INTERNATIONAL MONETARY FUND

IMF Country Report No. 16/65

ARGENTINA

FINANCIAL SECTOR ASSESSMENT PROGRAM

February 2016

FINANCIAL SECTOR STABILITY—TECHNICAL NOTE

The documents related to the Financial Sector Assessment Program for the Republic of Argentina were completed in 2013. The reports were prepared by an IMF team in spring of 2013 and were discussed and finalized by the IMF's Executive Board on July 12, 2013. The assessment and recommendations included herein reflect the views of IMF staff at that time and do not apply to developments occurred since then.

Copies of this report are available to the public from

International Monetary Fund • Publication Services
PO Box 92780 • Washington, D.C. 20090
Telephone: (202) 623-7430 • Fax: (202) 623-7201
E-mail: publications@imf.org Web: http://www.imf.org
Price: $18.00 per printed copy

International Monetary Fund
Washington, D.C.

INTERNATIONAL MONETARY FUND

ARGENTINA

FINANCIAL SECTOR ASSESSMENT PROGRAM

July 1, 2013

TECHNICAL NOTE

FINANCIAL SECTOR STABILITY

Prepared By
Monetary and Capital Markets Department

This Technical Note was prepared by IMF staff in the context of the Financial Sector Assessment Program in Argentina. It contains technical analysis and detailed information underpinning the FSAP's findings and recommendations.

CONTENTS

APPENDIX TABLES

Glossary

ANSES	Social Security Administration
BADLAR	Wholesale Rate
BCRA	Banco Central de la República Argentina
BIC	Bayesian Information Criterion
CAR	Capital Adequacy Ratio
CPI	Consumer Price Index
FSAP	Financial Sector Assessment Program
FGS	Sustainability Guarantee Fund
GDP	Gross Domestic Product
IFS	International Financial Statistics
LCR	Liquidity Coverage Ratio
LEBAC	Money Market Instrument Issued by the BCRA
MLE	Maximum Likelihood Estimation
NOBAC	Medium- and Long-term Instrument Issued by the BCRA
NPL	Nonperforming Loans
NSFR	Net Stable Funding Ratio
PD	Probability of Default
P&L	Profit and Loss Statement
ROA	Return on Assets
ROE	Return on Equity
RWA	Risk Weighted Assets
SME	Small- and Medium-sized Enterprise
SSN	National Insurance Supervisor
TD	Top-down
VAR	Vector Auto Regression
VIX	Volatility Index
WEO	World Economic Outlook

EXECUTIVE SUMMARY

The implementation of stress tests is conceptually challenging in the Argentinean context and the results must be interpreted with a high degree of caution. The stress tests use macroeconomic and satellite models to calculate the impact of adverse scenarios or shocks on banks. These models are estimated using historical data and are subject to estimation uncertainty. Model uncertainty is possibly severe in the case of Argentina, given the institutional and structural changes experienced by the country in the last two decades.

The stress tests examined the resilience of the Argentine banking system to solvency, liquidity, and contagion risks. The top-down stress tests were conducted through a macroeconomic scenarios approach and through sensitivity analysis. Macroeconomic scenarios were developed to assess the impact of adverse external shocks on the economy over a two-year horizon (2013–14), based on data available through September 2012. These shocks were calibrated to trigger a cumulative decline of real GDP growth equivalent to 13.3 percentage points, or 2 standard deviations. The effects of these shocks on individual bank's profitability and capitalization were assessed using satellite models. In addition, sensitivity stress tests assessed vulnerabilities of the system to key domestic shocks. The tests covered the 22 largest banks, which in terms of asset size account for 90 percent of the system.

These tests suggest that most banks are in a position to withstand substantial levels of stress while still phasing in capital requirements under Basel II, and credit risk is the most important vulnerability. Results from the macroeconomic stress tests indicate that declines in capital ratios in 2013 and 2014 are largely driven by deterioration in credit quality. Nonperforming loan (NPL) rates would rise sharply under an adverse scenario triggered by an external shock. In the most extreme adverse scenario, bank losses materialize as the decline in output increases the loan loss ratio in the banking system from 1.5 percent to more than 6 percent; in this scenario, capitalization in 6 of the 22 largest banks would fall below the required minimum of 8 percent—two banks are undercapitalized at the starting point of the exercise.

Banks appeared resilient to market risk but less so to sovereign risks. Banks hold highly liquid bonds and money market instruments issued by the central bank and the government. The adverse scenarios result in higher interest rates and inverted yield curves that cause sizable losses from holdings of sovereign securities. These losses, however, are partially offset as banks obtain gains from price appreciation when yields decline over time. More importantly, although yields on some of these instruments exhibit high volatility, the short duration of bank portfolios of these instruments limits their exposure to sovereign risks. Some instruments are also linked to inflation, the U.S. dollar, or the BADLAR deposit rate—features that also limit losses in adverse scenarios. The exposure of banks to corporate bonds, equity, commodities, foreign securities, and other sources of market risk are negligible. Regarding exchange rate risk, banks hold positive net open foreign currency exposures, and hence, a depreciation of the peso in the adverse scenarios would boost profitability.

In all adverse scenarios, the capital shortfall in the banking system would be small relative to the size of the economy. Although a number of banks would be under-capitalized in adverse scenarios, the estimated shortfall in the system in the most extreme scenario is less than 0.2 percent of GDP; this is due in part to the small relative size of the banking system.

Sensitivity tests also suggest that domestic shocks simulated by an increase in real interest rates or a depreciation-inflation spiral could deteriorate the credit quality of loan portfolios. Sensitivity tests based on credit risk models suggest that 5 of the 22 largest banks would be undercapitalized after a 900 basis point increase in real interest rates. Losses from credit risk would also spike in a scenario with a depreciation-inflation spiral. Assuming that real interest rates remain constant, a 30 percent peso depreciation that is partially transmitted to inflation would increase NPL ratios, and the capitalization of 5 banks could fall below the required minimum.

Sensitivity tests of concentration also pointed to the predominance of credit risk from common name concentrations. The failure of the five largest borrowers—a low probability event—would cause undercapitalization in 8 of the 22 banks subjected to the tests. Moreover, a number of firms are large counterparts of many banks simultaneously, compounding systemic risk.

Liquidity stress tests reveal that banks would be able to confront large deposit withdrawals. Cash flow-based liquidity stress tests assessed resilience to a strong shock characterized by liability run-off rates and haircuts on assets that were calibrated by type on Argentine historical data. If needed, the Banco Central de la República Argentina (BCRA) could assist banks that face liquidity shortfalls by waiving reserve requirements for a maximum period of 30 days or by injecting liquidity through its standing facilities. The results revealed that all banks would be able to confront persistent and sizable withdrawals of funding for 30 days without any assistance from the BCRA. After 30 days, only 2 of the 22 largest banks would need BCRA assistance in pesos and 1 in dollars, and in these cases, an extension of the reserve requirement waiver would suffice to render them liquid.

A reverse liquidity stress test also assessed the capacity of banks to withstand wholesale deposit withdrawals. The test assumed that banks faced 100 percent run-off rates on maturing wholesale deposits and full rollover rates in other funding lines. The results show that all banks have liquidity to deal with losses of 33 percent or more of wholesale deposits without reliance on BCRA assistance. Moreover, 15 of the 22 largest banks would be able to confront withdrawals of 100 percent of maturing wholesale deposits without experiencing a shortfall of liquid assets at anytime in the two-year assessment period.

Direct contagion risk through bilateral interbank exposures is limited. Interbank exposures are very small compared to banks' capitalization. As of September 2012, only one of the 22 large banks had a total interbank exposure that was larger than its excess of capital over the required minimum—and in this case, five other institutions would have to fail for that bank's capital to fall below the required minimum.

However, the banking system is interconnected with the FGS, which has the potential to create unexpected liquidity pressures. It has 6 percent of its portfolio invested in fixed-term deposits, for very short term (on average 35–40 days) and for some banks, Sustainability Guarantee Fund (FGS) deposits represent more than 4 percent of total deposits. The allocation mechanism for such deposits does not seem to be driven by transparent criteria as most of them as of September 2012 were invested below market prices (in the largest public bank, or in a private bank where the FGS is a significant shareholder). The absence of clear criteria and the consequent risk of sudden withdrawal may generate liquidity pressures for the smaller banks. Additionally, the large equity stakes of the FGS in some private banks raises governance issues.

Going forward, the BCRA could further refine its stress testing toolkit. The BCRA should further use the existing bank-level supervisory dataset containing detailed information on the balance-sheet and profit and loss (P&L) statements for the modeling part of the stress testing exercise, and establish a mechanism to make it available to the members of the stress testing team in a short notice. The BCRA has already started to refine the satellite models for profits of the top-down (TD) stress testing using higher frequency data to assure that smaller banks also get a good fit.

The insurance sector shows signs of financial vulnerabilities. A large percentage of the available capital for solvency is illiquid and not fully suitable to protect the companies in case of adverse events. The non-life sector is on a weaker financial footing than the life or retirement sectors, with vulnerabilities to credit and liquidity risks. It would be advisable to lift the recently introduced mandatory investment requirements, which risk accentuating these vulnerabilities.

Table 1. Argentina: Recommendations on Banking Stress Testing and Financial Stability

Recommendations and Authority Responsible for Implementation	Timeframe 1/
Banking Sector	
Use the bank-level panel supervisory dataset with detailed information on the balance-sheet and P&L statements for the modeling part of stress testing (BCRA).	Immediate
Enhance satellite models for credit risk (BCRA):	
- estimate dynamic panel models using quarterly data;	Immediate
- develop more granular models, including models of loan loss rates or default probabilities by economic sector, loan or borrower type;	Near-term
- explore alternative specifications and explanatory variables, including time-variant bank-specific variables.	Near-term
- develop default probability models (PD) based on individual borrower data.	
Enhance satellite models for sovereign risk (BCRA):	
- construct zero coupon yield curves for nominal and inflation-indexed fixed income instruments using as input yields on nominal (coupon) instruments;	Medium-term
- obtain smooth reference yield curves (nominal and real) using Nelson-Siegel or similar approaches;	Medium-term
- price fixed income instruments based on shifts in the estimated zero-coupon yield curves in the conduct of stress tests.	Medium-term
Enhance satellite models for net fee and service income and for operating and administration expenses (BCRA):	
- exploit the availability of quarterly data to estimate the models;	Near-term
- develop quarterly models based on a panel data approach and alternative models based on bank-specific regressions (to assess robustness)	Near-term
Sustainability Guarantee Fund (FGS)	
Auction fixed-term deposits in banks on a market price return base. Increase the maturity of these deposits to provide stable funds to the banking system (FGS).	Near-Term
Discourage unsupervised direct credit activities. Register all credit and debtor information from FGS loan programs in the credit bureau (FGS).	Near-Term
Establish a limit of 5 percent for the FGS exposure to banks in equity (FGS).	Near-Term
Insurance Companies	
Apply technical premiums and more efficiency, disallow more than two months of unpaid premia (SSN).	Immediate
Lift the recent investment guidelines for insurances and allow risk-transfer reinsurance (SSN).	Immediate

"I-Immediate" is within one year; "NT-near-term" is 1–3 years; "MT-medium-term" is 3–5 years.

INTRODUCTION[1]

1. Argentina's financial system is very small compared to similar countries and mostly transactional, but banks maintain significant buffers. A severe downsizing of the financial sector was one of the legacies of the 2001–02 crisis. The system has gradually expanded in recent years, but it remains small, bank-dominated, and transactional. Although the system is lacking in depth, banks have ample liquidity, solid capitalization, and strong asset quality; they also rely on conservative sources of funding and are generally profitable. Hence, the Financial Sector Assessment Program (FSAP) stress testing was conducted from an initial position of relative strength in the banking system.

2. The objective of the FSAP stress testing exercise is to assess the capacity of the banking system to withstand extreme but plausible macroeconomic shocks. The tests are means to explore weaknesses in a financial system and the channels through which adverse shocks are transmitted. FSAP stress tests can help to identify priorities for policy actions, such as those aimed at reducing specific exposures or building capital and liquidity buffers. The FSAP stress testing process can also help authorities identify informational and methodological gaps, and assess their preparedness to deal with situations of financial stress.

3. FSAP stress tests may differ from stress tests conducted by central banks, including those undertaken by the BCRA. The authorities and the FSAP team agreed on introducing methodological adjustments to the stress testing framework developed by the BCRA, with the objective of facilitating comparison with peer countries. The authorities conducted the tests in close cooperation with the FSAP team and provided access to detailed supervisory and macroeconomic data.

4. Key risks over the short-term are incorporated into the design of the stress tests. Risks for banks may arise from Argentina's links to the global economy. As a major exporter of agricultural products, Argentina is susceptible to a sharp decline in commodity prices. Also, Argentina's industrial production and automobile exports are closely tied to the growth of the Brazilian economy; as such, a sharp decline in the growth of Brazil could have adverse effects in Argentina. On the other hand, risks may also arise from domestic factors. In view of the high rate of inflation, a possible scenario might include the need for slower growth in base money to contain inflationary pressures, which would increase real interest rates. In addition, the memory of past crises still weighs on expectations and money demand in Argentina tends to be less stable than in other countries. Hence, another possible risk is that money demand could drop in real terms, leading to a decline in real credit supply and bank funding, and placing depreciation pressure on the currency.

[1] Prepared by Mario Catalán (MCM), with inputs for the section on insurance from Rodolfo Wehrhahn (MCM) and for the section on the FGS from Michel Rodolfo Canta (IMF consultant). Christina Daniel provided excellent research assistance.

5. Admittedly, the implementation of stress tests is conceptually challenging and stress test results must be interpreted with a high degree of caution. Stress tests use macroeconomic and satellite models to calculate the impact of adverse scenarios or shocks on banks. These models are estimated using historical data and are subject to estimation uncertainty. Model uncertainty is possibly severe in the case of Argentina, given the institutional and structural changes experienced by the country in the last two decades. The simple structure of the bank balance sheets mitigates some of the challenges. The stress testing exercise assumes that administrative controls currently in place, affecting banks and foreign exchange transactions, will remain in place and operate with effectiveness.

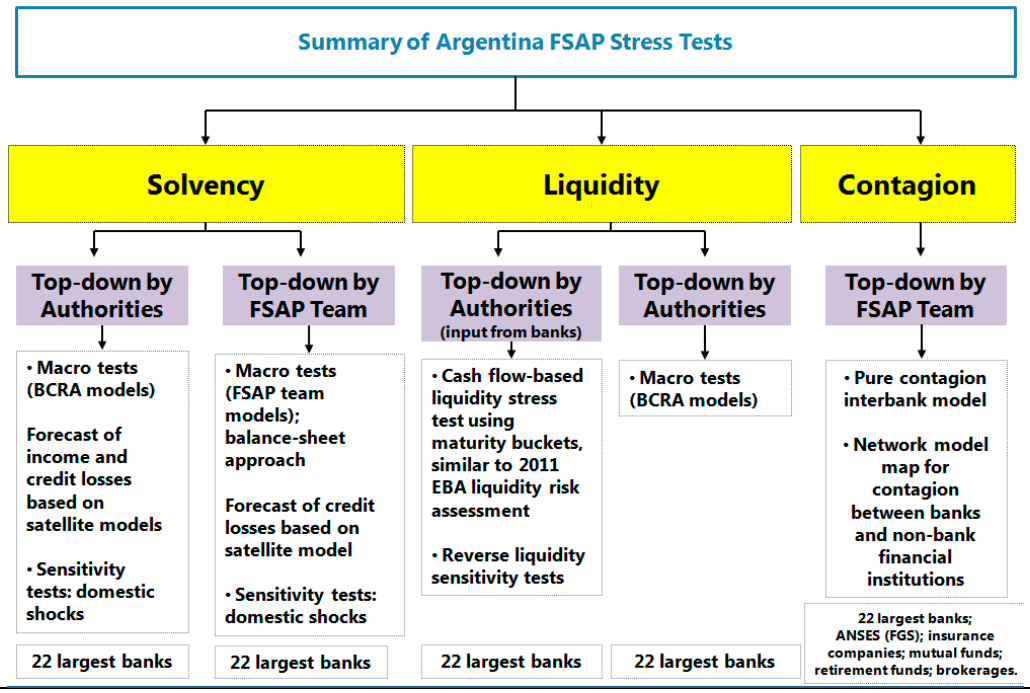
6. The rest of this Technical Note is structured as follows. Section II presents the different components of the banking system's stress tests: their description, design, methodology for implementation, and results. Sections III and IV presents the stability analysis corresponding to the Sustainability Guarantee Fund (FGS) and the insurance sector.

STRESS TESTING THE BANKING SYSTEM

7. The stress tests examined the resilience of the Argentine banking system to solvency, liquidity, and contagion risks (Figure 1). The TD solvency stress tests were conducted through a macroeconomic scenarios approach and through sensitivity analysis by the authorities (BCRA) and the FSAP team. Macroeconomic scenarios were developed to assess the impact of adverse external shocks on the economy over a two-year horizon (2013–14), based on data available through September 2012.[2] The effects of these shocks on individual bank's profitability and capitalization were assessed using satellite models developed by the authorities and validated by Fund staff. In addition, sensitivity stress tests assessed vulnerabilities of the banking system to key domestic shocks. The TD liquidity stress tests assessed the capacity of banks to confront large funding withdrawals of funding, using a maturity ladder analysis and specific information provided by banks to the BCRA for this purpose. The contagion tests also covered the nonbank financial institutions.

