

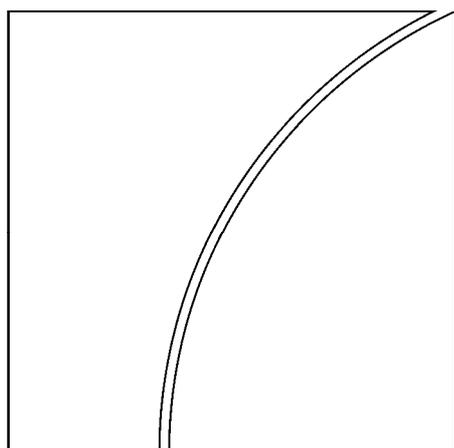
# Macroeconomic Assessment Group

established by the  
Financial Stability Board  
and the Basel Committee on  
Banking Supervision

## Final Report

Assessing the macroeconomic  
impact of the transition to  
stronger capital and liquidity  
requirements

December 2010



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## 1. Introduction

The Macroeconomic Assessment Group (MAG) was established in February 2010 by the chairs of the Financial Stability Board and Basel Committee on Banking Supervision to coordinate an assessment of the macroeconomic implications of the Basel Committee's proposed reforms. The membership of the MAG comprises macroeconomic modelling experts from central banks and regulators in 15 countries and a number of international institutions.<sup>1</sup> Stephen Cecchetti, Economic Adviser of the Bank for International Settlements (BIS), was asked to chair the Group.

The MAG's Interim Report<sup>2</sup>, published in August 2010, applied common methodologies based on a set of scenarios for shifts in capital and liquidity requirements over different transition periods. These scenarios served as inputs into a broad range of models developed for policy analysis in central banks and international organisations. Close collaboration with the International Monetary Fund (IMF) was an essential part of this process. The Group also consulted with experts in the private sector and the academic world, through both one-on-one interactions and collective roundtables. These discussions provided important context for the MAG's work, particularly on issues that were not captured by members' macroeconomic models.

Taking the median across the results obtained by group members, the Interim Report concluded that a 1 percentage point increase in the target ratio of tangible common equity (TCE) to risk-weighted assets would lead to a maximum decline in the level of GDP of about 0.19% from the baseline path, which would occur four and a half years after the start of implementation (equivalent to a reduction in the annual growth rate of 0.04 percentage points over this period), followed by a gradual recovery of growth towards the baseline. This figure is the sum of 0.16%, the median GDP decline estimated for specific countries by national authorities, and 0.03%, which is the potential impact of international spillovers (reflecting exchange rates, commodity prices and shifts in global demand) as estimated by the IMF. It is important to note that these results apply to any increase in target capital ratios, whether its source be higher regulatory minima for required buffers, changes in the definition of capital or risk-weighted assets, the application of a leverage ratio, or a decision by banks to maintain wider voluntary buffers above regulatory minima. The Interim Report also examined the impact of proposed measures by the Basel Committee to strengthen liquidity regulation. A 25% increase in the holding of liquid assets relative to total assets implemented over four years, combined with an extension of the maturity of banks' wholesale liabilities, was estimated to be associated with a median decline in GDP in the order of 0.08% relative to the baseline trend after 18 quarters.

This Final Report builds on the Interim Report's findings by simulating the macroeconomic impact of the changes to capital standards that were agreed in September 2010 by the group of Governors and Heads of Supervision (GHOS), which oversees the Basel Committee. Among other reforms, the GHOS proposed a strengthened definition of capital; calibrated requirements for minimum capital ratios and for a new capital conservation buffer; and specified a transition path for the new standards.

Drawing on these agreements, the analysis in the MAG's Interim Report has been extended along two dimensions. First, the impact of the transition to stronger requirements is studied assuming a transition period of eight years, in line with the transition path set out in the GHOS statement. Second, while the findings in the Interim Report were presented in terms of the impact of a generic one percentage point increase in target capital ratios, the present

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<sup>1</sup> The participants in the Group's work are listed in Annex 1.

<sup>2</sup> <http://www.bis.org/publ/othp10.pdf>.

report examines the impact of the overall increase in bank capital that will be needed to meet the new requirements. In doing this it makes use of an estimate of the December 2009 level of common equity capital relative to risk-weighted assets in the global banking system, based on the revised definitions in the new framework, drawing on the results of the Quantitative Impact Study (QIS) conducted recently by the Basel Committee, and compares this to what will be required under the agreed minimum ratio and capital conservation buffer.

No additional work was done on the impact of stronger liquidity requirements in this report, in view of the fact that the liquidity requirements are still subject to an observation period. The Liquidity Coverage Ratio will be introduced in 2015 and the Net Stable Funding Ratio in 2018. The estimates for the impact of these measures provided in the Interim Report assume a shorter implementation period than that agreed to by the BCBS, and can therefore be viewed as conservative estimates. Further, as discussed in the Interim Report, it would be inaccurate simply to add the estimated impact of meeting the liquidity requirements to the estimated impact of meeting the capital requirements. Banks' efforts to meet the capital requirements are likely to reduce the adjustments the banks will need to make to meet the liquidity requirements, and vice versa.

