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Dollarization and Maturity Structure of Public Securities: The Experience of Bolivia

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Abstract

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The public debt profile has improved in Bolivia in recent years, with regard to both the maturity structure and the currency composition. This paper analyzes changes in the public debt profile in Bolivia since 2000, and the role played by macroeconomic factors and the debt management strategy adopted by the authorities. We find that both played an important role, in particular the strengthening of the fiscal and international reserves positions and the appreciation of the *Boliviano*; and regulations promoting the use of the domestic currency. Our findings are consistent with Claessens, Klingebiel and Schmukler (2007)—who found that macro and institutional factors had an impact on debt profiles for a group of emerging and developed economies—and are in contrast with the original sin literature, which stresses that profiles are mainly determined by market incompleteness. We also compare the debt profile of Bolivia with those of other countries in Latin America, and find that there is still room for improvement against the regional benchmark, both in terms of maturity structure and currency composition.

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I. INTRODUCTION

As a result of macroeconomic instability, public debt profiles worsened in Latin America during the last decades of the twentieth century. This reflected developments in domestic financial markets, where the maturity of financial instruments gradually fell during the 1970s and 1980s, as high inflation created incentives for economic agents not to get exposed 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 U.S. dollar in domestic financial markets was promoted, in part to develop long term financial 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, 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 extending the maturity structure in financial markets. These characteristics in debt profiles have been identified as important sources of vulnerabilities and mismatches after the financial crises during the 1990s.⁴

However, the debt profile has improved in Bolivia recently, with an extending maturity structure and increasing proportion of debt issued in domestic currency. The market for domestic public debt has become deeper, mainly as the result of a gradual introduction of new financial instruments, in particular inflation-indexed paper. Since 1998, the stock of treasury paper in domestic currency auctioned at domestic financial markets increased from 14 percent of the total to more than 82 percent as of late 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 in 2007.^{5 6}

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 Liejohufvud (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 See, for example, Calvo and Reinhart (1999), Krugman (1999), Jeanne (2000), Aghion, Bacchetta and Banerjee (2001); Borensztein et al (2004); Broner, Lorenzoni, and Schmukler (2004); Burnside, Eichenbaum, and Rebelo (2001); Jeanne and Zettelmeyer (2002); and Inter-American Development Bank (IDB, 2007). Although Bolivian lack of access to international credit markets has safeguarded the country from sudden reversals in international capital flows, short term maturities and currency mismatches have posed challenges for the management of domestic treasury debt, especially taking into account the low level of reserves and the continuous banking runs that Bolivia experienced during the first five years of the 2000s.

⁵ As suggested in IDB (2007), the introduction of inflation indexed bonds may provide an alternative to improve the terms of a trade-off between currency denomination and maturity.

⁶ The lengthening of the maturity structure in Bolivia began somewhat late in relation to other countries in the region, which may be explained in part by the fact that Bolivia has no access to international capital markets.

(continued)

The improvement in the debt profile is the result of a complex debt management strategy; which was also aided by improving macroeconomic fundamentals. The authorities took gradual steps to promote the use of the Boliviano and extend the maturity of public securities, including: (i) incentives to hold financial assets in Bolivianos (for example, marginal reserve requirements for deposits in foreign currency); (ii) introduction of inflation-indexed bonds at increasing maturities;⁷ (iii) higher yields for instruments in Bolivianos at longer maturities; and (iv) appreciation of the Boliviano in the context of the crawling-peg regime. Better macroeconomic fundamentals were also critical. After going through financial stress in the early 2000s, Bolivia improved its fiscal and external balances, which helped to strengthen the Boliviano and reduce the likelihood of financial crises.

This paper analyzes recent developments in public domestic debt in Bolivia—in particular its currency composition and maturity structure. We look separately at paper issued by the central bank to conduct monetary policy, and at paper issued by the Treasury to finance its operations. Using transfer function models, we find that the debt management strategy and 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. This is important, as sound macroeconomic policies have been recognized as a critical prerequisite for improving debt profiles.⁸ We also compare Bolivia's debt profiles with those of other countries in Latin America, and find that there is still room for improvement, both in terms of maturity and currency composition.

Our results for Bolivia are consistent with Claessens, Klingebiel, and Schmukler (2007), who also found that institutional and macroeconomic factors are related to the depth, maturity, and currency composition of government debt for a group of emerging and developed economies. The results support the portfolio approach to financial dollarization, which suggests that sound macroeconomic fundamentals—that enhance credibility in the monetary regime—promote the development of financial markets in domestic currency. Our findings, though, contrast to some extent with the original sin literature, which downplays the effects of institutional and macroeconomic factors on public debt profiles, stressing that the latter are mainly determined by market incompleteness.

The paper is 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 reviews recent trends in the issuance of domestic treasury paper, both monetary

Schmukler and Vesperoni (2006) show that, after financial liberalization, access to international markets helped extend the debt maturity structure during the 1990s.

⁷ Combining short-term nominal instruments in domestic currency with increasingly longer maturities of inflation-indexed paper—in part taking advantage of a growing demand for the latter after the pension reform in the mid-1990s, which created pension funds willing to hedge long-term liabilities indexed to inflation (see Borensztein et al, 2006).

⁸ See Borensztein et al (2004).

policy and treasury financing purposes. Section 5 compares public debt dollarization and maturity structure in Bolivia with those in other Latin American countries. Section 6 shows econometric evidence on the effect of the debt management strategy and macroeconomic fundamentals on debt profiles; and section 7 concludes.

