June 2006
IMF Country Report No. 06/216

Spain: Financial Sector Assessment Program—Technical Note—Stress Testing Methodology and Results

This Technical Note on Financial Sector Assessment Program on Stress Testing Methodology and Results for Spain was prepared by a staff team of the International Monetary Fund as background documentation to the Financial Sector Assessment Program with the member country. It is based on the information available at the time it was completed in May 2006. The views expressed in this document are those of the staff team and do not necessarily reflect the views of the government of Spain or the Executive Board of the IMF.

The policy of publication of staff reports and other documents by the IMF allows for the deletion of market-sensitive information.

To assist the IMF in evaluating the publication policy, reader comments are invited and may be sent by e-mail to publicationpolicy@imf.org.

Copies of this report are available to the public from

International Monetary Fund ● Publication Services
700 19th Street, N.W. ● Washington, D.C. 20431
Telephone: (202) 623 7430 ● Telefax: (202) 623 7201
E-mail: publications@imf.org ● Internet: http://www.imf.org

Price: $15.00 a copy

International Monetary Fund
Washington, D.C.

FINANCIAL SECTOR ASSESSMENT PROGRAM

SPAIN

TECHNICAL NOTE ON STRESS TESTING METHODOLOGY AND RESULTS

MAY 2006

INTERNATIONAL MONETARY FUND
Monetary and Financial Systems Department

Contents

I. OVERVIEW

1. **This note presents a description of the stress test exercises for Spain's banking and insurance systems**.[1] The exercises were carried out in the context of the FSAP with the aim of assessing the resilience of the financial system to key risks. The note describes the coverage of the exercises, the risks considered, the magnitude of the shocks to the risk factors, the models and instruments, and the results. The material benefits from background work and documents prepared by the authorities.

2. **The stress tests were conducted at the consolidated group level, covering the most important risk exposures**. Shocks were applied, depending on the exercise, to either domestic business, overseas business, or both. Since Spain was in the process of implementing IFRS in 2005, the exercises were based on financial information as of end-2004.

3. **The stress tests for banking included sensitivity and scenario analysis**. Sensitivity analysis focused on the effects of one-off shocks to one or several risk factors, on the financial position of credit institutions. Scenario analysis assessed the effects of a simultaneous, internally consistent, change in a group of macroeconomic variables, on the financial position of credit institutions. Four scenarios were considered, taking into account the main risk factors and exposures of Spain's financial system: (a) a permanent increase in oil prices to US$80 per barrel; (b) a fall in real house prices in Spain and the United Kingdom;[2] (c) a 30-percent depreciation of the U.S. dollar against other currencies; and (d) a crisis in Latin America.[3] The effects of these shocks on the Spanish economy were simulated over a two-year window, with the help of models developed by the Bank of Spain (Banco de España, BE).

4. **The core set of stress test exercises were carried out directly by a group of systemically-important credit institutions following a bottom-up approach**. The exercises covered market risk, interest rate risk, credit risk, and liquidity risk. The institutions used their own datasets and internal models, while applying the shocks and scenarios agreed between the authorities and the mission. The participating institutions included the 7 largest financial groups, encompassing 37 credit institutions and roughly two-thirds of system assets (Table 1). These groups have

---

[1] Prepared by Francisco Vázquez with a contribution from Antonio García Pascual (insurance section).

[2] For Spain, the scenario considered a cumulative fall of real house prices by 30 percent over five years, which translated into decrease of real house prices of 17.3 percent during the first year and 4.6 percent during the second, emulating the time profile observed during the previous downturn. For the United Kingdom, the scenario considered a 37 percent fall in real house prices, which translated into a decrease of 20 and 8 percent decrease during the first and second year, respectively.

[3] A drop in house prices in the United Kingdom and a crisis in Latin America were chosen as adverse events that could affect Spanish banks, given their large presence in these markets.

Table 1. List of Groups Participating in the Stress Test Exercises

Banking Group	Assets (Percent of System)	Liabilities (Percent of System)
BSCH	30.8	29.6
BBVA	16.7	15.1
Caixa	7.3	8.5
Caja Madrid	4.7	5.1
Popular	3.4	3.8
Sabadell	2.3	2.6
Bankinter	1.6	1.3
Total Sample	66.9	65.9

Source: BE.

been identified as candidates for the IRB approach under Basel II, and are currently working in the implementation phase.

5. **Complementary exercises were carried out by both the authorities and the mission using a top-down approach**. Stress tests on selected sources of risk, covering the entire banking system, were implemented by the authorities using supervisory data and off-site supervisory models. These exercises included sensitivity analysis on credit risk and liquidity risk, as well as scenario analysis, providing a way to generalize and cross-check the results obtained by the participating credit institutions. The mission conducted a complementary exercise to assess equity risk in the banking book based on sensitivity analysis, and a series of macro-stress tests combining dynamic panel models with scenario analysis, to assess credit risk from exposures to the domestic market—particularly housing.

6. **To the extent possible and where applicable, parallel stress tests were conducted for the insurance sector**. The decision to cover insurance was motivated by its systemic importance and the cross-sector linkages arising from the ownership of insurance companies by credit institutions. The stress tests for insurance were conducted directly by a sample of 27 insurers, covering 50 percent of the non-life market and 62 percent of the life market. The exercises followed the approach of the Preparatory Field Study proposed by the Committee of European Insurance Supervisors (CEIOPS) in preparation of the new solvency standard for European insurance. Two sets of risk factors were assessed. The first encompassed market risks, interest rate risk, and credit risk, all of which were assessed using the shocks applied to the banking system. The second dealt with insurance-specific risk factors, including underwriting risk, lapse risk, and non-life risk. In the relevant cases, the results obtained for insurance were added to those obtained by their parent credit institutions to assess the cross-sector impact.

7. **Overall, the results indicated that the banking system would be able to absorb the losses associated with the shocks considered without systemic distress**. This reflects a

combination of factors, including the strong asset quality of the vast majority of credit institutions, the comfortable loan-loss cushion induced by the dynamic provisioning system, the use of sound risk management practices by the systemically important institutions, and the supportive macroeconomic environment.

8. **Equity price risk from investments not marked-to-market was found to be large but not a threat to capital adequacy due to large unrealized gains in many credit institutions**. Equities maintained at book value in the not-for-sale portfolios, which included large holdings of industrial participations,[4] represented a substantial source of risk for some credit institutions. An exercise based on a sample of 19 credit institutions representing roughly 80 percent of system assets, indicated that a 30 percent across-the-board drop in equity prices would generate losses equivalent to 8.6 percent of regulatory capital (14.3 percent for the sampled cajas). However, large unrealized gains in most systemically important credit institutions offered a substantial margin against a decline in equity markets, as they amounted to 12 percent of regulatory capital (24 percent for cajas). At the same time, market risks in the trading portfolios were found to be minimal, due to their relatively small size and the active use of hedging strategies by the systemically important institutions.

9. **Liquidity risk was found to be small, albeit some large credit institutions showed considerable reliance on the issuance of securities, which may entail risks if liquidity conditions were to deteriorate for the whole system**. The systemically important credit institutions have access to a diversified pool of funding and sound contingency liquidity plans. On average, the seven participating groups would be able to cope with a withdrawal of 39 percent of their maturing time deposits within a month, plus 11 percent of demand deposits, without cutting back their normal operations, even if they lose access to interbank market financing. For some institutions, however, the liquidity contingency plans relied heavily on the issuance of covered bonds. This strategy could entail risks should market sentiment or liquidity conditions deteriorate on a more systemic basis, especially given Spain's increasing dependence on capital inflows, the size of the current account deficit, and views about the behavior of the housing market in Spain.

10. **Credit risk was found to be the main source of risk, but it did not seem to pose an immediate threat to capital adequacy.** Sensitivity analysis based on an increase of the probabilities of default (PDs) of mortgage and commercial loans by 200 and 100 percent, respectively, from their end-2004 levels indicated that the systemically-important credit institutions would be able to absorb the associated losses without falling below the required minimum capital adequacy ratio (CAR).[5] Estimates by the participating credit institutions produced an average loss of 1.5 percent of Basel regulatory capital, in line with BE estimates

[4] In Spain, credit institutions' equity investments in nonfinancial firms are usually referred to as "industrial participations" when they entail substantial ownership or control. Before the introduction of IFRS in 2005, these investments were usually maintained in the not-for-sale portfolios.

[5] The shocks to PDs replicated the largest yearly increase observed during 1990-2004.

for the entire system. A robustness check conducted by the mission, combining a similar shock to PDs with more conservative loss-given-default (LGD) estimates (to account for the fact that recovery values tend to go down during the economic downturn), produced average losses of about 5 percent of Basel regulatory capital.

11. **The system was also found to be resilient to a more severe scenario of sustained deterioration in credit quality**. The exercise was based on a linear increase in PDs over three years, to their average levels observed during 1993–2004 plus two standard deviations. The estimated losses were considerably higher reflecting the differences in the underlying shock. Average losses were equivalent to 13 percent of Basel regulatory capital, with a maximum of 27 percent, and resulted in four credit institutions representing 5 percent of system assets, going slightly below 8 percent Basel CAR.

12. **Parallel estimates of credit risk, combining dynamic panel models with the projected scenarios, were broadly consistent with the above results**. Overall, the models predicted a larger impact under a fall in house prices, but no threat to capital adequacy. Average losses under this scenario were equivalent to 11 percent of Basel CAR with a maximum effect of 27 percent. The effects were larger for the cajas, reflecting their larger relative exposures to the housing market, with five institutions accounting for less than 3 percent of assets going slightly below 8 percent Basel CAR. For the other two scenarios, credit losses were smaller, averaging slightly less than 7 percent of regulatory capital for the oil price shock and 5 percent for the dollar depreciation.

13. **Stress tests based on scenario analysis, conducted by the participating credit institutions and BE produced even lower loss estimates**. For the participating credit institutions, the larger losses were associated with the dollar depreciation, with an average impact of 5 percent of regulatory capital. The losses associated with a fall in house prices in Spain and the United Kingdom represented slightly more than 2 percent of regulatory capital, while those associated with the crisis in Latin America were below 1 percent. The exercises conducted by the BE produced the same relative ordering of the scenarios in terms of the associated losses, but even lower estimates.

14. **For insurance, the stress tests indicated that the system is resilient to a wide range of shocks, with differences between life, non-life, and mixed insurers**. For the sector as a whole, the largest impact would come from a fall in real estate prices, with a 17 percent price drop entailing capital losses of 5.6 percent. Underwriting risk was found to be the second most important risk factor, entailing capital losses of 4 percent for the entire system. Across institutional segments the effects were varied, reflecting idiosyncratic business differences. For life insurers, the largest impact among the shocks considered would come from a downward parallel shift of the yield curve by 200 basis points, entailing capital losses of 24.8 percent. For non-life insurers, the largest estimated impact resulted from an upward parallel shift of the yield curve, entailing capital losses of 10 percent, while mixed insurance companies were found to be relatively more exposed to risks coming from the housing market.

15. **Cross-sector risks from insurance to the banking sector were found to be small**. In all cases, the losses obtained in the stress tests for insurance companies amounted to a negligible part of the regulatory capital of their parent credit institutions.

16. **The remainder of this note presents the stress test methodology and results in more detail**. The next section refers to the stress tests for the banking system, and the following section describes the stress tests for insurance.

II. Stress Tests for the Banking System

A. Methodology

17. **The stress test exercises were based on sensitivity analysis and scenario analysis, combining bottom-up and top-down approaches**. The exercises based on the bottom-up approach were conducted directly by a sample of systemically important credit institutions, and aggregated afterwards to protect confidentiality. In parallel, the BE and the mission conducted a series of stress test exercises based on supervisory data (both at the level of individual institutions and for the entire aggregated banking system) using a top-down approach. These results were used to validate and generalize the results obtained by the participating credit institutions.

Sensitivity analysis

18. **The exercises based on sensitivity analysis comprised four sources of risk:** (a) market risk; (b) interest rate risk on all assets and liabilities; (c) credit risk; and (d) liquidity risk.[6] In all cases, the shocks were calibrated using historical information, taking into account a time frame large enough to cover at least an entire economic cycle, or encompassing episodes of financial distress.

19. **The stress tests on market risk assessed the effects of various shocks to the levels and volatilities of relevant interest rates, exchange rates, and equity prices on the trading portfolios.** Taking into account the currency composition of bank balance sheets, shocks to interest rates comprised parallel shifts and tilts to the yield curves in euros, U.S. dollars, and British pounds, and increases in interest rate volatilities (Table 2). The exercises also considered the effects of a widening of spreads on corporate bonds. On exchange rate risk, the exercises entailed shocks to the levels and volatilities of the euro exchange rates against the U.S. dollar and the British pound. On equity price risk, the exercises considered an increase in the volatility of equity indexes as well as an across-the-board drop in stock market prices, calibrated from the observed movements of the IGBM (Madrid), the DAX30 (Frankfurt), and the S&P500 (U.S.). In all cases, the shocks were set to

[6] Market risk included: interest rate risk, equity price risk and exchange rate risk *on the trading portfolios only*. A separate exercise of interest rate risk was conducted on all assets and liabilities of the participating credit institutions.

the highest (i.e., least favorable) monthly variation during 1980–2004. Monthly volatilities were measured by the standard deviation of the series, computed from daily data.

Table 2. Shocks Used in Sensitivity Analysis to Market Risks 1/

Risk Factors	Size of the Shock
Interest rates (euro, U.S. dollar, and British pound exposures)	
Interest rate increase; negative tilt	short : 100 b.p.; long: 30 b.p.
Interest rate increase; positive tilt (*)	short : 30 b.p.; long: 100 b.p.
Interest rate decrease; negative tilt	short : -30 b.p.; long: -100 b.p.
Interest rate decrease; positive tilt	short : -100 b.p.; long: -30 b.p.
Increase in volatility of short-term interest rates	25 b.p.
Increase in volatility of long-term interest rates 2/	15 b.p.
Increase in corporate bond spreads 3/	15 b.p. to 300 b.p.
Equity price	
Across the board drop in equity prices (*)	-30 percent
Increase in the volatility of market indexes	200 b.p.
Exchange rate	
Appreciation 10 percent U.S. dollar/euro	-10 percent
Depreciation 10 percent U.S. dollar/euro	10 percent
Appreciation 7 percent British pound/euro	-7 percent
Depreciation 7 percent British pound/euro	7 percent
Increase in the volatility U.S. dollar/euro	170 b.p.
Increase in the volatility British pound/euro	120 b.p.