Based on the unweighted median estimate across 97 simulations, the MAG estimates that bringing the global common equity capital ratio to a level that would meet the agreed minimum and the capital conservation buffer would result in a maximum decline in GDP, relative to baseline forecasts, of 0.22%, which would occur after 35 quarters. In terms of growth rates, annual growth would be 0.03 percentage points (or 3 basis points) below its baseline level during this time. This is then followed by a recovery in GDP towards the baseline. These results, like the Interim Report estimates, include the impact of spillovers across countries, reflecting the fact that many or most national banking systems would be tightening capital levels at the same time. The estimated maximum GDP impact per percentage point of higher capital was 0.17%, which is slightly less than the 0.19% figure estimated for four-year implementation in the Interim Report. The point at which this maximum impact is reached, the 35th quarter, is quite a bit later than the maximum impact point estimated for four-year implementation in the Interim Report (the 18th quarter). As a result, the projected impact on annual growth rates is less.

As with the conclusions presented in the Interim Report, there are number of reasons why the actual impact could be *greater* than the one reported here. For one thing, banks may attempt to meet the stronger requirements ahead of the timetable set out by the Basel Committee. If they choose to implement the higher requirements in four years, for example, the impact on the level of GDP would be somewhat stronger, and moreover the impact on annual growth would be greater. Second, banks may choose to hold an additional, voluntary buffer of common equity capital above the amounts set out in the new framework. This could increase some of the effects estimated here.

Other factors might lead to a *smaller* GDP impact. First, over the past year many banks have strengthened their capital positions through new equity issuance and retained earnings. This will reduce the amount of additional capital that the system needs to accumulate in the future to meet the requirements. Second, banks have a number of options for responding to the stronger requirements, including reducing costs or shifting their portfolios towards safer assets, which in most cases were not explicitly modelled in the estimations performed by MAG members. These will reduce the need for them to increase loan spreads or cut back on lending volumes, thereby reducing the impact on real activity.

This report, like the MAG Interim Report, focuses only on the transitional costs of stronger capital requirements. The benefits of a well capitalised banking system, in terms of reducing the risk and cost of financial crises and reducing macroeconomic volatility, in turn leading to increased confidence of borrowers and lenders in the stability of the banking system, are well recognised and have been analysed in studies such as the *Assessment of the long-term economic impact of stronger capital and liquidity requirements*, which was published by the

Basel Committee in August 2010.<sup>3</sup> A capital regime materially stronger than ones seen in the recent past is likely to exert a beneficial impact on the macroeconomy that should more than offset the transitional costs of the adjustments that banks need to make to put the regime into practice.

The remainder of this report is organised as follows. Section 2 sets out the MAG's principal findings for the global impact of the calibrated capital requirements as implemented over an eight-year transition period. Section 3 examines how this impact might differ if banks choose to implement the requirements according to a faster schedule than the one required by supervisors. Section 4 offers broad conclusions and identifies open issues. The MAG Interim Report provides more detailed discussions of the transmission channels from bank capital to economic activity and of the methodologies used in the analysis.

## 2. Results

### 2.1 Impact of a one percentage point increase in capital ratios

MAG members drew on forecasting and policy analysis models that have been developed at their home institutions to estimate the impact on GDP of a one percentage point increase in bank capital ratios implemented over eight years.<sup>4</sup> In most cases the simulations were conducted over a twelve-year time horizon, in order to permit the analysis of developments after implementation has been completed. Banks were assumed to increase capital at a constant pace over these eight years. While the transition schedules agreed by the Basel Committee do not mandate a perfectly linear increase in capital requirements, the assumption of a linear increase was considered to be appropriate, since it would reflect the likelihood that banks would orient their behaviour towards the final capital target, rather than to intermediate thresholds. It should be noted that the increase in capital considered in this report reflects not only higher ratios, but also the phase-in of deductions and other definitional changes, the impact of which will vary from one bank to another.

The set of models used for this analysis was broadly similar to that used to produce the results presented in the group's Interim Report. In some cases, however, new models were added, previously estimated models were dropped, or changes were made to parameters. This was done to reflect the experience gained in the earlier exercise as to the robustness and informativeness of these models for the task at hand. For example, some models that are informative about macroeconomic dynamics over a relatively short time horizon such as two to four years are less useful over longer horizons such as eight years. A total of 97 sets of model results were submitted by group members.<sup>5</sup>

The lower right-hand panel of Graph 1 portrays the unweighted median path, across these 97 models, of the impact on GDP of a one percentage point increase in capital ratios implemented over eight years (32 quarters). Along this median path, GDP falls steadily relative to its baseline path, reaching a level 0.15% below baseline before recovering. This maximum impact occurs in the 35th quarter after the start of implementation, just under a year after implementation is completed. By the last quarter of the simulation (which members

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<sup>3</sup> <http://www.bis.org/publ/bcbs173.pdf>.

