

# Bank business models and the Basel system: Complexity and interconnectedness

by

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*The main hallmarks of the global financial crisis were too-big-to-fail institutions taking on too much risk with other people's money: excess leverage and default pressure resulting from contagion and counterparty risk. This paper looks at whether the Basel III agreement addresses these issues effectively. Basel III has some very useful elements, notably a (much too light "back-up") leverage ratio, a capital buffer, a proposal to deal with pro-cyclicality through dynamic provisioning based on expected losses and liquidity and stable funding ratios. However, the paper shows that Basel risk weighting and the use of internal bank models for determining them leads to systematic regulatory arbitrage that undermines its effectiveness. Empirical evidence about the determinants of the riskiness of a bank (measured in this study by the Distance-to-Default) shows that a simple leverage ratio vastly outperforms the Basel Tier 1 ratio. Furthermore, business model features (after controlling for macro factors) have a huge impact. Derivatives origination, prime broking, etc., carry vastly different risks to core deposit banking. Where such differences are present, it makes little sense to have a one-size-fits-all approach to capital rules. Capital rules make more sense when fundamentally different businesses are separated.*

*JEL classification: G01, G15, G18, G20, G21, G24, G28*

*Keywords: Financial crisis, Basel III, derivatives, bank business models, distance-to-default, structural bank separation, banking reform, GSIFI banks*

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## I. Introduction

The Basel Committee on Banking Supervision (BCBS) has continued to lead the process of bank micro-prudential reform since the global financial crisis in 2008-09, evolving a set of proposals collectively referred to as Basel III.<sup>1</sup> The latter is a vast improvement over Basel II, which created an across-the-board cut in capital for banks prior to the largest crisis since the 1930s. The BCBS proceeded to revise Basel II by adding on to it a vast set of complex new rules. The primary focus of the BCBS is on capital rules applied to risk-weighted assets; it has not been charged with examining the structural business models of banks to which these capital rules apply. By necessity the process has been one of policy “on the run”, which was not able to benefit from any evidence-based research. As more and more data on banks since the crisis comes to hand this situation is changing, and the relative importance of business model factors and capital and liquidity rules in influencing the riskiness of banks can be tested. This paper reviews the Basel III proposals, presents new evidence about the factors determining the riskiness of banks, and asks whether structural reform of banks business models is a necessary part of the reform process.

There are two broad paths to bank failure: fundamental insolvency and/or liquidity crises typically arising from counterparty risk. A sudden decline in asset values (if properly marked to market) can wipe out bank capital. But the very risk of this in a crisis makes counterparties unwilling to lend, which is especially problematic when banks need cash and/or liquid securities to meet margin calls for derivatives transactions, repos and other collateral needs.<sup>2</sup> This depends very much on the structural business model of banks. Bad assets, on the other hand, are easier to hide, particularly when they are illiquid, rely on mark-to-model valuations and/or are held to maturity in banking books.<sup>3</sup> These assets may take many years to mature, at which time their true recovery value is realised. If it is below the previously reported value write-downs will follow, and this can go on for some years after a crisis. Banks in this position (latent insolvency with bank and regulatory forbearance) are often forced into deleveraging and asset sales. Less important banks are sometimes forced to fail, though this discipline has been more common in the USA than in Europe. Where banks are systemically important, governments do intervene to lessen the deadweight losses to the economy from a systemic crisis, and this sort of implicit guarantee can lead to the under-pricing of risk, causing leverage and counterparty risk to be higher than it would otherwise be. The bank is rewarded if the strategy works and the taxpayer bears the risk alongside shareholders if it fails.

Historically, policy makers have at times, particularly in the USA, combined capital rules with policies that constrain the business models of banks (such as Glass-Steagall). But this was gradually undermined by the great push for deregulation in the past few decades. At the national level regulators are implementing the capital rules in different ways and are also combining this with some attempts to constrain certain aspects of what banks actually do, i.e. banks’ business models (Vickers, Volcker, Liikanen, and Swiss “separability” requirements).<sup>4</sup> This paper first looks at the Basel system historically, and then summarises

most of the key problems with it that contributed to the failure of regulation to avoid the recent global financial crisis. In Section II the paper summarises the recent Basel III proposals, and Section III critically analyses them. Section IV presents new empirical evidence on leverage and business model features that make banks risky and hence need to be addressed by regulation. That section argues that structural business model measures are essential alongside capital rules for large banks. Finally, Section V, in concluding, provides a summary of the main arguments. Annex A sets out the details the Basel III reforms, and Annex B provides a set of stability results for the modelling of bank risk.

## II. The Basel system historically

Capital regulations under Basel I came into effect in December 1992 (after development and consultations since 1988).<sup>5</sup> The aims were to require banks to maintain enough capital to absorb losses without causing systemic problems and to level the playing field internationally (to avoid competitiveness conflicts). A minimum ratio of 4 per cent for Tier 1 capital (which should mainly be equity less goodwill) to risk-weighted assets (RWA) and 8 per cent for Tier 1 plus Tier 2 capital (certain subordinated debt, etc.).<sup>6</sup> The Basel I risk weights were fixed by the BCBS. A “revised framework” known as Basel II was released in June 2004<sup>7</sup> after many issues arose with Basel I, most notably that regulatory arbitrage was rampant.<sup>8</sup> Basel I gave banks the ability to control the amount of capital they required by shifting between on-balance sheet assets with different weights, and by securitising assets and shifting them off balance sheet – a form of disintermediation. Banks quickly accumulated capital well in excess of the regulatory minimum, and capital requirements, in effect, had no constraining impact on bank risk taking.

Basel II cut risk weights across the board and introduced an enormous moral hazard into the pillar 1 capital rules for large complex banks by letting them use their own internal risk models to determine the riskiness of assets to which risk weighting would apply. Total RWA is based on a complex system of risk weighting that applies to “credit”; and adds on a calculation of “market risk” (MR) and “operational” risk (OR), which are calculated separately:

$$RWA = 12.5(OR + MR) + \sum_i w_i A_i \quad [1]$$

where  $w_i$  is the risk weight for asset  $i$ ; and  $A_i$  is asset  $i$ ; OR and MR are directly measured and grossed up by 12.5 for 8 per cent equivalence; and credit risk is the sum of the various asset classes, each weighted by its appropriate risk weight. Banks were to be able to choose between: first, a simplified approach (for smaller institutions without the capacity to model their business in risk terms) by using revised fixed weights; second, an approach based on external ratings; and third, an internal ratings-based (IRB) approach for sophisticated banks, driven by their own internal rating models. This paper focuses mostly on the latter banks, which are central to the issues of counterparty risk and systemic issues.

The IRB approach requires banks to specify the probability of default (PD) for each individual credit, its loss-given-default (LGD), and the expected exposure at default (EED). This requires highly-complex modelling and aggregation, and offers banks with the necessary expertise the possibility of deriving more risk-sensitive weights. This approach requires the approval of the bank’s supervisor. By proposing this system, the BCBS contributed directly to the build-up of leverage that was one of the principle causes of the crisis.

In previous studies Blundell-Wignall and Atkinson focused on several major problems with the Basel II approach, notably: portfolio invariance (no penalty for concentration);<sup>9</sup> the assumption of a single global risk factor;<sup>10</sup> pro-cyclicality of Basel; inconsistent internal models used for calculating risk weights and subjective inputs; unclear and inconsistent definitions (particularly capital); the inadequate treatment of interdependence risk (especially in the area of derivatives);<sup>11</sup> and the failure to deal with business models and the problem of too-big-to-fail (TBTF) (so that pillar 3 could never work). This latter TBTF aspect is important not so much because traders and shareholders are not punished by failed strategies – they are – but rather because other risk-taking institutions can assume that their counterparty positions will not default if the bank they deal with is TBTF. Risk taking is under-priced as a consequence. This issue relates to the structure of banks and their resolvability; while it directly affects the capital risked by a bank, it has not been the main focus of the BCBS.

### III. The Basel III reforms

Basel III looks to deal with the above issues by raising the quality of capital; by adding buffers for large banks; by adding charges for counterparty credit risk and by considering a very weak leverage ratio.<sup>12</sup> Basel III also aims to deal with liquidity coverage issues in the light of problems that arose in relation to meeting counterparty commitments (derivatives and repos in particular). It is also working on stable funding to avoid excessive dependence on short-term wholesale funding to fund long-term assets. Greater monitoring and disclosure to supervisors of risk factors (e.g. contractual mismatches) not otherwise directly addressed in the regulations is also mentioned. The main elements of the Basel III reforms are set out in Annex A.