Sources: Bank of Spain, and IMF staff estimates.
Notes:
The tests were applied to 7 banking groups covering 37 credit institutions and 67 percent of system assets.
Sensitivity analysis to multiple risk factors was also considered, entailing a combination of the shocks marked with (*).

1/ Applied to trading portfolios (i.e., actively traded assets and liabilities).
2/ For British pound exposures, the shock to volatility of long term interest rates was set to 25 b.p.
3/ The increase in corporate bond spreads was as follows: 15 b.p. for corporate bonds rated AAA through A; 100 for bonds rated BBB; and 300 b.p. for bonds rated below BBB.

20. **In addition to the shocks to single risk factors, the participating credit institutions estimated the effects of a combined shock to interest rates and equity prices on their trading portfolios**. The shocks were selected on the basis of their individual effects, maximizing the losses to be on the conservative side. The combination entailed an increase in interest rates in U.S. dollars and euros (by 30 b.p. at the short end of the yield curve and 100 b.p. at the long end), combined with an increase in the interest rates in British pounds (by 100 b.p. at the short end of the yield curve and 30 b.p. at the long end), and a 30-percent across-the-board drop in equity prices.

21. **The mission conducted a complementary exercise to measure equity price risk in the not-for-sale portfolios (i.e., banking book)**. The exercise was based on a sample of

19 credit institutions (7 banks and 12 cajas), jointly accounting for 80 percent of system assets at end-2004. The shock was an across-the-board 30-percent drop in equity prices as in the previous exercise. Unquoted participations, which accounted for 18 percent of the portfolio, were subjected to a similar shock.

22. **The stress tests also assessed interest rate risk on the overall structural positions of credit institutions**. The shocks entailed a parallel shift in the yield curve of 200 b.p., as well as an increase in its slope by 0, 50, and 100 b.p. at the one-day, three-year, and ten-year maturities, applying a linear interpolation for intermediate maturities. These shocks were applied directly by the participating credit institutions to all their assets and liabilities.

23. **The baseline exercises to assess credit risk were based on a shock to the PDs on two loan categories, mortgage credit and commercial credit**. Combined, these categories represented about 90 percent of total loans at end-2004. The size of the shocks was based on historic information taken from the credit registry (*Central de Riesgo*) for the period 1990–2004, and entailed an increase in the PDs of mortgage and commercial credit by 200 and 100 percent, respectively, from their 2004 levels. These shocks were applied to the PDs estimated by individual banks using their own internal datasets and models, and the effects computed over a one-year window. Losses were estimated by combining the stressed PDs with point-in-time LGDs, as estimated by each participating credit institution. The BE conducted a parallel exercise for the entire population of credit institutions at the aggregate level, using supervisory PDs and LGDs for each loan category. The point-in-time LGD estimates were 5 percent for mortgage loans and 25 percent for commercial loans.

24. **The mission carried out two additional stress test exercises of credit risk, based on sensitivity analysis**. The exercises were conducted on both a sample of 86 credit institutions accounting for roughly 94 percent of system assets, as well as on aggregate data for the entire system. These were used as a robustness check and to obtain information on the distribution of the results (both across and within institutional types).

25. **The first exercise used shocks to PDs similar to the baseline, combined with somewhat larger LGD estimates**. The exercise considered an increase in the LGDs to account for their typical deterioration during economic downturns. The stressed LGD values were set to 10 percent for mortgage loans (i.e., the floor set by Basel) and 45 percent for commercial loans, in line with the results obtained for the large international banks from G10 countries in the Third Quantitative Impact Study (Basel Committee of Banking Supervision).

26. **The second exercise considered a more severe deterioration of credit quality**. The exercise exploited information on loan quality during the economic downturn of the early 1990s. Shocks to the PDs of specific portfolio categories were set to their average values during 1992–2004 plus two standard deviations. To account for the fact that credit risk takes time to materialize, the exercise was conducted using a three-year window, using a linear

interpolation to increase the PD values from their current values at the beginning of the first year to the target values at the beginning of the third.[7]

27. **The assessment of liquidity risk was based on two exercises**. The first was applied by the systemically important credit institutions. It entailed a negative shock to the liabilities of an otherwise solvent credit institution—possibly triggered by adverse idiosyncratic rumors—not a systemic run. Each of the participating credit institutions was required to consider its planned response (i.e., its liquidity contingency plan), subject to the continuation of their normal business, and without resorting to extraordinary central bank financing. The institutions were allowed to select the size of the shocks, albeit on a pre-specified subset of their liabilities, and asked to describe their contingency liquidity plans in terms of sources and uses of funds, over one-week and one-month windows, using common reporting formats. This information was used to compute baseline results for each credit institution, with the relative evolution of its sources and uses of funds throughout the two sub-periods.

28. **To simulate a more stringent liquidity scenario the authorities and the mission considered two variations on the data provided by the credit institutions**. The ratios of sources versus uses of funds were recalculated after making two modifications to the information provided by the participating credit institutions. First, a minimum shock of 10 percent to demand deposits (4 percent for the first week) was applied to the responses of those institutions using a lower value. The shock was calibrated to the ninety-ninth percentile of the monthly changes in demand deposits for the participating credit institutions during 1994–2004. Second, the contingency plans were modified to close access to any proposed financing from the interbank market.

29. **The second exercise to assess liquidity risk was based on the comparison of various liquidity ratios**. The exercise was carried out by the authorities, using data for the seven credit institutions included in the sample, and conducting a parallel exercise for the entire banking system. A baseline liquidity ratio was computed comparing a broad definition of liquid assets (which included projected sources of funds within one month, plus available fixed- and variable-income securities) with liabilities maturing within one month. This liquidity ratio was recalculated by combining alternative shocks to demand deposits (in the range of 10–20 percent) with increasingly stringent assumptions on the capacity of credit institutions to liquidate their assets on short demand.

---

[7] For mortgages, the exercise entailed an increase in the PDs from 0.5 percent (the point-in-time estimate in 2004) to 6.3 percent at the end of the three-year window. For commercial loans, it entailed an increase in the PDs from 1.8 to 8.9 percent over the same period. The stressed PDs were roughly comparable to the levels observed in Spain in 1993, and below the peak levels used in a simulation exercise for an average EU bank, conducted by the ECB in 2004 (European Central Bank, Occasional Paper No.13, April 2004). The exercise also used stressed LGDs of 10 and 45 percent for mortgage and commercial loans, respectively.

Scenario analysis

30. **The stress tests also considered macroeconomic scenarios projected over a two-year horizon and based on extreme but plausible shocks to key exogenous variables.** This method facilitated the assessment of risks using an internally consistent combination of macroeconomic variables. The shocks to exogenous risk factors took into account key risk exposures. The projections were estimated by the BE with the help of existing econometric models. The models comprised four components: (a) the exogenous variables to be shocked, (b) the estimated effects of the shocks on a set of international variables using the National Institute Global Econometric Model (NiGEM), (c) the estimated effects on key Latin American economies using the Oxford Economic Forecasting model (OEF), and (d) the estimated effects on a set of macroeconomic variables in Spain, using macroeconomic models developed by the BE and effects on international variables.[8] The target macroeconomic variables simulated for the Spanish economy included GDP growth, credit growth, inflation, house prices, unemployment, interest rates, stock market prices, and the exchange rate, among others.

31. **Taking into account the most relevant risk factors and exposures of the Spanish banking system, four scenarios were considered**:

- **A decline in property prices in Spain and the U.K.** This scenario was motivated by the financial risks coming from the housing market. For Spain, the shock was calibrated by taking into account the drop in real house prices observed between 1992–1996 and estimates of house overvaluation obtained from various models developed by the BE. The proposed shock entailed a cumulative 30 percent decline in real terms over five years—17.3 percent during the first year and 4.6 percent during the second, emulating the time profile observed during the previous correction. This shock was consistent with the estimated overvaluation suggested by various models (i.e., 24–35 percent) and surpassed the historic correction observed in 1992–96.

  Due to the sizable mortgage portfolio of Abbey—a subsidiary of BSCH—the exercise also considered a concomitant drop in house prices in the U.K. The resulting scenario was applied separately to the relevant portfolios of Abbey, and the estimated losses were aggregated to those of its parent group. The shock entailed a cumulative 37 drop in real house prices over five years—20 percent during the first and 8 percent during the second. This would imply the correction of a 60 percent overvaluation in house prices in the United Kingdom, which is consistent with the upper limit of some

[8] The estimations were based on BE's quarterly macroeconomic model (Estrada *et al.* 2004: *"A Quarterly Macroeconomic Model of the Spanish Economy"*, Banco de España. Documento de Trabajo 0413), augmented with satellite equations to capture wealth effects, and to simulate the behavior of house prices, credit to households and firms, and NPLs in Spain.

estimates[9] and 15 percent above the drop in house prices observed between 1989 and 1992.

- **A permanent increase in oil prices**. This scenario was motivated by risks to economic activity associated with further increases in energy prices, especially given the high reliance of Spain on oil imports and its persistent current account deficit. The shock was calibrated to US$80 per barrel, the highest historic level in real terms, reached in 1980. This scenario entailed effects on the Spanish economy, captured by existing models developed by BE, as well as other effects (operating through commercial flows with the United States and Europe and changes in interest and exchange rates), that were modeled with the help of NiGEM. Effects on Latin America were comparatively smaller and therefore not included in the scenario.

- **A crisis in Latin America**. This scenario was motivated by the exposures of the large Spanish banks to Latin America, which, at end-2004, were concentrated in Mexico (53 percent), Chile (14 percent), Brazil (12 percent), and Argentina (4 percent). The scenario considered a political crisis in Mexico, transmitted to other countries in the region via turmoil in capital markets and international contagion. Taking into account current economic conditions and the distribution of risk exposures within the region, the scenario focused on the effects on México and Brazil. Potential effects on Chile were considered unlikely due to its robust macro-institutional situation. Other Latin American countries, such as Argentina and Venezuela, were not included in the scenario due to the relatively low bank exposures. Indirect effects in Spain via commercial flows were not taken into account as they were considered to be negligible.

  The scenarios entailed a combination of initial shocks to key financial variables. The effects on macroeconomic conditions were modeled with the help of the OEF, augmented with BE simulations. For México, the shocks entailed: (i) a permanent increase in the country risk premium by 400 b.p. (a tripling from current levels to those observed at end-2002); (ii) a 20-percent depreciation in the equilibrium exchange rate and an increase in the exchange rate risk premium by 150 b.p.; (iii) a permanent 50 percent drop in capital inflows relative to the levels observed in 2004; (iv) a gradual reduction of external competitiveness by 25 percent, originated by the effects of credit market restrictions on production costs.

  For Brazil, the initial shocks entailed: (i) a permanent increase in the country risk premium by 800 b.p. (a tripling from current levels to those observed in the first quarter of 2003); (ii) a 30-percent depreciation in the equilibrium exchange rate and

[9] See *"How Should Policymakers Respond to a Decline in House Prices?*", IMF Country Report No. 05/81, March 2005.

an increase in the exchange rate risk premium by 800 b.p.;[10] (iii) a permanent drop in capital inflows by 50 percent; and (iv) a gradual reduction in external competitiveness by 30 percent.

- **A depreciation of the U.S. dollar against other currencies**. This scenario was motivated by the persistent external U.S. imbalances, and entailed a sudden and permanent 30-percent nominal depreciation of the U.S. dollar against other main currencies, including the euro. This was slightly above the largest yearly depreciation of the U.S. dollar against the euro (ECU) observed in the last 25 years (25 percent in 1985). The effects of the shock in the U.S. and the euro area were simulated with the NiGEM. For Latin American countries, effects via commercial flows and sovereign spreads were captured directly with the OEF. For key Latin American countries, additional effects associated with turbulence in international capital markets were also considered by the BE, via increases in country risk premiums, currency depreciation, and permanent drop in capital flows. The effects of the shock (and the international environment) on the Spanish economy, were modeled directly by the BE using its own econometric models.

32. **The macroeconomic variables projected under each scenario, including the baseline, were used to estimate the impact on the financial position of banks**. The exercises were implemented using both top-down and bottom-up approaches. First, the participating credit institutions were asked to combine the projected scenarios with their own models to estimate the effects on their financial positions. Second, in order to validate and generalize the results obtained by the individual banks, the BE conducted a parallel exercise using off-site supervisory models for the aggregate banking system. These models simulated the impact of the projected macroeconomic conditions on relevant components of the aggregated balance sheet and income statement. In both cases, the effects of the stress tests based on scenario analysis were measured against the results of the baseline scenario.

33. **To provide an additional assessment of credit risk, particularly from exposures to the domestic housing market, the mission and the BE developed a set of macro stress test exercises based on dynamic panel models**. The models exploited a detailed panel database prepared by BE, covering roughly 90 percent of system assets during the period 1992–2004. The exercises were designed to provide a complementary assessment of credit risk in a way consistent with the scenarios described above. The use of dynamic panel techniques, combining time-series and panel data, allowed for the estimation of separate results across banks and cajas, and the dispersion within institutional groups.

[10] The depreciation of the equilibrium exchange rate in Mexico was assumed to be lower than that of Brazil since the latter is a relatively more closed economy.

Reporting formats

34. **The outcomes of the stress test exercises were presented using two metrics: (a) the impact on the ratio of regulatory capital to risk-weighted assets (CAR), using the Basel definition (see next paragraph); and (b) the impact on after-tax profits.** In most cases, the results included the average and maximum losses in terms of CAR and after-tax profits, and the average and minimum CAR after the shocks. Whenever possible, the reporting formats conveyed information on the distribution of the results, both across institutional types (i.e., banks, cajas, and cooperatives) and within, indicating the number of credit institutions and percent of system assets falling within specific CAR intervals after the shocks.

35. **The results of the stress tests on capital were measured against the Basel definition of own resources, while the impact on profits excludes the cushioning effect provided by provisions accumulated under the Spanish dynamic provisioning system**. The use of the Basel definition of regulatory capital was aimed at facilitating the comparison of the results with other FSAPs. Spanish solvency regulations are stricter than Basel criteria and do not count the statistical loan loss provision as part of own resources.[11] In addition, since Spain's dynamic provisioning system tends to smooth the accounting effects of loan losses on profits (Appendix 1), the reported results removed the workings of the system to reflect the true economic impact of the shocks considered, and to facilitate international comparison.[12]

36. **The losses experienced by insurance companies in the face of shocks were added to those experienced by their parent credit institutions to assess cross-sector risks in the corresponding stress test exercises.** This treatment was possible since insurance companies were not included in the consolidated financial statements of their parent credit institutions.

