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ATRADIUS ON HOW COMPANIES CAN BE READY FOR IFRS 9

OLIVIER PAUL SHEDS LIGHT ON THE UNPRECEDENTED CHANGES FACING THE TRADE FINANCE INDUSTRY

MARK CARNEY CONSIDERS THE IMPACT OF GLOBALISATION ON INFLATION

THE GLOBAL TRADE PLATFORM

FOREWORD

Welcome to the *WCR* Finance ePub. This publication has been prepared in response to readership demand for an overview of the financial sector in these turbulent and unique times.

All aspects of the sector are examined, with the most respected authors providing the reader with the most comprehensive information available. Our brief is to provide all the data necessary for the readership to make their own informed decisions. All editorials are independent, and content is unaffected by advertising or other commercial considerations. Authors are not endorsing any commercial or other content within the publication.

We are pleased to advise that the publication is sponsored by Atradius Credit Solutions, winner of the 2018 *WCR* *Best Credit Insurance Provider*, who are the leader in their field. Please click on the logo to link to details of their global leading products.

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A global architecture for international trade: a collaborative approach

Olivier Paul sheds light on the unprecedented changes facing the trade finance industry, and explains how ICC aims to positively shape the global trade landscape

The global economic system is going through a period of significant change, while also facing numerous and complex challenges – particularly when it comes to global trade. Indeed, the value of trade to emerging markets and companies trading in these regions is widely acknowledged. What is less clear, however, is the intrinsic value of trade finance in driving that trade.

Through financing orders and mitigating payment and supply risks for buyers and sellers, players can transact with distant and often unfamiliar counterparties with confidence. But in order to secure future stability and growth, the global trade architecture needs reassessing and reshaping. It needs to evolve – not least because the trade finance industry is facing a period of unprecedented technological innovation.

Such change throws up some challenges, for sure. But the opportunities for growth and development far outweigh any concerns. Given this, we at the International Chamber of Commerce (ICC) Banking Commission have an important role in helping prepare the industry for the future: advocating and influencing changes such as regulation, digitalisation and the entry of new players. Moreover, shared principles around regulation and compliance also help level the trade landscape and support those operating in the trade finance industry across the world.

A period of transformation

Certainly, the global trade environment is experiencing a period of transformation around policy, risk, and the provision of finance. As the ICC Banking Commission 2017 survey *Rethinking Trade and Finance* highlights, there are some major changes ahead for trade finance, involving regulatory changes, technological evolution and the entrance of new non-bank sources of liquidity.

At the same time, since the 2008 global financial crisis we have witnessed the growth of protectionist forces against trade – a global phenomenon that, while emerging in sometimes surprising ways, knows little with respect to ge-

ographic or developmental boundaries. This is of significant concern considering that trade generates macro-level benefits, such as helping turn startups into global companies generating employment.

Such rhetoric impacts the trade landscape and has a direct and indirect consequence on cross-border flows. In fact, despite the clear benefits, protectionism has translated into real measures, with new trade restrictions in 2016 reaching their highest levels since pre-crisis, and G20 economies adopting more trade-restrictive measures than trade facilitating ones. As a result, while trade growth is on the rise it has not yet reached pre-crisis levels with respect to outpacing global GDP growth.

... effective collaboration between banks, pension funds, fintechs and all industry players will be key for the development of the trade finance industry

Meanwhile, the trade finance industry has experienced dramatic shifts in the regulatory landscape. In the immediate aftermath of the financial crisis increased regulation was, justifiably, deemed imperative to the health and sustainability of the global financial system. However, the industry continues to search for the optimal balance between the need to foster global growth and implement efficient, risk-aligned, trade finance regulations.

For example, Basel III capital requirements have reduced the amount of lending a bank can offer at each level of capital reserves. According to the 2017 *Rethinking Trade and Finance* survey, financial institutions have reported both anti-financial crimes regulations and Basel III regulatory requirements (80% and 71%, respectively) as major impediments to trade finance provision.

Fortunately, efforts to refine Basel III regulations to better align to the trade finance industry are underway. Certainly, recent changes – aimed at reducing disparities in the way in which the internal ratings-based model is applied by banks – should help reduce regulatory complexity. Yet the impact of Basel III on lender appetite is undeniable.

Similarly, compliance requirements relating to anti-money laundering (AML) and know your customer (KYC) have unintentionally increased the costs and complexity of trade finance transactions for banks, requiring banks to employ additional capacity for new oversight responsibilities. This – along with reputational risks and concerns over low profit – is contributing towards banks de-risking and reducing correspondent relationships, particularly in emerging markets. The International Finance Corporation's 2017 *Survey on Correspondent Banking* found that, globally, 27% of survey participants noted a reduction in correspondent banking relationships in 2016, while several regions reported reductions with significant frequency.

