Prudential regulation: the aims and consequences of reform

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At its first two meetings – in Washington in November 2008 and in London in April 2009 – the G20 recognised the need to improve the regulation and supervision of financial institutions, particularly from the 'micro-prudential' point of view on which we focus in this article [1]. Over the past few months, several official reports and white papers on this issue have been published on both sides of the Atlantic, while international institutions have made their own contribution to the debate. The timetable agreed at the September 2009 Pittsburgh summit is highly ambitious, with the definition of new capital requirements required by the end of 2010 with a view to implementation at the end of 2012. On 8 and 9 December 2009, in the wake of the G20 meetings, the Basel Committee approved a whole raft of proposals on regulating bank capital and liquidity. They are to be open to consultation and subjected to impact studies this year[2 - 3].

In this article we place the reform of prudential regulation in the context of changes in bank solvency since the financial crisis broke. The impact of tougher regulatory capital requirements to cover banking risks is then shown using a leveraged portfolio model, while the associated risks to financing the economy are highlighted via the empirical literature. We wind up by arguing that other limits, such as implicit market constraints and the controversy over the predictability of banking failures, urge a measure of restraint on tighter bank capital requirements. In our view, they suggest that the other solutions contemplated by the G20 – the better prevention and handling of defaults on the part of institutions carrying major systemic risk, for example, or the regulation of bank liquidity – should be alternatives to, rather than complementary to, tougher capital requirements.

Recent trends in bank capital ratios

Public injections of regulatory capital and, more recently, capital increases, renewed profitability (cf. Chart 1) and adjustments to their business mix have enabled most of the major international banks to raise their solvency ratios to above their pre-crisis levels. Although the worst of the crisis appears to be over, additional losses could be announced in the months ahead, undermining solvency ratios once again. It is therefore important that banks be shielded from any pressure, including regulatory pressure, that could hamper their ability to reconstitute their capital base.

Return on Equity

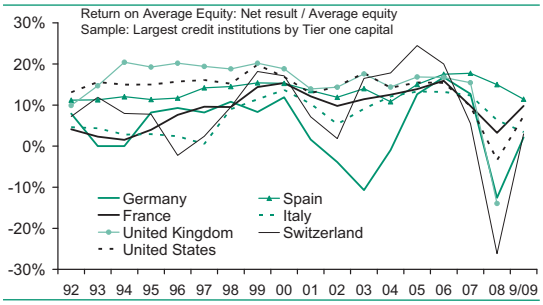

Chart 1 Sources: French Banking Commission, Banks' reports, BNP Paribas

Losses outweighed by stronger capital worldwide

Despite losses suffered on certain asset classes, European banks appear better capitalised today than they were when Lehman Brothers collapsed in the autumn of 2008 (cf. Chart 2).

Aggregated Tier one ratios

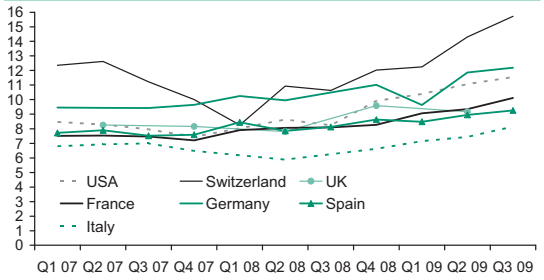

Chart 2 Source: Banks' reports, BNP Paribas calculations

Banks have worked on the numerator of their solvency ratios as well as the denominator. Initially benefiting from public injections of regulatory capital, they went on to bolster their own capital, taking advantage of improved market conditions to raise fresh equity. Between the beginning of the crisis and 8 December 2009, bank capital (excluding organic capital generation) increased by €836.8 billion [4], of which €465 billion from public sources. Average weighted assets have also been reduced, notably via sales. For example, UBS sold its Brazilian subsidiary Pactual for €1.9 billion in April 2009, thereby increasing its Tier 1 ratio by 0.5 point. Similarly, Barclays has sold its asset management subsidiary BGI for €9.6 billion.

Residual losses and bank solvency

Between April and October 2009, the IMF revised its estimate of potential losses in the financial system by some $600 billion to the downside, from $4,000 billion to $3,400 billion, reflecting the buoyancy of the financial markets and signs, albeit timid, of a recovery in activity. Of these losses, some $2,800 billion is attributed to banks, of which about $1,025 billion to US banks, $600 billion to UK banks and $800 billion to euro zone banks. Given the losses and write-downs already announced since the crisis broke, the IMF calculated in October that residual losses for UK, US and euro zone banks would amount to $140 billion, $420 billion and $470 billion, respectively, between Q3 2009 and Q4 2010. That would imply additional capital requirements in these banking systems, with the exception of the UK, if average Tier 1 solvency ratios are to be maintained above 10%. This is the level the market more or less expects ahead of official announcements of increased minimum capital requirements. But the IMF's estimates look somewhat pessimistic, at least as far as European banks are concerned. In its latest Financial Stability Review, published in December 2009, the ECB raised its estimate of euro zone bank losses for the period 2007-2010 from €488 billion (June 2009) to €553 billion. But in the light of provisions, losses and write-downs announced since then, the residual loss estimate has declined from €214 billion to €187 billion ($262 billion).

Reassuring stress test results

The results of the stress tests conducted by the Committee of European Banking Supervisors (CEBS) on the 22 largest European banks published at the beginning of October largely rule out systemic risk. They assumed declines in European Union GDP amounting to 5.2% in 2009 and 2.7% in 2010; not one of these banks suffered a decline in its core capital ratio to below 6%, even though simulated credit losses amounted to €400 billion ($580 billion) in 2009-2010.

While stiffening banks' resistance to future stress is a laudable G20 objective, tougher capital requirements are not free of perverse effects. As we explain below, using a conceptual framework, they can sometimes lead – in complete contradiction of the regulator's objectives – to an increase in banking risks. Moreover, many empirical studies show that excessive capital requirements can hamper banks' capacity to finance the economy.

Regulatory capital constraints and banking risks

In most cases, a bank's inability to meet its obligations to its depositors or creditors has a high social cost, especially when its bankruptcy has systemic implications. Prudential regulation implicitly constrains banks to internalise this cost by adapting the volume of their capital to the risks they take, and vice versa. While it is empirically difficult to assess the relationship between capital and banking risks, several academics have tried to do so using portfolio choice models. They generally conclude that in contrast with the regulator's expectations, and under certain conditions, tighter capital constraints can raise portfolio risks and bank default rates (cf. Koehn and Santomero (1980), Kim and Santomero (1988), Rochet (1992), Blum (1999)).

A simplified portfolio choice model

Based on the work just mentioned, we propose a simple model as a means of highlighting the potential effects of the various measures to consolidate bank solvency raised at the G20 meeting, namely more stringent overall capital requirements, increased weights for the riskiest assets and the introduction of a leverage constraint (cf. inset for a presentation of the model, equations in Appendix).

More stringent overall capital requirements

Assume that the regulator raises the overall capital requirement. In Chart 4, within the area $\left(x_1, x_2\right)$, the *(Tier1)* curve shifts towards the left. As the bank cannot increase its capital base, it reduces its average weighted assets. The point at which the *(RoE)* and *(Tier1)'* curves intersect defines the bank's new portfolio constraint, $\left(x'_{1,C}, x'_{2,C}\right)$. It follows that in order to satisfy its new constraint and maintain its profitability, the bank has to invest relatively more in assets *i*, whose margin adjusted for its weight in the Tier 1 denominator $\frac{r_i - r_D}{\alpha_i}$ is high (Kim *et al.* (1988), Rochet (1992), Oung (2003)). When the capital constraint starts to bite, the bank's portfolio choices depend solely on exogenous parameters (its ability to extract margin depends on the competition, money market rates, the asset and liability maturities and regulations, for example, while asset weights in the prudential ratio are set by the regulator).

Increase in the Tier one capital requirement
1st case: the return on allocated equity to low-risk asset is higher

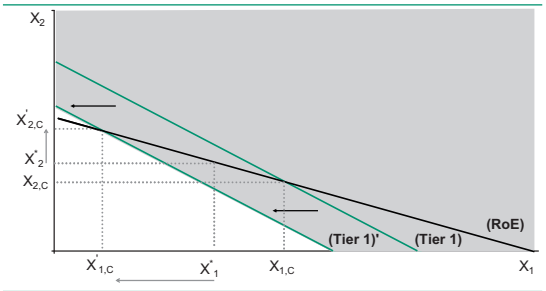

Chart 4 Source: BNP Paribas

- Case 1: adjusted for its weighting, the profitability of capital allocated to low-risk assets is higher.