In 2012 the BCBS launched the Regulatory Consistency Assessment Program (RCAP) to monitor the consistency of the introduction of Basel III in national jurisdictions and to provide analyses on the outcomes. The first set of findings published in January 2013 are of some concern – they show considerable variation in the risk weighting of assets held in the trading book due to factors other than risk exposure.<sup>13</sup>

#### **National approaches recognise that Basel III is not enough**

The FDIC in the USA has long pointed to the problems with the Basel risk-weighting approach, which creates only the “*illusion of capital adequacy*”.<sup>14</sup> The Collins Amendment to the Dodd-Frank Act, drafted by the FDIC, removes trust-preferred securities from Tier 1 capital and establishes that there be two floors for insured deposit institutions, bank and thrift holding companies and systemically important non-bank financial companies: i) not less than the generally applicable risk-based capital leverage ratio requirements; and ii) not quantitatively lower than these requirements as they were in effect for insured depository institutions as of the date of the enactment of the bill. In July 2013 the FDIC and the US Federal Reserve issued a joint statement referring to research that shows that the Basel III 3% leverage ratio would have done little to ameliorate the last crisis, and that 8 TBTF US insured bank holding companies would have to meet a 5% leverage rule, and 6% for insured depository institutions inside such groups, in order to be considered “well capitalized” for prompt corrective action purposes. At the same time the Volcker Rule was enacted to take up the issue of bank separation of certain risky business activities – the latter indicating agreement with those believing that bank risk could not be left to the Basel III standards alone.

The US has introduced the Comprehensive Capital Analysis and Review (CCAR) exercise and approves the capital plans of 18 bank holding companies (BHC).<sup>15</sup> The capital required is based on rigorous stress testing exercises. The US has doubled the amount of capital held by these 18 BHCs (to USD 792 bn at the end of 2012 from USD 393 bn in 2008). In mid-December 2012 the USA has proposed rules to deal with the operation of large foreign bank organizations (FBOs) in the USA.<sup>16</sup> They will be required to create intermediate holding companies (IHCs) comprising all US banking and non-banking operations, and all US rules on leverage, separation, etc. will apply to the IHCs (but not to branches). These IHCs would therefore (if the changes are implemented) face much tougher rules than in their home countries: US Basel III application, liquidity and leverage rules. These separated IHCs would also miss out on wider group netting benefits for derivatives and repos. The equal treatment of IHCs is consistent with the OECD view that all financial promises should be treated equally in regulations, at least in the USA.

The UK follows Basel III, but puts more weight on national micro and macro prudential regulation to be conducted within the Bank of England. As with the USA, recent speeches by the Bank of England have expressed grave reservations about the Basel III approach to capital rules, and the need to look at bank business models alongside them.<sup>17</sup> The Prudential Regulatory Authority (PRA) is working with individual UK banks to implement capital plans consistent with the recommendations of the Bank of England's new Financial Policy Committee (FPC). Where necessary, and based on stress tests, banks have to meet capital standards more exacting than Basel III. Following Lloyds, RBS and Nationwide reviews, the most recent plan announced for Barclays includes new capital issuance, a disclosure plan for dividends and the achievement of a 3% leverage ratio by June 2014 – some four years before the Basel III implementation of such a ratio. Recognising that Basel III leaves business model risk issues on the table, the UK authorities have approved the ring-fencing of retail banking in the Vickers report.

Europe's CDR IV follows Basel III more closely than in most other jurisdictions. However, following the 2011 stress tests, ministers at the EU summit in October of that year, agreed that a subset of 71 banks in the stress test should meet a CET1 ratio of 9% by 30 June 2012. Europe also aims to move to a banking union with one rule book and a Single Supervisory Mechanism. The ECB will be the main supervisor, working with national authorities, though some uncertainty remains about the funding of a single resolution fund. The ECB would notify the single resolution board, who would notify national authorities and resolution would occur with a bail in of perhaps 8% of unsecured creditors. As a pre-requisite for the ECB taking on this role there is to be a "Comprehensive Assessment" of Europe's Banks with capital needs assessed including dealing with forbearance in respect to bad assets. The problem with respect to the "tougher" 9% goal and the comprehensive assessment, is that banks can meet the target easily by adjusting (with their models and use of derivatives) the ratio of RWA to total assets (TA). The Basel ratio is not demanding due to this slippage, and greater credibility would be achieved if the test was based on a clean leverage ratio concept. Europe too has recognised that Basel III does not address business model risk issues with its Liikanen report.

Questions of capital and leverage must be considered alongside counterparty risk arising from bank business model issues: they are interdependent. This view is based on detailed empirical research using large panels of bank data.

### **Assessing Basel III**

Basel III represents an advance over Basel II, and more capital being required; the deductions from equity to improve the definition of capital; the measures to counter procyclicality; the revised LCR; and the NSFR idea might be singled out in this respect. However, using the portfolio invariance principle to add linearly refinements to the Basel II capital rules adds complexity without considering the business models of the banks to which they apply. This process is like creating a map on a one-to-one scale, by adding on more and more granular refinements. The above summary of some of the main features of Basel III have been accompanied by countless detailed documentation, formulas clarifications and extensions. This goes on continuously, and examples from mid-2013 alone include: revisions to the leverage ratio, loosening of the LCR rules, changes to the capital regulations for exposures to CCPs; a clarification on bank equity investment in funds; LCR disclosure standards; updating the method for identifying global systemically important banks (G-SIBs) and suggesting higher loss absorbency requirements for them; a consultative document for non-internal model methods for capitalising CCR exposures; and much more. Since the Basel III reform process started there are literally thousands of pages of additional documentation. This certainly adds to bank administrative costs, where armies of analysts are employed in risk control and compliance divisions; but the most important question really concerns whether despite all the complexity it is likely to be the most effective approach to avoiding future crises.

There are two very basic problems with Basel III.

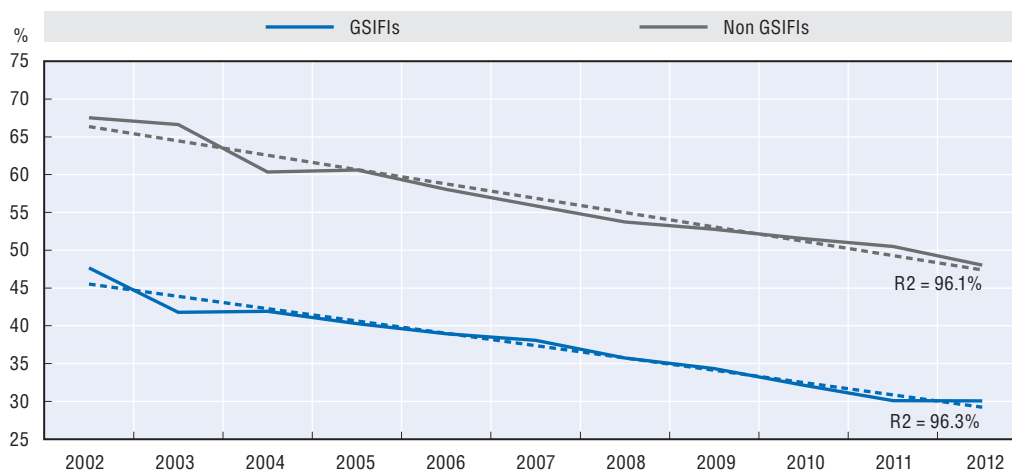
- First it is too complex, allowing large banks plenty of room to manipulate it both with their models and derivatives thereby avoiding effective control on leverage. In this respect the RCAP finding in January for the trading book risk weighting variations is no surprise.
- Second, notwithstanding all of the above rules, Basel III has not dealt with bank business model issues that are at the heart of TBTF under-pricing of risk and the interconnectedness that is associated with it. Instead the BCBS puts its faith into the capital and liquidity rules, while moving derivatives towards exchanges and CCPs to handle counterparty risk and will alleviate the need for banks to hold capital where this is achieved.

### **Complexity and leverage**

The financial system is a system of promises, so the most basic regulatory principle for financial markets should be that those promises are always treated in the same way, no matter how they are measured with models, transformed and/or shifted around in the global markets with derivatives. Basel III has continued with the Basel II IRB approach relying on banks own modelling of the riskiness of assets for the capital rule, and hence one should not be surprised that banks will report vastly different levels of capital to support an identical portfolio of assets. In a sense there is always going to be different Basel III for every bank in the world. Furthermore, banks can still shift the promises around by transforming risk with derivatives (particularly CDS) to minimise their capital costs – including shifting them beyond the jurisdiction of bank regulators – e.g. to the insurance or hedge fund sectors in a least regulated jurisdiction. While the LCR and NSFR are still under discussion, the approach suggested also relies on bank estimated payables and receivables and depositor behaviour in crisis and non-crisis situations. It mimics the capital standards approach by constructing ratio constraints, assigning weights, and relying on bank modelling.

