PARAGUAY

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PARAGUAY

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Approved by
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CONTENTS

EFFECTIVE BANKING SECTOR SPREADS IN PARAGUAY[1]

This paper analyses Paraguay's effective interest spreads using various methodologies. Operational costs, rising profits and the need to cover credit and liquidity risks are the main factors behind Paraguay's effective spreads. Improving data quality and mechanisms for sharing credit information could contribute to reduced spreads. Although the empirical results suggested that banking concentration has not given rise to greater spreads, adding new banking entrants may lower margins by increasing competition within the sector.

A. Introduction

1.   Interest rates spreads in Paraguay continue to be some of the highest in Latin America. A series of bank crises in the late 1990s and early 2000s weakened the financial system and pushed up spreads. In response, policymakers enacted a number of financial sector regulatory and supervisory reforms—assisted in part by the Fund's FSAP consultation process. At the same time, the system's profitability improved sharply as high commodity prices over last decade resulted in an expansion of bank deposits, which in turn led to an increase in credit growth. The prevailing view when these reforms were undertaken was that financial liberalization would improve the sector's competitiveness and efficiency and result in lower interest rate margins. In this context, the authorities have been trying to understand the factors behind the persistence in interest rate spreads.

2.   The purpose of this note is to examine Paraguay's effective interest spreads through accounting decompositions, financial ratio analysis, and spread regressions. Banks play an important intermediation role by transforming customer deposits into loans. While interest rate spreads reflect this risk-taking role, their level and evolution also contain information regarding regulation and operating costs as well as management decisions—all of which can be evaluated by accounting decompositions. Viewed from a slightly different angle, banks make profits through the use of leverage and an efficient deployment of their assets and operations. In this context, an examination of financial ratios focused on profit creation provides a complementary view to interest rate decompositions, and allows a deeper understanding of spreads. Finally, interest rate regressions offer a direct way to estimate the influence of risk, costs, bank concentration and market power factors on spreads.

3.   The paper is organized as follows. Section B provides some background and stylized facts on the Paraguayan banking sector. Sections C through E present the methodology and results of interest rate decompositions, financial statement analysis, and interest rate regressions, respectively. Section E concludes.
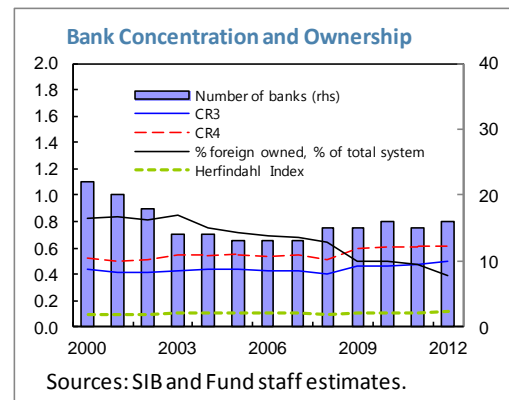
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[1] Prepared by Kevin Ross (WHD) and Viviana Garay (WHD-Asunción Office). The exact same analytical framework was used in Ross and Peschiera (2012) in their examination of Peruvian interest rate spreads—allowing for a comparison between these two Latin American banking systems.

B. Background and Stylized Facts

4.   As in many Latin American countries, Paraguay suffered a period of banking crises in the late 1990s. Financial liberalization a decade earlier had resulted in a sharp increase in the number of bank institutions (thirty-four by end-1994), many of which were unable to take advantage of economies of scale. Overtime, poor bank practices, weak management and corporate governance, as well as lax supervision, resulted in a wave of bank failures in second half of the 1990s. To a large extent, the authorities' use of extended central bank credits, forbearance, shifts of public deposits to weaker institutions, along with uncertain deposit insurance schemes served to extend and deepen the crisis. Throughout this period, depositors shifted funds from domestic banks under stress to foreign institutions, such that by end-2000 there were twenty-two banks in Paraguay, seventeen foreign and five domestic. Dollarization also increased sharply. The system suffered further disruptions in early part of the decade, as a deposit run linked to negative regional shocks caused the authorities to close the third largest bank (Banco Aleman, an Argentinean bank) in 2002. A second domestic bank was closed due to fraud, and six others left the system due to weak profitability—leaving just fourteen banks by end-2003.[2] The system remained around that size over 2004–07 as the economy stabilized and strengthened as improvements in financial sector supervision were enacted (see Box 1). The number of banks expanded during 2007–12 as some local financing companies and cooperatives linked to agricultural production received bank charters, even as foreign players continued to leave the market—citing low profitability.[3] Today the system has sixteen banks (seven foreign and nine domestic, including one state owned development bank).

5.   Concentration ratios have increased over the last decade as banks entered and exited; however, the banking system still appears to be competitive (see below).
Concentration ratios based upon the top three (four) banks in terms of asset size remained around 43 (52) percent in 2000–08, but have since risen to 50 (61) percent by end-2012. Herfindahl indices have risen only slightly from 0.09 to 0.11 (low concentration) and remain well below 0.20 (signaling high concentration). Foreign ownership or control of total banking system assets has steadily decline, from some 82 percent of the market in 2000-03 to 39 percent by end-2012.

Bank Concentration and Ownership

- Number of banks (rhs)
- CR3
- CR4
- % foreign owned, % of total system
- Herfindahl Index

Sources: SIB and Fund staff estimates.

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[2] The reduction reflected a generalized lack of confidence in the system rather than any particular *"flight to quality"* effect.

[3] In 2010 *Itau* from Brazil merged with *Interbanco*, becoming the 2nd largest bank in the system. One small bank closed operations in 2011, while financieras (*Vision, Itapúa, Familiar* and *Atlas*) and one cooperative (*Bancop*) started operating as banks. *CCB China* (2005), *Lloyds TBS* (2007) and *ABN Ambro* (2009) left the system as HSBC (2007) began operations.
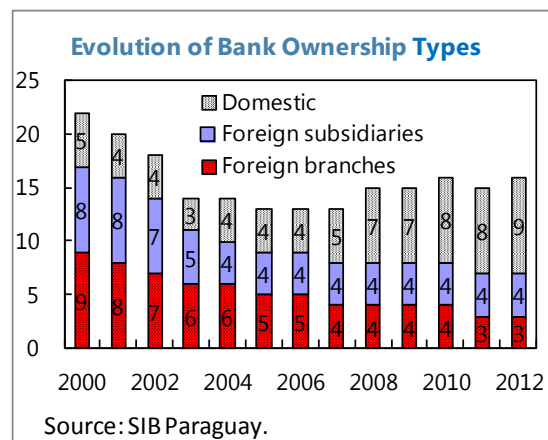

Box 1. Financial Sector Regulatory Reforms Since 2003

The authorities took a number of decisive actions to strengthen the banking system after the 2003 crisis.

- New bank *intervention* and *resolution plans* were enacted in 2003 which gave the *Superintendent of Banks* (SIB) more tools to deal with banks under distress. Intervention triggers and an allowable period to normalize operations (ninety days) were defined, while the resolution plan clearly pre-determined saleable and transferable assets, with remaining assets put under judicial liquidation. These plans also allowed the BCP to circumscribe and establish *systemic risk* and provided the authorities with much needed legal protections when they carried out their duties.

- Various resolutions under these plans shifted the SIB's supervisory framework toward a more *risk based approach*, with better definitions and categorization of credit risks, asset classes, provisions and accrual of interests. Provisions were increased and guidelines established on credit risk management, control and monitoring. In 2005 and 2010, the authorities also underwent FSAP assessments. In 2010 other BCP regulations were issued defining and categorizing financial and operational risks as well as a corporative governance framework for financial institutions.

- The financial system was also bolstered by new legislation covering the BCP, the institution that supervises financial cooperatives (INCOOP), and public pension funds. A *deposit guarantee fund* was also established in 2003 and managed by the BCP, with funds from the government and deposit institutions. The fund sets coverage at seventy-five times the minimum monthly wage. Finally, in 2005 a second tier development bank was created (Agencia Financiera de Desarrollo).

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6.   It is interesting to note that the sharp decline in foreign owned institutions took place equally across both subsidiary and branch institutional structures (see below). Generally, it is assumed that higher levels of foreign ownership within banking systems provide an increase in transfers of technology and management know-how, leading to improvements in efficiency and productivity. Branch networks are particularly useful in this regard since they tend to centralize funding, asset allocation, and risk management functions. Subsidiary structures tend to rely more on local funding sources—which could help local market development and financial stability. Still, major foreign players (e.g., BBVA, Citibank) remain in the system, while some domestic banks have key foreign

Evolution of Bank Ownership Types

Domestic
Foreign subsidiaries
Foreign branches

Source: SIB Paraguay.

minority shareholders (e.g., Rabobank in Regional, IFC in Continental, and Oikocredit in Vision). In this context, an open question is how changes in Paraguay's ownership structure over the last decade have affected productivity and efficiency within the system.

7.   Current bank loan portfolios reflect Paraguay's economic structure. Bank loan portfolios are concentrated in agriculture, livestock, wholesale-retail trade, and service sectors. Consumption, financial and industrial sector loans appear to be the focus of only a few particular banks. Surprisingly, some 43 percent of the loans of the state owned development bank, (seventh largest in the system) are consumer loans. For the system as a whole, 35 percent of the portfolio is in agriculture/livestock with a similar amount in trade/services; 15 percent in consumer loans, 10 percent in industry and 7 percent financial sector.

