

Financial regulatory reform after the crisis: an assessment

By Darrell Duffie¹

Executive Summary

"You never want a serious crisis to go to waste." – Rahm Emanuel, November 2008.

This report offers a brief assessment of the post-crisis regulatory reform of the financial system: the most sweeping re-regulation of banking and financial markets since the US "New Deal" reforms² conducted during the Great Depression.

In the 21st century, finance permeates the global economy more deeply and intricately than ever before. The financial crisis of 2007-09 revealed powerful new variations of the notion of a "bank run". As with the US reforms of the 1930s, governments have been energized by the heavy economic fallout of the crisis, especially given the revelations of socially excessive risk-taking and self-interested misbehavior. Commenters seethed over bailouts of wide swaths of the financial system, including banks, broker-dealers, a huge insurance firm, government-affiliated mortgage agencies, and money-market mutual funds. Staggering social costs were evident in lost output and employment. For example, within five quarters of the end of 2007, the real gross domestic product of the United States and the euro area each fell by about 4%, and were even further below their normal growth paths.³ The impact on Japan was even more severe. The euro area was then battered by a second wave of crisis arising from the exposure of its already weakened banking system to shaky sovereign debt and from worries over the future path of the eurozone.

Legislatures and finance ministers around the world empowered financial regulators to rehabilitate on a grand scale. The reform was well overdue. Many of the world's largest financial services firms had learned how to take unsafe levels of risk by exploiting weak regulatory solvency tests, opaque derivatives and securitization markets, and flight-prone sources of short-term financing.

¹ Graduate School of Business, Stanford University. My webpage at www.stanford.edu/~duffie/ provides related research and disclosure of potential conflicts of interest. Because I serve on the board of directors of Moody's Corporation, I do not cover credit rating agencies. I am extremely grateful for research assistance from Yang Song, conversations with Suresh Sundaresan and helpful comments from Viral Acharya, Jean-Edouard Colliard, Philipp Hartmann, Peter Hoffman, Nellie Liang, Sam Langfield, Mary Miller, Peter Nowicki, Paul Tucker, Joshua Younger, and an anonymous ECB commenter.

² Spurred by popular outrage over conflicts of interest in the banking sector that were revealed by the Pecora Commission and over the ravages of the Great Depression, the US Congress enacted the Banking Act of 1933 (which included the Glass-Steagall Act), the Securities Act of 1933, and the Securities Exchange Act of 1934, transforming financial services in the United States for decades to come.

³ See Lane (2013).

In the United States, the most toxic systemic financial firms were investment banks that relied heavily on run-prone wholesale short-term financing of their securities inventories. A large fraction of this funding was obtained from unstable money market mutual funds. A substantial amount of this money-fund liquidity was arranged in the overnight repo market, which was discovered by regulators to rely precariously on two US clearing banks for trillions of dollars of intraday credit. The core plumbing of American securities financing markets was a model of disrepair.

Leading up to the Great Financial Crisis of 2007-09, the biggest underlying sources of risk to the financial system were poorly monitored and excessive residential financing and weak peripheral European sovereign debt. Macroprudential regulation, however, is concerned with the resiliency of the financial system to shocks coming from almost any direction. In the words of Tucker (2014), "Overall, the test is whether the reforms can increase the resilience of the system as a whole, reduce contagion when trouble hits, and mitigate the pro-cyclicality of financial conditions."

Governments have set their financial regulators on a course of significant reduction of the likelihood and severity of future such crises. They demand an end to the moral hazard of bailouts. Regulators have clearly received the message. The striking breadth and depth of the ongoing reform is evident in the 2015 progress report⁴ of the Financial Stability Board (FSB) to G20 leaders.

For each of the G20 nations, the FSB summarized progress within "four core elements" of financial-stability regulation:

1. making financial institutions more resilient;
2. ending "too-big-to-fail";
3. making derivatives markets safer;
4. transforming shadow banking.

At this point, only the first of these core elements of the reform, "making financial institutions more resilient", can be scored a clear success, although even here much more work remains to be done.

These resiliency reforms, particularly bank capital regulations, have caused some reduction in secondary market liquidity. While bid-ask spreads and most other standard liquidity metrics suggest that markets are about as liquid for small trades as they have been for a long time,⁵ liquidity is worse for block-sized trade demands. As a trade-off for significantly greater financial stability, this is a cost well worth bearing. Meanwhile, markets are continuing to slowly adapt to the reduction of balance sheet space being made available for market-making by bank-affiliated dealers. Even more

⁴ See Financial Stability Board (2015b).

⁵ *Liberty Street Economics Blog*, a research blog series of the Federal Reserve Bank of New York has published an extensive series of short notes on market liquidity during 2015-16. These notes provide an array of measures and analysis of market liquidity, including coverage in the corporate bond and treasury securities markets. The easiest point of access to these notes is the [web page](#) of a frequent co-author of these notes, Tobias Adrian.

stringent minimum requirements for capital relative to risk-weighted assets would, in my view, offer additional net social benefits.

I will suggest here, however, that the regulation known as the leverage ratio has caused a distortionary reduction in the incentives for banks to intermediate markets for safe assets, especially the government securities repo market, without apparent financial stability benefits. I explain this with a simple model based on the notion of “debt overhang” introduced by Myers (1977). I will suggest adjustments to the leverage ratio rule that would improve the liquidity of government securities markets and other low-risk high-importance markets, without sacrificing financial stability.

I will describe how the other three core elements of financial-stability reform, those involving “too big to fail”, derivatives markets, and shadow banking, are still well short of their goals in key areas. I will argue that the proposed single-point-of-entry method for the failure resolution of systemic financial firms is not yet ready for safe and successful deployment. A key success here, though, is that creditors of banks do appear to have gotten the message that in the future, their claims are much less likely to be bailed out. Derivatives reforms have forced huge amounts of swaps into central counterparties (CCPs), a major success in terms of collateralization and transparency in the swap market. As a result, however, CCPs are now themselves too big to fail. Effective operating plans and procedures for the failure resolution of CCPs have yet to be proposed. While the failure of a large CCP seems a remote possibility, this remoteness is difficult to verify because there is also no generally accepted regulatory framework for conducting CCP stress tests. This represents an undue lack of transparency. Reform of derivatives markets financial-stability regulation has mostly bypassed the market for foreign exchange derivatives involving the delivery of one currency for another, a huge and systemically important class. Data repositories for the swaps market have not come close to meeting their intended purposes. Here especially, the opportunities of time afforded by the impetus of a severe crisis have not been used well.

The biggest achievement in the area of shadow banking is the new set of rules governing money market mutual funds. Money funds of the constant-net-asset-value (CNAV) type can usually be redeemed at a constant value, despite fluctuations over time in the actual market value of their assets. Many investors therefore treat CNAV funds like bank deposits, and thus subject to a run whenever the redemption value of the funds could fall. This is exactly what happened on a massive scale in the United States when Lehman Brothers failed. In the United States, after fits and starts that tested the influence of the Financial Stability Oversight Council, the Securities and Exchange Commission (SEC) has effectively forced CNAV money funds to invest only in government assets. Europe’s regulatory reform of its money market funds has been delayed, but seems likely to follow the outlines of the US reforms.

The G20 financial reforms have a wide range of other financial-stability objectives listed by the Financial Stability Board (2015b).⁶ For reasons of brevity and focus,

⁶ See Financial Stability Board (2015b), page 6.

however, I will not take the opportunity to address financial-stability regulatory reforms in these other areas.

In addition to financial-stability regulation, legislatures decided that the time is ripe for improving the competitiveness and fairness of financial markets, and have asked regulators to enforce new price-transparency and trade-competition requirements.

To the extent that financial-stability regulations have reduced the incentives for bank-affiliated dealers to make markets, regulations in support of competitive transparent all-to-all trading can mitigate losses in market liquidity. Some markets can become even more liquid once dealer intermediation of over-the-counter markets is supplanted with all-to-all anonymous trading venues, and once there is less fragmentation of trade across off-exchange multilateral platforms. Some of the fragmentation is due to lack of international regulatory coordination. I will suggest that there is plenty of room for more progress in this area.

The US Dodd-Frank competition rules are narrowly aimed at the swap market. Europe's Markets in Financial Instruments Directive (MiFID II) and proposed MIFIR implementing regulations are more ambitious in scope than the US reforms, but are moving much more slowly. Implementation of the most important trade-competition rules has been pushed back to early 2018.

The costs of implementing and complying with regulation are among the trade-offs for achieving greater financial stability. For example, in 2013 (even before the full regime of new regulations was in place) the six largest US banks spent an estimated⁷ \$70.2 billion on regulatory compliance, doubling the \$34.7 billion they spent in 2007. Compliance requirements can accelerate or, potentially, decelerate overdue improvements in practices.⁸ The frictional cost of complying with post-crisis regulations is easily exceeded by the total social benefits, but is nevertheless a factor to be considered when designing specific requirements and supervisory regimes.

Delays in completing and implementing regulations (particularly in Europe) have been harmful, especially in the light of the costs to businesses of regulatory uncertainty. Examples include delays in clarifying the implementation of MiFID II, as mentioned, and the 2012 Liikanen framework for ring-fencing and proprietary-trading limits for banks. This is not, however, the time to call a general halt to reforms in order to mitigate further costs and uncertainty. Continuing to put the significant

⁷ As reported by Kristen Glind and Emily Glazer, *Wall Street Journal*, 30 May 2016, based on estimates provided by Federated Financial Analytics, Inc. at <http://www.wsj.com/articles/nuns-with-guns-the-strange-day-to-day-struggles-between-bankers-and-regulators-1464627601?mod=e2tw>

⁸ For example, an executive at a global systemically important financial institution (G-SIFI) broker-dealer sent me the following unprompted private comment: "Due to ever-increasing requirements for documentation, ongoing monitoring, annual certifications, data lineage recording, etc., etc., etc., quant teams on the street are currently significantly hampered in any new development, spending instead their time on producing piles and piles of paper on legacy models that grow increasingly stale. New development means facing mandated model validation, audit, and regulatory reviews – something that can sometimes literally take years – so quant teams now mostly just give up, even when they know that models are in need of an overhaul ... In fact, the trend is for quants to 'dumb down' the models as much as possible, to cut down on the bureaucratic overhead."

remaining pieces of the reform into place, expeditiously, will add importantly to financial stability and market efficiency.

Among the important contributors to post-crisis regulatory reform are the supra-national forums for regulatory standards setting, coordination, and peer review. Much has been accomplished, in particular, by the Financial Stability Board, the Basel Committee on Banking Supervision, the Committee on Payments and Market Infrastructures (CPMI), and the International Organization of Securities Commissions (IOSCO). It is hard to imagine that progress would have been nearly as far reaching as it has been without the coordination of standards and the peer comparisons afforded by these groups.

Overall, the international financial regulatory reform movement has made large strides and still has a lot to accomplish. Progress has not been easy because of the sheer complexity of the financial system, competing private interests, and differing national objectives.

1 Making financial institutions more resilient

I begin with a discussion of progress with the first of the core reform elements – “making financial institutions more resilient”.