---

[11] The minimum CAR under Spanish solvency regulations is 8 percent as under Basel. The definition of own funds under Spanish solvency regulations, however, is stricter than the Basel definition. In terms of the amounts involved, the most important differences arise from the fact that Spanish solvency rules do not consider the statistical loan loss provisions as part of regulatory capital. Spanish regulations also impose deductions on own funds for shortfalls in provisions, for excess over limits in equity investments in non-financial companies, and for minority participations in financial companies in excess of certain limits, among other differences. Using the Basel definition of own resources, CAR for the entire system was 11.6 at end-December 2004, compared with 10.3 according to the Spanish definition.

[12] The Spanish dynamic provisioning system induces an accumulation of loan loss provisions during the upturn of the economic cycle, and uses the resulting fund to help cover loan losses during the economic downturn, thus enhancing banking solvency and financial stability.

B. Stress Test Results

Sensitivity analysis

37. **Market risks for the systemically important credit institutions were negligible, reflecting the small size of their trading portfolios and the active use of risk limits and controls by the large credit institutions**. On average, the trading portfolios of the participating credit institutions were roughly equivalent to one-third of their regulatory capital, or 6.4 percent of their credit portfolios. In all cases, the estimated losses on the stress tests for market risks accounted for a negligible part of regulatory capital (Table 3). The larger losses were obtained under the combined shocks entailing an increase in interest rates and drop in equity prices, albeit they only represented 0.07 percent of Basel CAR, on average, with a maximum impact of 1.35 percent.

Table 3. Selected Results of the Stress Tests on Market Risk and Interest Rate Risk

		Percent of Regulatory Capital		CAR After Shock (percent)		Percent of 2004 after-tax profits	
Source of Risk	Size of the shock	Average 1/	Worst	Average 1/	Worst 2/	Average 1/	Worst
Average CAR and ROA before shock were 12.68 and 0.9, respectively.							
I. Market Risks (Bank Estimates)							
Interest rate (Euro Exposures)							
Interest rate increase; negative tilt (short; long)	(100 b.p.; 30 b.p.)	-0.05	-0.13	12.68	10.14	-0.45	-0.79
Interest rate increase; positive tilt (short; long) (*)	(30 b.p.; 100 b.p.)	-0.04	-0.08	12.68	10.14	-0.32	-1.01
Interest rate (US dollar Exposures)							
Interest rate increase; positive tilt (short; long) (*)	(30 b.p.; 100 b.p.)	0.00	-0.03	12.68	10.14	-0.08	-0.37
Interest rate decrease; negative tilt (short; long)	(-30 b.p.; -100 b.p.)	-0.02	-0.07	12.68	10.14	-0.15	-0.34
Interest rate (British pound Exposures)							
Interest rate increase; negative tilt (short; long) (*)	(100 b.p.; 30 b.p.)	-0.02	-0.04	12.68	10.14	-0.24	-0.56
Interest rate decrease; negative tilt (short; long)	(-30 b.p.; -100 b.p.)	-0.01	-0.01	12.68	10.15	-0.08	-0.18
Increase in corporate spreads 3/	15 b.p.; 300 b.p.	-0.09	-0.32	12.67	10.12	-0.61	-1.70
Equity price risk in the trading book							
Across the board drop in equity prices (*)	-30 percent	-0.04	-1.30	12.68	9.99	-0.36	-15.15
Increase in the volatility of market indexes	200 b.p.	0.12	0.00	12.69	10.15	0.72	0.00
Exchange Rate Risk							
Appreciation 10% USD/Euro	-10 percent	0.01	-0.01	12.68	10.15	0.01	-0.11
Depreciation 10% USD/Euro	10 percent	-0.02	-0.06	12.68	10.14	-0.10	-0.30
Multiple Factors. Combination of shocks marked with (*)		-0.07	-1.35	12.67	9.99	-0.75	-15.73
II. Interest Rate Risk (Bank Estimates)							
Parallel increase in the euro yield curve	200 b.p.	2.10	-3.30	12.94	9.76	...	...
Parallel decrease in the euro yield curve	-200 b.p.	-2.80	-6.20	12.32	9.38	...	...
Increase and positive tilt in the yield curve (3 years; 10 years)	50 b.p.; 100 b.p.	1.30	-2.10	12.84	9.86	...	...
Decrease and negative tilt in the yield curve (3 years; 10 years)	-50 b.p.; -100 b.p.	-1.10	-3.10	12.54	9.77	...	...

Sources: Bank of Spain, and IMF staff estimates.

The sensitivity tests were applied to seven banking groups covering 37 credit institutions and 67 percent of consolidated system assets.

1/ Average change on CAR and profits is weighted by the own funds of the sampled credit institutions.

2/ Computed by applying the largest variation in CAR to the lowest CAR in the sampled institutions.

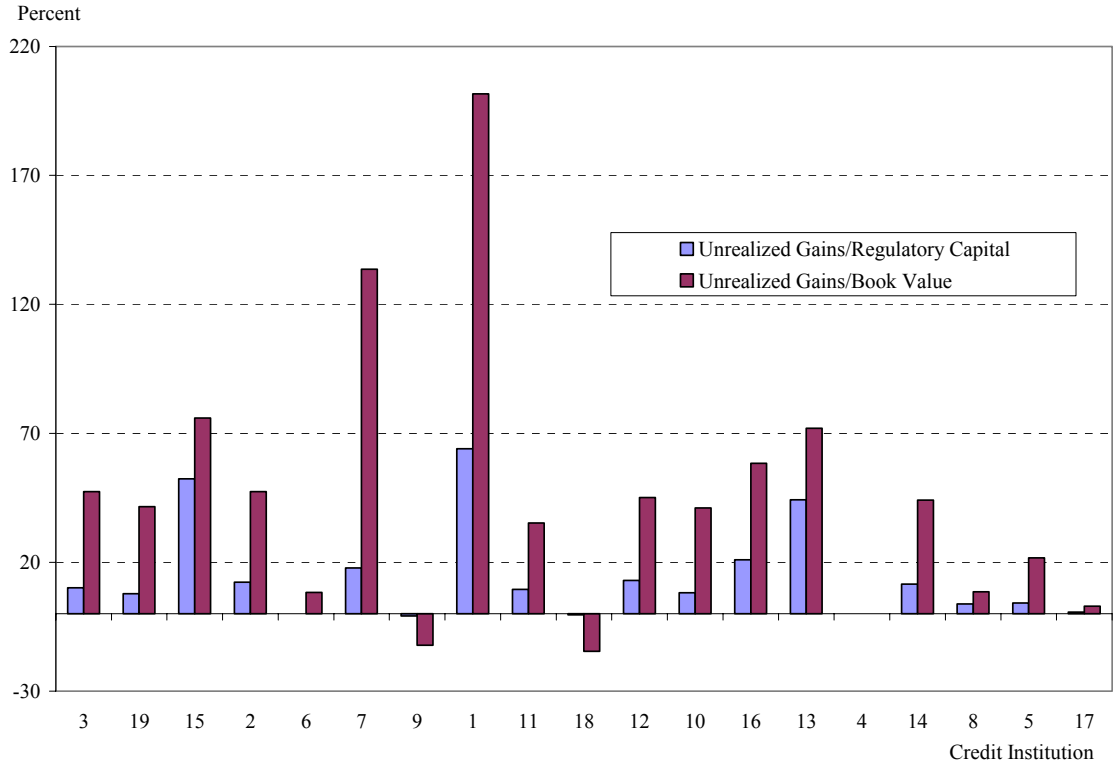
3/ The increase in corporate spreads is as follows: 15 b.p. for corporate bonds rated AAA through A; 100 b.p. for bonds rated BBB; and 300 b.p. for bonds rated below BBB.

38. **Equity risk in the banking book was found to be substantial, albeit large unrealized gains offered a cushion against adverse equity price movements**.[13] For the 19 credit institutions in the sample, accounting for roughly 80 percent of system assets average equity holdings in the banking book, at fair value, were equivalent to about one-third of the Basel regulatory capital. These investments entailed substantial unrealized gains, roughly equivalent to 50 percent of their book value, or 12 percent of the regulatory capital of the sampled institutions (24 percent for the cajas) (Figure 1). To reflect these unrealized gains, the own resources of the sampled institutions were adjusted upwards prior to the stress test exercise, resulting in an increase of average CAR from 12.7 to 14.4 percent. From these adjusted figures, a 30-percent drop in equity prices would result in an average loss equivalent to 8.6 percent of Basel regulatory capital, with a maximum impact of 21.6 percent (Table 4). This effect was substantially larger for the sampled cajas, reflecting their more sizeable investment portfolios relative to regulatory capital. Overall, the unrealized gains at current market prices were sufficient to cover the losses associated with the shock to equity prices for the entire sample. However, six banks and four cajas jointly accounting for 37 percent of assets in the sample would incur a net loss even after taking into account unrealized gains, with an average impact of 5.4 percent of regulatory capital and a maximum impact of 13.3 percent. No institution would fall below the minimum requirement.

39. **An exercise based on an historical value-at-risk (VaR) at the 99.5 percent confidence level and a three-month holding period produced roughly comparable results**. The exercise was based on the fair value of the equity investments of the 19 credit institutions covered in the previous exercise, using the composition of their portfolios as of end-December 2004. For quoted companies, which accounted for 84 percent of the portfolios, the evolution of prices was taken from individual stock market prices. Following a parallel approach, non-quoted companies were mapped into the six main sectors of the economy, as represented by the sector stock market indexes of the Madrid stock exchange. For each investment, price volatilities were computed at the daily frequency, using a three-month rolling window from February 2002 to September 2005. The VaR was computed at the 99.5 confidence level over a three-month holding period, as required by Basel II recommendations on equity holdings maintained in the banking book. The results indicate that, averaging over the entire period, the VaR represented 8.2 percent of regulatory capital, with a maximum of 24.1 percent, which was roughly in line with the previous result. However, the average VaR reflected the low volatility of stock markets in recent years. Substantially larger estimates were obtained in the aftermath of credit and corporate events of 2002. Further details on this exercise are presented in the companion Technical Note: *Nonfinancial Equity Investments of Spanish Credit Institutions*.

[13] Unrealized gains on equity portfolios originate when market values exceed book values.

Figure 1. Unrealized Gains on Equity Holdings in the Banking Book, 2004



Sources: BE and IMF staff calculations.

40. **The losses obtained for insurance companies in the parallel exercises of market risk were immaterial for the capital adequacy of their parent credit institutions**. In all cases, the losses represented a negligible part of the Basel regulatory capital of their parent banks, reflecting the large differences in size between the insurance and banking segments of the group.

41. **Interest rate risk on the entire balance sheet and off-balance sheet positions was found to be small**. Overall, credit institutions were more sensitive to decreases in interest rates, possibly reflecting the predominance of loans at floating rates (which shortens the duration of assets) and the increasing reliance on debt financing. A 200 basis point parallel drop in the euro yield curve would cause an average loss equivalent to 2.8 percent of Tier I and Tier II capital, with the maximum decline reaching 6.2 percent, which was well below the reference 20 percent suggested by the Basel Committee. As before, the integration of the results of the insurance companies in the corresponding exercise did not make any significant difference.

Table 4. Estimated Losses (-) on Equity Holdings in the Banking Book, December 2004
(In percent)

	CAR Before Shock	Loss in Percent of Regulatory Capital		CAR After Shock (percent)		Loss in Percent of 2004 after-tax profits	
	Average	Average	Worst	Average	Worst	Average	Worst
I. Sensitivity Analysis 1/							
Total Sample (Net losses) 2/	14.3	-8.6	-21.6	13.1	10.1	-147.7	-379.3
Commercial Banks	13.3	-5.1	-6.3	12.6	10.1	-157.8	-266.1
Savings Banks	16.1	-14.3	-21.6	13.8	10.7	-131.2	-379.3
Sub-sample (Net losses) 3/	12.3	-5.4	-13.3	11.6	10.1	-66.0	-379.3
Commercial Banks	12.1	-4.6	-6.8	11.6	10.1	-31.7	-194.3
Savings Banks	12.8	-9.4	-13.3	11.6	10.7	-235.6	-379.3
II. VaR Exercise							
Total Sample (Gross losses) 4/	12.7	-8.2	-24.1	11.7	8.2	-88.0	-250.4
Commercial Banks	12.6	-5.6	-8.2	11.9	9.9	-57.1	-116.1
Savings Banks	12.9	-13.3	-24.1	11.2	8.2	-147.2	-250.4

Source: Bank of Spain and IMF staff calculations.
The exercises were conducted on a sample of 19 credit institutions accounting for roughly 80 percent of system assets.

1/ CAR and regulatory capital were adjusted upwards by adding the unrealized gains in equity portfolios, to the own resources of credit institutions. The average CAR before the adjustment was 12.7 percent.
2/ Based on a 30 percent across-the-board drop in equity prices.
3/ The exercise was run on the sub-sample of CIs with insufficient unrealized gains to cover the losses (these included 10 CIs accounting for 37 percent of the assets in the sample).
4/ Based on a three-month 99.5 percent VaR.

42. **Liquidity risk was found to be small, and the exercises showed that the large credit institutions have a well diversified pool of funding sources**. Overall, the scenarios were mixed, reflecting differences in the business characteristics and other idiosyncratic factors across credit institutions. On average, the institutions assumed the withdrawal of 39 percent of the time deposits maturing within a month, and 11 percent of demand deposits (Table 5).[14] The results indicated that the sampled credit institutions would be able to cope with the hypothesized shocks without cutting back their normal operations. Moreover, the figures revealed the precautionary nature of the credit institutions' contingency plans, since they entailed a decision to increase asset liquidity, particularly during the first week. On average, the cumulative ratio of sources to uses of funds jumped to 1.98 during the first week and closed at 1.66 by the end on the month. These qualitative results remained valid after making two adjustments to the original figures to simulate more stringent liquidity conditions. The adjustments entailed increasing the shock to demand deposits to 10 percent (for all institutions), and closing down access to the interbank market.