Distribution of Bank Credits by Sector

Legend:
- Financial sector
- Consumption
- Industry
- Trade, Service, Exports
- Agriculture and Livestock

As of end-2012

Source: SIB Paraguay.
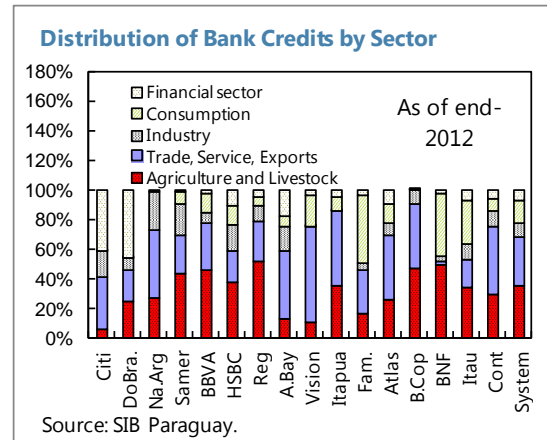
8.   Generally, Paraguayan banks appear to be well capitalized and funded. Figure 4 presents a number of financial soundness indicators using 2012 data for a variety of South American countries. Like many of its peers, the Paraguayan banking system is well funded through internal sources, with deposit to loan ratios near 100 percent. Thus, although some Paraguayan banks do tap foreign financing sources, there is no over-reliance on external financing of basic loan operations. Raw capital ratios in Paraguay are around 11 percent, resulting in a leverage ratio similar to region averages. At the same time, regulatory tier 1 capital risk weighted capital ratios in Paraguay (not shown here) are near 12.5 percent—which are at the regional average.

9.   Profitability ratios are at regional highs. Non-performing loans are low and appear to be adequately provisioned. Financial sector deepening indicators such as private banking credit to GDP and broad money stock to GDP are well below middle income averages. However, this also implies that the banking system has sufficient room to expand. Given the size of the commodity based export market and past inflation history, Paraguay still retains a high level of dollarization. Paraguay's efficiency indicators indicate that personal and other non-interest expenses relative to total gross income in Paraguayan banks are relatively low in comparison to other countries.

10.   The overall quality of the credit framework in Paraguay is somewhat weak. Table 1 presents data from the World Bank's Doing Business survey on the ease of getting credit in a number of South American countries. Paraguay's credit system was ranked 80th out of 185 countries, below most South American comparators. Only Venezuela, Bolivia and Brazil were ranked lower. This index is based upon two sub-component indicators related to the protection of legal rights and depth of available credit information. The legal framework, whereby the rights of borrowers and lenders with respect to secured transactions are protected, was rated a three

out of ten—again below average. Both private and public bureau credit coverage in Paraguay are below norms, although the overall depth of available information (coverage, scope and accessibility) is viewed positively. Also, the preponderance of agricultural and livestock credits to relatively strong borrowers with solid real property collateral may reduce incentives toward improving credit scoring mechanisms. Finally, the authorities are in the process of modifying bank laws in order to strengthen risk based capital charges , prudential measures, and the definition of problematic loans—all of which should provide incentives to improve the credit framework.

11. **To date there has been little research on the Paraguay banking system**. Previous work has focused on the role of foreign banks in the system and the factors behind relatively high interest margins. Using monthly panel data from January 2009 to May 2012, Biedermann, et.al (2012), found that high information costs in the financial intermediation process (proxied by non-performing loans) and elevated operating costs were the key factors behind expanded interest rate margins. They argue that the inability to acquire complete information on prospective clients increases adverse selection problems and credit risks, requiring a higher interest rate margin. They also noted the presence of substantial operating inefficiencies which have driven up costs and increase spreads. Espinola and Velazquez (2012) demonstrate that foreign banks have tended to focus on corporate sector loans in foreign currency, which inherently have smaller interest rate margins.

Economy	Ranking on Credit [1]	Strength of legal rights index (0-10) [2]		Depth of credit information index (0-6) [3]		Public registry coverage (% of adults)		Private bureau coverage (% of adults)	
	2012	2006	2012	2006	2012	2006	2012	2006	2012
Argentina	67	4	4	6	6	22.1	35.9	95.0	100.0
Bolivia	127	1	1	5	6	10.3	11.8	24.6	35.9
Brazil	97	3	3	5	5	9.6	36.1	53.6	61.5
Chile	52	4	6	5	5	25.9	35.6	22.1	25.8
Colombia	67	5	5	5	5	0.0	0.0	31.7	71.2
Ecuador	80	3	3	4	6	13.6	0.0	0.0	57.9
El Salvador	52	5	5	5	6	17.3	23.9	78.7	81.1
Honduras	9	6	8	4	6	11.2	16.3	18.7	31.2
Mexico	38	5	6	6	6	0.0	0.0	49.4	98.1
Paraguay	80	3	3	6	6	8.7	15.7	52.2	48.5
Peru	23	3	7	6	6	14.3	28.5	27.8	36.0
Uruguay	67	4	4	5	6	5.5	28.6	80.0	100.0
Venezuela	165	1	1	4	3	16.8	0.0	0.0	..
Average	...	**3.6**	**4.3**	**5.1**	**5.5**	**11.9**	**17.9**	**41.1**	**62.3**

Table 1. Quality of Legal Framework and Credit Information, 2006 and 2012

Sources: World Bank, Doing Business Database.

1/ Getting credit, overall ranking. Higher value reflects lower rank. No overall ranking available for 2006.

2/ Higher scores reflect better protection for both borrowers and lenders through collateral and bankruptcy laws.

3/ Higher scores indicate greater access to credit information.

C. Interest Rate Decompositions

12.   In general, banks require a combination of effective interest and non-interest rate margins to cover costs and to earn a profit. With non-interest rate margins determined by price setting behavior on bank services (fees and commissions), the various factors that determine effective interest rate spreads can be assessed through simple accounting decompositions.[1] Using balance sheet and income statement data, the effective interest rate spread can be decomposed into the following components[2]

$$(i_l - i_d) = [rr + p + oc + prov + tax + d] - nnii + e \qquad (1)$$

where:

i_l	=	the average effective interest rate charged on loans
i_d	=	the average effective interest rate provided on deposits
rr	=	required reserves/deposits,
p	=	profit margin/deposits
oc	=	overhead costs/deposits
prov	=	provisions/deposits
tax	=	tax payments/deposits
d	=	deposit insurance costs/deposits
nnii	=	net non-interest income/deposits
e	=	residual errors that arise from combining flow and stock data.

The identity indicates that effective interest rate spreads (i_l - i_d) will increase as bank costs—from reserve requirements, operations, provisions, taxes and deposit insurance—and profits increase, and fall with higher amounts of non-interest income.

13.   System wide accounting interest rate spread decompositions from 2000–12 are provided in Table 2, and lead to the following conclusions:

- Operational costs and profits tend to be the two main factors behind effective interest rate margins.

- Effective interest margins were relatively high from 2000–03 during a period of banking instability, but stabilized at between 7 to 8 percent as weak banks left the system. The margin

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[1] See IMF (2004) for a full derivation. In the analysis, we use annual income and balance sheet data from the BCP and from the SIB.

[2] It can be difficult to discern the true level of interest bearing assets and liabilities to use in the calculation of the effective lending and deposit interest rates. This can result in large residuals.

remained near these levels even as more domestic banks started to enter and as economic growth started to accelerate.

- Non-interest income for the banking system was inflated during 2000–03 due to sizable valuation and foreign exchange trading volatility. Although non-interest income has remained around 3½ percent since 2004, in reality it most likely has risen slightly given the growing negative residual.[3]

- The relative stability of total cost factors—at around 8–10 percent—hides the fact that operational costs have gradually declined from above 7 percent in 2000 to around 4½ in 2009, and then have risen to 5.6 percent in 2012.

- Reserve requirement and deposit insurance costs have remained around 2–3 percentage points. The cost of taxes and provisions in Paraguay has remained very low.

- Profitability averaged only around 2 percent through 2000–04, spiked above 4 percent in 2006-08, and has since declined to about 3½ percent over 2009–12. This more or less mimics changes in Paraguay's real GDP growth.

Table 2. Interest Rate Spread Decompositions: Total Banking System													
(In percent)													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Effective interest margin $(i_l - i_d)$	9.17	8.49	9.24	9.72	7.51	7.78	9.06	7.60	7.87	7.58	6.81	7.57	8.06
Reserve requirements *(rr)*	3.21	2.90	3.06	2.90	1.95	1.88	2.22	1.95	1.85	1.82	1.66	2.20	2.46
Deposit insurance *(d)*	-	-	-	-	0.19	0.41	0.40	0.37	0.39	0.40	0.42	0.41	0.42
Operational costs *(oc)*	7.58	6.92	7.47	6.09	5.58	5.86	5.51	4.63	4.78	4.59	4.98	5.32	5.60
Provisions *(prov)*	1.63	1.66	4.34	1.36	0.35	0.43	0.99	0.59	0.74	0.56	0.70	1.28	1.23
Taxes *(tax)*	0.09	0.06	0.07	0.19	0.25	0.54	0.42	0.36	0.43	0.32	0.34	0.29	0.30
Total cost factors	12.50	11.55	14.94	10.54	8.32	9.11	9.54	7.90	8.19	7.70	8.10	9.50	10.00
Profit *(p)*	1.92	2.86	1.33	0.70	2.28	3.08	4.15	3.87	4.58	3.34	3.43	3.46	3.52
Non-interest income *(nii)*	4.60	5.68	7.04	3.58	3.20	3.52	3.87	3.16	3.89	3.36	3.67	3.87	3.74
Residual *(e)*	(0.65)	(0.24)	0.02	2.06	0.10	(0.90)	(0.76)	(1.01)	(1.01)	(0.10)	(1.05)	(1.52)	(1.72)

Sources: SIB and fund staff estimates.

14.   Interest rate decompositions across various bank sub-groupings reveal substantial differences. Figure 5 graphically present the interest rate decompositions for the total banking

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[3] Paraguayan banks report large valuation inflows and outflows on foreign exchange trading and other non-core banking activities. Given that *non-interest income* is scaled by deposits, large valuation inflow effects that do not take into consideration *non-interest valuation* expenses can sharply increased this ratio, implying a large non-interest return that could be used to help to cover costs. This would be reflected by a large positive residual. To avoid this distortion, we report the *net non-interest income ratio*. However, this implies a somewhat smaller non-interest income margin—which can result in negative residuals.

system, as well as for our two separate comparative groupings: (i) the largest four banks (by asset size) versus other smaller banks in the system, and (ii) foreign versus domestic banks. While the graphs reflect sizable differences within the two groups, the gap between the behavior of domestic and foreign banks appears to be the most marked:

- *Non-interest margins* for the larger top four and other smaller banks had been very similar, oscillating around 3½ percent from 2003–09. Since then, small banks non-interest margins have started to rise and are above 4 percent as of 2012. Margins were much higher for domestic banks relative to foreign banks during the crisis at the start of the decade, and tended to be about 1 percentage point higher until 2009. After 2009, the foreign and domestic banks had similar non-interest margins of about 3½ percent.