1.1 Capital and liquidity regulations

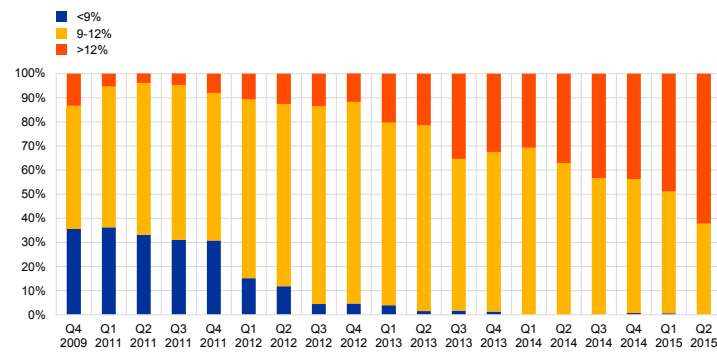
Thanks to the Basel III accords, the capital and liquidity cushions of the largest financial institutions are significantly higher than their pre-crisis levels. For example, the average Common Equity Tier 1 (CET1) capital ratios of the six largest US bank holding companies has increased from typical pre-crisis levels of 7% to 7.5% of risk-weighted assets to over 12% during 2015.⁹ While CET1 ratios are measured on a somewhat different basis in the European Union than in the United States, the European Banking Authority (2015a) reports¹⁰ that the 15 largest EU banks had improved their CET1 ratios from about 9.6% at the end of 2009 to about 12.3% by the end of the second quarter of 2015. Over the same span of time, as shown in Chart 1, the fraction of all EU banks with CET1 ratios below 9% dropped from 36% to zero.¹¹

⁹ See page 21 of Federal Reserve Bank of New York Research and Statistics Group (2016).

¹⁰ See European Banking Authority (2015), page 8.

¹¹ See European Banking Authority (2015), page 5.

Chart 1
Improving the capital ratios of EU banks



Data Source: European Banking Authority.
Note: Fractions of European banks with CET1 ratios in the indicated ranges: less than 9% (blue), between 9% and 12% (orange) and more than 12% (red).

This is a major achievement, and further improvements are planned. Adoption and implementation of the Basel III accords continues to make progress across the 27 member jurisdictions, as tracked by the Basel Committee on Banking Supervision (2016).

In addition to conventional requirements governing capital relative to risk-weighted assets, Basel III includes a minimum "leverage ratio" of capital to total (not risk-weighted) assets.

Beyond increasing capital requirements, the balance sheet liquidity of large banks is now regulated to meet a minimum liquidity coverage ratio (LCR), designed to ensure that cash outflows that could plausibly occur within 30 days are fully covered by ready cash sources. The LCR could be counterproductive, however, if it is not relaxed in times of stress so as to allow banks to actually access the liquidity sources that LCR requires. To my knowledge, this concern has not yet been addressed. A companion Basel-III liquidity regulation, the net stable funding ratio¹² (NSFR), designed to limit maturity transformation, remains to be implemented. Kashyap, Tsomocos, and Vardoulakis (2014) explain the beneficial effect of multiple capital and liquidity requirements, given the multiple modalities for bank failure.

Going further, the Fundamental review of the trading book conducted by the Basel Committee on Banking Supervision has now completely revamped the measurement of market risk and risk weights for market risk. The Basel Committee on Banking Supervision (2016) summarizes progress here as follows.

The deficiencies in the pre-crisis framework included an inadequate definition of the regulatory boundary between the banking book and trading book, which proved to be a key source of weakness in the design of the trading book regime. In addition, risk

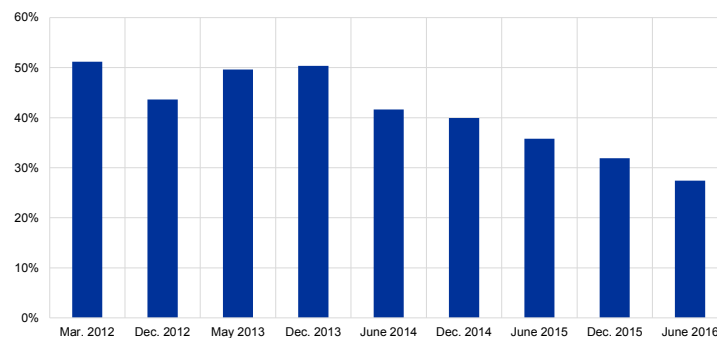
¹² See Basel Committee on Banking Supervision (2014b).

measurement methodologies were insufficiently robust. In particular, the models-based capital framework for market risk relied (and still relies) heavily on risk drivers determined by banks, which has not always led to sufficient capital for the banking system as a whole ... Compared to the current framework, the revised market risk capital standard is likely to result in an approximate median (weighted average) increase of 22% (40%) in total market risk capital requirements (i.e. including securitisation and non-securitisation exposures within the scope of the market risk framework).

As a gauge of whether bank failures are as great a threat to market participants as they were before the implementation of resiliency reforms, Chart 2 shows the fraction of credit default swap (CDS) referencing banks, versus non-banks, among the 15 most referenced corporations in the CDS market. Since early 2012, this fraction has declined from about 50% to about 28%. Currently, only Deutsche Bank and Barclays are in the top 15.

Chart 2
Banks are now less referenced by CDS, relative to non-banks

(y-axis: fraction of bank CDS in top-15 corporate CDS)



Data source: DTCC Trade Information Warehouse.
Notes: Of the 15 corporations most referenced in the CDS market by net notional outstanding, this chart shows the fraction of the total of the net outstanding notional CDS positions of these 15 firms, period by period, that reference banks. The banks that appear in the top 15 in at least one period are Wells Fargo, Deutsche Bank, Morgan Stanley, Goldman Sachs, Unicredit, Barclays, and J.P. Morgan.

1.2 Unintended consequences of leverage regulations

There have nevertheless been some unintended adverse consequences of the new capital regulations. Most obvious among these, the “leverage ratio” requirement has impaired liquidity in the market for repurchase agreements backed by government securities, especially in the United States.

As explained by the Financial Policy Committee of the Bank of England (2014c), the leverage ratio rule is meant as a backstop for the risk-weighted-asset capital requirement, because regulatory risk measures may not vary sufficiently with the true riskiness of assets. This can be a consequence of “regulatory arbitrage”, as explained by Colliard (2014), Kiema and Jokivuolle (2014), and Begley,

Purnanandam, and Zheng (2016). For example, in a sample of credit assets analyzed by the Basel Committee on Banking Supervision (2013b), the capital levels assigned by the most conservative banks were about 50% higher than those for the least conservative banks. The leverage ratio rule simply avoids the issue of risk measurement by assigning the same amount of required capital per unit of gross assets, regardless of the type of asset.

The US version of the leverage rule for the largest bank holding companies, known as the Supplementary Leverage Ratio (SLR), now requires these firms to have a minimum ratio of capital to total assets of 5%, regardless of the risk composition of their assets. (The bank subsidiaries of these holding companies must meet a 6% minimum leverage ratio.) Intermediation of low-risk assets is typically less profitable than intermediation of high-risk assets. Faced with the SLR, these largest US bank holding companies are cutting back significantly on the intermediation of some lower-risk assets. For example, the ratio of risk-weighted assets to total assets for these largest banks has grown since 2013 from 55% to about¹³ 65%. Appendix 1 provides additional discussion of the distortions in asset composition of bank balance sheets caused by the SLR.

The SLR has especially impaired the market for government securities repo intermediation. Per unit of gross assets, repo intermediation of government securities has extremely low risk and low profit margins per unit of assets. This suggests that the economic force underlying this decline in repo intermediation is a variant of what Myers (1977) called “debt overhang”, explained as follows.

On a typical repo intermediation trade, a bank-affiliated dealer lends cash to a counterparty who secures the loan with bonds, say treasuries. (The trade is not a loan in a legal sense, but amounts in effect to a secured loan.) The treasuries received by the dealer are then usually financed by the dealer itself on another repo, typically at a lower financing rate. The dealer profits from the difference between the two repo rates. Absent capital requirements, this repo intermediation trade is almost self-financing because the dealer passes the cash from one counterparty to the other, and the treasuries in the opposite direction. If a counterparty fails, the position can be liquidated with very low risk to the dealer because it is almost fully secured or over-secured by cash or safe treasuries. This trade causes almost no increase in the risk of the dealer’s balance sheet. When required by the leverage rule to have significantly more capital for this trade despite the extremely low risk, the dealer’s creditors benefit from the improved safety of their claims. The legacy shareholders therefore must suffer from a transfer of market value to the creditors.

In effect, this debt overhang implies a “rental fee” for space on the dealer’s balance sheet, equal to the wealth transfer from shareholders to creditors for the use of that space. In order for a trade to benefit the dealer’s shareholders, the profit on the trade must exceed the rental fee for balance sheet space.

¹³ See page 24 of Federal Reserve Bank of New York Research and Statistics Group (2016).

Typical pre-SLR bid-ask profit margins on government securities repo intermediation do not easily overcome the wealth transfer from shareholders to creditors once SLR is imposed. Large banks subject to SLR have therefore increased their bid-offer spreads in this market, driving down the volume of trade significantly.

The US. “GCF” repo market is now experiencing significant SLR distortions, evidenced by the reluctance of bank-affiliated dealers to provide repo financing to non-bank dealers. GCF repo volumes have declined by about 30% since 2012.¹⁴ More alarmingly, the amount of cash financing obtained by non-bank-affiliated dealers in this market¹⁵ declined by about 80% from 2013 to the end of 2015. In the last two years, a proxy measure of the effective bid-ask spread for US government securities repo intermediation increased from under 4 basis points to about 17 basis points, as shown in Chart 3. This spread is the difference between the financing rates paid by non-bank-affiliated dealers in the GCF repo market, relative to the financing rates paid by bank-affiliated dealers in the tri-party repo market.

In the last quarter of 2015, the three-month treasury-secured repo rates paid by non-bank dealers were higher even than the three-month *unsecured* borrowing rates paid by banks (LIBOR). This represents a significant market distortion. It was unlikely to have been a coincidence that failures of some important standard “arbitrage” pricing relationships became more severe around the same time, with increasingly negative interest rate swap spreads and bigger violations of covered interest parity.¹⁶ While SLR is not the source of the demand pressures causing these pricing misalignments, it is the most likely culprit for the failure to arbitrage them. The SLR increases “rental cost” for the space on a bank’s balance sheet needed to arbitrage these distortions.

¹⁴ See Adenbaum, Hubbs, Martin, and Selig (2016).

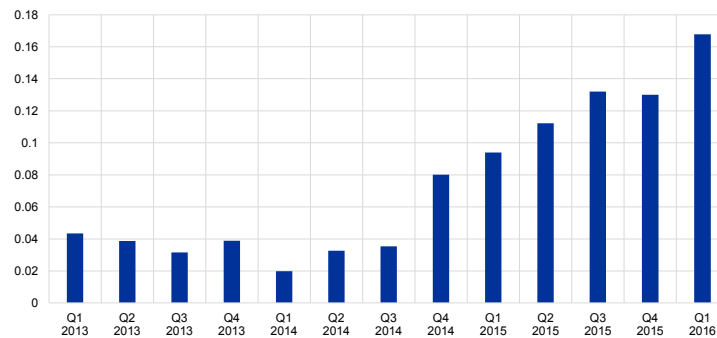
¹⁵ The relevant data are shown on Slide 39 of Martin (2016).

¹⁶ I am grateful to Professor Suresh Sundaresan of Columbia University for showing me his work, forthcoming, including Klingler and Sundaresan (2016), on the increasingly severe breakdown in late 2015 of these arbitrage relationships.