43. **For some institutions, however, the contingency plans relied heavily on the issuance of covered bonds**. The funding strategies of some credit institutions reflected their capacity to tap foreign markets in the context of the increasingly integrated euro area and investor demand of mortgage-backed securities. Leaving aside the projected sources from

[14] At end-2004, the liabilities of credit institutions with residents were mainly short-term. Demand deposits accounted for 50 percent, time deposits for 35 percent, and repos for the remaining 15 percent.

regular operations, the main sources of liquidity included issuing pre-approved bonds, which in most cases were ready to be executed within one month, and selling fixed- and variable-income securities. Overall, bond issuance represented 79 percent of the uses of funds implied by the exercise, albeit the minimum issuance needed to cover the liquidity needs was much lower, 12 percent, with the difference used to increase precautionary liquidity.[15] Some institutions, however, showed substantial reliance on debt issuance to cover liquidity needs, which could entail some risks if liquidity conditions deteriorate for the entire system.[16]

44. **The second exercise indicated that liquid assets were sufficient to cover a 20-percent drop in demand deposits plus all the liabilities maturing within a month**. The BE conducted an additional liquidity exercise, comparing directly various definitions of liquid assets, against maturing liabilities plus a drop in demand deposits. The exercise was applied both to the participating credit institutions and to the entire banking system. Two definitions of liquid assets were used, under alternative assumptions about their liquidity attributes. The broader definition included the projected sources of funds from regular operations within a month, plus all available fixed- and variable-income securities. The second assumed that variable income securities could not be liquidated on short notice, which was akin to imposing an extraordinary fall in their market prices. On the liabilities side, the smaller shock implied the withdrawal of all maturing liabilities within a month, while the other two scenarios added a further 10 and 20 percent withdrawal of demand deposits, respectively. Overall, the system appeared to be well prepared to endure these shocks, with the results ranging from an average coverage ratio of 1.27 under the least demanding scenario to 1.08 at the other extreme (Table 6). The average results for the sampled institutions were roughly similar to those obtained for the entire system. In some cases, the minimum coverage ratios dropped slightly below one, but the overall dispersion was relatively small.

[15] Liquidity from the sale of fixed- and variable-income securities represented 24 and 13 percent of the required funding, respectively.

[16] A more adverse liquidity scenario would exert pressure on spreads, but it is unlikely that credit institutions would lose access to this source of financing. In recent years, spreads on covered bonds have been remarkably low—even negative for some credit institutions—reflecting the positive market sentiment about the issuers, the quality of the underlying loan portfolios, the high over-collateralization, and the fact that bondholders have preferred creditor status in the event of bankruptcy and enjoy further security from other assets that do not formally qualify as collateral. Thus, under a stressed scenario, pressures on spreads on covered bonds could be mitigated by their low-risk characteristics. A description of recent trends of spreads on mortgage-backed securities in Spain is provided in the companion Technical Note: "Housing Prices, Household Debt, and Financial Stability."

Table 5. Spain: Results of the Stress Tests on Liquidity Risk, Exercise 1

	Ratio of Sources/Uses of Funds	
	Cumulative One Week	Cumulative One Month
Stress Test Results		
Unadjusted Figures (as provided by the credit institutions)		
Average	1.98	**1.66**
Minimum	1.09	1.01
Adjusted Figures (closing interbank market)		
Average	1.87	1.46
Minimum	1.09	1.00
Detail of the Proposed Sources of Funds (as provided by the credit institutions)		
Average		**1.66**
of which:		
Projected Sources From Regular Operations		0.46
Liquidity Withdrawal From Central Bank		0.05
Sale of Fixed-Income Securities		0.24
Sale of Variable-Income Securities		0.13
Debt Issuance		0.79
of which: Average debt issuance needed to cover liquidity needs		0.12
Memo: Stress Test Coefficients (in percent of own category)		
Renewal Interbank Assets	34	38
Renewal Interbank Liabilities	30	41
Renewal Loan Portfolio	79	74
Withdrawal Maturing Liabilities	28	39
Withdrawal Demand Deposits	4	10

Sources: Bank of Spain and IMF staff calculations.

45. **Credit risk was the main source of risk, but the exercises indicated that the systemically important credit institutions would be able to undergo the shocks considered with small effects on their capital**. The sensitivity analysis conducted by the sampled credit institutions indicated that increasing their estimated PDs of mortgage and commercial loans by 200 percent and 100 percent, respectively, from their end-2004 levels, would generate losses equivalent to 1.5 percent of regulatory capital, with a maximum impact of 5.1 percent (Table 7). These losses could be absorbed with the profits of one year, as they represent 17 percent of after-tax profits, on average, and slightly less than 60 percent in the worst case. Moreover, due to the cushion provided by the statistical provisions, the accounting effects on profitability would be lower, representing 10 percent of after-tax profits, on average, and slightly less than 14 percent in the worst case. As a result, the generic fund would fall by 13 percent, on average, with a maximum of around 25 percent for two of the sampled institutions.

Table 6. Results of the Stress Tests on Liquidity Risk, Exercise 2

	Sampled Credit Institutions		Total System
	Average	Minimum	Average
Sources of Funds 1/Uses of Funds 1	1.72	1.05	1.59
Sources of Funds 2/Uses of Funds 1	1.25	1.02	1.27
Sources of Funds 1/Uses of Funds 2	1.59	0.99	1.46
Sources of Funds 2/Uses of Funds 2	1.15	0.96	1.17
Sources of Funds 1/Uses of Funds 3	1.47	0.93	1.35
Sources of Funds 2/Uses of Funds 3	1.07	0.85	1.08

Notes:
Sources of Funds 1: Projected sources of funds within one-month, plus available fixed income securities, plus variable income securities

Sources of Funds 2: Projected sources of funds within one month, plus available fixed income securities
Uses of Funds 1: Maturing liabilities within one month
Uses of Funds 2: Maturing liabilities within one month, plus 10 percent of demand deposits
Uses of Funds 3: Maturing liabilities within one month, plus 20 percent of demand deposits
Source: Bank of Spain.

46. **A top-down approach based on aggregate data for the entire system yielded similar results**. The shocks were similar in size, but applied to the PDs estimated by the authorities using credit registry data. The expected losses were computed using LGDs of 5 percent for mortgages and 25 percent for commercial credit. The results were roughly similar to those obtained by the participating credit institutions, with an average drop in CAR of 1.5 percent. A limitation of this exercise, however, was the lack of information about the distribution of the results among credit institutions.

47. **Two parallel exercises conducted by the mission produced somewhat larger loss estimates, especially among cooperatives and cajas**. The exercises were conducted using both aggregate data for the entire system as well as a sample of 86 credit institutions covering 94 percent of system assets. The first exercise was based on a shock to PDs similar to that used in the baseline but applied somewhat larger LGDs, to account for their procyclical behavior.[17] The estimated losses accounted for 4.1 percent of regulatory capital, on average, for the sampled credit institutions, and 4.6 percent of regulatory capital for the entire system. Across institutional types, the losses were slightly larger for the cajas and cooperatives, but none of the institutions fell below the minimum regulatory capital.

[17] Since LGDs tend to be higher during economic downturns, Basel II requires supervisors to ensure that estimated LGD parameters reflect economic downturn conditions (i.e., "downturn LGDs").

Table 7. Sensitivity Analysis Estimates of Credit Risk, December 2004
(In percent)

	CAR Before Shock	Loss in Percent of Regulatory Capital		CAR After Shock		Loss in Percent of 2004 after-tax profits	
	Average	Average	Worst	Average	Worst	Average	Worst
Exercise 1							
Sample 1/	12.7	-1.5	-5.1	12.5	9.5	-17.4	-59.2
Total System	11.6	-1.5	...	11.4	...	-16.1	...
Exercise 2							
Sample 2/	12.7	-4.1	-7.8	12.2	8.6	-53.0	-68.7
Commercial Banks	12.6	-3.8	-7.8	12.2	8.6	-47.9	-7.4
Savings Banks	12.8	-4.7	-6.5	12.2	9.0	-60.2	-80.1
Total System	11.6	-4.6	...	11.1	...	-45.2	...
Commercial Banks	10.9	-4.1	...	10.5	...	-35.9	...
Savings Banks	12.5	-5.1	...	11.9	...	-57.6	...
Cooperatives	12.4	-5.8	...	11.7	...	-70.4	...
Exercise 3							
Sample 2/	12.7	-13.0	-26.5	11.0	7.1	-166.1	-273.0
Commercial Banks	12.6	-11.8	-20.9	11.1	7.1	-150.0	-256.0
Savings Banks	12.8	-14.8	-24.0	10.9	7.4	-190.2	-264.0
Total System	11.6	-14.3	...	9.9	...	-140.6	...
Commercial Banks	10.9	-12.7	...	9.5	...	-111.5	...
Savings Banks	12.5	-15.9	...	10.5	...	-180.0	...
Cooperatives	12.4	-18.0	...	10.2	...	-217.5	...

Source: Bank of Spain. Staff calculations.

Exercise 1 entailed a shock to PDs of mortgage and commercial loans of 200 and 300 percent, respectively, from their 2004 levels. For the sample, the shock was applied to the PDs estimated by the participating credit institutions. For the sysem, the shock was applied to the PDs estimated by BE . LGD values were not stressed. The participating credit institutions used their own LGD estimates, averaging 10.4 percent for mortgage loans 31.7 percent for commercial. The LGDs used by the authorities for the entire system were 5 percent and 25 percent for mortgage and commercial loans, respectively.

Exercise 2 entailed a shock to PDs of mortgage and commercial loans similar to those applied in exercise 1. LGD values were increased to 10 percent for mortgage loans, 45 percent for commercial, and 85 percent for

Exercise 3 entailed a shock to PDs equal to their average values over 1992-2004 plus two standard deviations, using LGDs of 10 percent for mortgages, 45 percent for commercial, and 85 percent for consumer and other loans.

1/ Conducted directly by 7 participating banking groups accounting for two-thirds of system assets.

2/ Based on a sample of 86 credit institutions accounting for 94 percent of system assets.

48. **The second exercise entailed a more extreme deterioration in credit quality, and the results still indicated the resilience of the system**. The mission carried out a more extreme exercise based on an increase in the PDs to their average values between 1992 and 2004 plus two standard deviations (6.31 and 8.86 percent for mortgages and commercial credit, respectively). As before, the stressed PDs were combined with stressed LGDs for specific loan categories. The estimated losses obtained in this exercise were substantially larger than those reported in the previous paragraph, reflecting the more severe underlying shocks, but still indicated no threat to capital adequacy. Average losses were 13 percent of

Basel regulatory capital for the sampled credit institutions and 14 percent for the entire system, and were roughly equivalent to 1.5 years of after-tax profits. As before, the estimated losses were somewhat larger for the cajas and especially for cooperatives (18 percent of their regulatory capital). The maximum impact represented roughly one-quarter of regulatory capital, with four credit institutions (about 5 percent of system assets) falling slightly below minimum required CAR. This scenario, however, was considered unlikely under current circumstances as it would probably require several years of sluggish growth to materialize. Accordingly, the results were interpreted as a medium-term lower-bound estimate.

Scenario analysis

49. **The scenarios considered did not translate into a sharp deceleration of GDP growth in Spain, or a substantial deviation of key macroeconomic variables from the baseline scenario**. The latter was projected using the spring economic forecast of the European Commission at the time of the exercise, complemented with BE simulations for some variables, such as house prices and credit to the private sector (Table 8). Under the baseline scenario, GDP was projected to grow at 2.7 percent in 2005 and 2.8 percent in 2006. This was roughly in line with the GDP growth rate observed in 2004 and consistent with base year 1995 National Accounts in Spain. However, base year 2000 National Accounts data, released after the publication of the European Commission spring economic forecasts entailed a substantial upward revision of both the level and growth of GDP. Consequently, macroeconomic conditions in Spain at the time of the exercises were better than those implicit in the baseline scenario. For the stressed scenarios, the largest (negative) impact on economic activity in Spain was obtained under the dollar depreciation, entailing a drop in GDP growth of 0.9 percent in 2005 and 0.6 percent in 2006 relative to the baseline. Overall, the models predicted a moderate impact on unemployment, particularly compared with historic figures, with the largest effects associated with the dollar depreciation and the falling house price scenarios. The evolution of inflation and interest rates reflected the presumption of no monetary policy reaction at the euro level to the assumed drop in house prices in Spain, the tightening of monetary policy in response to the oil price shock, and the opposite following the dollar depreciation. The simulations also entailed a slight deceleration of house prices in real terms under the baseline scenario and a more rapid correction under the oil scenario, with the growth rate of real house prices falling by 4 percent in 2005 and 2.4 percent in 2006. By assumption, the correction of house prices under the house price scenario was substantially larger, entailing a drop of 17.3 percent during 2005 and 4.6 percent in 2006.

Table 8. Scenario Analysis, Selected Variables, 2005–06
(Yearly averages, in percent)

	Baseline 1/		Deviations from the Baseline Scenario					
			Oil Price		House Price		Dollar Depreciation	
	2005	2006	2005	2006	2005	2006	2005	2006
GDP Growth	2.7	2.8	-0.1	-0.7	-0.4	-0.7	-0.9	-0.6
Unemployment Rate	10.4	10.3	0.1	0.4	0.2	0.6	0.4	0.9
Household Debt to Gross Disposable Income	104.1	103.5	-0.2	-1.7	-2.5	-4.3	0.3	0.9
Firm Debt to Profits	470.1	465.9	-3.3	-8.4	0.2	-0.2	3.8	5.8
Inflation	2.9	2.6	0.7	0.6	-0.1	-0.3	-0.5	-1.1
Short-term Interest	2.2	2.7	1.0	1.0	0.0	0.0	-0.9	-0.7
Long-term Interest	3.8	4.3	0.8	0.8	0.0	0.0	-0.3	-0.3
Real Growth of Housing Prices	-0.9	0.0	-3.1	-2.4	-16.4	-4.6	0.8	0.1

Source: European Commision, Bank of Spain and IMF staff calculations.
1/ The baseline scenario was based on the European Commission projections of Spring 2005, which were consistent with the 1995 Spanish National Accounts. A subsequent revision of Spanish National Accounts, published after the exercise, entailed an upward adjustment of both the GDP level and its rate of growth.