Risk-weight-optimisation to reduce the ratio of RWA to TA, and hence the corpus to which the capital rule applies, has always been a feature of the Basel system.<sup>18</sup> The objective of listed banks is to raise the share price which requires management to focus on a targeted ROE. Given that net profits at any point in time is constrained by the bank's business model and the level of competition, the target ROE can be achieved by reducing the capital (K) they hold, so:  $K^* = \pi / ROE^*$ . But  $K^*$  is also defined as a multiple of RWA assets in equation 1, dependent on OR, MR and the weights  $w(i)$ . The latter become endogenous to the corporate objective of maximizing the share price. As more complexity is added, the scope for endogenisation of the inputs to the capital and liquidity rules is increased. Banks can only be expected to take advantage of this. Figure 1 shows the ratio RWA/TA for 27 GSIFI banks (i.e. 21 GSIFI banks defined by the FSB and 6 former GSIFI banks that failed in the crisis referred to earlier), and 564 non-GSIFI banks. The use of models and derivatives to lower this ratio is systematic – it has the effect of raising leverage per unit of capital and improving the ROE.<sup>19</sup> Since the trading book reforms of 2008 and during all of the Basel III consultation process, these trends have continued unabated – the recent RCAP exercise showing that the capital required to support the identical portfolio of assets varies so widely between banks is entirely consistent with the time series findings shown here.<sup>20</sup>

Figure 1. **RWA to total assets: GSIFI banks versus non-GSIFI banks**



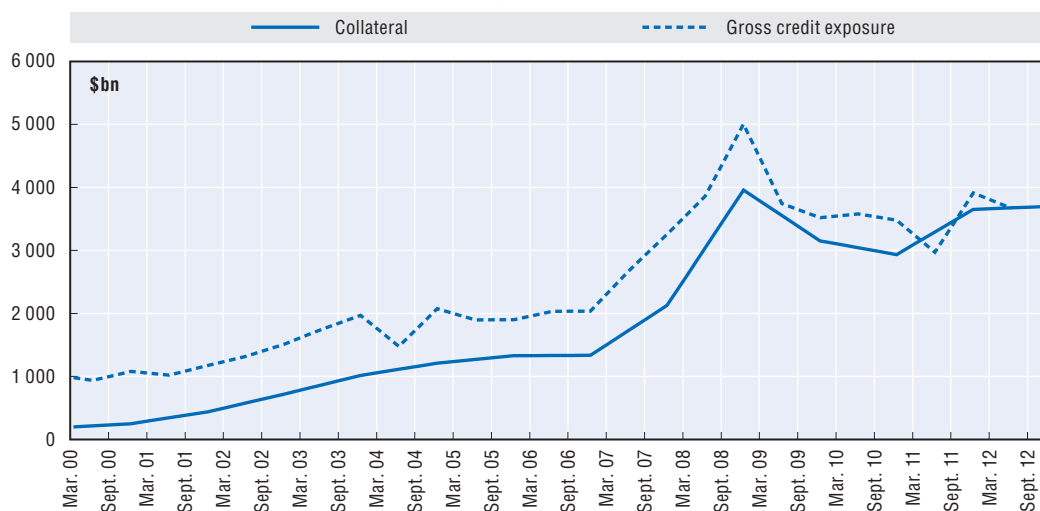
Source: Bloomberg, OECD.

These problems related to complexity and leverage could be removed by moving to a simple adequate leverage ratio, and leave banks' VaR modelling to their own internal risk controls without requiring it to be encompassed in (and hence contaminated by) the regulatory framework. Leverage, a key component of bank risk, would be controlled directly, and would depend only on appropriate accounting rules. Unfortunately, however, the 3% Tier 1 leverage ratio "back-up" goal being considered by the BCBS for 2019 is too lax. It allows leverage of 33-times capital and, in addition, banks are permitted to net derivatives transactions when calculating the leverage ratio. This latter arrangement has always puzzled the present authors: netting is a settlement concept, particularly in the event of default, and it does not in any way protect a bank from market risk. Hence netted derivatives are not an appropriate basis on which to base *ex-ante* capital rules. Leverage ratios that give rise to capital for *ex-ante* market risk would be larger than those allowed under Basel III.



Figure 2 shows an aspect of the crisis that lies at its very core – interconnectedness risk. The broken line shows the gross credit exposure (GCE) of derivatives (the gross market value – GMV – minus netting) and the collateral demanded to cover those open derivative positions, according to ISDA. From December 2007 to December 2008, the estimated collateral demanded rose from USD 2.1 tn to USD 4 tn, a net rise in collateral demanded was USD 1.9 tn; and collateral demanded has remained in the USD 3.2 tn to USD 4 tn range subsequently. These numbers are illustrative of the actual pressures that the banking system had to bear in the crisis years in respect to margin calls related to derivative and repo positions.

Figure 2. **The gross credit exposure (GMV netting) of derivatives and collateral**



Source: BIS, ISDA, OECD.

While derivatives enhance leverage and should be included in the leverage ratio, they also give rise to liquidity risk due to counterparty positions and the need to fund margin calls. New OECD empirical evidence based on a large panel of bank data sheds light on which leverage concepts matter for bank risk and which do not, and how leverage interacts with the structural business models of banks to determine overall risk. The findings with respect to the latter show very clearly that risk the weighting of assets does not address the structural business model issues that lead to default risk. Indeed, leverage and derivatives are shown to interact in ways that simply cannot be addressed by a reasonable single capital rule.

### **Interconnectedness and business model risk**

The process of arbitraging the Basel capital rules and embracing the innovations in structured products resulted in the rapid growth of wholesale funding of securities (including repos) hedged by CDS. Derivatives had many advantages for TBTF banks:

- Shifting ownership of assets enabled both the regulatory and tax system to be arbitrated. CDS hedging to reduce capital requirements. And use of interest rate swaps and CDS to arbitrage the tax system (at the very heart of the structured products business).



- TBTF banks meant that counterparty failure was highly unlikely to result in positions not being paid out – and certainly this belief was proved valid with the AIG bailout by the US government. Risk was under-priced. TBTF implicit guarantees affect CDS and other spreads, and these spreads are built into bank internal risk modelling, systematising the under-pricing of risk.
- With respect to defaults, both US and EU law exempted all credit collateralised with securities and any derivatives from the “automatic stay in bankruptcy” and rules on cross-default clauses. The institutions dealing with these products could in effect front-run all others in the case of defaults – pushing the risk to other creditors and the taxpayer – a phenomenon certainly illustrated in the Lehman default.

While GSIFI banks are the core of the derivatives origination business, most banks were drawn into funding securities with repos, hedging them with CDS, and moving into the fee-for-sale securitisation businesses. Many mortgage institutions competed for loans to securitise assets, driving yields down and moving into ever more marginal borrowers. In this respect it is more correct to say that capital markets banking caused the sub-prime crisis, rather than the latter causing a crisis in the former.

### **Counterparty derivatives and repo risk that is separable from leverage rules**

In a complex capital markets banking system a crisis will result in asset price volatility, and a sharp rise in margin and collateral calls (see Figure 2). These have to be met. In normal times the repo market and other forms of lending adjust and the system meets all of its commitments. But in a crisis this lending dries up, and banks fail not because they are insolvent (even though they may well be) but because liquidity stops functioning. The central bank responses with respect to quantitative easing in the USA and LTROs in Europe need to be understood in this context – the inability to meet margin calls is the rapid path to default.

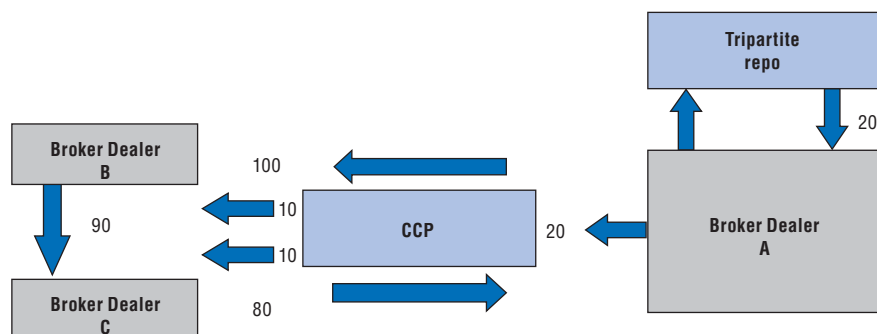
### **Collateral calls, tri-partite repos, etc.**

Figure 3 shows some elements of the interconnectedness:

- The broker-dealer bank A is engaging in derivative transactions with 2 counterparties B and C. Following the pale grey arrows for the case of no clearing, bank A is down 100 with B and up 80 with C. It is therefore exposed to a loss of 80 in the event of the default of C. For Bank A the Basel III CVA charge would apply to the netting set with C (no offsets in the simple example, so it applies to the 80).
- A is also down a net 20, when bank B is taken into account, and the crucial point is that this net 20 margin call has to be funded. Here there are choices, for example: a) If the bank has a sufficient pool of liquid assets it may sell them for cash, post collateral, and treat this as a receivable, b) it may use cash to take on offsetting derivatives positions; and c) it may take short-term repo loan (shown in Figure 3) with a clearing bank. But in a crisis situation the amounts may be too large and liquidity in the repo and derivatives markets may not be available.<sup>21</sup> If the broker dealer can't meet the margin call (e.g. Dexia) then it will default.