II. FINANCIAL DOLLARIZATION IN THE LITERATURE

The literature on financial dollarization is vast. Academic work during the last 10 years reviewed the experience of several developing and emerging economies that—in the context of inflation stabilization programs—favored the use of the U.S. dollar to lengthen the horizon of financial instruments in domestic markets. The studies on financial dollarization described below have guided our econometric exercise in section 6, which seeks to shed light on the effects of policy measures or the impact of macroeconomic developments on debt profiles in Bolivia.

The debt strategy implemented by the Bolivian authorities has been consistent with 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 that are not necessarily contradictory, and hence support different policy instruments that combine well 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.⁹ Notice that the currency choice is not the result of a market equilibrium, so that 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 U.S. dollar and domestic currency-denominated assets. In doing so, agents would target a minimum variance portfolio.¹⁰ U.S. dollar denominated assets will prevail if the variance of the real exchange

⁹ Eichengreen and Hausmann (1999) and Hausmann and Panizza (2003). 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.

¹⁰ See Ize and Parrado (2002); Ize and Yeyati (2003 and 2005); Barajas and Morales (2003); Ize and Powell (2005); and Ize (2005).

rate is relatively lower than that of the inflation rate.¹¹ Ize and Yeyati (2005) stress that lack of credibility in the monetary regime, which may trigger sharp exchange and financial crises, would shift portfolios towards U.S. dollar instruments. Jeanne (2005) also argues that monetary credibility matters for liability dollarization, as unpredictable monetary policies creates uncertainty for borrowers about the real value of their domestic currency debt, and may induce them to dollarize their liabilities. In terms of de-dollarization strategies, the portfolio approach points to sound macroeconomic fundamentals—to enhance credibility in the monetary regime—and a flexible exchange rate regime (henceforth, not explicitly reducing exchange rate variability).

Other explanations focus on policy asymmetries, in particular those related to exchange rate regimes. Policies that reverse overvaluations through nominal devaluations but do not correct undervaluations through nominal appreciations end up rewarding the U.S. dollar, as it becomes a *one-side bet*.¹² This policy aggravates the *peso problem*, i.e. lenders asking for a disproportionate premium on domestic currency instruments.^{13 14} This explanation highlights that de-dollarization efforts should incorporate a symmetric exchange rate policy that does not preclude appreciations if the latter are warranted by fundamentals.

Some work focuses on the existence of moral hazard, mainly related to expected bail outs by the government in case of a big depreciation of the domestic currency (see McKinnon and Pill, 1998 and Burnside, Eichenbaum and Rebelo, 2001). Borrowers choose to borrow in U.S. dollars to benefit from low interest rates in tranquil times as they expect to be bailed out in a crisis. This explanation suggests the need to avoid *currency-blind* prudential regulations, i.e., to adopt regulations that create incentives for lenders to factor in the risks of lending to agents that face currency mismatches. Although moral hazard does not affect directly the placement of public debt, well defined prudential regulation may put in place incentives for financial de-dollarization, which may increase demand for domestic currency treasury paper (see, for example, Ize and Yeyati 2003; Ize 2005).

¹¹ 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).

¹² 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).

¹³ 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 U.S. dollar debt.

¹⁴ See also Orellana and Mollinedo (1997) for the Bolivian case.

Drawing on empirical evidence, a branch of the literature focuses on the existence of original sin.¹⁵ As explained above, this approach is related to market incompleteness, and defines original sin as the inability of some economies to borrow abroad in their domestic currency (international original sin) and to borrow domestically long term in domestic currency (domestic original sin). It finds that only the absolute size of the economy is robustly correlated to the original sin, with no strong support for the idea that development and institutional quality are also correlated. Hausmann and Panizza (2003) find some evidence that monetary credibility may help reduce domestic original sin, but downplays it in light of the few degrees of freedom in their regressions. In contrast with the original sin literature, Claessens, Klingebiel, and Schmukler (2007) find that institutional and macroeconomic factors are related to the depth, maturity and currency composition of government bond markets for a group of developed and emerging economies. In the same vein, Jeanne and Guscina (2006) observe significant cross-country variation in the structure of domestic debt, the latter being associated with the monetary stability record; as we will see below, our findings for Bolivia are consistent with this work.

III. DOMESTIC DEBT IN BOLIVIA: INSTITUTIONAL ISSUES

Domestic debt is issued for monetary policy and treasury financing purposes. 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, in coordination with the central bank's Open Market Committee.

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 twelve-month maturities) and two- and four-year treasury bonds, mostly in domestic currency.¹⁶ 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.¹⁷ The treasury, which in the past used to issue short-term debt, is now concentrating on longer maturities, through bonds with six-month coupons, at a pre-determined interest rate, of six-, eight-, and ten-year maturities.

¹⁵ See Eichengreen and Hausmann (1999); Hausmann and Panizza (2003); and Hausmann, Panizza and Stein (2001).

¹⁶ 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).

¹⁷ Inflation-indexed paper was introduced in 2002, to create a financial market for *Bolivianos*.