Chart 3

Spread between US GCF repo and tri-party overnight repo rates

(difference in repo rates (percentages). The excess of overnight GCF repo rates over overnight tri-party repo rates, averaged within quarters)



Data sources: Bloomberg and BNY-Mellon.

European repo markets have also suffered from a loss in liquidity.¹⁷ Although the largest European banks are subject to a less stringent 3% leverage ratio rule, what matters with respect to repo market liquidity is whether the requirement is estimated by a bank's management to have a significant potential to become binding on its capital needs. Appendix 1 provides a simple model-based illustration of the order of magnitude of the debt overhang impact on European repo intermediation incentives, which amounts to roughly a doubling of the bid-ask spread in European government securities repo markets. I show that this spread impact is roughly twice the product of the minimum leverage ratio and the unsecured credit spread of large banks. Any distortions in Europe's repo markets caused by the leverage ratio rule may therefore diminish once Europe's largest bank-based securities intermediaries are much better capitalized. For now, according to data from the International Capital Markets Association (2016), the total volume of repo trade in Europe has been steady over the past four years, so the overall market impact of the distortions cannot be viewed as severe.

Based only on informal conversations, it seems plausible to me that some of the largest US and European banks have not done the analysis necessary to determine which of the various capital and liquidity regulations are likely to be binding under various balance sheet designs. Some banks might therefore be stifling their intermediation of low-profit high-asset activities more than a careful analysis of capital regulations would imply, out of caution over the potential adverse impact on shareholder returns.

The repo market is a crucial backbone for securities financing, rates trading, hedging and monetary policy transmission. Adding frictions to the government securities repo market is therefore harmful to market efficiency and the pass-through effectiveness

¹⁷ See International Capital Market Association (2015).

of central bank monetary policy. Financial stability is also not improved by these repo-market distortions. In fact, modeling by Baranova, Zijun, and Noss (2016) suggests that a loss of liquidity associated with reduced intermediation of securities financing markets due to the leverage ratio rule may be exacerbated in times of market stress.

Rather than imposing leverage ratio rules that distort the intermediation of low-risk markets like those for government securities repo, it would be more effective to increase minimum capital requirements for banks by applying proportionately higher risk weights on all assets, or perhaps with a reasonable floor on the risk weights of all assets, including government securities. It is surely distortionary and against the interests of financial stability that government securities can be held in the non-trading accounts of banks with a risk weight of zero. If total risk-weighted capital requirements are high enough, then the leverage ratio rule would not be a significant consideration of banks when they choose how to allocate space on their balance sheets. Another option would be to redefine the measured amount of gross assets represented by government securities repo intermediation by recognizing the effect of netting when it is achieved safely within the same asset class. (The rules already permit some netting of repo positions with the same counterparty, but not across counterparties.)

Repo-market liquidity might alternatively be enhanced by greater use of direct repo trade platforms and all-to-all central counterparties, so that bank balance sheets are not so heavily used for intermediation. So far, however, the success that Europe has achieved in these infrastructure areas has not been matched in the United States, where the repo-market liquidity problems are most severe. Lack of progress with repo CCPs in the United States is also connected with financial stability concerns that I will raise under the topic of shadow banking.

Appendix 1 offers additional discussion of the effectiveness of the leverage ratio requirement. In my view, the unintended negative consequences of this rule are greater than its benefits, given the available regulatory alternatives for achieving equally high or higher capitalization of banks with less distortion in safe-asset intermediation.

1.3 [Insulating conventional banking from capital markets activities](#)

Various regulatory approaches have been launched to insulate the conventional lending and deposit-taking businesses of banks from large losses incurred in other lines of business, especially those involving capital markets.

For example, the Dodd-Frank Act includes a prohibition known as the “Volcker Rule” on proprietary trading by US banks, with exemptions for hedging, market-making, and various financial instruments such as foreign exchange and government securities. I have written skeptically of the attempt to draw a useful distinction

between market-making and proprietary trading,¹⁸ where in fact there is no evident distinction. The potential unintended implications of enforcing the Volcker Rule are (i) a reduction in market-making by banks, causing some loss of market liquidity, at least in the near term; and (ii) eventually, increased market-making by firms that are less heavily regulated than banks, especially for minimum capital and liquidity requirements. So far, it is difficult to attribute any serious decline in market liquidity specifically to the Volcker Rule. And, so far, I cannot point to specific non-bank-affiliated market-makers that have become dangers to financial stability because of the Volcker Rule.

Europe has struggled with a wide range of formulations for how to limit proprietary trading by banks¹⁹ and how to insulate the capital supporting conventional “retail” banking from trading losses elsewhere in bank. The United Kingdom will allow banks to conduct proprietary trading, but will force banks to set aside capital that specifically protects their domestic conventional banking operations from potentially severe losses that could be incurred in their global banking and trading divisions. This is known as “ring fencing”. The originator of the ring-fencing concept, John Vickers, has publicly argued that the Bank of England, which enforces the rule, has not required sufficient levels of capital in each of the two “sides” of the bank.

Elsewhere in the European Union it has been difficult to find common ground across nations on how to implement some combination of the original ring-fencing and proprietary-trading limits proposed in the 2012 Liikanen Report.²⁰ Quoting an influential commenter, Kay Swinburne, a British member of the EU assembly: “The long and fractious discussions on the issue of bank structural reform and the many views expressed [in Parliament and by EU Member States] show just how divisive this issue is.”²¹

Near the end of the 20th century the United States struggled with and eventually gave up its 1933 Glass-Steagall separation of commercial banking and investment banking. The challenges to this separation, as with the Volcker Rule, are (i) the difficulty of clearly distinguishing between closely overlapping financial services; and (ii) the loss of synergies between these activities. While allowing investment banking and conventional banking services within the same bank holding company (subject to the Volcker Rule), US rules place a significant brake on trade between the bank and the non-bank subsidiaries of the same bank holding company. This brake,

¹⁸ See Duffie (2012a).

¹⁹ See European Commission (2014). In the EU’s proposal on structural reform measures, point (4) of Article 5 defines proprietary trading to be trading “for the sole purpose of making a profit for own account, without any connection to client activity, through use of a specifically dedicated desk”. This is in contrast with the definition of prohibited trading in Dodd-Frank Section 619 as “principally for the purpose of selling in the near term ... or otherwise with intent to resell in order to profit from short-term price movements”. Both the SLR and Dodd-Frank exempt government bonds. The United Kingdom will apply for derogation under the 2013 Financial Services Act. The EU provides scope for exemption of third-country banks with similar regimes, perhaps looking for mutual recognition with the United States. For more details and analysis, see Armour, Awrey, Davies, Enriques, Gordon, Mayer, and Payne (2016).

²⁰ See European Union (2012).

²¹ See Ambra-Verlaine (2015).

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formed by Sections 23A and 23B of the Federal Reserve Act, has been tightened by the Dodd-Frank Act.

In summary, the approaches that have been tried in this arena are (i) ring-fencing; (ii) Volcker-style proprietary trading restrictions; (iii) complete Glass-Steagall separation; and (iv) intra-firm trading restrictions. These approaches can be (and have been) used in combination. Governments have struggled mightily over the choices among these alternatives. Compelling cost-benefit comparisons of these restrictions are treacherously difficult, and all of these measures require complex rules that are tricky to interpret and enforce.

1.4 Supervisory stress testing

Outside of the Basel III framework, capital requirements have been significantly buttressed in some jurisdictions by periodic supervisory stress tests. Large banks must demonstrate that they would remain adequately capitalized even after the losses arising from major adverse macroeconomic scenarios that are stipulated by regulators. The United States first deployed stress testing shortly after the onset of the Great Financial Crisis. Since then, its Comprehensive Capital Analysis and Review (CCAR) tests have become a regular and important component of the Fed's regulation of bank resiliency. The European Banking Authority²² (EBA) and the European Central Bank (ECB) are now following suit with their own stress-testing regimes for Europe's large banks. The EBA tests will cover banks in the European Union with assets in excess of 30 billion euros. The ECB tests, conducted under the Single Supervisory Mechanism, will cover the 130 largest banks in the euro area. Nouy (2016) outlines key differences between the CCAR and SSM approaches.

1.5 Ending too-big-to-fail

The phrase "too big to fail" refers to the threat to the real economy of a catastrophic failure of a financial firm. So long as that threat exists, a government could again face the need to choose between (i) allowing the failure to severely impair its real economy; and (ii) using taxpayer funds to re-capitalize the firm. The problem is worsened when the financial firm and its creditors are emboldened in their risk-taking by the perception that they are implicitly backstopped by taxpayers. Clearly, any such perception should be cured. Governments have therefore asked their regulators to be in a position to safely resolve a systemically important firm's impending failure without deploying government capital.

1.6 Failure resolution with a single point of entry

An internationally agreed plan to reduce too-big-to-fail threats is the single-point-of-entry (SPOE) approach to failure resolution. At the threat of failure of a systemically

²² See European Banking Authority (2016).

important financial firm, a regulator is supposed to be able to administratively restructure the parent firm's liabilities so as to allow the key operating subsidiaries to continue providing services to the economy without significant or damaging interruption.²³ For this to be successful, three key necessary conditions are (i) the parent firm has enough general unsecured liabilities (not including critical operating liabilities such as deposits) that cancelling these "bail-in" liabilities, or converting them to equity, would leave an adequately capitalized firm; (ii) the failure-resolution process does not trigger the early termination of financial contracts on which the firm and its counterparties rely for stability; and (iii) decisive action by regulators.²⁴

To be effective and at the same time mitigate inefficient defensive behavior by creditors, failure resolution should also have predictable outcomes. A case in point is the unpredictable discretion²⁵ used in the resolution of Novo Banco in 2015. More predictable insolvency processes such as bankruptcy should be used whenever feasible. In the United States, Title I of the Dodd-Frank Act forces systemically important financial firms to show, with "living wills", that they could also be safely resolved by bankruptcy. Under Dodd-Frank, bankruptcy is the preferred first alternative for resolving the insolvency of a systemically important financial firm. Administrative failure resolution is a last resort. Up until now, however, it has been difficult for some US SIFIs to provide "living wills" that are judged acceptable by their regulators.²⁶

One of the key problems here is the exemption from bankruptcy of qualified financial contracts (QFCs) such as repos and swaps. Another potential impediment to bankruptcy resolution is the potential need for debtor-in-possession bankruptcy liquidity in amounts larger than might be available during a general financial crisis. In order to address these and other shortcomings of the current bankruptcy code when applied to systemically important financial firms, Jackson (2016) has proposed a new "Chapter 14" of the bankruptcy code.

1.7 The early termination of qualified financial contracts

Under normal circumstances, QFCs (including swaps, repos, securities lending agreements, foreign exchange derivatives, and clearing agreements) include terms that allow surviving counterparties to immediately terminate their contracts with failing counterparties in the event of insolvency proceedings such as a regulatory failure administration. When early termination is triggered, the surviving counterparties may apply the collateral they have received from their failing counterparty, exploit set-off rights against other obligations, and invoice the failed counterparty for any uncovered replacement costs, among other measures. For

²³ For an analysis of the framework, focusing especially on the European setting, see Center for Economic Policy Studies Task Force (2016).

²⁴ Tucker (2016) explains the importance of decisive action.

²⁵ See Declercq and Van de Graaff (2016).

