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Financial Sector Projections and Stress Testing in Financial Programming: A New Framework

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Abstract

This paper proposes a framework to check for consistency between the IMF's standard country surveillance tool, namely medium-term projections of the macroeconomic framework (including the real, fiscal, external, and monetary sectors), and the financial sector. Consistency here entails that the financial sector remain solvent in the medium term under the assumptions of the macroeconomic framework and that the macroeconomic framework is fine-tuned should threats to financial sector solvency arise as a result of assumptions underlying the medium-term macroeconomic framework projections. The proposed framework can also be used to conduct sensitivity analysis of the aggregated financial sector to various types of risks, including foreign exchange, interest rate, and credit risk. For surveillance purposes, this framework can easily be integrated into one of the standard sectoral files so that any update to the macroeconomic framework automatically feeds into the financial sector medium-term projections. We anticipate the proposed framework to be of interest to IMF economists as well as outside analysts.

JEL Classification Numbers: E60, G20, G21

Keywords: Financial Programming, Financial Institutions, Stress Testing

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[1] The framework was developed analytically in 2001–03 by Ritu Basu and Nada Choueiri and made operational for country surveillance and stress testing in 2004 by Ritu Basu and Antonio García Pascual. The project has benefited from the constant guidance and encouragement provided by Antonio Furtado, Edward Gardner, and David Marston and from comments and suggestions by Tomás Baliño, Juan José Fernández-Ansola, Olivier Frecaut, Daniel Hardy, Marc Quintyn, Vasudevan Sundararajan, and seminar participants at the Monetary and Financial Systems Department and the Middle East and Central Asia Department. This framework is already being used as an active surveillance tool in the context of Article IV consultations and early warning system technical assistance missions.

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I. INTRODUCTION

Over the past several years, financial sector work has gained prominence in Fund surveillance, particularly with the development of specialized financial sector surveillance work including Financial Sector Assessment Programs (FSAPs) and technical assistance. While several partial methodologies exist to monitor financial sector performance, an integrated framework of macroeconomic and financial sector surveillance in the medium-term context is largely nonexistent. This paper proposes a toolkit that allows consistent analysis of financial sector health within the standard macroeconomic framework developed for Fund surveillance.

The proposed toolkit permits a two-way consistency check between the specified macroeconomic framework and financial sector performance. It can be iterated upon until reasonable outcomes for both the macroeconomic framework and financial sector performance are obtained. The user can focus on a specific segment of the financial sector, such as the banking sector. The user can also focus on specific indicators of financial sector performance, such as profitability and solvency indicators. Alternatively, the toolkit can be expanded to encompass all segments of the financial sector, including nonbank financial institutions and the central bank. It can also be broadened to use other performance indicators in addition to profitability and solvency—for example, liquidity or asset quality.

II. WHY DO WE NEED THE FINANCIAL SECTOR SURVEILLANCE TOOLKIT?

A satisfactory path for financial sector performance is one among many (often conflicting) objectives for policy makers. Policy makers may struggle to achieve exchange rate and price stability, together with government debt sustainability and financial sector viability. The proposed tool provides a way to evaluate the trade-offs among these different objectives; it is not aimed at achieving the best outcome for the financial sector per se. In some cases, for example, while threats to government debt sustainability have taken priority in policy discussions with the Fund, balance sheet constraints imposed by the financial sector's large exposure to government debt have often prevented debt restructuring as a plausible solution. Instead, economic adjustment has proceeded through a combination of measures to improve the government's fiscal position—for example, through reducing the rate of return on government paper, often combined with costly compensatory central bank measures to ensure the health and solvency of the financial sector when the latter holds a large share of government paper. The proposed toolkit can help to quantify and assess the financial sector balance sheet consequences of such policy actions.

While this toolkit could represent a key addition to the Fund's four-sector medium-term surveillance framework (which includes the real, fiscal, monetary, and external sectors), it is not a substitute for analysis related to financial sector supervision. At best, it should be thought of as an off-site tool for judging the performance of the aggregated financial sector. In particular, the toolkit, as it stands now, is not capable of detecting vulnerability arising from individual bank behavior and performance. The latter is best monitored by on-site

supervision coupled with off-site, disaggregated banking sector analysis, including bank-by-bank stress-testing.[2]

The proposed financial sector surveillance toolkit could add significant value to the existing Fund surveillance tools. These tools can broadly be classified into four categories:[3] (i) the four-sector, dynamic, financial programming tool; (ii) dynamic debt sustainability analysis; (iii) financial soundness indicators (FSI) analysis and quasi-dynamic stress testing and scenario analysis in the context of FSAPs; and (iv) the relatively static balance sheet approach to surveillance. The toolkit presented in this paper complements this list by bringing together in one framework key aspects found in each of these four tools.

The first two surveillance tools are labeled dynamic as they are used to evaluate the economy over a medium-term horizon. Financial programming, in particular, entails a medium-term analysis of economic performance on the basis of macroeconomic flows of the fiscal, real, monetary, and external sectors. The debt sustainability analysis then builds on this framework a stock-based approach for evaluating fiscal and external sector performance. Essentially, the analysis generates paths of public and external debt in the context of the baseline scenario associated with the financial programming exercise, and then studies changes to the debt paths under various positive and negative stress scenarios. However, neither of these two methodologies is designed to evaluate financial sector performance or viability. The financial sector and the role of its institutions is largely ignored, or at best treated as a residual with an implicit assumption that financial institutions will continue to intermediate funds in all circumstances.

The stress testing and scenario analysis in the context of FSAPs partly addresses this shortcoming. This analysis essentially tries to assess under what circumstances would the financial sector likely come under stress and thereby cease to conduct its intermediation role. This analysis is done at both the aggregated and disaggregated levels of financial sector entities by studying the balance sheet impact of macroeconomic shocks. However, although the shocks are often modeled in a forward-looking perspective, they are usually applied to financial institutions' current balance sheets. Thus, while this approach partly mitigates the passive or residual role that the financial sector has in the first two approaches, it does not fully integrate the macroeconomic scenarios and financial institutions' performance in a medium-term context.

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[2] The recently completed FSAP mission to Norway integrates an aggregated top-down analysis of bank performance with a bottom-up stress testing approach. While this approach allows some comparability across the two methods as it relies on the same scenario and shocks, it still has shortcomings related to the translation of the macroeconomic shocks and scenarios into meaningful parameters for the individual banks' stress testing models.

[3] This classification misses some of the Fund's surveillance tools, for example, the Reports on Standards and Codes (ROSCs), as these bear no direct link with the proposed framework.

The fourth tool listed above, the balance sheet approach to surveillance, entails complementing the Fund's 4-sector programming analysis (the first tool above) with an analysis of stock imbalances to help uncover vulnerabilities or evaluate different options in crisis resolution. This approach rests on the analysis of asset and liability structures of the public sector, private financial sector, private nonfinancial sector, and the rest of the world to identify the presence of maturity mismatches and currency mismatches at a certain point in time. In doing so, it tries to gauge sectoral vulnerabilities and their spillover risks through sectoral interlinkages. This tool indeed complements the financial programming and debt sustainability tools by focusing on explicit assessment of financial sector balance sheet and exposures, but it does so in a static framework as the analysis is limited to the identification of these exposures only at a specific point in time.

Existing Fund surveillance tools therefore do not include explicit balance-sheet based analysis of the financial sector's performance in a dynamic context. The financial sector surveillance tool proposed in this paper tries to fill this gap by allowing for both consistent financial sector balance sheet analysis of the impact of projected macroeconomic developments and adjustment of the macroeconomic scenario should a balance sheet constraint arise in the medium term. In addition to ensuring a consistency check of this nature, the proposed tool can also be used to carry out stress testing analysis in a dynamic medium-term context.

III. Description of the Financial Surveillance Toolkit

The key feature of the proposed toolkit is to integrate the aggregated profit and loss (P&L) accounts of the financial sector into the standard programming exercise used in Fund surveillance. Medium-term projections for the P&L accounts are derived, together with the standard medium-term macroeconomic projections done in the context of Fund surveillance. This derivation draws on the stock-based macroeconomic projections themselves, but also requires additional and explicit projections for the paths of various interest rates underlying the financial sector's P&L accounts.