The typical tri-partite repo transaction may involve a Money Market Fund (MMF) earning a spread by providing finance to the broker dealer A, with a clearing bank intermediating and requiring securities as collateral. Liquidity can suddenly dry up due to a sharp fall in the value of the collateral pool; a refusal of the MMF to roll over a loan; or run on the deposits of the MMF. In the event of a liquidity halt, the broker dealer will need to

Figure 3. Collateral and margin calls



have liquid assets on its balance sheet to sell or pledge to meet the call; receive central bank support; or otherwise default. The tri-partite repo clearing banks centralise risk and connect multiple institutions, so that interconnectedness risk is a major feature. It is inconceivable that the authorities in a crisis could allow a clearing bank to fail. This implicit guarantee to the clearing bank itself causes risk to be under-priced.

### Central clearing counterparties (CCPs)

Basel III appears to assume that counterparty risk can somehow be destroyed by shifting it to a CCP, where the CVA charge is zero. But the CCP needs capital, and it must model risk and set appropriate margins commensurate with that risk for all of its counterparties like any other player. Following the dark arrows for the CCP case in Figure 3, the net exposure is still 20 for the system as a whole, as opposed to gross exposures of 270. Bank A still needs to sell assets or borrow in the repo market to meet its commitment to the CCP. The ability of the CCP to guarantee the trades depends on its skill in setting initial and variation margins, as well as having sufficient capital to cover all default scenarios (the counterparties are holding a zero CVA charge for these trades). For example, with a major stress event, suppose that Bank A suddenly owes a net 60, and the clearing bank refuses to lend it in a crisis. Bank A will fail. The CCP would have to guarantee the trades, but may not have the capital to do so.

In effect, the CCP is akin to the role of the clearing bank in a tri-partite repo transaction. Market risk is not destroyed by a CCP, and the problem of the under-pricing of that risk due to the TBTF implicit guarantee may be significantly worse. The CCP becomes a vital node, interconnecting multiple players in the financial system. The failure of such a node would lead to multiple contamination effects compared to bilateral trading. Governments and central banks could not allow the CCP to fail. Furthermore, since competition between CCPs can only really take the form of reducing collateral requirements to make the cost of trading cheaper for counterparties, margins may be reduced causing systemic risk to rise rather than to fall.

It also needs to be noted that it is the least risky parts of the derivatives market that can be subject to clearing, e.g. the large standardised and liquid interest rate swap market. Rather it is the derivatives that cannot easily be cleared that were in the forefront of problems. The non-cleared derivatives market includes *inter alia* the following:

- Very long-term interest rate swaps (e.g. 15-19 years) sought after by pension and insurance companies for liability management. A part of this market is non-standard and can't be cleared.

- Single name CDS. The CDS has the potential for extreme collateral call shifts when the probability of the default of the reference entity increases (these are popular for regulatory and tax arbitrage).
- Swaptions – options on interest rate swaps (the rights to swap fixed and variable interest rates). This is a large market is crucial in managing long-term interest rate risk across many industries. For example, if rates were thought to rise in the longer run, then a firm would have the option (not obligation) by exercising a swaption to pay fixed and receive the rising floating rate interest payments. These can be up to 30 years maturity and are highly illiquid. They can't be eligible for clearing.
- Forward rate agreement market for currencies with long horizons.
- Parts of the overnight index swap market. The floating rate leg is based on the reference rate of Fed funds or Libor, and it allows very short-term borrowers to manage interest rate risk inherent in sudden changes in cost of funding and income received on longer-term assets.
- Many OTC commodity, energy and equity derivatives can't be cleared.

Consider the following example. If a user takes a position in volatility with a swaption, the trader will typically hedge the market risk in the position with an interest rate option notional amount equal to some percentage of the swaption (the maturity and coupon of the swap would mirror those of the swap on which the swaption is based). But if the swap is mandated to be cleared with the CCP and the swaption is executed bilaterally, there is no benefit in clearing the swap from a risk point of view. The greater complexity may raise risk and will certainly increase collateral costs compared to keeping the swap and the swaption together bilaterally.<sup>22</sup>

#### ***CVA approach leads to concentration bias***

Does the Basel III CVA charge deal adequately with counterparty risk? The CVA charge applies additively across netting sets. This creates an incentive for increased concentration in the derivatives market. If B and C are one bank, forming a single new netting set, then instead of exposure to a loss of 80, bank A will be exposed only to a net loss of 20 within the netting set, and the CVA charge will be reduced (and reduced to zero if centrally cleared). The bank will be exposed to the same liquidity risk, but would hold less capital to deal with it. The Basel III CVA rule will encourage the larger broker dealers to trade with each other, raising the TBTF problem in the derivatives market and reducing competition. As noted in respect to leverage ratios, netting is a settlement concept, and it does not in any way mitigate market risk. Basing an *ex ante* capital rule on a settlement exposure concept makes little sense.

## **IV. New empirical evidence on leverage and interconnectedness risk**

While Basel III has propelled reform of capital rules, there has been no consensus on what to do about the risks created by the structure of bank business models. Approaches to the latter include the Vickers recommendations;<sup>23</sup> the Dodd-Frank Act Volcker rule;<sup>24</sup> and the Liikanen proposal that is influencing decisions in a number of European countries including France and Germany.<sup>25</sup> Most international organizations have focused on replacing Basel II with Basel III, improved supervision, better disclosure and cross-border co-operation. Better resolution regimes are proposed to deal with TBTF.<sup>26</sup> Academics have stressed the difficulties of interpreting rules based on separation proposals, and some have

been strongly against it.<sup>27</sup> These proposals have not, however, been informed by empirical research on the determinants of sudden moves of banks towards the default point. This section tests the Basel Tier 1 ratio, alongside a simple leverage ratio (with no Basel II netting) and the key business model attributes of banks.

### **The distance-to-default**

The starting point is to define a measure of the riskiness of individual banks that can serve adequately as the dependent variable in the panel regression study. The distance-to-default (DTD) is a measure that uses a combination of bank reported data, and market information to calculate the number of standard deviations a bank is from the default point, where the market values of assets equals the book value of debt. The formula to calculate the distance-to-default is derived from the option pricing model of Black and Scholes (1973) and is set out as follows:

$$DTD_t = \frac{\log\left(\frac{V_t}{D_t}\right) + \left(r_f - \frac{\sigma_t^2}{2}\right) \cdot T}{\sigma_t \sqrt{T}} \quad [2]$$

Where:  $V_t$ : Market value of bank's assets at time t,

$r_f$ : Risk-free interest rate,

$D_t$ : Book value of the debt at time t,

$\sigma_t^2$ : Volatility of the bank's assets at time t,

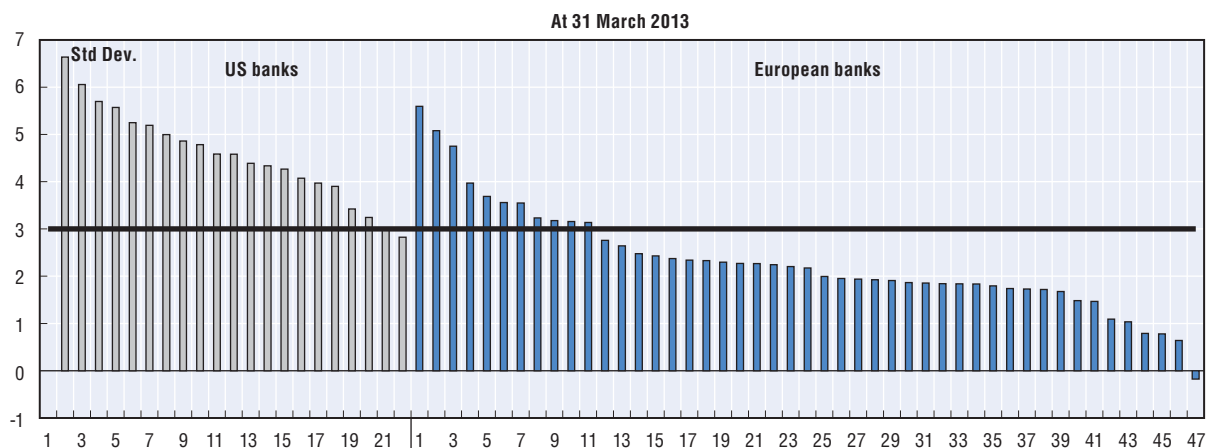
T: Maturity of the debt.

The calculation is set out in more detail in Appendix 1 of Blundell-Wignall and Roulet (2012).

From 1997 to 2004 the DTD typically averaged 3 standard deviations in 69 large banks in the USA, UK, the Euro area and Switzerland.<sup>28</sup> The weighted average DTD fell to 0 for banks in the UK and the USA, implying systemic insolvency, with many individual banks below the zero point. The average DTD fell to below 1 in Europe, with some major banks below the solvency point. The USA has recovered more quickly in 2011-12, while many European banks are still not at a safe point. Figure 4 shows the DTD for individual banks (shown simply with a number on the horizontal axis) for the most recent year 2012 (the UK and Swiss banks are shown with Europe). It is very clear that the US response to the crisis, with forced capital injections following proper stress tests on bank assets has led to US banks moving back well above the safe zone of 3 standard deviations, while European banks are more vulnerable.<sup>29</sup>

### **Modelling the DTD**

Recent empirical work by the OECD looks at the effects of the macro cycle and business model features of banks on their systemic riskiness, and the complex interaction of these factors bears directly on the debates about micro- and macro-prudential policy. This study extends the sample to large G20 banks (compared to that for US and European banks in Blundell-Wignall and Roulet (2012) for which all of the required data (particularly derivatives) is correctly reported in gross terms. The measure of the riskiness of banks used in this empirical work is the above concept of the DTD.