²⁶ The Board of Governors of the Federal Reserve System and the Federal Deposit Insurance Corporation (2016) identified numerous shortcomings and deficiencies in the 2015 failure plans of some US global systemically important financial institutions (G-SIFIs).

many of the world's largest financial institutions, when undergoing a failure-resolution process, the early termination of any significant segment of its QFCs would be dangerous, if not devastating. The markets for assets related to the terminated contracts would also be heavily disrupted. The goal of safe failure resolution would thus be thwarted unless early termination of QFCs can be controlled.

Under the Orderly Liquidation Authority of Dodd-Frank and under the EU Bank Recovery and Resolution Directive (BRRD), contractual early-termination triggers can be stayed by a failure administrative authority. The reach of these stays, however, does not generally extend across jurisdictions. Regulators have therefore asked major bank-affiliated dealers to voluntarily re-write some of their QFCs so as to include language that has an effect similar to that of a stay. These "voluntary stays" now cover a significant quantity of swap contracts under a protocol designed by the International Swaps and Derivatives Association (ISDA). This process of re-writing swap contracts to include failure-resolution stays is incomplete. Some buy-side firms are grappling with the decision of whether to agree to the protocol. In many cases, they are required to act with a fiduciary responsibility to their clients. When buy-side firms do agree to give up some of their early-termination rights, they may choose a specific jurisdictional setting for the failure resolution authority.²⁷

Meanwhile, regulators are likely to encourage bank-affiliated dealers to introduce contractual stays on failure-resolution termination for other forms of QFCs, such as repos, foreign exchange derivatives, and securities lending agreements. In the United States, the Federal Reserve has requested comments on its proposal to require systemically important bank holding companies to arrange for contractual failure-resolution "stays" for their repos and securities lending agreements in major foreign jurisdictions.²⁸ Centrally cleared QFCs would be exempted, which makes good sense given the potential for contagion of systemic risk when a central counterparty is delayed from closing out the positions of one or more large failing clearing members.²⁹

Until the destabilizing impacts of the early termination of QFCs are treated more comprehensively, it is unlikely that a large systemic financial firm that is active in the relevant QFC markets could be safely resolved, even using the single-point-of-entry model.

1.8 Maintaining liquidity during failure resolution

The ability of a large financial firm to avoid a run during a failure-resolution process is largely an issue of confidence of creditors and other counterparties. In addition to the potential for early termination of QFCs, significant wholesale depositors and other short-term creditors would consider their options carefully. Relatively little could be

²⁷ See Managed Funds Association (2015). On 5 May 2016, ISDA announced its ISDA Resolution Stay Jurisdictional Modular Protocol "designed to provide flexibility to allow adhering parties to choose which jurisdictional 'modules' to opt in to."

²⁸ See Board of Governors of the Federal Reserve System (2016).

²⁹ See Braithwaite and Murphy (2016) and Duffie and Skeel (2015).

gained by a policy of renewing their loans to the firm, and some of their assets could be lost. Many of the largest depositors are corporations, asset managers, and other entities that act as agents for investors or shareholders. These depositors have a legal fiduciary duty to protect the assets of their principals. These and other counterparties with the option to renew financing positions with the failing firm could easily take a wait-and-see attitude, gauging when it is safe enough to conclude new agreements with the bank. Even if the bank could quickly resume business in a diminished form, the resulting loss of credit provision or disruption to financial markets might be severe. The impact on the broader economy is difficult to predict, and would depend on the health of the rest of the financial system at the same time. This point is emphasized by Goodhart and Avgouleas (2014), who detail a host of other concerns about the SPOE model and provide a critical evaluation of the US and EU bail-in approaches. Once the risk of a large bank's failure is manifest, there may be significant pressure on its government to bail it out.

The fact that banks are now subject to the liquidity coverage ratio (LCR) rule does not imply that a run will be averted. Rather, the goal of LCR is that the balance sheet of the financial institution can withstand such a run, perhaps however in a form that significantly limits the ability of the bank to continue providing much new credit to the general economy.

1.9 Credibility and moral hazard

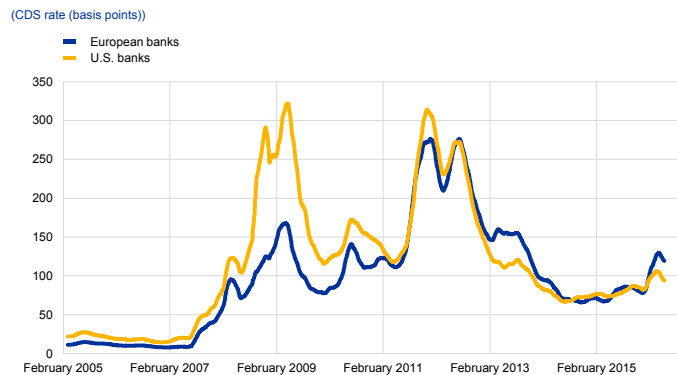
As far as mitigating the moral hazard of too-big-to-fail, what matters is the confidence of market participants that resolution authorities will actually attempt to use their powers when failure is about to occur, absent a bailout. Ignatowski and Korte (2014) provide empirical evidence that, on average, those US banks that have become subject to the Orderly Liquidation Authority (OLA) have responded by reducing their riskiness, relative to banks that were already subject to Federal Deposit Insurance Corporation (FDIC) resolution. They find no significant response to OLA, however, in the risk-taking behavior of the largest banks.

A sign of some progress with too-big-to-fail is the ironic fact that, despite more stringent liquidity and capital rules, the CDS rates of the largest banks are much higher than they were before the Great Financial Crisis, as shown in Chart 4. Apparently, creditors are more convinced than before that banks may indeed be allowed to fail, and that senior unsecured long-term bonds (obligations that are both covered by CDS and subject to bail-in) will bear a disproportionate share of expected default losses, relative to deposits and other operating liabilities.

A further sign of the credibility of failure resolution is found in an event study, conducted by Adonis Antoniadis and Paolo Mistrulli of the ECB's Financial Research Division, of the impact on European bank bond spreads of the 2013 failure resolution of Cypriot banks. Although agreement on the BRRD was reached only later in 2013, the intent of the BRRD was understood by the time of the Cyprus event. The results of this ECB study are reported by Hartmann (2015). The assumption underlying the study is that, before the BRRD, it was already credible that subordinated

bondholders are unlikely to be paid in the event of a bank failure. If the Cyprus event showed that, in the future, the BRRD could and probably would be applied to bail in senior creditors, then bond investors should have increased their expectations of future losses on senior debt, *relative to junior debt*. Indeed, by two months after the Cyprus event, on average across French, German, Italian, and Spanish banks, the spread between junior and senior debt declined by about 50 basis points.

Chart 4
Bank CDS rates are much higher than their pre-crisis levels



Data source: Bloomberg.
Notes: The trailing one-quarter average of the senior unsecured five-year CDS rates of a subset of US banks (Morgan Stanley, Goldman Sachs, J.P. Morgan, Citibank, Bank of America-Merrill Lynch) and of a subset of European banks (Barclays, BNP Paribas, Crédit Suisse, Deutsche Bank, Société Générale, UBS, Unicredit). In October 2008 Morgan Stanley and Goldman Sachs became banks and Merrill Lynch was acquired by Bank of America.

1.10 Total loss-absorbing capacity

An interesting debate has arisen over how to meet the requirement that large financial institutions have a sufficient combination of equity and debt subject to bail-in. Suppose that a bank has E in measured equity capital. Suppose further that failure-resolution regulations require that the bank is able to absorb a loss of as much as L while still leaving at least C in equity capital, after failure resolution causes the cancellation or conversion to equity of D in designated “bail-in” debt instruments. The implied inequality for minimum total loss-absorbing capital (TLAC) is then $E+D-L \geq C$, or equivalently, $E-C+D \geq L$. What portion, if any, of the “excess equity”, $E-C$, should be permitted to count toward meeting this TLAC requirement? Because E is imperfectly measured, some have argued that little if any of the excess equity should count toward TLAC, and that the requirement should therefore be $D \geq L$. Others have made the point that a TLAC rule which encourages a bank to have more debt and less excess equity surely increases the risk of failure in the first place. And then there is the middle ground of counting some fraction of the excess equity

toward the TLAC requirement, or having separate minimums for TLAC and for bail-in debt, as will be the case in the United States.³⁰

In modeling TLAC costs and benefits, Mendicino, Nikolov, and Suarez (2016) emphasize instead the following trade-off with agency costs. “As a protection against costly default, bail-in debt and equity are perfect substitutes. However, they differ strongly in their impact on incentives. This leads to the second key trade off faced by the regulator: the one between controlling risk shifting (for which outside equity is superior) and preventing excessive private benefit taking (for which bail-in debt dominates).”

1.11 Failure-resolution readiness

While much progress has been made toward the goal of “ending too-big-to-fail”, I do not view current failure-resolution processes as ready for immediate successful deployment. Under plausible circumstances, if one of the world’s largest complex global financial firms were placed into administrative failure resolution today, I doubt that the firm (or its designated successor) would be able to quickly resume providing anything close to a normal level and range of financial services. In some cases, there could be a disastrous shock to markets. While much progress has been made toward meeting this worthy objective and mitigating the associated moral hazard, it is too early to declare victory over too-big-too-fail. Gracie (2016) outlines work that remains to be done.

1.12 Lending of last resort

In one major jurisdiction, the United States, the financial “reform” process has been used to remove the legal capacity of the central bank to provide lending of last resort (LOLR) to individual firms outside of the regulated banking system. The suggested benefit of this restriction is that non-banks could take undue advantage of the protection of this part of the bank “safety net”, a form of moral hazard. This gap in LOLR coverage includes the huge dealer affiliates of the largest globally systemically important bank holding companies. This restriction on the central bank could exacerbate a crisis, or even cause a financial crisis that need not have occurred. Given the lessons of 2007-08 about the dangers posed to the economy by non-bank financial firms, and in the light of the increasingly heavy dependence of developed market economies on market-based finance, this curtailment of lending of last resort was a significant step backward for financial stability.

1.13 Making derivatives markets safer

Reducing the systemic risk of derivatives markets is also a work in progress. In the United States, the majority of standard over-the-counter derivatives are now centrally

³⁰ A different treatment of TLAC is proposed by the [Basel Committee on Banking Commission \(2015\)](#).

cleared by regulated clearing houses.³¹ The European Market Infrastructure Regulation (EMIR) central clearing mandate is coming into force in Europe, beginning in June 2016 with certain types of interest rate swaps. (A significant fraction of new interest rate swaps were already being centrally cleared.³²)

Central clearing improves the transparency of counterparty risk and should, in principle, reduce default contagion risk. The successful migration of a large fraction of swaps into clearing houses, known as central counterparties (CCPs), will be one of the most impressive accomplishments of the financial reform program.

I will also discuss slow progress with swap trade data repositories, some improvements in derivatives markets exposures, and the general weakness of regulations of the huge and systemically important market for deliverable foreign exchange derivatives.

1.14 Clearing house failure risk

A consequence of the big success in moving swaps into clearing houses is that the largest CCPs have themselves become too big to fail. These CCPs are now undergoing reviews of their default management and recovery plans regarding their compliance with the CPMI-IOSCO Principles for financial market infrastructures.³³ Regulatory stress tests of the resiliency of CCPs are contemplated at the level of local market regulators, but there is not yet an agreed global framework for stress testing.³⁴ In April 2016 ESMA published the results of its first annual CCP stress tests, based on its own stress criteria, and found³⁵ that “the system of EU CCPs can overall be assessed as resilient to the stress scenarios used to model extreme but plausible market developments.”