<sup>4</sup> National implementation of the new minima by supervisors is set to begin in January 2013, with the full set of requirements, including the capital conservation buffer and revised definitions, to be in place by January 2019. For the purposes of this study, we assume that banks begin to increase their capital ratios gradually from the start of 2011, resulting in an eight-year transition period.

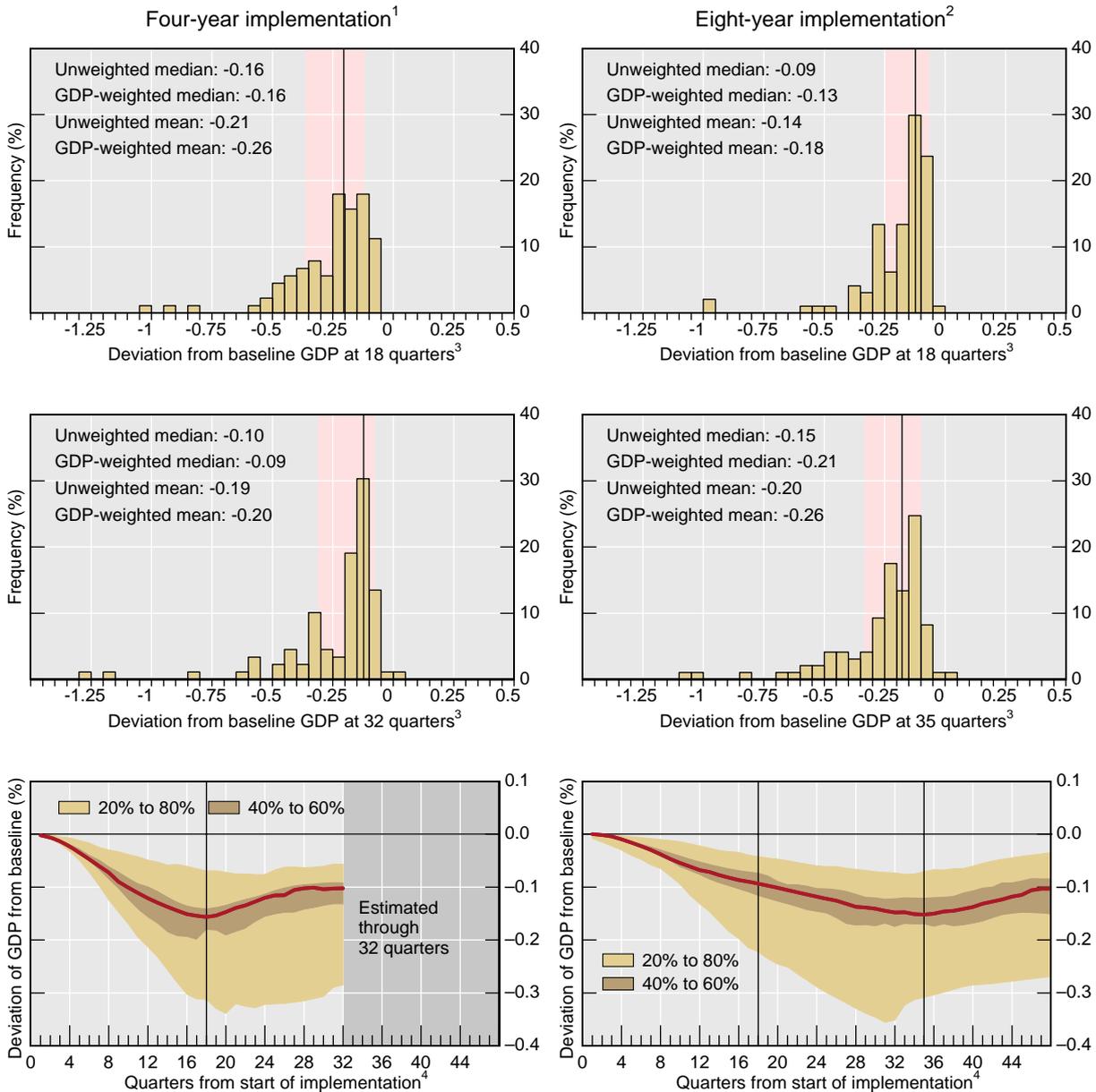
<sup>5</sup> Annex 2 describes the methodologies used and lists the number of submitted models by country or institution.

ran for 48 quarters, i.e. 12 years), GDP has recovered to a level 0.10% below baseline. The middle right-hand panel of Graph 1 shows the distribution of GDP estimates for the 35th quarter across the models submitted.