Figure 4. **Distance-to-default in 2012: US versus Europe**

Source: Bloomberg, authors' calculations.

A panel regression approach is used to explain the differences in DTDs across banks over the period 2005-2012. The sample consists of the top G20 internationally active commercial banks and broker-dealer banks by equity market capitalisation, for those banks where all the data required is available. In addition, six banks that failed in the crisis, but which can be considered as GSIFIs, HBOS, Merrill Lynch, Lehman Brothers, Washington Mutual, Wachovia and Bear Stearns are included. This is essential, as they are the main banks of size whose assets were absorbed by others included in the sample – they act essentially as dummy variables for the M&A activity involved that would otherwise distort the results with breaks in the data on leverage ratios, etc. – evidence on the robustness of this procedure is presented in the Annex B. There are a total of 90 banks in the sample, consisting of 26 FSB GSIFI banks (excluding non-listed banks), 6 failed former GSIFI banks, and 58 other large banks.

The empirical model takes account of systemic importance, leverage, and business model aspects. The model is estimated with two alternatives for leverage: the leverage ratio and the regulatory capital approach of the Basel Tier 1 ratio. The variables and results are shown in Table 1. LEV corresponds to the simple leverage ratio (total assets TA divided by core equity, with no risk weighting of assets, no netting of derivatives and US bank leverage is based on IFRS conversions), which is expected to have a negative sign. T1 is the Basel Tier 1 ratio based on risk-weighted-assets (T1/RWA), which is expected to have a positive sign. TD is the sum of the trading book and available-for-sale securities, and is expected to have a positive sign. The reason for this is that liquidity drives the banks' path to default in practice, when margin and collateral calls cannot be met. Liquid assets can be sold or used as collateral making a bank safer. WFD refers to wholesale funding as a share of total liabilities and is expected to have a negative sign – higher wholesale funding typically at a shorter duration is less stable than deposits for funding longer term assets.<sup>30</sup> GMV refers to the gross market value of derivatives as a share of the banks' total assets – appropriately converting all US banks to the IFRS concept for consistency. GMV is expected to have a negative sign – this is the quintessential interconnectedness variable where volatility drives rapid changes in margin requirements. BETA is a systemic importance variable, defined as the covariance of the firm's stock price with the national stock market,

using daily data to calculate annual observations, divided by the variance of the national stock index. It is expected to have a negative sign, on the grounds that the firm is more connected to the national macro and asset price cycle. Finally, %HPI refers to the annual percentage change in the national house price index, and is expected to have a positive sign as rising prices improve a borrower's equity in the home and vice versa.

Causality in the model is tested with an error correction model shown at the bottom of the table: the DTD in the current year adjusts to the gap between the actual DTD and its predicted level in the previous year. All of the error correction terms are large coefficients (rapid adjustment within the year) and are significant at the 1% level.<sup>31</sup> The full set of results and stability robustness in the face of different sample periods and the treatment of M&A through the crisis is presented in the Annex B.

The results may be summed up as follows:

- The Basel Tier 1 ratio appears to find no support as a determinant of the DTD. The simple leverage ratio case is the preferred model, shown in the first column of the first data panel.<sup>32</sup> LEV is well determined at the 1% level, for all banks, for the GSIFI banks and for the other large bank panels. A cut in leverage from say 50 (not un-typical of a GSIFI bank) to the OECD preferred maximum of 20 would raise the DTD by 1.2 standard deviations.
- The macro control variables in house prices and the market BETA are correctly signed and significant at the 1% level, across all models.
- In terms of arguments relating to the business model, the GMV of derivatives and wholesale funding have the expected negative signs and are significant at the 1% level for the full sample and for the GSIFI group. GSIFI banks with derivatives exposure of over 40% of their balance sheet (e.g. banks that engage in prime broking, etc.) are quite common and are of fundamental systemic significance. The OECD recommends separating those banks that undertake prime broking, market making, underwriting and origination once they exceed a GMV derivatives threshold of 10% of the balance sheet. A reduction from 40% to 10% would raise the DTD by 1 standard deviation using the full sample model and by 1.4 standard deviations using the GSIFI model.
- Wholesale funding is negatively linked to the DTD: a 20 percentage point cut would raise the DTD by 0.5 standard deviations.
- Trading assets have the expected positive sign that find support at the 5% level for the full sample and the GSIFI banks, but not in a sample of traditional banks that excludes the GSIFIs. A 20 percentage point rise would raise the DTD by 0.9 standard deviations.

### **The results and policy issues**

These results are intended to inform the debate on what matter for bank risk, thereby filling a gap whereby the regulatory response to the crisis has been made in a more ad hoc way: i.e. by responding to past events and consulting with the financial industry. Empirical evidence is important, as it focuses the debate in a more scientific way – if there are mistakes in the data treatment and model variables, then what are they and what other hypotheses can be tested?



Table 1. **Determinants of bank distance-to-default: Multivariate panel results**

	All banks		GSIFIs banks	Other large banks
Constant, $\alpha$	8.17*** (7.15)	6.74*** (4.75)	11.21*** (6.94)	6.55*** (8.72)
LEV: TA/Bank Equity	-0.04*** (-3.30)	-	-0.03*** (-3.21)	-0.05*** (-2.53)
T1: Basel Tier 1 Ratio	-	2.24 (0.58)	-	-
TD: Trading Book plus Available for Sale Securities/TA	4.51 ** (2.06)	3.72 (1.47)	3.34 ** (2.16)	3.79 (1.51)
WFD: Wholesale Funding/Total Liabilities	-4.14*** (-3.04)	-4.54 ** (-2.31)	-6.78*** (-2.47)	-1.81 (-1.30)
GMV: GMV of Derivatives/TA	-3.48*** (-2.42)	-5.39 ** (-2.21)	-4.79*** (-3.02)	-3.26 (-0.37)
BETA: CoVar Bank Stock Ret. with Ntl. Mkt Ret./Var. Mkt	-1.47*** (-5.36)	-1.33*** (-3.61)	-2.61*** (-4.75)	-1.21*** (-3.47)
%HPI: House Price Index ann. % change	16.29*** (4.98)	17.45*** (4.12)	20.10*** (6.70)	17.32*** (4.75)
DUM_MA: Dummy equals to 1 following M&A, else 0	-	-	-	-
R2	0.69	0.65	0.73	0.67
Fisher Statistic	11.25	9.47	12.58	9.76
P-Value F	0.00	0.00	0.00	0.00
Total Observations	569	569	201	368
VECM 1-year lagged residual (Engel & Granger test)	-0.85*** (-17.72)	-0.85*** (-18.01)	-0.78*** (-11.05)	-0.90*** (-14.20)

Note: This table shows the results of estimating multivariate regressions for an unbalanced panel of 108 US and European internationally active commercial banks and broker dealers with equity market capitalisation in excess of USD 5 bn over the period 2004-12. Cross-section and time fixed effects are used in the regressions as is the White diagonal covariance method. \*, \*\* and \*\*\* indicate statistical significance at the 10%, 5% and 1% levels, respectively. The VECM error correction results show adjustment of the current DTD to the previous year gap between the predicted and actual values, allowing one lagged innovation in the standard model. See Ericsson and MacKinnon (2002).

Given the process of innovation, it is possible that rules imposed by regulation may be actively worked around. This appears to be the case for the Basel T1 ratio which is uncorrelated with bank risk. The leverage ratio on the other hand is highly significant, and perhaps it too would be worked around were it to become binding. The current authors believe this is less likely, because the measure used in the study eliminates the mechanisms that the Basel approach builds explicitly into the capital rules: that banks own models are used to determine the risk weights, including the way derivatives are modelled and netted in the bank. If capital is the maximum of T1 or 1/LEV, the T1 can never be binding in a strong demand environment as banks can always solve for the weights on assets and use derivatives to ensure that  $T1 \leq 1/LEV$ . The leverage ratio in conditions of strong credit demand will be the binding ratio: oddly, it could become both a maximum as well as a minimum capital rule at such times.

The other interesting feature of the results is that the business model features of derivatives, wholesale funding and trading securities (related to counterparty exposures, liquidity issues and the TBTF cross-subsidisation of risk for GSIFI banks) are quite independent of leverage. These risks can become dominant and need to be treated separately from leverage.