50. **Several stress tests based on these scenarios were conducted by the participating credit institutions, the BE, and the mission**. The participating credit institutions were given the macroeconomic projections under the four scenarios, including projections for other economies (Box 1), and required to estimate the associated losses using their own internal models. Risks coming from the subsidiaries of Spanish banks overseas were also assessed using the macroeconomic projections obtained for the relevant countries. The BE conducted parallel stress tests based on aggregated information for the entire banking system to cross-check the results obtained by the participating credit institutions. The mission and the BE conducted additional exercises to assess credit risk originating from exposures to the *domestic* market, especially housing.

Results for the participating credit institutions and the entire system

51. **The results of the exercises based on the internal models of the participating credit institutions indicated that none of the scenarios considered posed a threat to their capital adequacy**. The participating credit institutions used their internal models to assess the losses associated with each scenario—including the baseline. The losses were projected and accumulated over two years, and reported in terms of deviations with respect to the baseline. Overall, the results indicated that the systemically important institutions are well prepared to absorb the losses associated with all the scenarios considered. The largest effects were obtained under the dollar depreciation, with an average impact of 4.6 percent of regulatory capital and a maximum impact of 24.5 percent (Table 9). After the shock, the average CAR of the participating institutions would fall to 12.1 percent, with a minimum of 9.6 percent. The estimated losses under the fall in house prices in Spain and the U.K. were lower, at 2.3 percent of regulatory capital, while those associated with the crisis in Latin America were below 1 percent.

Box 1. Scenarios. Results of Macroeconomic Simulations for Other Economies

The four scenarios were also simulated for other economies, including the U.K., the U.S., the euro area, and Latin America, with the purpose of capturing relevant risks originating from subsidiaries overseas, and to help project the effects of the external environment on the Spanish economy.

- The house price scenario in the U.K. considered a lagged expansionary monetary policy response to the drop in house prices, with short- and long-term interest rates falling by 192, and 90 b.p., respectively, during the second year. Despite the monetary response, the simulated effects on economic activity were stronger than those obtained for Spain. The models predicted an accumulated decrease in GDP growth of 2.9 percent over the two years with respect to the baseline scenario, and a 1.5 percentage points increase in unemployment, to 4.4 percent at the end of the two years. The effects on investment and credit markets (not shown) were also stronger in the simulations for the U. K. compared with the results obtained for Spain. This may be attributable to a number of factors, including (i) a more widespread financing of consumption through home equity withdrawal in the U.K., (ii) more vulnerable households, given their higher ratios of debt to disposable income, (iii) a larger drop in house prices considered in the scenario, and (iv) a different position in the business cycle.

- The dollar depreciation scenario entailed an expansion in economic activity in the United States and a deceleration in the other countries considered. For the United States, the depreciation of the U.S. dollar generated an increase in economic activity supported by the reduction of the current account deficit, and a contraction in monetary policy in response to higher inflation. For the United Kingdom and the euro area, the dollar scenario entailed the opposite, including a deterioration in external competitiveness and a drop in economic activity, combined with an expansionary monetary policy in response to lower inflation. Among Latin American countries, the dollar scenario entailed stronger effects for Mexico, reflecting commercial linkages with the United States, and for Brazil, reflecting its more vulnerable position to turbulence in international capital markets. In quantitative terms, the dollar scenario entailed an accumulated expansion in GDP growth in the United States of 1.8 percent relative to the baseline during the two years, and an accumulated drop of 2 percent for the euro zone, and 2.9 percent for the United Kingdom. The effects were larger for the Latin American countries, entailing an accumulated drop of 3.5 percent for Mexico and 4.5 percent for Brazil.

- The oil scenario entailed a deceleration of economic activity in both the U.S. and the euro area, and a slight expansion in the United Kingdom. The effects of the shock to oil prices on economic activity were larger in the United States than in the euro area, partly reflecting a tighter U.S. monetary policy in response to oil-induced inflationary pressures, and the appreciation of the U.S. dollar vis-à-vis the euro and the British pound. Overall, the oil scenario entailed an accumulated drop in economic growth of 1.2 and 0.8 percent in the U.S. and the euro area, respectively, with respect to the baseline, and a 0.25 percent accumulated expansion in the United Kingdom.

- The scenario of crisis in Latin America entailed a significant drop in economic activity in both Mexico and Brazil. The shocks considered caused an accumulated drop in GDP growth of 6.6 percent for Mexico and 5.8 percent for Brazil, combined with higher inflation and turbulence in financial markets. For Brazil, the simulations entailed a default on the domestic sovereign debt with an estimated 19.9 percent haircut.

52. **The exercises conducted by the BE for the entire system produced the same relative ordering of the scenarios in terms of the associated losses, but even lower estimates**. The simulations tracked the effects of the scenarios on loan quality and the main components of the profits and losses, for the entire system. Under the dollar scenario, the decrease in interest rates in the euro area, combined with the decline in economic activity in Spain, produced a drop in interest margins and commission fees, and a deterioration in loan quality. The estimated losses amounted to 1.8 percent of regulatory capital. Under the house price scenario, the estimated losses were even lower, amounting to 0.6 percent of regulatory capital. Under the oil scenario, the tightening of monetary policy in the euro area translated into an increase in interest margins that counteracted the estimated loan losses, resulting in a net gain with respect to the baseline.

53. **These results reflected the soundness of the system, but also the relatively mild macroeconomic projections obtained for Spain under the scenarios considered**. While the underlying shocks considered in the scenarios entailed low-probability but severe events, the resulting macroeconomic projections for Spain were relatively mild and close to the baseline. The results obtained, therefore, are subject to this important caveat. To provide complementary estimates, the mission and the BE conducted additional exercises combining dynamic panel models with scenario analysis, focusing on credit risk from domestic exposures.

Table 9. Results of the Scenario Analysis, 2005–2006

	Change in CAR		CAR After Shock		Effect on Profits	
	Average Impact	Maximum Impact	Average CAR After Shock	Worst CAR After Shock	Average Impact on Profits	Worst Impact on Profits
Average CAR participating institutions 12.7						
Average CAR system 11.6						
Sample Estimates 1/						
Dollar Depreciation	-4.6	-24.5	12.1	9.6	-8.3	-41.8
Oil Price Increase	0.4	-5.3	12.8	12.0	1.0	-7.1
Drop in House Prices	-2.3	-11.3	12.4	11.2	-4.9	-8.3
Crisis in Latin America	-0.7	...	12.6	...	-11.6	...
Entire System 2/						
Dollar Depreciation	-1.8	...	11.4	...	-14.2	...
Oil Price Increase	0.5	...	11.7	...	8.2	...
Drop in House Prices	-0.6	...	11.5	...	-2.9	...
Crisis in Latin America	-0.4	...	11.5	...	-7.5	...

Source: Bank of Spain.

1/ Estimations performed by participating credit institutions covering the seven largest financial groups and roughly two-thirds of system assets. Results in deviations from the baseline scenario.

2/ Bank of Spain estimates based on aggregated data for the entire banking system. Results are in deviations from the baseline scenario.

Exercises combining dynamic panel models with scenario analysis

54. **The mission, jointly with the BE, conducted a series of macro stress tests of credit risk from exposures to the domestic market, using a framework consistent with the scenario analysis**. The exercises were based on dynamic panel models, combining cross-section and time-series data. This approach has several advantages, including flexibility to: (a) obtain separate results across institutional types; (b) obtain a measure of the dispersion of the results, (c) differentiate between short- and long-term effects, and (d) conduct robustness check using slightly modified scenarios.

55. **The simulations were based on a comprehensive database constructed by the BE**. The sample included 158 banks and cajas, accounting for roughly 90 percent of system assets during the period 1992-2004. A filter was applied to exclude credit institutions with total assets below 0.01 percent of system assets. Mergers and acquisitions during the sampled period were handled by treating the pre- and post-merger institutions as separate cases. To disentangle risks originating from the housing market, loan portfolios and NPLs at the level of individual credit institutions were classified in four portfolio categories: (a) mortgages to households, (b) credit to real estate developers and construction companies, (c) commercial credit to other sectors, and (d) consumer and other credit.

56. **The BE used a thorough approach to overcome existing data limitations**. The database combined information from the credit registry (CIR) with accounting information taken from individual credit institutions. The use of data from the CIR permitted to overcome information limitations, since the available accounting data does not allow to distinguish between specific portfolio categories prior to 1999. The gain in terms of historic information, however, was at the cost of somewhat lower precision in terms of loan classification. The CIR conveys information on household loans with real collateral but does not distinguish by final uses, making it hard to disentangle mortgage credit and consumer credit with real collateral—such as car loans. To circumvent this, loans to households with real collateral were classified on the basis of their length, classifying as mortgages those granted for more than three years. As the information from the CIR could be mapped to credit institutions on *a solo* basis, the models were based on unconsolidated information on the characteristics and quality of loan portfolios, and the estimated losses were aggregated at the group level to assess the effects on capital adequacy, by linking each credit institution to its parent group.

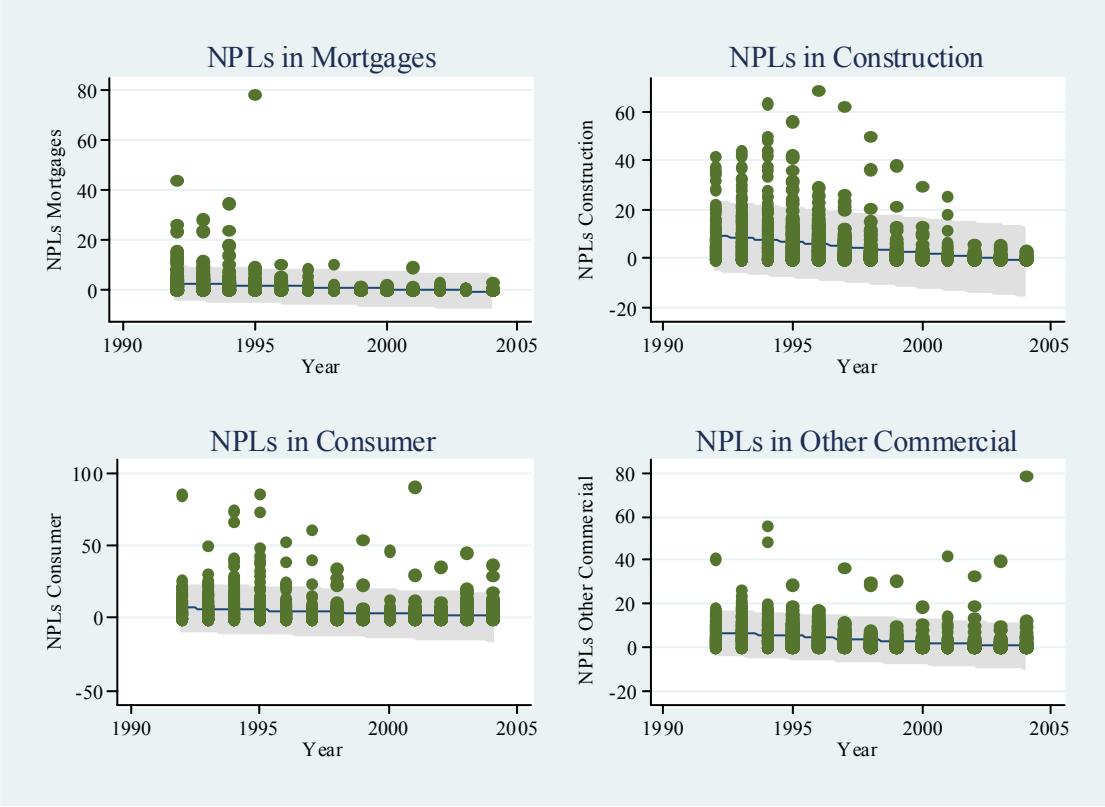
57. **The resulting data reflected the steady improvement in loan quality since the mid-1990s, albeit with substantial differences across individual credit institutions**. Loan quality displayed a strong procyclical behavior, with NPLs peaking during the economic downturn of the first half of the 1990s (Table 10). By far, the most sensitive category to the economic cycle in terms of quality has been credit to real estate developers and construction companies, with NPLs reaching 14.2 percent for the cajas in 1993 and 11.9 percent for banks in 1994. Across institutional types, NPLs have been systematically higher for the sampled cajas, except for consumer credit. Since the mid-1990s, loan quality improved across-the-board, reflecting the combination of rapid credit expansion and buoyant economic activity. These aggregate figures, however, masked a substantial dispersion in loan quality across individual credit institutions, particularly in consumer and commercial credit (Figure 2).

Table 10. Spain: Evolution of Problem Loans,
in Percent of Loans in Category, 1992-2004

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1992/04
Banks														
Total Portfolio	4.2	6.2	6.4	5.0	3.3	2.2	1.0	0.8	0.6	0.6	0.6	0.5	0.4	-3.8
Mortgages	2.6	2.8	3.0	1.7	0.8	0.5	0.3	0.2	0.3	0.3	0.2	0.2	0.1	-2.5
Construction	7.9	10.2	11.9	8.6	5.8	4.2	1.5	0.8	0.6	0.5	0.4	0.4	0.2	-7.7
Consumer	5.6	7.7	8.0	10.7	10.0	5.7	2.1	1.7	2.3	3.1	3.5	4.2	3.4	-2.2
Commercial	3.5	5.7	5.6	4.5	3.1	2.1	1.1	0.9	0.7	0.7	0.7	0.7	0.5	-3.0
Savings Banks														
Total Portfolio	6.5	7.7	6.7	5.2	4.3	2.6	1.6	1.1	0.8	0.7	0.7	0.6	0.5	-6.0
Mortgages	3.0	3.1	2.3	1.7	1.2	0.8	0.5	0.4	0.4	0.4	0.3	0.2	0.2	-2.8
Construction	11.0	14.2	13.6	10.6	9.2	5.6	3.0	1.8	1.0	0.6	0.5	0.6	0.5	-10.5
Consumer	5.6	5.9	5.2	4.6	3.7	2.3	1.5	1.2	1.1	1.2	1.1	1.0	0.9	-4.7
Commercial	7.4	9.0	8.4	7.0	6.1	3.8	2.4	1.6	1.2	1.1	1.2	1.0	0.9	-6.5

Source: Bank of Spain, and IMF staff calculations.

