the share of the stock of US dollar denominated treasury paper on total treasury paper. Absolute values of t-statistics are in brackets. *, **, *** indicate 10, 5 and 1% of significance, respectively.

The estimates in Table 3 focus on the maturity structure of treasury paper

They use monthly data between 2000 and 2006. Average maturity is defined as maturity at issuance, expressed in years. Inflation indexed bonds/total is the ratio of the stock of inflation indexed bonds over the total stock of auctioned paper. The long term premium is defined as the difference in yields of 4-year bonds against 1-year paper; and captures the premium offered by the central bank at the inception of long term paper in early 2000. The regression, on top of the autoregressive component; includes a fourth order moving average term.

The recent fiscal consolidation seems to have played a critical role in extending the maturity structure

Estimates in Table 3 suggest that the fiscal stance is statistically significant in explaining a longer maturity structure. The point estimates suggest that the impact of the fiscal stance on debt maturity is economically relevant; an increase of a percentage point of GDP in the fiscal balance would increase the ratio of average maturity by about 1½ months; against a mean value of the dependent variable of about 3½ months.

The debt management strategy—validating yield premiums for longer maturities and introducing inflation-indexed debt—has also played an important role

In early 2000, the debt management committees took the initial steps to develop the market for longer term debt. The first step included premiums on long term instruments aiming at setting a steeper yield curve in the market; an then introduce auctions of inflation-indexed bonds in 2002, after a change in the legislation tied pension payments to inflation. Estimates in Table 3 show that both the spread between long and short maturities and the introduction of inflation indexed bonds are statistically significant in extending the debt maturity structure.

Table 3
Maturity Structure of Open Market Operations
(All variables in levels)

Dependent Variable: Average Maturity

Explanatory Variables	**Coefficients**
Average Maturity (-1)	0.926960***
	[50.05302]
Fiscal Balance (-12)	0.126300***
	[4.940901]
Inflation-indexed Bonds/Total (-3)	0.027369***
	[4.302932]
Long Term Premium (-3)	0.467604***
	[5.610344]
Constant	0.025497***
	[4.065238]
Moving Average Component (4)	-0.552025***
	[5.464450]
Adjusted R^2	0.992761
Number of observations	72
Mean of dependent variable	0.406164
Durbin-Watson statistic	1.631396
Serial Correlation LM Test (4 lags)	1.506807
	(0.211161)
F-statistic	1948.444
	(0.000000)

The table reports OLS estimation for the average maturity at issuance of auctioned treasury paper. Absolute values of t-statistics are in brackets. *, **, *** indicate 10, 5 and 1% of significance, respectively.

7. Conclusions

The profile of domestic debt in Bolivia has improved significantly during the last years

Since the late 1990s; the stock of auctioned paper for treasury financing in domestic currency increased from 14 percent of the total to more than 82 percent as of September 2007. This was achieved at the cost of significant increases in inflation indexed debt; and the authorities are implementing a de-indexation strategy since early 2006. As for the maturity structure, the average maturity of treasury bonds went from 68 weeks in 1998 to 241 weeks (more than 4½ years) as of September 2007.

The authorities have implemented a complex strategy to extend maturities and shift the currency composition of debt towards the *Boliviano*

The authorities pursued policies that: (i) designed prudential regulations penalizing unhedged positions in foreign currency; (ii) softened asymmetries in the exchange rate regime; (iii) favored portfolios in domestic currencies; and (iv) gradually created markets for instruments in *Bolivianos*. This was achieved by introducing marginal reserve requirements for deposits in foreign currency; appreciating the *Boliviano* in the context of the crawling-peg regime; introducing a financial transaction tax for deposits in foreign currency; and introducing inflation indexed bonds at increasing maturities.

This debt strategy is supported by recent academic work on financial dollarization

The efforts to gradually introduce market instruments in *Bolivianos*—and to promote them—are consistent with the recommendations of the "*original sin*" hypothesis. The elimination of policy asymmetries, especially the ones related to the exchange rate regime, is consistent with the portfolio approach to financial dollarization. Finally, changes introduced to prudential regulation respond to recommendations from explanations that highlight moral hazard issues as driving dollarization.