The projection of the P&L accounts over the medium term ultimately generates a path for profits which, net of dividends, translates into a path for capital buildup. Capital-adequacy based solvency measures for the financial sector can then be constructed from the projected paths of capital and risk-weighted assets. Hence a first check for a consistently integrated macroeconomic and financial sector framework over the medium term can be performed: should the generated path of profitability and capital adequacy show a declining trend or fall below a pre-specified threshold, this would suggest that the assumptions underlying the macroeconomic framework are likely unsuitable for the sustenance of the financial sector and need to be revisited. This provides the main channel for feedback effects between the P&L accounts and the standard programming exercise used in Fund surveillance. Other feedback effects exist which will be clarified below.

In the case of banks, for example, the 8 percent requirement for the capital adequacy ratio (CAR) recommended by the Basel Committee on Banking Supervision can serve as a

threshold, or alternatively the measure can be made tougher as per a country's own prudential regulations. Should the financial sector performance fail by such pre-set criteria, the assumptions underlying the macroeconomic framework, interest paths, and other P&L inputs need to be adjusted so that a satisfactory path of financial sector performance is obtained. This exercise can also be done based on indicators of financial sector performance other than solvency and profitability.

The rest of this section elaborates a schematic representation of the financial sector surveillance toolkit and demonstrates how it can be used to carry out stress-testing and scenario analysis for the financial sector. To ensure clarity in the presentation, the focus is on the banking sector alone.[4] An extension of the framework to include an assessment of central bank performance is also introduced. Appendix I presents a simple application of the framework to a hypothetical country case.

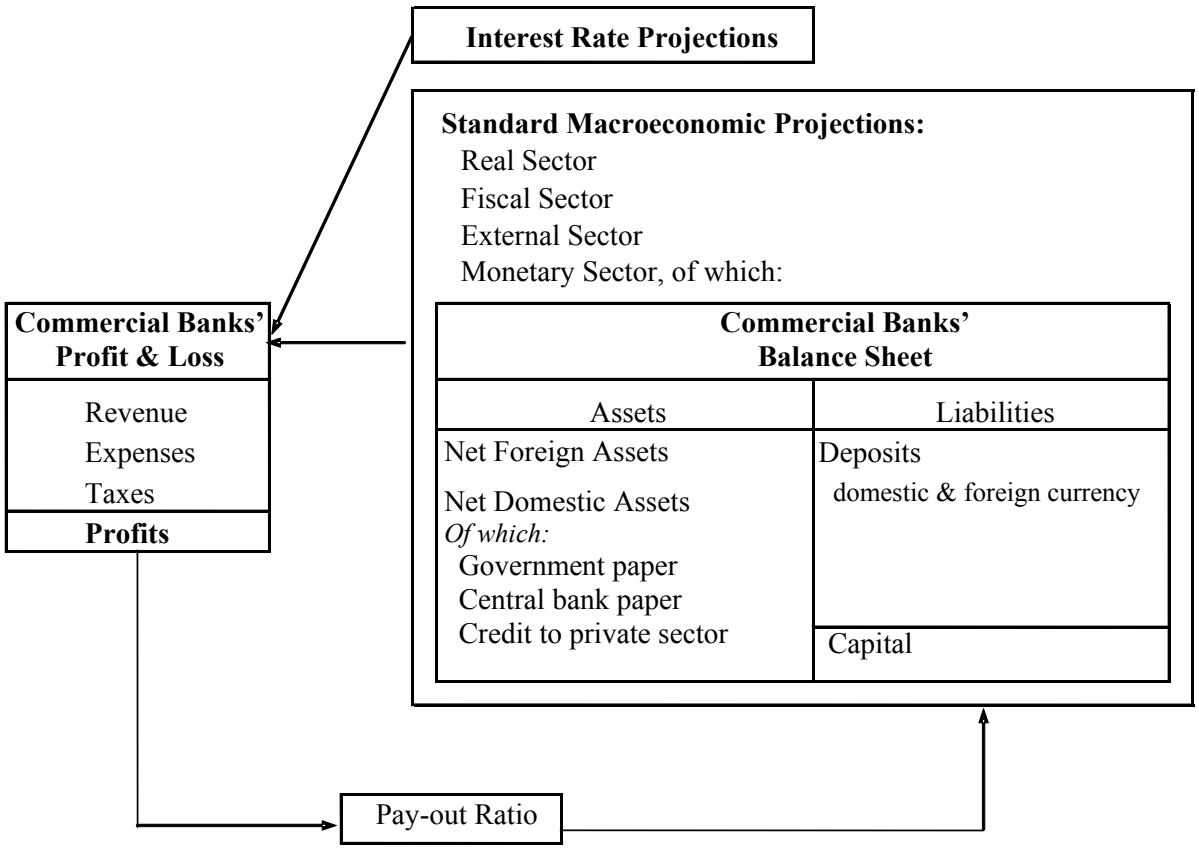
A. Structure of the Surveillance Tool with Focus on the Banking Sector

As mentioned above, the user's objective is to project the aggregated banking system's P&L statement together with the standard macroeconomic projections of real, fiscal, monetary, and external sector variables.[5] Figure 1 shows a sketch of the main linkages underlying the proposed tool when applied to the banking segment of the financial sector. Table 1 summarizes a generic framework of the consolidated P&L accounts of the banking sector which can be tailored to fit any specific country features. Both inputs from Fund standard macroeconomic projections and detailed assumptions on components of banks' P&L accounts (which can be broadly divided into interest- and noninterest-related elements) are needed to project these accounts. Once the P&L projection is completed, bank profits are calculated. Given a pay-out ratio, which determines the proportion of net profits that is split between shareholders and bank capital, the latter is then projected over the medium term. This path for bank capital is plugged into *other items net* in the standard monetary sector projections (in the "monetary survey"), which represents a *direct feedback effect* from the P&L accounts to the Fund's standard macroeconomic projections. The direct feedback of the

[4] Extending the tool to include nonbank financial institutions can be done albeit with care in modeling these institutions. This would be relevant for countries where such institutions are significant financial market players, for example, when the share of nonbank financial institutions' assets is a large enough share of total financial assets in the economy. The extension would rest on projecting, in addition to the consolidated P&L accounts of the banking sector, the consolidated P&L accounts of nonbank financial institutions along the lines outlined in Section II.A while tailoring the P&L accounts presented in this section to the activities of nonbank financial institutions.

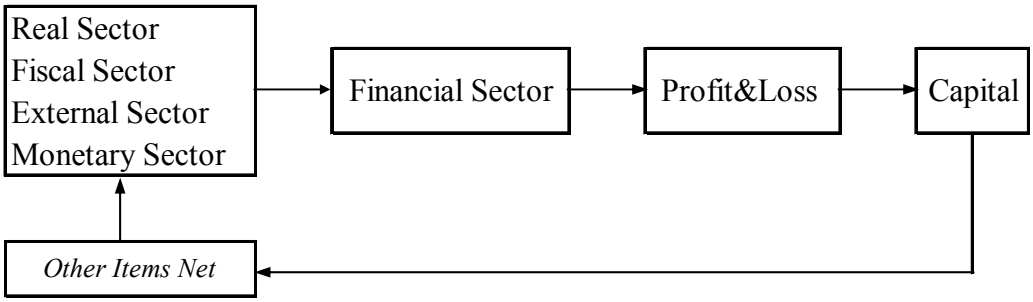
[5] *Off-balance sheet* items are not included in this framework because relevant data are generally not readily available. For surveillance of financial institutions, including their *off-balance sheet* exposures, see recent work by Avesani (2005) on market and credit risk indicators.

Figure 1. Schematic Representation of the Surveillance Tool



financial sector projections into the monetary survey—and, indirectly, into into the external, fiscal, and real sector projections—requires an iterative process to achieve an internally consistent financial programming framework (Figure 2).

Figure 2. Integrating the New Surveillance Tool into the Financial Programming Framework



Interest-related elements of the P&L accounts support an important link between the projection of these accounts and Fund standard macroeconomic projections. The projection of interest-related elements requires information on underlying stocks, most importantly the deposit base associated with banks' interest expenses and the credit base associated with banks' interest earnings, and such information is taken from the standard Fund macroeconomic projections. In particular, projections for foreign assets and foreign liabilities are provided by the external sector projections; projections for bank holdings of government paper are provided by the fiscal sector projections; and projections for bank deposits and bank holdings of central bank instruments and private sector loans are provided by the monetary sector projections.