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, the vice-minister of the treasury, and the director of treasury debt. They place treasury bills and bonds in an auction process.¹⁸ They also review developments in domestic and international financial markets, and in particular 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, using internet protocols. Under this system, participants can monitor offers from other agents in real time, giving them the opportunity to increase their bids until closing time. OEA allows participants to obtain information during the bidding process, which reduces the “winner’s curse” effect and thereby encourages participation. The central bank and/or the treasury can also place paper with the public through the central bank’s trading desk. In general, auction mechanisms are favored, but the authorities may decide to offer paper directly if the monetary program so requires, or if they intend to send signals to market participants about interest rates.¹⁹

The treasury also places long-term bonds with pension funds through non-market mechanisms. The 1996 pension reform legislation gave the treasury the option to place long-term bonds up to a certain share of pension funds’ revenue.²⁰ These are annual-coupon bonds at terms negotiated bilaterally between the treasury and pension funds. Up to 2002, the treasury placed U.S. dollar-indexed bonds, with a 15-year maturity, at 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, at an interest rate of 5 percent. Since early 2007, the treasury has been placing only 15-year inflation-indexed bonds at a 4 percent interest rate.

IV. REVIEW OF RECENT TRENDS IN PUBLIC DOMESTIC DEBT

This section reviews trends in public domestic debt. After a brief description of recent trends in paper placed for monetary policy and treasury financing, section 4.1 analyzes the currency composition and of public paper. Section 4.2 focuses on the maturity structure. For treasury financing, we distinguish between paper placed through competitive auctions in domestic

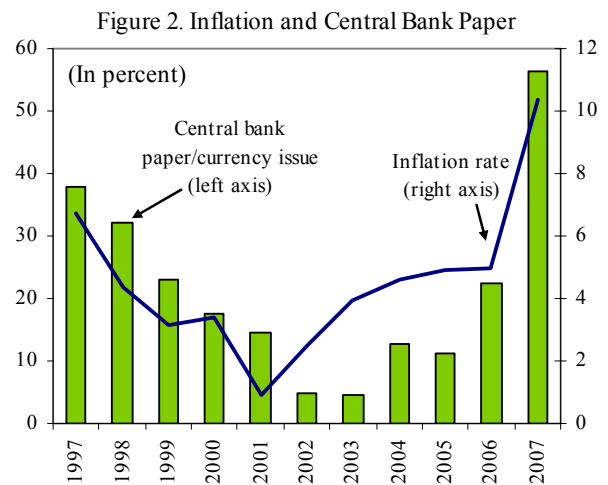
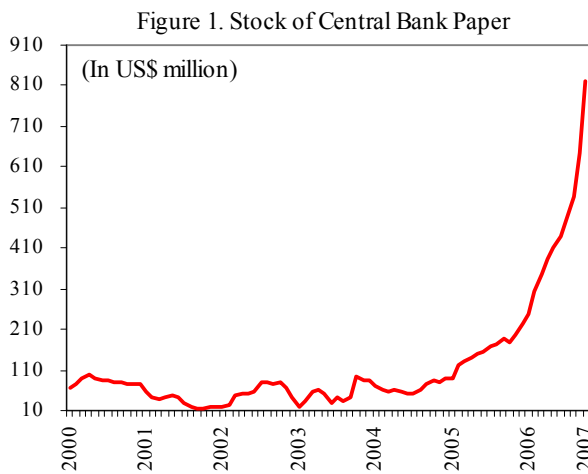
¹⁸ Notice that decisions about treasury bills and bonds are made with full information on the yield curve for both paper issued for monetary policy and treasury financing.

¹⁹ Improvements in the auction system (which before 2005 received biddings through closed envelopes delivered to the central bank), and more generally a better market infrastructure highlights the importance of what IDB (2007) calls “getting the right plumbing” to improve bond markets.

²⁰ A sort of call option over the pension funds’ cash flow.

markets and placements to pension funds, as financing conditions for the latter are negotiated bilaterally.²¹

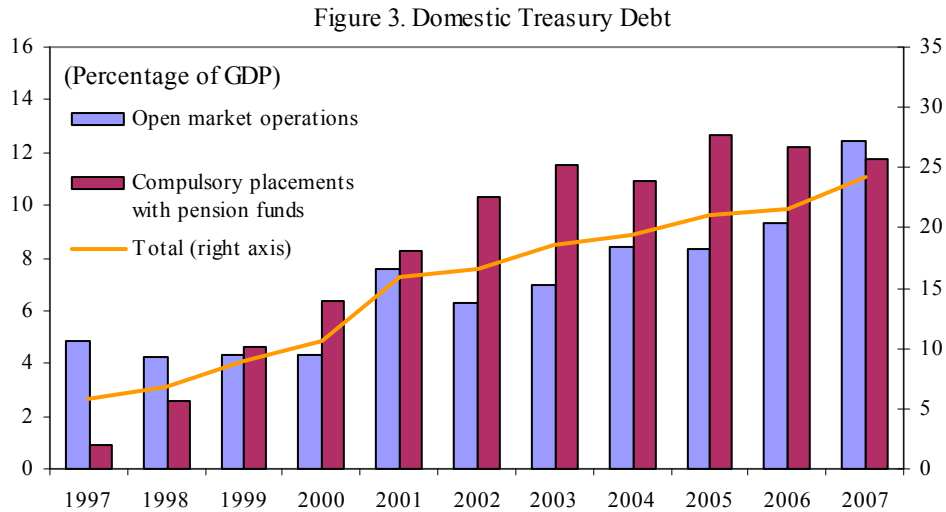
The stock of central bank paper has responded to the needs of monetary policy. As of late 2007, the stock of treasury bills—at more than US\$800mn—is the highest in history, reaching 56 percent of currency issue (Figures 1 and 2). Since 1997, the stock of central bank paper has had a close correlation with the evolution of consumer price inflation, with the exception of 2003 and 2005, years in which inflation was influenced by supply shocks. As the central bank acknowledges that—since early 2006—demand pressures are playing an important role, the stock of treasury bills will likely 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 more than 15 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 shows the fastest growth during the last 10 years—reaching more than US\$1,600 million (about 12½ percent of GDP) as of end-2007. The rapid growth in the domestic bond market for public debt—related in part to the creation of

