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Australia: Selected Issues

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INTERNATIONAL MONETARY FUND

AUSTRALIA

Selected Issues

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Approved by Asia and Pacific Department

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I. The Effectiveness of Fiscal Stimulus Measures[1]

A. Introduction

1. **With fiscal policy playing a central role in mitigating the impact of the global downturn, this chapter provides some insights on its likely effectiveness in supporting aggregate demand in Australia.** The IMF's Global Integrated Monetary and Fiscal Model (GIMF) is used to derive estimates of the potential aggregate demand impact of alternative fiscal measures and provides an estimate of the expected impact on GDP of the temporary discretionary measures announced by the Commonwealth government. The simulation analysis illustrates that the type of fiscal measure and the underlying behavioral responses have an important impact on the magnitude of fiscal multipliers. The GIMF simulations suggest that the cumulative impact after five years could be close to 10 percentage points of GDP for the announced stimulus measures that cumulate to almost 8 percentage points of GDP.

B. The Global Integrated Monetary and Fiscal Model

2. **GIMF, a model of the world economy derived from optimizing foundations, embodies a detailed representation of fiscal policy.** Fiscal authorities in GIMF consume goods, maintain public capital stocks, and provide transfers. These activities are financed through taxes on labor income, capital income, consumption expenditure, as well as non-distorting lump-sum taxes. For this application, a two-region version of the model has been calibrated to represent Australia and the rest of the world. [2]

3. **GIMF's non-Ricardian features allow fiscal policy to have a significant impact on household behavior.** The overlapping generations structure of GIMF increases the potential impact that the fiscal authority can have on households' consumption, saving, and labor supply decisions. Each period households face a constant probability of death. Because of this, households discount future tax liabilities as they may not be around to pay them. The implication is that fiscal choices regarding when and how to fund current spending or tax changes influence households' responses and thus the macroeconomic impact of these policy actions. In addition, a portion of households face liquidity constraints that prevent them from accessing capital markets to smooth their consumption over time. These households simply spend their disposable income in each period, and this can amplify the impact of policy actions that alter disposable income.

4. **Although public consumption expenditure in GIMF does not add directly to welfare, the public capital stock does.** In the model, public capital adds to the productivity

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[1] Prepared by Ben Hunt (ext. 36361).

[2] For a detailed description of GIMF, see Kumhof, M., and D., Laxton, 2007, "A Party without a Hangover? On the Effects of U.S. Government Fiscal Deficits," IMF Working Paper, WP/07/202.

of private capital. This complementarity serves to increase the macroeconomic impact of public investment via productivity and private investment decisions.

C. Fiscal Multipliers

5. **The GDP impact of alternative fiscal measures varies widely across instruments.** The model-simulated impacts on output of temporary (one-year), one-percent-of-GDP increases in the fiscal deficit to fund a range of fiscal initiatives are presented in Table I.1. The results in the first column illustrate that direct government spending has the largest impact on aggregate demand with both government consumption and investment expenditures having multipliers larger than one. Transfers targeted to low-income (liquidity-constrained) households and reductions in value-added taxes have the next largest effects. Reductions in taxes on labor income and transfers to all households have small and similarly-sized multipliers while reductions in taxes on corporate profits have essentially a zero multiplier.

Table I.1. Australia: Impact of Temporary Fiscal Measures on GDP
(Percent Deviation from Baseline)

	Base Case (No Monetary Accommodation)	**Sensitivity Analysis 1/** (No Monetary Accommodation)		**Base Case** (Monetary Accommodation)
		Lowest	Highest	
Public Investment	1.22	1.18	1.32	1.37
Public Consumption	1.12	1.11	1.14	1.32
Transfers to Liquidity Constrained Households	0.43	0.40	0.48	0.54
Value Added Taxes	0.27	0.23	0.31	0.35
Transfers to all Households	0.14	0.09	0.20	0.18
Tax on Labor Income	0.15	0.10	0.20	0.16
Tax on Corporate Income	0.01	0.01	0.03	0.02

1/ The sensitivity analysis included the degree of complementarity between private and public capital (base-case parameter 0.10, smallest 0.05, largest 0.20), households' planning horizon (base case 20 years, shortest 10 years), and the proportion of liquidity constrained households (base case 30 percent, smallest 20 percent, largest 40 percent).

6. **Sensitivity analysis illustrates how fiscal multipliers depend on key behavioral assumptions and the monetary authority's response.** Because GIMF is calibrated, it is useful to examine the sensitivity of the results to key calibration choices. For the fiscal measures considered, the degree of complementarity between private and public capital, the proportion of liquidity constrained households, and households' effective planning horizons were found to be the calibration choices that have the largest impact on the magnitude of the fiscal multipliers. However, the results in Table I.1 (columns 2 and 3) illustrate that plausible ranges for these calibration choices do not alter the magnitudes of the multipliers by a

significant amount.[3] If monetary policy does not initially respond to the higher inflation resulting from the fiscal measures, the impact on GDP increases by a nontrivial amount (Table I.1, column 4).

D. The Impact of Announced Discretionary Fiscal Measures

7. **As of the May 2009 Budget, the Commonwealth government had announced discretionary fiscal stimulus measures totaling almost 8 percent of GDP over five years.** Table I.2 presents a breakdown of the measures that are heavily focused on public investment and transfers to low- and middle-income families, measures that the multiplier analysis suggests should be highly effective at stimulating activity.

Table I.2. Australia: Fiscal Stimulus Measure as of May 2009 1/
(In Percent of GDP)

	2008	2009	2010	2011	2012	Cumulative
Transfers	0.8	1.2	0.2	0.1	0.1	2.4
Public Investment	0.0	1.2	1.7	1.2	0.4	4.5
Public Spending	0.0	0.4	0.1	0.2	0.1	0.8
Private Investment	0.0	0.1	0.1	0.0	0.0	0.2
Total	0.8	2.9	2.1	1.5	0.6	7.9

1/ These estimates are based on the material provided in the May 2009 Commonwealth Government Budget.

8. **GIMF estimates suggest that the announced stimulus will likely have a cumulative impact after 5 years of close to 10 percentage points of GDP.** Table I.3 presents the model-simulated impact of the stimulus measures on GDP under alternative behavioral assumptions. The estimated cumulative impacts on GDP after five years range between 5¼ and 12¾ percentage points. The lowest estimated cumulative impact of 5¼ percentage points assumes that only a small portion of households are liquidity constrained, the complementarity between private and public capital is very low, and monetary policy must be tightened in response to the fiscal easing. Given the current degree of stress in financial markets, the outlook for inflation, and obvious infrastructure bottlenecks in Australia, this estimate is likely too low. It is probably reasonable to expect the impact to be close to that achieved under the base-case calibration with monetary accommodation and highly targeted transfers, which would bring the cumulative impact over the five years close to 10 percentage points of GDP. The largest estimate of almost 13 percentage points of GDP,

[3] The only exception is the cumulative effect on GDP of the degree of complementarity between private and public capital. Doubling the degree of complementarity (0.10 to 0.20) increase the cumulative impact after 10 years on GDP from 2.25 percentage points to 3.85 percentage points. Cutting the degree of complementarily in half (0.10 to 0.05) reduces the cumulative impact on GDP to 1.48 percentage points.

however, is not outside the realm of possibilities, particularly if the infrastructure projects are targeted toward areas where bottlenecks have constrained the commodity sector.

Table I.3. Australia: GIMF Simulated Impact of Fiscal Stimulus on GDP 1/
(Percent Deviation from Baseline)

	2008	***2009***	***2010***	***2011***	***2012***	Cumulative
Lower Bound Calibration	0.06	1.85	1.79	1.27	0.29	5.26
Base Case Calibration	0.10	2.08	2.08	1.59	0.61	6.46
Base Case Calibration, Transfers Highly Targeted, Monetary Accommodation 2/	0.24	3.25	3.21	2.15	0.71	9.56
Upper Bound Calibration	0.15	2.58	2.68	2.21	1.21	8.83
Upper Bound Calibration, Transfer Highly Targeted, Monetary Accommodation	0.29	4.06	4.19	2.96	1.31	12.81

1/ This simulation is done assuming that in 2008, no one is aware of the fiscal stimulus introduced in 2009. However, from the start of 2009 and onwards, everyone is fully aware of the fiscal measures that will be taken over the subsequent 4 years.
2/ It is assumed that 60 percent of the transfers go to households that face liquidity constraints and thus spend all the transfer. In this simulation, the monetary policy rate does not respond to the increase in inflation resulting from the stimulus until 2011.

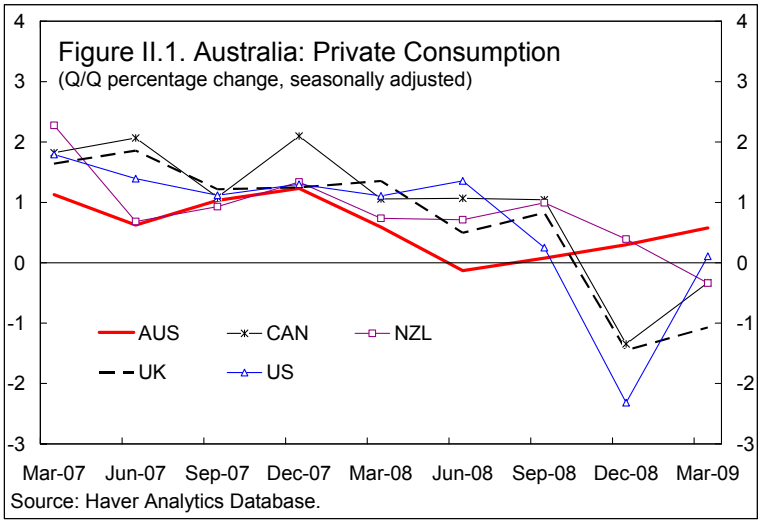
9. **The bill for the fiscal stimulus will eventually need to be paid with implications for real activity.** In the simulations, the stimulus expenditures are financed with increased public borrowing until 2012. Beyond 2012, a fiscal consolidation occurs to return public debt relative to GDP back to its initial level. During the consolidation period, where taxes and/or spending adjust, the level of GDP will be lower than it otherwise would be if no fiscal consolidation was required.