Explicit assumptions or projections of the various interest rates associated with the above stocks are also needed to project interest-related elements of the P&L accounts. Assumptions need to be formulated on the interest pricing strategies of various market players, including commercial banks, the government, and the central bank. This involves specifying benchmark rates for each interest rate involved—for example, the London interbank offfered rate (LIBOR) rate could serve as benchmark for the return on banks' foreign assets while the government domestic borrowing rate can serve as benchmark for the return on banks' domestic deposit liabilities. It also requires that the margins associated with each benchmark rate be explicitly specified. In the process, the user needs to account for existing transmission mechanisms from international to domestic interest rates as well as from domestic reference rates (such as government borrowing rates) to bank interest rates. Appendix I provides an example of a concrete approach for formulating such interest rate assumptions and projections.

Noninterest-related elements figure on both the income and expenses side of the P&L accounts. The main elements on the income side are usually net commissions earned, income from various bank operations such as foreign exchange operations and securities trading, recovered provisions, and administrative income from home offices and affiliates. On the expenses side, main elements are salaries and general expenses, provisions for problem loans, commissions paid on bank accounts, and expenses of home offices and affiliates. Explicit assumptions have to be formulated for each of these elements. A simple approach would be to assume that (a) most non-interest income elements grow in line with the size of banks' aggregate balance sheet, as measured by the sum of assets and liabilities; (b) general expenses grow in line with the CPI; (c) provisions grow in line with the size of nonperforming loans (NPLs); and (d) other expenses grow in line with the size of banks' aggregate balance sheet. Surely, country-specific information could suggest that different assumptions would be needed for any or all of these elements.

Provisions against credit risk are a key item involved in projecting the noninterest components of P&L accounts. As the path of these provisions depends on the path of NPLs, the latter needs to be specified. A simple approach could be that the user formulates an educated guess about how the share of NPLs in total private sector credit is likely to evolve over time. In other words, based on his/her knowledge of the economy, the user can explicitly assume a ratio of NPLs to total loans and use the monetary sector projections for

total loans to derive the path of NPLs. Alternatively, an approach resulting in model-based NPLs projections can be implemented. An empirical study on the determinants of credit risk in dollarized economies by Cayazzo et al. (forthcoming) provides estimates of the behavior of problem loans for a number of emerging (partially-dollarized) countries. Following this study, the user could estimate an equation specifying the growth of the ratio of NPLs to total loans as a function of a set of macroeconomic variables and use the projected path of these variables to determine the path of NPLs. Equation (1) provides an example of such a model to use but, depending on country-specific characteristics, the user could replace or augment the right-hand-side variables with other variables.[6]

Growth of NPL ratio = *F*(real GDP growth, inflation, interest rate, exchange rate change) (1)

Once the projection of P&L accounts is completed, feedback from these accounts to the standard macroeconomic projections takes place through the derivation of bank capital and the capital adequacy ratio (CAR). Assumptions on the tax rate on bank profits and the pay-out ratio[7] are formulated to derive bank capital recursively, using the following identity:

$$\text{Capital}(t+1) = \text{Capital}(t) + (1-\text{Tax}(t))* \text{Gross profits}(t) * [1 - \text{Payout ratio}(t)]$$

Capital is then plugged in the monetary sector projections, usually under "other items net" in the monetary survey. Finally, the projection of the CAR is done based on the following identity:

$$\text{CAR}(t) = \text{Capital}(t) / \text{Risk-weighted-assets}(t),$$

where risk-weighted assets need to be identified. One approach could be to assume that the share of risk-weighted assets in total assets remains constant over time, so that:

$$\text{Risk-weighted-assets}(t) = [\text{Assets}(t) * \text{Risk-weighted-assets}(t-1) / \text{Assets}(t-1)].$$

However, a better approach would be to use the data incorporated in the P&L projections on the banks' assets, including information on the types of assets, together with the supervisory authorities' risk-weighting guidelines by type of assets, to derive risk-weighted assets over the medium term. Such guidelines should be readily available and may vary widely from country to country. This approach may involve the user formulating explicit assumptions on the structure of assets by type—for example, whether foreign assets remain of the same investment grade in the medium term.

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[6] Depending on data availability, the user could estimate a structural VAR model to model the path of NPLs.

[7] The pay-out ratio is assumed to be zero if gross profits are negative.

The resulting CAR provides a benchmark for evaluating the consistency of macroeconomic projections with banking sector performance. If this ratio falls below a pre-specified benchmark, say the Basel Committee's 8 percent recommendation or, alternatively, the country-specific threshold as stipulated by the supervisory authorities, then the user's projections fail the bank solvency requirement and the assumptions underlying these projections need to be adjusted to raise the CAR.

B. Using the Proposed Tool for Scenario Analysis and Stress Testing

The framework developed in subsection A can be readily used to identify the effect of changes in the macroeconomic scenario built in a standard Fund programming exercise on banking sector performance. As noted above, the projection of the banking system's aggregated P&L accounts directly draws on elements from this macroeconomic scenario, largely through its dependence on projections developed under the scenario—projections for bank credit and deposits, government borrowing from the banking sector, etc. Therefore, changes in the macroeconomic scenario, whether stemming from changes in economic factors (growth, inflation, etc.) or policy factors (government spending, taxation, change in interest rate or exchange rate policies, etc.), will imply changes in banks' P&L through these linkages. By tracing these implications, the user can analyze the effects of macroeconomic scenario changes on banks' capitalization and hence performance.

The proposed toolkit is also useful to conduct stress testing of the banking system in a medium-term framework. The spirit of this exercise closely follows that of stress tests currently undertaken in the context of FSAPs (see, for example, Blaschke, Jones, Majnoni, and Martinez Peria, 2001). The user formulates a shock that captures changes in risks and traces its effect on banks' P&L accounts as developed above. A wide array of shocks can be captured in this framework. In particular, the user can conduct sensitivity analysis of the aggregated financial sector to foreign exchange, interest rate, and credit risk. The user can assume a change in the exchange rate, in one or more of the interest rates embedded in the framework as explained in subsection A, or in macroeconomic variables that affect credit, as specified in equation (1). Tracing the effect of this change on the results of the combined macroeconomic and P&L projections would indicate the sensitivity of the banking sector to such a change in a medium term framework. An application is shown in Appendix I.

C. An Extension of the Toolkit to Evaluate Central Bank Performance

The framework developed in subsection A can be expanded to include the central bank. Projections of central bank balance sheet items are often developed in the context of the Fund's standard medium-term macroeconomic projections, but the effects on the profit and loss accounts of the central bank over time are largely neglected. However, it may be useful to take into account such effects for the following reasons. First, the results of central bank operations imply quasi-fiscal gains/losses that could improve/worsen the public sector's deficit and debt path. Second, central bank losses may affect the conduct of monetary policy. Indeed, large losses may translate into negative net worth and require recapitalization of the central bank, often through the issuance of government bonds, which could compromise the

bank's independence and hence the effectiveness of monetary policy announcements and actions.[8]

Broadening the framework presented in subsection A to the central bank entails including a set-up for projecting the central bank's income statement (or P&L accounts). Practically, this implies including in the above toolkit a template that summarizes the central bank's P&L accounts. A set of variables projected within the standard medium-term macroeconomic framework would feed into this template to help project the central bank's income and expenses. The result on the central bank's gain or loss would be included in a public sector definition of deficit and debt, which would be monitored in the context of standard Fund surveillance. In the remainder of this subsection, we present the steps involved in setting-up a template to project the P&L accounts of a central bank drawing on the medium-term macroeconomic framework.

Table 2 provides a general diagram of a central bank's P&L accounts which can be tailored to the specifics of any country. The first column lists the main items included in these accounts that need to be projected in the medium term in order to calculate central bank profits. The adaptation of this list to a particular country could involve a significant amount of detail, partly depending on the preferences of the user. For example, the user faces the choice of whether the return on each type of foreign asset (gold, securities of each foreign government, etc.) should be itemized separately, or, alternatively, whether foreign assets should be classified in one or two broad categories and the aggregate return on each category reported as a separate item in the P&L accounts.