When $\frac{r_2 - r_D}{\alpha_2} > \frac{r_1 - r_D}{\alpha_1}$, the bank reduces its investment in the most risky asset (cf. Chart 4). Portfolio risk diminishes (lower variance in the return on the portfolio), but leverage increases. As the negative slope of the RoE curve is more pronounced in absolute terms than that of the balance sheet constraint $x_2 = A - x_1$, any shift in the combination $\left(x_1, x_2\right)$ along the RoE curve upwards and to the left is accompanied by an increase in the size of the balance sheet A. The moderate capital cost of the least risky asset (a low weight α_2 in the prudential ratio denominator) offsets the lower return on that asset relative to the risky asset (more profitable, but more expensive in capital terms). The market's demand for profitability constrains the bank to maintain a bigger portfolio overall, however, which for a given level of capital raises its leverage. The risk to capital associated with the new portfolio constraint $\sigma_E^2(x'_{1,C})$ is, by definition, higher than the risk associated with the optimal portfolio $\sigma_E^2(x_1^*)$ and under certain conditions higher than the risk associated with the old portfolio constraint $\sigma_E^2(x_{1,C})$ as well. Thus the bank's risk of default increases, despite the regulator's intention of increasing financial stability, if the 'size' effect (increased leverage) prevails over the 'portfolio restructuring' effect (lower portfolio risk).

- Case 2: adjusted for its weighting, the profitability of capital allocated to low-risk assets is lower.

When $\frac{r_1 - r_D}{\alpha_1} > \frac{r_2 - r_D}{\alpha_2}$, the bank increases the share of the risky asset on its balance sheet, heightens the regulatory risk on its portfolio but reduces its leverage (cf. Chart 5). The incidence on the risk of default also depends on the respective magnitudes of the two effects (Kim et al. (1988), Rochet (1992)).

Inset: our simplified model

▪ Notations and assumptions

Here we model portfolio choice for a representative bank. For simplification purposes, we assume that the bank may invest in only two types of asset, although this assumption does not limit the relevance of the exercise (generalisation to *n* assets does not modify the results obtained, cf. Kim *et al* (1980), (1988), Rocher (1992)).

Optimal and constrained portfolios

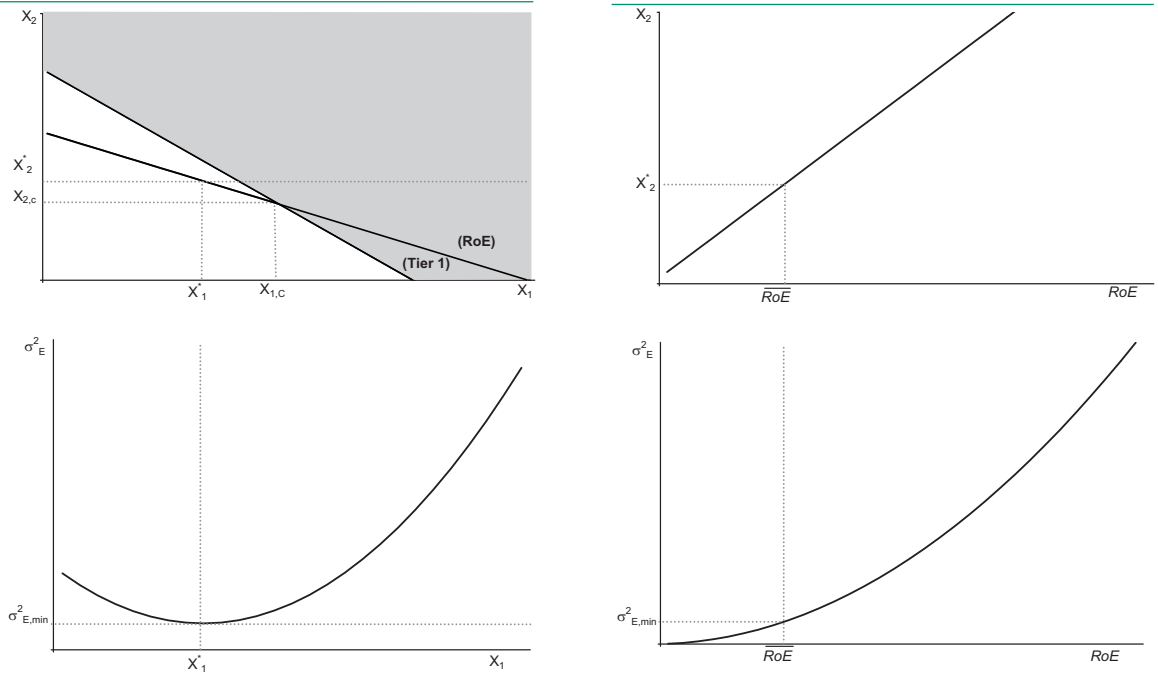

Chart 3

Source: BNP Paribas

Asset volumes are expressed x_i, average returns r_i and their variance σ_i^2 with *i=1.2*. Asset 1 is more profitable than the second $r_1 > r_2$ but also riskier $\sigma_1^2 > \sigma_2^2$, so that no asset dominates the other. The bank's liabilities are made up of debt *D*, with a known cost r_D such that $r_D < r_2 < r_1$, as well as of equity capital *E*, whose quality conforms to prudential regulations. Assuming that markets are imperfect, and in order to simplify our analysis, we suppose that the bank cannot strengthen its ordinary capital base, i.e. $E = \overline{E}$ (this is a recurrent hypothesis in portfolio choice models). A more sophisticated approach would involve modelling the endogenous costs of adjusting capital as a function of the bank's risk profile, its debt level and its expressed capital requirement (assuming a given balance sheet size). To summarise, the bank's balance sheet equilibrium is expressed as $x_1 + x_2 = D + \overline{E}$, the size of its portfolio $x_1 + x_2 = A$ and $RoE = (r_1 x_1 + r_2 x_2 - r_D D) / \overline{E}$. We suppose that the bank seeks to

maintain its profitability at a level consistent with the market's demands $\overline{RoE}$. Returning to our chart, this hypothesis implies that in the area $\left(x_1, x_2\right)$, the bank's portfolio is on the *(RoE)* curve (cf. Chart 3, top left quadrant). In our model, the bank's utility function is implicit: the risk level accepted depends on the expected profitability (cf. Chart 3, bottom right quadrant).

- **The optimal portfolio**

At a given profitability $\overline{RoE}$, the bank chooses the asset pair $\left(x_1, x_2\right)$ that minimises the risk to its equity, i.e. the variance in its return, expressed σ_E^2 (cf. Chart 3, bottom left quadrant). This risk may be assimilated to the risk of the bank's default. Under these hypotheses, the optimal portfolio size and allocation are functions of the respective margins on the two assets corrected by the variance of the returns on each, i.e. $\frac{r_i - r_D}{\sigma_i^2}$ (cf. Appendix). If the net return on the least risky asset, adjusted for its variance, exceeds that on the most risky asset, $\frac{r_2 - r_D}{\sigma_2^2} > \frac{r_1 - r_D}{\sigma_1^2}$, the bank will invest relatively more in the low-risk asset, $x_2^* > x_1^*$, and vice versa.

- **The solvency constraint**

We assume that optimally the bank initially meets the minimum solvency requirement set by the regulator $\left(E / RWA\right)_R$, who compares capital with average weighted assets. $RWA = \alpha_1 x_1 + \alpha_2 x_2$, where α_i is the regulatory weight for the asset *i* and $\alpha_1 > \alpha_2$. This hypothesis is consistent with a given capital base $\overline{E}$: the bank constitutes a cushion of excess capital (limiting the chances of a future shortfall) when the adjustments to the solvency ratio are costly (in terms of both reputation and raising ordinary shares) (Rime, 2001). This has been confirmed empirically, with all the major international banks reporting more capital than the present Basel requirement. On the chart, in the area $\left(x_1, x_2\right)$, it follows that the 'optimal' portfolio, which is the minimisation programme solution, expressed $\left(x_1^*, x_2^*\right)$, is under the *(Tier1)* curve (cf. Chart 3, top left quadrant). We define the pair $\left(x_{1,C}, x_{2,C}\right)$ as the 'constraint' portfolio, i.e. that for which the Tier 1 constraint actually bites. On the chart, and in the area $\left(x_1, x_2\right)$, this point is at the intersection of the *(RoE)* and *(Tier1)* curves (cf. Chart 3, top left quadrant). In the top left quadrant in Chart 3, the portfolio choices corresponding to all the combinations $\left(x_1, x_2\right)$ in the grey area may not be realised, as they do not satisfy the profitability and Tier 1 constraints.