Graph 1

**Aggregate impact of a 1 percentage point increase  
in the target capital ratio, excluding spillover effects: distribution of estimated  
GDP deviation across all models**

In per cent



<sup>1</sup> Distributions are computed across the 89 cases used in the MAG Interim Report, excluding those designed to measure the impact of international spillovers. <sup>2</sup> Distributions are computed across the 97 cases contributed for the MAG Final Report, excluding those designed to measure the impact of international spillovers. <sup>3</sup> The shaded areas indicate the range between the 20th and 80th percentile. The vertical line indicates the unweighted median at the quarter indicated (measured from start of implementation). <sup>4</sup> The vertical lines indicate the 18th and (for the eight-year case) 35th quarters.

For comparison, the left-hand panels of Graph 1, which are taken from the Interim Report, replicate the exercise assuming that the implementation period is four years. As discussed further in Section 3 below, the impact on the level of GDP relative to baseline from a shorter transition period is somewhat greater and takes place over a shorter time horizon.

The new results are broadly similar when model results are weighted by GDP in forming the median,<sup>6</sup> or when the mean result is examined rather than the median. The GDP-weighted median estimate of the reduction of GDP relative to baseline in the 35th quarter is 0.21% and the GDP-weighted mean is 0.26%. Three-fifths of the results forecast a GDP reduction of between 0.07% and 0.30% at the 35th quarter. However, there are a number of results exceeding 0.50%, indicating that downside risks remain a concern.

These effects result from a combination of wider lending spreads and reduced lending volumes (Table 1). The unweighted median estimate is for a decline of lending of 1.4% relative to baseline at the 35th quarter, and a 1.5% decline by the end of the simulation. Lending spreads, in the meantime, are projected to widen by 15.5 basis points by the 35th quarter, and to narrow somewhat thereafter.

**Table 1. Estimated deviations of lending spreads, volumes and GDP from baseline forecasts for a one percentage point increase in the target capital ratio implemented over eight years**

	Lending volume <sup>1</sup> (in percent)		Lending spreads <sup>2</sup> (in basis points)		GDP <sup>3</sup> (in percent)	
	Q35	Q48	Q35	Q48	Q35	Q48
Unweighted median	-1.38	-1.47	15.5	12.2	-0.15	-0.10
GDP weighted median	-1.11	-1.11	16.6	12.8	-0.21	-0.18
Unweighted mean	-1.29	-1.46	18.6	17.6	-0.20	-0.16
GDP weighted mean	-1.85	-1.89	17.9	16.7	-0.26	-0.22

<sup>1</sup> Results reported for 38 models. <sup>2</sup> Results reported for 53 models. <sup>3</sup> Results reported for 97 models. Not including international spillover effects.

As was done for the Interim Report, the IMF estimated the likely spillover effects that would result from the simultaneous strengthening of bank capital across countries. This exercise predicted that a one percentage point increase in capital ratios implemented over eight years would result in an additional 0.02% fall in GDP below baseline after 35 quarters. By the end of the simulation (the 48th quarter), the impact of spillovers is less than 0.01%. A dynamic stochastic general equilibrium model with banking estimated by the Bank of Canada obtained qualitatively similar results for the impact of international spillovers.

The overall effect of a one percentage point capital increase can thus be found by adding this estimate of spillover effects to the 0.15% median referenced above for the 35th quarter, for a total of 0.17%, while leaving the effect at the 48th quarter unchanged at 0.10%. In terms of growth rates, these results imply a 0.02 percentage point reduction in annual growth over the first 35 quarters, followed by a 0.02 percentage point increase in growth over the subsequent 13 quarters.

<sup>6</sup> In a weighted median, the sum of the weights on the values above the median value equals the sum of the weights on values below the median. As in the Interim Report, the weights reflect the share of each country's GDP in the total GDP of the countries in the MAG analysis. In cases where there was more than one estimate for a given economy, the GDP weight was equally divided among the different estimates. In calculating the GDP-weighted median, estimates that applied to more than one country (such as euro area or global estimates) were dropped.