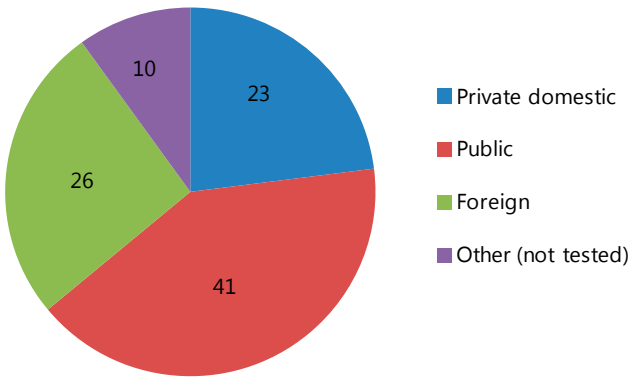
[2] It is common practice in FSAPs to implement the stress tests over a five-year horizon in normal times, while a two-year horizon is chosen in crisis times or in countries subject to a high degree of macroeconomic uncertainty at the time of the exercise. In the case of Argentina, a two-year horizon was considered appropriate due to the high degree of uncertainty surrounding the official measurement of key macroeconomic variables, and the fact that the international community has not had the opportunity to fully assess Argentina's macroeconomic performance since the last Article IV consultation with the IMF, which was concluded in 2006.

Figure 1. Argentina: Summary of Argentina FSAP Stress Tests



8. The stress tests covered the 22 largest banks, which in terms of asset size account for 90 percent of the system. The list of banks subjected to the tests includes 10 private domestic banks (23 percent of assets), 5 public banks (41 percent of assets), and 7 private foreign banks (26 percent of assets).

Figure 2. Argentina: Asset Shares of the Banking System



Source: Banco Central de la República Argentina.

A. Solvency Stress Tests

Solvency stress tests were conducted through a macroeconomic scenarios approach and through sensitivity analysis. These tests were based on TD exercises by the authorities (BCRA) and the FSAP team and covered credit, market, and sovereign risks.

9. Stress tests based on macroeconomic scenarios and those based on sensitivity analysis can be viewed as providing complementary risk assessments. In the approach based on macroeconomic scenarios, changes in macroeconomic conditions cause a simultaneous change in several risk factors that impact banks' profitability, in-balance and off-balance sheet positions—including exchange and interest rates, net interest income, non-performing loans, net fee income, operating expenses, etc. In contrast, sensitivity tests assess the effects of shocks to one risk factor at a time, holding all other factors constant. Thus, to a first approximation, sensitivity tests can be interpreted as measuring the "partial" contribution of each risk factor to the combined risks faced by banks.

Macroeconomic Tests

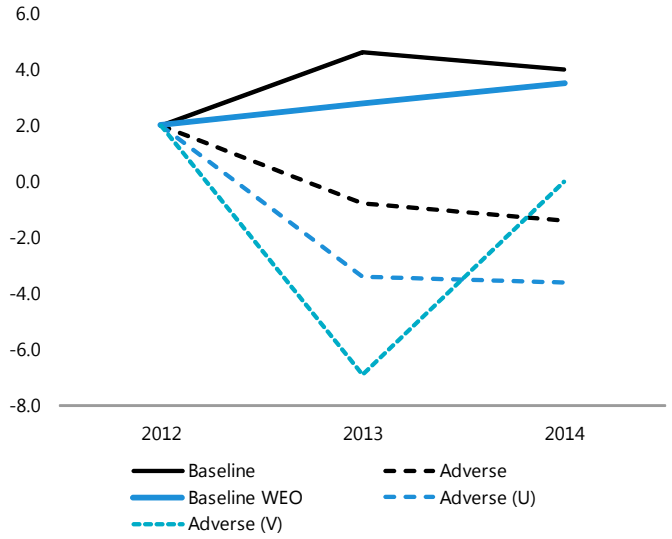
10. Macroeconomic scenarios were developed to assess the impact of adverse *external* shocks on the economy over a two-year horizon (2013–14). The macroeconomic scenarios simulated the effects of external shocks such as declines in main trading partners' growth, adverse terms of trade shocks, and a rise in global risk aversion that triggers capital outflows. Once the macroeconomic scenarios were constructed, the transmission of the shocks to individual bank's profitability and capitalization were assessed using satellite models developed by the authorities and validated by Fund-staff. These "macroeconomic stress tests" were dynamic in nature and required specific assumptions regarding banks' behavior, balance sheet growth, and the evolution of off-balance sheet exposures.

11. The macroeconomic stress tests rested on two baseline scenarios. These baseline scenarios were characterized by an improvement in external conditions in 2013–14 that result in a gradual recovery in output growth. Specifically, a faster pace of global growth, particularly in Brazil, gradually boosts the demand for Argentine exports while international commodity prices fluctuate around current levels. Growth is also supported by a recovery in grain harvest, following the drought that affected production in 2012. The two scenarios include one based on the authorities' projections and another based on Fund-staff projections (World Economic Outlook baseline). The authorities used BCRA models and expert judgment to construct their scenarios. Fund-staff analyzed the transmission of external shocks to the domestic economy using Vector Auto Regression (VAR) analysis. Appendix I describes both approaches.

12. These macroeconomic tests assessed the effects of three adverse scenarios (Figure 3). These included: (i) an adverse scenario based on the authorities' baseline resulting in a cumulative decline of GDP equivalent to 1.7 standard deviations over two years; (ii) a U-shaped adverse scenario relative to the Fund-staff baseline; and (iii) a V-shaped adverse scenario also relative to Fund-staff

baseline. The latter two scenarios result in a cumulative decline of real GDP growth equivalent to 2 standard deviations (13.3 percentage points) over two years.[3]

Figure 3. Argentina: Macroeconomic Scenarios: Real GDP Growth, 2012–14
In percent



Source: Authorities' and staff's calculations.

13. The tests based on the Fund-staff baseline, and those based on the authorities' baseline, were implemented using different methodologies and assumptions. The tests corresponding to the authorities' baseline and adverse scenarios were implemented using the existing BCRA methodology. This approach allows for growth in credit and deposits to differ from nominal GDP growth. Thus, in a crisis, money demand could fall sharply in relation to GDP, leading to a similar fall in credit and in risk-weighted assets. In contrast, and following standard international practice, the tests corresponding to the Fund-staff baseline scenario and the adverse scenarios (ii) and (iii) assumed a "constant" balance sheet: banks' balance sheets grew in line with nominal GDP (since nominal growth was not negative in any scenario). Due to differences in scenarios, assumptions, and methodology; the tests based on the authorities' baseline yield more positive results than those based on the FSAP approach (Fund-staff baseline).

[3] A standard deviation of (two-year cumulative) real GDP growth, calculated based on data for the period 2001–2012, is equal to 6.6 percentage points. The two-year cumulative growth rate in the Fund-staff baseline scenario is $g^{\text{Baseline}}_{2012-14} = \left(\text{Real GDP}^{\text{Baseline}}_{2014} / \text{Real GDP}_{2012}\right) - 1.$ In the two adverse scenarios relative to the Fund-staff baseline real GDP in 2014 satisfies $g^{\text{Adverse}}_{2012-14} = g^{\text{Baseline}}_{2012-14} - 0.133 = \left(\text{Real GDP}^{\text{Adverse}}_{2014} / \text{Real GDP}_{2012}\right) - 1.$

Note that the sample period includes the years in which Argentina experienced the most severe economic downturn in its history.

14. The adverse macroeconomic scenarios relative to the Fund-staff baseline reflect downside global risks. Fund-staff investigated the transmission of external shocks to the domestic economy using Vector Auto Regression analysis (Appendix I). The results indicate that adverse U- and V-shaped scenarios could be triggered by several factors:

- Sensitivity to trading partners' growth. A one-standard deviation shock (decline) in trading partners' growth—equivalent to a 4 percentage point deviation from baseline—reduces real GDP in Argentina by nearly 3 percentage points after four quarters. This implies an elasticity of about 0.75 with respect to "global" growth, broadly in line with that of other emerging markets.[4]

- Sensitivity to terms of trade and global risk aversion. Argentina's GDP exhibits high sensitivity to changes in terms of trade and global risk aversion, as measured by the volatility index (VIX). A 10 percent decline in terms of trade sustained for 8 quarters reduces domestic output by about 2 percentage points, and a one standard deviation shock in the VIX reduces domestic output by 4.5 percentage points relative to the baseline.

15. The macroeconomic scenarios include projected paths of inflation, exchange and interest rates, and unemployment (Table 2). In adverse scenarios, the rise in unemployment—calculated based on country-specific estimates of the Okun's law—reflects slower economic activity. Also, in response to capital outflow pressures, the BADLAR deposit rate rises and the peso depreciates against the dollar at a faster pace than in the baseline—although, as noted above, current exchange and administrative controls are assumed to remain in place and operate effectively. The peso depreciation is partially transmitted to domestic prices, increasing inflation as measured by the GDP deflator.

[4] See IMF Regional Economic Outlook: Western Hemisphere, "Rebuilding Strength and Flexibility," April 2012.

Table 2. Argentina: Stress Tests: Macroeconomic Scenarios

(In percent)

		Projections	
	2012	2013	2014
Real GDP growth			
Baseline Authorities	1.9	4.6	4.0
Adverse Authorities	1.9	-0.8	-1.4
Baseline WEO[1]	1.9	2.8	3.5
Adverse (U)	1.9	-3.4	-3.6
Adverse (V)	1.9	-6.9	0.0
GDP deflator growth			
Baseline Authorities	15.3	15.5	16.8
Adverse Authorities	15.3	10.8	15.1
Baseline WEO	15.3	17.1	15.0
Adverse (U)	15.3	15.3	13.1
Adverse (V)	15.3	14.6	12.0
Unemployment rate[2]			
Baseline Authorities	6.9	6.6	6.2
Adverse Authorities	6.9	8.2	8.0
Baseline WEO	6.9	6.7	6.4
Adverse (U)	6.9	10.5	10.6
Adverse (V)	6.9	12.6	8.4
Nominal exchange rate, peso per US dollar[3]			
Baseline Authorities	13.8	11.2	11.0
Adverse Authorities	13.8	18.6	11.9
Baseline WEO	13.8	17.8	16.0
Adverse (U)	13.8	21.5	15.0
Adverse (V)	13.8	26.4	12.0
Nominal annual interest rate[4]			
Baseline	15.4	16.0	15.4
Adverse	15.4	17.7	16.6
Baseline WEO	15.4	16.7	16.4
Adverse (U)	15.4	20.6	17.3
Adverse (V)	15.4	21.4	16.4

1/ All the WEO numbers correspond to the January update.

2/ The numbers indicate end-of-year unemployment rates. Unemployment rates in scenarios based on the Fund-staff baseline were obtained by applying the Okun's law. Estimates of the Okun coefficient for Argentina are in the range 1.7-2.3: a decline in real GDP growth of 1.7-2.3 percentage points increases the unemployment rate by 1 percentage point. See World Bank, 2012, "The labor market story behind Latin America's transformation," Office of the Chief Economist for the Latin America and the Caribbean Region, October; and Collyns, C. and G. Russell Kincaid , 2003, "Managing Financial Crises: Recent Experience and Lessons for Latin America," IMF Occasional Paper No. 217.

3/ The numbers indicate end-of-year rates of depreciation of the peso against the US

4/ The numbers correspond to the BADLAR interest rate as of December of each year.

16. In all the solvency stress tests, pass-fail hurdle rates were consistent with Basel III (Table 3). The minimum total capital adequacy ratio was 8 percent over the whole stress testing period, and the minimum Tier 1 capital ratio was assumed to increase from 4 percent in 2012 to 5.5 percent in 2014.

Table 3. Argentina: Solvency Threshold
(In percent)

Year	2012	2013	2014
Minimum Total Capital	8.0	8.0	8.0
Minimum Tier 1 Capital	4.0	4.5	5.5

Satellite Models

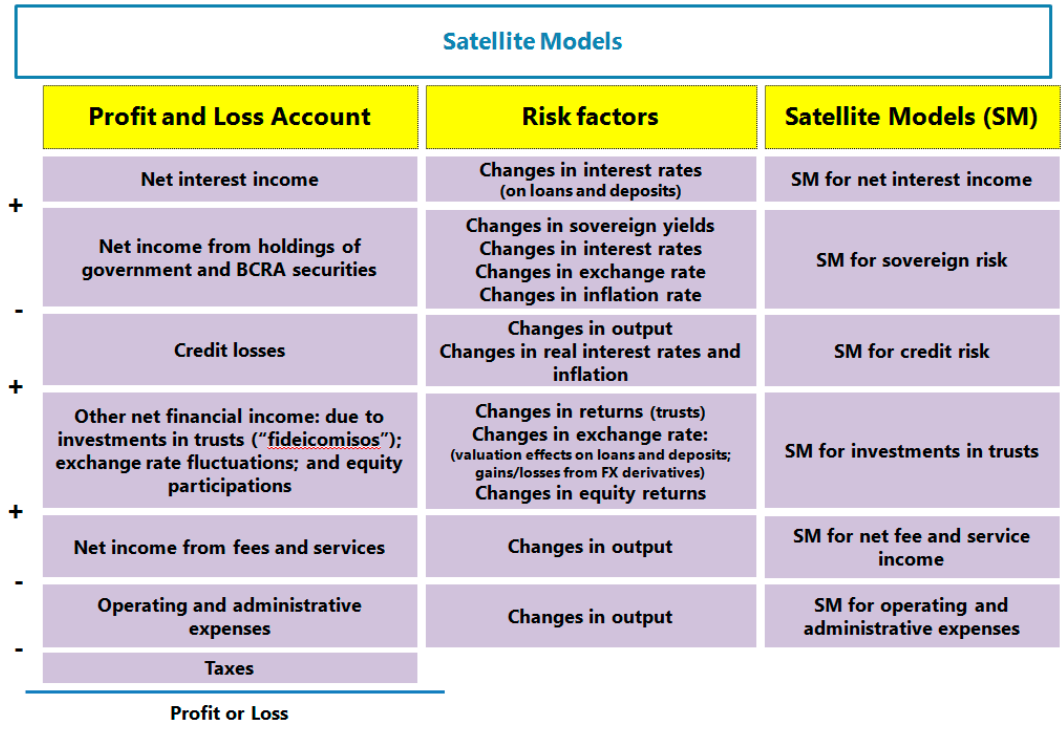
17. Satellite models were used to assess the effects of external shocks on individual banks' profitability and capitalization. Satellite models developed by the BCRA were used to quantify how changes in macroeconomic variables affect banks' profits and capitalization. The most relevant of these models—in terms of impact on stress tests results—were analyzed and validated by Fund-staff. [5]

18. Specific satellite models were developed to project each of the main lines of profits and losses. The BCRA uses a number of satellite models to project credit losses; movements in yield curves for the pricing of bonds and money market instruments; net interest income; net fee and service income; operational and administrative expenses; and other sources of profits. These models are estimated using econometric techniques and bank-specific annual data spanning almost two decades (Appendix II).

19. Precise estimations of satellite models are challenging due to past institutional and regime changes. Long data series, which are needed for improved econometric estimation, cover the institutional and regime changes from the convertibility period (currency board) to the post-convertibility period. In addition, Argentina experienced banking crises in 1995 and 2001. These regime changes and past crises may create structural breaks in the models. However, they also provide hard evidence on how variables can behave under extreme conditions, which improves the numerical calibration of shocks.

[5] Note that the satellite models used in the tests based on the authorities' baseline were different from those used in the tests corresponding to the Fund-staff baseline. In the latter case, satellite models were revised to incorporate comments and suggestions made by the FSAP team.

Figure 4. Argentina: Satellite Models



20. The satellite models used by the BCRA for credit risk have similarities to those used in advanced and other G20 economies. Given the current risk profile of Argentine banks, appropriate modeling of credit risk is highly relevant for the validity of stress tests. The BCRA uses a dynamic panel data model whereby loan loss rates are determined by real GDP growth, real interest rates, the rate of inflation, and bank specific characteristics. A similar approach is used in other G20 countries.[6] The estimation of the model appears robust to variations in the sample period. Specifically, the parameters of the model were estimated with data through 2008 and 2012, and no significant differences in results were found.

21. The satellite model for interest income is based on a maturity ladder approach. Regarding market risk, the BCRA uses econometric techniques to project shifts in yield curves by type of instrument—treating separately the instruments denominated in pesos, in pesos adjusted by inflation or linked to the BADLAR rate, and in U.S. dollars. The approach to modeling net fee and

[6] The model for credit risk used in Argentina has similarities to some of the models used in other countries. For a survey of authorities' approaches to stress testing credit risk, see Foglia, Antonella (2009), "Stress Testing Credit Risk: A Survey of Authorities' Approaches," International Journal of Central Banking, Vol. 5, No. 3, September. In some advanced countries, however, aggregate credit risk analysis based on dynamic panel data is complemented with more granular approaches that seek to differentiate loan losses by borrower type.

service income, and operating and administrative expenses is similar to that used in other countries (e.g., U.K. RAMSI model).