Increase in the Tier one capital requirement
2nd case: the return on allocated equity to high-risk asset is higher

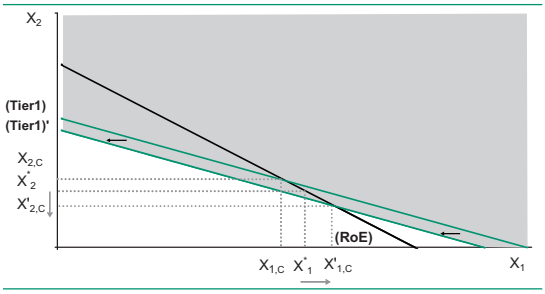

Chart 5 Source: BNP Paribas

In short, the risk of default can sometimes rise even when the regulator correctly defines the weights for the two assets (case 1). This happens when the impact of the increase in leverage prevails over that of the reduction in portfolio risk.

Increased weights for the riskiest assets

Now suppose that the regulator raises the cover for the most risky asset α_1, such that adjusted return on the capital allocated to this asset is lower than that on the less risky asset, i.e. $\frac{r_2 - r_D}{\alpha_2} > \frac{r_1 - r_D}{\alpha_1}$.

- Case 1: no change to the overall capital requirement. On Chart 6, and in the area $\left(x_1, x_2\right)$, the *(Tier1)* curve pivots to the left.

Increase in the risk weight for the riskiest asset
1st case: the Tier one capital requirement remains unchanged

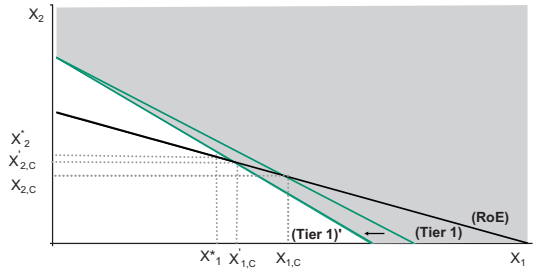

Chart 6 Source: BNP Paribas

The intersection of the *(RoE)* and *(Tier1)'* curves defines the bank's new portfolio constraint, expressed $\left(x'_{1,C}, x'_{2,C}\right)$. The measure is pertinent. The bank does not alter its choices (assuming the optimal portfolio is still in compliance with the regulations) and the risks always are minimal.

- Case 2: the overall capital requirement is increased. As we see in Chart 7, and within the area $\left(x_1, x_2\right)$, this causes the *(Tier1)* curve to pivot to the left. The effects of the change in requirement may therefore prove perverse, with portfolio risk rising even though the bank invests relatively less in the riskier asset. This happens when the bank specialises excessively in the less risky asset (less portfolio diversification), and the measure is all the more counterproductive when the portfolio reallocation is based on significant gearing.

Increase in the risk weight for the riskiest asset
2nd case: the Tier one capital requirement increases

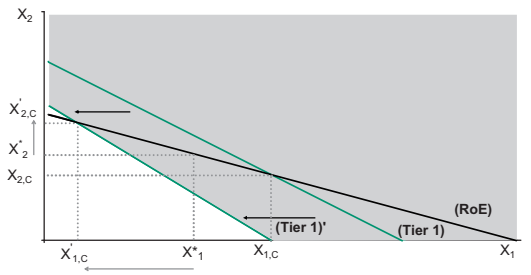

Chart 7 Source: BNP Paribas

To sum up, the effectiveness of an increased weight for the riskier asset can be blunted when it is associated with a tighter overall requirement and the bank does not diversify its portfolio enough (this effect is aggravated when the variances in returns on the two assets are poorly or negatively correlated).

Moreover, Blum (1999) has shown that the reform timetable is not without significance. He considers the behaviour of a bank that maximises the expected value of its equity, with a non-zero probability of default constraint, in a two-period, two-asset model (one asset is risk-free, the other is risky and weighted). His work shows that a more stringent capital requirement for the risky asset that is announced one period in advance leads the bank to take on more risk: if raising ordinary share capital is expensive, the only possibility of raising capital tomorrow lies in taking more risk today. In the context

of inter-temporal arbitrage, the bank is encouraged all the more to profit from a high marginal return on risk (the amount that could be invested in the risky asset per euro of additional capital is greater with a looser solvency constraint) for the fact that this return is bound to decline in the future, when the constraint tightens.

The introduction of a leverage constraint

It follows from this research that when the regulator tightens its requirements and imposes greater cover for the riskier asset, the bank reallocates its capital to the less risky asset but increases its balance sheet, such that the risk to capital increases.

In order to make good certain shortcomings in the Basel requirements (a poorly capitalised bank with limited ability to increase debt or strengthen its capital may have a high propensity to take risks, cf. Rochet (1992), or underestimate risks, cf. Blum (2007)), the G20 has decided to introduce a leverage constraint to complement the minimum solvency requirements.

We now assume that the regulator sets a leverage constraint and tightens the overall capital requirement. We also suppose that the returns on the two assets and their relative weights are such that the bank is encouraged to invest in the less risky asset, i.e. $\frac{r_2 - r_D}{\alpha_2} > \frac{r_1 - r_D}{\alpha_1}$.

- Case 1: the leverage constraint does not bite.

The bank is geared by less than the new constraint and therefore retains some leeway to adapt to the new Tier 1 requirement. It reallocates its portfolio in favour of the least risky asset. As this asset is less profitable and any increase in its leverage is subject to a regulatory limit, it has to accept a decline in its profitability. In Chart 8, in the area $\left(x_1, x_2\right)$, the *(Tier1)* and *(RoE)* curves shift to the left. The intersection of the *(RoE)'* and *(Tier1)'* curves defines the bank's new portfolio constraint, expressed as $\left(x'_{1,C}, x'_{2,C}\right)$. The measure is therefore effective: the shares of the risky asset, portfolio risk and the risk to capital are all reduced.

Increase in the Tier one capital requirement and introduction of a leverage ratio

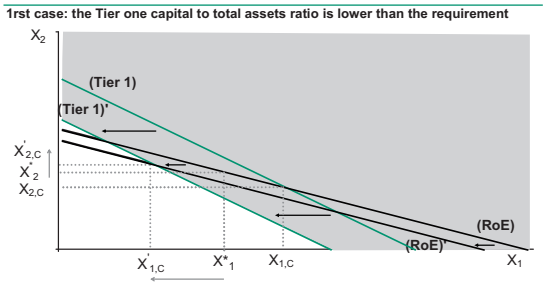

Chart 8 Source: BNP Paribas

- Case 2: the leverage constraint does bite.

The bank's gearing is initially higher than the regulatory limit. It therefore has to scale back its activities. The new constraint can therefore prove counterproductive: the stiffer the leverage constraint, the more the bank is encouraged to increase its portfolio risk in order to maintain its profitability (cf. Chart 9).

Increase in the Tier one capital requirement and introduction of a leverage ratio

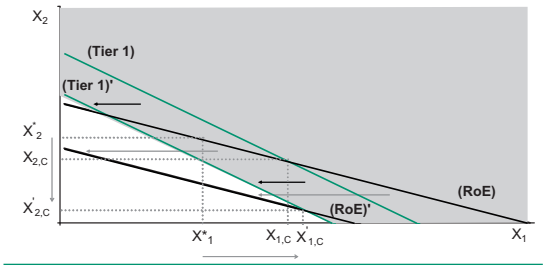

Chart 9 Source: BNP Paribas

In the light of this simplified analysis, and even though some proposals appear theoretically attractive, two aspects should be considered in future impact studies:

- strengthening financial stability. A more appropriate definition of requirements – notably for the riskiest market activities – and their more uniform application to international banks would be welcome. From this point of view, the standardisation of accounting standards would be an indispensable prerequisite (cf. *infra*).