²¹ The data on treasury bills and bonds were obtained from the open market operations office at the Central Bank of Bolivia (OMO), which holds a complete database of each issuing of treasury paper, both for monetary policy objectives and treasury financing. Regarding maturity structure and currency composition, OMO produces weekly indicators to analyze trends on a high frequency basis, although in this paper we use monthly and annual information.

pension funds in the context of the pension reform²²—has allowed the treasury to diversify its sources of financing.²³



Financing through competitive auctions has picked up in the last five years, following a period of stability during 1997-2000, when the stock of treasury bonds was equivalent to around 4 percent of GDP.²⁴ However, the fiscal consolidation after 2002 witnessed an increase in the contribution of domestic financing through competitive auctions as the market gradually developed.

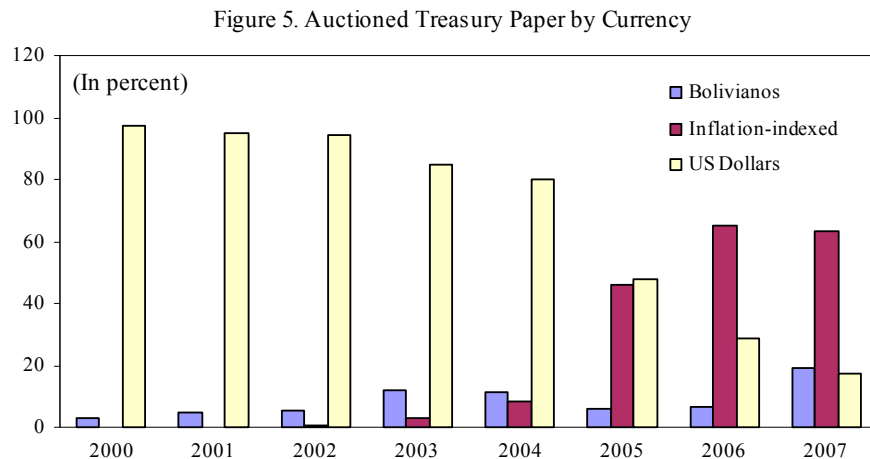
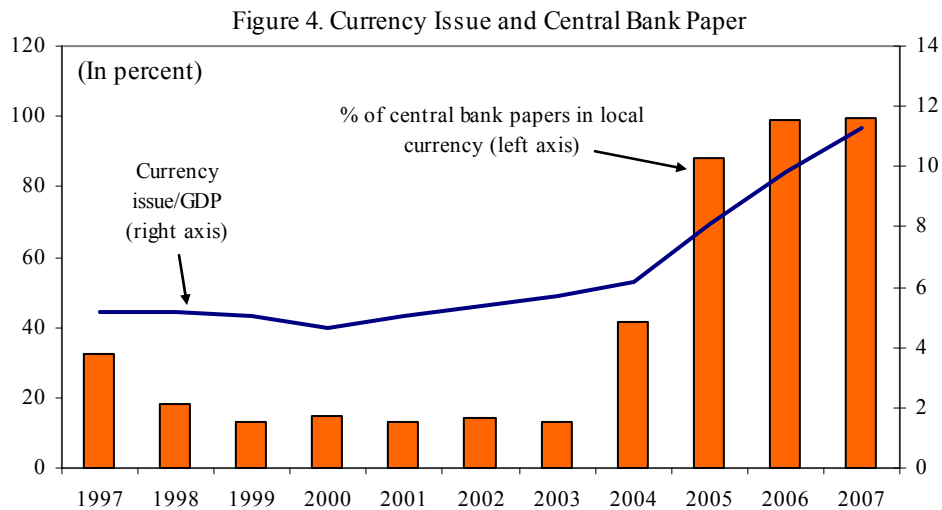
²² Borensztein, Eichengreen, and Panizza (2006) and IDB (2007) suggest that several factors explain the size of bond market capitalization, including *inter alia* country size, financial system development, macroeconomic stability and institutional issues.

²³ IDB (2007) notes that the turn towards domestic financing is not a development restricted to Bolivia, but to Latin America more generally. The report suggests that this has taken some analysts to conclude that Latin American countries are gradually reducing their vulnerabilities, given that foreign currency denominated external debt held by international investors is more sensitive to global factors than domestic debt held by local investors.

²⁴ External credit was mainly granted by multilateral agencies and bilateral donors; on concessional terms.