³¹ See, for example, Powell (2015). According to ISDA [SwapsInfo](#), for 2016 (until June), of new trades of the type required to be cleared by US regulation, 82% of interest rate swaps and 82% of credit default swap index products are now centrally cleared in regulated CCPs. The Bank for International Settlements (2016) reports that, of the global CDS market, 34% are now centrally cleared.

³² See Abad, Aldasoro, Aymanns, D'Errico, Rousová, Hoffmann, Langfield, Neychev, and Roukny (2016).

³³ See Committee on Payment and Settlement Systems, Board of the International Organization of Securities Commissions (2012a, 2012b, 2014) and Risk Magazine (2016). The Committee on Payment and Settlement Systems is now officially named the Committee on Payments and Market Infrastructures (CPMI).

³⁴ In an interview with Risk Magazine (2016), Benoît Cœuré, Chairman of the CPMI and member of the ECB's Executive Board, stated: “I believe it would be helpful to enhance our capacity to identify and address financial vulnerabilities in CCPs at an early stage by complementing CCP in-house stress testing with a framework for supervisory CCP stress testing that can be conducted across jurisdictions. Supervisory stress testing can be a key building block of the macroprudential framework for CCPs if it accounts for the propagation of risk across CCPs as well as the spillover to, and spillback from, their clearing members.” Cœuré (2016) adds to these remarks by outlining five elements of the macroprudential approach to CCPs being coordinated at the CPMI-IOSCO level: (i) identifying CCPs that are systemically relevant in more than one jurisdiction; (ii) ensuring robust recovery buffers; (iii) identifying and mitigating pro-cyclical margining practices; (iv) developing a framework for supervisory stress testing that can be conducted across jurisdictions; and (v) “understanding and assessing interdependencies between CCPs and their participants.”

³⁵ See ESMA (2016).

Although statements of regulatory objectives for the failure resolution of CCPs are now generally in place,³⁶ actionable plans and procedures for failure resolution have not yet been promulgated for comment, let alone put into place. This is contrary to the Key Attributes for financial market infrastructures set out by the Financial Stability Board (2014).³⁷ The FSB Resolution Steering Group's most recent survey of progress stated³⁸ that "resolution frameworks for CCPs are not well developed. Systematic cross-border resolution planning processes are not yet in place for any of the largest CCPs although efforts are underway to establish such processes. The majority of respondents noted that their jurisdictions intend to develop or are still in the process of developing resolution regimes or policies for CCPs." In the United States, at least to my knowledge, no official-sector entity has even announced that it will take steps toward preparing its CCP administrative failure-resolution plans and procedures. Legal experts do not even agree on the applicability to CCPs of the Dodd-Frank's Orderly Liquidation Authority.³⁹

Mandating the central clearing of a vast amount of derivatives long before having an operating plan for the administrative failure resolution of systemically important CCPs represents an important deficiency in the financial reform process.

1.15 Trade data repositories

Trade data repositories for derivatives have been set up and are now being populated with transactions data, but the resulting databases are not yet of much use for monitoring systemic risk. Slow progress in this area can probably be ascribed to (i) early regulatory uncertainty over how the data would be used effectively in practical financial stability applications; (ii) some lack of systemic perspective, in the sense of the critique of post-regulatory reform offered by Claessens and Kodres (2014); and (iii) weak international coordination.

There has not been a sufficiently clear distinction, in creating these vast new databases, between the two rather different classes of applications, which rely on two different types of data.

1. *Bilateral outstanding counterparty exposures, by underlying asset class, before and after netting and collateral.* Here, the greatest potential applications include monitoring risk flows through the network of key market participants, collateral usage, and counterparty risk mitigation practices, by asset type. Using data collected under the European Market Infrastructure Regulation (EMIR), Abad, Aldasoro, Aymanns, D'Errico, Rousová, Hoffmann, Langfield, Neychev, and

³⁶ See Committee on Payment and Settlement Systems, Board of the International Organization of Securities Commissions (2014), European Union (2014), Financial Stability Board (2014), Financial Stability Board (2015c), and Her Majesty's Treasury (2014).

³⁷ According to Key Attribute 11.4, "Resolution authorities for an FMI should, in cooperation with the FMI's oversight or supervisory authorities (where distinct from the resolution authority), develop resolution strategies and operational plans to facilitate the effective resolution of the FMI in a way that ensures continuity of the critical functions carried out by the FMI."

³⁸ See Financial Stability Board (2015d).

³⁹ See Lubben (2015) and Steigerwald and DeCarlo (2014).

Roukny (2016) illustrate the potential usefulness of swap data repositories in this application area.

2. *Transactions.* Here, the greatest potential applications include: (i) post-trade price transparency, for the purpose of improving market competition, an issue discussed later in this report; (ii) investigation of financial misconduct such as insider trading or market manipulation; and (iii) conducting studies of the efficiency and stability of markets, for example diagnosing the causes and effects of “flash crashes.”

Separate from the construction of jurisdiction-level derivatives trade data repositories, the G20 Data Gaps Initiative (DGI) has triggered the construction of a relatively comprehensive and unified international data “hub”, housed at the Bank for International Settlements. The Staff of the IMF and the FSB Secretariat (2015) explains how this data hub will include a unified, granular and relatively comprehensive financial-stability database, with a special focus on the soundness and exposures of global systemically important banks (G-SIBs). Phase 2 of the DGI, about to commence, will incorporate a focus on systemic inter-linkages, and has the promise of linking jurisdiction-level derivatives data so as to permit a more systemic perspective on financial stability in the derivatives market, and beyond.⁴⁰

Until the jurisdiction-level trade data repositories are better constructed and can be used in a linked manner, the promise of the derivatives data repository initiative will remain substantially unfulfilled.

1.16 Regulatory pressure to reduce swap exposures

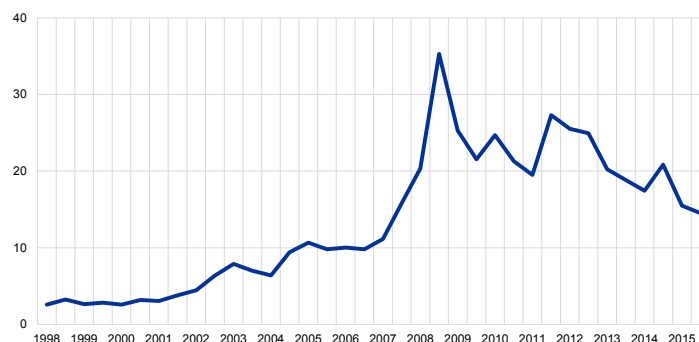
The pressure of capital and liquidity requirements and soon-to-be-implemented minimum margin requirements for the swaps of dealers has significantly reduced the amount of market risk in the swap market, and will continue to reduce it. Chart 5 shows that the total gross market value of outstanding OTC derivatives positions is now less than half of its peak 2007 level.⁴¹ The vast majority of these derivatives still have a major bank-affiliated dealer on at least one side of the trade. Because of regulation, these dealers have a much lower incentive to maintain large derivatives portfolios than they did before 2007.

⁴⁰ See Staff of the IMF and the FSB Secretariat (2015), page 28, Recommendation II.6: Derivatives. “BIS to review the derivatives data collected for the International Banking Statistics (IBS) and the semi-annual over-the-counter (OTC) derivatives statistics survey, and the FSB, in line with its 2014 feasibility study on approaches to aggregate OTC derivatives data, to investigate the legal, regulatory, governance, technological, and cost issues that would support a future FSB decision on the potential development of a mechanism to aggregate and share at global level OTC derivatives data from trade repositories. The G-20 economies to support this work as appropriate.”

⁴¹ Gross market values are before netting and collateral. After netting, counterparty exposures were reduced from \$3.3 trillion at the end of 2008 to \$1.8 trillion most recently. For both gross market values and counterparty exposures after netting (but before collateral), see http://stats.bis.org/statx/srs/tseries/OTC_DERIV/H:N:D:A:A:A:5A:5J?t=D5.1&c=&p=20152&i=1.8&x=OD_TYPE.2.CL_OD_TYPE

Chart 5
Post-reform decline in gross swap market values

(gross market value (USD billions))



Data source: Bank for International Settlements (2016).

Note: Gross market value of derivatives, in billions of US dollars, before netting and collateral.

Although the latest BIS triennial derivatives transactions volume data will not be released until later in 2016, data gathered from trade repositories by ISDA (2016b) suggest that total swap transactions volumes have been relatively steady over the last several years, just as total gross market values have declined. This represents an important improvement in the efficiency of counterparty risk management and collateral use.

This improvement in exposure efficiency could potentially be ascribed somewhat to central clearing, which has the ability to reduce exposures through netting across many clearing members. Achieving a reduction in swap exposures through central clearing is effective, however, only if a sufficiently large fraction of swaps are centrally cleared and if clearing is concentrated in relatively few clearing houses, as shown by Duffie and Zhu (2012). Otherwise, central clearing can actually increase total swap exposures. Because of the lack of well-coordinated data repositories, we are still unable to tell how much central clearing has helped or hurt, overall, on this dimension.⁴² Recent work by Ghamami and Glasserman (2016), however, has cast some doubt on the capital and collateral efficiency of central clearing, to the extent that it has been implemented up to this point.

The greatest source of improvement in OTC derivatives exposure efficiency is clearly due to “trade compression”, by which redundant long and short positions involving multiple dealers are discovered via data sharing by dealers with special utilities. These compression utilities then algorithmically initiate trades that effectively cancel the redundant positions. By April 2016, the largest such service provider, TriOptima, reported⁴³ that its compression service had effectively “torn up” a cumulative total of \$784 trillion notional of redundant derivatives. ISDA (2015) shows the remarkable

⁴² For the special case of the CDS market, this question is addressed by Duffie, Scheicher, and Vuilleme (2015).

⁴³ See [triReduce statistics](#).

impact of compression activity on the amount of outstanding positions in the interest rate swap market, which accounts for most of the compression. Trade compression is a private initiative that was not directly promoted by regulation. Indirectly, however, the pressure of regulatory capital and margin requirements has surely been responsible for a substantial increase in beneficial trade compression.

1.17 Foreign exchange derivatives

“Deliverable” foreign exchange (forex) derivatives, those involving an exchange of one currency for another, represent as much systemic risk as any class of derivatives other than interest rate swaps. Nevertheless, deliverable forex derivatives remain only lightly regulated. The US Treasury Department exempted forex derivatives from key Dodd-Frank regulations involving margin, central clearing and platform trading. The explanations offered by the US Treasury for this exemption were based heavily on the notion that forex derivatives entail a small amount of counterparty risk. This suggestion is simply not correct, as I have documented.⁴⁴ Changes in the market values of deliverable forex derivatives during their lifetimes represent a systemically large amount of counterparty risk, unless safely margined. The United States has no current or proposed regulation of these instruments for central clearing, initial margin, or variation margin. Data provided by the Foreign Exchange Committee (2016) show a monthly transactions volume of \$8.5 trillion of forex derivatives, the majority of which are for maturities of greater than one month, and with a high degree of concentration in individual currency pairs, especially euros versus US dollars. Forex derivatives involving the US dollar account for about half of all trade. In Europe, EMIR has not designated deliverable forex derivatives for central clearing or initial margins, but will require the exchange of variation margin,⁴⁵ a big improvement over the stance of US regulations.