- refocusing universal banks on their traditional business of lending. We may reinterpret the results of our portfolio choice model by assuming that asset 1

designates the bank's riskiest business, such as trading and loans to small and mid-sized businesses, and that asset 2 designates less risky activities like loans to households and to large firms of high credit quality. The first drawback of the regulations is that the bank is more able to control its risk of default if it reduces its leverage. And in order to do this, it has to lower its profitability objective, which in the longer term weakens its capacity to generate capital internally and raise equity from the outside. The second drawback is that the regulations limit the supply of financing to the companies most dependent on bank loans. Empirical studies have identified the mechanisms by which prudential requirements are susceptible to restrict loan volumes and raise the cost of intermediated financing[5].

The impact of more stringent capital requirements on financing for the economy

Within the academic literature, issues related to regulatory capital did not really surface until the beginning of the 1990s, with the adoption of the first Basel Accord. From 2000 onwards, numerous academic studies bearing on the macroeconomic effects of the new arrangements were published in the context of the public consultation procedure run by the Basel Committee ahead of the Basel II reform. Most of this work focused on the procyclical nature of the regulations or portfolio shifts arising from changes to risk weights. The impact of tighter regulatory requirements on financing for the economy has not really been subjected to a more in-depth examination, probably because the introduction of the first pillar of Basel II consisted of a more sensitive measure of risk rather than tougher prudential rules.

The introduction of international capital requirements in 1988 (the Basel I Accord) did to some extent create a precedent in terms of assessing the impact of tighter capital requirements on lending volumes, notably in the USA (before 1988, American banks were subjected to a leverage constraint). While the substitution of government bonds for loans to the private sector on bank balance sheets may be partly attributed to the provisions of Basel I (i.e. an increase in the cost of the latter relative to the former, which carry a zero weight), academic work has highlighted certain mechanisms through which stiffer prudential requirements can inhibit bank lending.

Most of the literature generally attributes the US credit crunch of the 1990s to worsening bank solvency[6], itself a result of an erosion in bank capital (restrictive monetary policy, worsening credit quality), the new prudential regulations and the introduction of fresh leverage and reserve constraints (Bernanke and Lown (1991), Hall (1993), Brinckmann and Horvitz (1995), Hancock, Laing and Wilcox (1995), Peek and Rosengren (1995), Thakor (1996), Hancock and Wilcox (1998), Furfine (2000), Kishan and Opiela (2000), among others). Given the variety of estimation methods, observation periods, banks sampled, control variables and capital adequacy specifications (inverted leverage ratios matching Tier 1 capital with unweighted assets or the Basel capital ratio), it is perhaps unsurprising that these studies attribute different degrees of responsibility to prudential regulation. But they all suggest that an exogenous shock that reduces the amount of excess capital, either by raising the regulatory or economic capital requirement (sub-section 1) or by undermining bank solvency (sub-section 2), has a negative impact on financing for the economy in terms of both loan volumes (sub-section 3) and the cost of credit (sub-section 4).

Tighter constraints and reconstituting a capital cushion

Some studies emphasise that bank solvency relative to regulatory or economic targets is more important than absolute solvency in analysing the economic impact of changes in capital requirements (cf. Brinckmann *et al* (1995), Hancock *et al* (1995), Ito and Sasaki (1998), Gambacorta and Mistrulli (2004), for example).

- Maintaining a cushion of excess regulatory capital

Brinkmann *et al* (1995) show that the changes in prudential regulations wrought by Basel I hampered the supply of credit from both insufficiently capitalised and adequately capitalised US banks. The authors consider a sample of US banks deemed solvent relative to the requirements of the US regulators in 1988 (a primary capital to total assets ratio of 5.5% and a total capital ratio of 6%) and whose cushions of excess capital were affected in different ways by the Basel regulations. They split this sample into three

groups, defined by whether their excess capital increased (for these banks, the introduction of the Basel I accords may be interpreted as a reduced capital requirement), decreased or proved insufficient (a tighter capital requirement, in these two cases) relative to the new prudential standards. The authors show that for the period 1987-91, the rate of increase in lending on the part of less well-capitalised or insufficiently capitalised banks was significatively slower than that for banks whose regulatory constraint had eased, and that they had substituted low-risk (and low-weight) assets for credit within their portfolios [7]. Independently of their initial capital situation, the change in the rules also led banks to increase their capital (by raising fresh equity and issuing subordinated debt) in order to consolidate their solvency ratios. They conclude that the introduction of the Basel requirements partly explains why banks did not respond to easier monetary policies and support the recovery that followed the 1990-91 recession. These findings were consistent with those of Bernanke *et al* (1991), Hall (1993), Berger and Udell (1994), Peek *et al* (1995) and Hancock *et al* (1998), among others.

- More stringent requirements interpreted as a cost

Based on this result, Furfine (2000) argues that the gap between a bank's solvency ratio and the regulatory capital requirement may be assimilated to a cost that decreases as the cushion of excess capital increases. The closer the capital ratio is to the minimum required, the higher the probability of a future shortfall and the higher the risk that the market's and the regulator's opinion of the bank worsens. For the former, this implies an increase in the cost of bank debt and/or the cost of issuing new shares; for the latter, it could imply recapitalisation plans, revisions to dividend payout policy, the institution's closure or bankruptcy (cf. Ito *et al* 1998 for comparable modelling of the banks' cost function). Moreover, the marginal cost of the requirement is a diminishing and convex function: the more comfortable the bank's cushion of excess capital, the less costly it is for that bank to raise its capital ratio. With reference to a sample of US credit institutions over the period 1989-97, Furfine concludes that among the mechanisms considered (including capital erosion and lower demand for loans), only the change in prudential regulations can explain why American banks simultaneously reduced their loan outstandings, increased their holdings of government bonds and raised their capital ratios in 1990-91.

The theoretical role of bank capital in transmitting monetary shocks

Extending this argument, any event that erodes bank capital, and whether the regulatory capital requirement bites or not, may be assimilated to a more stringent economic capital requirement, at least as far as bank lending is concerned. The underlying idea is that in the presence of a capital constraint, an exogenous shock that reduces a bank's cushion of excess capital has a negative effect on its lending. As the contraction in the cushion and its reconstitution are costly, lower lending volumes are synonymous with capital savings. This effect is all the more marked with imperfect markets [8]. Theoretical monetary policy transmission mechanisms – via credit and via bank capital – that are based on assumptions of imperfect debt and bank capital markets offer a conceptual framework adapted to the analysis of the economic consequences of changes in prudential regulations.

- Strengthening the bank credit channel via regulatory capital requirements

According to bank credit transmission theory, tighter monetary policy (a rise in reserve requirements) reduces the supply of bank loans because banks have no easy access to other forms of financing. The central hypothesis is that the bank debt market is imperfect (Van den Heuvel 2002): in the presence of information asymmetries on the quality of bank assets, and given that elements of liabilities not subject to reserve requirements are not covered by public guarantee arrangements, investors demand a premium on the returns they earn on bank debt issues. Following a monetary policy shock, banks' refinancing costs increase all the more when they have limited capital and when the risk of loss for creditors is high (Kishan *et al* (2000)). Contracting volumes of intermediated loans are particularly damaging to the economy, as market financing is an imperfect substitute for bank credit.

- The bank capital channel

According to the bank capital theory, the contraction in bank profits following monetary policy tightening (a rise in central bank interest rates) limits

banks' capacity to accumulate capital. If the latter proves insufficient, and if issuing new shares is too costly, banks will reduce their supply of credit in order to meet regulatory requirements or to reduce the risk of a future shortfall (Thakor (1996), Tanaka (2003)). The existence of this mechanism is based on two assumptions: firstly, that the interest-rate risk inherent in banks' maturity transformation is imperfectly hedged; and secondly, that an imperfect capital market prevents banks issuing new shares easily in order to improve their solvency.