More importantly, the extent of detail will often depend on a country's specific monetary policy features. For example, if the central bank does not hold government-issued debt, there will be no need for a separate category to register interest income on government assets. If the central bank has lent significant amounts to the financial sector, for instance, in the context of restructuring operations, a separate category may be needed to record central bank income from claims on domestic financial institutions. Also, if the central bank does not remunerate bank reserves, there will be no corresponding item on the expenses side of the P&L accounts. If, however, the central bank has different remuneration rates for different types or amounts of deposits, then the user may need to report the associated expenses in detail.

The second and third columns of Table 2 specify the variables needed to project the corresponding items listed in the first column and the source of these variables. Stock

[8] Model central bank laws, as recommended by the IMF, should include features for coverage of central bank losses, usually in the form of reserves. The level of reserves may be set as a multiple of capital or, as has been the case more recently, as percentage of the monetary liabilities of the central bank. When a central bank has a negative net worth, the law would require the government to issue to the central bank, securities that bear interest at market rates.

variables needed to project interest-related items can be derived from monetary sector projections of the central bank's and financial institutions' balance sheets. Associated interest rates can be projected based on benchmark rates—such as World Economic Outlook (WEO) interest rates for foreign assets and liabilities, and domestic interest rates for other stock variables. The mark-up added to these benchmark rates can be determined based on historical data and can be adjusted according to information on future policy changes or user expectations of market developments. The projection of noninterest items is likely to change depending on country characteristics and on the detailed information that the user has on these items. In the absence of detailed information, best judgment can be used to determine the future path of these items—allowing them to grow in line with either the CPI or GDP is usually most convenient.

Table 1. Projecting the Banking Sector's P&L Accounts

Main Items of the P&L Accounts	Variables Needed for Projection	Source of These Variables
Income		
Interest received		
on foreign assets	Stock of foreign assets held by commercial banks	Monetary or external sector projections
	Average rate of return on these foreign assets	WEO projections for international interest rates
on government debt holdings	Stock of government debt held by commercial banks, by type	Fiscal/Monetary sector projections
	Associated average rate of return on these types of public debt	Fiscal sector projections
on credit to the private sector	Stock of commercial banks' credit to the private sector	Monetary sector projections
	Associated average rates charged on such credit	Depends on interest-pricing strategies of banks
on holdings of central bank	Stock of central bank instruments held by commercial banks	Monetary sector projections
instruments	Associated average rates of return on these instruments	Monetary sector projections
on other assets	If known, size of these assets and associated average rate	Depends on the assumptions
	of return; otherwise, explicit assumption based on historic data	
Commissions earned	Historical data/other relevant information depending on country specifics	Explicit assumptions needed, e.g. growth in line with banks' aggregate balance sheet
Income from various bank operations (foreign-exchange operations, securities trading, etc.)	Historical data/other relevant information depending on country specifics	Explicit assumptions needed, e.g. growth in line with banks' aggregate balance sheet
Other income	If details not available, could grow in line with GDP or with average interest rate, depending on main source of this item	Real/Monetary sector projections
Expenses		
Interest paid		
on foreign liabilities	Stock of foreign liabilities held by commercial banks	Monetary or external sector projections
	Average rate of return on these foreign liabilities	WEO projections for international interest rates
on private sector deposits	Stock of deposits with commercial banks (could be by type)	Monetary sector projections
	Average rate of return on these deposits, by type if needed	Depends on interest-pricing strategies of banks
on public sector accounts	Stock of public sector deposits with commercial banks	Monetary/fiscal sector projections
	Average rate of return on these deposits	Depends on interest-pricing strategies of banks
other liabilities	If known, size of these liabilities and associated average rate of return; or else, explicit assumption based on historic data	Depends on the assumptions, usually monetary sector projections
Provisions	NPLs and information on supervisory rules for provisioning	Monetary sector projections, and other information depending on provisioning rules
Commissions paid	Historical data/other relevant information depending on country specifics	Explicit assumptions needed; e.g., growth in line with banks' aggregate balance sheet
Salaries and general expenses	Mostly administrative expenses, could grow in line with the CPI	Real sector projections
Other expenses	Historical data/other relevant information depending on country specifics	Depends on the assumptions

Table 2. Projecting a Central Bank Income Statement

Items of an Income Statement	Variables Needed for Projection	Source of These Variables
Income		
Interest received		
on foreign assets	Stock of foreign assets held by the central bank	Monetary or external sector projections
	Average rate of return on these foreign assets	WEO projections for international interest rates
on government debt holdings	Stock of government debt held by the central bank	Fiscal/Monetary sector projections
	Average rate of return on this government debt	Fiscal sector projections
other assets	If known, size of these assets and associated average rate of return; otherwise, explicit assumption based on historic data	Depends on the assumptions
Other income	If details not available, could grow in line with GDP or with average interest rate, depending on main source of this item	Real/Monetary sector projections
Expenses		
Interest paid		
on foreign liabilities	Stock of the central bank's foreign liabilities	Monetary or external sector projections
	Average rate of return on these liabilities	WEO projections for international interest rates
on financial sector deposits	Financial institutions' deposits at central bank	Monetary sector projections
	Average rate of return on these deposits	Monetary sector projections
on central bank paper	Stock of central bank paper held outside the central bank	Monetary sector projections
	Average rate of return on this paper	Monetary sector projections
on public sector accounts	Stock of public sector deposits at central bank	Monetary/fiscal sector projections
	Average rate of return on these deposits	Monetary sector projections
Provisions	Information on central bank rules for provisioning	Depends on central bank rules for provisioning
General expenses	Mostly administrative expenses, could grow in line with the CPI	Real sector projections

APPLICATION OF THE PROPOSED FRAMEWORK TO A HYPOTHETICAL COUNTRY CASE

This appendix provides an application of the framework developed in this paper to a hypothetical country case. The focus is on the banking sector. The companion CD-ROM (available from the authors upon request) should be consulted for several details which could not be covered in the text. Section I.A describes the country's aggregated banking sector P&L accounts. Section B presents a detailed description of the underlying rationale for projecting interest rates and nonperforming loans. Section I.C provides a summary of the baseline results. Section D demonstrates how the toolkit can be used to carry out scenario analysis for the financial sector under stresses of large devaluations and associated interest rate and credit risk shocks. Section I.E presents the results of sensitivity analyses of bank profitability to changes in policy parameters and risk factors: two cases are considered, increased banking sector competition and the adoption of Basel II.

A. Aggregated P&L Accounts of the Banking Sector

The example is tailored to a country with three key features: fixed exchange rate, large-scale dollarization of bank assets and liabilities, and substantial bank exposure to the sovereign. It is assumed that about two-thirds of commercial bank deposits and four-fifths of commercial bank loans are denominated in foreign currency (FC). Commercial bank exposure to the sovereign is assumed to represent just above half of total bank assets and nearly half of it is denominated in local currency (LC). Table 1 below shows the main initial assumptions:

Table 1. Main Initial Assumptions 1/

Balance Sheet Items, Commercial Banks	LC, billion	(percent of total assets)	**Interest Rates** (in percent)	
Deposits with Central Bank	28,146	31.2	6-month USD LIBOR	1.3
of which in FC	11,776	13.0	5-year U.S. Note	3.0
of which Certificates of Deposit	11,686	12.9	LC Treasury Bond (2 year)	7.8
LC Loans	3,711	4.1	FC Treasury Bond (5 year)	7.0
FC Loans	18,795	20.8	LC Commercial Bank Deposit	7.8
LC Treasury Bonds	11,366	12.6	FC Commercial Bank Deposit	3.6
FC Treasury Bonds	9,595	10.6	LC Commercial Bank Loan	13.4
Foreign Assets	14,934	16.5	FC Commercial Bank Loan	9.1
LC Private Sector Deposits	23,491	26.0	Certificate of Deposit	4.9
FC Private Sector Deposits	37,974	42.1	FC Deposit at the Central Bank	3.2
Nonresident Deposits	11,623	12.9		

1/ Additional details on other balance sheet items and interest rates are available from the authors upon request.