- *Effective interest spreads,* for the most part have declined throughout the period. Spreads for the larger and smaller banks were of equal size and pattern until 2007, at which time spreads for the smaller banks increased substantially reaching around 10 percent by 2012. Larger bank effect spreads have continued to decline and now stand under 7 percent. The gap between foreign and domestic banks has remained sizable throughout the period. The effective interest rate margin of domestic banks has fallen from 12 percent in 2002 to around 8 percent today. Foreign bank effective margins have decline from around 9 percent to about 7 ½ percent by 2012.

- *Profits* for larger banks expanded rapidly to about 6 percent in 2006–08 and have settled in at around 4 percent today. Smaller banks profits have increased more gradually and remain under 3 percent. Foreign bank profits have tended to be higher than domestic firms, and have ranged between 3 to 4 percent after recovering from Paraguay's banking disruptions at the start of the decade.

- *Looking at costs,* the smaller banks markedly higher expenses (of 10–12 percent) were driven by higher operational costs (7–8 percent), reserve requirements (2–3 percent), and provisions and deposit insurance (1–2 percent). Operational costs in particular have risen sharply by about 2 percentage points since 2007. The larger four banks reported much lower operational costs and reserve requirements than smaller banks (2 to 4½ percentage points), while the breakdown and evolution between foreign and domestic banks was very similar.

D. Financial Statement Analysis

15.   Financial statement analysis focuses on three key financial ratios.[4] These ratios are the return on equity (RoE), return on assets (RoA), and net interest margin (NIM), each of which can be further decomposed into two separate ratios. To assess profitability of the system, it

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[4] Variables not defined in the text include: (i) EBT, earnings before tax; (ii) TA, total assets; (iii) IR, interest revenue; (iv) IE, interest expense; and (v) EA, earning assets.

would be important to analyze these ratios and their subcomponents to provide insights into banking sector performance and management over time.

- **RoE is the ratio between after tax earnings (EAT) and book value of equity (BE).** It presents the earnings per unit of invested capital, making it a universally comparable indicator for measuring the profitability of investment. RoE consists of three components: (i) tax policy (TP = EAT / EBT); (ii) financial leverage (LEV = TA / BE); and (iii) return on assets (RoA = EBT / TA). RoA changes are often the main cause of changes in bank's performance, whereas tax policy and leverage effects should be relatively stable.

$$RoE = TP \times LEV \times RoA, \hspace{4cm} (2)$$

- **A bank's RoA can be further disaggregated into three components.** This would include: (i) burden (B = NNIR / TA); (ii) earning assets ratio (EAR = EA/TA); and (iii) net interest margin (NIM = (IR-IE) / EA). Burden measures the success in maintaining control over operating costs. It is normal for the bank's burden to have a negative value, since non-interest revenues (NNIR, revenues from fees and commissions) are not able to cover all non-income related costs. Earning asset ratios usually have a minor role in determining changes in RoA, but are a good indicator for analyzing the strategic focus of individual banks. The net interest margin (NIM) reveals the net income from investing through borrowed funds.

$$RoA = B + EAR \times NIM, \hspace{4cm} (3)$$

- **Finally, the net interest margin (NIM) can also be decomposed into three variables:** (i) return on earning assets (REA = IR / EA); (ii) cost of liabilities (COL = IE / L); and (iii) liabilities to earning assets (LEA = L / EA). The return on earning assets directly connects earning assets and interest revenue, and is a measure of the average rate of lent funds. COL is an indicator of the average price of borrowed capital, while LEA measures the intensity of the bank's investment activities.

$$NIM = REA - COL \times LEA. \hspace{4cm} (4)$$

16.   Broadly speaking, the main driver of banking sector profitability has been a greater generation of return on assets (Table 3). RoE has steadily increased from its 2003 low point, peaking at 28 percent in 2008 before falling back down to 21 percent in 2012.[5] Negative tax policy effects were a drag on profitability in 2003 but since then reflect the sector's stable and

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[5] Looking from the bottom up in 2012, the return on earning asset was 11.7 percent. However, 4.4 pps (1.2 x 3.6) are subtracted given the cost of liabilities and their size relative to earning assets—leaving a 7.3 percent NIM. Since only 72 percent of *all assets* are utilized for earning activities, the return is further cut to 5.6 percent. Given the need to cover administrative burdens it is reduced by another 2.7pps to 2.6 RoA. This RoA, however, is levered up 8.7 times, increasing the return to 22.6 percent, whereby tax policies lower it to 20.7 percent RoE. Compared to 2011, lower leverage was a key factor behind the reduction in RoE.

relatively low 10 percent rate. The systems gearing ratio increased during 2000-03, and but has more or less hovered around 9–9½ percent from 2004 onward. RoAs gradually increased from their 2003 nadir of only a ½ percent to 3½ percent in 2008, before settling down to around 2½ percent today. The stronger RoA numbers are the result of more intensive use of assets (as seen by the earning asset ratio), as well as by improved "burdens" given some reductions in administrative costs and healthy non-interest income revenues. From the lower end of the table we can see that net interest margins have remained relatively stable as lower returns on earning assets have been somewhat offset by lower liability costs and some reduction in the amount of liabilities relative to earning assets.

Table 3. Paraguay: Financial Statement Analysis of the Banking System													
(in percent)													
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Return on Equity (EAT/BE)	**10.6**	**17.2**	**8.3**	**4.3**	**15.4**	**18.4**	**24.1**	**25.7**	**28.4**	**23.2**	**22.3**	**22.4**	**20.7**
Tax Policy (U=EAT/EBT)	0.95	0.98	0.95	0.73	0.89	0.82	0.90	0.91	0.91	0.90	0.90	0.92	0.92
Financial Leverage (LEV=TA/BE)	7.7	7.8	8.5	9.8	9.2	8.7	8.0	9.1	9.0	9.7	9.3	9.6	8.7
Return on Assets (ROA=EBT/TA)	1.4	2.2	1.0	0.6	1.9	2.6	3.3	3.1	3.5	2.7	2.7	2.5	2.6
Return on Assets (EBT/TA)	**1.4**	**2.2**	**1.0**	**0.6**	**1.9**	**2.6**	**3.3**	**3.1**	**3.5**	**2.7**	**2.7**	**2.5**	**2.6**
Burden [(NIR-NIE)/TA)]	-3.7	-2.6	-4.1	-4.3	-2.5	-2.6	-2.9	-2.0	-1.6	-1.9	-1.9	-2.5	-2.7
Earning Asset Ratio (EA/TA)	0.68	0.68	0.66	0.61	0.64	0.69	0.71	0.71	0.69	0.67	0.72	0.72	0.72
Net Interest Margin [(IR-IE)/EA)]	7.7	7.1	7.8	8.0	6.8	7.4	8.7	7.2	7.3	6.8	6.3	7.0	7.3
Net Interest Margin ((IR-IE)/EA)	**7.7**	**7.1**	**7.8**	**8.0**	**6.8**	**7.4**	**8.7**	**7.2**	**7.3**	**6.8**	**6.3**	**7.0**	**7.3**
Return on Earning Assets (IR/EA)	15.3	13.8	13.6	13.4	9.4	9.0	10.7	9.4	10.1	10.1	9.2	10.2	11.7
Cost of Liabilities (IE/L)	5.9	5.3	4.3	3.6	1.9	1.3	1.6	1.8	2.1	2.5	2.4	2.6	3.6
Liabilities on Earning Assets (L/EA)	1.3	1.3	1.3	1.5	1.4	1.3	1.2	1.2	1.3	1.3	1.2	1.2	1.2
Source: SIB and fund staff estimates.													

17.   Small and domestic banks actually have better NIM results—but this advantage is eliminated by their lower levels of deployed assets and greater administrative burdens (Figure 6). Smaller and larger banks had similar net interest margins (NIMs) until 2008 when smaller banks return on earning assets increased sharply. However, smaller banks deploy a much lower amount of earning assets (around 65 percent versus larger banks 75 percent). They also have higher negative burdens (-3 to -4pps) which further detracts from their high NIMs. Thus their RoAs have tended to be lower than top 4 banks RoAs. Given somewhat similar leverage and tax policy impacts, this gap in RoAs has remained between small and large bank overall profitability (RoE). Despite higher liabilities to earning assets and higher liability costs, domestic banks tended to have higher NIMs given their greater return on earning assets. However, domestic banks tended to deploy less earning assets and have higher administrative burdens— which again results in lower RoAs. With slightly higher leverage ratios, domestic banks RoEs ratios end up being basically in line with foreign banks.

E. Interest Rate Regressions

18.   Estimation of the interest rate spread panel regressions broadly follows the framework of Ross and Peschiera (2012). Using quarterly data (2000q1 to 2012q4) provided by the SIB we estimated the following equation: [6]

$$Spread_{it} = \alpha + \beta_1 NPL_{it} + \beta_2 Liq_{it} + \beta_3 MR_{it} + \beta_4 Cost_{it} + \beta_5 Share_{it} + \beta_6 IC4_t + \beta_7 Libor_t$$
$$+ \beta_8 ER_t + \beta_9 Inf_t + \epsilon_t \qquad (5)$$

The dependent variable is the effective interest rate spread (Spread), as defined previously. The main explanatory variables reflect credit and market risks, as well as operating and liquidity costs and all should positively impact interest margins. For example, as non-performing loans (NPL) increase, banks would have an incentive to increase margins in order to better reflect actual credit risks. Similarly, an increase in the liquidity asset ratio (Liq), calculated as liquid over total assets, represents a lost opportunity cost of undertaking financial intermediation and would increase margins. Market risk (MR) is defined as each bank's disposable investment over their total assets, while (Cost) are administrative costs over total assets. Two other variables, market share (Share) and the bank concentration ratio (IC4), are also employed in separate regressions to test if banks market power or concentration in the system has an impact on margins. The general assumption is that both variables should increase margins. Additional macroeconomic conditioning variables: (i) the 3-month Libor rate; (ii) domestic inflation (Inf); and (iii) the Guaraní-U.S. dollar exchange rate—are also included.