Solvency, an inadequate indicator of banks' capacity to maintain lending volumes

In this framework, and in the presence of constraints on regulatory capital and market imperfections, banks reduce their lending to the economy when their solvency worsens. Assuming that a bank's capital position influences its ability to raise non-guaranteed debt and issue new shares, a well-capitalised bank should be better placed to limit the transmission of a shock to its lending volumes. The conclusions of the empirical literature on this subject vary, however. Several studies, notably Bernanke *et al* (1991), Hancock *et al* (1998), Peek and Rosengren (1997), Berger *et al* (1994) and Kishan *et al* (2000), confirm that poorly capitalised American banks (in terms of leverage) adjusted their supply of credit more significantly during the recession of 1990-91[9]. Similarly, the least solvent Japanese banks reacted to the stock market slump of the 1990s – which reduced the unrealised capital gains included in Tier 2 capital – by issuing subordinated debt, just as the most solvent banks did, but also by lending less (Ito *et al.* (1998)). On the other hand, Ediz, Michael and Perraudin (1998) estimate that UK banks generally increased their risk-adjusted capital ratios over the first half of the 1990s by consolidating their capital rather than by substituting low-weight assets (government securities) for high-weight assets (loans to private companies). This finding should be placed in a context of UK banks' high profitability at the time and the consequently greater capacity to generate capital internally. Altunbas, Fazylov and Molyneux (2002) conclude that within the EMU, poorly capitalised banks (in terms of leverage) adjust their credit supply more in response to tighter monetary policy. Their results are not statistically significant for the major countries, however, such as Germany and France. Based on a sample of French banks observed over the period 1993-2002, Loupias, Savignac et Sevestre (2001) cast doubt on this relationship, arguing instead that as small French banks are relatively well capitalised, a size effect can come into play, and in the opposite direction to that suggested by the capitalisation level (measured as the ratio of capital to assets), on the transmission of changes in monetary policy (cf. Hancock *et al* (1995), Hubbard, Kuttner and Palia (2002)). Bardos, Foulcher and Oung (2002) point out that under Basel II, and when the economic situation worsens, the rise in weighted risks and in capital requirements significantly reduces new lending, albeit after a time lag. Using French data for the period 1993-2001, they estimate that lag at four quarters for all customer loans and three quarters for loans to SMEs. The relationship is very different in respect of large firms, with heightened corporate risks inducing a tighter capital requirement but triggering a rise in lending over the two following quarters. According to the authors, this result reflects major firms' market and negotiating power.

More generally, the level of solvency may determine a bank's ability to absorb shocks but it is not a sufficient condition for maintaining lending volumes. Gambacorta *et al* (2004) demonstrate that balance sheet structure and information asymmetries can limit the role of bank capital. Their analysis is based on a large sample of Italian credit institutions that together account for 80% of domestic lending, and lends credibility to the hypotheses of a credit channel and a capital transmission mechanism. The study concludes that the impact of monetary tightening (or an economic downturn) on lending is less significant or even insignificant when banks are well capitalised. Such banks are even able to maintain their credit supply because they have easier access to sources of financing not subject to reserve requirements (certificates of deposit, for example) and to bank capital, while credit supply from less well capitalised banks decreases[10]. The results show, however, that Italian cooperative institutions, which are better capitalised than the banks, are not as capable of isolating their credit supply from shocks. Following monetary tightening, these institutions – smaller, more exposed to interest-rate risk, more exposed to information asymmetries and that face higher costs in adjusting their capital because of less access to subordinated debt products – significantly

restrict their lending volumes, and to a degree comparable with that noted for less well capitalised banks.

The impact of the regulatory capital level on the cost of intermediated financing

The relationship between bank solvency and the cost of credit has rarely been subjected to empirical analysis. Lown and Peristiani (1996) conclude that during the 1990s credit crunch, increased reluctance to lend among American banks with low leverage ratios was associated with above-average interest rates on new loans. With the economic downturn eroding bank capital, weakly capitalised banks apparently raised their lending rates in order to boost their solvency, thereby helping to slow credit growth over the period. According to Hubbard *et al* (2002), this result stands even when account is taken of the particular characteristics of loans, borrowers and creditors.

Depreciation and banking solvency

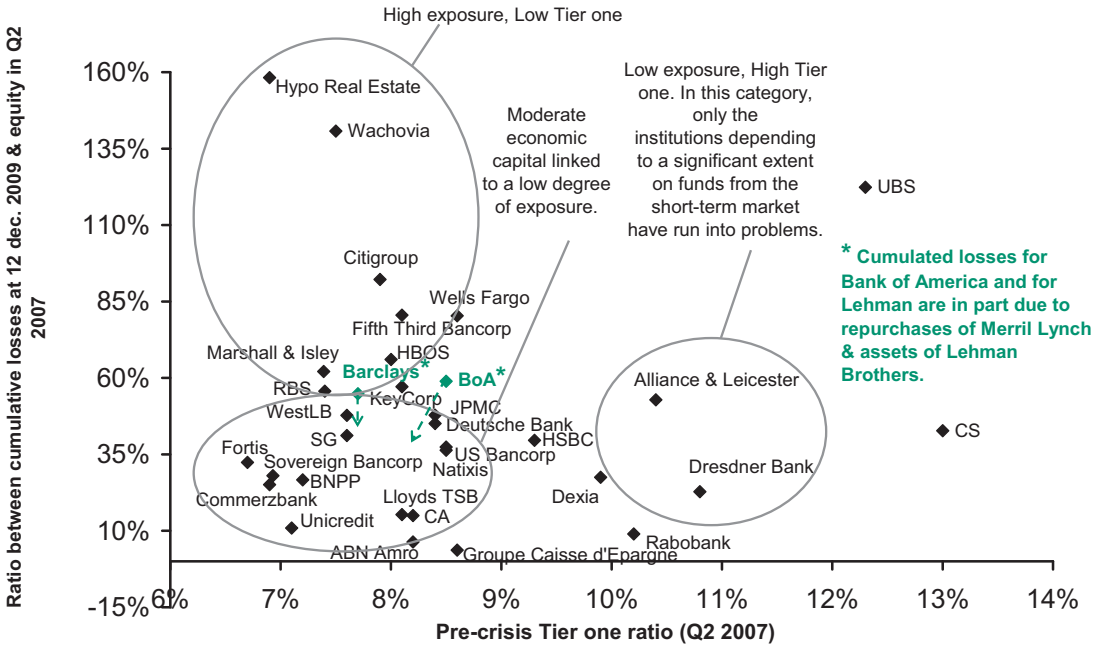

Chart 10 Sources: Bloomberg, Banks' reports, BNP Paribas

These conclusions are worth closer examination. Firstly, in research based on data for 1988, before the US recession and the introduction of the Basel I accords, Lown *et al* (1996) found a positive correlation between the cost of credit and the leverage ratio, with the best capitalised banks charging higher than average lending rates. Secondly, comparisons of lending rates and growth rates contradict the notion that the transmission of shocks during crises varies according to capitalisation level. During the 1990-91 recession, and independently of their solvency ratios, banks raised both their risk premiums (for which the gap between the average interest rate on new loans and the yield on government bonds of the same maturity is considered a good approximation) and their margins (the differential between the average interest rate on new loans and the average yield on certificates of deposit), and in a virtually symmetrical fashion. Lastly, the data highlight the role played by the Basel requirements, which increased capital constraints on some banks as a function of their risk

profile. As early as 1988, the announcement of the new requirements produced a general increase in the cost of credit, particularly among the less well capitalised banks.

Hubbard *et al* (2002) also show that companies with for which the cost of information is high – small firms, unrated firms and firms heavily dependent on bank financing, in line with the credit channel theory – were penalised the most. This confirms Hancock *et al* (1995), who found that the loan categories and customers most affected by a relative decline in bank solvency were also those most exposed to information asymmetries (see also Hancock *et al* (1998)).

Above and beyond solvency, the need to favour liquidity

The recent crisis showed that high solvency ratios are not necessarily a good defence against a bank's default. At the same time, a solvency ratio that appears moderate even if stronger than the regulatory requirement, should not necessarily be considered a sign of vulnerability. Most of the institutions that ran into difficulties during the crisis had fairly comfortable solvency ratios, and their problems had more to do with liquidity (cf. Chart 10, page 13). This fact had prompted regulators to broaden their discussions to complementary measures. Some are seeking to prevent banks defaulting (liquidity ratios), while others are seeking to limit the impact of a bank default (covenants).