The improvement in macroeconomic fundamentals has also been critical to improve the profile of public debt

After going through financial stress during 2000-2004—years in which the fiscal stance was fragile and Bolivia experience several bank runs, bringing the country at the brink of severe financial crises—the macroeconomic fundamentals have improved significantly, helped by a favorable international situation. The empirical evidence in this paper suggests that this improvement has played a critical role both in reducing debt dollarization and in lengthening the maturity structure. In particular, the strengthening of the fiscal and international reserves positions, and the recent appreciation of the *Boliviano* have proved instrumental for the debt management strategy.

Despite significant progress; a comparison of Bolivia with other Latin American countries suggests that there is room for improvement

Excluding pension fund placements; the average remaining maturity in Bolivia—at 2½ years—is about half the average in the region. Average maturity at issuance, though, is

higher in Bolivia than in any other country of the sample, with the exception of Peru, suggesting that Bolivia is gradually aligning with the rest of the region. As for dollarization, Bolivia's domestic currency composition of open market paper is at the average in Latin America; but only higher than three out of nine other countries in the sample.

The evidence in this note suggests that, looking ahead, keeping a sound macroeconomic environment is essential for further improvements in debt profiles

As noted, the econometric evidence—based on transfer function models that combine structural and time series analysis—suggests that macroeconomic fundamentals have played a critical role both in extending maturities and de-dollarizing financial instruments. The maintenance of a sound macroeconomic environment, then, will help attaining further improvements in debt profiles.

A sound macroeconomic stance also seems to be of the essence to push forward the incipient process of debt de-indexation

The gradual process towards de-indexation of public domestic debt—the second stage in the "*Bolivianization"* process—which the authorities intend to achieve together with further extensions in the maturity structure of debt; calls for the maintenance of macroeconomic stability; and in particular low inflation, for which a sound fiscal position, a flexible exchange regime, and a skillful management of the significant external windfall due to high energy and mineral prices will be of the essence.

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Technical Appendix

First Estimation

1. Definition of the variables

- **DOL:** Stock of US dollar denominated treasury paper / total treasury paper [I(1)]
- **PSFB:** Public sector fiscal balance in percentage of GDP [I(1)]
- **NIR:** Net international reserves (plus RAL) in percentage of GDP [I(1)]
- **EXCH**: 12 month CPI index [I(1)]
- **YIELD:** Difference between foreign and local currency interest saving deposit rates [I(1)]
- **REQ:** Reserve requirement effective interest rate in foreign currency [I(1)]

2. Cointegration

Dolado (1999) and Granger (1990) show that, regardless of the order of integration of individual variables; variables can show group-wise integration that allows studying the relationship between variables in levels.

Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: DOL PSFB NIR EXCH YIELD REQ
Lags interval (in first differences): 1 to 2
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.392196	113.5373	95.75366	0.0017
At most 1 *	0.297952	73.20711	69.81889	0.0261
At most 2	0.242383	44.55306	47.85613	0.0988
At most 3	0.126390	22.06931	29.79707	0.2947
At most 4	0.085511	11.12450	15.49471	0.2040
At most 5 *	0.046818	3.883898	3.841466	0.0487

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
** MacKinnon-Haug-Michelis (1999) p-values.

3. Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.256727	Prob. F(4,60)	0.904439
Obs*R-squared	1.194728	Prob. Chi-Square(4)	0.878966

4. Correlogram – Q-statistics

1	-0.008	-0.008	0.0042	0.948
2	0.103	0.103	0.7981	0.671
3	-0.049	-0.048	0.9844	0.805
4	-0.044	-0.056	1.1336	0.889
5	0.042	0.053	1.2728	0.938
6	0.204	0.216	4.5867	0.598
7	0.087	0.080	5.2050	0.635
8	-0.118	-0.174	6.3586	0.607
9	-0.043	-0.050	6.5156	0.687
10	-0.069	-0.002	6.9219	0.733
11	-0.079	-0.094	7.4590	0.761
12	0.031	-0.043	7.5407	0.820
13	0.006	-0.003	7.5437	0.872
14	0.007	0.063	7.5478	0.912
15	0.035	0.081	7.6643	0.937
16	-0.082	-0.088	8.3054	0.939
17	-0.111	-0.112	9.4848	0.924
18	-0.138	-0.127	11.334	0.880
19	-0.068	-0.085	11.796	0.894
20	-0.023	-0.040	11.848	0.921
21	0.039	0.009	12.002	0.940
22	-0.292	-0.311	21.008	0.520
23	0.003	0.062	21.009	0.581
24	-0.101	0.064	22.137	0.571
25	0.051	0.064	22.428	0.611
26	0.066	0.008	22.925	0.637
27	0.028	-0.033	23.018	0.684
28	-0.112	-0.055	24.519	0.654
29	0.033	0.076	24.654	0.696
30	0.088	0.025	25.629	0.694
31	0.049	-0.006	25.941	0.724
32	0.117	0.068	27.751	0.682