### **No one capital rule will suffice**

When the DTD measure is back-engineered to calculate the additional amount of capital that would be required by banks through the crisis period to keep the level above 3.0 standard deviations (a safe level, implying a less than 1% chance of default, where extreme market volatility doesn't take the bank quickly to the zero level) it becomes clear that any capital rule will be insufficient for the GSIFI banks.<sup>33</sup>

- In 2009, the 69 large US and European banks in this study had USD 1.6 trillion in capital, but those below 3 standard deviations in the DTD would have required USD 4.5 trillion more to stay at the safe level (almost a quadrupling).
- The GSIFI banks in this group had USD 1.1 trillion of the capital, but would have required USD 3.6 trillion in addition to have been safe: i.e. to not have required capital injections and "back-door" support on a massive scale by the world's central banks. The capital rule cannot possibly come close to making these banks safe without addressing the business model issues and TBTF.

The issue for GSIFI banks arises because of what they do in the capital markets unrelated to deposit taking and lending: origination (including derivatives), market making (prime broking) and underwriting. These are very different businesses, which require inventories of securities subject to mark-to-market price and volatility shifts, particularly where margin and collateral calls are concerned and liquidity is critical. To hold capital even remotely near the levels needed in the good times to be safe in a tail risk event would seem to be unreasonable.

Where vast differences in business models are concerned it makes no sense to aim for a one-size-fits-all capital rule (neither Basel T1 nor LEV). Such a single rule does not exist. It is for this reason that the OECD argues for separating the fundamentally different business model features in a non-operating holding company (NOHC), where the subsidiaries are ring-fenced in a legal structure that is binding. In the case of a separation between a core deposit taking bank and a securities subsidiary, the structure implies explicitly that the creditors of the latter cannot chase the assets and capital of the former (and vice versa). This ensures that the risks of these very different businesses will be priced according to where they are taken, without the implicit subsidy of a TBTF bank. The cost of capital and credit will rise for the securities subsidiary and the business will be smaller for the same allocation of capital from the non-operating parent. Different minimum leverage rules can apply to the deposit bank (at least 5%) and the securities firm (lower). The core deposit bank will be safer and the securities subsidiary will not be TBTF. If a universal bank has derivatives exposure that is above 10% of TA on an IFRS basis, it is moving into businesses that go beyond the normal hedging required for its assets and liabilities and should be considered for separation.<sup>34</sup> The size of trading assets and available for sale securities is clearly an ameliorating factor, which is very relevant for stand-alone investment banks. Provided these banks are on a level playing field with NOHC separated securities subsidiaries of previously universal banks, then the pricing of risk should work to adjust the size and structure of their businesses over time in all of the right directions. This would be in strong contrast to the Lehman Brothers episode, where that investment bank was a direct beneficiary of its treatment under Basel in the interbank market, and was able to use counterparties where TBTF cross-subsidisation of risk was very much present.

## V. Concluding remarks

Basel II proposed changes to the capital requirement rules that allowed large banks to run their own internal models to calculate the riskiness of the assets to which the capital rules would apply, introduced pro-cyclicality into those rules, and did so at a time when financial innovation made it easier for banks to shift risk via securitization, CDS and off-balance sheet exposures. Banks systematically reduced the ratio of RWA/TA and had insufficient capital to deal with the crisis as it emerged. This crisis had at its core both leverage and interconnectedness risk related to the changing business models in banking.

In reforming Basel, the BCBS sought to add linearly greater complexity to the system utilizing the Basel model properties of portfolio invariance. This complexity has made it even more difficult to bring capital rules into alignment for all financial institutions – it has not achieved the regulatory principle that the financial promises should be treated in the same way no matter where they are shifted. Furthermore, the panel regression results showed that the DTD is correlated with the simple leverage ratio but not at all with the Basel Tier 1 ratio; yet despite the evidence, the reform process continues to focus on allowing banks to run complex models for risk weighting to control leverage, while business model features that have strong independent effects on the DTD have not been the subject of co-ordinated global reforms.

The Basel add-on proposals for interconnectedness risk and central clearing are untested, and there has been no sign of the size of derivatives businesses and repo funding in GSIFI banks being reduced by current and prospective Basel reforms. The CVA charge applies at the netting set level, and is additive across netting sets. Like other aspects of Basel, the approach does not reward diversification. A large number of netting pools will give rise to less scope for cross-product netting that would risk more positive CVA charges with volatility events. If larger GSIFI banks choose to deal more and more with each other, they increase the scope for cross-product netting and reduce the CVA charge possibility. Hence the Basel rule encourages more concentration in derivatives – it increases the TBTF problem in derivatives rather than reducing it. Furthermore, netting is a settlement process concept – netting provides no protection for market risk. Basing capital rules on netting pool is not in the interests of the future stability of the financial system.

As noted before, the panel regression results suggest that a simple leverage ratio is essential, but it cannot compensate for the large impact on the DTD of business model features. This brings the discussion back to the necessity of structural separation and where the lines for separation should be drawn. The bank regulators paradox is that large complex and interconnected banks need very little capital in the good times, but they can never have enough in an extreme crisis. Separation of fundamentally different business segments is required to deal with this problem. Derivatives should be the most important flag for a separation rule.

### Notes

1. See all of the BCBS references below, all available at [www.bis.org/bcbs/index.htm](http://www.bis.org/bcbs/index.htm).
2. Similarly, fear of insolvency can lead to a run on deposits. This can be the most rapid path to default.
3. Such as level 2 and level 3 assets, i.e. assets that do not have a fair market value or are illiquid.
4. See US Congress (2010), ICB (2011), Liikanen (2012) and FINMA (2013).

5. See BCBS (1988).
6. Banks may use a default risk weighting or a sophisticated internal model approach to defining how risk assets are – the lower the risk the lower the weight for capital purposes. A third tier of capital is defined in the Market Risk Amendment to the original accord.
7. See BCBS (2004).
8. See Jackson (1999).
9. See Gordy (2003).
10. See Gordy (2003). Almost prophetically, he says: “A single factor model cannot capture any clustering of firm defaults due to common sensitivity to these smaller scale components of the global business cycle. Holding fixed the state of the global economy, local events in, for example, France are permitted to contribute nothing to the default rate of French obligors. If there are indeed pockets of risk, then calibrating a single factor model to a broadly diversified international credit index may significantly understate the capital needed to support a regional or specialized lender.”
11. See for example Blundell-Wignall and Atkinson (2008, 2010, 2011) and OECD (2009).
12. See BCBS (2011).
13. See BCBS (2013c). In fact for portfolios of identical assets the gap between the highest to the lowest capital needed to support the portfolio was 300%.
14. See Hoenig (2013) and also Norton (2013).
15. See Federal Reserve (2013).
16. See Federal Reserve (2012).
17. See Andrew Haldane (2012, 2013).
18. Basel II permitted sophisticated banks to model the riskiness of their own portfolios to calculate risk-weighted assets (RWA) to which the capital rules were applied – an approach that continues under Basel III. By reducing the ratio of RWA to total assets banks are able to minimise the capital required to conduct their activities and hence to expand leverage. The change in SEC rules in 2004 allowed investment banks to be supervised on a consolidated entities basis, in place of the strict SEC limitations on leverage. This was equivalent to the regulatory minimum that US banks would need to operate in Europe. The huge problems with the move to Basel II were at the heart of the problem. See Blundell-Wignall and Atkinson (2008, 2010, 2011, 2012); Blundell-Wignall et al. (2012); and Blundell-Wignall and Roulet (2012).
19. The BCBS has started to look at risk-weight manipulation via modeling and to take it more seriously; see BCBS (2013c).
20. Variants of this chart and commentary may be found in Blundell-Wignall and Atkinson (2008, 2011).
21. It is surprising how many economists, bankers and financial analysts point out that these clearing banks got through the crisis without failing, as though this suggested that the structures were safe. These views make no allowance for the massive support and bailouts that banks received from governments (particularly the US). Allowing AIG to fail for example could have collapsed the entire edifice. This is not the structure that is desirable for the future.
22. In other words, the delta and gamma of a long-dated interest rate hedge may end up residing in different silos.
23. Blundell-Wignall et al. (2009). See ICB (2011).
24. See section 619 of Dodd-Frank (US Congress, 2010).
25. Liikanen (2012).
26. For example, see IMF (2011), p. 2.
27. See Duffie (2012) for the former and Goodhart (2011) for the latter.
28. This sample includes the largest publicly traded commercial banks in the USA and in Europe with total assets that exceed USD 50 bn. The GSIFI banks comprise 21 of the GSIFI banks in the USA and Europe, as officially defined by the FSB in November 2011. Banks are left out where the data did not extend back to 1997.
29. A standard deviation of 2 implies a 5% chance of default, which is too high for the global financial system.

30. This is short-term (including repo) and some longer-term debt securities that need to be rolled – it excludes deposits, equity, subordinated debt and derivatives liabilities from total liabilities.
31. The error correction equation takes the lagged residuals of the panel regression, and allows for one lagged change in the dependent variable.
32. The T1 variable is not significant in any of the sub models, and these are not shown for simplicity.
33. See Blundell-Wignall and Roulet (2013) where these calculations are set out in full.
34. For example, Wells Fargo, a large US GSIFI that is very safe, requires only around 7% of its portfolio on an IFRS no-netting basis to run its business. It would not be considered for separation under such a proposal.