A regulatory minimum to be handled with care

In the light of the empirical literature, the real determinant of the level of bank solvency is not so much the regulatory requirement as the implicit market requirement. And as the latter is largely outside the regulator's control, it generates a risk of an increase in bank capital to above the regulator's objective. In such circumstances, the negative effects on credit supply may outweigh the expected benefits in terms of financial stability. The second drawback of solvency ratios lies in their poor predictive power for individual bank defaults.

- Implicit vs. regulatory requirements

All the major international banks have solvency ratios well above the regulatory minima (Tier 1 ratios of around 8-12%, compared with a regulatory 4%). It is therefore reasonable to believe that capital constraints, and notably a bank's ability to raise fresh debt or issue new shares, start to kick in much before regulatory limits are reached. Flannery and Rangan (2002) show that since 1995, and in contrast with what was observed between 1986 and the start of the 1990s, increases in bank capital and the maintenance of capital ratios above regulatory requirements among US institutions stemmed largely from market pressure. In other words, market discipline is one of the key factors in high levels of bank capital.

- Limited predictive power in terms of bank defaults

Another important drawback to tightening capital requirements lies in the limited usefulness of high solvency ratios as protection against bank defaults. During the recent financial crisis, several European institutions with Tier 1 ratios that were comfortably above prudential requirements but below international standards turned out to have very little exposure to risky structured debt products. In our view, an average Tier 1 level may mean weaker economic capital that matches a less risky portfolio than the Basel II risk weights suggest all on their own. Conversely, many institutions with comfortable Basel II ratios had difficulties. We can only emphasise the poor predictive power of the solvency ratio considered on its own, in terms of bank failure.

While the issue has not been definitively resolved, some of the empirical literature suggests a troubling relationship between capital and banking risk. Thus Shrives and Dahl (1992) found a positive correlation between the level of capital and risk exposure among 1,800 American banks between 1983 and 1987. More recently, Paroush and Schreiber (2008) obtained a similar relationship for savings and mortgage banks over the period 1995-2006.

Limiting procyclical tendencies

As Taylor and Goodhart (2004) pointed out, increases in risk weights during economic downturns tend to increase the denominator of the Basel II solvency ratio and strengthen its procyclical character.

- Rendering overall capital ratios less sensitive to the cycle

One means of limiting this procyclical characteristic would be adjusting the overall capital requirement as a function of the economy's position in the business cycle.

The variant retained in the G20 discussions has this aim but would stiffen the present requirements over the cycle on average. This is because it would add a countercyclical capital requirement that would be more stringent during periods of rapid growth and diminish during phases of slower or negative growth.

Among the measures proposed by the Basel Committee in the consultation document it published in December, we note an objective of a smaller decline in the probability of default used in IRB approaches when the credit cycle is in a helpful phase. Along the same lines, the UK's Financial Services Authority (FSA) has already proposed making probabilities of default (PD) less dependent on the cycle by applying a corrective component. The purely cyclical component of PD would be ignored, in other words, leaving only a 'through the cycle' component. Saurina and Trucharte (2006) show that the substitution of a mean PD for the whole cycle for an instantaneous PD significantly reduces the pro-cyclical nature of the regulations. The Basel Committee is also considering smoothing weights over time with the use of moving averages.

As far as the first solution is concerned, impact studies will consist of simulating a cyclical downturn while retaining the highest average PD for each asset class over the cycle. The impact of the second proposal will be evaluated using the historical average PD for each asset class.

In practice, each solution raises implementation difficulties (determining the tough in activity, assessing potential GDP) as well as problems of distorting competition between national banking systems whose economic cycles are never perfectly synchronised.

Moreover, and apart from the extreme case of financial crisis, banks hold more capital than the regulatory minima in order to cover unexpected losses that could arise from exogenous economic shocks.

- Towards new provisioning rules

In parallel with its aim of limiting the procyclical character of overall capital requirements, the Basel Committee announced in its December document that it would encourage more vigorous provisioning.

Firstly, and with an eye to the homogeneity of prudential regulations, the Committee would support the IASB[11] in its bid to set accounting standards on provisioning. At the moment, the basis of the definitions used in the Basel regulations differs greatly from accounting standards. The Committee believes that losses could be provisioned for on a simple statistical basis, without any event implying that the loss would actually arise. In contrast, the IASB has considered so far that a probable loss may be provisioned for only in consequence of a precise event. Accounting provisions therefore differ from expected losses as defined in the Basel II regulations, implying changes to the determination of capital levels.

When outstandings of provisions booked for credit risk are lower than expected losses, regulatory capital should cover this shortfall. In contrast, when outstandings of provisions exceed expected losses, regulatory capital is increased by that excess.

The Committee intends to draft supervisory principles consistent with this new accounting approach and will encourage regulators to promote provisioning rules in accordance with 'expected loss', as already applied to Spanish banks.

Handling institutions bearing systemic risk

In an extension of the G20's decisions, the Financial Stability Board (FSB) has set out a project timetable with the aim of submitting proposals for institutions 'too big to fail' by the end of October 2010. These institutions are defined as those that would generate significant systemic risk in the event of default. The FSB's work has three components. The first is preventive, with the intention of reducing the probability and occurrence of default. This involves examining the various prudential and regulatory arrangements, including specific measures concerning capital, resources and legal and operational structures. The second component is concerned with the ordered liquidation of a failing institution and assessments of actual attempts to achieve it, which implies exchanges of information with the authorities. The third component concerns strengthening core infrastructures and the financial markets to limit risks of contagion.

Discussions on emergency plans concerning international banks, based on FSF cross-border

cooperation principles, have already started and will continue into the first half of 2010. The FSB working party on cross-border crisis management has prepared a list of the main issues that should be addressed in any discussion of emergency plans. The latter cover emergency resources and means of reducing risk (cutbacks in certain businesses, even the cessation of non-core business) in order to guarantee the continuity of financial services; they also include the steps the authorities should take in view of orderly liquidation if reducing risks is impossible or does not enable the institution to be saved.

At the St Andrews G20 meeting on 7 November 2009, finance ministers and central bankers urged the introduction of the appropriate tools and homogenous plans for saving or liquidating the institutions in question by the end of 2010.

Harmonised accounting standards, an indispensable precondition for the introduction of a leverage ratio

There is little sense in calculating a total assets to equity leverage ratio if the underlying accounts are not standardised. For example, Deutsche Bank's total balance sheet on 30 September 2009 amounted to €1,660 billion according to IFRS, but just €915 billion according to US GAAP. Similarly, the application of US GAAP increases the group's equity from €35.7 billion to €37.2 billion, reflecting a different fair value for the group's own debt. For the same banking group, leverage was 47 using IFRS and 25 using US GAAP.

In its final communiqué, the G20 called for the convergence of European IASB and American FASB accounting standards by June 2011. Given that this project was described in only five lines in the communiqué, however, it hardly looks like a priority. Note also that the mention of a need to adjust the leverage ratio for different accounting standards suggests that harmonisation may not be complete when the ratio is introduced as a regulatory constraint.

For its part, the European Commission has postponed the implementation of the first part of the new IFRS 9 for financial instruments, which the IASB published on 12 November. The Commission prefers to await the complete standard, which cannot be made mandatory until 2013.

New liquidity requirements

The British economist Walter Bagehot (1826-1877), who was one of the first academics to study the role of lender of last resort, originated the now sacred law that support from the monetary authorities is legitimate only for as long as the beneficiary institution is illiquid but solvent. The application of this rule assumes nonetheless that the central bank is capable of distinguishing between illiquidity and insolvency ex ante, and unfortunately that is not always the case. To make things more difficult, the very concept of bank liquidity is open to interpretation. In its strict sense, bank liquidity means the capacity to convert deposits of central bank money immediately, via asset sales or by using reserves held at the central bank. But there is also a broader definition, which concerns market liquidity. Bank assets are liquid for only as long as the markets on which they are exchanged are themselves liquid. Liquidity problems emerge ahead of insolvency, which is an easily understood concept in an environment featuring numerous illiquid markets.

Several studies have highlighted the complementary nature of liquidity and solvency requirements. Allen and Gale (2000 and 2004) show that liquidity requirements are a precious prudential tool when financial markets are incomplete.