19.   Table 4 presents the two panel regression estimates.

- The main result is that the key explanatory variables—credit risks, liquidity and operational costs—are all positive (in line

Table 4. Interest Spread Regressions [1/]

	Regression 1 (market share)	Regression 2 (bank concentration)
NPL $_t$	0.0187	0.0179
(t)	(3.1)	(3.0)
LIQ $_t$	0.0250	0.0247
(t)	(5.5)	(5.6)
MR $_t$	---	---
(t)	---	---
COST $_t$	0.3639	0.4374
(t)	(3.6)	(4.6)
LIBOR $_t$	0.0265	-0.0049
(t)	(1.16)	(0.18)
ER $_t$	-0.0001	-0.0001
(t)	(1.0)	(1.7)
INF $_t$	0.0222	0.0286
(t)	(2.4)	(3.1)
C	0.9979	2.6451
(t)	(3.1)	(3.0)
SHARE $_t$	-0.0326	...
(t)	(2.81)	...
IC4 $_t$	...	-0.0303
(t)	...	(2.3)
AR(1)	0.46	0.44
(t)	(7.4)	(7.4)
R^2	0.7203	0.7189
Prob (F)	0	0
No. banks	10	10
Observations	490	490

Source: SIB, and Fund staff estimates.
1/ t-statistics are below the estimated coefficients.
Robust standard errors were estimated using cross sectional SUR (PCSE) methods.

[6] All estimations are done in EVIEWS using unbalanced panel data regression techniques assuming fixed effects. Robust estimators were calculated using White cross sectional SUR corrections to ensure robust standard errors.

with theory) and highly significant.[7] In particular, a one percent increase in operational costs increases margins by between 0.36 and 0.44 percentage points. Changes in NPLs and liquidity factors have a much lower impact on margins.

- The coefficient estimate for bank concentration variable (IC4) is negative, and indicates that for every 1 percentage point increase in system wide bank concentration, the effective interest rate margin declines by 0.03 percentage points. Thus concentration does not appear to be an impediment to bank competition. This result is not surprising in the Paraguay case given that margins have declined in recent years as concentration has slightly increase.

- The coefficient for an individual bank's market share is also negative and implies that for every 1 percentage point increase in a bank's market share, the effective interest rate margin falls by 0.0326 percentage points. This result indicates that banks, however slightly, have been willing to reduce margins to gain a larger part of the market—providing some evidence of competition.

- Finally, the results of the macro conditioning variables are somewhat surprising. The exchange rate and international interest rates have no impact on effective margins. This may be due to low currency mismatches in the banking system, and the limited linkages to international markets. Higher inflation, however, does appear to cause banks to raise margins.

F. Conclusions

20.   The Paraguayan banking system compares relatively well with other Latin American banking systems. Banks are well capitalized, have ample access to deposit funding sources, and are profitable. Most importantly, the authorities have taken a number of decisive steps to strengthen supervision and ensure stability in the financial system within the last decade. Nevertheless, the credit delivery system still appears somewhat weak with little improvement in key metrics in recent years. The consolidation process has resulted in a slightly more concentrated banking system with substantially lower levels of foreign participation. Nevertheless, effective interest rate margins have declined by a small amount as concentration ratios increased. This suggests that greater concentration has not had a negative impact on competition in the sector. Indeed, the panel regressions indicated that increases in system wide concentration levels actually reduced effective margins. In addition, the regressions demonstrate that banks which gained market share also ended up lowering effective spreads. The impact of credit risks, in the form of NPLs, on margins has been relatively minor.

21.   While effective interest rate spreads for the system as a whole have been stable, they have varied widely among certain bank groupings. Surprisingly, both interest and non-
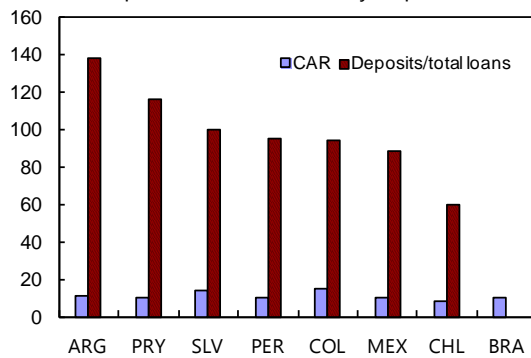
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[7] Banks in Paraguay hold few disposable investments (e.g., bonds) which are actively traded. Thus the market risk variable was dropped from the regression analysis.

interest spreads as well as the return on interest earning assets on a system wide basis have remained relatively stable throughout Paraguay's banking consolidation process and as the economy expanded. For the most part banks profitability increased—in line with strong growth in the overall economy—due to reductions in personnel and administrative expenses. Moreover, a greater deployment of interest earning assets and a lower cost of funds environment also helped to bolster profits. Most striking, the experience and behavior of the smaller and larger banks have been significantly different. While they had similar margins (especially until 2008), larger banks have been much better at controlling costs and more intensively using assets, and thus generating higher levels of profit. Despite having a larger cost of funds, domestic banks have higher net interest margins. However, they do not use assets as intensively and have higher operating costs—and thus lower profits than foreign banks.

22. **Overall, the results provide some policy implications.** The authorities acknowledge that the quality and sharing of credit information needs to be improved to foster financial deepening and social inclusion. This should help to reduce credit risk premiums and spreads within the banking system—allowing greater access to financial products. Taking steps to increase banking competition by attracting new entrants could also help to reduce spreads.

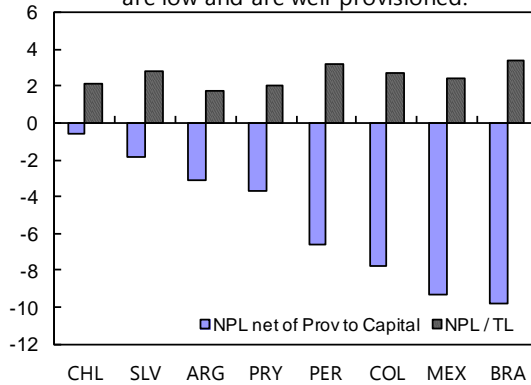## Figure 1. Banking Sector Indicators, 2012

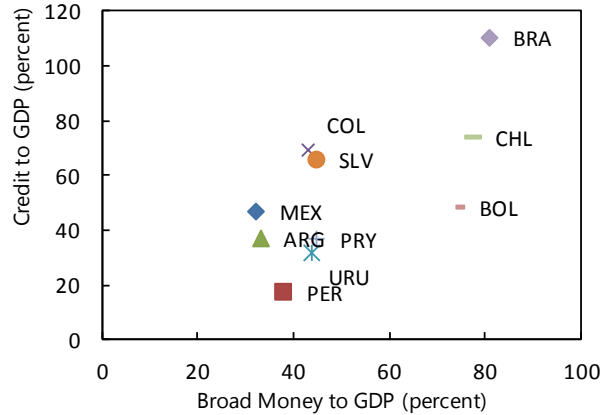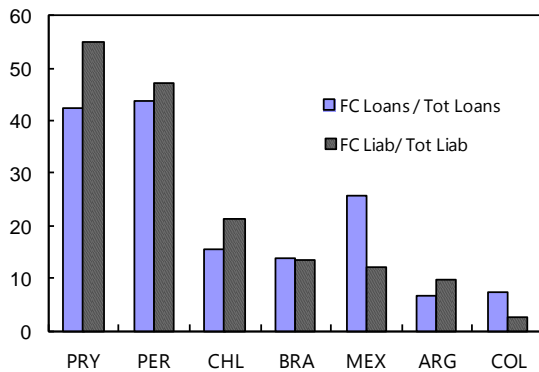**Paraguayan Banks are well capitalized and funded by deposits.**

CAR ◻ Deposits/total loans ◼

ARG PRY SLV PER COL MEX CHL BRA

Profitability levels are high...

RoA ◻ RoE ◼

ARG PRY PER COL MEX CHL BRA SLV
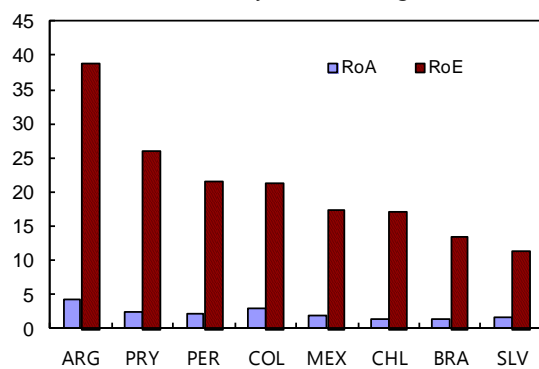
...and non-performing loans are low and are well provisioned.

NPL net of Prov to Capital ◻ NPL / TL ◼

CHL SLV ARG PRY PER COL MEX BRA

Financial depeening is still relatively low with lots of room to expand.

Credit to GDP (percent) vs Broad Money to GDP (percent)

BRA, COL, SLV, CHL, MEX, BOL, ARG, PRY, URU, PER

Dollarization levels in Paraguay are high, particularly on the deposits ...

FC Loans / Tot Loans ◻ FC Liab/ Tot Liab ◼

PRY PER CHL BRA MEX ARG COL

Non-interest expenses represent a relatively small portion of gross income.