A. Currency Composition of Public Debt

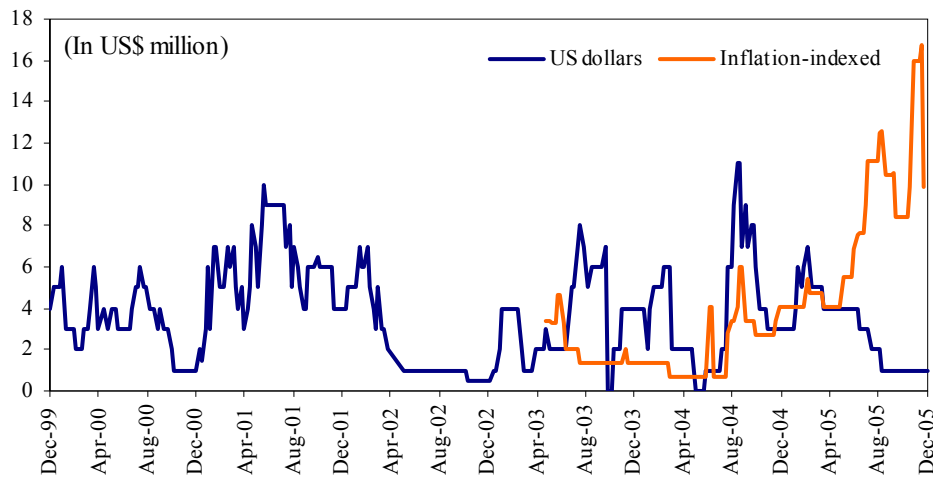
Consistent with the de-dollarization trend, the central bank has increasingly placed paper in domestic currency. The stock of currency issued, although still at low levels by international standards, has increased from its lowest in 2000 (about 4¾ percent of GDP) to the highest in 10 years (11 percent of GDP) in 2007. Consistent with this trend, the stock of central bank paper in domestic currency—which in 1999 reached a low of about 13 percent of the total—has increased to 99 percent of the total in 2007 (Figure 4).



Treasury paper auctioned in domestic markets was mainly issued in U.S. dollars until 2004 (Figure 5). As a consequence, the stock of U.S. 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 that of credit to the private sector by the financial system—as of end-2003, U.S. dollar credit to the private sector represented 97 percent of total credit.

In 2005, issuance of inflation-indexed bonds picked up, gradually replacing U.S. 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, more appetite for instruments in Bolivianos was likely related to positive macroeconomic developments and several policy measures favoring the use of domestic currency, like the increase in reserve requirements for U.S. dollar deposits, a tax on financial transactions in U.S. 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. The treasury reduced its offer of two- and four-year inflation-indexed bonds in favor of non-indexed treasury bonds in Bolivianos.²⁵ The latter—offered for the first time in history—were well received by the market, as evidenced by increasing placements at decreasing yields during the last months. In 2007, the treasury introduced six-, eight- and ten-year non-indexed bonds in Bolivianos, with nominal annual yields between 9 and 11 percent.²⁶

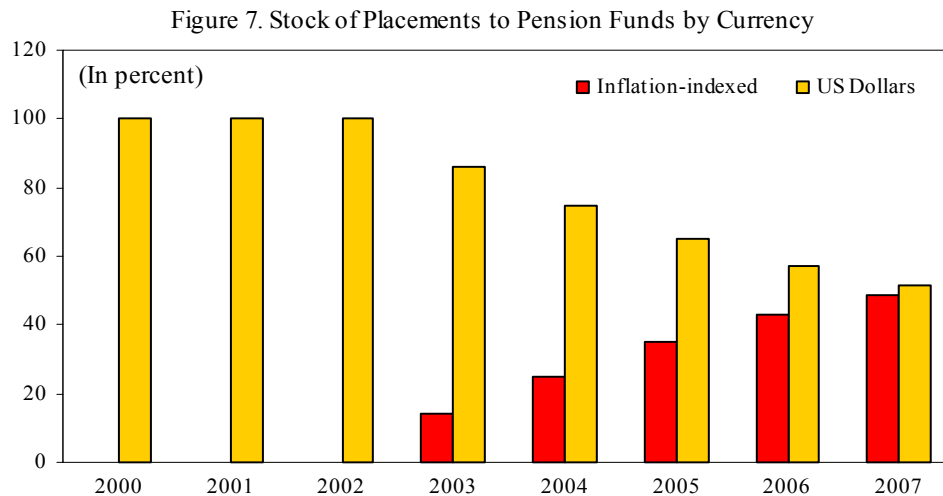
U.S. dollar treasury paper auctioned in domestic markets fell to less than 20 percent of the total by September 2007. This paper fell steadily since 2003; from about 85 percent of auctioned paper to 17 percent in 2007 (see Figure 5). It was basically replaced by both inflation indexed bonds and nominal paper in Bolivianos, which add up to more than

²⁵ 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.

²⁶ These are relative low yields, compared with the expected yield obtained by inflation indexed paper, calculated as the coupon paid by the paper plus the expected inflation rate, proxied by the median of inflation projected in the central bank monthly survey.

US\$650 million in late 2007, representing 64 and 19 percent of total auctioned paper respectively.²⁷

Treasury placements to pension funds—which started in 1997—shifted from U.S. dollar-indexed treasury bonds to inflation-indexed bonds in 2003. Pension fund financing to the treasury started with 15-year U.S. dollars indexed bonds. In 2003, the original 1996 legislation on pension reform was amended to index pension payments to inflation—these payments were previously indexed to the U.S. dollar. At that time, the treasury and pension funds renegotiated their original agreement, replacing U.S. dollar-indexed debt by inflation-



indexed bonds (Figure 7). This revision allowed the government to de-dollarize treasury debt, while enabling the pension funds to hedge against future pension payments.