II. AUSTRALIAN HOUSEHOLD VULNERABILITIES[4]

A. Introduction

10. If the economic downturn in Australia is to be milder than in other industrial countries, resilience in private consumption spending will be essential. To this point in the downturn, private consumption growth in Australia has slowed, but not nearly to the same extent as in the United States, the United Kingdom, or Canada (Figure II.1). This chapter examines the position of Australian households relative to those in several other advanced countries to assess how well household spending can be expected to hold up going forward.

11. **The comparison suggests that, in addition to rising unemployment and slower income growth, the key vulnerability that Australian households face is the value of their housing wealth**. House price appreciation has been the single largest contributor to the growth in Australian household wealth over the last decade. The metrics examined suggest overvaluation in house prices as of March 2009 in the range of 0–20 percent. Although a sharp correction in house prices toward the upper end of this range could prove disruptive for private consumption because of its implications for household wealth, a number of factors should contribute to gradual and orderly adjustment. First, a significant moderation in house price inflation has already occurred and prices appear to have stabilized. Second, the significant decline in mortgage interest rates, a government subsidy for first-time home buyers, and continued strong net immigration will all provide considerable support for housing demand and thus prices. This in turn should help maintain households' wealth, confidence, and consumption expenditure. Nevertheless, a sharp fall in house prices over the next few years remains a tail risk.



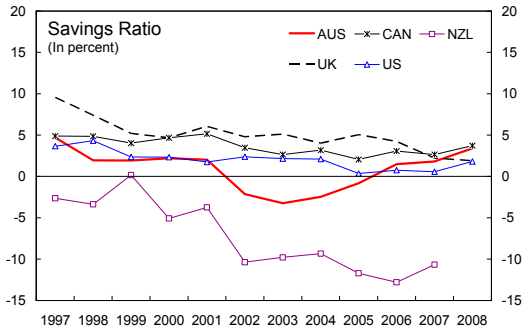
[4] Prepared by Ben Hunt (ext. 36361), Khoi Viet Nguyen (ext. 37417), and Patrizia Tumbarello (ext. 34395).

B. Household Saving and Wealth

12. **Although Australian households accumulated significant debt prior to the downturn, household consumption appears to be in a less precarious position than in some other countries.** Similar to the situation in other advanced countries, the household savings rate in Australian declined over the first half of the last decade. However, the savings rate subsequently recovered and has returned to positive territory (Figure II.2). There has also been a significant increase in household debt relative to disposable income. While this debt accumulation occurred in many countries, the rise in debt service costs, owing to a prolonged period of tight monetary policy, was dramatic in both Australia and New Zealand.[5] Australian households, however, appear to have covered a portion of their increased debt-service burden by reducing consumption as a share of disposable income. Consequently, Australian households may have entered the downturn with consumption expenditure closer to a sustainable level.

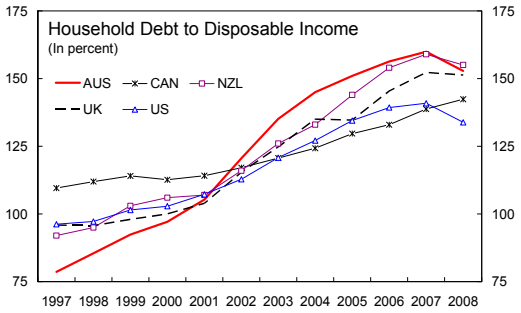
Figure II.2. Australia: Household Savings

As in other countries, Australian households savings rate fell…



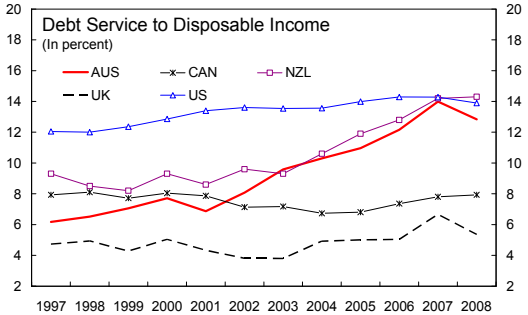
Source: Haver Analytics; OECD.

…and debt accumulated.



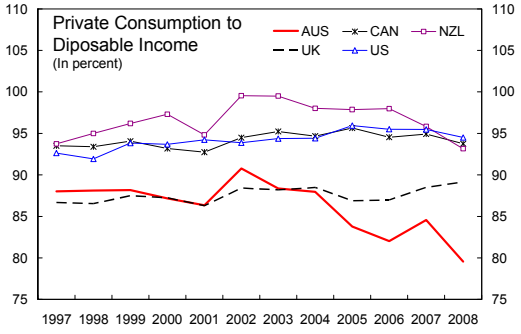
Sources: RBA; RBNZ; Eurostat; Haver Analytics Database; and Fund staff calculations.

Debt service cost rose dramatically in Australia and New Zealand,…



Sources: RBA; RBNZ; Eurostat; Haver Analytics Database; and Fund staff calculations.

……but Australian households covered part of the cost by reducing consumption.



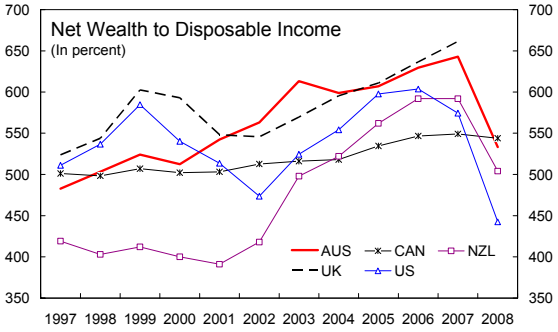
Sources: World Economic Outlook; and Fund staff calculations.

[5] With the decline in variable mortgage interest rates in Australia, debt-service costs moved below 12 percent of disposable income in the first quarter of 2009.

13. **Despite the run-up in debt, Australian households' net wealth position has risen over the last decade, but the improvement has been largely housing wealth** (Figure II.3). Australian and New Zealand households currently have net wealth positions that are well above their levels a decade earlier. However, in part this reflects their relatively low holdings of financial wealth, which has been hit hard in many countries by falling equities prices. Australian households, like those in New Zealand and the United Kingdom, hold a large portion of their wealth as housing. As outlined in Kohler and Smith (2005), the concentration of the population in large urban centers in Australia can partially account for the higher proportion of housing in wealth. However, this doesn't mitigate the risk to household consumption. With housing such a large share of their wealth and house prices having risen so significantly over the last decade, Australian household wealth, and thus spending, could be vulnerable to a large decline in house prices.

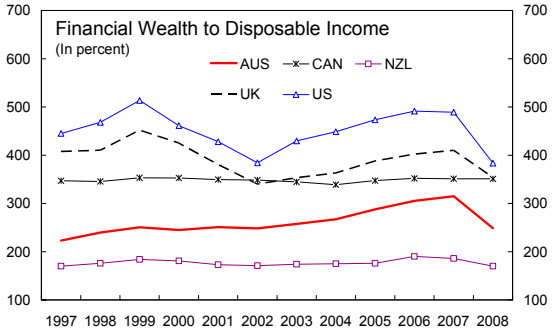
Figure II.3. Australia: Household Wealth

Australian households net wealth position has improved over the last decade.



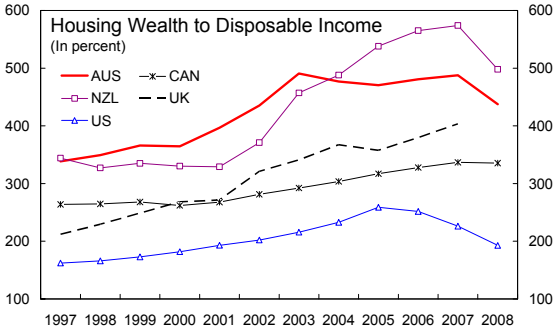
Sources: RBA; RBNZ; Eurostat; OECD; Haver Analytics Database; and Fund staff calculations.

Although financial wealth is a relatively low share…



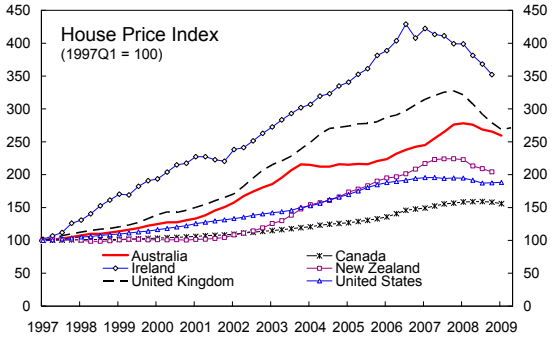
Sources: RBA; RBNZ; Eurostat; Haver Analytics Database; and Fund staff calculations.

… And housing wealth is a relatively high share.



Sources: RBA; RBNZ; Eurostat; OECD; Haver Analytics Database; and Fund staff calculations.

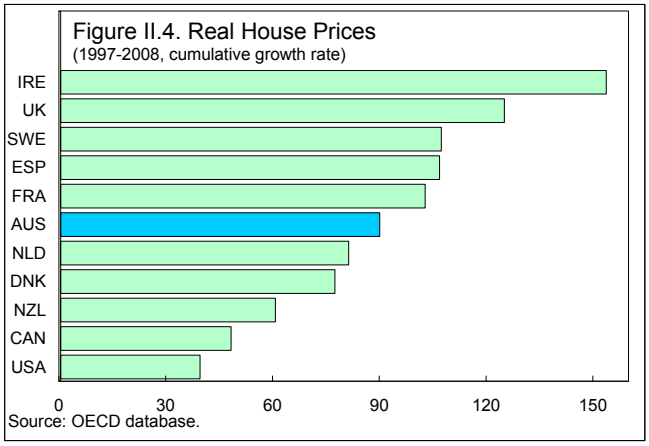
This leaves Australian households vulnerable to an unwinding of the large run-up in house prices.



Sources: Haver Analytics Database; and Fund staff calculations.

C. Metrics of House-Price Valuation

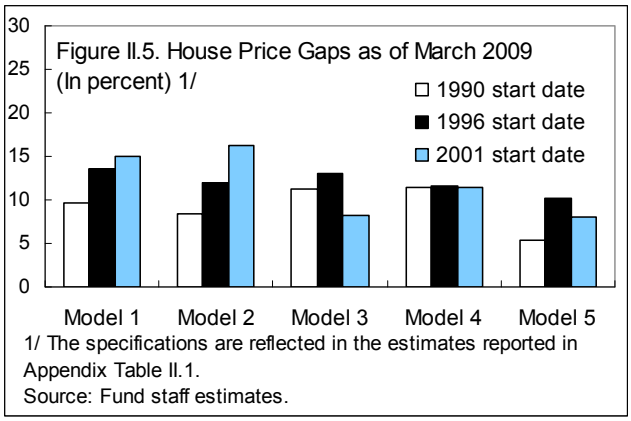
14. **As in other countries over the last ten years, real house prices have risen rapidly in Australia, and here we use two metrics to assess house-price valuation** (Figure II.4). First, an econometric approach is used to derive estimates of the house-price gap (i.e., the extent to which the increase in house prices in recent years cannot be explained by economic factors). Second, the ratios of house prices to disposable income and house prices to rents are compared to various estimates of their sustainable levels (long-run moving averages).