Personnel Expenses/Non-interest Expenses ◻ NIE/ Gross Income ◼
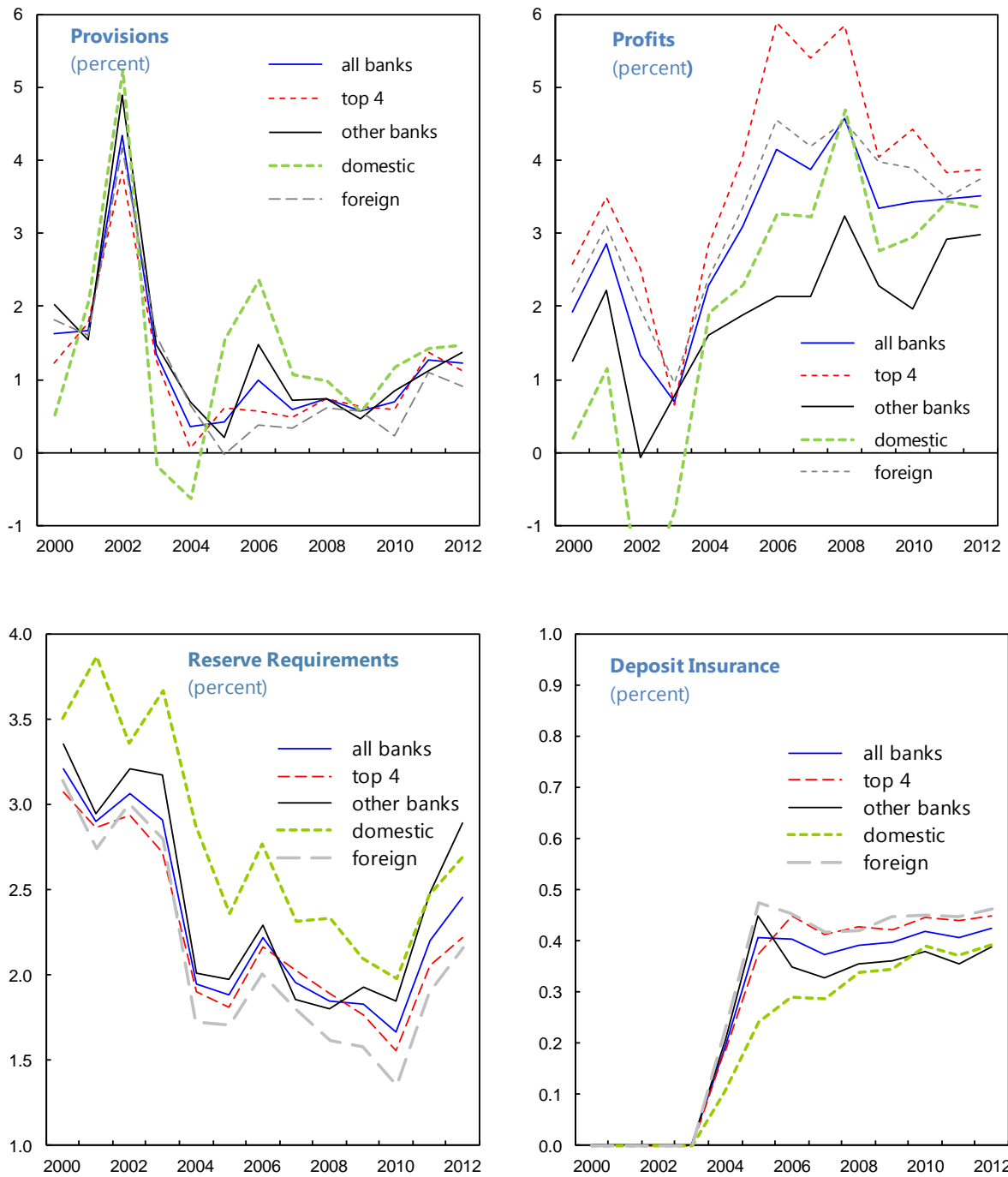
MEX PER ARG SLV CHL BRA COL PRY
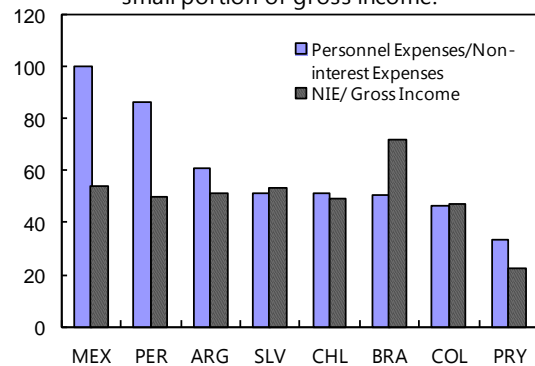
Sources: Financial Soundness Indicators, IFS, and WDI.

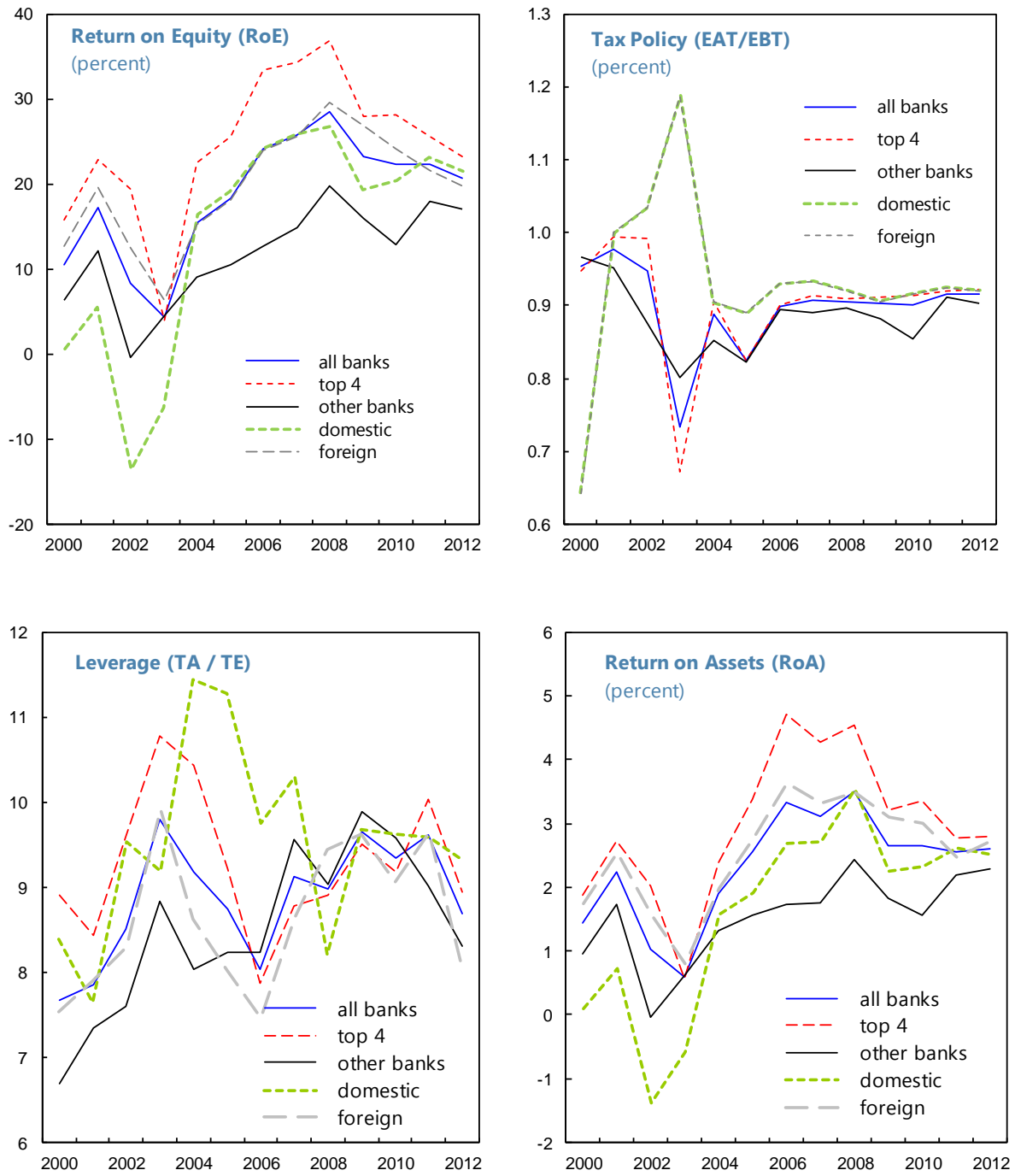Figure 2. Paraguay: Interest Rate Spread Decompositions, 2000-12
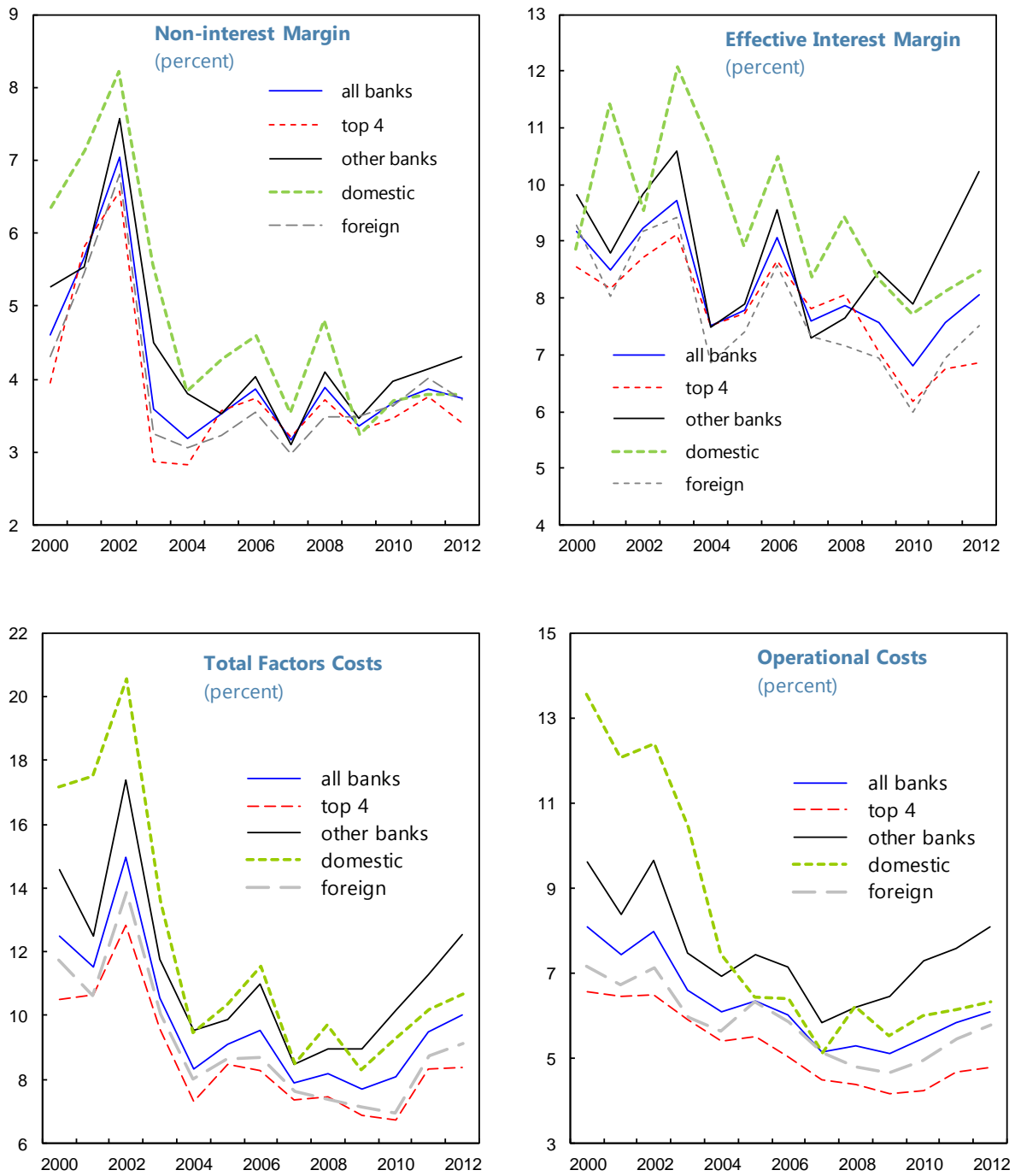
Sources: SIB data and Fund staff estimates.