22. Ongoing work at the BCRA seeks to introduce further refinements to satellite models. The BCRA estimates its main satellite models using long series of bank-specific annual data.[7] Work in progress at the BCRA is pursuing the development of satellite models that will be estimated in a richer data environment. These new models are set to exploit the availability of monthly and quarterly bank-specific data going back to the year 1994.

Results

23. The macroeconomic stress tests reveal that credit risk is the most important vulnerability. Results from the macroeconomic stress tests based on the Fund-staff baseline indicate that declines in capital ratios in 2013 and 2014 are largely driven by deterioration in credit quality. NPL rates are currently low, but they would rise sharply under an adverse scenario triggered by an external shock. In the U-shaped adverse scenario, capitalization in 4 of the 22 largest banks would fall below the required minimum of 8 percent, while in the V-shaped scenario, 6 banks would be undercapitalized (Figure 6).[8] Bank losses materialize as the decline in output increases the loan loss ratio in the banking system from 1.5 percent to 4.4 and 6.2 percent in the U- and V-shaped scenarios, respectively, by 2014. Note that capital is calculated in conformity with the new standard under Pillar 1 of Basel II adopted in January 2013. Moreover, almost all the capital in the banking system consists of common equity and retained earnings (part of Tier 1 capital).[9] Hence, for most banks, the total capital hurdles are more restrictive than those corresponding to Tier 1 capital (Figure 7).

24. Banks hold liquid bonds and money market instruments, mostly those issued by the central bank and to a much lesser extent securities issued by the government. Banks' hold (zero-coupon) money market instruments issued by the BCRA with maturities of up to 270 days (LEBACs). These instruments are nominal and denominated in pesos. Banks also hold longer-term coupon bonds with maturities of up to three years (NOBACs). Principal and coupons on these bonds are either fixed or floating-rate (linked to the BADLAR deposit rate). Banks also hold bonds issued by the government (treasury), denominated in both pesos[10] and U.S. dollars. Banks' exposure to foreign sovereigns is negligible.

[7] Market risk models are the exception: yield curve models are estimated using daily data.

[8] All these results take into account the two banks, accounting for 9 percent of banking assets in the sample, that are undercapitalized at the starting point of the exercise. Those banks are under plans to restore solvency in the near future.

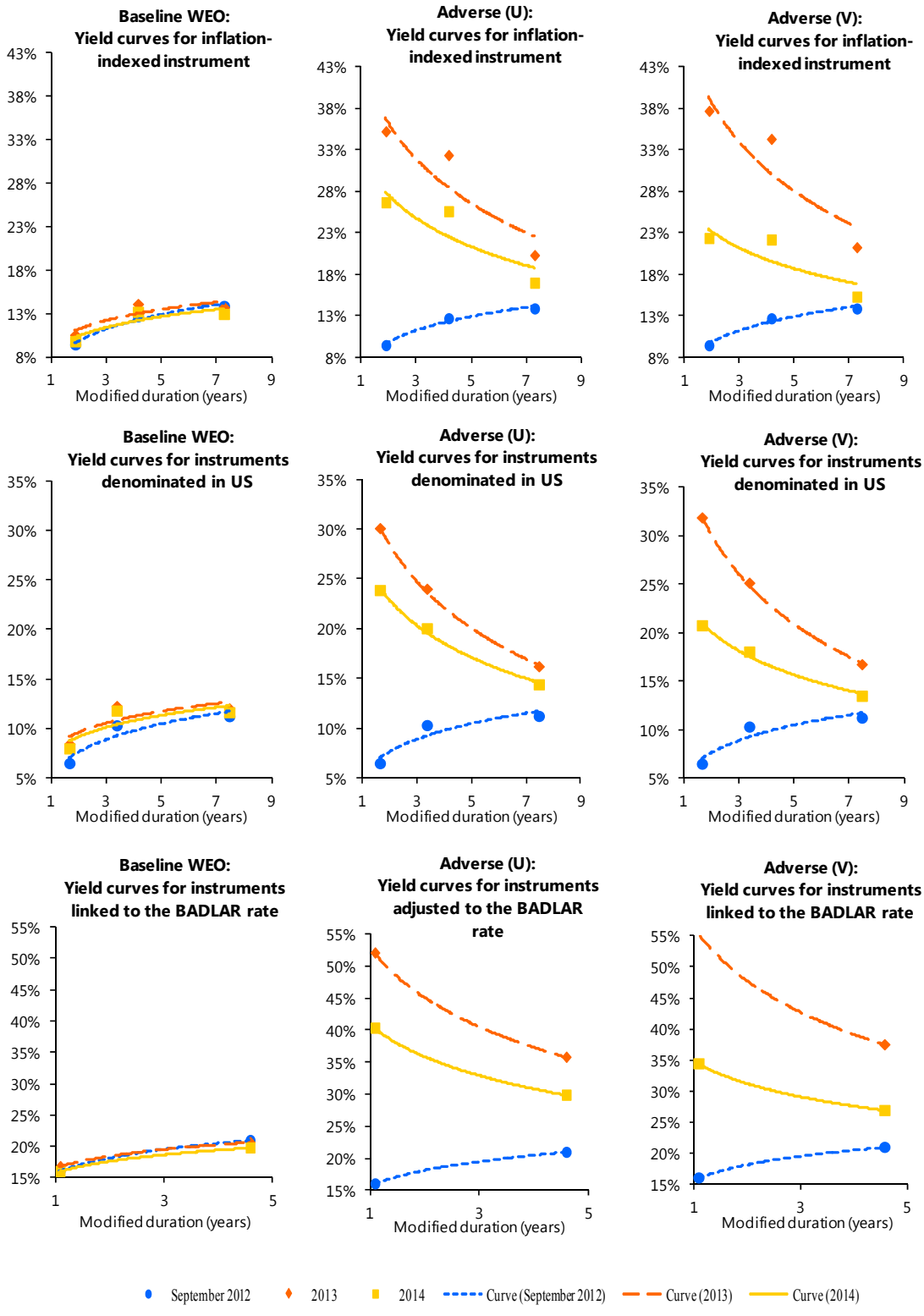
[9] The BCRA allows the inclusion of retained earnings from the current year in Tier 1 capital only after the bank's financial statements have passed an external audit. Before such audit has been passed, retained earnings are temporarily recognized as Tier 2 capital.

[10] The peso-denominated treasury instruments include a small fraction of inflation-adjusted bonds.

25. Banks exhibit mild vulnerability to sovereign risks. The adverse scenarios result in significantly higher interest rates[11] and inverted yield curves (Figure 5) that through haircuts cause sizable losses from holding of sovereign paper. These losses, however, are partially offset as banks obtain gains from price appreciation when yields decline over time. More importantly, although yields on some of these instruments exhibit high volatility, the short duration of bank portfolios of these instruments limits their exposure to sovereign risks. Some of these instruments are also linked to inflation, the U.S. dollar, or the BADLAR deposit rate—these features produce gains for banks from quasi-fiscal activities which partially offset their losses in adverse scenarios. The exposure of banks to foreign sovereign risk is insignificant.

[11] The simulated yield changes were very large: in the V-shaped adverse scenario, average yields increased by about 1,500 basis points for U.S. dollar denominated bonds; 2,000 basis points for peso denominated bonds adjusted by inflation; and about 2,800 basis points for bonds linked to the BADLAR interest rate. Yield changes of peso-denominated nominal instruments—including fixed coupon bonds and discount money market instruments—were about 450 basis points.

Figure 5. Argentina: Yield Curves by Sovereign Instrument and Macroeconomic Scenario



Source: Banco Central de la República Argentina.

26. Banks appeared resilient to non-sovereign market risk. The exposure of banks to corporate bonds, equity, commodities, non-sovereign foreign securities, and other sources of market risk are negligible. Regarding exchange rate risk, banks hold positive net open foreign currency exposures—these include balance sheet exposures as well as positions in foreign currency forward and future contracts. Hence, a depreciation of the peso in the adverse scenarios has a positive impact on profits.[12]

27. In all adverse scenarios, however, the capital shortfall in the banking system would be small relative to the size of the economy. Although a number of banks would be under-capitalized in adverse scenarios, the capital shortfall in the banking system would be small relative to the size of the economy—in the V-shaped adverse scenario the system's shortfall is estimated at about 0.2 percent of GDP. This is due in part to the small size of the banking system relative to the size of the economy.

Recommendations on Advancing the Stress Tests Methodology

28. In future stress testing exercises, the following enhancements of satellite models are recommended to better align Argentina's framework with best international practices. The BCRA is already working to implement some of the recommendations that follow:

- *Data*. Reducing the uncertainty on the measurement of economic variables in recommended.[13]
- *Satellite models for credit risk*. A three-pronged approach is recommended. First, enhancements to the current model, based on dynamic panel techniques, could involve the use of available quarterly data (instead of annual data). Given a richer data environment, the inclusion of additional bank-specific and time varying explanatory variables should be explored. Second, the BCRA should develop more granular models of credit risk, including models of loan loss rates or default probabilities by economic sector (e.g., agriculture, commerce, manufacturing, etc.), type of loan (e.g., consumer, mortgage, corporate, etc), or type of borrower (e.g., individuals, small- and medium-sized enterprises (SMEs), large corporations, etc.). Third, the BCRA could develop models of probability of default (PD), estimated based on individual borrower data. Information available through the Central de Deudores del Sistema Financiero could be useful to start the model refinement process. However, the development of models with sufficient granularity may also require collection of new data.

[12] As noted above, macroeconomic stress tests are dynamic, and hence, assumptions need to be made regarding the evolution of banks' derivative positions over time. It was assumed that gains or losses from banks' positions in currency forwards and futures materialized at the expiration of the contracts. As contracts matured, banks did not enter into new (long or short) positions in these instruments, implying that hedging or speculative strategies that banks had put in place prior to September 2012 were discontinued.

[13] The IMF has issued a declaration of censure and called on Argentina to adopt remedial measures to address the quality of the official GDP and CPI-GBA data. Alternative data sources have shown significantly lower real growth than the official data since 2008 and considerably higher inflation rates than the official data since 2007. In this context, the Fund is also using alternative estimates of GDP growth and CPI inflation for the surveillance of macroeconomic developments in Argentina.

- *Satellite models for sovereign risk*. The BCRA should estimate the term structure of nominal and real interest rates using standard methods.[14] A suggested agenda could involve the following steps:

  Step 1. Starting with observed yields corresponding to a set of nominal coupon bonds, obtain zero-coupon yield curves using standard approaches (replication of zeros; bootstrapping; recursive or simultaneous equation approaches; or regression methods). The term structure is the set of zero-coupon yields for different maturities. Note that a similar approach could be applied to inflation-indexed bonds. Yields corresponding to inflation indexed bonds are usually interpreted as "real" yields and can be used to construct the term structure of "real" interest rates for an economy; this step, however, should be carefully analyzed in the case of instruments adjusted to CER.[15]

  Step 2. Using a set of zero-coupon bonds, obtain smooth reference curves (nominal and real) using interpolation methods (e.g., the standard Nelson-Siegel approach).

  Step 3. Use projected shifts in zero-coupon yield curves to conduct the stress tests. Due to the presence of inflation-indexed bonds, the macro scenarios should include separate projections for a real and a nominal interest rate. Then, the response of zero-coupon yield curves with respect to changes in the interest rates projected in the macro scenario should be measured using regressions.

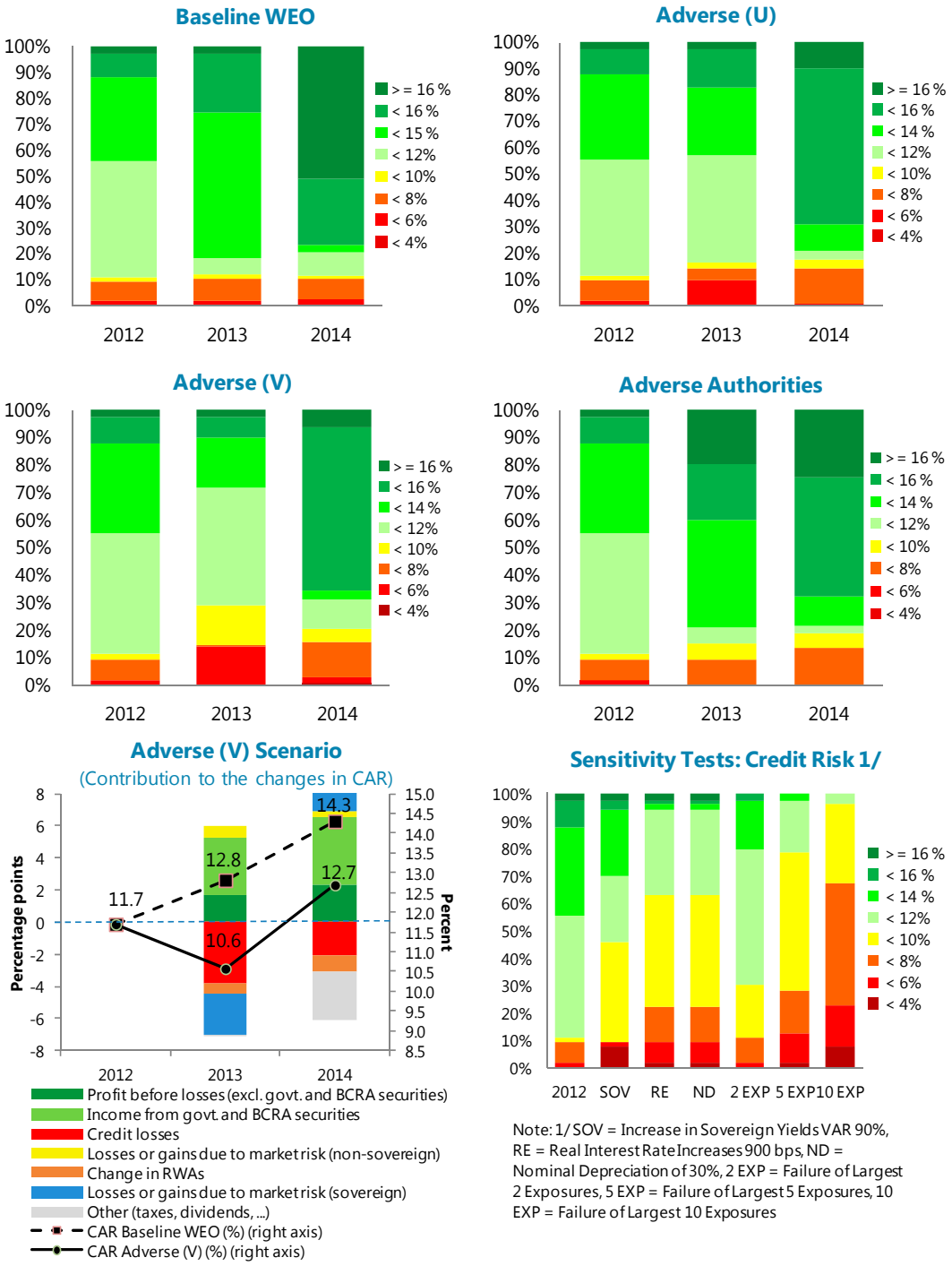
- *Satellite models for net fee and service income and for operating and administration expenses*. In the future, the use of available quarterly data is recommended as an enhancement. This would allow the conduct of more powerful stationarity tests and a reassessment of the model's specification—possibly to include additional macroeconomic control variables that could affect the cross-scenario sensitivity of projections. In a richer data environment with quarterly series, the authorities could explore whether a panel data approach, or an approach based on bank-specific regressions is more appropriate.[16]

[14] This is possible even if most of the instruments are of maturities shorter than five years.

[15] Ignoring default risk, the yields on inflation-indexed bonds can be interpreted as proxies for real rates in an economy only if the index used to calculate the bond's cash flows reflects price variations in the economy (actual inflation). If there is a gap between actual inflation and the price indexation mechanism embedded in a bond, such bond is not truly an "inflation indexed bond" and its yields cannot be interpreted as real rates.

[16] In this regard, one of the challenges is that due to variations in idiosyncratic bank histories, the regression specifications that deliver good fitness to the data vary across banks. A panel data approach is more parsimonious but, given the structural variations across banks, it may be insufficient to fit the data tightly.