The interest-related components of the P&L accounts

By design, the commercial banks' main source of income is interest earned on their government debt holdings—LC denominated debt, assumed to be in the form of treasury bills (T-bills) and FC denominated debt, assumed to be in the form of Eurobonds. In addition, they also earn interest income on holdings of central bank paper, assumed to be in the form of certificates of deposit (CDs), direct deposits at the central bank which we assume here are denominated in FC, private sector loans (in both LC and FC), and foreign assets. Banks pay interest on private sector deposits, foreign liabilities, and subordinated debt.

- Interest earned on T-bills and Eurobond holdings is an inherent part of fiscal accounts and is therefore provided separately by the fiscal sector projections.

- Interest earned on credit to the private sector is calculated based on the projected stocks of foreign and domestic currency credit, an input from the monetary sector projections, and on the commercial bank lending rates in LC and FC, which are linked to the deposit rates in corresponding currencies plus a spread.

- Interest earned on foreign assets is calculated based on the projected stocks of foreign assets, an input from the balance of payments projections. The interest rate on foreign assets is assumed to be linked to the 6-month U.S. dollar LIBOR (hereafter referred to as "LIBOR") because commercial banks' foreign assets are assumed to be largely invested in highly-rated investment-grade liquid assets.

- Foreign currency deposits with the central bank are assumed to be remunerated according to their maturity structure, with interest rates linked to the LIBOR. The overall stock of commercial bank deposits is an input from the monetary sector projections, with a given split between short- and long-term deposits that is assumed to remain constant over time.

- Central bank CDs are an input from the monetary sector projections and are assumed to include two types: special CDs, which are long-maturity and high-yield instruments; and regular CDs remunerated at a rate assumed to grow in line with LIBOR over the medium term.

- Interest expenses on private sector deposits are calculated based on the stocks of domestic and foreign currency deposits obtained from the monetary sector projection. The interest rates paid on these deposits are linked to the T-bill and Eurobond rates, respectively, assuming rates of return on government debt serve as reference rates for banks.

- The share of LC to FC in commercial banks' foreign liabilities is assumed to be the same as of the one that holds for domestic private sector deposits.[9] The interest rate

[9] An alternative assumption can be that all foreign liabilities are denominated in foreign currency.

paid on these liabilities is assumed to be a weighted average of the domestic and foreign currency deposit rates.

- Subordinated debt is assumed to account for a very small proportion of bank liabilities. Related interest expenses are projected as a constant ratio relative to deposits, using the ratio from the most recent observation.

The noninterest-related components of the P&L accounts

The non-interest component of the P&L accounts of the banking sector are set to include commissions, fees, other operating income, general and administrative expenses, and provisions.

- On the income side, net commissions are projected as a constant share of deposits plus loans, on the presumption that net commissions are generated from the asset as well as from the liability side of the balance sheet.

- Other income—which includes net income from foreign exchange operations and from securities portfolio, recovered provisions, other operating income, and extraordinary income—is projected as a constant share of the sum of deposits and loans. As this can be a rather volatile item, it is preferable to base the projection on the average share observed over several years. In this example, the average share over the last 5 years is used.

- On the expenditure side, general and administrative expenses—which include general expenses, salaries and wages, and net income from affiliates—are assumed to grow in line with the CPI (which is provided by the macroeconomic projections).[10]

- Loan-loss provisions are projected as a share of problem loans. The latter can be assumed to remain a constant share of total loans (maintained constant at the level of the most recent observation). Alternatively problem loans can be projected based on estimates of Equation (1). The latter approach is developed in the next section.

The projections listed above allow deriving gross profits over time. To derive the projection of bank capital, the tax rate on profits and the payout ratio need to be specified. The tax rate is assumed to be 15 percent, and the payout ratio is assumed to be zero from 2005 onwards.

B. Interest Rate and NPL Projections

This section concentrates on two key elements involved in projecting banks' P&L accounts. First, it elaborates the projection of interest rates on government debt, central bank CDs, and commercial bank credits and deposits, in both domestic and foreign currency. Underlying

[10] The user, subject to data availability, could implement a more refined projection based on the number of employees in the banking sector and the growth of average salaries.

these rates are various assumptions regarding the transmission mechanisms from international to domestic interest rates and from domestic reference rates to commercial bank interest rates. Additional assumptions are also embedded in these interest rates on the size of various types of risks such as sovereign risk and credit risk. These risks are measured through spreads, whose values are represented by baseline parameters that can be modified for stress-testing purposes. Second, this section presents a method for projecting problem loans based on estimates of Equation (1) by Cayazzo et al. (forthcoming), thus providing the key input for the projection of loan loss provisions.

Interest rate projections

Interest rate projections are particularly important in this example because of the large share of interest income and expenses in the banks' profit and loss accounts: by construction, interest income of the aggregated commercial banking sector accounts for about 85 percent of total income, and interest expenses represent 70 percent of overall expenses. These large shares stem from the assumed large exposure of commercial banks to sovereign interest-bearing assets and to the private sector in the form of loans, as well as from their reliance on private sector deposits for funding—corresponding to about 80 percent of total bank assets.

Detailed projections for commercial banks and central bank rates are not part of the usual set of medium-term macroeconomic projections in a standard IMF financial programming exercise: the user should develop such projections. In this example, we propose to estimate a stylized model for the transmission mechanism of international reference rates to domestic rates in order to identify the main factors driving domestic interest rates. Figure 3 represents the linkages featured in such a model when applied to the country example at hand. There is a direct link from U.S. dollar interest rates (the six-month LIBOR rate and the five-year U.S. T-bill rate are used in this example) to interest rates on government debt (LC T-bills and U.S. dollar Eurobonds, respectively). A direct link is also assumed between these international rates and rates of return on central bank instruments. Commercial banks in turn are assumed to link the interest rates offered on private sector deposits and loans to the rates of return on government paper.

The specific assumptions underlying the baseline interest rate projections are as follows:

- International reference rates used are taken from the September 2005 WEO assumptions.

- Spreads between interest rates on government T-bills and Eurobonds, on the one hand, and the LIBOR and U.S. T-bill rate, on the other, are set at 650 basis points (bp) and 350 bp, respectively. They are assumed to remain at these levels as public debt is assumed to remain broadly unchanged in the near-term, and fall slightly during 2006–09. The choice of the LIBOR and the U.S. T-bill rate as the specific reference rates for sovereign T-bills and Eurobonds, respectively, is largely based on the maturity structure of those two instruments. The interest rate on Eurobonds, which are assumed to have a longer average maturity than T-bills, is linked to the reference rate corresponding to an instrument with longer maturity itself, U.S. T-bills.

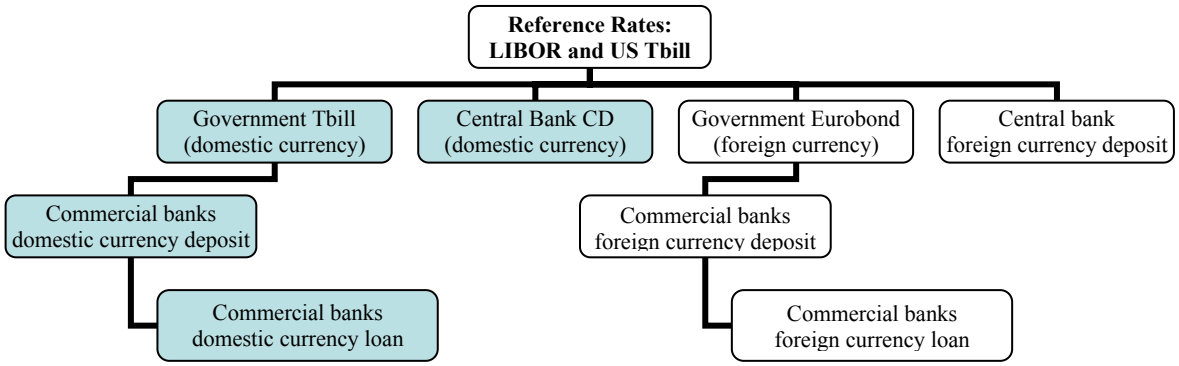
- Interest rates on government debt in the secondary market—or, if the latter is not well-functioning, in the primary market—can be used as reference rates for interest rates on commercial bank deposits. Alternatively, the rate on central bank CDs could also be used. In this example, the rate in the primary market is adopted as the key reference interest rate for commercial banks' rates. The LC deposit rate is assumed to follow the T-bill rate minus a spread of 150 bp, and the FC deposit rate is set at 150 bp below the Eurobond rate. Furthermore, a correction is made to account for the effect of the term-structure as the average maturity of foreign currency deposits (short-term) differs from that of Eurobonds (over two years).