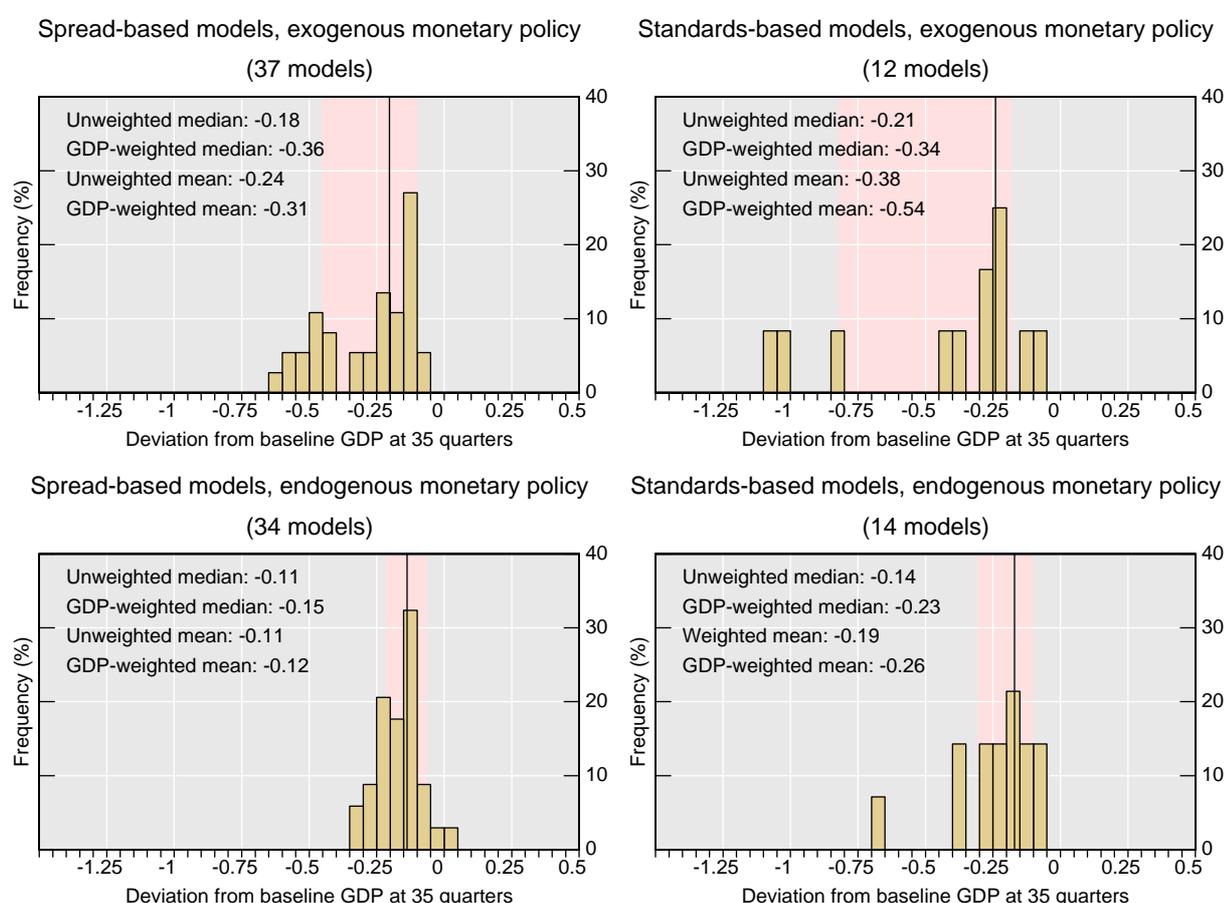
## 2.2 Distribution of results across modelling assumptions

The models used to generate these results employ a variety of assumptions. Graph 2 divides the modelled effects according to their treatment of two issues that are of particular relevance to the question at hand, namely: (1) whether the macroeconomic effects operate primarily through wider credit spreads or also, separately, through a reduction in lending (a tightening in lending standards) that goes beyond the impact of wider spreads; and (2) whether the model estimates incorporate the likely response of monetary authorities to any predicted slowdown in growth.

Graph 2

### Aggregate impact of a 1 percentage point increase in the target capital ratio implemented over eight years, excluding spillover effects: distribution of estimated GDP deviation across selected models<sup>1</sup>

In per cent



<sup>1</sup> Distributions are computed across models that meet the specified criteria. The vertical line indicates the unweighted median. The shaded areas indicate the range between the 20th and 80th percentile. Quarters are measured from start of implementation.

As in the Interim Report, models that seek to take account of rationing or lending standard effects (Graph 2, right-hand panels) generated a stronger macroeconomic impact than models without such effects (Graph 2, left-hand panels). Focusing on models that do not incorporate a monetary policy response (the top two panels of Graph 2), the 35-quarter impact of a one percentage point increase in the target capital ratio implemented over 8 years (using unweighted medians) rises from 0.18% in models that look only at credit spreads to 0.21% in models that also incorporate lending standard effects.

Models that incorporated the potential response of monetary policy (the bottom two panels of Graph 2) tended to estimate a milder macroeconomic impact of increases in bank capital. The reduction in GDP at the 35th quarter relative to baseline is estimated to be 0.11% in the case of models based only on credit spreads (Graph 2, lower left-hand panel) and 0.14% for models that also incorporated the impact of tightened lending standards (Graph 2, lower right-hand panel).

As noted in the Interim Report, the very low levels of nominal interest rates currently prevailing in many countries may reduce the effectiveness of conventional monetary policy measures in mitigating adverse macroeconomic outcomes. However, over the longer time horizon that is considered in the present report, it is reasonable to expect that rates will eventually normalise to the point where conventional monetary policy responses will regain their typical levels of effectiveness.