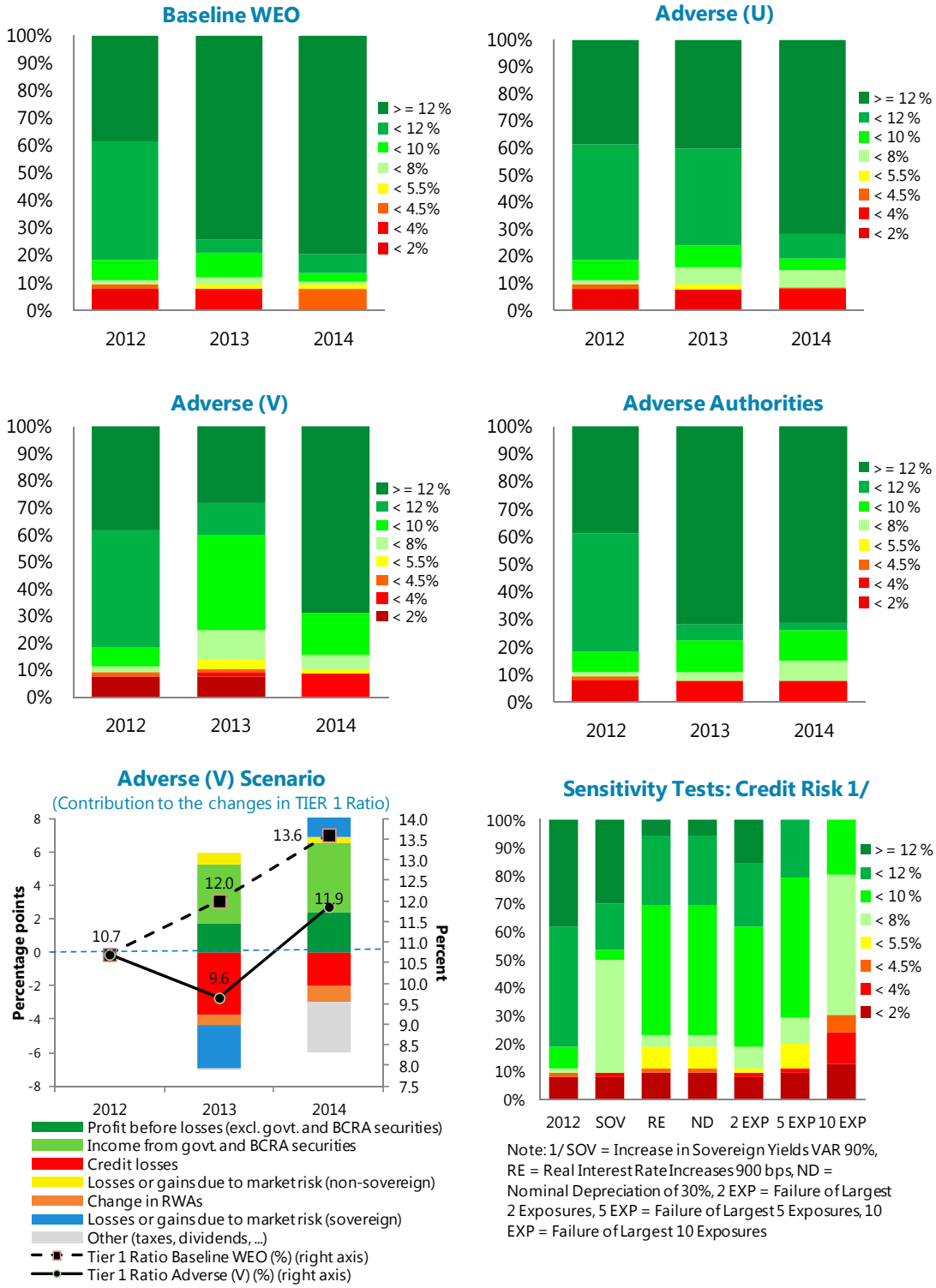
Figure 6. Argentina: Bank Solvency Stress Tests, CAR Ratios



Note: 1/ SOV = Increase in Sovereign Yields VAR 90%, RE = Real Interest Rate Increases 900 bps, ND = Nominal Depreciation of 30%, 2 EXP = Failure of Largest 2 Exposures, 5 EXP = Failure of Largest 5 Exposures, 10 EXP = Failure of Largest 10 Exposures

Source: Authorities' and staff's calculations.

Figure 7. Argentina: Bank Solvency Stress Test Results, Tier 1 Ratios



Note: 1/ SOV = Increase in Sovereign Yields VAR 90%, RE = Real Interest Rate Increases 900 bps, ND = Nominal Depreciation of 30%, 2 EXP = Failure of Largest 2 Exposures, 5 EXP = Failure of Largest 5 Exposures, 10 EXP = Failure of Largest 10 Exposures

Source: Authorities' and staff's calculations.

Sensitivity Tests

29. Sensitivity stress tests assessed vulnerabilities of the banking system to key *domestic* shocks. These included: a tightening of domestic monetary conditions aimed at containing inflation pressures (a rise in domestic real interest rates); a loss of confidence in the monetary and financial system that triggers capital outflows and widens the gap between the parallel and official exchange rates (a nominal depreciation of the peso); a failure of a number of large corporate exposures (concentration); and a sharp decline in the prices of sovereign securities. Unlike macroeconomic stress tests, sensitivity tests were static: they assessed the instantaneous impact of different shocks on the banks' balance sheets and off-balance sheet positions as of September 2012. In all the sensitivity tests, banks' risk-weighted assets were assumed to stay constant after the application of the shocks.[17]

An Increase in Real Interest Rates Due to a Tightening of Domestic Monetary Conditions

30. A sensitivity test suggests that domestic shocks simulated by an increase in real interest rates could deteriorate the credit quality of loan portfolios. A tightening of domestic monetary conditions may be required to contain inflationary pressures or prevent capital outflows if exchange and capital controls become less effective over time. Sensitivity tests based on credit risk models, developed by the authorities and validated by Fund-staff, suggest that 5 of the 22 largest banks would be undercapitalized after a 900 basis point increase in real interest rates.[18]

31. This sensitivity result shows only the partial impact of changes in interest rates on credit quality and bank capitalization. This test assumes that banks earn no pre-impairment profits under stress; also, the increase in real interest rates is sustained for a period of two years and only affects banks' credit losses and loan loss ratios directly, with output assumed to stay constant.[19] By definition, it may be stringent as a measure of overall impact as banks are likely to continue earning positive pre-impairment profits that are not included in the analysis.

32. This test also ignores second-round effects through which a tightening of monetary conditions could be transmitted to banks. A monetary tightening could boost

[17] The methodology draws on the work of Li Lian Ong; Rodolfo Maino; and Nombulelo Duma (2010).

[18] The magnitude of the real interest rate shock is extreme but falls within the range of historical observations. For instance, the BADLAR interest rate increased from 11 percent to 20 percent in the period June-October 2011.

[19] We noted above that, in contrast to macroeconomic tests, sensitivity tests are "static." However, the credit risk model used to assess the effect of a rise in real interest rates, or a depreciation of the peso, on loan loss rates is dynamic and estimated based on annual data (Appendix II). This implies that the interest rate or depreciation effects are fully transmitted to loan loss rates only after two years. These tests are still considered "static" because banks' balance sheets, and other variables such as foreign currency forward or future positions, do not adjust and are taken as observed in September 2012.

confidence by lowering inflation expectations; it could also help contain deposit or capital outflows. Although starting from an initial situation of double digit inflation, a monetary tightening could be either expansionary—if sufficiently credible, persistent, and supported by a broader policy program—or contractionary in the short-run. In the latter case, it could exacerbate credit losses in the banking system.

Nominal Peso Depreciation Triggered by a Loss of Confidence

33. A sensitivity test assessed how losses from credit risk would spike in a scenario with a depreciation-inflation spiral. Assuming that real interest rates remain constant, a 30 percent peso depreciation that is partially transmitted to domestic prices would increase inflation by 6 percentage points—under a 0.2 pass-through assumption.[20] NPL ratios would increase by about ½ percentage point on average, with variation across banks. If banks earned no pre-impairment profits, the capitalization of five banks could fall below the required minimum. As in the case of the interest rate sensitivity test, this result shows only the partial impact of a depreciation of the peso on credit quality and bank capitalization. It is therefore limited in scope and subject to caveats, including the fact that banks are assumed to earn no pre-impairment profits under stress and output is assumed to remain constant.

34. A separate sensitivity test assessed how banks would obtain gains from market risk in a scenario with a depreciation-inflation spiral. Setting the effect of a peso depreciation on credit losses aside, separate sensitivity tests were undertaken to assess how profits would rise as a result of banks' net open foreign currency exposures—which include banks' net positions in foreign currency forwards and futures. These tests indicate that a 30 percent depreciation of the peso against the U.S. dollar would increase the capital adequacy ratio (CAR) in the system by 1.4 percentage points, from 11.7 percent to 13.1 percent. Although the sizes of the effects vary across-banks, only one bank would suffer a loss and 21 of the 22 banks would obtain benefits ranging from 0.4 to 5.2 percentage points of CAR.

35. These sensitivity tests ignore second-round effects of a scenario with a depreciation-inflation spiral. There is a risk that a sustained and sizable depreciation of the peso could cause a spike in the rate of inflation. Higher inflation could lead to a significant reduction in real money demand, and a (real) credit contraction. The latter would have adverse effects on output and exacerbate credit losses.

[20] There is a high degree of uncertainty regarding the value of the exchange rate pass-through, particularly under current macroeconomic conditions, which are characterized by persistent and high (double-digit) inflation rates.

A Failure of a Number of Large Corporate Exposures

36. Sensitivity tests of concentration also pointed to the predominance of credit risk from common name concentrations. The failure of the five largest borrowers—admittedly a low probability event—would cause undercapitalization in 8 of the 22 banks subjected to the tests. A more stringent test shows that failure of the 10 largest counterparts would result in undercapitalization of 12 banks. Moreover, a number of firms are large counterparts of many banks simultaneously, compounding systemic risk. Note that as some of these firms operate in the agro-industrial sector, a decline in commodity prices could be a possible trigger for the materialization of common name concentration risk.

A Decline in the Prices of Sovereign Securities

37. Banks hold positions in highly liquid bonds and money market instruments issued by the central bank and the government. "Sovereign exposures" were defined broadly to include securities issued by the government (treasury) as well as those issued by the BCRA. Banks hold money market instruments issued by the BCRA with maturities of up to 270 days (LEBACs): these (zero-coupon) instruments are nominal and denominated in pesos. Banks also hold longer-term coupon bonds with maturities of up to three years (NOBACs). Principal and coupons on these bonds are either fixed or floating-rate (linked to the deposit rate BADLAR). Finally, banks also hold bonds issued by the government, denominated in both pesos and U.S. dollars.

38. Sensitivity tests assessed the impact of increases in sovereign yields by type of instrument on exposures in both the banking and trading books. Losses on sovereign exposures were measured through changes in yields leading to a re-pricing of securities using a modified duration (cash-flow) approach. Specifically, one-year changes in yields were calculated based on daily series corresponding to the period 2007–12, and then the 50th and 90th percentiles values of the distributions were determined for each type of instrument. The simulated yield changes were of similar magnitude to those applied in the V-shaped adverse macroeconomic scenario. Average yields increased by about 1,500 basis points for U.S. dollar denominated bonds; 2,000 basis points for peso denominated bonds adjusted by inflation; and about 2,800 basis points for bonds linked to the BADLAR interest rate. Yield changes of peso-denominated nominal instruments—including fixed coupon bonds and discount money market instruments—were about 450 basis points.

39. The results suggest that banks are mildly vulnerable to sovereign risk. Once changes in yields are determined, the corresponding haircuts are then calculated based on the observed duration of the bank portfolios. Note that in the exercise, haircuts were applied to adjusted (marked-to-market) balance sheet values—previous losses or gains defined in terms of economic valuation were recognized before the application of the haircuts under stress. The test results indicate that the increase in sovereign yields, combined with the short duration of the banks' portfolios, lower the CAR in the system by 1.3 percentage points, from 11.7 percent to 10.4 percent, with the impact across banks varying from 0.1 to 3.2 percentage points of CAR.

B. Liquidity Stress Tests

40. Liquidity stress tests based on a maturity ladder analysis were undertaken to assess the capacity of banks to withstand severe funding pressures. The liquidity stress tests were implemented using a TD approach, using information on maturity structures of assets and liabilities that was collected from banks specifically for this purpose. The exercise captured (i) a bank's liquidity needs derived from outflows, (ii) its available standby liquidity from inflows, and (iii) its liquidity buffers available to counterbalance liquidity gaps. The sensitivity analysis also included a reverse liquidity stress test that assessed the capacity of banks to withstand maximum withdrawal of wholesale deposits. Finally, a TD liquidity test linked to the macroeconomic scenarios based on the authorities' baseline was also conducted. Note that common practice in FSAPs is to implement the liquidity tests assuming an underlying environment in which funding pressures are sizable but limited to a number of banks (not systemic).[21]

41. Banks' funding consists mainly of deposits from individuals, SMEs, and large corporations, and funding provided by institutional investors. Cash outflows are generated by the need to pay contracted and contingent liabilities under specific assumptions regarding the capacity of banks to re-issue liabilities in adverse conditions. The funding structure of the banking system (excluding own capital), can be described as follows:

- 65 percent is non-collateralized funding provided by legal entities: non-financial public sector (FGS included) (27 percent); SMEs (17 percent); large enterprises (17 percent);[22] other institutions regulated by the BCRA (0.4 percent); unregulated institutions with financial activities (3.2 percent); and others (0.4 percent);
- 32 percent is funding due with individual depositors (physical persons); and
- the remaining 3 percent of the funding sources includes own issuances; secured funding; liabilities related to derivatives transactions and committed credit lines; and other liabilities.

42. The liquidity tests assessed the capacity of banks to confront large and sudden withdrawals of funding. Funding pressures were captured through specific time profiles of run-off rates for different funding sources. The general principle guiding the choice of run-off rates was the following: more informed and sophisticated depositors withdraw funding

[21] The underlying environment in which a bank's resilience to liquidity shocks is tested should affect the calibration of deposit run-off rates and asset haircuts. Under generalized banking panics—bank runs affecting many banks, including systemically important ones—the scramble for liquidity usually results in fire sales of assets, and hence, larger haircuts. Similarly, run-off rates on deposits should be higher when a panic sets in and triggers widespread bank runs.

[22] Following Argentine laws, SMEs were differentiated from large ones according to a total revenue criterion: enterprises with less than 10 million pesos in annual revenue, or its equivalent in foreign currency, were considered SMEs.

more rapidly than less informed depositors. This guiding principle is consistent with historical experience and empirical studies of depositor behavior (Appendix IV).

- *Sight deposits.* The withdrawals of sight deposits held by large enterprises amounted to 15 percent of the initial balance in the first day, and increased up to 25 percent within one month. Withdrawals of sight deposits corresponding to SMEs and individuals amounted to 7.5 percent of the initial outstanding balance in the first day and increased to 10 percent within a two month horizon.[23]

- *Time and other deposits.* For a given time period, the run-off rates on deposits are defined as the fraction of the deposits that mature in that period that are withdrawn by the depositors. In the tests, these rates were constant at 40 percent for deposits held by large corporations. They were assumed to gradually increase from 15 to 25 percent for deposits held by SMEs and from 10 to 25 percent for deposits held individuals.

- *Nonfinancial public sector.* A 20 percent run-off rate, constant across different maturities, was imposed on funding sources related to the non-financial public sector.

- *Others.* The assumed run-off rates were 60 percent on own issuances, 100 percent on secured funding, and 10-40 percent on committed credit lines.

43. Deposit run-off rates were calibrated based on Argentina's historical experience. For international standards, the liquidity stress tests assumed high run-off rates on deposits—a fast pace of deposit withdrawals. Argentina's experiences with banking panics during the convertibility period allow an informed calibration of the exercise.[24] Specifically, run-off rates on individual banks were calibrated to be higher than those experienced by a typical bank during the crises of 1995 and 2001. These are very high for a number of reasons:

- Systemic (generalized) banking panics occurred in the 1995 and 2001 crises. In such conditions, deposit run-off rates tend to be higher, and asset haircuts tend to be lower than when liquidity shortages are limited to individual banks.

- During the convertibility period, the BCRA had limited powers to act as a lender of last resort in pesos or in U.S. dollars. This could have exacerbated depositors' jitters, leading to high run-off rates. Such run-off rates, however, are less likely to materialize under current institutional arrangements—whereby the BCRA is free to act as lender of last resort and the degree of dollarization in the system is low.

[23] Note that due to the instantaneous maturity of sight deposits, run-off rates on these deposits are defined as the fractions of initial outstanding balances that are withdrawn in a given period of time.

[24] References on depositor behavior and market discipline in Argentina include: Barajas and others (2007); Martínez Pería and Schmukler (2001); Schumacher (2000); and Catalán and Barajas (2012).

44. Banks standby liquidity inflows stem mostly from maturing loans and debt securities. Assets that can generate cash proceeds over time include: maturing loans (76 percent), debt securities (19 percent), reverse repos (4 percent), and others (1 percent). For different assets and maturity buckets, specific run-off rates were applied to convert the maturing amounts into cash proceeds. Specifically, 50 percent rates were applied to maturing loans to households and enterprises; 100 percent rates were applied to maturing loans to financial institutions and cash flows from debt securities and reverse repos. These represent the cash inflows that a bank can generate under the going concern assumption: its actions do not compromise banking relations with important borrowers, and cause no business disruptions or premature liquidation of debt instruments in the market or with the BCRA.