- The spread between deposit and lending rates is assumed at 500 bp for foreign currency instruments and at 400 bp for domestic currency instruments.

- The interest rate on most central bank CDs is linked to the LIBOR plus a constant spread. Only a subset of central bank CDs is assumed to be long-term and carry a fixed rate of return, set at 11 percent.

- By assumption, banks' FC deposits at the central bank can have a maximum maturity of three years. The interest rate on such deposits with three-year maturity, when newly issued, is set at 3¾ percent for 2004 and at the LIBOR plus a spread of 130 bp for 2005–09. New FC deposits with less than three-year maturity are assumed to earn the LIBOR on average. Existing three-year foreign currency deposits, which would mature between 2004 and 2006, are assumed to be rolled over at the prevailing average three-year FC deposit rate.

Figure 1. Interest Rate Transmission Mechanism



NPL Projection

As indicated above, the projection of NPLs is an important input to project loan loss provisions in the P&L accounts. The future path of NPLs could be set a priori, based on assumptions about the health of the corporate and household sectors. For example, assuming the quality of private sector loans is not likely to change significantly over the medium term, the NPL to total loan ratio could be set at a constant (say 30 percent) threshold. However,

provisions against credit risk being a key element among the noninterest components of the P&L accounts, it would be preferable to make use of model-based projections of NPLs.

Such a model can be based on Cayazzo et al. (forthcoming), who provide estimates of the behavior of problem loans for a number of partially-dollarized countries. In modeling the growth of the NPL to total loans, these authors adopt the following model specification:

Growth of NPL ratio(t) =
f[real GDP growth(t-1), depreciation(t-1), inflation(t-1), lending rate(t-1)] (a)

Table 2 shows the results from estimating equation (a) for selected countries. The results indicate that a depreciation of the domestic currency increases the growth rate of the NPL ratio (currency-induced credit risk) in Bolivia, Peru, and Poland, but has no statistically significant effect in Brazil, Chile, or the Slovak Republic. In all countries the authors found a significant effect of the growth of NPLs arising from output deceleration and rises in interest rates. Inflation reduces the real value of debt thus facilitating repayment, and this effect was found in Peru; however, the opposite effect is found for Bolivia.

Table 2. Estimates of Annual NPL Growth Rates in Selected Banking Systems

	Brazil	Bolivia	Chile	Peru	Poland	Slovak Republic
Depreciation	-0.06	6.9**	-0.02	1.57**	0.47**	-0.01
Production growth	-1.45**	-7.5**	-4.73**	-0.91*	-0.64**	-1.13*
Interest Rate	0.55**	3.3**	3.60**	4.70**	3.10**	2.40***
Inflation	0.60	1.5*	0.49	-5.40**	0.61	-0.24
Adjusted R^2	0.55	0.58	0.67	0.82	0.66	0.30
Observations	Jan98-Jan04	90:Q1-04:Q3	Feb97-Oct04	Dec94-Sep04	Nov99-Apr04	Jan96-Sep04

Source: Cayazzo et al. (forthcoming). Estimates are based on monthly data, except for Bolivia where quarterly data are used. Also, a post-1998 dummy variable is included in the case of Bolivia to capture structural changes in the economy and the financial system, including the opening to foreign bank participation. The symbols "*" and "**" indicate statistical significance at the 90 and 95 percent level, respectively, based on Newey-West heteroskedasticity-autocorrelation consistent variance-covariance matrix estimates.

In this paper's example, the NPL to total loan ratio can be linked to the other macroeconomic variables using the elasticity parameters estimated for the countries in Table 2. A qualitative assessment can be made to decide which country can be best used as proxy for the country at hand. Because of similar loan dollarization levels (around 80 percent) and exports to GDP ratios (around 15 percent)—which proxies the degree of currency mismatches in the nonbank private sector—Peru appears to be the closest candidate among the countries in Table 2.

C. Summary of Baseline Results

This section presents the results obtained when implementing the proposed toolkit in the context of a baseline macroeconomic scenario for the hypothetical country at hand. The

companion CD-ROM includes detailed information and macroeconomic assumptions underlying this baseline scenario. Table 3 presents the projections obtained under that scenario for the banking sector's P&L accounts. The results show a significant drop in banks' profits from 2006 onwards, which implies a steady decline in the capital adequacy ratio to 18.1 percent by 2009. Profitability is squeezed for the following reasons, all of which stem from the macroeconomic framework projections: (i) net financing needs of the government, an important source of interest income for commercial banks, is projected to further decline on account of sustained primary surpluses and available privatization proceeds; (ii) private sector credit growth is not expected to pick up significantly to generate additional income to banks, due to over-leveraged corporates and other structural inefficiencies; and (iii) additional issues of high-yielding central bank CDs—another significant source of income for banks—are projected to be moderate, especially after 2006, consistent with ensuring a smooth reserve path over the medium term. On the positive side, less exposure to the sovereign would tend to reduce banks' main vulnerability.

More specifically, banks' net interest income, the main source of income, falls in 2004–06 as (i) interest rate on government securities come down considerably over the last year and (ii) a large amount of high-yield public debt and central bank deposits mature. The fall in interest income derived from the sovereign highlights the extent of the dependence of commercial banks' profits on government and central bank paper. As for interest expenses, they increase significantly over the medium term because of the large proportion of dollar-denominated deposits (around 65 percent of total deposits) and the projected significant increase in the deposit rate from 2005 onwards (linked to the WEO projection for the LIBOR).

Banks in general are assumed to be cautious about lending to a highly leveraged corporate sector, limiting further prospects of private sector led growth. Corporates, on the other hand, may have limited alternatives for raising equity finance (and reducing leverage), particularly in the absence of long-term institutional investors and a well-functioning capital market. In addition, the high-interest environment, perpetuated by the size of government funding needs and banks' practice of lending through overdraft facilities, also dampens private credit growth. The projected high levels of problem loans have a comparatively small effect on banks' overall net profits, as private sector credit represents a relatively small share of bank assets (below 25 percent of total assets).

D. Alternative Scenario

This section illustrates the implications of changes in baseline scenario assumptions on the framework's results. It presents the effects of a 20 percent devaluation of the local currency in 2005. The devaluation is assumed to be "orderly:" it only has a minor impact on depositor confidence and does not lead to expectations of further exchange rate changes. While subject to a number of ad-hoc assumptions whose main purpose is to maintain simplicity, this alternative scenario illustrates the sensitivity of the results obtained in Section C. to changes in macroeconomic assumptions underlying the projections. It shows that the devaluation would have a significant negative impact on profitability and on the CAR for the aggregated banking system, especially in 2005–06, although the CAR would remain well above the 8 percent Basel requirement (Table 2).

Main macroeconomic assumptions

- The devaluation is assumed to take place on January 1, 2005. No further changes in the exchange rate are assumed for 2006–09.

- The pass-through of the devaluation to consumer price inflation is assumed to be 50 percent and to be fully reflected in average inflation for 2005, with no further inflation inertia. The real exchange rate thus depreciates by 10 percent.

- The devaluation is associated with an increase in interest rates to offset its impact on investor confidence. Interest rate increases are assumed to be higher for LC assets than FC assets, consistent with the assumption of no run against the domestic currency. In particular, compared to the baseline scenario, rates of return on T-bills and Eurobonds are projected to be 500 and 300 bp higher in 2005, and 250 and 150 bp higher in 2006, respectively.

- Higher inflation and interest rates are assumed to reduce real GDP growth to 1 percent in 2005 and 2 percent in 2006. Increased competitiveness and a catch-up of investment activity are expected to raise growth to 5 percent annually thereafter.

- Access to financing sources for the government remains unchanged compared with the baseline scenario.

- Foreign currency deposits are assumed to remain stable in dollar terms, while growth of domestic currency deposits slows down in the short term.