### **2.3 The new requirements relative to the global capital shortfall**

To inform the calibration of revisions to the Basel Capital Framework, the Basel Committee conducted a Quantitative Impact Study (QIS) that assessed the impact of the Committee's capital and liquidity proposals on individual banks and the banking industry.<sup>7</sup> The QIS found that, under the Committee's revised definitions of capital and risk-weighted assets, the risk-adjusted common equity tier 1 (CET1) capital ratio of the sample of large, internationally active banks surveyed was 5.7%. The sample of smaller banks included in the study reported a higher CET1 ratio. The QIS did not attempt to estimate system-wide capital ratios, though it did note that coverage of the sample of larger banks approached 100%, while coverage for the sample of smaller banks was lower and varied across countries. The reported ratio for each group of banks was computed by taking the sum of the relevant banks' CET1 capital divided by the sum of the banks' risk-weighted assets.

For the purposes of the present study, we assume the common equity capital ratio in the global financial system under the revised definitions at the start of the simulation exercise is the same as the QIS's weighted average ratio for the larger banks at the end of December 2009, ie 5.7%. For a number of reasons, this is likely to represent a conservative estimate of the actual current global capital ratio. First, capital levels in the banking system are likely to have risen since December 2009, given improvements in bank profitability and the likelihood that banks have started to adjust their portfolio composition and strategy in response to recent and anticipated policy changes. Second, this weighted average is calculated across a subset of the surveyed banks, namely those that were large (in terms of absolute capital levels), well-diversified and internationally active. As noted, the sample of smaller banks considered by the QIS averaged higher ratios. Third, the QIS results do not factor in earnings retention and other mitigating actions going forward. For example, global banks are likely to meet the new standards in part by de-risking certain capital markets activities and by running off legacy exposures which are disproportionately penalised by the new standards, but which are not associated with traditional lending activities.

The calibrated Basel Committee proposals envisage a minimum common equity ratio of 4.5%, augmented by a capital conservation buffer of 2.5%, for an overall common equity Tier 1 capital ratio across the global banking system of 7% at the end of the eight year transition period. To achieve this target from a "starting point" of 5.7%, banks would need to raise their capital ratios by 1.3 percentage points. The GDP-impact estimates produced by MAG members were in most cases linear in bank capital. Thus, we can multiply the estimated impacts (including spillover effects) of a one percentage point increase in capital reported

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<sup>7</sup> The report of the QIS can be found here: <http://www.bis.org/publ/bcbs186.htm>.

above by 1.3 to obtain an estimate of the overall impact. Recall that each percentage point of additional capital was estimated to lower the path of GDP to a point 0.17% below its baseline forecast after 35 quarters, and to 0.10% below baseline in the final quarter of the simulation. This would suggest that banks' efforts to achieve the stronger capital requirements would lead to an overall reduction of GDP to a level 0.22% below baseline forecasts after 35 quarters, followed by an increase in growth to the point where GDP would stand 0.13% below baseline at the end of the simulation, i.e. the twelfth year.

Translating these GDP level effects into annual growth rates, growth would slow by some 0.03 percentage points (that is, 3 basis points) on an annualised basis during the 8 <sup>3</sup>/<sub>4</sub> years following the start of implementation. In subsequent quarters, annual GDP growth would be projected to increase by 0.03 percentage points through the end of the simulation period.

These estimates refer to the impact on global growth of the needed increase in capital in the global banking system. As in the Interim Report, the MAG member institutions submitted results estimating the macroeconomic impact of a common, generic change in standards, that is a one percentage point increase in capital implemented over eight years, and the median and mean results reported here refer to the impact of this change on a representative economy. The actual effects of the strengthened requirements, however, are likely to be distributed unevenly across individual banks and national banking systems. All else equal, countries in which the capitalisation of a relatively larger share of the banking system currently falls below the global average are likely to experience a relatively greater economic impact, while the effect will be diminished or absent in countries where bank capital levels are already close to or above the proposed minimum requirements. Moreover, within national banking systems there is variation across banks in terms of the degree of adjustment still needed.

Should banks choose to accumulate an additional capital buffer of common equity above these required levels, then each additional percentage point increase in their target capital ratio built up smoothly over an eight year horizon would be predicted to lower GDP by a further 0.17 percentage points after 35 quarters. In terms of growth rates, each additional percentage point in the capital ratio held as a voluntary buffer would lower annual growth by some 0.02 percentage points during the period of buildup, and would add 0.02 percentage points to growth during the subsequent return towards the baseline path.

The level of such a buffer is difficult to predict based on past experience, especially in view of the changes in the regulatory and supervisory regime. For example, it is difficult to say whether, and to what extent, banks' ability to access the capital conservation buffer in times of stress will influence their desired buffer in normal times. Choices are thus likely to vary, both across banks and over time, and will evolve as experience with the new capital framework accumulates.