15. **The econometric approach models house price growth as a function of the following variables**: growth in per capita disposable income, changes in working age population (or alternatively lagged net immigration), changes in equity prices and credit, short-term and long-term interest rates (or alternatively mortgage rates). All versions of the model include an affordability ratio (the lagged ratio of house prices to disposable income) as a medium-term anchor. Some versions of the model considered also include lagged real house price growth to better capture the observed persistence.

16. **As is the case with all reduced-form econometric models, the results from this model need to be interpreted cautiously, but can still be informative.** First, exogeneity of variables assumed to be independent is not guaranteed. Second, such models rarely perfectly capture the underlying theoretical relationships that they are used to proxy. Finally, but not unrelated, results can be highly dependant on sample periods considered and specification. That being said, this type of modeling approach has been used elsewhere to provide estimates of house price overvaluation, for example see Terrones (2004), and should be interpreted a just another piece of evidence contributing to an assessment of potential disequilibrium in house prices.

17. **The resulting econometric estimates suggest that house-price overvaluation ranges between 5 and 15 percent as of March 2009 depending on different specifications and starting dates for the comparison**. The estimated house-price gaps from five models (Appendix Table II.1) are presented in Figure II.5 under three different start dates for generating the models' predicted levels for house prices.[6] All models and start dates imply some degree of overvaluation, the simple average of which is 11 percent. These results should be interpreted cautiously because models selected on the basis of their ability to fit the data, may not actually be effectively capturing the underlying fundamentals determining sustainable prices. For example, the low current interest rates help explain current house prices, but looking ahead Australian interest rates will undoubtedly return to a more neutral level.



18. **The simple metrics of the price-to-rent ratio and the price-to-income ratio also point to some house price overvaluation in Australia** (Figure II.6). Over the last couple of decades many industrial countries witnessed rapid house price appreciation. While prolonged high house price appreciation does not in itself constitute overvaluation, the ratios of house prices to income and to rent provide some simple measures of potential misalignment. However, care must be taken when evaluating the current level of these ratios relative to their long-run trends. Structural changes such as permanently lower nominal interest rates, rising incomes, and the increasing scarcity of land close to main urban centers can contribute to sustainable increase in these ratios. In Australia, the scarcity of land close to main urban centers is an important factor. As argued in Ellis and Andrews (2001), the fact that such a high proportion of Australia's population live in two major centers tends to drive up average house prices and thus the ratio of prices to incomes. One way to allow for this is to evaluate the current levels relative to a range of long-run moving averages that proxy for the sustainable level. The gaps relative to 10-, 15-, and 20-year moving averages presented in Table II.1 indicate that in all but one case, the price-to-income and price-to-rent ratios appear to be above sustainable levels.

[6] Because the equation is estimated in first differences, to generate estimates of the house-price gap, the fitted values from the regressions are used to generate an estimated level for house prices to compare against the level of house prices at the end of the sample period. Consequently, the start date for generating the estimated level for house prices can influence the estimate of the house-price gap.

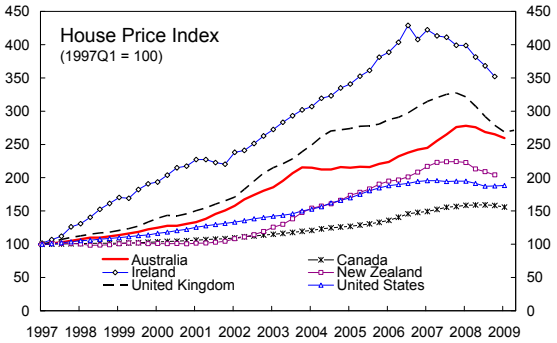
Table II.1. Australia: Percent Deviation from Estimated Sustainable Levels as of March 2009

	Relative to 10-Year Moving Average	Relative to 15-Year Moving Average	Relative to 20-Year Moving Average
Price-to-Income Ratio	-6.1	3.3	7.4
Price-to-Rent Ratio	6.7	20.9	30.4

Sources: OECD Database and Fund staff calculations.

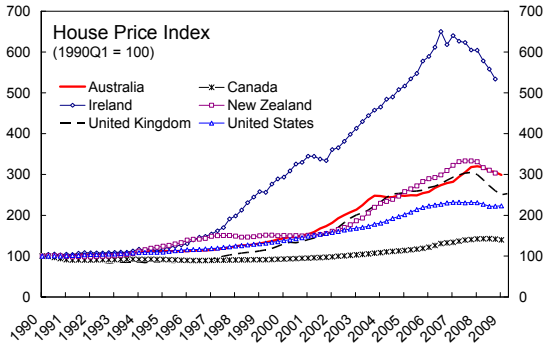
Figure II.6. Australia: House Prices

Australian house prices rose substantially over the past decade…



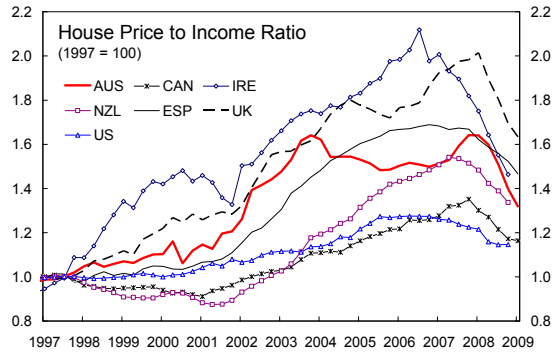
Sources: Haver Analytics Database; and Fund staff calculations.

…but over a longer period, the increase was exceeded by few other countries.



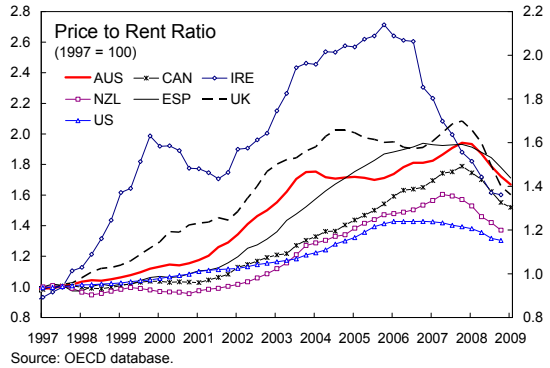
Sources: Haver Analytics Database; and Fund staff calculations.

This is reflected in a high price-to-income ratio and…



Source: OECD database.

…a high price-to-rent ratio.



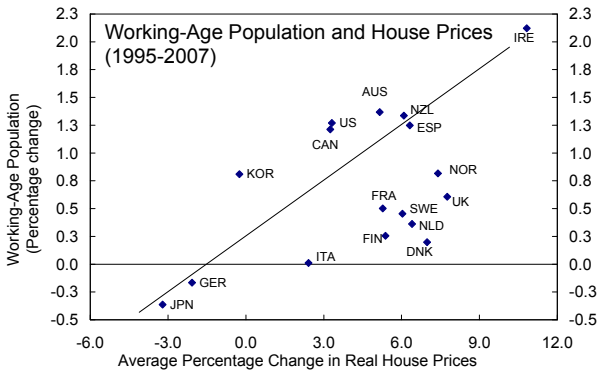
Source: OECD database.

D. Assessment of Potential Overvaluation and Risks

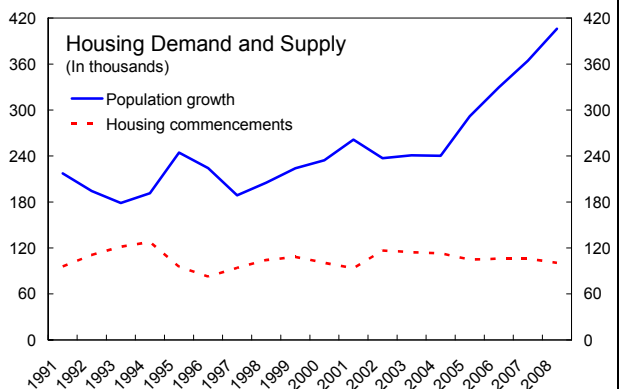
19. **A reasonable assessment of the metrics considered would suggest overvaluation in the range of 0 to 20 percent as of March 2009.** Although the price-to-rent ratio was roughly 30 percent above its 20-year moving average, this is likely too a long a period to use for the estimate of the sustainable level given the significant structural change that has occurred over the period. Further, using only a 10-year moving average may be too short, particularly given the duration of Australia's most recent economic expansion. Based on the 15-year moving averages, the gaps at the end of the first quarter of 2009 would suggest a range of overvaluation of roughly 0–20 percent. This range also encompasses the range of estimates of overvaluation coming from the econometric analysis. While the range of overvaluation may appear to suggest significant adjustment in house prices could be required, it is useful to remember that sustainable levels can be achieved if incomes and rents grow faster than house prices, or other fundamentals, such as migration, change. Thus house prices alone need not do all the adjustment and the adjustment that is required in prices, can occur gradually.

20. **Looking ahead, several factors suggest that any required house price adjustment is likely to be orderly.** First, after declining q/q by 2 percent in 2009 Q1, preliminary data for the second quarter of 2009 indicate that house prices have started to rise again. Second, variable mortgage interest rates have fallen by almost 400 basis points since the RBA started to ease monetary policy in September 2008 and are expected to remain low for an extended period of time. Third, the government's subsidy for first-time home buyers, which lasts through 2009, will also provide support for housing demand. Finally, the gap over the last several years between population growth and housing starts should result in strong demand for housing over the next few years (Figure II.7).

Figure II.7. Australia: Housing Demand and Supply



Sources: UN database, OECD database, and Fund staff calculations.



Source: Australian Bureau of Statistics.