Deliverable forex derivatives are more difficult to regulate than conventional derivatives because they involve the exchange of two actual currencies. This requires international coordination, which has been lacking,⁴⁶ or raises “extra-territoriality” concerns. Forex derivatives are also operationally more costly to regulate, again because of the need to handle different currencies. Meanwhile, forex derivatives markets represent a major source of systemic risk that is significantly under-regulated.

1.18 Transforming shadow banking

A financial stability transformation of shadow banking is hampered by the complexity of non-bank financial intermediation and by the patchwork quilt of prudential regulatory coverage of the non-bank financial sector. There is significant variation in

⁴⁴ See Duffie (2011).

⁴⁵ MacKenzie (2016) explains that forex derivatives may actually be subject to variation margin requirements before other forms of derivatives covered under MiFID II.

⁴⁶ See Amir-Mokri, Brandt, Donley, and Young (2015).

shadow banking business activities and regulatory frameworks across jurisdictions, and even within some key jurisdictions such as China and the United States.

The most recent Peer Review Report on shadow banking provided by the Financial Stability Board (2016) states that: "Few authorities ... seem to have a systematic process involving all relevant domestic authorities to ensure that the regulatory perimeter encompasses non-bank financial entities where necessary to ensure financial stability ... or the ability to collect sufficiently detailed information from entities that they do not already supervise." Sections 2.2 and 2.3 of this Peer Review provide a useful summary of concerns in this area.

Designing an effective regulatory framework for shadow banking relies on setting clear boundaries for the activities to be regulated. The Financial Stability Board (2015) sets out five classes of shadow banking entity:

1. entities susceptible to runs, such as certain mutual funds, credit hedge funds and real-estate funds;
2. non-bank lenders dependent on short-term funding, such as finance companies, leasing companies, factoring companies and consumer-credit companies;
3. market intermediaries dependent on short-term funding or on the secured funding of client assets, such as broker-dealers;
4. companies facilitating credit creation, such as credit insurance companies, financial guarantors and monoline insurers;
5. securitisation-based intermediaries.

Most of these types of entity use their balance sheets to offer credit, like a bank, and are subject to insolvency failure risk through maturity transformation. Mutual funds, however, are different. They are agent-based investors in capital markets. The main systemic risks that mutual funds pose are the heavy price impacts that can be caused in underlying asset markets by rapid investor redemptions.⁴⁷ Mutual funds probably deserve additional liquidity regulation and prudential supervision by securities markets regulators, but I doubt they should be regulated as members of the world of "shadow banking".

The exception is the special case of money market mutual funds, especially those of the constant net asset value (CNAV) type, whose shares can be redeemed in most cases at a constant value, despite fluctuations over time in the actual market value of their assets. Many investors treat CNAV funds like bank deposits. This implies that CNAV funds are subject to a run whenever the redemption value of any large fund could fall. Uncertainty about the actual position of other funds would likely cause redemptions to be widespread across funds. This is exactly what happened on a massive scale in the United States when Lehman Brothers failed. To stop the run,

⁴⁷ See Zeng (2016). Methods for treating this problem include "swing pricing".

the Treasury Department was forced to offer a guarantee to all money funds. Failing that, broker-dealers who relied for short-term financing on money funds would have themselves required massive emergency alternative funding. Global reform of CNAV money funds continues.⁴⁸

In the United States, after fits and starts by the Securities and Exchange Commission (SEC) and some arm-twisting of the SEC by the Financial Stability Oversight Council, significant progress has finally been made in getting CNAV money market mutual funds to rely less heavily on non-government assets. This has been done by forcing prime funds (which are allowed to invest in a range of non-government assets) to discontinue CNAV accounting. As a consequence, investors and fund managers are migrating from prime funds to government-only funds.

Europe's regulatory reform of its money market funds has been delayed. In May 2016 the European Council proposed a "Presidency compromise", that, if adopted, would probably lead the European money fund industry to eventually look much like that of the United States.⁴⁹

Hedge funds, private equity firms and non-bank-affiliated broker-dealers have increased their credit intermediation since the crisis, probably as a result of heavier banking regulation. The failures or near failures of most of the major US investment banks in 2008 spurred the surviving investment banks to become parts of bank holding companies, thus subject to the much tighter regulation applied to bank-affiliated broker-dealers. That opens the door for the entry of large broker-dealers that would not be subject to heavy bank-based regulation. So far, however, there are no extremely large broker-dealers that are not affiliated with banks. As for hedge funds, the effective failure of Long-Term Capital Management in 1998 amply demonstrated the potential for large hedge funds to threaten financial stability through fire sales of their assets and through contagion to bank-based prime brokers and creditors. The systemic risks posed by the unwinding of extremely large hedge funds should be carefully watched and controlled. I don't see much regulatory action in this specific area.

While there is a generally emerging view that regulation in the shadow-banking world should focus on activities rather than entities, an activity-based approach is not a reliable substitute for prudential regulation and supervision at the entity level, especially for entities that are large, complex, or conduct a significant amount of financial intermediation (of any kind, whether shadow banking or other), including large hedge funds, non-bank-affiliated broker-dealers, and mutual funds (including exchange-traded funds).

⁴⁸ For a peer review of the progress of money fund reform, see Board of the International Organization of Securities Commissions (2015).

⁴⁹ The Council of the European Union Presidency compromise states "existing Constant Net Asset Value MMFs (CNAV MMFs) should, 24 months from the date of the entry into force of this Regulation, only operate in the Union as either a CNAV MMF that invests in public debt instruments or as a Low Volatility Net Asset Value MMF (LNAV MMF). Alternatively, existing CNAV MMFs would be able to choose to operate as variable net asset value MMFs (VNAV MMFs)." See General Secretariat of the Council, [Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on money market funds - Presidency compromise](#), 10 May 2016.

While progress has been made, the infrastructure of the United States securities financing markets is still not safe and sound. The biggest risk is that of a fire sale of securities in the event of the inability of a major broker-dealer to roll over its securities financing under repurchase agreements. As I have mentioned, the Federal Reserve no longer has the legal capacity to act as a lender of last resort to an individual broker-dealer, no matter how systemic. While the intraday risk that such a failure poses for the two large tri-party-repo clearing banks has been dramatically reduced, the United States still has no broad repo central counterparty with the liquidity resources necessary to prevent such a fire sale. In this case, the Fed does have the legal right to act as a lender of last resort, but has no policy that it would do so. The Bank of England, on the other hand, has stated that it would be a lender of last resort to key financial market infrastructure.

As emphasized by Baklanova, Copeland, and McCaughrin (2016), there is a need for more comprehensive monitoring of all securities financing transactions, including securities lending agreements.

1.19 Improving trade competition

The second central aim of the regulatory reform is to improve the competitiveness of financial markets, with a focus on off-exchange trading. The legacy structure of over-the-counter (OTC) markets has represented an inefficiently low degree of competition, as I will explain.

To the extent that financial stability regulations have reduced the incentives for bank-affiliated dealers to make markets, regulations in support of price transparency and competitive trading venues can mitigate losses in market liquidity. Some markets could become even more liquid once dealer intermediation of OTC markets is supplanted with more all-to-all anonymous trade competition.

Here, the biggest pre-reform deficiencies were related to price transparency and direct competitive bidding for trades, both of which aid price discovery and the ability of investors to conduct effective low-cost comparison shopping. The result should be deeper and more liquid markets, lower execution costs, and better allocative efficiency. Appendix 2 explains why predominantly bilateral trade is uncompetitive and inefficient.

Beginning in 2003, the United States had already brought post-trade price transparency into its corporate and municipal bond markets with its TRACE initiative. The Dodd-Frank Act has instead aimed at the swap market. Standardized swaps have been designated for immediate and public transactions reporting and for trade on multilateral trading facilities (MTFs), known in US regulation as swap execution facilities (SEFs). Japan has followed a course similar to that of the United States, and has achieved roughly the same level of implementation.

Europe's Markets in Financial Instruments Directive (MiFID II) and proposed MIFIR implementing regulations are more ambitious in scope than US trade-competition reforms, but are moving more slowly. Some important regulations are still being

designed. Implementation of some of the most important rules, including mandates for trade on MTFs, has been repeatedly delayed, and at this point is not scheduled until early 2018. Europe's MiFID proposal covers a wider set of instruments, including corporate bonds, and seems likely to have a broader and more complex set of rules and exemptions.

At least until recently, a lack of coordination between US and EU authorities has been an unfortunate impediment to reform. The U.S. Commodity Futures Trading Commission (CFTC) began quickly,⁵⁰ but laid out aggressively extra-territorial rules that seemed to delay and hamper cooperation. The most contentious issues between the United States and EU have been related to mutual recognition of CCPs and multilateral trading facilities. As noted by IOSCO (2015), market participants strongly support cross-border recognition of trading facilities and CCPs, given the alternative of heavy costs of market fragmentation. As I will explain, execution costs are lower if more market participants compete on the same platform. Further, as modeled by Duffie and Zhu (2012), multilateral netting at fewer CCPs reduces counterparty exposures and collateral requirements. Recently, the United States and EU have been making more progress with mutual recognition.

1.20 Mandates for trade on exchanges and trade platforms

In the United States and Japan, significant steps have been made toward pre-trade price transparency and competitive swap trading, especially through the migration of over-the-counter trade toward exchanges and multilateral trade facilities (MTFs). Until new regulations forced some trading onto multilateral trading facilities, most OTC trade was typically conducted by private bilateral negotiation between two dealers, or between a "buy-side" firm and a dealer. Now, more than two-thirds of new trades in standardized interest rate swap and credit default swap index trading in the United States is conducted on MTFs.

Buy-side firms typically obtain their positions on MTFs at which more than one dealer responds to requests for quotes (RFQ). A significant fraction of inter-dealer trade is conducted on MTFs that use a central limit order book. The result is sometimes called a "two-tiered" market. In terms of improving competition and lowering trading costs to buy-side market participants, the reforms fall short by not bringing all wholesale market participants, including dealers and buy-side firms, together onto common trade venues using "all-to-all" anonymous central limit order books.

⁵⁰ In describing its implementation of Dodd-Frank reforms, the CFTC (2013) wrote: "One of the most important goals of the Dodd-Frank Act is to bring transparency to the opaque OTC swaps market. It is generally accepted that when markets are open and transparent, prices are more competitive and markets are more efficient. The legislative history of the Dodd-Frank Act indicates that Congress viewed exchange trading as a mechanism to "provide pre- and post-trade transparency for end users, market participants, and regulators." As such, exchange trading was intended as "a price transparency mechanism" that complements Title VII's separate central clearing requirement to mitigate counterparty risk. Additionally, legislative history reveals a Congressional expectation that, over time, exchange trading of swaps would reduce transaction costs, enhance market efficiency, and counter the ability of dealers to extract economic rents from higher bid/ask spreads at the expense of other market participants."

On an all-to-all central limit order book⁵¹ (CLOB), the best price quotes on the limit order book are transparent to all market participants and are simultaneously executable. For example, a buyer can choose the lowest of all of the simultaneously available quoted prices. This is the essence of effective pre-trade price transparency. Moreover, on an all-to-all CLOB, a buy-side firm has the option to supply quotes to other market participants, thus offsetting some of its execution costs with the ability to both make and take quotes. Setting up CLOB venues is justified when trading activity is sufficiently broadly spread and frequent to generate attention to trading opportunities by liquidity providers and to provide sufficient fee income to the venue operator.