Basing itself on the first CEBS recommendations, which were issued in June 2009, but before the CEBS and the Basel Committee set new international liquidity rules in the wake of the G20, the FSA has already set standards that are binding on all institutions established in the UK. In 2010, UK banks are going to have to increase their liquidity (cash and government securities) by £110 billion (€119.6 billion) and reduce their reliance on short-term financing instruments by 20%.

On 9 December, the Basel Committee set liquidity objectives to which European banks now have to meet. They are to create two liquidity cushions by 30 June 2010, the first large enough to cope with a serious crisis lasting a week, and the second with a one-month horizon. These new rules will require banks to provide supervisors with financial shock simulations.

It would perhaps be opportune at this point to evaluate the superiority of a relatively complex liquidity indicator that will be costly for banks to

implement against a simpler, tried and tested measure such as the loan to deposit ratio (cf. Chart 11).

Loan to deposit ratio at 30 september 2009

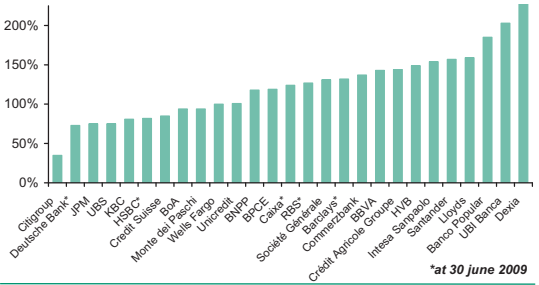

Chart 11 Sources: Bloomberg, Banks' reports

Conclusion

By highlighting the weaknesses of the Basel II system, the financial crisis rendered reform of financial regulations inevitable. Although US commercial banks had still not formally applied Basel II when the crisis broke, all the major international banks had largely incorporated these prudential rules in their management decisions, and all were damaged more or less severely by the train of events. It remains to be seen whether this failure stemmed from shortcomings in Basel II in terms of scope (liquidity) or among particular players (US investment banks, hedge funds), or arose instead from excessively low solvency minima. Our feeling is that the first factor was the most important, but the various G20 initiatives do not appear to be the result of any clear diagnosis. There is a risk that layer upon layer of constraints will be imposed, each apparently justifiable in terms of financial stability when considered independently but with a degree of redundancy when taken together. We can readily imagine an institution that scrupulously respects the three regulatory constraints (solvency, leverage and liquidity) presenting a greater microeconomic risk of default than another institution with a very comfortable liquidity ratio but whose other ratios are slightly lower than the regulatory requirements.

The main danger is that new regulations affect the financing of the real economy without significantly reducing the individual risk of bank default or improving financial stability. Ideally, impact studies would lead regulators and commercial banks to analyse the extent to which the various rules proposed by the G20 and being drafted by the Basel Committee are complementary or substitutable. Once again, the aim should be to minimise the impact on financing the economy and preserving its efficiency in terms of financial stability.

28 December 2009

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APPENDIX

The optimal portfolio

The bank seeks a rate of return $\overline{RoE}$ in line with the market's requirements. In the area $\left(x_1, x_2\right)$, the *(RoE)* curve may be expressed as

$$x_2 = \frac{r_D - r_1}{r_2 - r_D} x_1 + \overline{E}\frac{\overline{RoE} - r_D}{r_2 - r_D} \text{ (RoE).}$$

We may also suppose that the bank seeks to minimise the risk to its equity, i.e. the variance of its return, expressed as $\sigma_E^2 = \left(\sigma_1^2 x_1^2 + \sigma_2^2 x_2^2\right) / \overline{E}^2$ when the covariance between the returns on the two assets is zero. Under the (*RoE)* constraint, the bank's programme may be described as follows:

$$\underset{x_1}{Min} \frac{\sigma_1^2 x_1^2}{\overline{E}^2} + \frac{\sigma_2^2}{\overline{E}^2}\left(\frac{r_D - r_1}{r_2 - r_D} x_1 + E\frac{\overline{RoE} - r_D}{r_2 - r_D}\right)^2$$

where $\frac{\partial \sigma_E^2}{\partial x_1} > 0, \frac{\partial^2 \sigma_E^2}{\partial {x_1}^2} > 0$ for all x_1 : the $\sigma_E^2\left(x_1\right)$ function is convex in the area $\left(x_1, \sigma_E^2\right)$ and admits an overall minimum, termed x_1^* (cf. Chart 3). Note that the portfolio risk (the variance of the portfolio's return) is expressed $\sigma_P^2 = \left(\sigma_1^2 x_1^2 + \sigma_2^2 x_2^2\right) / A^2$ and leverage $A / \overline{E}$.

The optimal allocation for the asset portfolio is deduced from the first-order condition of the minimisation programme $\frac{\partial \sigma_E^2}{\partial x_1} = 0$ and the constraint (*RoE*):

$$x_1^* = (r_1 - r_D)\overline{E}\left(\overline{RoE} - r_D\right)\frac{\sigma_2^2}{\sigma_1^2(r_2 - r_D)^2 + \sigma_2^2(r_D - r_1)^2},$$

$$x_2^* = (r_2 - r_D)\overline{E}\left(\overline{RoE} - r_D\right)\frac{\sigma_1^2}{\sigma_1^2(r_2 - r_D)^2 + \sigma_2^2(r_D - r_1)^2}.$$

When $x_1 + x_2 = A$, we obtain $A^* = \left[\sigma_2^2(r_1 - r_D) + \sigma_1^2(r_2 - r_D)\right]\frac{\overline{E}\left(\overline{RoE} - r_D\right)}{\sigma_1^2(r_2 - r_D)^2 + \sigma_2^2(r_D - r_1)^2}$.

It follows that optimally the bank invests most in the asset with the highest variance-adjusted margin. Thus the share of the less risky asset in the optimal portfolio is all the higher, $x_2^* > x_1^*$ and $\frac{x_2^*}{A^*} > \frac{x_1^*}{A^*}$, when $\frac{(r_2 - r_D)}{\sigma_2^2} > \frac{(r_1 - r_D)}{\sigma_1^2}$. If this ratio is unique irrespective of *i*, the share of each of the two assets in the optimal portfolio is identical, i.e. $x_1^* = x_2^* = A^* / 2$.

The portfolio constraint

The bank seeks a solvency ratio *E/RWA* at least as high as the regulatory requirement. In the area $\left(x_1, x_2\right)$, the *(Tier1)* curve is expressed

$$x_2 = \left(\frac{E}{\left(E / RWA\right)_R . \alpha_1} - x_1 \right) \frac{\alpha_1}{\alpha_2} \text{ (Tier1),}$$

where $\left(E / RWA\right)_R$ is the minimum regulatory capital ratio. The *(Tier1)* and *(RoE)* curves shift as indicated on Chart 12.

Shift in (Tier1) and (RoE)

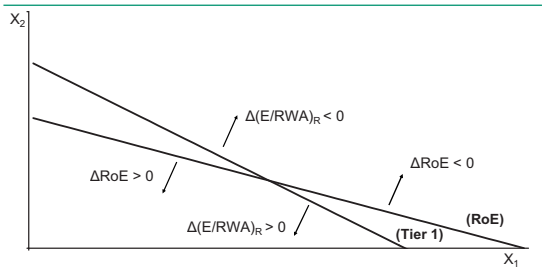

Chart 12 Source: BNP Paribas

The allocation of the portfolio constraint is deduced from the *(RoE)* and *(Tier1)* equations:

$$x_{1,C} = \left[\frac{\bar{E}(r_2 - r_D)}{\left(E / RWA\right)_R} - \alpha_2 \bar{E}\left(\overline{RoE} - r_D\right) \right] \frac{1}{\alpha_1(r_2 - r_D) + \alpha_2(r_D - r_1)},$$

$$x_{2,C} = \left[\frac{\bar{E}(r_D - r_1)}{\left(E / RWA\right)_R} + \alpha_1 \bar{E}\left(\overline{RoE} - r_D\right) \right] \frac{1}{\alpha_1(r_2 - r_D) + \alpha_2(r_D - r_1)},$$

and $A_C = \left[\frac{\bar{E}(r_2 - r_1)}{\left(E / RWA\right)_R} + \left(\alpha_1 - \alpha_2\right) \bar{E}\left(\overline{RoE} - r_D\right) \right] \frac{1}{\alpha_1(r_2 - r_D) + \alpha_2(r_D - r_1)}.$

The bank's optimal portfolio is equivalent to that of the constrained bank when the solvency ratio emerging from the optimal combination $\left(x_1^*, x_2^*\right)$ is identical to the minimum regulatory ratio. Here, we assume that the capital ratio associated with the optimal portfolio exceeds the regulatory requirement $\left(E / RWA\right)^* > \left(E / RWA\right)_R$.