### **3 Impact of a more accelerated response of banks to the new requirements**

As noted in the Interim Report, banks may seek to implement the stronger capital requirements ahead of the schedule set out by supervisors. They might be motivated to do this in order to prove their underlying capital strength to the markets, particularly if their competitors are doing the same.

If this is the case, the more rapid implementation schedule considered in the Interim Report would again become relevant. It will be recalled that, across the 89 models submitted for that analysis, the median impact on GDP for a one percentage point increase in capital implemented across four years was at its largest after 18 quarters, when GDP was projected to be 0.19% below baseline (including the effects of international spillovers). The median

path then recovered to a level about 0.12% below baseline by the end of eight years (Graph 1, left-hand panels). Using the figures set out in section 2.3 above for the overall increase in capital needed to bring the global capital ratio to a level meeting the strengthened requirements, this would suggest an overall impact of GDP of 0.25% at the 18th quarter, which would translate into a reduction of 0.05 percentage points in annual growth rates, followed by a recovery. As discussed above, growth would fall further should banks choose to accumulate an additional, voluntary common equity buffer above the required amount over the same period.

The impact would be still greater if banks choose a two-year implementation schedule. As reported in the Interim Report, if a one percentage point increase in capital is implemented over two years, GDP would fall a maximum of 0.22% relative to baseline before recovering. The maximum GDP loss in the two-year case was projected to occur in the 10th quarter after implementation. The overall maximum GDP impact in the 10th quarter of implementing the strengthened requirements would thus be 0.29%. In terms of annual growth rates, growth would need to fall by 0.11 percentage points during that time before recovering.

To summarise, the shorter implementation scenarios are estimated to provide a somewhat larger decline in the maximum amount by which the level of GDP is projected to fall relative to baseline, reflecting sharper adjustment costs, although the amounts do not differ greatly. The more rapid implementation scenarios also imply a greater impact on growth rates, since the projected decline in the level of GDP relative to baseline would take place over a shorter time frame in these scenarios.

#### **4. Conclusions and open issues**

This Final Report extends the analysis presented in the MAG Interim Report of the potential impact of stronger capital requirements on growth over the next several years.

Viewed in terms of the median across all national estimates, the results presented above suggest that the strengthened capital requirements proposed by the Basel Committee are likely to have a relatively modest impact on growth: GDP is projected to fall by 0.22 percentage points below its baseline level in the 35th quarter after the start of implementation, followed by a recovery of growth towards baseline. This implies that annual growth rates will be reduced by 0.03 percentage points for 35 quarters, followed by a period during which annual growth will be 0.03 percentage points higher. These estimates assume that banks act so as to bring the global common equity capital ratio to a level that would meet the agreed minimum and the capital conservation buffer, according to the eight-year transition path set by supervisors. If banks choose to implement the new requirements ahead of the schedule set out by supervisors, the impact on the overall level of GDP will be somewhat greater and compressed into a shorter time period, resulting in a greater impact on growth rates. These effects would also be accentuated to the degree that banks choose to hold an additional voluntary equity capital buffer above the new standards.

As with any forecasting exercise, especially given the length of the horizon used here, there are a number of uncertainties. In particular, as identified in the Interim Report, there are a number of factors that may influence the impact of the capital requirements on bank lending, loan pricing and growth, but were not explicitly incorporated in the models estimated by MAG members. These include the ability of banks to alter their business models in response to the new capital regime (such as by altering their asset composition, reducing inefficiencies, or increasing their reliance on fee-based income); the development of non-bank credit channels; and the capacity of markets to absorb new equity offerings by banks. As noted in the Interim Report, the ability of banks to make these adjustments and the ability of markets to absorb new capital issues are likely to be greater if the transition period is a relatively long one, so the macroeconomic impact would be lessened by a longer transition. The eight year

transition period agreed by the Basel Committee is likely to be long enough to enable many of these offsetting adjustments to take place. However, these factors would be less likely to exert a countervailing influence to the extent that banks voluntarily choose to implement stronger capital ratios on an accelerated schedule. In addition, as noted in Section 1, no additional work was done on the impact of stronger liquidity requirements in this report, in view of the fact that the liquidity requirements are still subject to an observation period.

Although the results presented in this report and the Interim Report incorporate a number of methodological and theoretical advances in the modelling of the macroeconomic effects of conditions in the financial sector, economists still have a great deal to learn about these relationships. Further research is needed on such questions as how banks adjust their risk profiles, loan pricing, and lending behaviour in response to regulatory changes; how changes in banking sector leverage, credit spreads and bank lending volumes affect the dynamics of the macroeconomy; and the relative role of bank and non-bank credit channels in supporting macroeconomic activity. It is hoped that the ongoing debate over appropriate policies to strengthen the financial system will continue to stimulate theoretical and empirical research on these important issues.

## **Annex 1: Participants in the Macroeconomic Assessment Group**

(The names in bold are the primary representatives of the respective institutions.)