APPENDIX II.1. AUSTRALIA: HOUSE PRICE MODELS

The growth rate of real house prices was modeled as a function of the following variables:

- *Past growth rates of real house prices*. If the growth rate of house prices is persistent, then the current growth rate must be serially correlated with the past growth rate. Higher values of this correlation coefficient imply higher persistence;
- *Past housing affordability ratio*. If the growth rate of house prices shows long-run reversion to fundamentals, this implies that prices would tend to fall when they are out of line relative to income levels. Hence, the coefficient of the housing affordability ratio—the ratio of real house prices to (per capita) real income—must be negative;
- *Fundamentals.* The growth rate of house prices is positively affected by household real disposable income growth—as this increases households' purchasing power and borrowing capacity. Other fundamentals influencing house prices include the growth rate of real credit, a proxy for mortgage debt, as this indicates that households are less credit rationed; the past growth rate of real stock prices—which captures households' efforts to rotate their portfolio in favor of housing; working age population (or alternatively migration) growth, as this proxies for the growth rate of households; and
- *Interest rates*. The growth rate of house prices is negatively affected by interest rates (including mortgage rates) because lower rates increase households' capacity to borrow.

This model was estimated using quarterly data over the period Q1 1987–Q1 2009.

The econometric results confirm that real house prices in Australia show high persistence, long-run reversion to fundamentals, and dependence on economic fundamentals, especially working-age population growth (Appendix Table II.1).

Appendix Table II.1. Australia: Determinations of House Prices in Australia: Empirical Results, 1987Q1-2009Q1

Explanatory Variables	Dependent Variable Real House Price (growth)				
	Model 1	Model 2	Model 3	Model 4	Model 5
Lagged dependent variable					
Lagged real house price (growth)	...	...	0.57***	0.55***	0.60***
Reversion					
Lagged housing affordability ratio 1/	-0.05***	-0.057***	-0.03**	-0.041***	-0.04***
Other variables					
Lagged real disposable income (Per capita, growth)	0.180	0.153*	0.22*	0.23*	0.201*
Short-term interest rate (percent)	-0.003	...	-0.022	...	...
Long-term interest rate (percent)	0.000	...	0.000	...	...
Real credit (growth)	0.123	0.015***	0.012	-0.01	-0.022
Lagged real stock prices (growth)	-0.005	-0.008	0.000	-0.005	-0.001
Working-age population (growth)	3.02**	...	2.68**	2.48**	...
Mortgage interest rate (percent)	...	-0.003***	...	-0.002***	-0.001***
Lagged net long-term migration to population (t-3) population (t-3)	...	0.01*	...	...	0.014***
Number of observations	89	89	89	89	89
R-squared	0.23	0.24	0.51	0.51	0.52
Breusch-Godfrey LM test	0.000	0.000	0.09	0.09	0.050

Source: Fund staff estimates.

Notes: * denotes significance at 10 percent level, ** at 5 percent level, *** at 1 percent level.

1/ Lagged ratio of house prices to disposable income.

References

Ellis, L., and D., Andrews, 2001, "City Sizes, Housing Costs, and Wealth," *Reserve Bank of Australia Research Discussion Paper,* 2001–08.

Kohler, M., and K. Smith, 2005, "Housing and the Household Wealth Portfolio: The Role of Location," *Reserve Bank of Australia Research Discussion Paper* 2005–10.

Terrones, M., 2004, "What Explains the Recent Run-Up in House Prices?," Box 2.1 in Chapter 2, *World Economic Outlook*, September 2004 (Washington: International Monetary Fund).

III. Australian Bank and Corporate Sector Vulnerabilities—An International Perspective[7]

A. Introduction

This chapter focuses on how the exposure to the corporate sector may impact the health of the banking system. It also compares Australian banks with their international peers. Finally, it investigates banks' exposure to credit risk using the new Basel II Pillar 3 disclosure data.

21. **The Australian banking sector entered the financial turmoil in a sound position and has been resilient to the global crisis.** Banks' capital ratios are well above the regulatory requirements. The major banks' AA credit ratings have remained unchanged since the crisis unfolded, and they were able to raise private equity capital in the midst of the global crisis. Impaired assets are still low by international standards, although they have increased in the past year.

22. **The international downturn points to several vulnerabilities.** On the liabilities side, banks remain exposed to rollover risks on short-term wholesale funding. On the assets side, banks are vulnerable to the household sector as well as to possible corporate sector distress.

23. **Nonetheless, the risks from the corporate and household sectors appear to be manageable.**[8] Results from contingent claim analysis suggest that Australian banks' potential losses from their corporate exposures could amount to as much as 2 percent of total banking sector loans, less than in other countries in the region. Analysis of banks' exposure to the corporate and household sectors shows that banks are able to withstand potential losses from sizable shocks to their loan portfolio. These results should be interpreted with caution as they are not rigorous stress tests. The Australian Prudential Regulation Authority (APRA) has regularly stress tested the banking system but it would be advisable to undertake more extreme stress-test scenarios than applied in the past and include Australia's overseas subsidiaries.

B. The Global Turmoil: Impact on Australian Banks

24. **The impact of the global financial crisis on banks' asset quality has been limited so far.** This reflects banks' small exposure to U.S. and domestic securitized assets and to U.S. investment vehicles holding structured finance products.[9, 10] Australian banks' balance

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[7] Prepared by Előd Takáts (ext. 34532) and Patrizia Tumbarello (ext. 34395).

[8] An analysis of banks' exposure to the housing sector was presented in *Australia: Selected Issues*, IMF Country Report No. 08/311, D. Rozhkov, 2008.

[9] The stock of residential mortgage-backed securities (RMBS) and asset-backed commercial paper (ABCP) outstanding was about $A 160 billion in March 2009, about 40 percent below the peak of mid 2007, but is small compared with total financial sector credit of about $A 1,900 billion. Moreover, most of banks' RMBS

(continued)

sheets are heavily weighted toward domestic loans, in particular the low-risk households. Conservative capital adequacy rules imposed by APRA and regular stress testing of banks helped limit risks. The large banks are less leveraged than banks in comparable countries (Section D). On the liabilities side, however, banks had sizable short-term external debt obligations, and access to offshore wholesale markets was disrupted by the Lehman Brothers collapse in September 2008. Policy measures introduced to cope with the crisis, such as wholesale funding guarantees and guarantees on all deposits under a million dollars introduced in October 2008, have allowed banks to continue to access international capital markets and helped ensure liquidity.

25. **Financial soundness indicators remained strong through March 2009.** The international financial turbulence reduced profitability, but not significantly, and banks were able to raise equity during the turmoil relatively easily from private capital markets (Tables III.1 and III.2). Total capital has increased since 2007 and has remained well above

Table III.1. Australia: Selected Financial Soundness Indicators of the Banking Sector 1/
(In percent)

	Dec-05	Dec-06	Dec-07	Sep-08	Dec-08 2/	Mar-09 2/
Profitability						
Return on assets (after tax)	1.0	0.9	0.9	0.4	0.6	...
Return on equity (after tax)	14.7	17.8	16.6	9.9	15.2	...
Capital adequacy						
Regulatory capital to risk-weighted assets	10.4	10.4	10.2	10.9	11.4	11.4
Tier I capital to risk-weighted assets	7.6	7.4	7.2	7.6	8.2	8.4
Of which: Four largest banks 2/	7.3	7.0	6.7	7.4	8.1	8.2
Smaller domestic banks	8.7	9.8	9.5	8.2	8.9	10.2
Asset quality						
Gross impaired assets to total assets	0.2	0.2	0.2	0.5	0.8	1.0
Of which: Four largest banks 2/	0.2	0.2	0.2	0.4	0.6	0.8
Smaller domestic banks	0.2	0.3	0.3	0.9	1.7	2.1
Net impaired assets to equity	1.8	1.9	1.9	6.2	8.4	...
Specific provisions to impaired assets	37.1	39.1	39.5	31.5	36.3	38.0
Risk-weighted assets to total assets	59.3	57.1	54.4	44.9	43.0	42.5

Sources: Reserve Bank of Australia, APRA, and Fund staff estimates.
1/ Quarterly data.
2/ Break in December 2008 data due to the reclassification of St. George from smaller domestic banks to four largest banks after its takeover by Westpac, and the inclusion of Bankwest in four largest banks after its takeover by the Commonwealth Bank of Australia (CBA).

operations were generally carried out as true sales to unrelated parties not to banks' own special purpose vehicles or other off-balance sheet entities. Investors' capital losses on RMBS holdings have been limited by lenders mortgage insurance and credit enhancements from profits of the securitization vehicles.

[10] Information reported in the largest banks' disclosure statements indicates either no direct exposure to U.S. securitized assets (Westpac and the Commonwealth Bank of Australia), or limited exposure. In particular, Australia and New Zealand Banking Group Limited (ANZ) has reported an exposure of about $A 500 million to U.S. asset-backed securities (ABS); and the National Australia Bank (NAB) has disclosed $A 360 million exposure to U.S. ABS collateralized debt obligations (CDOs) and $A 1 billion exposure to U.S. credit wrapped ABS.

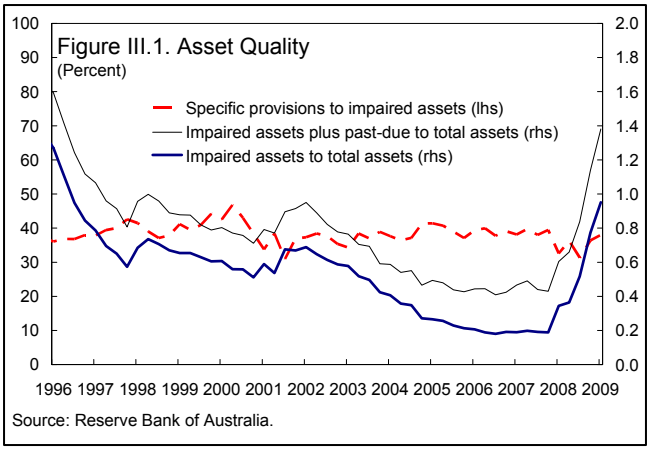
the regulatory requirement of 8 percent of risk-weighted assets while Tier 1 capital rose to 8 percent of risk-weighted assets. Staff estimates of tangible common equity (TCE) depict a similar picture with TCE over assets increasing to over 4 percent for the four major banks in the last six months.