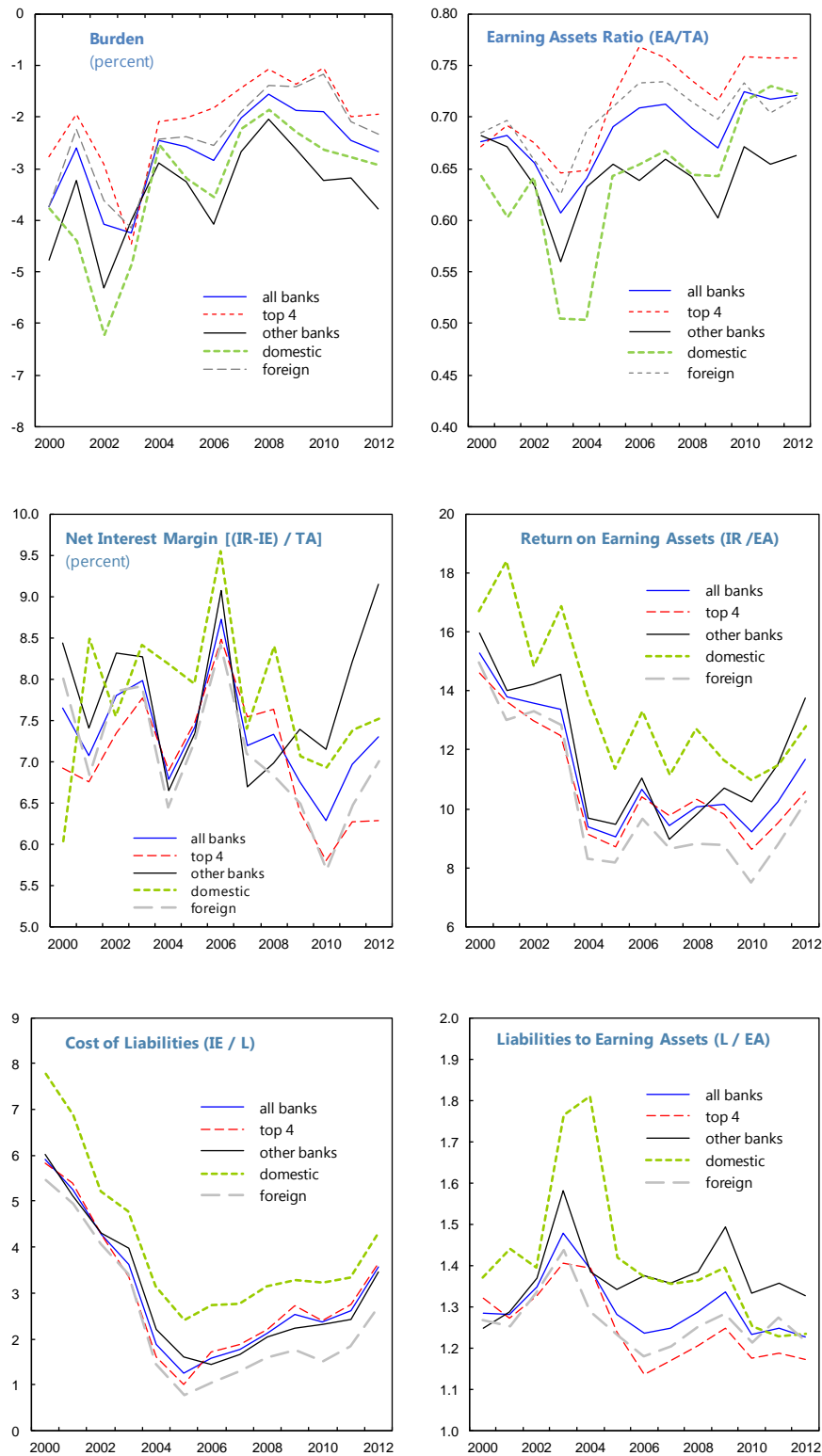## Figure 2. Paraguay: Interest Rate Spread Decompositions, 2000-12 (Concluded)

Sources: SIB data and Fund staff estimates.

Figure 3. Paraguay: Financial Statement Analysis, 2000-12

Sources: SIB data and Fund staff estimates.

Figure 3. Paraguay: Financial Statement Analysis, 2000-12 (Concluded)

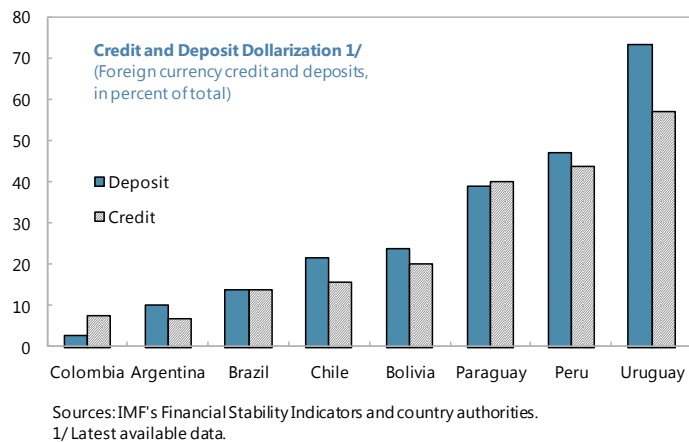

Sources: SIB data and Fund staff estimates.

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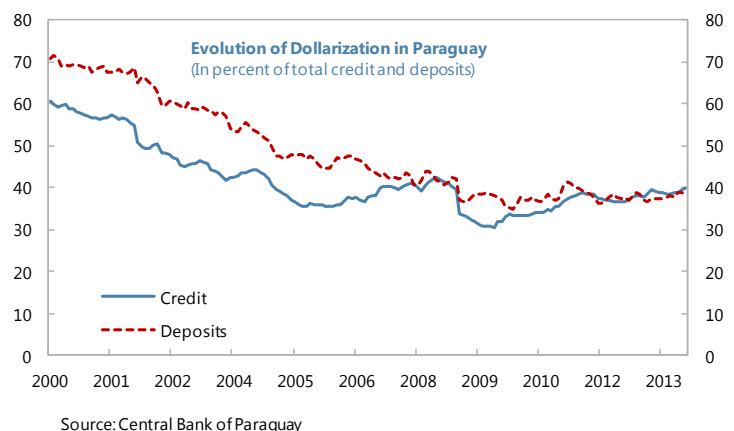# A PATH TO FINANCIAL DE-DOLLARIZATION IN PARAGUAY[1]

Despite a sharp decline during the last decade, financial dollarization in Paraguay remains high. This paper analyzes the effects of financial dollarization and whether macro-prudential tools could deepen the de-dollarization process observed during the last decade. Empirical results show that high credit and deposit dollarization have hindered the effective transmission of changes in the central bank policy rate to retail rates and explain the large exchange rate pass-though to inflation. Cementing Paraguay's sound macroeconomic fundamentals and tightening prudential regulations could further entrench a sustained reduction in dollarization.

A. Introduction

1.   Paraguay is one of the most dollarized economies in the region. Financial dollarization deepened in the 1990s as consequence of a severe financial crisis that wiped out about half of the banking sector, making the U.S. dollar the preferred currency to minimize risks for both savers as well as lenders (Garcia-Escribano and Sosa, 2011). During the last decade, as macroeconomic stability was restored and inflation declined, Paraguay experienced a gradual and sustained decline in dollarization. However, in recent years, the de-dollarization process appears to have stalled, probably in part because of Paraguay's openness and the prominence of its agribusiness industry (an industry that trades exclusively in dollars).

Credit and Deposit Dollarization 1/
(Foreign currency credit and deposits, in percent of total)

■ Deposit
□ Credit

Sources: IMF's Financial Stability Indicators and country authorities.
1/ Latest available data.

2.   The purpose of this paper is to quantify the effects of financial dollarization in Paraguay and identify possible de-dollarization drivers. Financial dollarization is a source of concern for policy makers as it hinders the effective conduct of monetary policy by weakening the monetary transmission channel and exacerbating an already high exchange-rate pass-through (see below). The introduction of prudential regulations that internalize the risks of

Evolution of Dollarization in Paraguay
(In percent of total credit and deposits)

—— Credit
---- Deposits

Source: Central Bank of Paraguay

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[1] Prepared by Juan F. Yépez.

dollarization could help tilt the playing field against foreign currency loans and deposits. Among these regulations, higher capital and provisioning requirements for foreign exchange loans could be implemented, with special attention required to unhedged borrowers, as well as lower loan-to-value ratios on foreign currency loans. Increases in the spread between the required reserve requirement ratios on foreign currency deposits and domestic currency deposits could encourage banks to attract local currency deposits, thereby reducing dollarization.