This is subsequently impacting the amount of trade finance available in these markets and primarily affecting small and medium-sized enterprises (SMEs). In fact, de-risking and the loss or potential loss of correspondent banking

relationships limits the positive impact that banks can make in maximising a country's macroeconomic growth and stability.

So, what does all this mean for the trade finance landscape? The latest *Rethinking Trade and Finance* report revealed that 61% of respondent banks reported more demand than supply for trade finance, while the Asian Development Bank (ADB) also reported a US$1.5 trillion gap between supply and demand for trade finance. Furthermore, SMEs experience the most difficulties accessing trade finance – impacting their growth, and ability to expand internationally.

Adding to this complex picture, the trade finance industry is also adjusting to the entry of new players – such as challenger banks, fintechs, pension funds, hedge funds and insurers. While these entrants should be encouraged – they provide additional sources of liquidity and foster innovation – they must also decide whether they want to purely disrupt the trade finance landscape or to complement it.

Efforts underway

While there are various challenges in the trade finance industry, these must be balanced by the considerable efforts aimed at improving the global trade environment. Limiting any negative impacts of protectionism should, of course, be a priority. This is precisely why ICC is working with the World Trade Organisation (WTO) to establish new trade recommendations for all nations. Both organisations sincerely believe that a level playing field for trade helps reduce negative perceptions of trade.

ICC's annual Open Markets Index (OMI) provides a useful tool, representing 90% of trade and investment worldwide and highlighting the levels of trade openness in different economies. The four main components of the OMI consist of: observed openness to trade, trade policy settings, foreign direct investment openness, and trade-enabling in-

frastructure. Despite pledges to enable trade as a driver of growth and job creation, the 2017 OMI report found that G20 economies are failing to demonstrate global leadership on trade openness, with only Canada placed among the world's top 20 open markets.

Yet in order encourage trade growth and help close the financing gap, we must also foster financial inclusion: in this respect defined as including SMEs in the global financial landscape (both in developed and emerging markets). While there are multiple reasons behind the financing gap, one of the key causes is the regulatory environment for trade and the constraints this places on banks financing of trade, especially for SMEs. Raising awareness around the low risk profile and true characteristics of trade finance to regulators is therefore a key area of advocacy for the Banking Commission.

For instance, ICC Banking Commission's annual *Trade Register* surveys bank default rates on trade instruments – providing an evidence-based support for our advocacy efforts geared towards a greater risk-aligned treatment of trade finance. The *Trade Register* highlights the favourable risk profile of trade finance instruments when judged against comparable asset classes, such as corporate lending. It also aims to further increase the attractiveness of trade finance to banks – helping maintain and even add to bank-supplied liquidity for cross-border commerce.

What's more, the *Trade Register* findings reinforce the case for trade finance to be increasingly recognised as a reliable and investible asset class to institutional investors – potentially providing further funding and support for the industry.

Levelling the playing field

In an increasingly complex landscape, the importance of guidance – with respect to compliance and its application – is critical. To this end, ICC, the Wolfsberg Group and BAFT formed the Trade Finance Principles Drafting Group in

April 2014. The group aims to provide guidance on a broad range of trade finance compliance areas, such as control mechanisms (eg. customer due diligence). The group benefits from diverse expertise and perspectives, considering the combined member base from all three partner institutions.

In particular, the *Trade Finance Principles* outline the role of financial institutions in managing processes addressing financial crime risks, as well as compliance with national and regional sanctions and embargoes. Such a collaborative effort ensures that practices around financial crimes compliance for trade transactions are standardised, and that all banks operate on a level playing field. This is crucial considering the global nature of the industry, as well as the fact shared principles need to consider variations in cultures and sizes of all banks involved in trade finance.

The Group updated these *Principles* earlier this year, since changing regulatory expectations made it necessary to identify where expectations have also changed, and where the basic principles, or their application, needed readdressing.

The digital revolution

Meanwhile, much of the industry's focus is currently around the digital revolution, as the digitalisation of trade finance is now widely understood to provide benefits around efficiency, costs and transparency – as well as in encouraging new entrants and wider collaboration.

As this year's *Rethinking Trade and Finance* report highlights, the digitalisation of the trade finance industry is influencing business models and strategies for corporates and banks, primarily due to its power to simplify and reduce costs. Indeed, through increased transparency and reduced risk, digitalisation can potentially help trade banks meet their regulatory and compliance requirements. In turn, this allows banks to better serve SMEs and stimulate trade flows.

Clearly, industry players should focus on accelerating the benefits of digitalisation in line with wider trade finance goals, particularly as increased collaboration will enhance progress. This is precisely why ICC Banking Commission launched a Working Group on Digitalisation earlier this year, with a focus on helping the industry *"accelerate the digital journey"*.

The Working Group aims to do this specifically through assessing the 'e-compatibility' of ICC rules for trade finance – developing a set of minimum standards for the digital connectivity of service providers, and examining the legal and practical issues related to the validity and value of data and documents in digitised form.