Under this latter hypothesis, and according to the values of the parameters, two cases may be envisaged.

1/ If $\alpha_1 (r_2 - r_D) + \alpha_2 (r_D - r_1) > 0$ i.e. $\frac{(r_2 - r_D)}{\alpha_2} > \frac{(r_1 - r_D)}{\alpha_1}$, it follows that $x_2^* > x_{2,C}$ and $A^* > A_C$: the optimal portfolio $\left(x_1^*, x_2^*\right)$, which by definition minimises the risk to equity, is less risky (the variance in the portfolio's returns is lower) than the portfolio constraint $\left(x_{1,C}, x_{2,C}\right)$ but the bank is more highly geared than the constrained bank. On Chart 3, and in the area $\left(x_1, x_2\right)$, this implies that the slope of the *(Tier1)* curve is greater than that of the *(RoE)* curve in absolute terms, $-\frac{\alpha_2}{\alpha_1} > \frac{r_D - r_2}{r_1 - r_D}$, and that the optimal combination $\left(x_1^*, x_2^*\right)$ is to the left of the constrained combination $\left(x_{1,C}, x_{2,C}\right)$.

2/ Conversely, if $\alpha_1 (r_2 - r_D) + \alpha_2 (r_D - r_1) < 0$ i.e. $\frac{(r_2 - r_D)}{\alpha_2} < \frac{(r_1 - r_D)}{\alpha_1}$, it follows that $x_2^* < x_{2,C}$ and $A^* < A_C$: if the return on capital allocated to the most risky asset is higher, the optimal portfolio is both riskier and smaller than the constrained portfolio (cf. Chart 5).

More generally, the bank optimally invests more in asset *i*, relative to the constrained bank when the margin on this asset adjusted for its weight in the Tier 1 ratio denominator $\frac{r_i - r_D}{\alpha_i}$ is high.

More stringent overall capital requirements

We assume the regulator raises the solvency requirement. In the area $\left(x_1, x_2\right)$, the slope of the *(Tier1)* curve is unchanged but its initial value on the y-axis declines. The new *(Tier1)'* curve is expressed as $x_2 = \left(\frac{E}{\left(E / RWA\right)_R^{'} . \alpha_1} - x_1 \right) \frac{\alpha_1}{\alpha_2}$ where $\left(E / RWA\right)_R^{'} > \left(E / RWA\right)_R$, the new minimum capital ratio. The representative bank's portfolio is deduced from the *(RoE)* and *(Tier1)'* equations

$$x_{1,C}^{'} = \left[\frac{\overline{E}(r_2 - r_D)}{\left(E / RWA\right)_R^{'}} - \alpha_2 \overline{E}\left(\overline{RoE} - r_D\right) \right] \frac{1}{\alpha_1 (r_2 - r_D) + \alpha_2 (r_D - r_1)}$$

Similarly, $x_{2,C}^{'}$ and $A_C^{'}$ may be expressed with the substitution of $\left(E / RWA\right)_R^{'}$ for $\left(E / RWA\right)_R$ in $x_{2,C}$ and A_C. The objective of minimising the variance in the return on equity prohibits the bank from specialising in one of the two assets. Depending on the values of the parameters, the increase in the regulatory requirement increases or reduces risk-taking.

Under the hypothesis $(r_2 - r_D)/\alpha_2 > (r_1 - r_D)/\alpha_1$, $\frac{\partial x_1}{\partial (E/RWA)_R} < 0, \frac{\partial x_2}{\partial (E/RWA)_R} > 0$ and $\left|\frac{\partial x_1}{\partial (E/RWA)_R}\right| < \left|\frac{\partial x_2}{\partial (E/RWA)_R}\right|$ hence $\frac{\partial A}{\partial (E/RWA)_R} > 0$ (cf. Chart 4).

An increase in the risk weight for the riskiest asset

1/ The regulator retains an unchanged solvency requirement but increases the weight of asset 1 in the prudential ratio calculation. In the area (x_1, x_2), the y-intercept of the *(Tier1)* curve is unchanged but the slope increases in absolute terms (cf. Chart 6). The new *(Tier1)'* curve is expressed as follows: $x_2 = \left(\frac{E}{(E/RWA)_R.\alpha_1'} - x_1\right)\frac{\alpha_1'}{\alpha_2}$ where $\alpha_1' > \alpha_1$.

2/ The regulator raises the solvency requirement as well as the weight of asset 1 in the prudential ratio calculation. In the area (x_1, x_2), the y-intercept of the *(Tier1)* curve declines and the slope increases in absolute terms (cf. Chart 7). The new *(Tier1)'* curve is expressed as follows: $x_2 = \left(\frac{E}{(E/RWA)_R'.\alpha_1'} - x_1\right)\frac{\alpha_1'}{\alpha_2}$ where $(E/RWA)_R' > (E/RWA)_R$ and $\alpha_1' > \alpha_1$.

The introduction of a leverage constraint

We assume that the regulator raises the solvency requirement and constrains the bank to avoid excessive leverage. In the area (x_1, x_2), the y-intercepts for the *(Tier1)* and *(RoE)* curves decline (cf. Charts 8 and 9). The new *(Tier1)* curve is termed *(Tier1)'* and the new *(RoE)* curve is expressed as follows: $x_2 = \frac{r_D - r_1}{r_2 - r_D}x_1 + \bar{E}\frac{RoE' - r_D}{r_2 - r_D}$ where $RoE' < \overline{RoE}$.

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[1] Micro- and macro-prudential concerns are closely related, however. The recommendations in the Larosière report on financial supervision, published on 26 February 2009, served as the basis for the EU's position at the Pittsburgh G20 summit on 24-25 September 2009. This set of measures has been submitted to the Council and European Parliament so that the new structures may be operational in 2010.

[2] Strengthening the resilience of the banking sector, Consultative Document, Basel Committee on Banking Supervision, December 2009.

[3] International Framework for liquidity risk measurement, standards and monitoring, Consultative Document, Basel Committee on Banking Supervision, December 2009.

[4] Source: Bloomberg. We thank Anthony A.S. Benhamou for his precious help in researching and compiling banking and financial data.

[5] cf. Mésonnier (2005) for a review of the literature.

[6] Berger and Udell (1994) are exceptions. They argue that demand factors are more determinant in reallocating bank portfolios than the credit crunch hypothesis.

[7] In our view, these estimates have two drawbacks: the authors do not indicate whether the lending growth rates for the three groups they identify were statistically identical before 1987, and their regression does not integrate any control variable to isolate the effect of deteriorating loan portfolio quality over the period.

[8] Blum and Hellwig (1995) made the first theoretical formalisations of the relationship between capital requirements and bank loan outstandings. Based on an assumption of imperfect substitutability between market and bank financing, they show in the context of an IS-LM model that the rigid link between bank capital and bank lending (a short-term constraint on raising fresh capital) aggravates the effects of a demand shock on the price and volume of equilibrium production. Above the limit at which the link becomes a constraint, any increase in the regulatory capital requirement reduces the sensitivity of activity to shocks, but not to the extent of offsetting its initial aggravation.

[9] Peek and Rosengren (1997) suggest a singular method for identifying supply-side effects alone by analysing the lending behaviour of subsidiaries and branches of Japanese banks in the USA in the period 1988-95.

[10] Bank capitalisation is considered with respect to the amount of capital they have in excess of the minimum prudential requirement. This lends credibility to the result just mentioned, that a decline in solvency has a negative effect on credit even when the constraint does not bite.

[11] Founded in 1973, the IASB is a private not-for-profit organisation that aims to establish internationally-accepted accounting standards, to promote their use and, more generally, to harmonise accounting practices and the way accounts are presented worldwide. Its 15 members, who are experts designated by the International Accounting Standards Committee Foundation (IASC), are responsible for the development and publication of International Financial Reporting Standards (IFRS).

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