Banking sector assumptions

- Interest rates on FC deposits at the central bank and on CDs issued by the central bank are assumed to increase by the same amount as the Eurobond and T-bill interest rates, respectively.

- The interest margins between lending and deposit rates are maintained at their baseline levels; the same holds for the spreads between T-bills and LL deposits, and between Eurobonds and foreign currency deposits.

- The ratio of NPLs to total loans is assumed to be given by equation (a). The elasticities in (a) are approximated by a weighted average of those listed in Table 2. Despite this “sub-optimal” choice of elasticities, sensitivity analysis of profitability to a range of elasticity assumptions showed that projections would not be affected significantly given the moderate exposure of banks to credit risk (private sector loans are assumed to account for only 23 percent of bank assets).

Table 3. Summary Operations of Commercial Banks, Baseline Scenario

(In billions of LC, unless otherwise indicated)

	2002	2003	Proj. 2004	Proj. 2005	Proj. 2006	Proj. 2007	Proj. 2008	Proj. 2009
Revenue	6,767	6,747	5,953	7,793	9,336	10,032	10,596	11,134
Interest income	6,154	6,046	5,186	6,975	8,467	9,112	9,629	10,118
Interest earned on government securities	2,895	3,006	1,311	1,943	2,365	2,798	3,099	3,382
Tbills and bonds	...	...	415	917	1,254	1,795	2,029	2,389
Eurobonds	...	...	896	1,026	1,111	1,003	1,070	994
Interest earned on other loans & advances	2,172	1,476	2,068	2,593	3,154	3,402	3,598	3,825
LC loans & advance	...	...	406	519	683	869	1,075	1,302
FC loans & advances	...	...	1,662	2,073	2,471	2,532	2,524	2,524
Interest earned from other sources	1,086	1,564	1,807	2,440	2,948	2,912	2,931	2,910
Interest earned on foreign assets	...	...	272	661	1,123	1,340	1,476	1,551
Interest earned on deposits at the Central Bank	...	...	576	792	916	840	893	891
Interest earned on Central Bank CDs	...	...	959	987	908	731	563	468
Net commissions earned	313	338	368	392	417	441	464	487
Other income	300	364	399	426	452	479	503	528
Expenditure	5,891	5,982	5,625	7,466	9,276	10,009	10,495	10,957
Interest expenses	4,248	4,222	3,806	5,596	7,345	8,025	8,454	8,855
Interest paid on foreign liabilities	276	276	610	986	1,378	1,543	1,636	1,698
Interest paid on debt	44	36	40	43	46	48	51	53
Interest paid on deposits	3,936	3,910	3,157	4,567	5,921	6,434	6,768	7,104
General & admin expenses	1,293	1,363	1,404	1,432	1,468	1,498	1,528	1,558
Provisions	351	396	414	438	463	486	513	544
Net profits	708	636	279	278	51	19	86	150
Total assets	82,290	92,846	99,526	105,469	111,099	116,900	121,843	127,000
Total capital	5,780	6,432	6,571	6,849	6,900	6,919	7,005	7,155
Total capital/Total assets (in percent)	7.0	6.9	6.6	6.5	6.2	5.9	5.7	5.6
Capital adequacy ratio (in percent)	19.4	22.3	21.2	20.9	20.0	19.0	18.5	18.1
Interest rate assumptions (in percent):								
US$ LIBOR (6 month) 1/	1.9	1.3	1.6	3.4	5	5.3	5.3	5.3
FC deposit rate	4.2	3.6	3.7	5.4	7.0	7.3	7.3	7.3
LC deposit rate	10.3	7.8	6.7	8.4	9.6	9.8	9.8	9.8
FC lending rate	10.0	9.1	8.7	10.4	12.0	12.3	12.3	12.3
LC lending rate	16.6	13.4	10.7	12.4	13.6	13.8	13.8	13.8
Eurobond (5 year, marginal rate)	7.9	7.0	7.0	8.3	9.2	9.5	9.8	9.9
Tbill (2 year, marginal rate)	14.1	7.8	8.2	9.9	11.1	11.3	11.3	11.3
Central Bank CD rate	...	4.9	4.8	6.5	8.1	8.4	8.4	8.4
Central Bank FC deposit (3 year rate)	...	...	3.8	4.7	6.3	6.6	6.6	6.6
Volumes								
LC deposits	20,277	26,031	26,989	27,832	29,266	30,773	32,217	33,750
FC deposits	4,746	48,441	55,044	59,867	64,012	68,287	71,700	75,173
LC loans	4,055	3,711	3,897	4,482	5,602	7,002	8,578	10,294
FC loans	8,702	18,795	19,641	20,427	20,721	20,623	20,584	20,623
Foreign assets	4,326	14,934	18,617	20,871	23,978	27,086	29,141	29,941
Foreign liabilities	11,065	14,021	16,597	18,097	19,697	21,297	22,147	22,947
FC deposits with the central bank	8,164	11,776	13,761	14,129	14,723	14,340	14,340	14,283
LC deposits with the central bank	1,085	2,087	3,286	2,082	2,194	2,312	2,424	2,544
Holdings of Central Bank CDs	572	11,686	10,232	9,495	7,316	7,685	5,744	5,434
Special time deposits with the Central Bank	...	...	1,055	1,055	1,055	...	...	...
Other assumptions (in percent)								
Ratio of gross problem loans to total loans	29.8	31.7	31.7	31.7	31.7	31.7	31.7	31.7
Share of after-tax profits going to capital	80.0	50.0	50.0	100.0	100.0	100.0	100.0	100.0

Source: Central bank and IMF staff own estimates.
1/ As per WEO, 6-months U.S. dollar LIBOR.

Main results

Revaluation gains: Commercial banks have a net long foreign exchange trading position of less than 1 percent of core capital (of about LC 100 billion). The devaluation of the local currency therefore leads to a net gain in 2005, but the quantitative effect is relatively small.

Table 4. Summary Operations of Commercial Banks, Devaluation Scenario

(In billions of LC; unless otherwise indicated)