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## ANNEX A

### Summary of the Basel III reforms

#### Main features of the Basel III capital regulation reform

- *Raising the quality consistency and transparency of the capital base:* Basel III stresses that quality equity is the best form of capital and hence requires multiple deductions from common equity (goodwill; minority interest; deferred tax assets net of liabilities; bank investments in its own shares; bank investments in other banks, financial institutions and insurance companies (with the 10% rule); provisioning shortfalls; and other minor deductions, such as the banks' defined-benefit pension scheme holdings of the bank's shares. Criteria for Tier 2 capital are toughened: it must be subordinate to depositors, have a 5-year minimum maturity and there must be no incentives to redeem. Tier 3 capital is abolished. Common Equity T1 (CET1) as a percent of RWA is to be phased in from 3.5% in 2013 to 4.5% by 2015, and total Tier 1 from 4.5% to 6% over the same period.
- *Capital Conservation Buffer:* Outside of periods of stress a buffer is to be phased in to 2.5% above the CET1 minimum by 1 January 2019. This may be run down in periods of stress, and built up again afterwards (e.g. by reducing discretionary dividend distributions, buybacks and staff bonus payments).
- *Dealing with pro-cyclicality:* To deal with this problem, largely introduced by Basel II anyway, a countercyclical buffer will apply, which can vary in a range of 0-2.5%, based on national authorities assessment of excess credit growth, weighted by the operations of the bank in all its different jurisdictions. More forward – looking provisioning shortfalls to be deducted from equity should also be seen in the context of addressing pro-cyclicality, as should the longer-run calibration of the PD in modelling risk.<sup>1</sup>
- *The 2019 introduction of a leverage ratio:* The BCBS is proposing a parallel run (2013 to 2017) that could result in a 3% leverage ratio based on Tier 1 capital, maintained on a 3-month-ended basis from 2019. Banks have begun testing this now to see what it means for their businesses. Exposure consists of on-balance sheet assets, plus derivatives at replacement cost with positive values (plus an add-on for potential future exposure, e.g. 5% or 10%), plus securities financing, plus other off-balance sheet exposures (with a 100% credit conversion factor). Legally valid bilateral netting of derivative transactions is allowed for calculating derivatives exposure.<sup>2</sup> For written credit derivatives the full notional value is to be used in the exposure measure, but any purchased CDS on the same reference entity can be netted if its remaining maturity is equal to or greater than the written derivative. Collateral received can't be netted against derivatives exposure – the replacement cost of derivatives must be grossed up by any collateral used to reduce

its net value. This is because collateral received doesn't reduce leverage as the bank can re-hypothecate the collateral received. Collateral provided must gross up the exposure measure where it would otherwise reduce on-balance sheet exposure: under IFRS the fall in cash assets is grossed up by a rise in receivables. Under GAAP where derivative instruments are held off balance sheet the replacement cost is to be arrived at by summing the positive fair values. For credit derivatives the full notional value of written contracts must be reduced by any purchased CDS of the same reference entity, where the maturity of the purchased CDS is greater than the written CDS.

### Dealing with systemic risk and interconnectedness

- *The Trading Book reforms of 2008*: An Incremental Risk Charge (IRC) equal to the estimated default and migration risk of un-securitised products over a 1-year capital horizon,<sup>3</sup> to allow for credit default and migration risk in bank trading books. These types of losses cannot be captured in banks' shorter-term VaR modelling. This is aimed at providing for the sort of losses that resulted from banks unwinding trading book assets in illiquid markets in 2008; it has the effect of adding to RWA.

Subsequently, Basel III attempts further to deal with interconnectedness risk by better calibration of the capital rules:

- *A capital requirement for counterparty credit risk (CCR)*: Using stressed inputs, helping to remove pro-cyclicality that might arise from using current volatility-based risk inputs.
- *Credit valuation adjustments (CVA)*: Capital charges on positive exposures which are (therefore) associated with the deterioration in the creditworthiness of a counterparty (as opposed to its outright default), valuing counterparty risk in bond equivalents and applying the market risk (MR) regulatory charge to such bond equivalents (after deducting the IRC). Transactions with a Central Clearing Counterparty – CCP – can be excluded, as can certain non-material securities financing transactions. The CVA is calculated within each of the netting sets, and is then added across netting sets.<sup>4</sup> Banks employ CVA desks to hedge with external counterparties to get CVA credit offsets to this charge.
- *A pillar 1 capital charge for wrong-way risk*: Transactions with counterparties, especially financial guarantors, whose PD is positively correlated with the amount of exposure. This will be done by adjusting the multiplier applied to the exposure amount identified as wrong-way risk.
- *An asset valuation correlation multiplier (AVC)*: Of 1.25, to be applied to exposures to regulated financial firms with assets of at least USD 100 bn (since AVCs were 25% higher during the crisis for financial versus non-financial firms). This would have the effect of raising risk weights for such exposures.
- *The application of tougher (longer) margining periods*: As a basis for determining regulatory capital when banks have large and illiquid derivative exposures to counterparties.
- *A zero risk weight for counterparty risk exposure with exchanges and CCPs*: Hence creating an incentive to use exchanges and CCPs (since higher charges will apply for bilateral OTC derivatives).

### Dealing with liquidity coverage issues<sup>5</sup>

- *The Liquidity Coverage Ratio*: Banks are required to maintain a ratio equal to or greater than 100% of High Quality Liquid Assets (HQLA) to total net cash outflows for the next 30 days (enough to cover a stressed event).



- **HQLA:** Consists of level 1 assets which are mostly those used in central bank transactions, such as cash, central bank reserves, securities backed by some sovereigns and central banks; plus level 2 assets, category A (certain sovereign debt, covered bonds and corporate debt), and category B (lower-rated corporate bonds, residential mortgage backed securities, and certain equities). Level 2 assets can be at most 40% of HQLA and 2B at most 15%.
- **Cash net outflow:** Consists of payables liabilities (including off-balance sheet commitments) multiplied by the rates that they are expected to run down in a stressed event, less receivables times the rate at which they are expected to flow in. Inflows are capped at 75% of expected outflows to ensure a minimum HQLA holding. In normal periods the ratio is maintained, but can be used with supervisory approval in the event of a stress event.

### Proposals under consideration with respect to stable funding

- **Net Stable Funding Ratio:** While work is still on-going (to be reported in 2014), the proposal is that banks maintain a ratio equal to or greater than 100% of available stable funding to required stable funding.
- **Available Stable Funding:** Is defined as: Tier 1 and Tier 2 capital (100%) + preferred stock not in Tier 2 with maturity  $\geq 1$  year (100%) + liabilities  $\geq 1$  year (100%) + stable shorter-term retail and small business funding (with  $\leq \text{€ } 1 \text{ m}$  per customer) (85%) + less stable (e.g. uninsured non-maturity) retail and small business funding (70%) + unsecured wholesale funding (50%). Central bank discounting is excluded to avoid over reliance on central banks.
- **The Required Stable Funding (RSF):** Is based on balance-sheet and off-balance-sheet exposures, and is defined as: cash, securities  $\leq 1$  year, loans to financial firms  $\leq 1$  year (0%) + unencumbered marketable sovereign, central bank, BIS, IMF, etc., AA or higher with a 0% Basel III risk weight (20%) + Gold, listed equities, corporate bonds AA- to A-  $\geq 1$  year, loans to non-financial corporate  $\leq 1$  year (50%) + loans to retail clients (85%) + all else (100%). Off-balance-sheet exposures to be included are conditionally revocable and irrevocable credit facilities to persons, firms, SPVs and public sector entities: a 10% RSF of the currently undrawn portion. All other obligations will have an RSF set by the national supervisor.

### Notes

1. The Basel III proposals are broadly consistent with the 2009 independent Geneva Report, see Brunnermeier et al. (2009), which favours leaning into the credit cycle. However, the authors propose that micro-prudential policy should fall to national Financial Stability Authorities, consolidating all financial institutions at a national level, while macro prudential should fall to the national central bank, which would co-ordinate site inspections and other roles with the financial stability authority (FSA). National FSAs are recommended, as national authorities pay in the case of defaults. But international co-ordination should be achieved with supervisory colleges.
2. See BCBS (2013b). The sum of all positive and negative mark-to-market values. But not any contracts with walk away clauses, e.g. no obligations to a defaulter counterparty.
3. At the 99% confidence interval.
4. The notional of the bond is the EAD of the counterparty (treated as fixed); the maturity of the "bond" is the effective maturity of the longest dated netting set of a counterparty; and the time horizon is one year (as opposed to the 10-day period for MR).
5. This was softened greatly, compared to the original cash and government bonds focus, as it became clear that collateral shortage is a major issue; see BCBS (2013a).