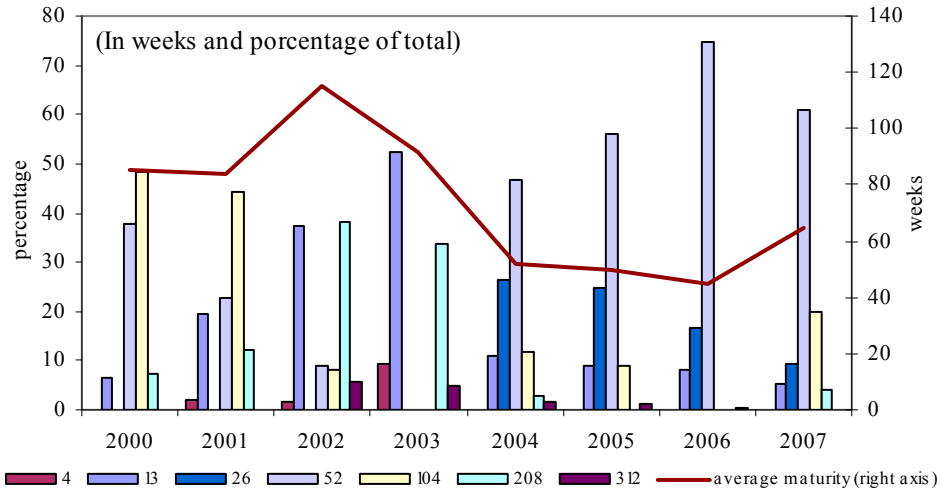
B. Maturity Structure of Public Debt

The maturity structure of central bank paper, concentrated in the short term, responds to the needs of monetary policy. The Central Bank of Bolivia issued treasury bills at two-, four-, and six-year maturities in the early 2000s, aiming not only at monetary policy operations but also at developing long term markets. However, the central bank has been increasingly concentrating on short term paper over the last three years (Figure 8). As a result, almost two-thirds of placements were of one-year maturity in 2007, with the remainder distributed mainly across three-, six- and 24-month maturities.²⁸

²⁷ 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.

²⁸ In 2007, aiming at mopping up liquidity for longer periods, the bank took over two- and four-year maturity issues, which had been introduced by the treasury a couple of years earlier.

Figure 8. Central Bank Paper: Maturity Structure



In contrast, the treasury has pursued a strategy of lengthening the maturity structure of paper placed in competitive auctions. Since early 2004, the treasury has favored the placement of two- and four-year treasury bonds. On average, the maturity at issuance of auctioned treasury paper has been raised by almost two years between 2004 and 2007 (from 140 weeks to 241 weeks, Figure 9a). The average remaining maturity has also increased, from 70 weeks in 2004 to 151 weeks in 2007 (Figure 9b). As a consequence, more than 70 percent of auctioned paper is now coming due in more than one 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 Treasury Paper: Remaining Maturity

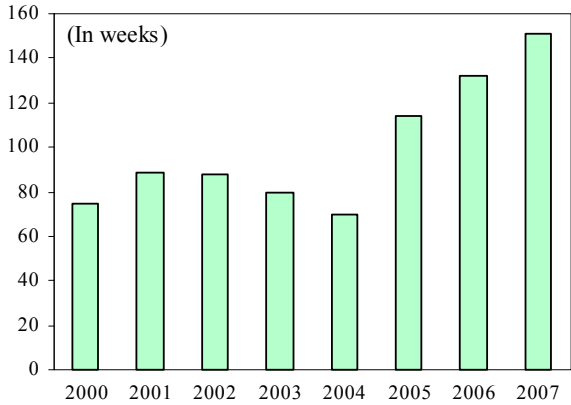
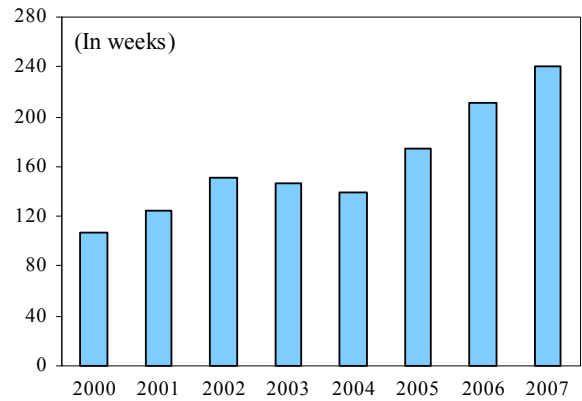
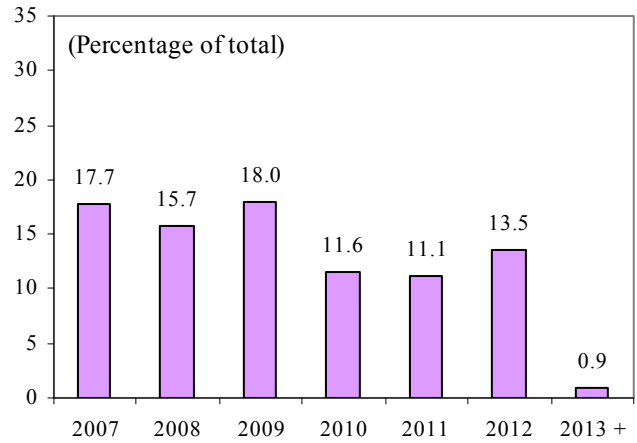


Figure 9b. Auctioned Treasury Paper: Maturity at Issuance



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 rise to an average 13-year maturity at issuance. The average remaining maturity has fallen steadily to about 11 years (Figure 10a). In early 2007, the treasury and the pension funds agreed to discontinue placements of nine-year bonds, so the maturity structure of those instruments is shifting back towards longer maturities.