Unfortunately, even after the implementation of Dodd-Frank, buy-side firms tend to avoid trading swaps on existing CLOB platforms. An important impediment here is the practice known as “name give-up”, by which the identity of the buy-side firm must be “given up” to whichever firm is allocated its trade. This leaves a buy-side firm with little control over leakage of information about its trading intentions, as explained by the Managed Funds Association (2015a). This means that buy-side firms are effectively encouraged to trade on RFQ-based MTFs. The average trading costs of buy-side firms are therefore higher than would be the case without the practice of name give-up.

Another important loss of market competition arises from the fragmentation of trade across many different trade platforms. Well-established economic theory implies that markets are more efficient and investors receive better pricing when more market participants compete for trade at the same venue. Most obviously, from the viewpoint of a quote seeker, the best price from among a small set of bidders is not as attractive as the best price available from an enlarged set of bidders. This is true even if the bids do not depend strategically on the size of the bidding population. For example, for a would-be seller of a financial asset, the highest of the first five prices drawn from a given pool of potential bid prices is not as high as the highest of the first 50 bid prices. Strategic competition among bidders further improves the best price available to the quote seeker. That is, a given bidder will compensate for an increase in the population of competing bidders by bidding more, being aware that a given bid price is less likely to be the highest price as the set of bidders is enlarged.⁵²

Chart 6, from a study of bond trading platforms by Hendershott and Madhavan (2015) confirms the theoretically anticipated relationship between the number of

⁵¹ The dominant trading mechanism of modern derivatives and securities exchanges is the central limit order book, a form of auction market in which any exchange participant can anonymously place orders to buy or to sell. An order to buy typically specifies both a quantity and a “bid”, which is the price at which the order submitter is willing to buy up to the specified quantity from any exchange participant. A sell order, similarly, specifies a quantity for sale and an offer price, executable by any exchange participant. A trade is executed whenever a buy order and a sell order “cross”, meaning that the bid price is at least as high as the offer price. A “market order” is a request to trade at the best available standing limit order. For example, a market order to buy is executed at the lowest-price limit orders to sell that are already on the limit order book.

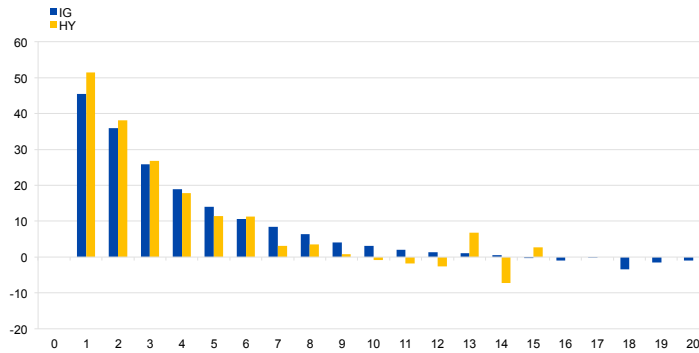
⁵² A typical theoretical result is due to Cripps and Swinkels (2006). The cost of fragmentation is also evident in the results of Hoffman (2013), who provides empirical evidence that cross-venue access friction, such as the absence of a trade-through rule, reduces competitiveness by increasing adverse selection. He analyzes trading in French and German stocks, and finds that trades on Chi-X, a low-cost trading platform, carry significantly more private information than those executed in the primary markets.

dealers providing quotes on MarketAxess, a corporate bond MTF, and the expected trading cost to the quote requester, controlling for other factors. Chart 6 shows that the expected trading cost declines rapidly with the number of dealers providing quotes.

Chart 6

Increasing platform competition lowers transactions costs

(x-axis: trade cost (basis points); y-axis: number of dealers quoting)



Source: Hendershott and Madhavan (2015).

Notes: How transaction costs vary with the number of dealers responding to a request for quotes. The chart shows costs in basis points of notional amount, by the number of dealer responses in all electronic auctions on Market Axess in the sample with at least one response, broken down for investment-grade (IG) and high-yield (HY) bonds. Data are from January 2010 through April 2011, excluding all interdealer trades.

As explained by ISDA (2016a), one of the causes of fragmentation has been the lack of harmonization between the EU and United States with respect to rules and mutual recognition of trading facilities. The Final Report of the IOSCO (2015) Task Force on Cross-Border Regulation provides a range of examples and principles for “passporting”, a form of mutual recognition.

1.21 Post-trade price transparency

In any market format, competition is generally improved by fast and comprehensive post-trade transaction reporting. The quick public dissemination of transactions prices gives all market participants an indication of the prices at which trades may be available in the next short interval of time. Knowledge of the “going price” is a particularly important mitigant of the bargaining disadvantage of buy-side market

participants, who generally have much fewer direct observations of trading encounters than do dealers.⁵³

Post-trade transaction reporting also allows buy-side investors to monitor and discipline the execution quality of their past trades by comparing the prices that they obtained from a dealer with the prices that were obtained for other trades conducted elsewhere in the market at around the same time. A dealer, aware of being monitored in this fashion through post-trade price dissemination, and at risk of losing reputation and repeat business over poor execution prices, will provide somewhat better pricing to its customer.

Post-trade price transparency was mandated for the US corporate bond market beginning in 2002, in the form of the Transaction Reporting and Compliance Engine (TRACE). This eventually led to the public reporting of trade prices for essentially all US corporate bonds and some other fixed-income instruments. TRACE has lowered bid-ask spreads in most of the segments of the bond markets that it covers, although the impact on market liquidity has not been uniformly positive, as explained in Appendix 3, which summarizes the empirical evidence on the impact of TRACE.

Until post-trade transactions reporting is more effectively amplified by the full implementation of MiFID, buy-side participants in Europe's OTC markets will not have effective post-trade price transparency.

2 Appendices

2.1 SLR and intermediation distortions

Regulators are now requiring that a large bank's capital must exceed a given fraction of the bank's total quantity of assets, irrespective of their riskiness. This "leverage requirement" is simpler than the conventional risk-weighted-asset (RWA) capital requirement, which calls for capital levels that depend on the average risk profile of the bank's asset portfolio. Conventional RWA capital rules had not worked well leading up to the Great Financial Crisis because the risks of some assets were badly understated. That's not so surprising for those assets whose riskiness is measured by banks themselves. Banks typically prefer lower capital levels than regulators would judge sufficient, and thus have a moral hazard to understate risks. Regulators, for their part, assign relatively undifferentiated and unrealistically low risk weights to sovereign debt.

⁵³ The SEC (2010) described the degree of price transparency for single-name CDS, which it calls "security-based swaps" (SBS), by writing: "By reducing information asymmetries, post-trade transparency has the potential to lower transaction costs, improve confidence in the market, encourage participation by a larger number of market participants, and increase liquidity in the SBS market. The current market is opaque. Market participants, even dealers, lack an effective mechanism to learn the prices at which other market participants transact. In the absence of post-trade transparency, market participants do not know whether the prices they are paying or would pay are higher or lower than what others are paying for the same SBS instruments. Currently, market participants resort to "screen-scraping" e-mails containing indicative quotation information to develop a sense of the market."

Putting aside these incentive problems in setting risk weights, the risks are often difficult to estimate. The simplicity of the new leverage requirement, which treats all assets as though equally risky, has thus promoted its heavy use in new capital rules, to the point that the balance sheet management of some of the largest banks seems to be determined in significant part by these new gross leverage requirements. This has implied a shift by some large banks away from low-risk low-profit intermediation, consistent with modeling by Kiema and Jokivuolle (2014).

Models in which both banks and regulators are averse to risk-taking by banks, developed by Kim and Santomero (1988), Rochet (2008), and Glasserman and Kang (2014), show that “flattening” regulatory risk weights across asset classes, relative to actual risks, could inefficiently distort risk-taking by banks, causing them to shift from low-risk assets to high-risk assets. This is not a surprise. Kiema and Jokivuolle (2014) also show that the leverage ratio rule can reduce financial stability by causing more banks to be jointly vulnerable to similar high-risk assets, unless the minimum leverage ratio pushes capital levels much higher.

Debt overhang may be an even greater source of distortion in intermediation incentives under the supplementary leverage ratio. Debt overhang, a concept attributable to Myers (1977), refers to the incentive of a firm to avoid positive-net-present-value investments when the additional capital required for the investment causes a sufficiently large transfer in value from shareholders to creditors, due to a safer balance sheet. When a bank issues equity in order to meet a high regulatory capital requirement for a low-risk position, thus making its balance sheet safer, bank creditors benefit from a transfer of wealth through the increased safety of their debt claims. For such an intermediation trade to be economically viable, its mark-to-market profit must exceed the associated wealth transfer to creditors, as modeled by Andersen, Duffie, and Song (2016). Debt overhang is smaller for more highly capitalized banks, therefore giving them an important advantage in competing for trades.

A natural reformation of risk-weighted capital requirements would make some differentiation across asset classes based on risk, but be conservative. An improved approach would recognize that, other things equal, banks are likely to invest more heavily in assets with lower risk weights. Even for an asset class that is fairly judged to be quite safe, concentrated investment increases the likelihood, given a bank failure, that this asset class is responsible for much of the loss. So, the lowest risk weights should not be as low as they are today. Moreover, as a bank’s investments become more concentrated in a given asset class, the associated risk weights for that asset class should go up. The same principle applies on a systemic basis. As investments by banks, in aggregate, become more concentrated in a given asset class, risk weights for that asset class should rise.

Further, assets whose risks are difficult to judge should be assigned higher risk weights. If an extreme-scenario loss is heavily model dependent, and if we are uncertain about which model to use, one should apply a model that is likely to be relevant contingent on the event of a large loss. When in doubt regulators should be more conservative.

I now offer a simplified illustration of the debt-overhang impact of the SLR on the incentive of a bank to conduct a repo intermediation.⁵⁴

Consider a bank acting as a securities dealer, possibly through an affiliate subject to consolidated capital requirements under the Basel G-SIB standards. For simplicity, suppose that the SLR is binding for this bank, so that it must have at least C in additional capital for each additional unit of measured assets, regardless of the asset risk. On a candidate repo trade, the bank would initially receive from its counterparty German government bonds (Bunds) with a market value of $1+H$, in exchange for 1 in cash, where H is a "haircut" designed to protect the bank from counterparty failure. At maturity in one day, the bank returns the Bunds to the counterparty in exchange for $1+R$, where R is the repo rate, measured for simplicity on a per-day (rather than annualized) basis. The repo rate R exceeds the bank's cost of funding by some rate spread G . In this case, the bank can obtain funding in the repo market by using the same Bunds as collateral.

Repos are exempt from stays at counterparty failure, so the bank could suffer an unexpected loss on this trade only if, within a day, both of two unusual events happen: (i) the counterparty defaults; and (ii) the value of the Bunds drops by more than the haircut H . In practice, this combined outcome is so unlikely that an event of this type has not been reported since the 1982 failure of Drysdale Government Securities, when counterparties had mistaken their haircut assignments.⁵⁵ So, in the absence of capital requirements, because this trade is nearly risk-free, it has essentially no effect on the market values of the bank's debt and equity, other than the intermediation gain of G , which we can assume for simplicity is paid to equity as a distribution. Because the SLR is binding, however, the bank must have approximately C in additional equity in order to conduct this trade. A simple way for the bank to arrange this additional equity is to retire approximately C worth of unsecured debt, funded by an equity issuance of the same amount. In practice, the bank would not conduct an equity issuance for each repo trade. Instead, it would have a policy for how much repo it wishes to conduct on a normal on-going basis, and adjust its capital structure so as to meet its capital requirements, with some buffer designed to conservatively avoid compliance problems.