3.   **The paper is organized as follows. Section B discusses dollarization's macroeconomic effects.** Section C describes possible paths for financial de-dollarization, and Section E concludes.
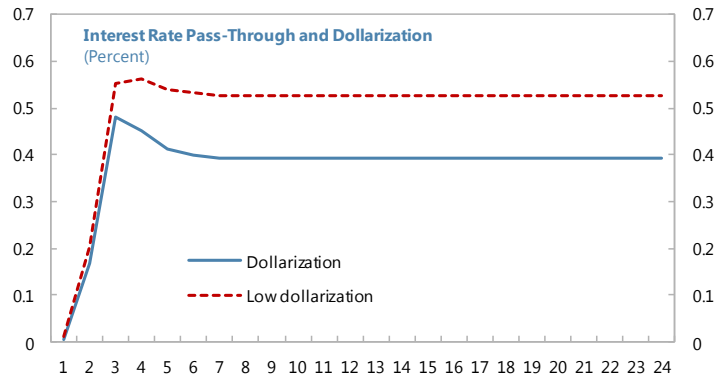
B.   Macroeconomic Effects of Dollarization

4.   **Empirical results indicate that the effectiveness of the interest rate channel is diluted when most intermediation is in dollars.** Dollar loans can expand freely as a result of dollar inflows and increases in domestic interest rates may have little effect on the perceived cost of dollar loans (Ize and Levy Yeyati, 2005). Moreover, a high degree of dollarization makes bank balance sheets vulnerable, leading to a fear of floating that can be detrimental for effective interest rate transmission (Leiderman et al, 2006). Following Saborowski and Weber (2012), a panel VAR (PVAR) model with interaction terms is employed to quantify the effects of dollarization on the effectiveness of interest rate transmission in a multi-country setting (120 country panel, monthly data 2000-12). This econometric model allows for relationships of endogenous variables in the model—the policy rate and a weighted average of retail rates— to vary depending on different levels of dollarization.[2] The model sheds light on how the degree of pass-through is affected by the degree of dollarization of a country. Results show that a country that goes from a credit dollarization ratio of 40 percent (Paraguay's current level of dollarization) to a ratio of 30 percent will likely increase its interest rate pass-through by 14 percentage points.

Source: Fund staff estimates.

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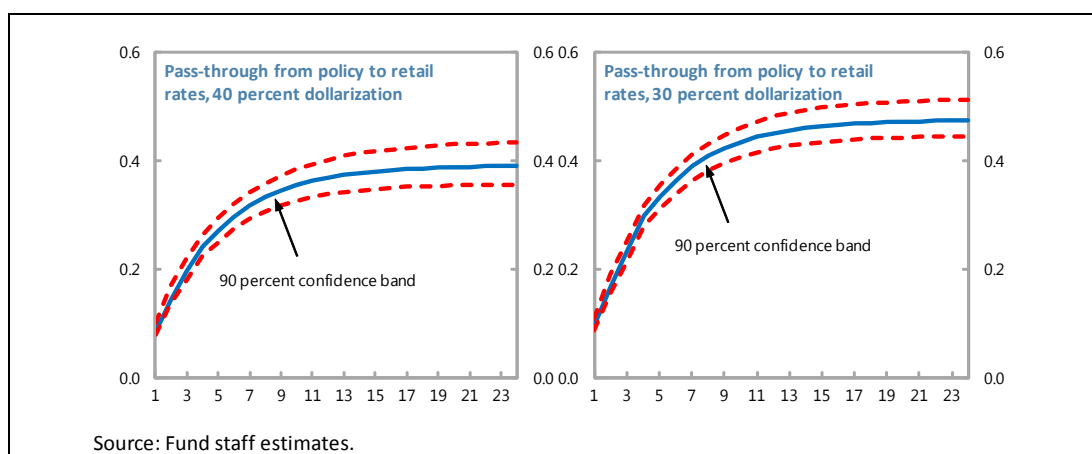
[2] See Appendix I for description of the empirical models used in this section.

5.   Similar results can be observed in a Paraguay-specific country analysis. A standard three variable VAR is used to identify the transmission mechanism for policy rates into retail rates, controlling for the effect of financial dollarization. Two impulse responses of retail rates to a

1 percentage point increase in the policy rate are estimated. The first impulse response is estimated from the standard three variable model specification (policy rate, dollarization ratio, and average retail rate). The second impulse response function corresponds to a modified model, where a sequence of structural errors is first estimated in order to zero out the effect of dollarization in the first impulse response. The difference

Interest Rate Pass-Through and Dollarization
(Percent)

— Dollarization
---- Low dollarization

Source: Fund staff estimates.

between the two impulse response functions represents the effect of dollarization in the interest rate transmission mechanism. As it can be seen below, and consistent with the panel VAR finding, lowering dollarization ratios increases the interest rate pass-through by about 14 percentage points.
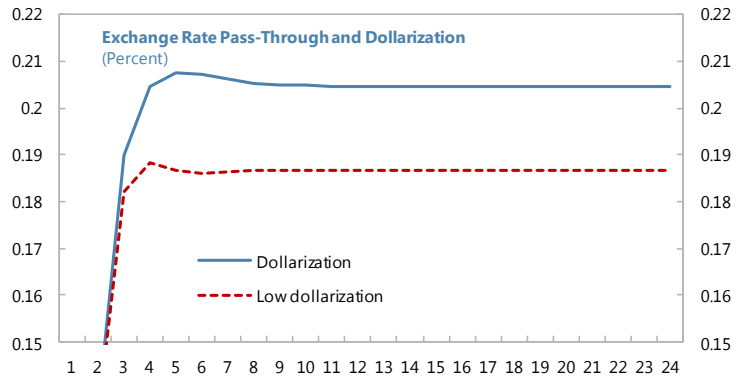
6.   Dollarization is associated with higher exchange rate pass-through, which could limit the flexibility of monetary policy and its countercyclical capacity.[3] Paraguay's 12-month exchange rate pass-through to inflation is one of the highest in the region, and the highest among

other highly dollarized countries with an inflation targeting regime. Using the same econometric analysis presented above, it is possible to quantify the effect of financial dollarization on the transmission from changes in the nominal effective exchange rate into inflation. A three variable VAR is estimated using the nominal effective exchange rate, deposit dollarization ratio, and CPI (m/m percent change). A counterfactual scenario is constructed where the effect of dollarization on the response of inflation to the exchange rate shock is zeroed out. Under this scenario, where the effect

Exchange Rate Pass-Through

	Bolivia	Chile	Paraguay	Peru	Uruguay
2-months	2.5	1.3	7.5	1.9	3.5
6-months	11.8	5.2	14	13.8	12.3
12-months	23.2	10.6	20.5	18.4	17.2

Source: Fund staff estimates.

Exchange Rate Pass-Through and Dollarization
(Percent)

— Dollarization
---- Low dollarization
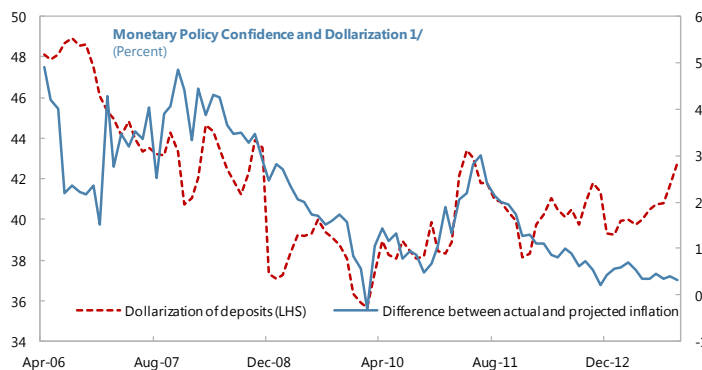
Source: Fund staff estimates.

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[3] Ize and Levy Yeyati, 2005.

of dollarization is zeroed out, the long run pass-through decreases to 18.6 percent.
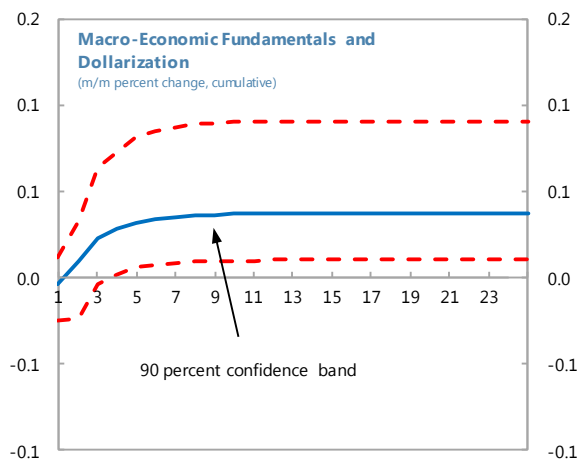
C. A Path to De-dollarization

7.   Financial dollarization is closely associated with periods of high uncertainty that undermine the public confidence in the local currency. Kokenyne et al. (2010), using data on deposit and credit dollarization for a sample of thirty-two emerging markets between 2001 and 2009, find that higher exchange rate volatility coupled with stable inflation fosters de-dollarization.

García-Escribano (2010) analyzed de-dollarization across categories of loans and deposits in Peru and finds that de-dollarization has been driven by macroeconomic stability. In the case of Paraguay, increasing the public confidence in the government's policy objectives and fostering sound macroeconomic fundamentals have been crucial factors in reducing the high dollarization ratios observed since the beginning of the 2000's. To test how important are sound macroeconomic fundamentals to deepen a de-dollarization process, following Saborowski et. al. (2013), this paper uses a time-varying composite macroeconomic fundamental index. This index ranks thirty-two countries along four dimensions—growth, inflation, fiscal and current account balances—and compute a country's overall fundamentals rank at time t as the simple average of its four ranks in that period. By estimating a simple VAR consisting of this index and a deposit dollarization ratio, it is observed that the reduction of the ranking by 1.5 standard deviation, equivalent to one position (an improvement in fundamentals), reduces the deposit dollarization ratio by 4 percentage points.[4]

Monetary Policy Confidence and Dollarization 1/
(Percent)

- - - Dollarization of deposits (LHS) ——— Difference between actual and projected inflation

Sources: BCP and Fund staff estimates.
1/ Monetary policy confidence is measured as the difference of year t-1 inflation forecast and actual inflation (t).