Figure 9c. Auctioned Treasury Paper: Amortization Schedule



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. More than 50 percent of total pension fund treasury paper will come due after 2017.

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

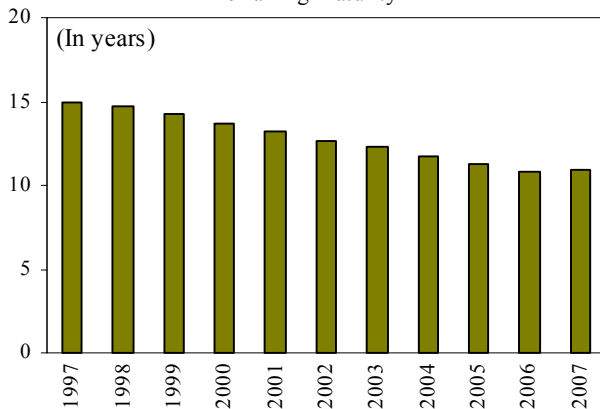
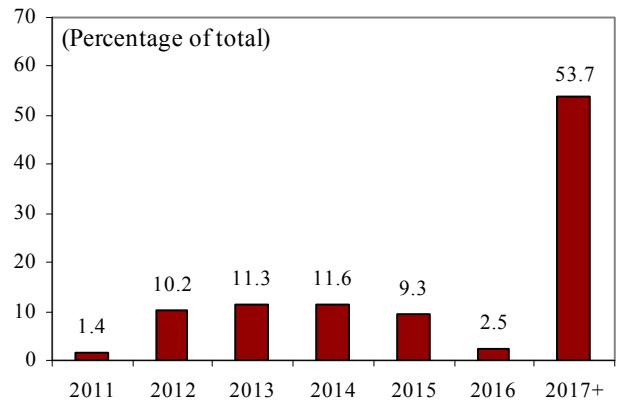


Figure 10b. Stock of Placements to Pension Funds Bonds: Amortization Schedule



V. BOLIVIA IN PERSPECTIVE: TREASURY PAPER IN LATIN AMERICA²⁹

As a result of the increase in treasury placements in recent years, the stock of public domestic debt in Bolivia is high compared with that of other countries in the region. Bolivia displays one of the highest domestic 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.³⁰ 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. While Bolivia's debt maturity looks high in relation to the average for Latin America (see Table 1), this is in part related to compulsory treasury placements to pension funds, which are made at a 15-year maturity. Excluding these placements, the average remaining maturity in Bolivia—at 2½ years—is about half the average for other countries in the region (excluding 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 itself 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).³¹ De-dollarization of domestic debt will likely continue in coming years, which would allow Bolivia to align the currency denomination of its domestic debt with that in other countries that have made faster progress in replacing U.S. dollar denominated debt.

²⁹ This section focuses on domestic debt issued for treasury financing.

³⁰ Placements through this channel will be reduced as pension funds are allowed to increase investments abroad.

³¹ Treasury paper issued to pension funds comprises a higher proportion of foreign currency denominated debt because only U.S. dollar bonds were issued immediately after the pension reform was implemented, in part because pensions were indexed to the U.S. 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 U.S. 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
<i>Excluding compulsory placements to pension fund.</i>	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.

VI. CURRENCY COMPOSITION AND DEBT MATURITY: DEBT MANAGEMENT AND MACROECONOMIC FUNDAMENTALS³²

As in the rest of Latin America, macroeconomic instability in Bolivia played a critical role in shaping the public debt profile in recent 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 extend 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 in determining the domestic debt profile 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 strengthens the domestic currency (i.e. the monetary regime, also in line with the portfolio approach); and (iii) exchange rate policy, to test the arguments of the one-sided bet against the domestic currency described above.

³² This section focus on domestic debt issued for treasury financing, placed through competitive auctions. This debt reflects both policy decisions and market reactions to the latter.

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 seek to assess the impact of changes in the prudential regulation framework, and in particular the increase in marginal reserve requirements on U.S. dollar portfolios, which is in line with recommendations from the moral hazard approach to financial dollarization.

In the spirit of transfer function models, we combine structural and time-series analysis.³³ 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 estimated models may 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.

The estimates in Table 2 focus on dollarization of treasury paper. They use monthly data between 2000 and 2006, expressed in first differences. The dependent variable is defined as the share of U.S. dollar denominated paper over the total. Fiscal balance is defined as the 12-month fiscal balance as percentage of GDP.³⁴ Net international reserves are also defined in terms of GDP. The rate of exchange rate crawl is defined as the monthly depreciation (appreciation) of the Boliviano. The yield differential captures the difference between U.S. dollar and Boliviano denominated assets—which captures, in the short term, measures like the wedge introduced by the financial transaction tax on U.S. dollar portfolios. The U.S. dollar reserve requirement is the effective reserve requirement on U.S. dollar deposits (and captures the marginal reserve requirement imposed on U.S. 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.³⁵ The international reserve position—which

³³ Details on the stochastic properties of the data, cointegration relations, and diagnostic tests for the regressions are illustrated in the technical appendix.

³⁴ We use monthly fiscal data for the non-financial public sector, and calculate the fiscal position for the last 12-months. For GDP, the statistical institute produces quarterly data. The denominator in the ratio for the fiscal balance is calculated as follows: for each end-of-quarter month, we add GDP figures for the last four quarters, and repeat the previous end-of-quarter figure for the two months in between.