In our simple example, the remaining legacy unsecured creditors benefit to the extent that the retired debt no longer claims a share of the recovery value of the bank's assets in the event that the bank defaults. Instead, that default-contingent recovery claim is absorbed by the remaining unsecured creditors. The market value of this additional default-contingent debt recovery claim, per unit of retired debt, is the difference D between the market value of a default-free debt claim and the market value of an unsecured debt claim on the bank. This difference D is therefore equal to the credit spread S of the bank's unsecured debt. Because C units of debt were retired, the net gain in value to the legacy debt is therefore CS . Given that the

⁵⁴ This example is related to the modeling of funding value adjustments by Andersen, Duffie, and Song (2016).

⁵⁵ Garbade (2006) describes the failure of Drysdale Government Securities in 1982, and explains that losses suffered by repo counterparties were caused by haircuts that did not correct for accrued interest. Garbade goes on to show how contracting practices have changed to prevent such occurrences.

balance sheet of the bank is otherwise unchanged, the shareholders' net gain is the funding spread G on the repo trade, less the wealth transfer of CS to legacy unsecured creditors. Thus, the incremental impact of the capital requirement on the bank's incentive to conduct the repo is equal to CS .

For illustration, consider an SLR of 3% (the current European minimum regulatory leverage ratio for the largest EU banks) and a typical annualized bank credit spread of 100 basis points.⁵⁶ The bank must therefore lower its bid and raise its offer for Bund repo intermediation by $CS = 3$ basis points each in order to compensate shareholders for the effect of SLR,⁵⁷ for a total impact on the bid-offer spread of 6 basis points (bp). According to the ICMA European Repo Council (2015): "Historically, for short-dated liquid repo markets, typical bid-ask spreads would be less than 5bp, and possibly only 1-2bp." So, the impact of the SLR on repo intermediation incentives is bigger than the entire pre-SLR bid-ask spread.

The International Capital Markets Association (ICMA) European Repo Council (2015) states that the leverage ratio rule is a major friction in the provision of repo intermediation by European banks. In terms of the impact of the SLR on repo market liquidity, however, Europe has the benefit over the United States of (i) a lower SLR; (ii) an active direct repo electronic platform trading market; and (iii) some broad-market central clearing of repos. I have already described the dramatic reduction in volume and enormous increase in bid-ask spread in the US government securities repo market since the imposition of the 5% SLR on the largest US bank-affiliated broker-dealers.

As for the actual total quantity of repos conducted in Europe (whether by EU or non-EU banks), the latest survey of the EU repo market by the International Capital Markets Association (2016) shows little change in volume over the four-year period ending December 2015. Bucalossi and Scalia (2016) estimate little adverse impact of the leverage ratio rule on European repo market activity.

The direct repo market accounts for over half of all European repo trade.⁵⁸ However, most European repo intermediation, even on direct repo platforms, is done by banks. The market may someday evolve to one in which non-bank participants could offer significant direct repo intermediation, thus returning some liquidity to the market. Europe's CCP advantage should allow some European banks to net some of their long and short positions so as to reduce their measured repo assets.⁵⁹ That is, a bank doing matched-book repo intermediation with counterparties on both sides that clear through the same CCP can reduce its asset position by netting its long and short positions at the CCP, thus reduce its regulatory capital requirement for

⁵⁶ From Bloomberg data, as shown in Chart 4, the average of the CDS rates of global banks during 2016 is about 100 basis points. The CDS rate for Deutsche Bank during 2016 has averaged approximately 150 basis points, see [Bloomberg](#).

⁵⁷ Under Basel II rules, risk weights on repo were typically 20%, or one-fifth of the effect of a binding SLR risk weight of 100%.

⁵⁸ See ICMA, [Mapping the interdealer European repo market](#).

⁵⁹ The benefits of repo CCP in the Eurex Repo General Collateral Pooling (GCP) market are documented by Ebner, Fecht, and Schulz (2016). According to the survey conducted by ICMA (2016), roughly one-fifth of European repo trade is centrally cleared.

conducting repo intermediation, and therefore narrow its required bid-offer spread. As I have mentioned, the initiatives to begin a broad market repo CCP in the United States have not yet succeeded.

2.2 Why bilateral trade is often inefficient

In an opaque bilateral over-the-counter (OTC) market, two buy-side firms are rarely, if ever, able to identify each other as beneficial direct trade counterparties. Almost invariably, a buy-side firm has no reasonable option but to trade with a dealer. In order to conduct a trade in the bilateral OTC market, a representative of a buy-side firm would typically contact a dealer's trading desk and ask for bid and offer quotes. The quotes are good only when offered, and only for trade sizes up to a conventional notional quantity that can depend on the type of product. The buy-side representative can either agree immediately to trade at the dealer's bid or offer, or can decline. If the buy-side firm agrees, then an increase in the notional quantity may also be negotiated. The dealer may agree to increase the notional quantity of the trade at the same price terms or may demand additional price compensation for increasing the size of the trade.

This "bilateral" (one-on-one) trade negotiation places a buy-side firm at a substantial bargaining disadvantage to a dealer. A buy-side firm rarely has as much information as the dealer concerning the "going price" for the specific product. Thus, when offered given price terms by a dealer, a buy-side firm cannot be confident whether the dealer's quotes are near the best available quotes in the market. The buy-side firm does not know, moreover, which dealers are likely to provide the best quotes for the trade in question.

As opposed to a dealer, a buy-side firm seeking to sell cannot obtain better pricing by trading directly with another buy-side firm that has a natural motive to buy, and vice versa. Moreover, a buy-side firm cannot force two or more dealers to compete effectively against each other for the trade because of the bilateral nature of the bargaining encounter. I will now elaborate on this last point.

A buy-side firm has the option to reject the price terms quoted by the dealer with whom it is negotiating, and search for better terms from another dealer. But the buy-side firm must negotiate with dealers sequentially, that is, one at a time. The buy-side firm cannot choose the best from among various different dealers' simultaneously executable quotes. The mere fact that a buy-side investor can eventually request quotes from different dealers does not in itself cause dealers to compete aggressively with each other in order to win the investor's trade. In this setting of one-on-one negotiation, a buy-side market participant has no ability to force dealers to compete directly with each other. When facing a buy-side customer, each dealer holds a degree of monopoly power over its buy-side customer because

the customer has no ability to pick the best of many simultaneously executable price quotes.⁶⁰

In some cases, a buy-side firm would contact one or more dealers only to discover that the quoted prices are not sufficiently attractive, and would decline to trade at all. Because of the low degree of competition in the OTC market, the buy-side firm may have missed the opportunity to make a beneficial trade that might have been available at sufficiently attractive price terms in a more competitive market, such as that provided by an exchange. Missed opportunities for beneficial trade represent an additional cost of an opaque OTC market.

When providing quotes in the OTC market, a dealer provides bid and ask prices that trade off the impact of widening the quoted bid-ask spread on (i) the profit that would result from agreement by the buy-side firm; and (ii) the probability of agreement. Widening the bid-ask spread increases the former and reduces the latter, because a wider quote increases the incentive of the buy-side firm to search for more favorable terms from another dealer (or to simply decline to trade). If the dealer perceives that the buy-side firm does not have an attractive “outside option” to search for other quotes, the dealer can widen its bid-ask spread accordingly. In a dealer-dominated opaque OTC market, the buy-side firm’s outside option is a costly delay to find another suitable dealer, followed by another negotiation with a new dealer who has a bargaining position of similar strength to that of the first dealer contacted. There is no opportunity to get the two dealers (or more than two dealers) to bid directly against each other. The poor outside options available to buy-side firms in an opaque market therefore imply wider bid-ask spreads than would be available on an exchange. This discourages some trade, and the associated gains from trade are lost, a reduction in welfare.

2.3 TRACE price transparency

A significant experiment with post-trade price transparency was the introduction, mandated by the SEC beginning in 2002, of the Transaction Reporting and Compliance Engine (TRACE), which eventually led to the public reporting of trade prices for essentially all US corporate bonds and certain other fixed-income instruments. This appendix summarizes the empirical evidence of the impact of TRACE post-trade price transparency on the liquidity and competitiveness of US corporate bond trading.

Bessembinder and Maxwell (2008) reported that: “The introduction of transaction price reporting for corporate bond trades through the TRACE system in 2002 comprised a major shock to this previously opaque market. Investors have benefited from the increased transparency through substantial reductions in the bid-ask spreads that they pay to bond dealers to complete trades. Conversely, bond dealers have experienced reductions in employment and compensation, and dealers’ trading activities have moved toward alternate securities, including syndicated bank loans

⁶⁰ See Zhu (2012) and Duffie, Dworczak, and Zhu (2015), who model the impact on allocative efficiency.

and credit default swaps. The primary complaint against TRACE, which is heard both from dealer firms and from their customers (the bond traders at investment houses and insurance companies), is that trading is more difficult as dealers are reluctant to carry inventory and no longer share the results of their research. In essence, the cost of trading corporate bonds decreased, but so did the quality and quantity of the services formerly provided by bond dealers.”

Bessembinder, Maxwell, and Venkataraman (2006) found that with the introduction of TRACE, trade execution costs fell by about 50% for those bonds whose transactions were covered by TRACE. They also found a spillover effect: even for bonds not covered at that time by TRACE, transactions costs dropped by 20%. The authors speculate that publishing the prices of TRACE-eligible bonds provided additional information on the fair market values of bonds not eligible for TRACE reporting.

Harris and Piwowar (2007) also find that TRACE reduced transactions costs. Goldstein, Hotchkiss, and Sirri (2007), however, find that less frequently traded bonds and very large trades showed no significant reduction in bid-ask spread with the introduction of public transaction reporting under TRACE. Moreover, Goldstein, Hotchkiss, and Sirri (2007) and Asquith, Covert, and Parath (2014) do not find that TRACE increased trading activity. Indeed, Asquith, Covert, and Parath (2014) found that TRACE *reduced* trading activity significantly for high-yield bonds. A reasonable interpretation is that, with the reduced profitability of market-making caused by greater price transparency, dealers had a reduced incentive to make markets, especially in thinly traded bonds.

Bessembinder and Maxwell (2008) note the dramatic increase in corporate bond trading volume on the electronic platform – MarketAxess – that followed the introduction of TRACE, saying: “We believe that TRACE improved the viability of the electronic market. In the presence of information asymmetries, less-informed traders will often be dissuaded from participating in a limit order market, knowing that their orders will tend to be ‘picked off’ by better-informed traders if the price is too aggressive, but left to languish if not aggressive enough. TRACE likely increased traders’ willingness to submit electronic limit orders by allowing traders to choose limit prices with enhanced knowledge of market conditions.”

While bid-ask spread is often a useful measure of trading costs, Asquith, Covert, and Parath (2014) focus on intraday price dispersion. The relevance of this measure is motivated by the idea that, in an opaque OTC market, the same bond, on the same day, can be traded by dealers at much different prices with some customers than with other customers, even if there has been no significant new fundamental information on the bond’s quality during the day. Asquith, Covert, and Parath (2014) show that the intraday dispersion of prices for riskier corporate bonds was reduced on average by over 40% with the introduction of TRACE post-trade price transparency for those bonds. This represents a dramatic reduction in effective trading costs for those buy-side investors who, without TRACE transparency, had been paying far higher trading costs than other (presumably more sophisticated and better informed) market participants.

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