Chairman	<b>Stephen G Cecchetti</b> Bank for International Settlements
Reserve Bank of Australia	<b>Jonathan Kearns</b> Chris Becker Dan Fabbro Adam Gorajek Jarkko Jääskelä David Jennings
Central Bank of Brazil	<b>Nelson F Souza Sobrinho</b>
Bank of Canada	<b>Césaire Meh</b> Neville Arjani Paul Corrigan Carlos De Resende Ali Dib José Dorich Rhys Mendes Nikita Perevalov Yang Zhang
People's Bank of China	<b>Hong Zheng</b>
Bank of France	<b>Laurent Clerc</b> Jean-Pierre Villetelle Simon Dubecq Antipa Pamfili Eric Mengus Olivier Loisel Benoît Mojon
Deutsche Bundesbank	<b>Thilo Liebig</b> <b>Alexander Schulz</b> Sandra Eickmeier Victoria Galsband Barbara Meller Michael Scharnagl Niels Schulze
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Financial Services Agency, Japan	<b>Satoshi Ikeda</b> Ryoichi Suwa

Bank of Japan	<b>Ryo Kato</b> Toyo Shirota Wataru Hirata Ryoma Ikeda Tomoki Tanemura
Bank of Korea	<b>Byunghee Seong</b> Jaerang Lee Hueechae Jung
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Netherlands Bank	<b>Jan Willem van den End</b> Beata Bierut Robert-Paul Berben
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Swiss National Bank	<b>Carlos Lenz</b>
Financial Services Authority, UK	<b>Peter Andrews</b> Michael Straughan Matthew Osborne Sebastian De Ramon Zanna Iscenko
Bank of England	<b>Jack McKeown</b>
Board of Governors of the Federal Reserve System	<b>Michael Kiley</b> Jae Sim
Federal Reserve Bank of New York	<b>Simon Potter</b> Vasco Curdia
European Commission	<b>Werner Roeger</b>
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International Monetary Fund	<b>Scott Roger</b> Jan Vlček Francis Vitek
Financial Stability Board	<b>Nigel Jenkinson</b>
Basel Committee on Banking Supervision	<b>Neil Esho</b>

Bank for International Settlements

**Benjamin Cohen** (Secretary)

Stefan Avdjiev

Dietrich Domanski

Srichander Ramaswamy

Jhuvesh Sobrun

Jimmy Shek

## Annex 2. National results

The analysis in this report is based on 97 model results submitted by the MAG member institutions. Table A2.1 summarises members' contributions.

The Interim Report focused on the output of the 89 submitted models that used a “two-step approach”, in which lending spread and volume impacts were generated by “satellite models”, and then used as inputs into the standard macroeconomic forecasting and policy analysis models in use at central banks and other agencies. The satellite models incorporated a number of techniques. Some of these used a “model bank” approach, which involved estimating banks' adjustments to their capital and assets in response to differences between their actual and target (desired) capital ratios. The estimated target ratio was inferred from the past behaviour of capital ratios, or simply based on average capital levels over a specified period of time. Members then estimated an econometric model in order to capture the response of various balance sheet items to the distance-from-target variable, while controlling for other factors such as GDP growth, the policy rate, inflation, and aggregate bank charge-offs. Others used simpler approaches, such as accounting-based estimates that held a control variable (such as the bank's return on equity) constant and calculated the adjustments to balance sheet and lending spread variables that would be needed to achieve the desired capital target under this constraint.

Most of the results that are summarised in the present report also use this two-step approach. A small number of results, however, make use of techniques submitted to the MAG and discussed as “alternative approaches” in the Interim Report, namely reduced form estimations or bank-augmented dynamic stochastic general equilibrium (DSGE) models. The reduced form estimations use past statistical relationships among capital, growth and other variables to estimate the likely growth effects of tighter capital and liquidity regulation, through the use of vector auto-regression techniques. DSGE estimations aim to provide a coherent framework for policy discussion and analysis by capturing the dynamic relationships among different macroeconomic variables while being grounded in microeconomic theory. Unlike most DSGE models, bank-augmented DSGE estimations model financial intermediaries and their balance sheets explicitly. The reduced form and bank-augmented DSGE estimates were added to the overall population of models summarised in the present report because members felt they had gained experience in constructing and estimating these models, relative to the Interim Report, and were more confident that they accurately captured the impacts being considered here.

**Table A2.1. Number of model outputs submitted to MAG subgroups**

Country/region	Number of models		
	By national authority	By IMF	By ECB, European Commission
Australia	1	2	...
Brazil	3	2	...
Canada	6	2	...
China	...	2	...
France	2	2	...
Germany	1	2	...
India	...	2	...
Italy	5	2	...
Japan	4	2	...
Korea	4	2	...
Mexico	1	2	...
Netherlands	7	...	...
Russia	...	2	...
Spain	1	2	...
United Kingdom	3	2	...
United States	4	7	...
Euro area	...	5	15
Sum of the above	42	40	15