Table III.2. Australia's Four Largest Banks: Selected Financial Soundness Indicators
(In percent)

	ANZ		NAB		CBA		Westpac 1/	
	Mar-09	Sep-08	Mar-09	Sep-08	Dec-08	Jun-08	Mar-09	Sep-08
Profitability								
Return on assets	0.5	0.6	0.6	0.6	0.8	1.1	0.8	1.0
Return on equity	10.3	10.7	12.7	11.9	12.7	11.9	14.3	21.0
Net interest margin	2.2	2.0	2.1	2.3	2.0	2.0	2.2	2.1
Capital adequacy								
Tier one capital ratio (Basel II)	8.2	7.7	8.3	7.3	8.8	8.2	8.4	7.8
Total capital ratio (Basel II)	11.0	11.1	12.2	10.9	11.4	11.6	11.4	10.8
TCE/total assets 2/	4.9	4.9	4.4	4.0	3.6	3.8	4.2	4.0
TCE/tangible assets 3/	4.9	4.9	4.5	4.1	3.7	3.9	4.3	4.0
Assets quality and provisioning								
Past due 90 days plus/total loans	0.5	0.3	0.5	0.3	0.4	0.3	0.3	0.2
Gross impaired to total assets	0.7	0.4	0.6	0.3	0.4	0.1	0.6	0.2
Net impaired assets to equity	8.3	4.2	7.3	4.6	5.3	1.5	5.2	3.6
Specific provision to gross impaired assets	36.1	36.9	32.5	30.0	41.8	40.8	42.9	32.6
Total provision to gross impaired assets	110.4	198.1	105.6	137.9	131.8	250.8	125.6	167.8
Liquidity								
Cash to total assets	5.3	5.3	2.7	2.8	2.0	1.6	0.7	0.9
Cash and due from banks to total assets	6.4	7.4	7.2	9.9	4.4	3.0	4.8	6.3

Sources: Banks' disclosure statements, and Fund staff calculations.
1/ Includes St. George.
2/ TCE = tangible common equity = total equity minus intangible assets (including goodwill).
3/ Tangible assets = total assets minus intangible assets (including goodwill).

26. **However, a deterioration in banks' asset quality has been evident since early 2008** (Figure III.1). Past due loans plus impaired assets rose to around 1 percent of total assets for the four largest banks as of March 2009, and several large banks have increased their specific provisions for bad loans. Gross impaired assets for the smaller domestic banks have deteriorated more than for the four larger banks, with past due plus impaired assets for all banks reaching almost 1½ percent of assets in March 2009 and for smaller domestic banks nearly



3 percent. This mainly reflects smaller banks' relatively large exposures to some lower quality commercial property and to a lesser extent their higher share of low-doc lending.[11] Nevertheless, the aggregate Tier 1 capital of the smaller domestic banks was more than 10 percent as of March 2009.

27. **A key remaining vulnerability is the roll-over risk associated with sizable short-term external debt.** Banks' wholesale funding (domestic and offshore) accounts for about 50 percent of total funding, of which about 60 percent is offshore (Table III.3). Financial institutions short-term external debt (on a residual maturity basis) is estimated by staff at about $A 400 billion (35 percent of GDP) in March 2009.

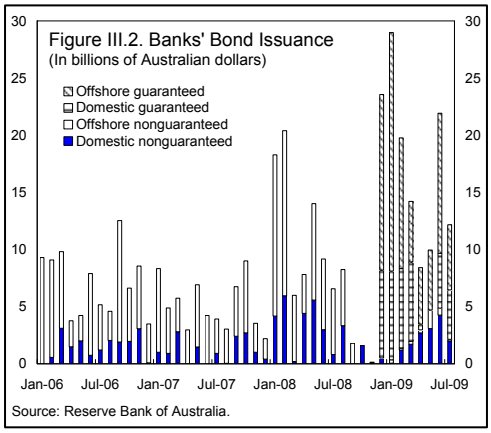
Table III.3. Australia: Australian Banks' Liabilities
(Percent of total)

	Dec 06	Dec 07	Dec 08	Jun 09
Deposits	41.5	39.3	42.5	45.3
Domestic wholesale funding	23.3	26.7	24.7	21.1
Offshore wholesale funding	29.0	28.2	28.7	30.0
Securitization	6.2	5.8	4.1	3.6
Total funding liabilities 1/	100.0	100.0	100.0	100.0
Memorandum item:				
Equity (as a percent of total liabilities)	5.8	5.6	6.2	6.7

Sources: APRA, Reserve Bank of Australia, and Fund staff calculations.

1/ Excluding equity.

28. **The establishment of deposit and wholesale funding guarantees in October 2008 helped maintain confidence in the financial sector**. As a result, banks were able to raise about $A 140 billion between December 2008 and early July 2009 (Figure III.2) and have rolled over short-term debt. Recognizing the increased importance of liquidity and rollover risks associated with short-term liabilities, banks have started to increase medium-term funding.



[11] As of September 2008, total commercial property exposures of smaller domestic banks amounted to $A 33 billion—about 12 percent of smaller banks' total assets—with specific provisions accounting for 97 percent of impaired commercial property exposures.

C. How Would Banks Handle a Jump in Corporate Defaults?

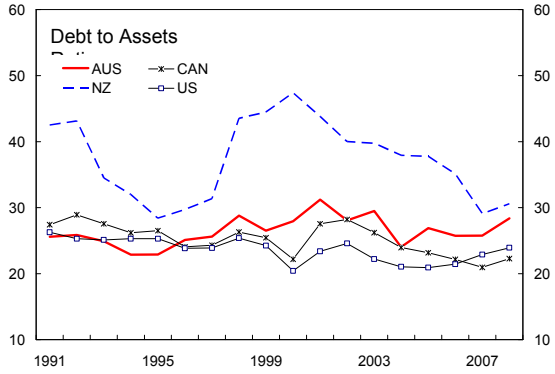
29. **The corporate sector entered the current crisis in a relatively healthy position with moderate leverage and strong balance sheets** (Figure III.3). Balance-sheet indicators show that the nonfinancial corporate sector is sound. Leverage (i.e., debt to assets ratio and debt to equity ratio) has remained stable and broadly similar to other advanced countries. Profitability has improved considerably since the late 1990s and liquidity has increased. Yet, as the global crisis unfolded, balance sheets of nonfinancial firms across the globe have started to weaken.

30. **Market-based indicators suggest that corporate solvency risks have increased in Australia since 2008, in line with all the other advanced economies, but risks remain manageable**.[12] We apply the contingent claim approach (CCA) to estimate risk indicators for the nonfinancial corporate sector, such as distance to distress and probability of default. The CCA approach tries to uncover the market's view of what is likely to happen in the corporate sector by combining balance sheet accounting information with share prices prevailing in the financial market to obtain forward looking measures of the risk of defaults and potential losses. We then translate the corporate sector's expected losses into bank sector losses, using a simple assumption: namely that all banks are equally exposed to the corporate sector and thus will suffer the same relative losses in their books. Appendix III.1 provides a more detailed explanation of the CCA methodology.

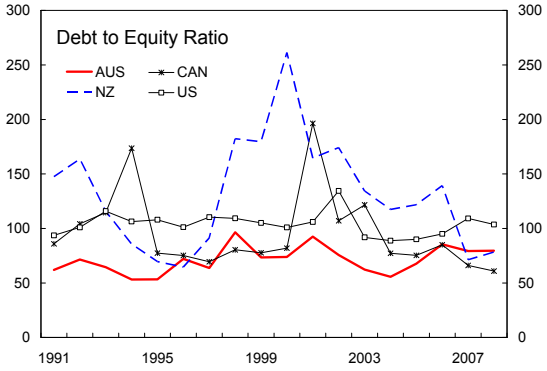
[12] This section builds on the analysis by Jain-Chandra, N'Diaye, and H. Oura, 2009. The analysis covers only listed companies.

Figure III.3. Selected Balance Sheet and Market-Based Indicators for Nonfinancial Firms 1/

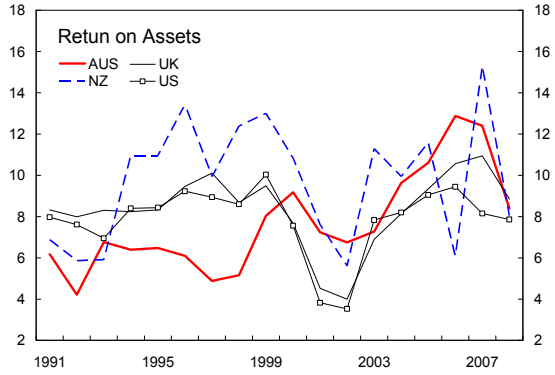
Leverage has remained stable in Australia…



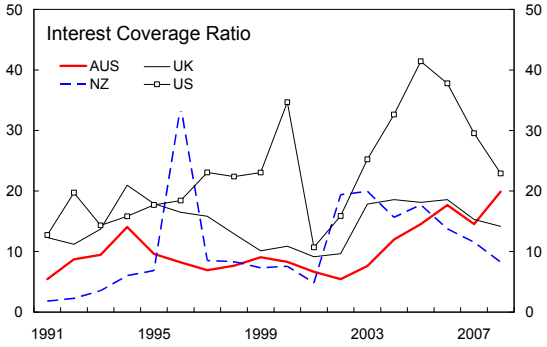
…since the early 1990s.



Profitability fell in Australia in 2008 but remained slightly above other countries…

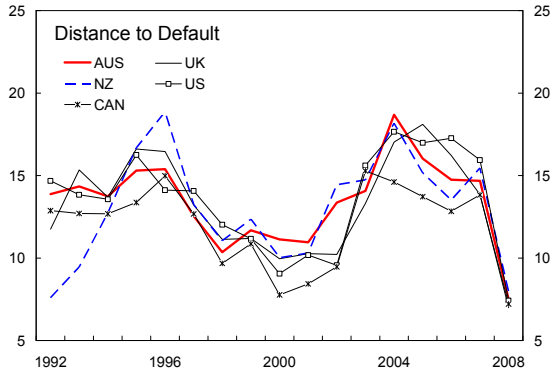


…and liquidity has increased in Australia.

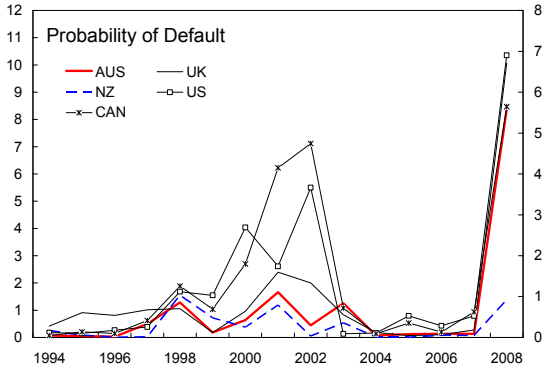


CAP weighted average. Earnings before interest and taxes to interest payments falling

However, risk default indicators have worsened recently…



…with the probability of default jump in 2008.