	2002	2003	Proj. 2004	Proj. 2005	Proj. 2006	Proj. 2007	Proj. 2008	Proj. 2009
Revenue	6,767	6,747	5,953	9,064	11,639	11,118	10,573	11,722
Interest income	6,154	6,046	5,186	8,227	10,771	10,198	9,607	10,706
Interest earned on government securities	2,895	3,006	1,311	1,988	4,023	3,884	3,077	3,971
Tbills and bonds	...	...	415	792	2,715	2,711	1,819	2,811
Eurobonds	...	...	896	1,196	1,309	1,173	1,258	1,159
Interest earned on other loans & advances	2,172	1,476	2,068	3,403	3,589	3,402	3,598	3,825
LC loans & advance	...	...	406	729	809	869	1,075	1,302
FC loans & advances	...	...	1,662	2,674	2,780	2,532	2,524	2,524
Interest earned from other sources	1,086	1,564	1,807	2,836	3,158	2,912	2,931	2,910
Interest earned on foreign assets	...	...	272	661	1,123	1,340	1,476	1,551
Interest earned on deposits at the Central Bank	...	...	576	1,067	1,103	840	893	891
Interest earned on Central Bank CDs	...	...	959	1,107	932	731	563	468
Net commissions earned	313	338	368	392	417	441	464	487
Other income	300	364	399	445	452	479	503	528
Expenditure	5,891	5,982	5,625	10,904	11,245	10,267	10,737	11,181
Interest expenses	4,248	4,222	3,806	8,792	9,040	8,025	8,454	8,855
Interest paid on foreign liabilities	276	276	610	1,545	1,682	1,543	1,636	1,698
Interest paid on debt	44	36	40	43	46	48	51	53
Interest paid on deposits	3,936	3,910	3,157	7,204	7,313	6,434	6,768	7,104
General & admin expenses	1,293	1,363	1,404	1,573	1,612	1,644	1,677	1,711
Provisions	351	396	414	539	593	597	605	615
Net profits	708	636	279	-1,840	335	723	-163	460
Total assets	82,290	92,846	99,526	103,352	109,265	115,771	120,465	125,931
Total capital	5,780	6,432	6,571	4,732	5,066	5,790	5,626	6,086
Total capital/Total assets (in percent)	7.0	6.9	6.6	4.6	4.6	5.0	4.7	4.8
Capital adequacy ratio (in percent)	19.4	22.3	21.2	14.7	14.9	16.1	15.0	15.6
Interest rate assumptions (in percent):								
US$ LIBOR (6 month) 1/	1.9	1.3	1.6	3.4	5	5.3	5.3	5.3
FC deposit rate	4.2	3.6	3.7	8.4	8.5	7.3	7.3	7.3
LC deposit rate	10.3	7.8	6.7	13.4	12.1	9.8	9.8	9.8
FC lending rate	10.0	9.1	8.7	13.4	13.5	12.3	12.3	12.3
LC lending rate	16.6	13.4	10.7	17.4	16.1	13.8	13.8	13.8
Eurobond (5 year, marginal rate)	7.9	7.0	7.0	11.3	10.7	9.5	9.8	9.9
Tbill (2 year, marginal rate)	14.1	7.8	8.2	14.9	13.6	11.3	11.3	11.3
Central Bank CD rate	...	4.9	4.8	11.5	10.6	8.4	8.4	8.4
Central Bank FC deposit (3 year rate)	...	...	3.8	7.7	7.8	6.6	6.6	6.6
Volumes								
LC deposits	20,277	26,031	26,989	27,832	29,266	30,773	32,217	33,750
FC deposits	44,746	48,441	55,044	59,867	64,012	68,287	71,700	75,173
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Foreign liabilities	11,065	14,021	16,597	18,097	19,697	21,297	22,147	22,947
FC deposits with the central bank	8,164	11,776	13,761	14,129	14,723	14,340	14,340	14,283
LC deposits with the central bank	1,085	2,087	3,286	2,082	2,194	2,312	2,424	2,544
Holdings of Central Bank CDs	572	11,686	10,232	9,495	7,316	7,685	5,744	5,434
Special time deposits with the Central Bank	...	...	1,055	1,055	1,055	...	...	...
Other assumptions (in percent)								
Ratio of gross problem loans to total loans	29.8	31.7	31.7	39.0	40.6	39.0	37.4	35.9
Share of after-tax profits going to capital	80.0	50.0	50.0	100.0	100.0	100.0	100.0	100.0

Sources: Central Bank and IMF staff estimates.
1/ As per WEO, 6-month U.S. dollar LIBOR.

Net Interest Income: Following the devaluation, the increase in the rate of return on government paper is passed on to banks' deposit and lending rates, and to the rates on commercial bank deposits with the central bank. The large deposit base (over 80 percent of assets) being mostly short term by assumption, interest rate changes are fully passed through to banks' interest expenses in the devaluation year. Thus the substantial increase in interest rates in 2005–06 relative to the baseline leads to a significant increase in banks' interest expenses, but this is not matched in size by the increase in interest income on commercial bank deposits with the central bank and T-bills and Eurobond holdings—the increase in interest rates on government debt is spread out over the medium term because of the maturity structure of this debt. In the outer years, net interest income improves relative to 2005–06 boosted by both increasing rates of return on government paper and bank deposit rates returning to their baseline level.

Non-Interest Income/Expenses: A key effect of the devaluation is on banks' indirect exposure to exchange rate risk through unhedged borrowers. Overall, the devaluation and subsequent changes to inflation and real GDP growth rates lead to a moderate deterioration in the NPL ratio from 32 percent in 2004 to 39 percent in 2005 and 41 percent 2006. Both exchange rate devaluation (adjusted for inflation) and the fall in GDP growth tend to worsen credit quality. However, during 2007–09, credit quality improves as a result of the positive output effect of the real devaluation.

E. Sensitivity Analysis (Stress Testing)

The previous sections have used the proposed financial surveillance tool both as an integral part of the financial programming exercise and to evaluate alternative macroeconomic scenarios. This section shows how this tool can also be used to conduct sensitivity analysis of banking sector performance to economic and/or policy shocks. As an example, two scenarios are considered:

- **Scenario 1**: A competitive squeeze in the deposit-lending spreads. In the baseline scenario, spreads between the commercial bank average deposit rate and the average lending rate are projected to remain constant over the medium term at 500 bps and 400 bps for foreign and domestic currency, respectively. A test of the results' sensitivity to this assumption can be constructed by assuming that, because of increased competition in the banking industry, say, these spreads are squeezed from 2005 onwards to 300 bps and 200 bps for foreign and domestic currency deposits, respectively.

- **Scenario 2**: A change in policy. In addition to Scenario 1, this scenario assumes a change in prudential regulations stipulating higher risk-weighting of government debt held by commercial banks, in accordance with the enhanced risk-based approach buttressed by Basel II. In the baseline scenario, T-bills are zero risk-weighted and Eurobonds are risk-weighted with weights ranging from 20 percent to 50 percent depending on maturity. This scenario, assumes a risk weight of 20 percent for T-bills and 100 percent for Eurobonds.

Introducing these changes to the framework built in the previous sections yields the results summarized in Table 5. Under Scenario 1, because of the large share of interest income in banks' P&L, losses increase substantially from 2005 onwards. However, the high level of bank capital in 2004 allows banks to absorb losses during 2005–09, at the expense of the CAR falling from 20.7 percent in 2005 to 15.3 percent by end-2009. Superimposed on this shock, the assumption in Scenario 2 of an increase in the risk-weight of government debt leads to a large increase in bank risk-weighted assets—banks' holding of T-bills and Eurobonds is about 26 percent of total assets. This increase in risk-weighted assets in 2005 further reduces the CAR rapidly to 14.7 percent in 2005 and to 10.9 percent by 2009.

Table 5. Sensitivity Analysis

(In billions of LC, unless otherwise indicated)

		2003	2004	2005	2006	2007	2008	2009
Scenario 1	CAR (in percent)	22.3	21.2	20.7	19.1	17.5	16.4	15.3
	Net Profits	636	279	-298	-208	-288	-164	-160
Scenario 2	CAR (in percent)	22.3	21.2	14.7	13.8	12.8	11.8	10.9
	Net Profits	636	279	-298	-208	-288	-164	-160

Note: IMF staff estimates. Scenario 1 assumes a decrease in the spread between bank deposit and lending rates from 2005 onwards. Scenario 2 assumes that, in addition to the rate change in Scenario 1, T-bills and Eurobonds are risk-weighted at 20 percent and 100 percent, respectively.

References

Allen, M., C. Rosenberg, C. Keller, B. Sester, N. Roubini, 2002, "A Balance Sheet Approach to Financial Crisis," IMF Working Paper 02/210 (Washington: International Monetary Fund).

Avesani, R. G., 2005, "FIRST: A Market-Based Approach to Evaluate Financial System Risk and Stability," IMF Working Paper 05/232 (Washington: International Monetary Fund).

Blaschke, W. J., M. T. Jones, G. Majnoni, S. Martinez Peria, 2001, "Stress Testing of Financial Systems: An Overview of Issues, Methodologies, and FSAP Experiences," IMF Working Paper 01/88 (Washington: International Monetary Fund).

Cayazzo, J, S. Heysen, A. Garcia Pascual, E. Gutierrez, forthcoming, "Toward the Effective Supervision of Partially Dollarized Financial Systems," in *Financial Dollarization: The Policy Agenda* (Palgrave Macmillan).

International Monetary Fund, 2004, "Eastern Caribbean Currency Union: Financial System Stability Assessment, including Report on Observance of Standards and Codes on Banking Supervision," IMF Country Report No. 04/293. Available via the internet at http://www.imf.org/external/pubs/ft/scr/2004/cr04293.pdf

———, 2005, "Norway: Financial System Stability Assessment, including Reports on the Observance of Standards and Codes on the following Topics: Banking Supervision, Insurance Regulation, and Payment Systems," IMF Country Report No. 05/200. Available via the internet at http://www.imf.org/external/pubs/ft/scr/2005/cr05200.pdf

Owen E., Alfredo M. Leone, Mahinder Gill, and Paul Hilbers, 2000, Macroprudential Indicators of Financial System Soundness, IMF Occasional Paper No. 192. Available via the internet at http://www.imf.org/external/pubs/ft/op/192/OP192.pdf