Figure 2. Spain: Evolution of Problem Loans for Individual Credit Institutions,
in Percent of Loans in Category, 1992-2004

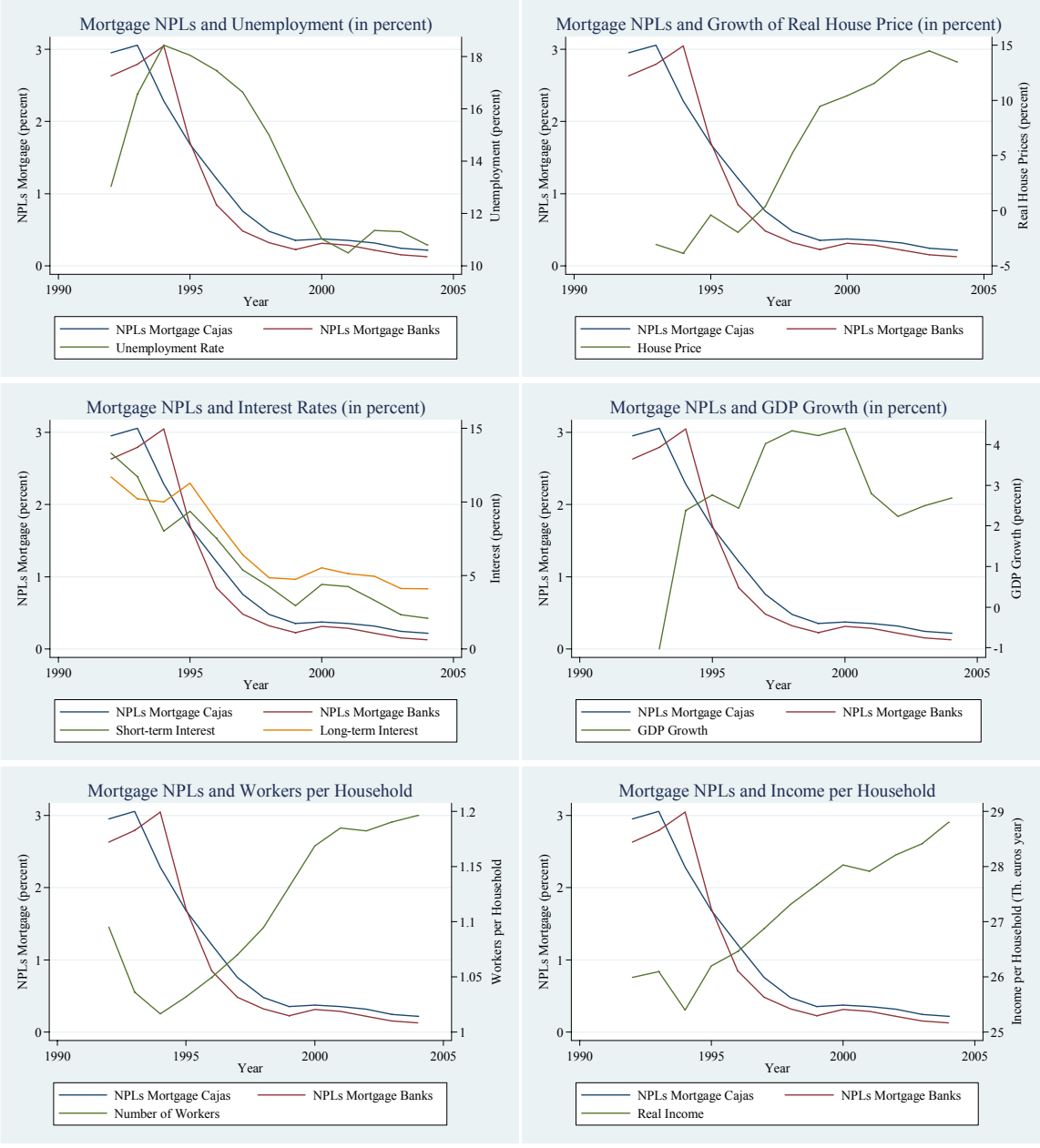


Source: BE. Staff calculations.

58. **During the period considered, the quality of mortgage portfolios moved in tandem with key macroeconomic variables**. In particular, the quality of mortgage portfolios improved with the number of workers per household, real household income, and

real house prices (Figure 3). On the other hand, the quality of mortgage portfolios deteriorated during periods of higher interest rates or unemployment. The slight increase in unemployment observed between 2001-2002, however, was not accompanied by a change in the trend of NPLs, possibly due to the overall supportive economic environment.

Figure 3. Spain. Mortgage Loan NPLs and Selected Macroeconomic Variables, 1992-2004



Source: BE and IMF staff estimates.

59. **The models were formulated to assess the sensitivity of loan quality, for each loan category, to changes in macroeconomic conditions**. All the estimates shared the form:

$$NPL_{i,t} = \alpha_i + \rho NPL_{i,t-1} + \sum_{s=0}^{k} \beta_{F,t-s} MACRO_{F,t-s} \ .$$

Where $NPL_{i,t}$ stands for the logit transformation of non-performing loans of credit institution i in year t, α_i stands for the fixed-effect for credit institution i, and $MACRO_{F,t-s}$ stands for macroeconomic factor F, in period t-s.[18] The specifications did not consider bank-specific, time-varying explanatory variables (other than the lagged NPLs), to keep them parsimonious and to facilitate the projections using the series provided in the macroeconomic scenarios. The lag structure was allowed to differ for each of the macroeconomic explanatory variables, exploring with one and two lags given the yearly frequency of the data. All the equations were estimated in first-differences using the Arellano-Bond estimator and treating the macroeconomic variables as strictly exogenous, which appeared to be the correct treatment from the perspective of the individual credit institutions.

60. **The preferred specifications included GDP growth, the real growth of house prices, and the long-term interest rate**. The set of explanatory variables was allowed to differ across equations, to reflect idiosyncratic differences in the sensitivity of loan quality to macroeconomic conditions across loan categories. Several macroeconomic variables were considered, including GDP growth, unemployment, household indebtedness, real disposable income per household, short- and long-term interest rates, and the real growth of house prices. The latter was of particular interest to gauge risks coming from exposures to the domestic housing market.

61. **The results showed substantial differences in the sensitivity of loan quality to changes in macroeconomic conditions across portfolio categories**. Overall, the coefficients had the expected signs and were statistically significant—in most cases at the one percent level. As expected, the results reflected the marked inertia of NPLs, with the autoregressive coefficients ranging between 0.35 for consumer loans to 0.66 for commercial credit (Table 11). More importantly, the sensitivity of loan quality to macroeconomic conditions differed across loan categories. The quality of credit to real estate developers and construction companies was substantially more sensitive to changes in house prices, while the quality of mortgage and consumer credit was more sensitive to changes in interest rates.

[18] Since NPLs are by definition bounded in the interval [0, 1], the variable was subject to the logit transform $log(NPL/(1-NPL))$, to avoid econometric problems.

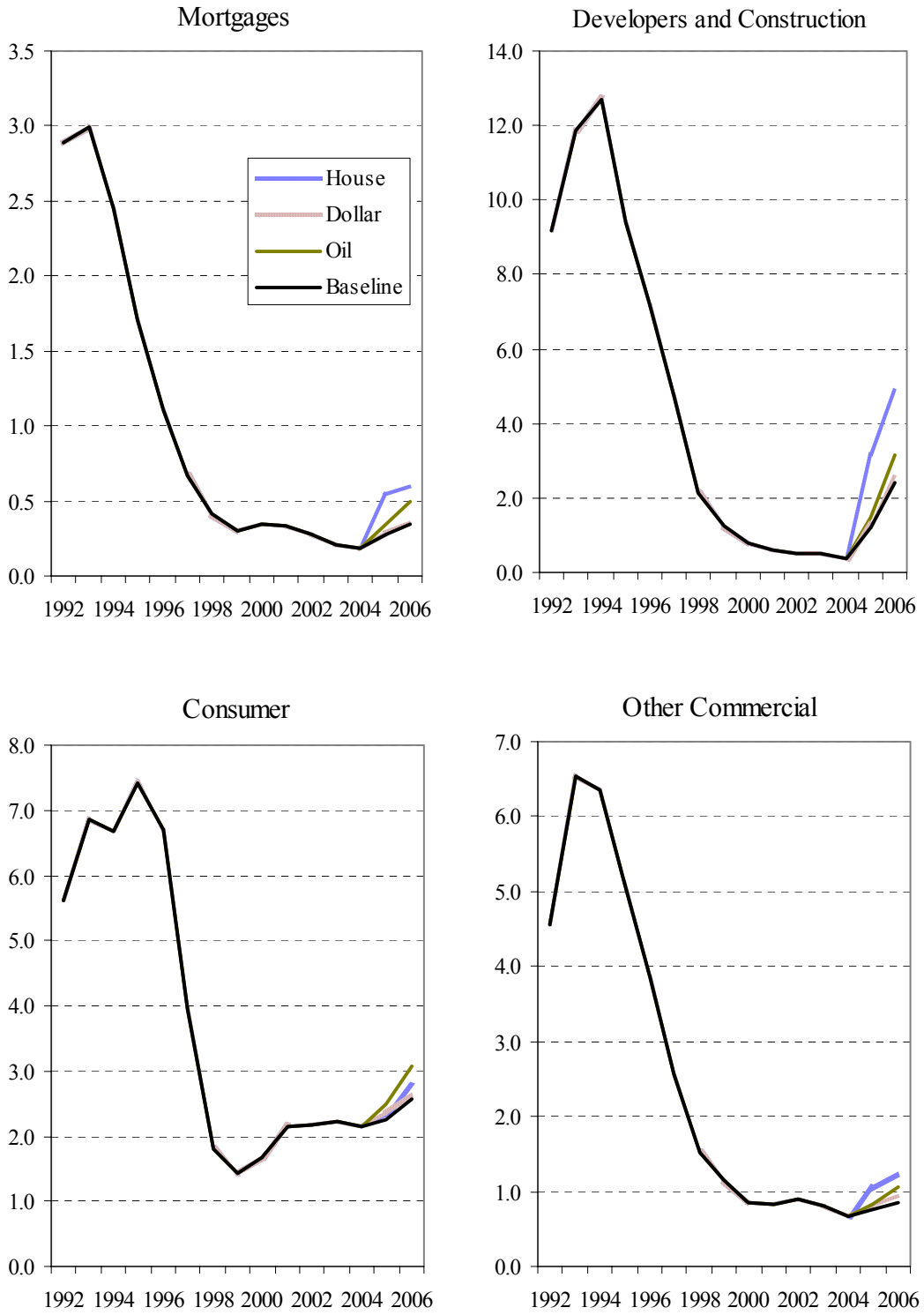
Table 11. Spain: Regression Results, Dependent Variable is Logit of NPLs

	[1] Developers	[2] Commercial	[3] Mortgage	[4] Consumer
LD. logit NPLs Developer Loans	0.582			
	[6.51]**			
LD. logit NPLs Firm Loans		0.660		
		[5.69]**		
LD. logit NPLs Mortg Loans			0.461	
			[3.49]**	
LD. logit NPLs Consumer Loans				0.354
				[3.71]**
D.GDP Growth	-0.091	-0.110	-0.100	-0.082
	[3.81]**	[6.29]**	[4.28]**	[5.21]**
D.Real Growth of House Prices	-0.065	-0.018	-0.038	
	[4.91]**	[1.79]	[2.45]*	
D.Long-term Interest	0.028	0.040	0.103	0.116
	[1.65]	[2.56]*	[4.44]**	[5.70]**
Observations	942	986	736	850
Number of banks	121	130	98	114
Arellano-Bond Test for AR(1) z =	-4.9	-3.66	-2.22	-3.15
Arellano-Bond Test for AR(2) z =	-0.31	0.44	-1.13	-1.37

Source: Bank of Spain and IMF staff calculations.
Absolute value of t statistics in brackets
* significant at 5%; ** significant at 1%
LD: Lagged difference; D: First Difference.

62. **For each credit institution, loan quality was projected over a two-year horizon, by combining the results of the panel estimations with the scenarios described above**. The models produced an across-the-board deterioration in loan quality under all the scenarios considered, albeit with substantial variation across loan categories (Figure 4). The most sensitive portfolio was credit to real estate developers and construction companies, particularly under the house price scenario, where NPLs increased from 0.4 percent in 2004 to 4.9 percent in 2006—still less than half the ratio observed in 1994. For mortgage loans and commercial credit, the main deterioration in credit quality was also associated with the house price scenario, albeit the effects were more moderate than in the previous case. For consumer credit, the main deterioration was associated with the oil scenario due to the associated increase in interest rates, with NPLs growing from 2.2 percent in 2004 to 3.1 percent in 2006.

Figure 4. Spain: Projected NPLs by Scenarios and Portfolio Categories, in Percent of Loans in Category, 1992-2006



Source: BE and IMF staff calculations.

63. **For each scenario, the estimated losses were projected and accumulated over two years**. The NPLs obtained for each loan category and credit institution were mapped into corresponding PDs, assuming a one-to-one relationship between percent changes in NPLs and percent changes in PDs. For each credit institution and loan category, the losses were computed by combining the resulting PDs with the stressed LGDs used in the sensitivity analysis of credit risk. The losses were measured on an incremental basis using two metrics. First, against the losses obtained from the PDs and LGDs observed in 2004 (thus implicitly maintaining the losses observed in 2004 throughout the projected period). Second, against the losses obtained for the projected baseline scenario (to facilitate the comparison with the results reported by the participating credit institutions and BE in the exercises based on scenario analysis).

64. **On average, the yearly losses obtained under the three scenarios were below the after-tax profits of the sampled institutions**. The estimated losses were converted to their yearly equivalent (i.e., dividing the cumulative losses by two) before comparing them against profits. On average, the system appeared well prepared to absorb the yearly losses of each scenario with the profits of one year. The results, however, showed a marked variation across individual credit institutions, partly reflecting differences in profitability. In particular, under the house price scenario, the yearly average losses represented 70.1 percent of after-tax profits for the entire sample, and 116.2 percent for the cajas. For one small bank (one percent of assets in the sample) the yearly losses represented 459.5 percent of profits. Parallel, but less severe results, were obtained under the other two stressed scenarios.