Source: Worldscope and Fund staff calculations.
1/ Listed companies, only, CAP weighted average.

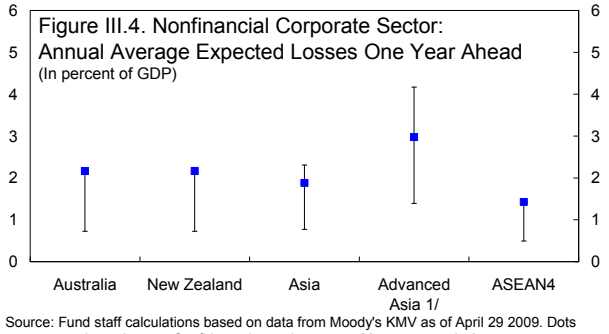
31. **Compared to simple accounting ratios, default risk indicators have two main advantages**: they are forward looking and they combine various dimensions of risk into a single statistic, which gives the overall impact on vulnerability from potentially offsetting changes, such as a rise in leverage versus a rise in profitability. The default risk of a firm is computed from its balance sheet and equity price data under the assumption that the equity market price should incorporate investors' estimate of the company's default risk. On the other hand, balance sheet indicators based on accounting data are backward looking indicators that can deteriorate rapidly under stress.

32. **CCA analysis suggests that**:

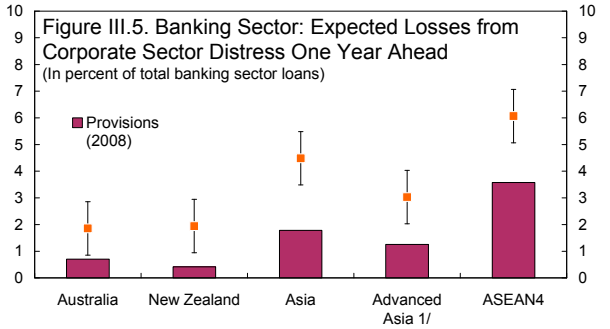
- *Expected corporate default losses* could amount to around 2 percent of GDP based on historical recovery rates of around 40 percent, lower than other advanced countries in Asia (Figure III.4).[13]

- *Banks' losses* could amount to about 2 percent of total March 2009 loans (Table III.4), less than for other countries in the region (Figure III.5). See Appendix III.1 for details of the calculation.

33. **However, there are some caveats that should be noted in interpreting the CCA results.** First, the volatility of the equity market has been particularly high in recent months, which could have magnified the distance to default and the probability of default measures. Second, bank lending to the nonfinancial corporate sector has slowed significantly in 2009 suggesting that leverage has also declined since 2008. Finally, the nonfinancial corporate sector has raised significant equity capital during the first quarter of 2009.[14]



Source: Fund staff calculations based on data from Moody's KMV as of April 29 2009. Dots represent point estimates. Confidence intervals assume 80 percent and 40 percent recovery rate in case of default. Listed companies, only.
1/ Advanced Asia consists of Hong Kong SAR, Japan, Korea, Singapore, and Taiwan Province of China.



Source: Fund staff calculations. Dots represent point estimates. Confidence intervals assume 80 percent and 40 percent recovery rate in case of default.
1/ Advanced Asia consists of Hong Kong SAR, Japan, Korea, Singapore, and Taiwan Province of China.

[13] The recovery rate refers to the share of collateral recovered when the default occurs.

[14] During Q1 2009, private nonfinancial companies raised over $A 18 billion in shares and other equity, almost twice as much as the amount raised during the same period in 2008.

Table III.4. Effects of Corporate Sector Distress on the Banking Sector: CCA Results

	Corporate Sector Expected Losses 1 Year Ahead (Percent of total corporate liabilities) 1/	Banking sector				
		Total Bank Loans	Bank Loans to Corporate Sector	Loan-Loss Provisions	Implied Additional NPL/Losses	NPL/Losses in Percent of Total Bank Loans
		In billions of Australian dollars				
	A	*B*	*C*	*D*	E=A*(B-D)*(C/B)	*E/B*
Australia 2/	5.9	1,651	501	17.9	29.1	1.8
New Zealand 3/ 4/	3.5	280	122.0	1.2	4.3	1.5

Sources: Based on MKMV-Credit Edge data as of April 29. 2009; and Fund staff calculations.

1/ Nonfinancial corporate sector. Listed companies only.
2/ Columns B, C, and D report data as of March 2009.
3/ Columns B, C, and D report data as of September 2008.
4/ Columns B, C, D, and E are in New Zealand dollars.

D. International Comparison of Australian Banks

34. **Australian banks are compared in this section with international banks using simple measures of leverage, deposit and liquidity ratio as indicators of future performance.** Huang and Ratnovski (2009) use the 2006 values of these three measures to explain the performance of the largest international banks during the financial turmoil. They find that these variables, or in certain cases threshold dummies of them, are significantly correlated with negative events such as imminent failure or large stock price declines. This finding paves the way for our analysis, where we use the current values of the three measures to assess the position of Australian banks.

35. **Based on these measures, Australian banks seem to be robust and are roughly comparable with Canadian banks.** We use the latest, mostly 2008, measures of leverage, deposit and liquidity ratios from the Bankscope database for 60 large banks in an international comparison to assess the current position of Australian banks. We find that Australian banks have stronger leverage positions (Table III.5), but weaker deposit and liquidity ratios (Tables III.6 and III.7) than the major Canadian banks. Compared to the median of large international banks, a similar picture arises. The four Australian banks are in the upper half of the sample in terms of leverage and around the median in terms of deposit and liquidity ratio. In sum, Australian banks seem to be among the stronger institutions roughly in the same place as their Canadian counterparts.

Table III.5. Australia: Leverage of Australian Banks

Rank	Bank Name	Country	Equity/Total Assets 2008	2006
19	**National Australia Bank**	**AU**	**5.7**	**7.2**
20	Toronto Dominion Bank	CA	5.6	5.5
23	**Australia and New Zealand Banking Group**	**AU**	**5.5**	**5.7**
27	**Commonwealth Bank of Australia**	**AU**	**5.1**	**5.5**
34	**Westpac Banking Corporation**	**AU**	**4.5**	**5.4**
38	Royal Bank of Canada RBC	CA	4.0	4.0
39	Banque de Montreal-Bank of Montreal	CA	3.9	4.5
41	Bank of Nova Scotia (The) - SCOTIABANK	CA	3.8	4.6
50	Canadian Imperial Bank of Commerce CIBC	CA	3.2	3.3
	Median of banks in the sample		*4.5*	*5.1*

Sources: Bankscope and Fund staff calculations.

Table III.6. Australia: Deposit Ratio of Australian Banks

Rank	Bank Name	Country	Deposits/Total Assets 2008	2006
7	Bank of Nova Scotia (The) - SCOTIABANK	CA	68.3	69.6
8	Toronto Dominion Bank	CA	66.7	66.4
9	Canadian Imperial Bank of Commerce CIBC	CA	65.8	66.7
13	Banque de Montreal-Bank of Montreal	CA	61.9	63.7
17	Royal Bank of Canada RBC	CA	60.6	64.0
24	**Commonwealth Bank of Australia**	**AU**	**57.7**	**50.0**
27	**National Australia Bank**	**AU**	**55.3**	**51.7**
44	**Australia and New Zealand Banking Group**	**AU**	**46.5**	**52.3**
49	**Westpac Banking Corporation**	**AU**	**43.1**	**48.5**
	Median of banks in the sample		*50.9*	*53.9*

Sources: Bankscope and Fund staff calculations.

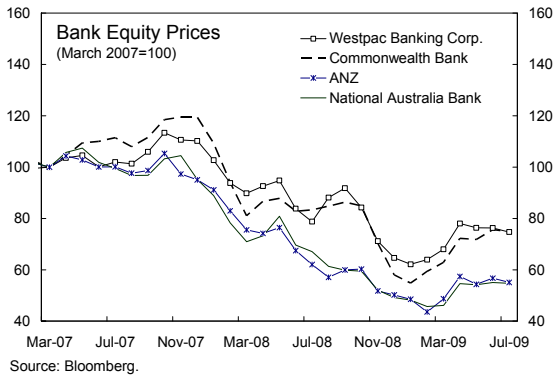
Table III.7. Australia: Liquidity Ratio of Australian Banks

Rank	Bank Name	Country	Liquid Assets/Total 2008	2006
12	Royal Bank of Canada RBC	CA	17.6	28.6
15	Banque de Montreal-Bank of Montreal	CA	16.5	17.0
23	Canadian Imperial Bank of Commerce CIBC	CA	10.9	21.2
27	**Westpac Banking Corporation**	**AU**	**10.0**	**23.1**
28	Toronto Dominion Bank	CA	10.0	20.9
29	Bank of Nova Scotia (The) - SCOTIABANK	CA	9.9	17.3
38	**Commonwealth Bank of Australia**	**AU**	**6.2**	**23.6**
44	**National Australia Bank**	**AU**	**4.6**	**4.3**
52	**Australia and New Zealand Banking Group**	**AU**	**3.4**	**2.9**
	Median of banks in the sample		*8.3*	*13.1*

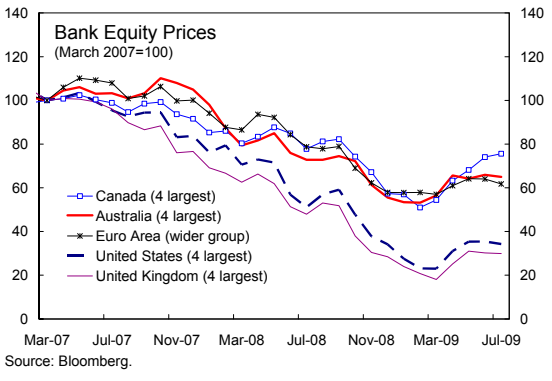
Sources: Bankscope and Fund staff calculations.

36. **Furthermore, market based indicators seem to support the similarity between Australian and Canadian banks** (Figure III.6). The market based equity price and CDS spread indicators show very strong co-movement among the four major Australian banks. The similarity between Australian and Canadian banks is also supported by the strong correlation between their equity indicators, and also by the divergence shown with other advanced countries.