45. Banks can counterbalance negative funding gaps by using their cash holdings, by liquidating assets in the market, or drawing assistance from the BCRA. If needed, the BCRA could assist banks that face liquidity shortfalls by waiving reserve requirements for a maximum period of 30 days or by injecting liquidity through its standing facilities. Banks were assumed to pay a price, however, if reliance on BCRA emergency liquidity assistance was needed, as market haircuts were assumed to be lower than BCRA haircuts.

46. Liquidity stress tests reveal that banks would be able to confront large deposit withdrawals. The results revealed that all banks would be able to confront persistent and sizable withdrawals of funding for 30 days without any assistance from the BCRA. After 30 days, only two of the 22 largest banks would need BCRA assistance in pesos and 1 in dollars, and in these cases, an extension of the reserve requirement waiver would suffice to render them liquid. Besides access to own minimum required reserves, no bank would need emergency liquidity assistance from the BCRA for two years. The BCRA has initiated a pilot program to develop a framework for calculating the liquidity coverage ratio (LCR) and the net stable funding ration (NFSR) for all banks, and the three banks tested so far show ratios above 100 percent for both indicators.

Table 4. Argentina: Bank Liquidity Test Results

Survival Period for Pesos Liquidity	Up to one day	Greater than one day and up to one week	Greater than one week and up to one month	Greater than one month and up to two months	Greater than two months and up to three months	Greater than three months and up to six months	Greater than six months and up to one year	Greater than one year and up to two years
Number of banks meeting contractual obligations without BCRA support	22	22	22	20	20	20	20	20
Number of banks meeting contractual obligations with BCRA support	22	22	22	22	22	22	22	22

Note: Results for pesos liquidity stress tests. It is assumed that the BCRA waives compliance with the minimum reserve requirement for up to one month. The results show that two banks need liquidity support to comply with the fully enforced minimum reserve requirement after one month. These two banks, however, would need no other liquidity assistance if the BCRA were to waive the minimum reserve requirement for a period

47. A reverse liquidity stress test also assessed the capacity of banks to withstand maximum wholesale deposit withdrawals. The test assumed that banks faced 100 percent run-off rates on maturing wholesale deposits and full rollover rates in other funding lines.[25] The results show that all banks have liquidity to deal with losses of 33 percent or more of total wholesale deposits, without recurring to BCRA facilities. Moreover, 15 of the 22 largest banks would be able to confront withdrawals of 100 percent of maturing wholesale deposits without experiencing a shortfall of liquid assets at anytime in the two-year assessment period.

C. Contagion Stress Tests and Interconnectedness with Nonbanks

48. Direct contagion risk through bilateral interbank exposures is limited. The framework proposed for contagion analysis was similar to that presented in Cihak (2007).[26] However, interbank exposures in Argentina are very small compared to banks' capitalization, and hence, the final analysis stands out for its simplicity. The analysis shows that as of September 2012, only one of the 22 largest banks had a total interbank exposure that was larger than its excess of capital over the required minimum—and in this case, five other institutions would have to fail for that bank's capital to fall below the required minimum.

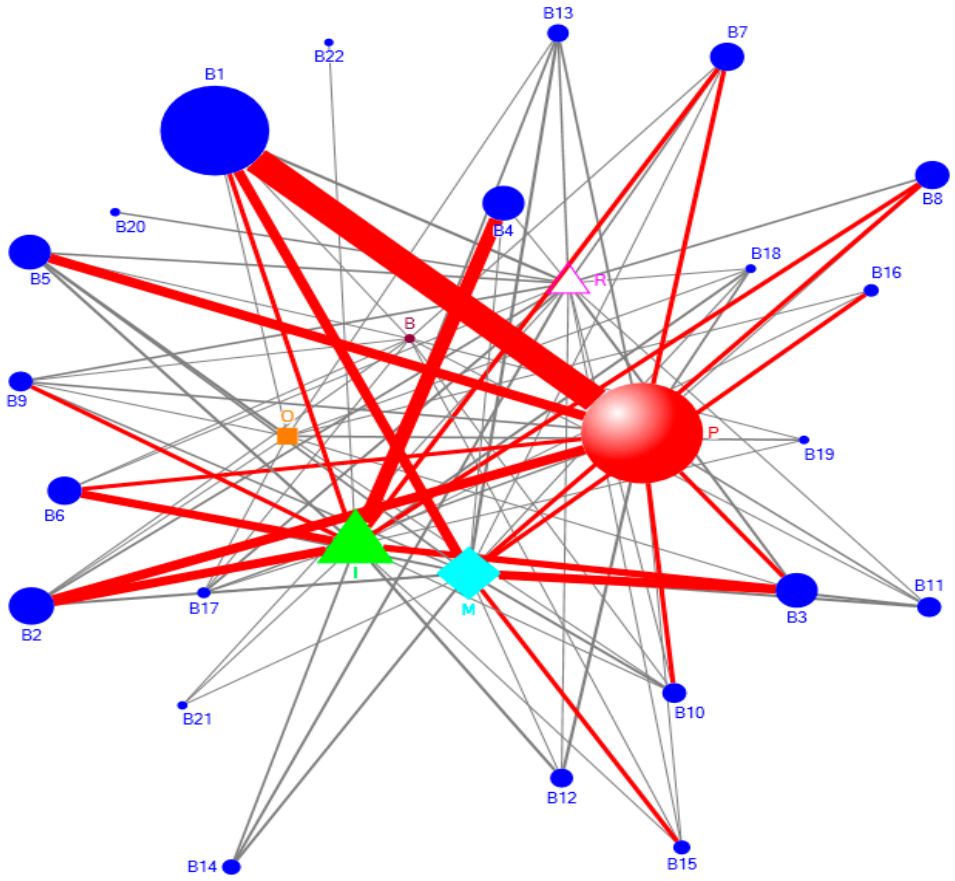
49. However, the banking system is interconnected with the FGS, which has the potential to create unexpected liquidity pressures.[27] It has 6 percent of its portfolio invested in fixed-term deposits, for very short term (on average 35–40 days) and for some banks, FGS deposits represent more than 4 percent of total deposits. The allocation mechanism for such deposits does not seem to be driven by transparent criteria as most of them as of September 2012 were invested below market prices (in the largest public bank, or in a private bank where the FGS is a significant shareholder). The absence of clear criteria and the consequent risk of sudden withdrawal (even if not materialized so far) may generate liquidity pressures for the smaller banks. Additionally, the large equity stakes of the FGS in some private banks raises governance issues.

[25] Wholesale deposits include those held by enterprises (excluding SMEs—those with less than 10 million pesos in annual revenue).

[26] Cihak, Martin, 2007, "Introduction to Applied Stress Testing", available at http://www.imf.org/external/pubs/ft/wp/2007/wp0759.pdf.

[27] Deposits from insurance companies and mutual funds in banks are dispersed and exhibit low degree of concentration, and the cross-border exposures of banks abroad are not significant enough to merit a quantitative analysis.

Figure 8. Argentina: Network Map of the Banks and Nonbanks Interlinkages



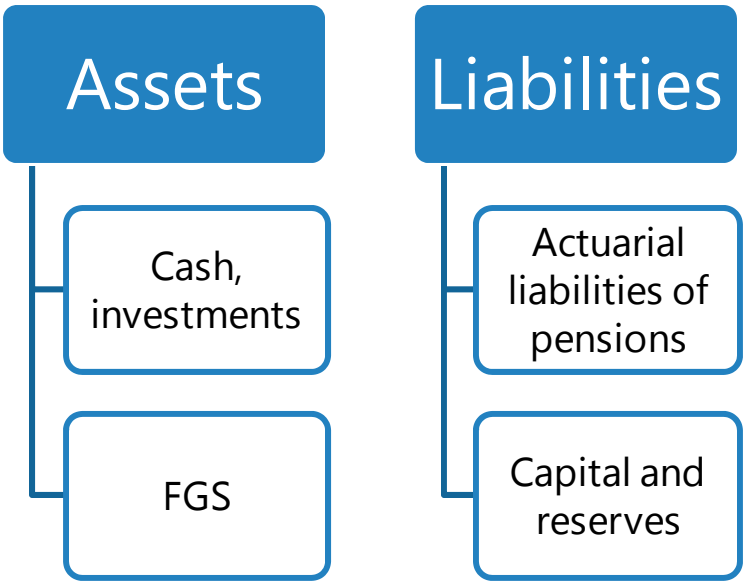
Source: Staff's calculations based on data from BCRA.

Note: Linkages (edges) are bilateral assets and liabilities. Top 20 largest connections are represented by red edges, all other connections by gray edges. Nodes: Blue circles represent banks (B1-B22), Red sphere represents ANSES including the FGS (P), Lime solid triangle represents insurance companies (I); Aqua solid diamond represents mutual funds (M); Fuchsia triangle represents retirement funds (R); Orange solid square represents other financial institutions (O); Brown disk represents brokerages (B).

THE SUSTAINABILITY GUARANTEE FUND

50. The FGS, which is a public entity under the control of the Social Security Administration (ANSES), is the main institutional investor in Argentina. It accounts for 20 percent of the financial system and about 11 percent of GDP. Created in 2007, it received in late 2008 the proceeds from the nationalization of the private pension funds. The FGS is currently the main provider of long-term financing through its support to productive and infrastructure projects. The pension system is now a public pay as you go scheme and contributions are paid to ANSES, which manages and owns the FGS. With the caveat that the ANSES balance sheet is not readily available, the graph below illustrates how the FGS contributes to ANSES's balance sheet as investment and capital.

Figure 9. Argentina: Simplified Balance Sheet of ANSES

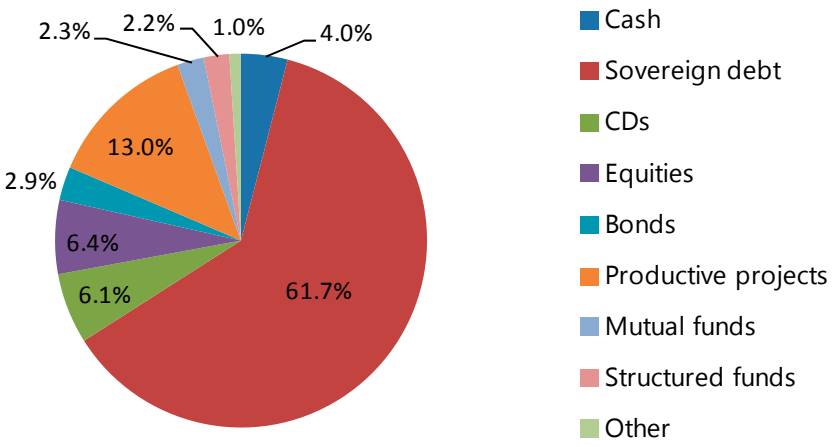


Source: Staff's elaboration based on interviews.

51. The portfolio of the FGS is subject to market risk. About four-fifths of the investment portfolio of the FGS is concentrated in fixed term instruments with a duration of five years on average. Simple estimates[28] of the market risk effects in the FGS portfolio, assuming all fixed term instruments were marked to market, shows that for every 100 bps increase in the interest rate, the economic value of its investment portfolio would decline by 3.4 percent. Moreover, while detailed information is not publically available, a fraction of this debt is probably bonds indexed to official inflation.

[28] The methodology used here is based on the modified duration, assuming the current average level of BADLAR rate (15 percent) as the average yield. Modified duration is a price sensitivity measure, defined as the percentage change in price following a change in 100 bps in the yield.

Figure 10. Argentina: Breakdown of FGS Assets



Source: FGS.

52. Lending activities may create credit risk. The FGS has begun to try to extend credit, and since it falls outside the regulatory perimeter of the BCRA and loans are not registered in the credit registry, this could be a source of risk.

53. The FGS is interconnected with the banking system via the holding of fixed-term deposits, cash in banks, and ownership of banks. Over 6 percent of the portfolio is invested in fixed-term deposits, the majority in public banks, following a gradual withdrawal from private banks and a move to shorted maturity (on average 45 days). However, some private banks still have a material share of their deposits invested by the FGS. The cash is shared between three banks, which are the custodian banks. So far the FGS has mostly rolled-over its fixed-term deposits, however the lack of clarity on the allocation criteria may create unexpected pressures on banks. The FGS owns 31 percent of the third largest private bank in Argentina with about 6 percent of deposit market share and has stakes in 4 other private banks.

INSURANCE COMPANIES

54. Overall the insurance sector shows signs of financial vulnerabilities. Profitability in the industry has improved, as the nominal return on equity (ROE) has risen from 8 percent in 2006 to 22 percent in 2012. However, the nominal ROE in 2012 is still below many indicators of inflation, such as wage growth, although it is still somewhat above the rate of increase in the GDP deflator. The nominal ROE is supported by returns on investment, and not underwriting income, where many insurers are experiencing losses. Going forward, it would be important to boost income from underwriting to provide a more sustainable source of overall profitability. Under the current solvency regime, 4 companies have solvency ratios below 100 percent and 57 have ratios below 125 percent. For the industry as a whole the actual solvency margin has amounted to 175 percent of the

minimum solvency margin for the past several years. However, the assets that bear significant credit risk, like unpaid premia and other receivables as reported in 2012, amount to 100 percent of the free capital available to the sector (ARG$18.34 billion). This situation implies that a large percentage of the available capital for solvency is illiquid and not fully suitable to protect the companies in case of adverse events.

Table 5. Argentina: Trends in Asset Mix of Insurance Companies, 2009–12

	Non-life				Life			
	2009	2010	2011	2012	2009	2010	2011	2012
Domestic								
Public bonds and notes	22.0	26.4	26.4	21.7	48.2	54.2	54.2	52.1
Cash and other deposits	6.8	6.6	6.0	5.7	5.3	7.0	6.1	9.6
Investment trusts and funds	5.1	5.8	8.2	13.9	9.1	8.4	10.9	15.4
Commercial fixed interest	17.9	14.1	14.4	21.7	14.7	7.6	6.6	13.1
Secured loans	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2
Real estate	2.0	1.6	1.3	1.2	1.3	1.2	0.9	0.8
Other investments	0.8	0.9	1.0	1.0	0.2	0.1	0.1	0.6
Foreign investments	10.8	9.1	8.0	0.5	16.8	17.6	16.2	3.5
Outstanding premiums	21.3	21.6	21.4	20.7	0.7	0.8	0.9	1.2
Reinsurance recoverables	1.3	1.3	1.1	1.5	0.1	0.0	0.0	0.0
Other creditors	7.4	8.0	7.9	8.1	2.8	2.2	3.1	3.1
Operating assets	4.4	4.3	4.0	3.8	0.8	0.7	0.6	0.5
Total	100	100	100	100	100	100	100	100

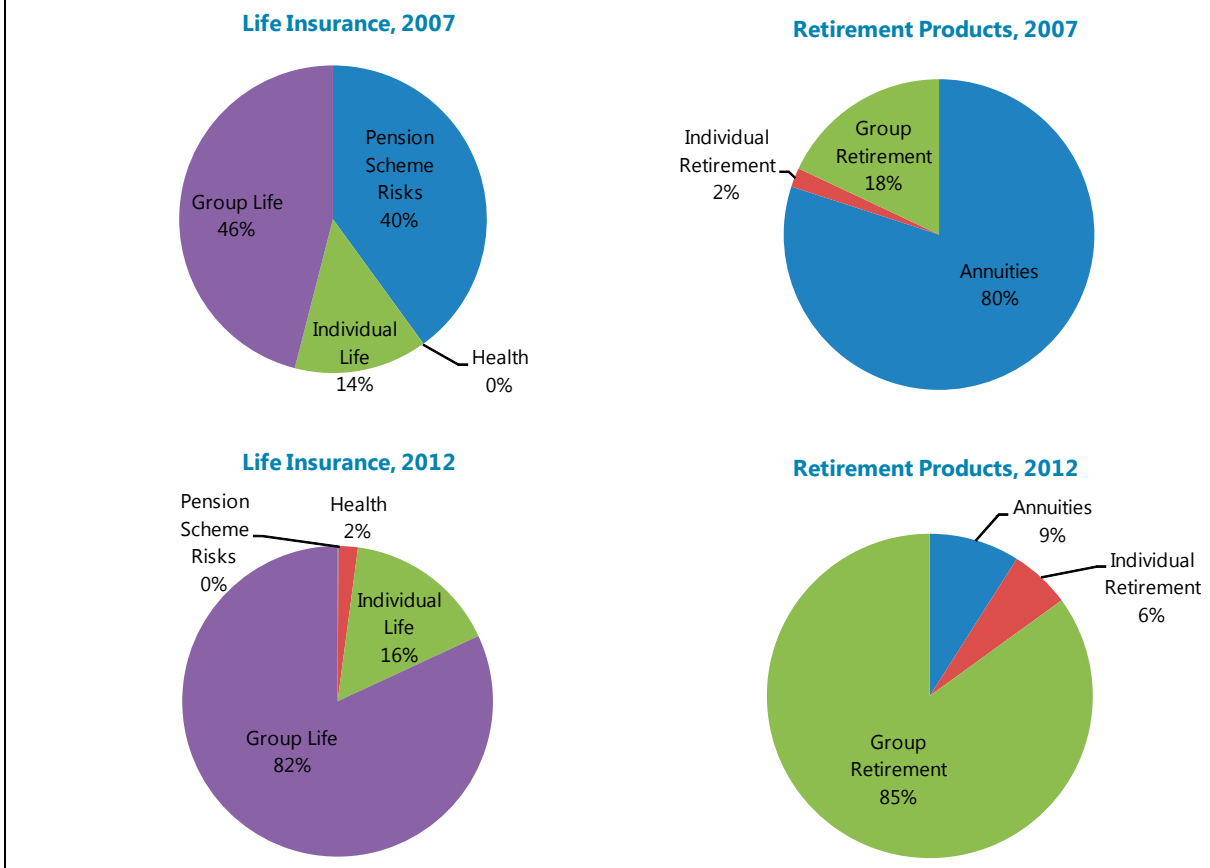
Source: SSN.