Macro-Economic Fundamentals and Dollarization
(m/m percent change, cumulative)

90 percent confidence band

8.   Despite the marked improvement in Paraguay's fundamentals and higher public confidence, the de-dollarization process has stalled. Reinhart, Rogoff, and Savastano (2003) document that dollarization persists after periods of substantial decline in inflation and after macroeconomic stability has been restored. Kokenyne et al.(2010) posit that once dollarization takes
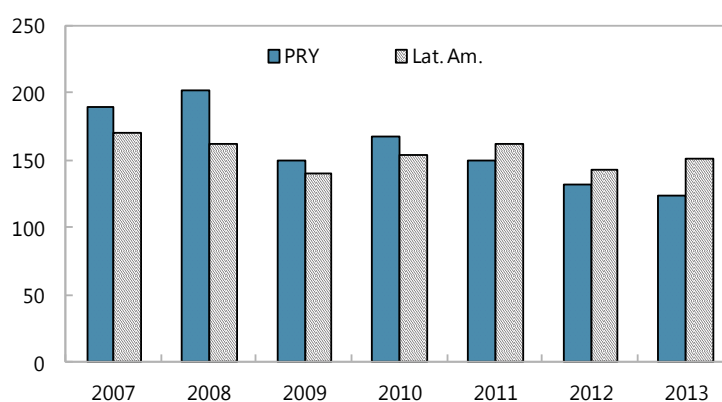
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[4] The empirical model follows the interaction panel VAR framework proposed by Towbin and Weber (2013).

hold, economic agents are reluctant to switch back to using the local currency, because they lack confidence and the cost of re-denominating transactions is high until consensus is reached among market participants on the use of the local currency. At the same time, the increased dollarization levels observed during 2012 and 2013 could be explained in part due to rising international interest rates resulting from the normalization of monetary policy in the U.S. (and a strengthening of the U.S. dollar), and to the extent that financial market participants can arbitrage between domestic and foreign currency instruments, has increased the demand for dollar denominated loans in Paraguay.

9. Deepening the de-dollarization process will require policies that would induce agents to internalize the risks of dollarization and tilt the field against foreign currency loans and deposits. Despite a tightening in their regulation, provisions are declining and are slightly below regional average provisioning of non-performing loans; therefore there is scope for higher capital and provisioning requirements for foreign exchange loans. Banks in Paraguay rely almost entirely on deposits. On average, deposits constitute about 85 percent of total liabilities, most of them in checking and savings accounts (60 percent of total deposits). The effective average reserve requirement on domestic currency deposits is relatively higher than neighboring

Provisions to Nonperforming Loans
(In percent)

Sources: IMF's Financial Soundness Indicators and Central Bank of Paraguay.

countries (11 percent), while the effective average reserve requirement for foreign exchange deposits (19 percent) is slightly below the ones observed in other neighboring countries (Daban Sanchez, 2011).

10. A 4-variable VAR is estimated to see the effect of prudential measures on credit and deposit dollarization. The econometric model is estimated for monthly data for the period 2000-2013, similar to the estimations in García-Escribano and Sosa (2011). Given the prominence of deposits as a funding source for banks, it comes at no surprise that a reduction in foreign currency deposits will have a significant negative effect of foreign currency loans. A 4 percentage point increase in the spread between foreign and local currency legal reserve requirement reduces deposit dollarization by 0.5 percentage points while the effect on foreign currency loans is a 0.3 percentage point reduction. A 10 percentage point increase in the spread between foreign currency and local provisioning requirements reduces foreign currency loans by about 0.6 percentage points and has no significant effect on deposits.

Impulse Responses to a Tightening in Prudential Requirements
(In percent, cumulative)

Response of deposit dollarization ratio to a 4 percentage point increase in rerve requirement
(In percent, cumulative)

Response of credit dollarization ratio to a 4 percentage point increase in rerve requirement
(In percent, cumulative)

Response of deposit dollarization ratio to a 10 percentage point increase in provisions
(In percent, cumulative)

Response of credit dollarization ratio to a 10 percentage point increase in provisions
(In percent, cumulative)

Sources: Fund staff calculations.

D. Final Remarks

11.   Despite a significant reduction in dollarization ratios in Paraguay's financial system at the beginning of the decade, recent supply shocks and a stronger U.S. dollar have stalled the de-dollarization process. This suggests that further efforts may be needed to restart this process, which would pose an important challenge given Paraguay's openness and the prominence of the agribusiness sector for its economy.

12.   Given the negative effects of dollarization on the effectiveness of monetary policy and large pass-through that the exchange rate has on inflation, Paraguay should continue striving for lower dollarization in its financial system. This paper presented a path for financial de-dollarization based on the following findings:

- A reduction in dollarization ratios by 10 percentage points from currently 40 percent, will likely increase the long-run pass-through from the policy rate to retail rates by 14 percentage points from the current pass-through (a one percentage point increase the policy rate results in only a 0.36 percentage point increase in retail rates after twenty-four months).

- Current financial dollarization ratios in Paraguay account for 20 percent of the pass-through effect from movements in the exchange rate to inflation.

- Cementing sound macroeconomic fundamentals along with higher public confidence regarding the government's policy objectives are paramount steps for a sustained de-dollarization process.

13.   However, it is important to note that due to Paraguay's openness and the prominence of the agribusiness and livestock sectors, sectors that trade exclusively in dollars; dollarization would remain a key feature of the Paraguayan financial system over the foreseeable future.

Annex I. Description of Empirical Models

1. **The empirical model follows Weber and Saborowski (2013) and implements an interaction panel VAR (IPVAR) framework introduced by Towbin and Weber (2013).** The model includes the central bank policy rate and a weighted average of bank lending rates in a monthly frequency from 2000–12, for all countries for which data from the IMF's International Financial Statistics is available (120 countries). The dynamic interaction between these endogenous variables is allowed to vary deterministically with the share of dollar denominated loans as a share of total loans. The relationship between the variables in this model is assumed to be governed by a system of "structural" equations. Ignoring the constant term, the system can be written as:

$$A_0 y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t$$

Where $A_l = \beta_l + \mu_l * dollar_i$ are $(k \times k)$ matrices of coefficients, ε_t is a (k×1) vector of structural shocks that are assumed to be uncorrelated with one another; A_0 is a (k×k) impact matrix that contains the contemporaneous relations among variables, and yt is a (k×1) vector of variables.

The reduced form of the structural model can be written as:

$$y_t = B_1 y_{t-1} + \ldots + B_p y_{t-p} + e_t$$

where $B_p = A_0^{-1} A_p$ and $e_t = A_0^{-1} \varepsilon_t$ for p =1, …, 4.[1]

The model can be estimated by ordinary least squares, imposing restrictions on A_0 to identify the coefficients in the structural form. Identification is achieved through a Choleski decomposition of the variance-covariance matrix Σ_e of reduced-form errors e_t. What is more, conditional impulse response functions are constructed and evaluated at different points of the sample distribution of the dollarization ratio.

2. **Paraguay specific VARs are also estimated to quantify the effects of dollarization on interest rate transmission and the exchange-rate pass-through to inflation.** The VAR includes the central bank policy rate, credit dollarization ratio, the weighted average of bank lending rates with monthly data from 2000–2013 (all in first differences). The pass-through of exchange rate to inflation is calculated using a VAR with the nominal effective exchange rate, deposit dollarization ratio, and CPI monthly inflation. In both estimations a recursive ordering is assumed, characterized by the idea that the more exogenous variables of the model precede the endogenous ones.[2] To quantify the effects of dollarization on the interest rate transmission and in amplifying the exchange-rate pass-through, counterfactual scenarios are constructed by holding impulse responses of dollarization ratios fixed at zero at all forecast horizons.[3] This hypothetical impulse response is then compared with the actual response to quantify the relative importance dollarization in hindering the interest

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[1] The lag length was chosen according to the Akaike Information Criterion (AIC).

[2] The model is qualitatively robust to different orderings.

[3] This counterfactual analysis follows closely from the analysis of Sims and Zha (1998), Bernanke, Gertler, and Watson (2003), and Bachman and Sims (2012).

transmission and amplifying the exchange-rate pass-through. To see this more clearly, consider the impulse response of the dollarization ratio (DOLLAR) to a shock to the policy rate (LRM):

$$IRF_{DOLLAR^{LRM}}(LRM, t) = B^{t-1}A_0^{-1}(DOLLAR^{LRM}, LRM^{LRM})(1)$$

The counterfactual analysis looks at a sequence of shocks such that (1) is equal to zero. Therefore, in the first month after impact this entails:

$$A_0^{-1}(DOLLAR^{LRM}, LRM^{LRM}) + A_0^{-1}(DOLLAR^{LRM}, DOLLAR^{LRM}) * \varepsilon_{DOLLAR^{LRM}, t=1} = 0$$

The required innovation $\varepsilon_{DOLLAR^{LRM}, t=1}$ is:

$$\varepsilon_{DOLLAR^{LRM}, t=H} = -\frac{A_0^{-1}(DOLLAR^{LRM}, DOLLAR^{LRM})}{A_0^{-1}(DOLLAR^{LRM}, LRM^{LRM})}$$

The required values for subsequent innovations can be recursively estimated as:

$$\varepsilon_{DOLLAR^{LRM}, t=H} - \frac{IRF_{DOLLAR^{LRM}}(LRM^{LRM}, H) + \sum_{j=1}^{H-1} B^{H-1}A_0^{-1}(DOLLAR^{LRM}, LRM^{LRM}) * \varepsilon_{DOLLAR^{LRM}, j}}{A_0^{-1}(DOLLAR^{LRM}, DOLLAR^{LRM})}$$

where h= 1, ... , H.

The impulse response to the a shock to the central bank policy rate holding dollarization equal to zero at all horizons h is computed as:

$$\widetilde{IRF}_i(LRM, t = H) =$$
$$IRF_{DOLLAR^{LRM}}(LRM^{LRM}, H) + \sum_{j=1}^{H-1} B^{H-j}A_0^{-1}(DOLLAR^{LRM}, LRM^{LRM}) * \varepsilon_{DOLLAR^{LRM}, j}$$

with *i* being an indicator for each variable in the system.

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