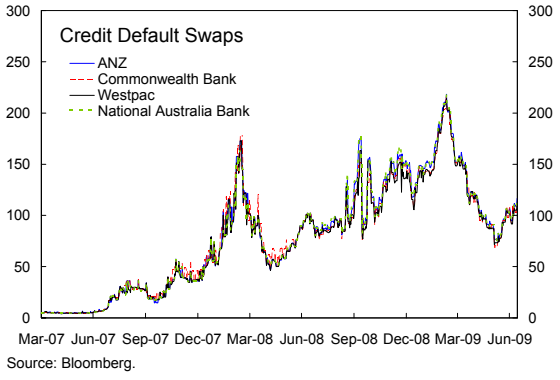
Figure III.6. Australia: Banking Sector Developments



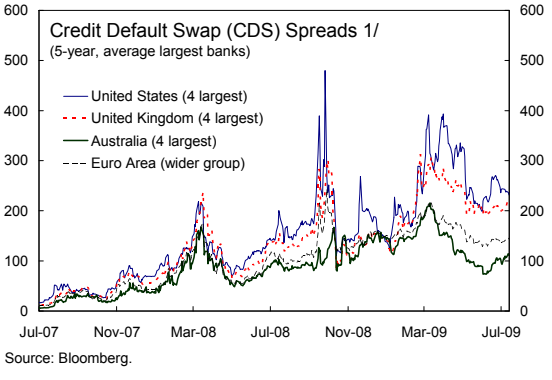
Source: Bloomberg.



Source: Bloomberg.



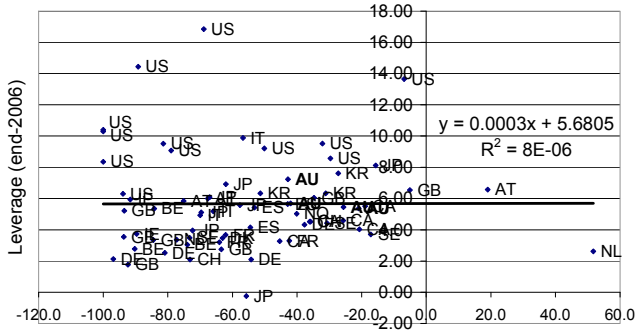
Source: Bloomberg.



Source: Bloomberg.

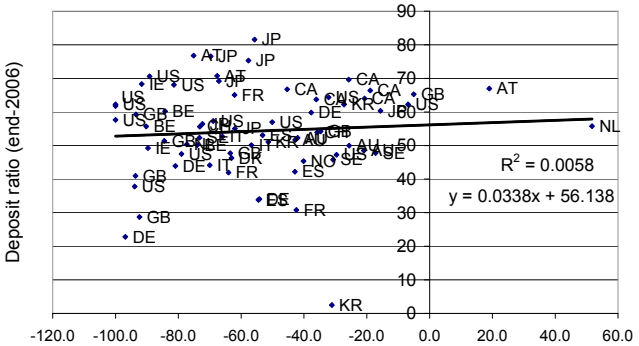
37. **Some caution might be warranted in using liquidity, deposit, and leverage ratios as indicators of bank's future equity price performance.** Most importantly, banks stock price evolution does not seem to have been affected by any one of these variables during the turmoil, in a binary analysis as shown by the weak linear correlation (Figures III.7–9).

Figure III.7. Australia: Share Price Evolution (2006-09) and Leverage (end-2006)



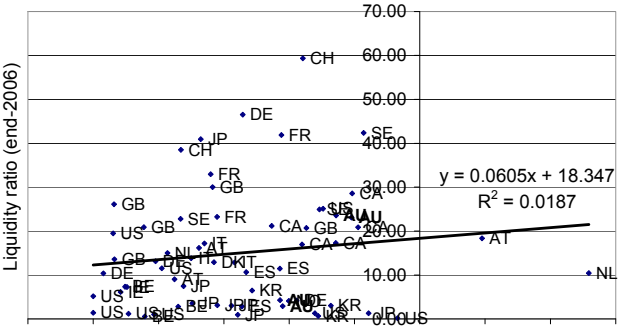
Sources: Bankscope and Fund staff calculations.

Figure III.8. Australia: Share Price Evolution (2006-09) and Deposit Ratio (end-2006)



Sources: Bankscope and Fund staff calculations.

Figure III.9. Australia: Share Price Evolution (2006–09) and Liquidity Ratio (end-2006)



Sources: Bankscope and Fund staff calculations.

38. **These figures highlight the complexity of the assessment and suggest attention should be paid to asset quality and other more complex measures.** This is not surprising given the lessons learned during the financial turmoil. For instance, Icelandic banks had excellent leverage ratios before the turmoil (Table III.8), but they failed subsequently. It seems that meaningful assessments need to include focus on asset quality, quality of supervision and regulation, market structure (including securitization), and competition, among other possible features.

Table III.8. Australia: Banking Sector Financial Soundness Indicators for Australia and Comparator Countries, 2007

	Australia	Austria	Canada	Finland	Greece	Iceland	Ireland	New Zealand	Portugal	Spain	United Kingdom	Sample Average 1/
	(In percent, except where otherwise indicated)											
Capital												
Assets to Tier 1 capital multiple 2/	**33.2**	28.8	26.4	185.1	25.6	16.2	43.7	24.8	32.1	25.4	51.2	45.9
Assets to total capital multiple 2/	**23.2**	19.9	21.7	156.9	30.8	13.0	33.3	21.9	21.2	16.3	33.8	36.9
Asset quality												
Impaired loans to total loans	**0.3**	3.4	0.5	0.5	6.2	0.9	0.7	0.2	1.3	1.0	1.6	1.6
Provisions to impaired loans	**216.6**	82.0	156.7	62.5	43.3	84.2	52.3	239.6	154.8	188.4	59.0	112.3
Profitability												
Return on average assets	**1.0**	0.8	0.9	2.1	1.2	1.6	0.5	1.0	0.9	1.0	0.6	1.1
Return on average equity	**17.4**	11.5	18.1	21.8	17.1	18.5	14.5	16.9	14.4	14.4	13.7	16.1
Net interest margin	**1.8**	1.9	1.8	1.4	3.0	1.4	1.0	2.0	1.9	1.8	1.1	1.7
Dividend payout	**74.2**	19.7	43.4	60.9	35.9	21.3	56.0	61.0	35.4	22.1	49.5	40.5
Composition of assets and liabilities												
Mortgages to total loans	**53.1**	5.4	10.2	7.6	27.8	3.5	1.7	56.0	21.4	5.0	15.8	15.4
Loans to total assets	**61.8**	53.3	47.7	45.4	61.8	59.8	52.8	69.4	68.3	67.6	43.4	57.0
Retail deposits to total liabilities	**41.3**	41.5	31.7	31.0	60.8	29.7	25.7	56.6	46.5	42.1	38.1	40.4
Liquid assets to deposits and ST funding	**4.1**	15.1	2.1	25.6	20.8	16.5	9.0	5.3	9.0	9.5	7.7	12.0

Sources: Bankscope, APRA, RBA, and Fund staff estimates.

1/ Simple (unweighted) average of comparator countries, excluding Australia.

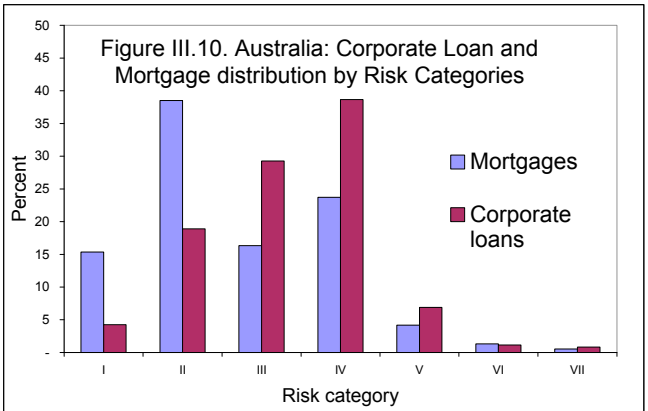
2/ Assets include off-balance sheet items; figures expressed as a multiple, not in percent.

E. Asset Quality Shocks

39. **In order to analyze the asset quality of banks, this section simulates a shock to banks' loan portfolios.** The analysis is based on new Pillar 3 reports under the Basel II framework that provide finely granulated asset quality data for the major banks. Banks' loan portfolios are organized into several risk categories in the Pillar 3 reports. In each risk category the probability of default (PD) and the loss given default (LGD) is estimated. Supervisors can adjust these variables to reflect the risks undertaken appropriately. In particular, APRA prescribed having at least 20 percent LGD ratios for mortgages instead of the general Basel II frameworks' 10 percent floor. The PD and LGD data is used to calculate the likely losses the bank might suffer in a year. This loss can be contrasted to existing general and specific provisions of banks. Here, we collect data from the Pillar 3 reports for the large four banks and aggregate them.[15] We also consolidate the loan portfolios into seven risk categories.

[15] The four banks are: Australia and New Zealand Bank, Commonwealth Bank of Australia, National Australia Bank, and Westpac.

40. **The analysis focuses on residential mortgages and corporate loans.** Mortgages have been traditionally the focus of analysis of the Australian banking sector as they constitute around half of total credit exposure. However, corporate loans, though smaller in volume, are considered by the banks in their Pillar 3 statements to be much riskier than mortgages (Figure III.10). Thus, they also require appropriate attention.



41. **A simple shock to banks' loan portfolio is undertaken as follows:**

- For corporate loans, we shift the risk categories up by one category to a higher risk (Table III.9). In other words, we assume that the probability of default and loss given default characteristics of category I loans are changed to reflect the PD and LGD characteristics of category II loans, and so forth. We use the adjusted PDs and LGDs to calculate the expected losses by categories under this shock scenario.

- For mortgages, we shift the risk categories up by one and double the LGD floor to 40 percent.

- Other loans are also shocked by shifting the risk categories up by one category. However, in the case of these loans, LGDs floors are not modified.