³⁵ The rate of exchange rate crawl and the international reserve position are the only contemporaneous variables in the regression, and endogeneity issues may be raised about them. For example, Calvo and Reinhart (2000) “fear of floating” and Claessens et al (2007) note that the degree of foreign currency liabilities can affect whether countries choose to let their currencies float. However, the case of Bolivia does not likely raise

(continued)

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 statistically significant as well in explaining the evolution of dollarization as is the reserve requirement on U.S. dollar deposits, which reduces dollarization of public debt.³⁶

Table 2: Dollarization of Open Market Operations
(All variables in first difference)

Dependent Variable: USD Paper/Total	
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 U.S. dollar denominated treasury paper on total treasury paper. Absolute values of t-statistics are in brackets. *, **, *** indicate 10, 5 and 1% of significance, respectively.

endogeneity issues, mainly for two reasons: (i) the crawling-peg introduced by Bolivia after hyperinflation in the mid-1980s has not been changed since then, and (ii) the recent appreciation trends are clearly related to the dramatic shift in its external position. Bolivia's external current account moved from a 4 percent of GDP deficit in 2002 to a 12 percent of GDP surplus in 2006 (lack of access to international markets makes Bolivia's capital account less relevant and less prone to volatility). A similar argument applies to Bolivia's reserve position.

³⁶ As noted earlier, the link between public debt dollarization and reserve requirements on U.S. dollar deposits is an indirect one. Higher reserve requirements may provide incentives for banks to capture liquidity in *Bolivianos*, which may increase demand for public paper in *Bolivianos* as well.

The estimates in Table 3 focus on the maturity structure of treasury paper. They use monthly data between 2000 and 2006. Average maturity is based on 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 four-year bonds versus one-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 improvement in the fiscal position in recent years seems to have played a critical role in extending the maturity structure. Estimates in Table 3 point to a statistically significant effect of the fiscal stance in explaining a longer maturity structure. The point estimates suggest that the impact of the fiscal position 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.

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.

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 a premium on long term instruments, aimed at setting a steeper yield curve in the market; and introduction of 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 explaining the debt maturity structure.

VII. CONCLUSION

The profile of domestic debt in Bolivia has improved significantly in recent 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 80 percent as of late 2007. This has been achieved in the context of significant increases in inflation-indexed debt, and the authorities are implementing a de-indexation strategy since early 2006. The average maturity of treasury bonds rose from 68 weeks in 1998 to 241 weeks (more than 4½ years) in 2007.

The authorities have implemented a complex strategy to extend maturities and shift the currency composition of debt towards the Boliviano. They pursued policies that: (i) defined prudential regulations, penalizing unhedged positions in foreign currency; (ii) softened asymmetries in the exchange rate regime; (iii) favored portfolios in domestic currency; and (iv) gradually created markets for instruments in Bolivianos. In this context, the authorities introduced marginal reserve requirements for deposits in foreign currency; appreciated the Boliviano under the crawling-peg regime; imposed a financial transaction tax on deposits in foreign currency; and introduced inflation-indexed bonds at increasing maturities to develop a market for long term financial instruments.

The de-dollarization strategy has been consistent with the findings of recent academic work on financial dollarization. The efforts to gradually introduce market instruments in Bolivianos—and to promote them—are consistent with the original sin literature. The elimination of policy asymmetries, especially the ones related to the exchange rate regime, is consistent with the portfolio approach to financial dollarization. Finally, the changes introduced to prudential regulation echo recommendations from academic research that has highlighted moral hazard issues as drivers of dollarization.

The improvement in macroeconomic fundamentals, though, has been probably the most critical cause of improvement in the profile of public debt. After going through financial stress during 2000-2004—years in which the fiscal position was fragile and Bolivia experience several bank runs, taking the country at the brink of severe financial crises—the macroeconomic fundamentals have improved significantly. The estimation results in this paper suggest that this improvement has played a critical role both in reducing debt dollarization and in lengthening the debt maturity structure. In particular, the strengthening of the fiscal and international reserves positions, and the recent appreciation of the Boliviano have proved fundamental, along with the debt management strategy.

Our results for Bolivia are consistent with Claessens, Klingebiel, and Schmukler (2007), who also found that institutional and macroeconomic factors are related to improvements in debt

profiles in a group of emerging and developed economies. The results support the portfolio approach to financial dollarization, which suggests that sound macroeconomic fundamentals—i.e. credibility in the monetary regime—promote the development of financial markets in domestic currency. On the other hand, our findings contrast with the original sin literature, which downplays the effects of institutional and macroeconomic factors on public debt profiles, stressing that the latter are mainly determined by market incompleteness.

Despite significant progress, a comparison with other Latin American countries suggests that there is room for improvement in Bolivia's debt profile. 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 currently higher in Bolivia than in any other country of the sample, with the exception of Peru, suggesting that Bolivia is gradually aligning itself with the rest of the region. As for dollarization, Bolivia's share of domestic currency in open market paper is at the regional average, but lower than five out of the nine countries in the sample.

Looking ahead, the evidence suggests that keeping a sound macroeconomic environment will be essential for further improvements in the debt profile. 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 in de-dollarizing financial instruments.

A sound macroeconomic stance also seems to be of the essence for pushing 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 critical.

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Technical Appendix

First Estimation

1. Definition of the variables

- **DOL:** Stock of U.S. 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, such variables can show group-wise integration that allows studying the relationship between them 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

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
		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

Autocorrelation	Partial Correlation	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	19.136	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	23.236	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	25.962	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