65. **The results in terms of CAR were roughly in line with those obtained in the sensitivity analysis of credit risk, albeit with fatter tails**.[19] Overall, the larger impact was associated with the house price scenario, with average losses equivalent to 11 percent of regulatory capital (a maximum impact of 27.4 percent) and average CAR falling to 11.3 percent at the end of the two years (Table 12). The other three scenarios produced average losses ranging between 4.9 and 6.6 percent of regulatory capital, with maximum values of about 12–15 percent of regulatory capital. The distribution of the results indicated that a few small institutions (less than one percent of sampled assets each) would fall slightly below minimum CAR. In particular, five institutions accounting for 2.5 percent of assets would fall below minimum CAR under the house price scenario, and three institutions accounting for 2 percent of system assets would fall below minimum CAR under the oil price scenario. Across institutional types, the losses were higher among the segment of cajas, reflecting their larger exposures to real estate developers and construction companies (26 percent of their loan portfolio at end-2004, against 20 percent for banks). The system thus, appeared well prepared to undergo the simulated scenarios without a threat to capital adequacy.

[19] See the results of sensitivity analysis to credit risk previously reported in Table 7.

Table 12. Spain: Results of the Stress Tests Based on Panel Data Models
(In percent)

	Percent of Regulatory Capital		CAR After Shock (percent)		Percent of 2004 after-tax profits	
	Average	Worst 1/	Average	Worst 1/	Average	Worst 1/
Baseline 2/	-1.9	-4.9	12.5	9.9	-12.1	-89.0
Commercial Banks	-0.8	-4.9	12.5	9.9	-4.7	-89.0
Savings Banks	-3.5	-4.4	12.4	10.1	-22.6	-47.9
Stressed Scenarios (Deviations from Baseline)						
Dollar Depreciation	-3.0	-6.6	-0.4	-0.4	-19.1	-120.3
Commercial Banks	-1.8	-6.6	-0.2	-0.4	-11.2	-120.3
Savings Banks	-4.7	-6.5	-0.6	-0.4	-30.4	-62.3
Oil Price Increase	-4.7	-10.4	-0.6	-0.7	-29.8	-188.6
Commercial Banks	-2.7	-10.4	-0.3	-0.7	-17.3	-188.6
Savings Banks	-7.4	-10.8	-1.0	-0.6	-47.8	-101.0
Drop in House Prices	-9.1	-22.4	-1.2	-1.4	-58.1	-370.5
Commercial Banks	-5.3	-20.5	-0.7	-1.4	-33.4	-370.5
Savings Banks	-14.5	-22.9	-1.9	-1.2	-93.6	-207.0

Source: Bank of Spain and IMF staff calculations.
1/ Among credit institutions with size above one percent of assets in the sample.
2/ The estimated losses under the Baseline are based on the projected PDs and the unstressed LGDs (i.e., the actual LGDs in 2004). The results are measured on an incremental basis with respect to 2004 (i.e., the losses resulting from the actual PDs and LGDs in 2004).

The projected losses under the alternative scenarios are based on the projected PDs and stressed LGDs. The results are measured in terms of deviations with respect to the Baseline scenario.

For comparability with other FSAPs, the impact of the scenarios in terms of after-tax profits does not take into account the available Statistical Fund. Accordingly, the impact of the scenarios on after-tax profits, from the accounting perspective, will be smaller.

III. STRESS TESTS FOR INSURANCE[20]

66. **The stress testing followed an approach similar to that of the Preparatory Field Study (PFS) proposed by the Committee of European Insurance Supervisors (CEIOPS) in preparation of the new solvency standard for European insurance, "Solvency II."** The stress tests were conducted by 27 insurers, covering 50 percent of the non-life market and 62 percent of the life market. The first tests measured the effect on the solvency margin of shocks to interest rates, credit risk, and market risks, including shocks to equity prices, real estate prices, and exchange rates. The design of these tests, in terms of interest rate curves and size of shocks, was similar to those applied to credit institutions. For credit risk, the analysis followed the same methodology of the PFS, which is broadly in line with the standardized approach of Basel II; alternatively, institutions were allowed to use credit spreads.

67. **Prior to the stress test analysis, a fair value estimation of all assets and liabilities increased net assets for the whole industry by 82 percent, with individual institution increases ranging between 8 and 360 percent**. The revaluation of real estate assets had the largest impact on the increase of net assets.

A. Summary of the Guidelines for the Preparatory Field Study

68. **The general guidelines given to insurance companies for the stress testing and fair-value estimation were the following**:

- The reported values should be based on the situation at December 31, 2004 (or December 31, 2003 if end-2004 data are not available).
- Insurance companies may either report the values on a consolidated group basis, without taking into account any revaluation of non-EEA subsidiaries, or may report for the largest insurance entities within the group (i.e., either on management group, or legal entity).
- Firms should report a value of liabilities that represents broadly a market-consistent assessment of the firm's liabilities.
- Liabilities for unit-linked insurance policies should be determined by reference to the value of assets covering these liabilities.
- Liabilities for all other life insurance policies should be assessed as the best estimate of the present value of future cash flows, taking account of expected mortality rates, interest rates and expenses of administration.

---

[20] This section summarizes from the note prepared by the *Dirección General de Seguros y Fondos de Pensiones* (DGSFP) in the context of the Spain FSAP: "*Análisis de sensibilidad del sector asegurador español a 31-12-2004*." Summary prepared by Antonio García Pascual.

- Appropriate assumptions should be made about the take-up rate for options to secure guaranteed amounts of cash on voluntary discontinuance.
- For with-profit policies, the expected amounts of future bonuses that are discretionary or which depend on the experience of the firm should be shown separately.
- Where possible, reinsurance assets should be assessed on assumptions that are consistent with the value placed on the liabilities.

Valuation of Liabilities

69. *Risk groups*. In order to determine the liabilities adequately, each homogenous risk group needs to be valued. A homogeneous risk group consists of a set of contracts with similar characteristics. Insurers may use the definition/composition of homogeneous risk groups that is most suitable for their portfolio.

70. *Mortality and morbidity rates.* Firms should make their best estimate of likely future mortality and morbidity rates. For annuities in payment, this should include allowance for expected increases in longevity.

71. *Expenses of administration*. Allowance should be made for the likely costs of administering the policies, along with relevant overhead expenses, including any staff pension costs.

72. *Persistency rates*. Appropriate assumptions should be made by the insurance company about the expected rate of discontinuance of policies at points of time where there is a guarantee as to the amount of the cash sum that may be withdrawn. However, no discontinuances should be assumed at points of time where the amount of any payment to policyholders would be at the discretion of the insurance firm.

73. *Bonus rates.* Any guaranteed future bonus additions for with-profit policies should be included in the cash flows that are to be valued for those policies. For with-profit policies where the payment of a future bonus is at the discretion of the insurer, or where it is expected that the level of the bonus will depend on the future experience of the insurance firm, then this potential bonus should not be included in the cash flows that are to be valued. However, the present value of this expected bonus should be shown separately in the table.

74. *Technical interest rates*. Two alternative valuation methods are proposed in this study for calculating the insurance liabilities of life insurers (see Appendix II for details), namely:

- discounting the cash flows with the full term structure (default), or
- the duration approach (fallback option).

First, under the full-term structure approach, the whole cash flow projection is constructed and each year's cash flow is then discounted at the corresponding interest rate for that duration. Second, under the duration approach, the main difference from present practices is

the replacement of the fixed technical interest rate by a discount rate that corresponds to the duration of that insurance portfolio. This discount rate is based on the expected rate of return from government securities of an equivalent duration. Thus, if the liabilities have a maturity of 8 years, the most suitable discount rate is one at an 8-year spot rate.

75. *Treatment of Options.* Qualitative information is to be provided about the nature and extent of any options (such as the option to take an annuity on guaranteed terms) given to policyholders.

Valuation of assets

76. **Investment assets should be reported, to the extent possible, on a market value basis**. For assets that are not regularly traded, they should be shown here at the value for which it is thought they could have been sold if the firm had been attempting to sell them for one month before the balance sheet date. If no market prices are available, the value might be determined by applying mark-to-model techniques.

77. **All relevant assets should be reported on the balance sheet, including derivatives and other off-balance sheet items**. Derivatives should be reported corresponding to their underlying risk category. Thus, a derivative based on equities should be reported under the category of equities. Firms should follow a principle-based approach.

Single events

78. **In order to have more risk-sensitive capital requirements, CEIOPS proposed that a solvency capital requirement should be determined in relation to the net risk profile of an institution**. This net risk profile may be examined quantitatively by calculating the impact of a set of single events on the financial position. The single events are assumed to occur in isolation on the balance sheet date. The single events to consider are: (a) interest rate risk; (b) credit risk; (c) market risk (equity, real estate, and foreign exchange); (d) underwriting risk; (e) lapse risk; and (f) non-life risk.[21] In the calculations only the investments and liabilities for which the insurer bears the risk are taken into account. Thus, institutions may omit from the stress test the unit-linked liabilities for which the policyholder bears the investment risk, together with the investments that are covering these unit-linked liabilities.

79. *Interest rate risk.* Firms are asked to consider both a rise and a fall in the term structure of interest rates.

---

[21] Regarding non-life risk, underwriting risk were stressed by increasing the average amount of "mass events" and the frequency of "peak events" (see section on Stress Test Results, for details).

80. *Credit risk*. For credit risk, the default method is broadly in line with the standardized approach of Basel II. As an alternative, institutions may also use credit spreads. The institutions are allowed to apply both approaches on a case-by-case basis (for details please refer to Appendix III).

81. *Underwriting risk*. For underwriting risk, firms should evaluate the effect of the more severe for each risk group of either an increase or decrease of the factors in the survival or sickness tables by 15 percent.

82. *Lapse risk.* Lapses are also important to consider. Therefore firms should calculate the effect of an increase in the lapse rate of 50 percent.

B. Stress Test Results

83. **Overall the stress tests show that the system is resilient to a wide range of shocks, with differences between life, non life, and mixed insurers**. Two important factors underpin the resilience of the insurance firms to the stress tests as well as to market events of recent years, such as the dramatic fall in interest rates and the fall in the stock markets of 2001: first, the strengthening of asset-liability management techniques as part of the regulatory requirements and market practices (i.e., "immunization techniques"); and second, the conservative structure of the investment portfolio of the industry.

- **For the insurance sector as a whole, the largest impact would come from a fall in real estate prices of 17 percent**, which would reduce insurers' capital (i.e., shareholders' equity) by 5.6 percent.[22] Life underwriting risk would have the second largest impact on insurers' capital (a fall of 4 percent). Among the interest rate shocks, the largest impact would come from a parallel fall in the interest rate curve of 200 basis points, which would reduce capital by 1.3 percent. There is also substantial variation in the impact of these shocks across the participating insurance institutions, as shown by the various measures of dispersion reported in Table 13 (i.e., standard deviation, minimum and maximum).

- **For life insurers, the largest impact would come from a downward parallel shift of the yield curve by 200 basis points**, which would reduce capital by 24.8 percent. This sizable impact is largely the result of a fall in the discount rate applied to the liabilities (i.e., to the expected future cash flows from insurance premium), which for life insurance typically have a much longer duration than for non-life. In contrast, a parallel increase of 200 basis points in the interest rate curve would improve insurers' capital by 8.1 percent. The shocks to credit and real estate risk would reduce capital by 9.9 percent and 3.9 percent respectively.

[22] The size of the shocks to risk factors were similar to those applied in the stress tests for the banking system (except for insurance-specific risk factors). The fall in real estate prices (17 percent) corresponds to the first year of the house price scenario.

- **For non-life insurers, the largest impact would come from a parallel shift upward of 200 basis points in the yield curve**, which would reduce capital by 10 percent. This effect is largely explained by their large share of fixed-income securities, such as treasury bonds. A fall in real estate prices has also a significant effect on capital—a decrease of 7.1 percent.

- **For mixed insurance companies**, **the largest impact on capital (a 5.6 percent fall) would result from a fall in real estate prices**. Interest rate shocks have a limited impact on mixed insurance companies, suggesting a netting effect of its impact on assets and liabilities. The effect of the credit shock is also fairly small (1.5 percent of capital).

84. **The second set of stress tests dealt with insurance-specific risk factors.** These tests included:

- "**Underwriting risk.**" Firms evaluated the more severe effect for each risk group of either an increase or decrease of the factors in the survival or sickness tables by 15 percent.
- "**Lapse risk.**" Firms applied a 50-percent increase in their historical surrender rates.
- "**Non-life risk**" is organized in two groups. Group 1 corresponds to "mass events" where the probability of occurrence is "high" but the size of the claim is relatively "small" (it includes all the risks not included in Group 2, see next). Group 2 covers those risks where the probability of occurrence of large size claims is "significant" (marine, aviation and transport; fire; third party motor liability; third party liability; credit; surety; and industrial multi-risk). Group 2 is divided into two subcategories: claims below €30,000 and claims equal to or above €30,000. Firms applied the following shocks by group: an increase of 10 percent in the average cost of claims was applied to group 1 and group 2 with claims below €30,000; and to group 2 with claims equal to or above €30,000, an increase of 15 percent in the frequency of claims.

85. **For the sector as a whole, the largest impact from the insurance-specific shocks would come from underwriting risk**, which would result in a fall of 4 percent in capital. For life insurers, the largest impact on capital (a decrease of 18 percent) would result from an increase of 15 percent in the mortality rates. For non-life insurers, the largest impact on capital (a decrease of 7.3 percent) would result from a 10-percent increase in the average claim in the case of "mass events". For mixed insurance companies, the largest impact on capital (a decrease of 1.4 percent) would also come from an increase in the average claim of peak events.