55. The non-life sector is on a weaker financial footing than the life or retirement sectors, with vulnerabilities to credit and liquidity risks. Profitability tends to be lowest in the nonlife sector, with considerable variability across firms. Among the 20 largest non-life insurance firms, 7 had ROEs in excess of 25 percent in 2012, while 9 had ROEs below 15 percent. The relatively low ROE for this sector reflects the poor underwriting results, as claims paid plus expenses have exceeded premium income for the past several years. Since profits on substantial investment returns are not sustainable, the industry would need to apply technical premiums and become more efficient. In addition, the balance sheets of non-life insurers report that accounts receivable are quite high, especially with outstanding premia equivalent to about one-fifth of total assets and one-third of the total annual nonlife premia (Table 5). New regulation that disallows more than two months of unpaid premia to be admissible as assets would reduce credit risk. For the 20 largest nonlife insurers in 2012, liquid assets amounted to 106 percent of claims paid on average, although 6 of these firms had liquid assets that fell below 75 percent of claims paid. In addition, there are a high number of court claims, which could suggest dissatisfaction with claim settlements and could possibly indicate liquidity strains.

56. The life insurance sector has been declining since 2001 and now accounts for less than 30 percent of the whole insurance sector. Moreover, life insurance now relies mostly on annual renewal of group life insurance, which means that its liabilities now have a much shorter duration than in the past. In this context, the recent introduction of the mandatory investments of up to 30 percent of assets in economic projects and infrastructure could lengthen the duration of assets,

possibly accentuating a maturity mismatch on the balance sheets of the life insurers. In this regard, it would be important to adapt the new investment guidelines that apply to insurance companies. It would be preferable to lift these guidelines, but at a minimum they should be tailored to allow a firm to avoid significant maturity mismatches between its assets and liabilities.

Figure 11. Argentina: Product Shares by Class of Insurance, Life Insurance, and Retirement
(Percent of Gross Premium)



Source: SSN.

57. Contagion risk from the insurance sector to the banks is limited. Banks are exposed to the insurance sector through deposits and some bonds held as assets of insurance companies, and these amounts have very limited significance for the funding of the banking sector. Only two banks hold equity in insurance company subsidiaries.

Appendix I. Argentina: Methodology for the Construction of Macroeconomic Scenarios

The tests based on the authorities' baseline, and those based on the Fund-staff baseline, were implemented using different methodologies and assumptions.[29]

Macroeconomic scenarios based on the authorities' baseline

Step 1. Projection of key macroeconomic variables using models and expert judgement. The macroeconomic scenarios are constructed using both macroeconomic models and expert judgment. The BCRA uses a VAR model and a small dynamic macroeconomic model in the New Keynesian tradition to project the paths of key macroeconomic variables: real GDP, a short-term interest rate (overdraft lending rate, in pesos), the inflation rate (based on the GDP deflator), and the nominal exchange rate.[30] These variables are projected taking as given the foreseen paths of the sovereign spread and exogenous external variables—including the terms of trade and an international interest rate (the U.S. Federal Funds rate).

Step 2. Projection of a broader set of interest rates. The future paths of key deposit rates are projected based on regression models of the form:

$$\text{Spread}\,(i_t^{\text{30-60 day time deposits, pesos}} - i_t^{\text{overdraft, pesos}}) = f(\text{macro variables}),$$
$$\text{Spread}\,(i_t^{\text{BADLAR private banks, pesos}} - i_t^{\text{overdraft, pesos}}) = f(\text{macro variables}).$$

Note that these models take as input the macroeconomic projections obtained in step 1. The other main lending interest rates (consumer loans, mortgages) are then projected using regressions of these interest rates on the rate corresponding to 30–60 day time deposits. A similar approach is used to project interest rates for transactions denominated in U.S. dollars.

Step 3. Projection of aggregate money demand (M2). As part of the standard approach to financial programming, the demand for real money balances is estimated using econometric models: real M2 aggregates that include dollar denominated deposits are regressed on interest rates. The estimated coefficients are used to project real M2, using as inputs real GDP and the nominal interest rates obtained in steps 1 and 2 above.

[29] The methodology developed by the BCRA to conduct their stress tests is described in "BCRA, Informe al Directorio 736/45/13."

[30] The open economy model incorporates four standard dynamic equations—a Phillips curve; an IS curve; an uncovered interest parity condition; and a Taylor rule—and is estimated using Bayesian techniques. Variants of the model can accommodate different types of monetary and exchange rate regimes (pure fixed, pure floating, dirty floating). The model and its estimation are described in Elosegui P., Escudé G., Garegnani L., and J. Sotes (2007), "Un Modelo Económico Pequeño para Argentina", Estudios BCRA, No. 3, February. Available in: http://www.bcra.gov.ar/pdfs/investigaciones/modeloeconomico.pdf. In addition to this model, the BCRA also uses VAR methodology, described in Gutierrez Girault, M. (2008), "Modelling Extreme but Plausible Losses for Credit Risk. A Stress Testing Framework for the Argentine Financial System", BCRA, June.

Step 4. Projection of elements of the monetary survey, including aggregate credit and deposits. Future paths of credit and deposit aggregates (in both pesos and U.S. dollars) are projected through the application of standard financial programming techniques. The balance-sheet identity for the consolidated banking system (including the BCRA and depository institutions) is given by: $M2 = C + D = NFA + DC + OIN$ where C=currency in circulation; D=demand and time deposits; NFA=Net Foreign Assets; DC=Domestic Credit; OIN=Other items net. Note that in order to project domestic credit (DC) and deposits (D), assumptions must be made regarding the evolution of international reserves (NFA), other items net (OIN) and the ratio of currency-in-circulation to deposits.

The sized of the BCRA balance sheet (the monetary base) is projected imposing assumptions on the evolution of the money multiplier. The imposition of further assumptions regarding accumulation of net foreign assets by individual banks and the BCRA allow disentangling balance sheet projections for the BCRA and (consolidated) depository institutions—NFA projections must be consistent with the financial programming of the external sector. Finally, domestic credit by the BCRA and individual institutions can be channeled to the public or private sectors. These projections are guided by expert judgment; however, they need to be consistent with the financial programming of the fiscal sector (deficit projections and treasury's debt issuance).

It must be stressed that this approach yields projections of deposit and credit aggregates of the consolidated banking system that will not necessarily grow at the same rate as nominal GDP. This is a key difference between the methodologies used under the authorities' baseline and that used under the Fund-staff baseline.

Step 5. Projection of bank-specific deposits and credit. Before accounting for stress-related losses, balance sheets of individual banks are assumed to grow at the same rate as the aggregate balance sheet of the system. In other words, the relative size of each bank in the system —in terms of assets—is assumed to remain constant over time.

Macroeconomic scenarios based on the Fund-staff baseline[31]

Fund-staff analyzed the transmission of external shocks to the domestic economy using VAR analysis.

Data. All data series used are monthly and taken from the IMF's International Financial Statistics (IFS), Haver, and CEIC; when needed, these series are complemented with information posted in the BCRA' website. The series are sampled quarterly and average values are used in the case of financial market data (interest rates, exchange rate and VIX), which are available monthly. The sample period is 1993–2012 and the variables used in the estimations are: U.S. real GDP, Brazil real GDP, U.S. federal funds rate, U.S. VIX, Argentina's terms of trade (the price of exports index was also used in

[31] Prepared by Roberto Guimaraes-Filho (MCM).

robustness exercises), the benchmark short-term 30-day deposit interest rate, the nominal effective exchange rate, and Argentina's real GDP. The GDP and GDP deflator series are seasonally adjusted by X-12, and then, annualized log-growth rates are calculated.

Model. The economy evolves according to the following VAR model:

$$B_0 y_t = k + B_1 y_{t-1} + \ldots + B_p y_{t-p} + u_t$$

where y_t is the n x 1 data vector containing external economic growth (in Brazil and United States), U.S. VIX, U.S. interest rate, terms of trade growth, domestic inflation, domestic economic growth, domestic interest rate, and nominal effective exchange rate; k is a vector of constants, B_i is an n x n matrix of coefficients (i = 1, ..., p), and u_t is a white-noise vector of "structural" shocks, with diagonal variance-covariance matrix D.

The model can be rewritten as: $y_t = c + C_1 y_{t-1} + \ldots + C_p y_{t-p} + e_t$, where $e_t = B_0^{-1} u_t$ is also a white-noise vector process, with variance-covariance matrix given by $\Omega = B_0^{-1} D (B_0^{-1})'$. The identification of shocks amounts to imposing restrictions on the matrix B_0 that orthogonalize the reduced form errors, eliminating their contemporaneous correlation. A standard identification scheme is the recursive ordering (Cholesky) proposed by Sims (1980), which assumes that B0 has a lower triangular structure. This is equivalent to imposing a hierarchical ordering structure on the variables, with the most exogenous variable ordered first and the most endogenous ordered last.

Estimation. The reduced form model is estimated by least-squares (MLE) and the lag structure is determined according to the Bayesian information criteria. The standard errors for the impulse response functions are calculated according to Sims and Zha (1999). According to the lag selection criteria (multivariate BIC), generally one or two lags are sufficient to accommodate the dynamics present in the data.[32] In the case of the non-recursive model, the structural shocks are identified without imposing coefficient restrictions on the lagged structural parameters of the model; instead, the following contemporaneous restrictions are imposed:

- Trading partners' growth is exogenous with respect to all the variables in the system.
- Global risk aversion shocks respond to trading partners' growth shocks given that the latter includes U.S. GDP growth.

[32] Residual tests reveal mild forms of autocorrelation (but not of heteroskedasticity) that can be reduced by adding more lags (or dummies) to the baseline model. To preserve degrees of freedom, the 1-lag structure with one crisis dummy was preserved for the baseline results presented in this note.

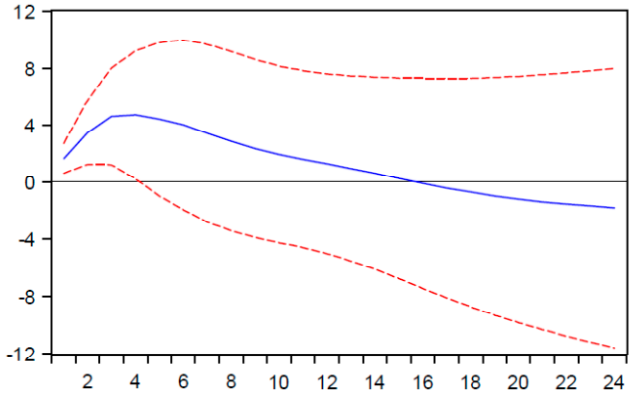
- U.S. interest rate responds to both U.S. GDP growth (as in the case of a modified Taylor rule) and global risk aversion.
- Domestic terms of trade shocks respond contemporaneously to trading partners' growth.
- Domestic inflation reacts contemporaneously to terms of trade and domestic activity (modified Phillips curve relationship).
- Domestic activity responds to trading partners' activity (through exports) and to global risk aversion (through investment). As generally assumed in this literature, the coefficient on inflation is assumed to be zero given the "stickiness" in production plans.
- Domestic interest rates reacts to global uncertainty, foreign interest rates, inflation (Fisher effect), and domestic activity (through a money demand relationship).
- The nominal effective exchange rate reacts contemporaneously to all variables in the system.

The above restrictions imply that the non-recursive structural model can be written as:

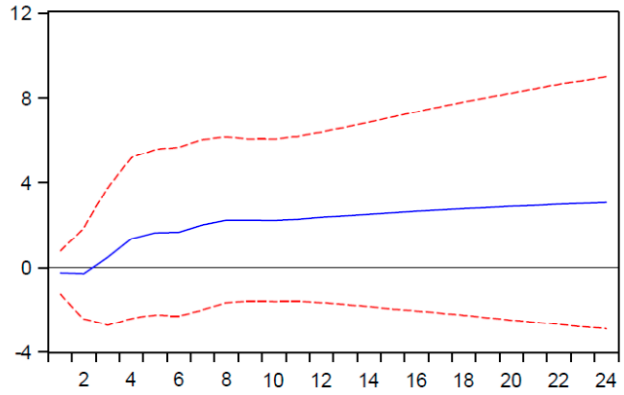
$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & a_{54} & 1 & a_{56} & 0 & 0 \\ a_{61} & a_{62} & 0 & a_{64} & 0 & 1 & 0 & 0 \\ 0 & a_{72} & a_{73} & 0 & a_{75} & a_{76} & 1 & 0 \\ a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & 1 \end{bmatrix} \begin{bmatrix} g_{y*,t} \\ \sigma_t \\ i_{*,t} \\ g_{tot,t} \\ \pi_t \\ g_{y,t} \\ i_t \\ g_{neer,t} \end{bmatrix} = B(L) \begin{bmatrix} g_{y*,t} \\ \sigma_t \\ i_{*,t} \\ g_{tot,t} \\ \pi_t \\ g_{y,t} \\ i_t \\ g_{neer,t} \end{bmatrix} + \begin{bmatrix} u_{gy*,t} \\ u_{\sigma,t} \\ u_{i*,t} \\ u_{gtot,t} \\ u_{\pi,t} \\ u_{gy,t} \\ u_{i,t} \\ u_{gneer,t} \end{bmatrix}$$

where , $B(L) = \sum_{i=1}^{p} B_i(L^i)$ and consistent to the notation above, ux,t is the vector of structural shocks. Note that shocks 1, …, 8 correspond to the variables in the data vector above. The over-identifying restrictions are generally not rejected at the 5 percent level in the case of the baseline VAR.

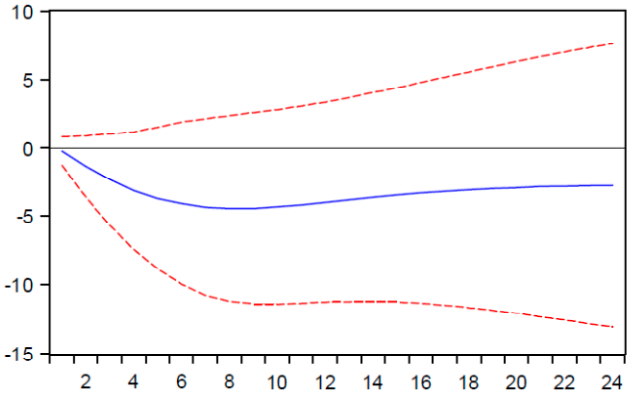
Accumulated Response of Real GDP to a Structural One Std. Deviation Shock in Trading Partners' Growth



Accumulated Response of Real GDP to a Structural One Std. Deviation Shock in Terms of Trade



Accumulated Response of Real GDP to a Structural One Std. Deviation Shock in Global Risk Aversion



In the macroeconomic scenarios based on the Fund-staff baseline, individual bank's balance sheets were assumed to stay constant as a share of nominal GDP (since nominal growth was not negative in any scenario). This "constant" balance sheet assumption implies the following:

Assets: the value (in pesos) of total assets, and the values of every sub-category of assets—including credit, fixed assets, cash holdings, bond holdings, etc.—grow at the same rate as nominal GDP. This implies that in nominal terms, the size of the balance sheet is scaled up, but the (relative) structure of assets remains unchanged compared to the previous period. Another implication of the constant-asset-structure assumption is that the value of risk-weighted assets (RWA) also grows at the same rate as nominal GDP.

Liabilities: capital is projected based on the outstanding capital available at the end of the previous period, and current period's profits net of dividends distributed and taxes paid: $\text{Capital}_{t+1} = \text{Capital}_t + \text{Profits}_{t+1} - \text{Dividends}_{t+1} - \text{Taxes}_{t+1}$. Note that when losses materialize, the term Profits has a negative sign. Also, current BCRA regulation on dividend distribution—whereby a bank can distribute dividends only when its CAR exceeds the minimum regulatory requirement by 75 percent—was assumed to remain in place during the stress testing period. For banks that were qualified to distribute dividends, the payout policy was assumed to be consistent with past behavior. Also, according to the formula, there was no injection of external capital during the period in any macroeconomic scenario.