Second Estimation

1. Definition of the variables

- **MAT:** Average maturity at issuance of treasury paper in years [I(1)]
- **PSFB:** Public sector fiscal balance in percentage of GDP [I(1)]
- **UFV:** Stock of inflation-indexed treasury bonds / total treasury paper [I(2)]
- **PREM:** Long term premium of open market operations interest rates [I(1)]

2. Cointegration

Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: MAT PSFB UFV PREM
Lags interval (in first differences): 1 to 2
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob*.*
None *	0.256274	50.44860	47.85613	0.0280
At most 1	0.200578	26.46595	29.79707	0.1154
At most 2	0.096881	8.332786	15.49471	0.4305
At most 3	0.000972	0.078802	3.841466	0.7789

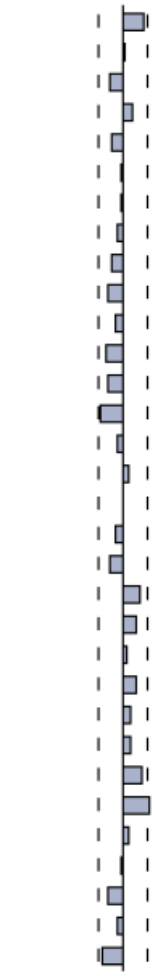
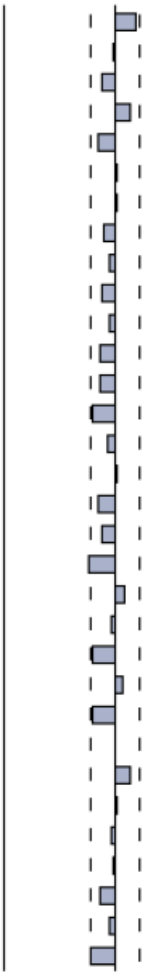
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
** MacKinnon-Haug-Michelis (1999) p-values.

3. Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.506807	Prob. F(4,62)	0.211161
Obs*R-squared	6.345700	Prob. Chi-Square(4)	0.174776

4. Correlogram – Q-statistics

		AC	PAC	Q-Stat	Prob
1		0.182	0.182	2.4827	
2		0.019	-0.014	2.5116	0.113
3		-0.125	-0.130	3.7195	0.156
4		0.086	0.140	4.3025	0.231
5		-0.107	-0.156	5.2158	0.266
6		-0.011	0.022	5.2261	0.389
7		-0.016	0.020	5.2459	0.513
8		-0.051	-0.114	5.4620	0.604
9		-0.115	-0.053	6.5745	0.583
10		-0.138	-0.129	8.2152	0.513
11		-0.077	-0.052	8.7333	0.558
12		-0.148	-0.145	10.678	0.471
13		-0.142	-0.142	12.492	0.407
14		-0.217	-0.212	16.828	0.207
15		-0.049	-0.070	17.049	0.254
16		0.047	0.013	17.258	0.304
17		-0.002	-0.149	17.259	0.369
18		-0.071	-0.124	17.756	0.404
19		-0.117	-0.240	19.135	0.384
20		0.156	0.084	21.623	0.303
21		0.120	-0.039	23.132	0.282
22		0.031	-0.209	23.235	0.332
23		0.116	0.081	24.687	0.312
24		0.073	-0.209	25.287	0.336
25		0.077	-0.001	25.952	0.356
26		0.171	0.140	29.336	0.250
27		0.247	0.023	36.552	0.082
28		0.044	-0.029	36.788	0.099
29		-0.015	-0.012	36.816	0.123
30		-0.144	-0.131	39.436	0.094
31		-0.045	-0.047	39.698	0.111
32		-0.187	-0.223	44.354	0.057