Table 13. Spain: Summary of Stress Test Results for Insurance Firms, Impact on Insurer's Capital, December 2004
(In percent)

	Total	Avg.	Std. Dev.	Max.	Min.
All Institutions					
Interest rate risk: Increase in slope	-0.5	-1.1	10.8	27.8	-30.2
Interest rate risk: Decrease in slope	0.7	0.7	13.7	26.1	-45.5
Interest rate risk: Parallel shift out	0.7	-3.2	30.5	79.2	-114.5
Interest rate risk: Parallel shift in	1.3	6.2	38.7	192.0	-115.2
Credit risk	3.0	3.8	7.6	24.6	-13.0
Real state risk	5.6	3.9	7.5	26.0	-9.2
Underwriting risk	4.0	7.1	15.1	62.2	-14.0
Lapse risk / persistency risk	-1.2	-3.1	8.1	5.0	-27.1
Non life risk (group 1) 1/	0.5	0.1	7.0	11.5	-32.8
Non life risk (group 2, "mass" events) 2/	1.0	1.2	3.2	11.4	-9.4
Non life risk (group 2, "peak" events) 2/	1.7	1.6	2.1	6.7	0.0
Life Institutions					
Interest rate risk: Increase in slope	-2.8	-4.5	18.2	27.8	-30.2
Interest rate risk: Decrease in slope	2.7	2.5	23.6	26.1	-45.5
Interest rate risk: Parallel shift out	-8.1	-19.1	43.0	19.4	-114.5
Interest rate risk: Parallel shift in	24.8	32.5	46.3	122.0	-33.1
Credit risk	9.9	7.4	11.6	24.6	-13.0
Real state risk	3.9	4.2	5.7	13.4	0.0
Underwriting risk	18.2	18.2	23.0	62.2	-14.0
Lapse risk / persistency risk	-3.5	-9.0	12.9	5.0	-27.1
Non life risk (group 1)	0.1	0.0	0.1	0.2	0.0
Non life risk (group 2, "mass" events)	0.0	0.0	0.0	0.0	0.0
Non life risk (group 2, "peak" events)	0.0	0.0	0.0	0.0	0.0
Non life institutions					
Interest rate risk: Increase in slope	4.7	1.3	3.2	7.9	0
Interest rate risk: Decrease in slope	-5.3	-1.5	3.7	0.0	-9.1
Interest rate risk: Parallel shift out	10.0	2.8	6.9	17.0	0.0
Interest rate risk: Parallel shift in	-13.0	-3.7	9.0	0.0	-22.0
Credit risk	1.0	0.6	4.3	6.6	-6.5
Real state risk	7.1	-0.1	7.7	12.2	-9.2
Underwriting risk	0.0	0.0	0.0	0.0	0.0
Lapse risk / persistency risk	0.0	0.0	0.0	0.0	0.0
Non life risk (group 1)	7.3	3.6	4.1	11.5	0.0
Non life risk (group 2, "mass" events)	4.7	4.6	3.3	11.4	2.4
Non life risk (group 2, "peak" events)	4.6	3.2	2.0	5.7	0.7
Mixed institutions					
Interest rate risk: Increase in slope	-1.3	-0.2	6.7	11.7	-16.7
Interest rate risk: Decrease in slope	2.0	0.6	8.4	18.8	-14.4
Interest rate risk: Parallel shift out	0.5	3.8	26.0	79.2	-34.7
Interest rate risk: Parallel shift in	-1.5	-5.5	36.2	32.3	-115.2
Credit risk	1.5	3.1	5.0	11.8	-2.8
Real state risk	5.6	5.5	8.1	26.0	0.0
Underwriting risk	0.9	3.5	8.0	15.1	-12.6
Lapse risk / persistency risk	-0.8	-0.8	3.1	4.3	-9.2
Non life risk (group 1)	-1.4	-1.6	9.4	2.8	-32.8
Non life risk (group 2, "mass" events)	0.2	0.3	3.1	3.5	-9.4
Non life risk (group 2, "peak" events)	1.3	1.8	2.2	6.7	0.0

Note: The results are presented in percent of insurer's capital (a positive number indicates a reduction in capital).
1/ Group 1 refers to those claims related to "mass events" (i.e. high frequency but low claims).
2/ Group 2 covers the following risk categories: marine, aviation and transport; fire; third party motor liability; third party liability; credit; surety; and industrial multi-risk. Group 2 is divided into two subcategories: group 2 "mass events" , which corresponds to claims under 30,000 Euro, and group 2 "peak events", which corresponds to claims equal to or above 30,000 Euro.

LOAN LOSS PROVISIONING IN SPAIN[23]

86. Beginning in 2000, Spain has been pioneering the use of dynamic provisions as a way to enhance banking solvency and financial stability. The mechanism builds from the well-known fact that credit growth, and the quality of the loan portfolios, exhibit strong cyclical fluctuations. Typically, rapid credit growth and improvement in asset quality go with the expansionary phase of the economic cycle, and are reversed with the downturn. Dynamic provisioning recognizes that, at least for some portfolios, there is a measurable probability of future loss that originates as soon as a new loan is granted, which could be provisioned. By anticipating credit events in a statistical sense, dynamic provisioning facilitates the buildup of provisions during the expansionary phase, helping smooth banks' profits and solvency over the business cycle.

87. This Appendix describes the functioning of the dynamic provisioning mechanism in Spain, comparing the rules for loan classification and provisioning established in the initial regulation (Circular 9/1999), with those implemented in June-2005 (Circular 4/2004).

Loan Provisioning Under Circular 9/1999

88. Under the prudential regime launched in 2000, banks were required to build three types of provisions:

Provision	Formula
Generic:	$g = \alpha \Delta L$
Specific:	$s = \gamma \Delta P$
Statistic:	$e = \beta L - s$

89. Where the variables are defined as follows: s specific provision, g generic provision, e statistic provision, ΔP is the change in problem loans, ΔL is the change in total loans, and L is the total value of the loan portfolio. The (vectors of) provisioning parameters: α, β, and γ are based on historical information on loan impairment and losses given default, as well as improvements in credit risk measurement and management by

Parameters of the Statistic Loan Loss Provisions 1/
Circular 9/1999

Risk category	Beta (in percent)
Risk free	0.0
Low risk	0.1
Medium/low risk	0.4
Medium risk	0.6
High/medium risk	1.0
High risk	1.5

1/ These parameters apply to the performing loan portfolio.

[23] Sources: Bank of Spain Circular 9/1999 and Circular 4/2004. An analysis of the cyclical behavior of bank credit, loan losses and loan provisions in Spain is presented in: *Credit Growth, Problem Loans and Credit Risk Provisioning in Spain*, Documento de Trabajo No. 0018, Banco de España, 2000, and in *Credit Cycles, Credit Risk and Prudential Regulation*, Documento de Trabajo No. 0531, Banco de España, 2005.

Spanish credit institutions. The parameter α corresponds to the generic (or statutory) provision, which is a general reserve equivalent to 1 percent of the loan portfolio plus documentary credits, except for residential mortgage loans with loan-to-value ratios below 80 percent, and securitized mortgage loans, which require 0.5 percent. The parameter β corresponds to the statistic provision, which varies between 0 percent and 1.5 percent, depending on the risk category of individual loans, while the parameter γ corresponds to the specific provisions and depends on the actual degree of loan impairment as well as on country risk (text tables).

90. The novelty of this system was the introduction of the statistical provision, intended to capture the latent risk of the loan portfolio (the term βL) which fluctuates with the business cycle. For example, during an economic upturn, the statistical provision tends to be positive, as the latent risk of the loan portfolio exceeds its actual deterioration (captured by the specific provision s). This causes an increase in the statistical fund S. In accounting terms, a positive statistical provision is considered a cost for the bank and is registered against income on a quarterly basis. On the other hand, during an economic downturn, the statistical provision becomes negative and is registered as a revenue, deducting the resources from the statistical fund (as long as the fund has a positive balance). The statistical fund has a cap of three times the latent risk, that is: $0 \leq S \leq 3\beta L$.

Parameters of the Specific Loan Loss Provisions
Circular 9/1999

Period since payment date	Gamma (percent)
General	
Less than 3 months	0
3 to 6 months	10
6 to 12 months	25
12 to 18 months	50
18 to 21 months	75
More than 21 months	100
Residential mortgages 1/	
Less than 3 years	0
3 to 4 years	25
4 to 5 years	50
5 to 6 years	75
More than 6 years	100

1/ Applies to residencial mortgage loans which are first mortgages and with total bank's risk exposure below 80 percent of the property value.

91. Total provisions in any given quarter, tp, are given by the sum of the three components. Assuming that limits are not reached, this implies that banks have to provision the actual deterioration of their loan portfolios plus the latent risk: $tp = g + e + s = \alpha\Delta L + \beta L$.

Loan Provisioning Under Circular 4/2004

92. The new circular merges the generic and statistical provisions and changes the values of the provisioning parameters. Using the previous notation the provisioning rules now become:

Provision	**Formula**
Generic:	$g = \alpha\Delta L + (\beta L - s)$
Specific:	$s = \gamma\Delta P$

The generic provisions accumulate in a generic fund, *G*, which is required to remain within the following limits: $0.33\alpha L < G < 1.25\alpha L$

93. Total provisions in any given quarter, *tp*, are given by the sum of the two components. Assuming that limits are not reached, this implies that banks have to provision the actual deterioration of their loan portfolios plus the latent risk: $tp = g + s = \alpha\Delta L + \beta L$,

94. Since the values of the provisioning parameters have changed, the effects of the new regulation on provisioning levels will depend on the specific characteristics of the loan portfolios of individual banks. On impact, however, the new regulation is expected to release some provisions for the system as a whole, due to the combined effects of the cap on the generic fund, and the substantial amount of resources accumulated in the statistical fund (above €8 billion at end-June 2004).

Parameters of the Statistic Loan Loss Provisions 1/
Circular 4/2004

Risk category	Alpha (percent)	Beta (percent)
Risk free	0.0	0.0
Low risk	0.6	0.2
Medium/low risk	1.5	0.6
Medium risk	1.8	0.9
High/medium risk	2.0	1.5
High risk	2.5	2.3

1/ These parameters apply to the performing loan portfolio.

Parameters of the Specific Loan Loss Provisions
Circular 4/2004

	Gamma (percent)			
	Without real guarantees		With real guarantees 1/	
Period since payment date	Firms	Other clients	Firms	Other clients
General				
Less than 3 months	0	0	0	0
3 to 6 months	5.3	4.5	4.5	3.8
6 to 12 months	27.8	27.4	23.6	23.3
12 to 18 months	65.1	55.5	55.3	47.16
18 to 21 months	95.8	93.3	81.4	79.3
More than 21 months	100	100	100	100
Residential mortgages 2/				
Less than 3 years	3			
3 to 4 years	25			
4 to 5 years	50			
5 to 6 years	75			
More than 6 years	100			

1/ Loans guaranteed by properties (other than those specified in 2/ below), and with total bank's risk exposure below 70 percent of the property value.
2/ Applies to residencial mortgage loans which are first mortgages and with total bank's risk exposure below 80 percent of the property value.

Insurance, Valuation of Liabilities: Discounting Methods

Details of discounting with the full-term structure (default method)

95. The expected value of the pension and insurance liabilities is the present value of the expected cash flows arising from the contracts. The expected cash flows are based on underwriting principles (mortality rates, claims frequency, surrender rates, frequency of transfers of value, etc.) that are deemed to be realistic. An institution must take into account expected demographic, legal, medical, technological, social or economic developments. This means for example, that the foreseeable trend in life expectancy must be reflected in the expected value.

96. The present value of the expected cash flows is equal to the value of an investment with identical cash flows to these expected cash flows which will be paid with certainty. Such an investment replicates the expected cash flows of the liabilities. Therefore, the expected value is not affected by the institution's actual investments.

97. If possible (not obligatory for this initial study), embedded options are taken into account as a replication of the conditional cash flows (contingent claims) based on methods and assumptions that are deemed realistic. This value may be determined for example, by option valuation techniques.

Details of the duration approach (fallback option)

98. Under the duration approach, the institution discounts the insurance liabilities using the present (actuarial administrative) valuation techniques at the most suitable discount rate. Thus, it replaces the current fixed technical interest rate by the most suitable discount rate corresponding to the average expected duration of the portfolio.

99. The idea is as follows: each homogenous risk group in the portfolio of liabilities, consisting of various cash flows and associated maturities, is regarded notionally as a single cash flow at a single moment corresponding to the average duration of these cash flows. An appropriate spot rate of interest for this duration can then be used to discount the original liabilities portfolio, to obtain an approximation for the expected value.

Insurance, Treatment of Credit Risk

100. In order to determine the capital surcharge corresponding to the credit risk, two possible approaches were proposed for the Preparatory Field Study, which could be applied interchangeably on a case-by-case basis:

- Default method: standardized approach of Basel II
- Alternative: credit spread method

Default method: standardized approach of Basel II

101. The standardized approach of Basel II applies a risk weight that is assigned from the external rating of the exposure of the financial contract. For specific details we refer to the Basel Capital Accord.[24] We propose here a simplified version of the Basel II standardized approach.

102. External ratings may be used to establish a risk weight in the standardized approach. External ratings are widely available for (exposures on) central governments and institutions, and to a lesser extent for corporations. For the purpose of this study, exposures on all bonds and other counterparties (including claims for example, on reinsurers or intermediaries) have to be risk weighted as follows:

External rating	AAA-AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-	Unrated
Risk weight Severe shock (in percent)	20	50	100	150	200	150

103. With respect to the default method in the standardized approach, we distinguish a severe shock. This severe shock uses values broadly corresponding to the values assigned in Basel II for corporate bonds.

104. The method for computing the capital requirement is as follows. An investment in a AAA-rated treasury bond of €100 issued by a central government with a risk weight of 20 percent is, therefore, 20 percent x 8 percent x €100 = €1.6.

[24] Basel Committee on Banking Supervision (June 2004), *International Convergence of Capital Measurement and Capital Standards. A Revised Framework*, pp. 15-47 (http://www.bis.org/publ/bcbs107.htm).

Alternative: using credit spreads

105. Credit risk is expressed in the credit spread. This is the difference between the effective yields on a collection of cash flows whose payment depends on the creditworthiness of counterparties and the effective yields on the same collection of cash flows as if they were certain to be paid. Generally, bonds of a highly creditworthy government are regarded as default free. In practice, therefore, the credit spread of, say, corporate bonds is derived by comparing the effective yield on a corporate bond with the effective yield on a government bond of the same duration. As well as corporate loans, a claim on a counterparty, for example, a reinsurer, intermediary or counterparty in a private derivatives contract, may also carry credit risk.

106. The required solvency does not need to be determined for every single investment with credit risk or claim on a counterparty. The stress test is to be performed by changing the observed credit spread on the investment portfolio (including claims for example, on reinsurers or intermediaries) by a certain fixed factor. This means that the shock is lower in absolute terms if the credit spread observed at the reporting date is low. The extent to which an institution is sensitive to the shock in the credit spread depends on the maturity characteristics of the cash flows and claims in the portfolio.

107. Firms may determine the credit risk in the following way. Given the total investment portfolio, including claims on counterparties, the firm has to determine the effect on the assets of an immediate increase in credit spreads.[25]

[25] The shocks used for the credit spreads were as follows: an increase of 15 basis points (bp) for corporate bonds rated in the range of AAA to A and a 100 bp (300 bp) increase for those with a rating of (below) BBB.