The remaining liabilities were calculated as a residual—as the difference between the value of assets and capital. The (relative) structure of these liabilities—in terms of deposit types, bonds issued, and other categories of liabilities—was assumed to remain invariant compared to the previous period.

Note an implication of the "constant" balance sheet assumption: banks that exhibit larger declines in capital have larger gains in deposits and other liabilities. This is counterintuitive and counterfactual. However, the "constant" balance sheet assumption is convenient to avoid another well-known difficulty in stress testing. If the balance sheet of a bank declines sharply (proportionally more than GDP) in an adverse scenario, there are two implications: first, higher loan loss rates and haircuts are applied to a smaller asset base, and as a result losses could decline rather than increase (as expected under adverse conditions); second, the value of risk-weighted assets (denominator of the CAR) declines sharply, and hence, the CAR could rise in adverse scenarios. Thus, the constant balance sheet assumption provides an common anchor for the stress tests that facilitate comparisons—it prevents the tests from being affected by optimistic projections of total assets- and credit-to-GDP.

Appendix II. Argentina: Satellite Models

Satellite Model for Net Interest Income

The BCRA uses bank-specific information on flow-of-funds and loan maturity, and its own projections of deposit and lending rates to project net interest income. First, a broad set of lending and deposit rates is projected using regression methods, as discussed above. Separate trajectories for all the relevant interest rates are obtained for the baseline and adverse macroeconomic scenarios. Second, for each bank, interest income and expenses are projected based on bank-specific balance sheet, flow-of-funds, and loan maturity data (available as of September 2012), imposing roll-over assumptions on loans and deposits, and using the interest rates' paths projected for the corresponding macroeconomic scenario.

Satellite Model for Credit Risk

Bank-specific loan loss rates were projected using dynamic panel models. The tests based on the Fund-staff baseline were implemented using the following satellite model for credit risk:

$$LLR_{i,t} = \mu_i + \alpha_1 \cdot LLR_{i,t-1} + \beta_1 \cdot \mathrm{g}_t + \beta_2 \cdot \left(\mathrm{g}_t\right)^2 + \gamma_1 \cdot \mathrm{rr}_t + \gamma_2 \cdot \pi_t + \delta_1 \cdot CR_{i,t-1} + \delta_2 \cdot \left(CR_{i,t-1}\right)^2 + \delta_3 \cdot \left(CR_{i,t-1}\right)^3 + \varepsilon_{i,t}^j \ ,$$

where the indexes i and t indicate, respectively, the banking institution and the time period. LLR denotes the logistic transformation of the loan loss rate: $LLR = \ln(\frac{\text{loan loss rate}}{1-\text{loan loss rate}})$.

g denotes real GDP growth; *rr* is the (ex-post) real interest rate defined as the difference between the (lagged) short-term nominal lending rate (corresponding to overdrafts or "adelantos") and contemporaneous inflation measured by the GDP deflator; π denotes the rate of growth of the GDP deflator; *CR* is the bank-specific and time varying capital-assets ratio; μ_i denotes bank specific fixed effects.

The model was estimated based on an unbalanced panel dataset including 193 banking institutions and the annual observations for the period 1994–2011. The dynamic panel model was estimated with a two-step Arellano-Bond approach, and the results were robust to changes in this period. The estimated coefficients (except for the bank-specific fixed effects) are presented in the following table:

Dependent variable: loan loss rate (logistic transformation)

Explanatory variable	Coefficient
Loan loss rate (lagged)	0.19
Real GDP growth	-9.77
Real GDP growth squared	73.70
Capital to assets ratio (lagged)	-2.89
Capital to assets ratio squared (lagged)	2.25
Capital to assets ratio cubic (lagged)	-0.53
Real interest rate: nominal lending rate (peso loans, short term) (lagged) - growth of GDP deflator	1.52
Growth of GDP deflactor	1.86

Wald chi2(8) = 574.50 Prob > chi2 = 0.0000

Arellano-Bond test for zero autocorrelation in first-differenced errors

Order	z	Prob > z
1	-5.0859	0.0000
2	.89139	0.3727

H0: no autocorrelation

Note that the model is non-linear in real GDP growth: the loan loss rate increases at an accelerated rate as real GDP growth declines further. Also, the effects of changes in the real interest rate and inflation are captured in separate terms to facilitate the implementation of sensitivity tests—e.g., exchange rate depreciation with a pass-through effect on inflation, but no effect on the real interest rate. The only bank-specific and time varying variable included is the capital-to-assets ratio: a higher value of the ratio reduces moral hazard, limiting banks' incentives to take excessive credit risk.

The estimated model appears quite robust to variations in sample period and real interest rate measures. Regarding the choice of the sample period, the parameters of the model were estimated with data through 2008 and 2012, and no significant differences in results were found. However, enhancements of the model in future stress testing exercises are feasible. These could involve the use of quarterly data (instead of annual data) and, given a richer data environment, the inclusion of additional bank-specific and time varying explanatory variables.

In the estimated model, the sensitivity of the loan loss rate to changes in output can be illustrated with a numerical example that suggests that loss rates could rise significantly under an adverse scenario. Assuming an intercept equal to the average value of the fixed effect (-3.1); a constant real interest rate (rr=0.03); a constant capital-asset ratio (CR=0.09), and an initial loss rate of 1.7 percent (similar to the one corresponding to private banks in 2012); the paths of the loss rates consistent with real GDP growth rates corresponding to the baseline and adverse macroeconomic scenarios would be the following.

	Baseline (WEO)	
	GDP Growth Rate	Loan Loss Rate
Year 0		0.017
Year 1	0.028	0.017
Year 2	0.035	0.017

	Adverse (U)	
	GDP Growth Rate	Loan Loss Rate
Year 0		0.017
Year 1	-0.038	0.034
Year 2	-0.031	0.035

	Adverse (V)	
	GDP Growth Rate	Loan Loss Rate
Year 0		0.017
Year 1	-0.07	0.059
Year 2	0.00	0.027

The tests based on the authorities' baseline were implemented using the following model:

$$LLR_{i,t} = \mu_i + \alpha_1 \cdot LLR_{i,t-1} + \beta_1 \cdot g_t + \beta_2 \cdot \left(g_t\right)^2 + \beta_2 \cdot \left(g_t\right)^3 + \gamma_1 \cdot i_{t-1} + \delta_1 \cdot CR_{i,t-1} + \delta_2 \cdot \left(CR_{i,t-1}\right)^2 + \delta_3 \cdot \left(CR_{i,t-1}\right)^3 + \lambda_1 \cdot spread_{i,t-1} + \varepsilon_{i,t}^j \ ,$$

where i is the nominal market interest rate corresponding to overdraft loans in domestic currency observed at the end of the previous period; and spreadi is the difference between bank i's average nominal lending rate corresponding to all the credit lines and the corresponding lending rate for the whole system. The estimated coefficients are presented in the following table:[33]

Dependent variable: loan loss rate (logistic transformation)

Explanatory variable	Coefficient
Loan loss rate (lagged)	0.29
Real GDP growth	-6.57
Real GDP growth squared	60.94
Real GDP growth cubic	-472.73
Nominal interest rate (lagged)	1.13
Capital to assets ratio (lagged)	-2.08
Capital to assets ratio squared (lagged)	2.17
Capital to assets ratio cubic (lagged)	-0.51
Spread (lagged)	1.21

Satellite Model for Net Fee and Service Income

The tests based on the Fund-staff baseline were implemented using the following model:

$$NSIA_{i,t} = \alpha + \beta \cdot NSIA_{i,t-1} + \varepsilon_{i,t},$$

[33] The regression presented in the Table was run with ordinary-least-squares (OLS).

where *i* and *t* denote, respectively, the bank and the annual period. NSIA is the net fee and service income-to-assets ratio—the component of return on assets (ROA) accounted for by net fee and service income. The model was estimated for each bank using annual data for the period 1994-2012. Taking as given the limitations imposed by the use of annual data, analysis was conducted to assess whether an additional right-hand side term, including variables such as unemployment, real GDP growth, or nominal GDP growth, would fit into the model. IMF and BCRA staff concluded in favor of using a simple autoregressive model of order 1.

This approach is satisfactory for the task at hand. However, it has a number of limitations that could be bypassed in future stress testing exercises by using higher frequency data. The use of quarterly data would allow the conduct of more powerful stationarity tests and a re-assessment of the model's specification—possibly to include real GDP growth as a significant control variable or higher order autoregressive terms; or to specify the model as an ARMA process. In the future, it is recommended to explore a more general model of the form $NSIA_{i,t} = \alpha + \beta \cdot NSIA_{i,t-1} + \gamma \cdot X_{i,t} + \varepsilon_{i,t}$, where *X* is a vector of both macroeconomic variables (e.g., unemployment rate or real GDP growth) and bank-specific time-varying control variables.

In the tests based on the authorities' baseline, net fee and service income was projected using the following model:

$$NSI_t = C + \alpha_1 NSI_{t-1} + \alpha_2 NSI_{t-4} + \alpha_3 UNEMP_{t-2} + \alpha_4 (DEFLATOR_t - DEFLATOR_{t-1}) + \alpha_5 UNEMP_{t-2} * D0201_t$$

where t denotes a quarterly period; *C* is a constant term; *NSI* denotes net service income in nominal terms; *UNEMP* is the unemployed population; *DEFLATOR* denotes the GDP deflator*; D0201*: is a dummy variable that takes the value 1 in the period 2001-Q1 to 2002-Q2, and 0 otherwise. The model was estimated based on data for the period 2003-Q1 to 2011-Q4, and the estimated values of the coefficients are the following:

Dependent variable: NSIt

Expanatory variable	Coefficient
C	171.8
NSI_{t-1}	0.761
NSI_{t-4}	0.327
$UNEMP_{t-2}$	-0.147
$DEFLATOR_t - DEFLATOR_{t-1}$	4.001
$UNEMP_{t-2} * D0201_t$	0.000

This latter model exhibits a number of limitations when compared to the model used for the tests based on the Fund-staff baseline (presented above). These limitations include: the non-stationarity of the series and the likely spurious nature of the regression; and loss of precision due to the use of aggregate data instead of bank specific data.

Satellite Model for Operating and Administrative Expenses

In the tests based on the Fund-staff baseline, the following model was used to project the operating and administrative expenses (AE) of each individual bank:

$$\left(\frac{AE}{NSI}\right)_{i,t} = \alpha + \beta \cdot \left(\frac{AE}{NSI}\right)_{i,t-1} + \gamma \cdot \text{Real GDP growth}_t + \varepsilon_{i,t}.$$

The model was estimated for each individual bank i using annual data for the period 1994-2012. Real GDP growth is included as an explanatory variable to capture the fact that a bank's wage payroll tends to be sticky while NSI is flexible and goes down during recessions. Thus, the ratio of operating and administrative expenses-to-net fee and service income tends to increase in adverse scenarios. Note that due to the importance of payroll expenses in banks' income statements, the exclusion of this effect would lead to underestimation of expenses and an over-estimation of bank profitability in the adverse scenarios—which would bias the stress test results, reducing the quality of the exercise.

This model, adopted by the BCRA, has a similar structure to that used in the UK (known as the RAMSI model). The RAMSI model includes Real GDP growth as a determinant based on its theoretical appeal: as a way to capture "cost stickiness." In the RAMSI model, however, the ratio of operating expenses is defined with gross fee income in the denominator.
Although satisfactory in its current state, some technical limitations of the model could be bypassed in future stress testing exercises by exploiting the availability of higher frequency data. The use of quarterly data would allow the conduct of more powerful stationarity tests and a re-assessment of the model's specification.

In the tests based on the authorities' baseline, the following model was used to project the nominal administrative expenses (AE) of the whole banking system:

$$AE_t = C + \alpha_1 AE_{t-1} + \alpha_2 AE_{t-3} + \alpha_3 (BANKEMP_{t-2} - BANKEMP_{t-3}) + \alpha_4 (DEFLATOR_t - DEFLATOR_{t-1}) + \alpha_5 (DEFLATOR_{t-2} - DEFLATOR_{t-3})$$

where *C* is a constant term; *BANKEMP* is the number of employees in the banking system; and *DEFLATOR* is the GDP deflator. The model was estimated based on aggregate data for the period 2003:Q3 to 2011:Q4; the estimated values of the coefficients are the following:

Dependent variable: AE_t	
Expanatory variable	Coefficient
C	-133.5
AE_{t-1}	0.734
AE_{t-3}	0.322
$BANKEMP_{t-2}$ -$BANKEMP_{t-3}$	0.064
$DEFLATOR_t$ - $DEFLATOR_{t-1}$	19.255
$DEFLATOR_{t-2}$ -$DEFLATOR_{t-3}$	12.401

This model shares some of the limitations highlighted above in reference to the satellite model for net fee and service income: the non-stationarity of the series and the likely spurious nature of the regression; and loss of precision due to the use of aggregate data instead of bank specific data.

Satellite Model for Sovereign Risk

Changes in valuation of bond and money market instruments due to adverse shocks are calculated through a two-step procedure. In the first step, movements in yield curves are estimated. In the second step, the valuation impact is calculated using a modified duration approach.

Step 1. Shifts in yield curves. The BCRA constructs models to evaluate movements of yield curves in stressed scenarios. The yield curves corresponding to different types of instruments—nominal in pesos; inflation-adjusted in pesos; linked to the BADLAR rate; and denominated in US dollars—are constructed and evaluated separately.

Let $y_{M,t}^{m}$ denote the yield corresponding to the maturity range *m* for an instrument type *M* at time *t*, where where *M* = {nominal in pesos; inflation – adjusted in pesos, nominal in U.S. dollars}. The sensitivity of yields on bonds and money market instruments with respect to changes in the time deposit rate $i_t^{30-60 \text{ day time deposits}}$ (in the same currency denomination) is assessed through the linear regression: $y_{M,t}^{m} = C + \alpha \cdot i_t^{30-60 \text{ day time deposits}} + \varepsilon_{i,t}$.. This regression is estimated using weekly data during the period 2006–12.

	In pesos	In pesos, inflation-adjusted			In U.S. dollars		
Parameter	Maturity range 1 (0-2 yrs.)	Maturity range 1 (0-2 yrs.)	Maturity range 2 (2-6 yrs.)	Maturity range 2 (>6 yrs.)	Maturity range 1 (0-3 yrs.)	Maturity range 2 (3-6 yrs.)	Maturity range 2 (>6 yrs.)
a	2.99	3.32	2.56	1.17	1.68	1.28	0.61
C	-0.08	-0.21	-0.12	-0.01	-0.06	0.00	0.05

Using the estimated coefficients and the projections of time deposit rates, it is possible to project the shifts in yield curves during the stress testing period and for the different scenarios. Floating rate instruments—linked to the BADLAR rate—are treated separately, taking into account the evolution of the BADLAR deposit rate projected in previous steps.

Step 2. Valuation effects. Once the movements in yield curves have been estimated for different instruments and scenarios, the instruments are re-priced: new prices are set equal to the present value of future cash flows discounted at the new yields. Non-publicly traded instruments—those with no known market value, which include some series of LEBACs and NOBACs—are priced using yield curves of similar traded instruments.

Other Satellite Models

For the overall exercise, these models are less relevant than the ones presented above because they refer to categories of assets in which banks have low exposures. The methodology developed by the BCRA to conduct their stress tests is described in "BCRA, Informe al Directorio 736/45/13."

Appendix III. Argentina: Contributions to the Changes in CAR—Adverse Scenario (V)

Changes over time in the capital adequacy ratio $CAR = \frac{Capital}{RWA}$ can be expressed as follows:

$$\Delta CAR_{t+1} = CAR_{t+1} - CAR_t = \frac{\Delta Capital_{t+1}}{RWA_t} - \frac{\Delta RWA_{t+1} \cdot CAR_t}{RWA_{t+1}} - \frac{\Delta Capital_{t+1} \cdot \Delta RWA_{t+1}}{RWA_t \cdot RWA_{t+1}}.$$

In the last expression, the first term on the right indicates the (partial) contribution of changes in capital (numerator) to variations in the CAR ratio; similarly, the second term is the contribution of changes in RWA (denominator). The third term captures the (joint) contribution of changes in RWA and capital to changes in the CAR ratio. The latter term is (very) small in size and can be added to the contributions of RWA, capital, or both. For the construction of the decomposition chart, we add the joint effect (third term) to the contribution of changes in capital (numerator), as follows:

$$\text{Contribution of } \Delta Capital \text{ to } \Delta CAR = \frac{\Delta Capital_{t+1}}{RWA_t} \cdot (1 - \frac{\Delta RWA_{t+1}}{RWA_{t+1}})$$

$$\text{Contribution of } \Delta RWA \text{ to } \Delta CAR = -\frac{\Delta RWA_{t+1} \cdot CAR_t}{RWA_{t+1}}$$

Assuming no capital injections in the period, the evolution of capital over time can be further decomposed as follows:

$$\Delta Capital_{t+1} = Capital_{t+1} - Capital_t = Profit\ before\ losses_{t+1} - Losses\ due\ to\ stress_{t+1} - Dividends_{t+1} - Taxes_{t+1}$$

X=source of change in capital (numerator)	Contribution of X to changes in CAR
- Profit before losses (excl. govt and BCRA securities) - Income from govt. and BCRA securities - Credit losses - Losses/gains due to market risk (non-sovereign) - Losses/gains due to market risk (sovereign) - Other (taxes, dividends, …)	$\frac{\Delta X_{t+1}}{RWA_t} \cdot (1 - \frac{\Delta RWA_{t+1}}{RWA_{t+1}})$
Change in risk weighted assets	$-\frac{\Delta RWA_{t+1} \cdot CAR_t}{RWA_{t+1}}$

Note: profits before losses include the following items: net interest income; net fee and service income; and operating and administrative expenses.