## ANNEX B

*The DTD model and stability tests*

The empirical model takes account of macro-prudential influences, leverage, and business model aspects. The equation is estimated with two alternatives for leverage: the leverage ratio and the regulatory capital approach of the Basel Tier 1 ratio. The empirical model is specified in equation (A1); where the subscripts  $i$  and  $t$  denote the bank and the period, respectively:

$$DTD_{i,t} = \alpha_{i,t} + \beta_2 K_{i,t} + \beta_3 TD_{i,t} + \beta_4 WFD_{i,t} + \beta_5 GMV_{i,t} + \beta_7 BETA_{i,t} + \beta_8 \%HPI_{i,t} \quad [A1]$$

$K$  corresponds to the simple rule leverage ratio (LEV), which is expected to have a negative sign, or to the Basel tier 1 ratio (T1), which is expected to have a positive sign. The equation is estimated twice, once with LEV, excluding the Basel capital concept, and once with T1, excluding the simple leverage ratio. Other variables are as defined in the text. The two equations for the LEV and T1 alternatives are estimated for all banks, the GSIFI banks and the other large banks in the sample, using ordinary least heteroskedasticity of error, cross-section and time-fixed effects are introduced into the regression. The regression results for the full sample period are shown in Table B1.\*

The two columns for the “all banks” sample and the first columns (for LEV) in the “GSIFI banks” and “Other large banks” correspond to those in the main text. Two forms of stability tests are carried out. First, for the “GSIFI banks” case, the 6 large banks that failed in the crisis but were absorbed by other GSIFI banks are included to act as dummy variables for M&A. Otherwise the large jumps in assets and liabilities for the absorbing bank might distort the results. In the column marked “GSIFI banks-FSB”, only those banks on the FSB GSIFI list are included, and the panel regression is run with dummy variables that take on a value of 1.0 from the date of acquisition and 0 elsewhere. There are no significant differences for the parameters for the GSIFI banks-FSB case.

The second stability test is to run the model over a shorter sample period from 2004-10, which includes sufficient observations for robust estimation, and appropriate variability of the data in crisis and pre-crisis years. The main features of the results are:

- The leverage ratio has the correct sign and remains significant at the 1% level in all 8 models for the 2 sample periods. The Basel T1 ratio on the other hand remains insignificant and changes sign between the different panels. The leverage ratio appears to be stable for the full large sample of GSIFI and non-GSIFI banks. However, for the

\* This analysis adds a further year to the one reported in Blundell-Wignall and Roulet (2012).

Table B1. **Determinants of bank distance-to-default: Multivariate panel results 2005-12**

	All banks		GSIFIs banks		GSIFIs banks - FSB		Other large banks	
Constant, $\alpha$	8.17*** (7.15)	6.74*** (4.75)	11.21*** (6.94)	10.36*** (3.89)	10.57*** (4.90)	9.45*** (3.86)	6.55*** (8.72)	5.74*** (4.54)
LEV: TA/Bank Equity	-0.04*** (-3.30)	-	-0.03*** (-3.21)	-	-0.04*** (-4.09)	-	-0.05*** (-2.53)	-
T1: Basel Tier 1 Ratio	-	2.24 (0.58)	-	-2.49 (-0.35)	-	0.10 (0.02)	-	-1.05 (-0.22)
TD: Trading Book plus Available for Sale Securities/TA	4.51 ** (2.06)	3.72 (1.47)	3.34 ** (2.16)	1.80 (0.80)	3.99*** (2.74)	2.43 (1.22)	3.79 (1.51)	4.44 (1.50)
WFD: Wholesale Funding/Total Liabilities	-4.14*** (-3.04)	-4.54 ** (-2.31)	-6.78*** (-2.47)	-8.46 ** (-2.14)	-6.59*** (-2.41)	-8.09 ** (-2.13)	-1.81 (-1.30)	-3.29 * (-1.85)
GMV: GMV of Derivatives/TA	-3.48*** (-2.42)	-5.39 ** (-2.21)	-4.79*** (-3.02)	-7.21*** (-2.50)	-4.51 ** (-2.27)	-6.25 ** (-2.05)	-3.26 (-0.37)	-4.38 (-0.49)
BETA: CoVar Bank Stock Ret. with Ntl. Mkt Ret./Var. Mkt	-1.47*** (-5.36)	-1.33*** (-3.61)	-2.61*** (-4.75)	-2.12*** (-3.43)	-2.12*** (-3.10)	-1.85*** (-3.05)	-1.21*** (-3.47)	-1.17*** (-2.80)
%HPI: House Price Index ann. % change	16.29*** (4.98)	17.45*** (4.12)	20.10*** (6.70)	21.49*** (4.75)	20.31*** (4.62)	20.64*** (4.36)	17.32*** (4.75)	17.19*** (4.29)
DUM_MA: Dummy equals to 1 following M&A, else 0	-	-	-	-	-1.22*** (-3.94)	-1.05*** (-3.32)	-	-
R2	0.69	0.65	0.73	0.68	0.72	0.67	0.67	0.64
Fisher Statistic	11.25	9.47	12.58	10.37	12.25	10.25	9.76	8.36
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Observations	569	569	201	201	191	191	368	368
VECM 1-year lagged residual (Engel & Granger test)	-0.85*** (-17.72)	-0.85*** (-18.01)	-0.78*** (-11.05)	-0.80*** (-11.56)	-0.77*** (-10.66)	-0.81*** (-11.24)	-0.90*** (-14.20)	-0.70*** (-11.88)

Source: Authors' calculations.

Table B2. **The model tested over a shorter sample period: 2007-10**

	All banks		GSIFIs banks		GSIFIs banks - FSB		Other large banks	
Constant, $\alpha$	5.17*** (3.80)	3.87*** (3.62)	9.88*** (7.41)	7.18*** (4.17)	7.69*** (7.80)	6.80*** (4.13)	3.96*** (2.36)	4.23*** (3.40)
LEV: TA/Bank Equity	-0.04*** (-3.93)	-	-0.03*** (-3.31)	-	-0.03*** (-3.43)	-	-0.01*** (-3.95)	-
T1: Basel Tier 1 Ratio	-	-1.60 (-0.43)	-	5.14 (0.65)	-	4.89 (0.60)	-	-4.43 (-1.27)
TD: Trading Book plus Available for Sale Securities/TA	7.59*** (4.49)	7.35*** (3.35)	6.31*** (3.18)	5.50 ** (1.96)	7.01*** (3.94)	5.71 ** (2.04)	2.30 * (1.73)	3.08*** (2.36)
WFD: Wholesale Funding/Total Liabilities	-2.15 * (-1.72)	-2.13 (-1.34)	-9.24*** (-3.97)	-8.23*** (-2.93)	-6.77*** (-6.26)	-7.56*** (-2.86)	0.73 (1.54)	0.28 (0.50)
GMV: GMV of Derivatives/TA	-4.10*** (-3.74)	-6.49*** (-4.49)	-5.97*** (-3.58)	-7.41*** (-5.63)	-4.60*** (-2.64)	-7.27*** (-5.65)	-6.11 (-1.08)	-9.41 (-1.44)
BETA: CoVar Bank Stock Ret. with Ntl. Mkt Ret./Var. Mkt	-0.85*** (-3.05)	-0.76 ** (-2.22)	-1.94*** (-4.80)	-1.55*** (-8.62)	-1.33*** (-3.67)	-1.42*** (-8.44)	-0.96*** (-2.70)	-0.86 * (-1.83)
%HPI: House Price Index ann. % change	12.39*** (3.03)	13.67*** (2.62)	11.62*** (3.17)	12.70*** (2.78)	11.39*** (2.65)	11.98*** (2.58)	10.57 ** (2.24)	10.78 ** (2.24)
DUM_MA: Dummy equals to 1 following M&A, else 0	-	-	-	-	-0.40*** (-2.47)	-0.14 (-0.96)	-	-
R2	0.63	0.61	0.71	0.65	0.65	0.61	0.44	0.44
Fisher Statistic	3.86	3.64	4.53	3.85	3.51	3.21	2.64	2.12
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Observations	303	303	104	104	98	98	199	199

Source: Authors' calculations.

“Other large banks” sub-sample the leverage ratio appears to strengthen in the full sample to a value of -0.05 (Table B1), versus -0.01 in the short sample (Table B2).

- The GMV of derivatives business model feature appears to be robust and stable between the 2 periods.
- The wholesale funding and trading securities variables for the most part seem well determined, but have larger (correctly signed) coefficients in the short sample.
- The macro-control variables are very well determined, and have smaller values in the short sample.

In all cases the causality in the model, tested with an error correction model shown at the bottom of the table, show large coefficients (rapid adjustment) and are significant at the 1% level.

It is not surprising that there should be some structural changes in coefficients in samples that run through the global crisis and sweeping regulatory changes. The current authors feel it is perhaps surprising how well the model holds up in terms of its basic insights. This empirical work is not intended to find a stable forecasting model. Rather, it is intended to provide empirically-based insights for regulators as to what appears to matter for the safety of banks. Using the full sample, with as much variability of data as possible is best suited to this end.