Table III.9. Australia: Losses Under Risk Category Shifting and 40 Percent Mortgage LGD Floor Assumption

Risk Categories (I - VII):	I	II	III	IV	V	VI	VII
Regulatory credit exposure			(In millions of Australian dollars)				
Corporate	29,848	132,248	204,900	270,630	48,307	8,024	5,880
Residential mortgage	125,240	313,816	133,114	193,393	34,132	10,838	4,407
Other	188,191	80,712	19,305	45,389	16,788	4,996	1,261
Exposure weighted average LGD				(In percent)			
Corporate	50.8	53.9	47.4	36.6	36.2	45.2	47.7
Residential mortgage	20.0	20.0	20.5	20.9	20.4	20.3	20.6
Other	45.7	52.4	57.0	60.1	65.9	67.6	61.7
Average midpoint probability of default				(In percent)			
Corporate	0.01	0.08	0.31	1.77	6.41	19.46	100.00
Residential mortgage	0.06	0.19	0.41	1.74	5.83	22.19	100.00
Other	0.02	0.11	0.38	1.75	5.84	22.17	100.00
Adjusted average probability of default				(In percent)			
corporate	0.08	0.31	1.77	6.41	19.46	100.00	100.00
residential mortgage	0.19	0.41	1.74	5.83	22.19	100.00	100.00
other	0.11	0.38	1.75	5.84	22.17	100.00	100.00
Expected losses by categories under adjuste probability of default and higher mortgage LGD			(In millions of Australian dollars)				
Corporate	13	228	1,707	5,971	3,811	3,630	2,808
Residential mortgage	88	471	875	4,764	3,324	4,335	1,763
Other	79	134	188	1,716	2,371	3,377	778
Total losses by category	181	833	2,770	12,451	9,506	11,343	5,348

Sources: Basel II Pillar 3 disclosure statements and Fund staff calculations.

42. **Banks seem to be resilient to this shock** (Table III.10). The total losses amount to $A 42½ billion, around 2 percent of risk-weighted assets. About 4/5 of the losses are mortgages and corporate loans. We apply these losses on provisions first and then the remainder on banks' capital. Banks' average total capital adequacy ratio is reduced to 9.2 percent. Even the hardest hit bank's total capital adequacy ratio remains above the regulatory 8 percent minimum after this shock. Moreover, this shock does not take account of mortgage insurance, which may reduce the impact of higher mortgage defaults on bank capital.

Table III.10. Impact on the Capital of the Four Large Banks of Risk Shifting and 40 Percent Mortgage LGD Floor Assumption

Total losses (millions of Australian dollars)	42,432
Mortgage losses (millions of Australia dollars)	15,621
Corporate losses (millions of Australian dollars)	18,167
Provisions (millions of Australian dollars)	15,942
Total losses to capital (millions of Australian dollars)	26,490
Risk-weighted assets (millions of Australian dollars)	1,152,573
Loss as percent of risk-weighted assets	2.3
Implied new total capital adequacy ratio (average of four banks)	9.2
Implied minimum new total capital adequacy ratio among the four banks	8.3
Implied new tier 1 capital adequacy ratio (average of four banks)	6.1
Implied new tangible common equity to tangible asset ratio	3.2

Sources: Basel II Pillar 3 disclosure statements and Fund staff calculations.

43. **In another scenario, we assess the increase in PDs needed to reduce the capital adequacy ratio of the bank to the regulatory minimum** (Tables III.11 and III.12). Our analysis suggests a six-fold increase in PDs would be needed to reduce the total average capital adequacy ratio below 8 percent. In this scenario we assume no shift in risk categories but LGDs of 40 percent for mortgages. Average Tier 1 capital would remain above the regulatory minimum of 4 percent and TCE would fall to 2½ percent. However, two banks' total capital adequacy ratios would shrink below the 8 percent regulatory minimum. This result shows that a sizable shock is needed to reduce capital to regulatory minimums.

Table III.11. Australia: Losses Under Six-Times Probability of Default and 40 Percent Mortgage LGD Floor Assumption

Risk Categories (I - VII):	I	II	III	IV	V	VI	VII
Regulatory credit exposure			(In millions of Australian dollars)				
Corporate	29,848	132,248	204,900	270,630	48,307	8,024	5,880
Residential mortgage	125,240	313,816	133,114	193,393	34,132	10,838	4,407
Other	188,191	80,712	19,305	45,389	16,788	4,996	1,261
Exposure weighted average LGD				(In percent)			
Corporate	50.8	53.9	47.4	36.6	36.2	45.2	47.7
Residential mortgage	20.0	20.0	20.5	20.9	20.4	20.3	20.6
Other	45.7	52.4	57.0	60.1	65.9	67.6	61.7
Average midpoint probability of default				(In percent)			
Corporate	0.01	0.08	0.31	1.77	6.41	19.46	100.00
Residential mortgage	0.06	0.19	0.41	1.74	5.83	22.19	100.00
Other	0.02	0.11	0.38	1.75	5.84	22.17	100.00
Adjusted average probability of default				(In percent)			
corporate	0.08	0.50	1.88	10.62	38.44	100.00	100.00
residential mortgage	0.35	1.15	2.45	10.46	35.00	100.00	100.00
other	0.11	0.65	2.25	10.48	35.05	100.00	100.00
Expected losses by categories under adjusted probability of default and higher mortgage LGD			(In millions of Australian dollars)				
Corporate	13	362	1,829	10,561	6,734	3,549	2,808
Residential mortgage	175	1,444	1,298	8,056	4,726	4,335	1,763
Other	99	284	259	2,912	3,992	3,377	778
Total losses by category	287	2,091	3,385	21,529	15,451	11,261	5,348

Sources: Basel II Pillar 3 disclosure statements and Fund staff calculations.

Table III.12. Impact Under Six-Times PD Increase and 40 Percent Mortgage LGD Floor Assumption

Total losses (millions of Australian dollars)	59,353
Mortgage losses (millions of Australia dollars)	21,796
Corporate losses (millions of Australian dollars)	25,855
Provisions (millions of Australian dollars)	15,942
Total losses to capital (millions of Australian dollars)	43,411
Loss as percent of risk-weighted assets	3.8
Implied new total capital adequacy ratio (average of four banks)	7.8
Implied minimum new total capital adequacy ratio among the four banks	6.6
Implied new tier 1 capital adequacy ratio (average of four banks)	4.6
Implied new tangible common equity to tangible asset ratio	2.5

Sources: Basel II Pillar 3 disclosure statements and Fund staff calculations.

44. **The shocks discussed above are in the ballpark of the CCA based results discussed earlier in this chapter**. In order to compare the results, we need to focus on the corporate losses. The CCA based estimate is close to the corporate loan loss impact of the more severe shock where PDs are increased by six times (Table III.13).

Table III.13. Australia: Corporate Loan Losses 1/

	Corporate Loan Losses (In billions of Australian dollars)	Percent of Banking Sector Loans
Risk-shifting and LGD floor shock (Table III.10)	18.2	1.1
Six-times PD increase and LGD floor shock (Table III.12)	25.9	1.6
Contingent claim based analysis (Table III.4)	29.1	1.8

Source: Fund staff calculations.

1/ Before provisioning for losses.

45. **Though banks seem resilient, more complex stress testing is needed.** The above shocks do not constitute a rigorous stress test and the results are only indicative of the health of the banking sector. APRA has regularly stress tested the banking sector but it would be advisable to undertake more extreme scenarios than applied in the past and to include Australia's overseas subsidiaries. In particular, stress tests should include a more protracted and serious macroeconomic downturn than what was applied in the 2006 Financial Stability Assessment Program.

APPENDIX III.I. AUSTRALIA: CONTINGENT CLAIM ANALYSIS

The CCA is a risk-adjusted balance sheet framework where equity and risky debt of a firm or financial institution derive their value from assets. In this framework, first proposed by Robert Merton (1973) and by Black and Scholes (1973), the total value of assets is equal to the market value of equity and risky debt. Asset values are uncertain and in the future may decline below the point where debt payments on scheduled dates cannot be made. Debt is "risky" since there is a chance of default. The assets are stochastic and evolve according to a "distress barrier". See Gray and Malone (2008) for a comprehensive analysis of the CCA framework.

We estimate the default probability and distance-to-default according the to Black-Scholes-Merton (BSM) option pricing model. BSM derive the market's assessment of default risk for a company from its equity price, assuming that the market price reflects investors' correct calculation of default risk. The BSM default probabilities show the theoretical probability of default one year-ahead. See the formulas and computational notes below for further details. Distance-to-default—an input into the default probability—shows how much the asset value needs to fall one-year-ahead for a firm to default given its current balance sheet position. It is reported in terms of the number of standard deviations of asset returns: the higher this number, the lower the BSM probability of default. According to the BSM model, the logarithm of a firm's assets is assumed to follow the standard Brownian motion.

The distance to default within one year is equal to (DtD)= $3+\frac{\log(A)-\log(B)+\left(\mu-\frac{\sigma_A^2}{2}\right)}{\sigma_A}$,

where A is total assets, B is the default barrier measured as short-term debt plus one half of long-term debt plus interest payments, μ is the expected return on assets (based on last year's annual capital gain including dividends), and σA is the standard deviation of the asset return. Because *DtD* is normally distributed with mean zero, we add 3 to the calculated *DtD* measure so that the reported *DtD* is always positive. DtD is calculated from pooled data, adding all inputs into a synthetic company at the country level. Asset values and the standard deviation of asset returns are derived using the Black-Scholes-Merton option pricing formula, with stock prices and their volatility as inputs.

Computation of Banks' Expected Losses from Corporate Sector Distress

Banks' expected losses from corporate sector distress (Figures III.4 and III.5) were calculated using information from Moody's KMV implied CDS (EICDS) spreads and banks' exposure to the corporate sector.

The calculation involved the following steps:

- Expected losses for the corporate sector one year ahead embedded in EICDS spreads were calculated using the contingent claim analysis framework.

- The corporate sector expected losses were expressed as ratios of the corporate sector's total liabilities. It was then assumed that all the corporate sector's creditors would suffer the same relative losses in their books in order to overcome lack of more precise calculation on the seniority structure of the debt and on the relative importance of domestic versus foreign financing sources.

- Banks' current performing loans to the corporate sector were calculated. Here in the absence of information on banks' current provisions for losses on loans to the corporate sector, banks' overall provisions for losses were subtracted from the current stock of their loans to the corporate sector, and the resulting amount was scaled by banks' exposure to the corporate sector.

- The relative losses calculated in the second step were multiplied by the current stock of performing loans to the corporate sector. The resulting amount was the expected increase in banks losses stemming from banks' exposure to the corporate sector.

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