Appendix IV. Argentina: Liquidity Stress Tests

Run Off Rates for Cash Outflows

(In percent)

	Up to one day	Greater than one day and up to one week	Greater than one week and up to one month	Greater than one month and up to two months	Greater than two months and up to three months	Greater than three months and up to six months	Greater than six months and up to one year	Greater than one year and up to two years
Cash Outflows								
Own issuances due								
short term (initial maturity less than 1 year)	60	60	40	40	40	40	40	20
long term (initial maturity more than 1 year)	80	80	80	60	60	60	60	30
Unsecured funding due with legal entities								
with revenue less than $ 10.000.000 (or equivalent amount in foreign currency)								
sight deposits	7.5	1	0.5	1	0	0	0	0
others	15	15	15	20	25	25	25	3
with revenue more than $ 10.000.000 (or equivalent amount in foreign currency)								
sight deposits	15	5	10	0	0	0	0	0
others	40	40	40	40	40	40	40	3
financial institutions regulated by the BCRA	75	75	75	75	30	30	30	15
other institutions with financial activities	75	75	75	75	30	30	30	15
non-financial public sector	20	20	20	20	20	15	12	12
Secured funding due to legal entities								
secured by bonds and money market instruments issued by the BCRA	100	100	100	100	100	100	100	100
secured by government (treasury) debt instruments with publicly quoted prices	100	100	100	100	100	100	100	100
secured by government (treasury) debt instruments without publicly quoted prices	100	100	100	100	100	100	100	100
secured by other instruments	100	100	100	100	100	100	100	100
Repos due with the BCRA	100	100	100	100	100	100	100	100
Funding due with depositors (physical persons)								
sight deposits	7.5	1	0.5	1	0	0	0	0
other	10	10	10	15	20	25	25	3
Outflows from derivatives	100	100	100	100	100	100	100	100
Undrawn volume of commited credit/liquidity lines to								
financial institutions regulated by the BCRA	10	20	50	75	100	100	100	100
fideicomisos	40	40	40	40	40	40	40	20
other financial institutions	10	15	20	25	30	30	30	30
physical persons and legal entities of the non-financial public sector	1	2	3	4	5	5	5	5
others	10	20	50	75	100	100	100	100
Others	0	0	0	0	0	0	0	0

Note: a run-off rate is defined as the fraction of the liability amount maturing in a given period that is withdrawn by the claim holders. Sight deposits are an exception, however. Due to the instantaneous maturity of sight deposits, a run-off rate on these deposits is the fraction of the initial outstanding balance that is withdrawn in a given period of time.

Run Off Rates for Cash Inflows

(In percent)

	Up to one day	Greater than one day and up to one week	Greater than one week and up to one month	Greater than one month and up to two months	Greater than two months and up to three months	Greater than three months and up to six months	Greater than six months and up to one year	Greater than one year and up to two years
Cash Inflows								
New own issuances (already contracted)	100	100	100	100	100	100	100	100
Loans maturing								
to financial institutions regulated by the BCRA	100	100	90	70	50	50	50	25
to other institutions with financial activities	100	100	90	70	50	50	50	25
to others								
credit cards	50	50	50	30	30	10	10	10
other	50	50	50	30	30	10	10	10
Inflows from derivatives	100	100	100	100	100	100	100	100
Paper in own portfolio maturing	100	100	100	100	100	100	100	100
Reverse repos								
secured by bonds and money market instruments issued by the BCRA	100	100	100	100	100	100	100	100
secured by government (treasury) debt instruments with publicly quoted prices	100	100	100	100	100	100	100	100
secured by government (treasury) debt instruments without publicly quoted prices	100	100	100	100	100	100	100	100
secured by other instruments	100	100	100	100	100	100	100	100
Volume of available credit/liquidity lines from								
financial institutions regulated by the BCRA	10	20	50	75	100	100	100	100
other financial institutions	10	15	20	25	30	30	30	30
Others	100	100	100	100	100	100	100	100

Counterbalancing Capacity

(In percent)

	Market Haircut	BCRA Haircut	Up to one day	Greater than one day and up to one week	Greater than one week and up to one month	Greater than one month and up to two months	Greater than two months and up to three months	Greater than three months and up to six months	Greater than six months and up to one year	Greater than one year and up to two years
Counterbalancing Capacity										
Cash and reserves in the BCRA	0	0	100	100	100	100	100	100	100	100
Unencumbered BCRA eligible collateral										
bonds and money market instruments issued by the BCRA	5	15	30	50	100	100	100	100	100	100
government (treasury) debt instruments with publicly quoted prices	15	25	30	50	100	100	100	100	100	100
government (treasury) debt instruments without publicly quoted prices (not included in VELI	n.a	30	30	50	100	100	100	100	100	100
Instruments eligible for VELI										
Collateralized loans	n.a	35	30	50	100	100	100	100	100	100
Others	n.a	30	30	50	100	100	100	100	100	100
Equity	40	n.a	5	12	50	100	100	100	100	100
Other assets accepted by the BCRA as collateral	n.a	35	5	12	50	100	100	100	100	100

Appendix Table 1. Argentina: Stress Test Matrix

Domain		Assumptions		
		Bottom-Up by Banks	Top-Down by Authorities	Top-down by FSAP Team
BANKING SECTOR: SOLVENCY RISK				
1.Institutional Perimeter	Institutions included	n.a.	• 22 major banks : Banco de la Nación Argentina; Banco de la Provincia de Buenos Aires; Banco de Galicia y Buenos Aires S.A.; Banco Santander Río S.A.; Banco Macro S.A.; BBVA Banco Frances S.A.; HSBC Bank Argentina S.A.; Banco de la Ciudad de Buenos Aires; Banco Credicoop Cooperativo Limitado; Banco Patagonia S.A.; Standard Bank Argentina S.A.; Citibank N.A.; Banco Hipotecario S.A.; Banco de la Provincia de Cordoba S.A.; Banco Supervielle S.A.; Nuevo Banco de Santa Fe S.A.; Banco Itaú Argentina S.A.; Banco de San Juan S.A.; Banco Comafi S.A.; Banco de la Pampa Sociedad de Economía Mixta; Nuevo Banco de Entre Rios S.A.; and Banco Industrial S.A.	• 22 major banks : Banco de la Nación Argentina; Banco de la Provincia de Buenos Aires; Banco de Galicia y Buenos Aires S.A.; Banco Santander Río S.A.; Banco Macro S.A.; BBVA Banco Frances S.A.; HSBC Bank Argentina S.A.; Banco de la Ciudad de Buenos Aires; Banco Credicoop Cooperativo Limitado; Banco Patagonia S.A.; Standard Bank Argentina S.A.; Citibank N.A.; Banco Hipotecario S.A.; Banco de la Provincia de Cordoba S.A.; Banco Supervielle S.A.; Nuevo Banco de Santa Fe S.A.; Banco Itaú Argentina S.A.; Banco de San Juan S.A.; Banco Comafi S.A.; Banco de la Pampa Sociedad de Economía Mixta; Nuevo Banco de Entre Rios S.A.; and Banco Industrial S.A.
	Market share	n.a.	• Ninety percent of total sector assets	• Ninety percent of total sector assets.
	Data and baseline date	n.a.	• September 2012. • Supervisory data. • Scope of consolidation: Solo. • Coverage of sovereign	• September 2012. • Publicly available data: balance sheet and income statements. • Data provided by authorities.

Domain		Assumptions		
		Bottom-Up by Banks	Top-Down by Authorities	Top-down by FSAP Team
			exposures: Trading and banking books including own sovereign, valuated at MTM values.	• Scope of consolidation: Solo. • Coverage of sovereign exposures: Trading and banking books including own sovereign, valuated at MTM values.
. Channels of Risk Propagation	Methodology	n.a.	• Authorities' macroeconomic and satellite models, with FSAP team guidance.	• FSAP team VAR model. • Breaking Point Method by Ong, Maino, and Duma (2010).
	Satellite Models for Macro-Financial linkages	n.a.	• Models for credit losses • Methodology to calculate net interest income • Methodology to calculate losses from bonds and money market instruments (sovereign and other issuers) • Models for market risk • Expert judgment •	• Model for credit losses
	Stress test horizon	n.a.	• 2013–14.	• 2013–14.
3. Tail shocks	Scenario analysis	n.a.	• Two baseline scenarios: Baseline (authorities) and Adjusted Baseline (WEO). • Three adverse scenarios incorporate the *external shocks* listed in the RAM, including a recession in Brazil caused by a sudden stop of capital inflows to Emerging Markets; and a sharp decline in commodity prices caused by a global recession: (i) a U-shaped adverse scenario based on authorities' baseline based on a cumulative decline of GDP of 1.7 standard deviations over two years; (ii) a U-shaped adverse scenario based on the WEO baseline; and (iii) a V-shaped adverse scenario based on the WEO baseline. The latter two scenarios result in a cumulative decline of GDP equivalent to 2 standard deviations over two years. •	
	Sensitivity analysis	n.a.	• Sensitivity analysis to evaluate domestic shocks: (i) tightening of domestic monetary conditions aimed at containing inflation pressures	

Domain		Assumptions		
		Bottom-Up by Banks	Top-Down by Authorities	Top-down by FSAP Team
			and (ii) a loss of confidence in the monetary and financial system that triggers capital outflows and widens the gap between the parallel and official exchange rates; • A failure of a number of large corporate exposures; • Sovereign shock based on the 90th percentile of the changes in bond yields.	
4.Risks and Buffers	Risks/factors assessed (How each element is derived, assumptions.)	n.a.	• Credit losses. • Losses from bonds and money market instruments (sovereign and other issuers) in the banking and trading books. • Market risk, including foreign exchange risk.	• Credit losses. • Losses from fixed income holdings/ sovereign • Market risk
	Behavioral adjustments	n.a.	• Balance sheet growth in line with nominal GDP • Dividends can only be paid out by banks that remain adequately capitalized and subject to BCRA regulation.	• Balance sheet growth in line with nominal GDP • Dividends can only be paid out by banks that remain adequately capitalized and subject to BCRA regulation.
5. Regulatory and Market-Based Standards and Parameters	Calibration of risk parameters	n.a.	• Backward-looking rates for specific provisioning. • Fixed risk-weights for RWAs.	• Backward-looking rates for specific provisioning. Fixed risk-weights for RWAs.
	Regulatory/Accounting and Market-Based Standards	n.a.	• Regulatory Capital and Tier 1 Capital • Standard approach • Basel III hurdle rates	• Regulatory Capital and Tier 1 Capital • Standard approach • Basel III hurdle rates
6. Reporting Format for Results	Output presentation	n.a.	• Capital shortfall system wide. • For each hurdle rate (or range), percentage of assets that fail.	• Capital shortfall system wide. • For each hurdle rate (or range), percentage of assets that fail.

Domain		Assumptions		
		Bottom-Up by Banks	Top-Down by Authorities	Top-down by FSAP Team
BANKING SECTOR: LIQUIDITY RISK				
1. Institutional Perimeter	Institutions included	n.a.	• 22 major banks : Banco de la Nación Argentina; Banco de la Provincia de Buenos Aires; Banco de Galicia y Buenos Aires S.A.; Banco Santander Río S.A.; Banco Macro S.A.; BBVA Banco Frances S.A.; HSBC Bank Argentina S.A.; Banco de la Ciudad de Buenos Aires; Banco Credicoop Cooperativo Limitado; Banco Patagonia S.A.; Standard Bank Argentina S.A.; Citibank N.A.; Banco Hipotecario S.A.; Banco de la Provincia de Cordoba S.A.; Banco Supervielle S.A.; Nuevo Banco de Santa Fe S.A.; Banco Itaú Argentina S.A.; Banco de San Juan S.A.; Banco Comafi S.A.; Banco de la Pampa Sociedad de Economía Mixta; Nuevo Banco de Entre Rios S.A.; and Banco Industrial S.A.;	n.a.
	Market share	n.a.	• 90 percent of total sector assets.	n.a.
	Data and baseline date	n.a.	• September 2012. • Source: Granular data provided by banks for this purpose and supervisory data. • Scope of consolidation: solo.	n.a.

Domain		Assumptions		
		Bottom-Up by Banks	**Top-Down by Authorities**	**Top-down by FSAP Team**
2. Channels of Risk Propagation	Methodology	n.a.	Three methods: • Cash flow-based liquidity stress test using maturity buckets. • Macro stress tests: authorities' macroeconomic and satellite models with FSAP team guidance. • Reserve liquidity test as sensitivity tests.	n.a.
3.Risks and Buffers	Risks	n.a.	• Funding liquidity. • Market liquidity.	n.a.
	Buffers	n.a.	• Counterbalancing capacity. • Central bank facilities.	n.a.
4. Tail shocks	Size of the shock	n.a.	• Bank run and dry up of wholesale funding markets, taking into account haircuts to liquid assets. • Run-off rates calculated following historical events and LCR rates.	n.a.
5. Regulatory and Market-Based Standards and Parameters	Regulatory standards	n.a.	• Liquidity gap, survival period. • Basel III draft standards (LCR and NSFR).	n.a.
6. Reporting Format for Results	Output presentation	n.a.	• Liquidity gap by bank and currency, aggregated. • Survival period in days by bank, number of banks that still can meet their obligations.	n.a.

Domain		Assumptions		
		Bottom-Up by Banks	Top-Down by Authorities	Top-down by FSAP Team
BANKING SECTOR: CONTAGION RISK				
1.Institutional Perimeter	Institutions included	n.a.	n.a.	• 22 major banks : Banco de la Nación Argentina; Banco de la Provincia de Buenos Aires; Banco de Galicia y Buenos Aires S.A.; Banco Santander Río S.A.; Banco Macro S.A.; BBVA Banco Frances S.A.; HSBC Bank Argentina S.A.; Banco de la Ciudad de Buenos Aires; Banco Credicoop Cooperativo Limitado; Banco Patagonia S.A.; Standard Bank Argentina S.A.; Citibank N.A.; Banco Hipotecario S.A.; Banco de la Provincia de Cordoba S.A.; Banco Supervielle S.A.; Nuevo Banco de Santa Fe S.A.; Banco Itaú Argentina S.A.; Banco de San Juan S.A.; Banco Comafi S.A.; Banco de la Pampa Sociedad de Economía Mixta; Nuevo Banco de Entre Rios S.A.; and Banco Industrial S.A.; • FGS; mutual funds; insurance companies, retirement funds, brokerages.
	Market share	n.a.	n.a.	• 90 percent of total sector assets.
	Data and baseline date	n.a.	n.a.	• December 2012. • Source: institutions' own, supervisory. • Scope of consolidation: Solo.

Domain		Assumptions		
		Bottom-Up by Banks	Top-Down by Authorities	Top-down by FSAP Team
2. Channels of Risk Propagation	Methodology	n.a.	n.a.	• Network model map using centrality measures for contagion between banks and nonbanks financial institutions. • Pure contagion interbank model by Cihak (2007)
3. Tail shocks	Size of the shock	n.a.	n.a.	• Pure contagion: default of institutions; market closure; or retrenchment of claims
4. Reporting Format for Results	Output presentation	n.a.	n.a.	• Network Model Map.

References

Burrows, Oliver; Learmonth, David, and Jack McKeown, 2012, "RAMSI: a Top-down Stress-testing Model," Bank of England, Financial Stability Paper No. 17, September.

Cihak, Martin, 2007, "Introduction to Applied Stress Testing," available at http://www.imf.org/external/pubs/ft/wp/2007/wp0759.pdf.

Collyns, C. and G. Russell Kincaid , 2003, "Managing Financial Crises: Recent Experience and Lessons for Latin America," IMF Occasional Paper No. 217.

Foglia, Antonella (2009), "Stress Testing Credit Risk: A Survey of Authorities' Approaches," International Journal of Central Banking, Vol. 5, No. 3, September.

Nelson, Charles, and Andrew Siegel, 1987, "Parsimonious Modeling of Yield Curves," The Journal of Business, Vol. 60, No. 4, October, pp. 473–489.

Ong, Li Lian; Rodolfo Maino; and Nombulelo Duma (2010), "Into the Great Unknown: Stress Testing with Weak Data," IMF Working Paper No. 282.

World Bank, 2012, "The Labor Market Story behind Latin America's Transformation," Office of the Chief Economist for the Latin America and the Caribbean Region, October.