Still, while digitalisation has the potential to bring benefits and transform the trade finance industry, its success relies on a rules-based approach as well as the development of standards. We aim to prepare the industry for the significant technological changes underway and ensure that today's rules – used by 90% of the banking industry – remain up to date.

Eventually, the Group intends to create standards to on-board third-party providers, attracting non-bank providers and fintechs while ensuring harmonisation across the industry. This will aid efficiency while also bringing transparency and reducing operational risk.

Collaboration is key

Ultimately, with a host of new changes around regulation, compliance, digitalisation, and new players entering the industry, effective collaboration between banks, pension funds, fintechs and all industry players will be key for the development of the trade finance industry.

It is here that international organisations such as ICC can work together with other multilateral organisations in order to drive the industry and support such collaboration. Such efforts go a long way in helping to prepare the

trade finance industry for future developments and positively shape the trade landscape – strengthening the global economy and increasing prosperity for communities worldwide. ■

Olivier Paul is International Chamber of Commerce (ICC) Banking Commission's Head of Policy

Ten years ago, the world watched as companies considered too established to fail, did so, with aplomb. One decade on, the fallout from the 2008 'credit crunch' is still felt the world over. No surprise then, that much has been done to ensure that the financial impact on businesses of any future financial crisis is mitigated. New regulations and legislation have been put in place to help companies prepare for and manage bad debts whether they be sudden and unexpected, or predictable.

One such measure is IFRS 9, a new regulation for companies that report using IFRS accounting standards, which comes into force in January 2018. IFRS 9, besides other areas, encourages businesses to adopt processes, standards and models that more accurately calculate and provision for potential future trade credit losses.

The objective behind the new regulation is simple. To upgrade the trade credit risk provisioning process by requiring companies to comply with a new set of credit impairment principles. Businesses will need to have greater insight into the insolvency risk posed by their buyers and provision accordingly. In real terms, the idea is that as a result, trade credit risk will be more accurately and more transparently represented on a company's Balance Sheet than ever before.

What do businesses need to put in place?

The regulation introduces an upgrade of the current trade credit risk provisioning by moving from the 'incurred loss' model to the 'expected trade credit losses' model (ECL).

Under the incurred loss model companies often make no provisions at all for receivables that are not yet overdue. IFRS 9 is meant to ensure that the trade credit risk that is inherent in every single receivable is accounted and provisioned for, even if expected losses are low.

So, what do these new requirements demand? In simple terms, many businesses will need to modify their current trade credit information systems and processes in order to facilitate debt provision changes. For financial institutions, this will prove particularly challenging due to their substantial exposure to trade credit risk. For non-financial organisations, it's significantly less complicated and is something that your trade credit insurer can really help with.

Andreas Tesch, CMO of leading global trade credit insurer Atradius, explains:

> *"To date, many companies have relied on a 'trigger event' such as an invoice becoming overdue, before making a bad debt reserve for the particular buyer. Historically, this has been deemed perfectly acceptable practice – however, the new regulation will require businesses to provision based on the overall level of credit risk in the receivables portfolio from January 2018 onwards, and not just based on the overdue ones."*

For businesses seeking a clear, simple route forward on IFRS9, one which streamlines process and alleviates the need to make choices from a multitude available, partnering with a trade credit insurer and collections agency has obvious advantages

"Companies will need to take into account all of their receivables and all of their buyers when calculating their expected trade credit loss. So, insight into the likelihood of your buyer defaulting on payment and the health of your overall portfolio, becomes vital. We have a wealth of information and expertise at our fingertips, that will help companies to do this."

Let's look at some of the things businesses currently face in order to become IFRS 9 compliant.

The challenges

One of the biggest challenges faced by financial and non-financial organisations alike is that this regulation is 'principle based'. It doesn't provide clear definitions or processes to follow, in order to be compliant. And whilst there is a positive in that this gives companies flexibility to establish what they deem to be the best route for their particular organisation, there also exists the downside that a multitude of decisions need to be made regarding the methodologies to be put in place, requiring significant time and resources in order to build the model that still needs to be approved by auditors.

The next major challenge facing finance teams will be to obtain the right kind of data. There are a number of facets a business will examine in order to determine buyer quality. Probability of default information and loss given default details will become important, along with other external risk factors such as macroeconomic developments. Data analysis will need to be consistent across regions while still considering sector specific factors and ensuring transparency and auditability of the underlying processes.

Once data requirements are in place, the third challenge is determining how to model all of the trade credit risk parameters needed for the calculations of ECL (ie. the bad debt reserves). The business has a number of modelling approaches to choose from, each potentially leading to different values for the ECL estimates. The calculations used

in the model are likely to include segmentation by geography, sector, product type or customer rating, will have to be auditable and will need to provide all the details required for making IFRS 9 disclosures.

The final hurdle is then to embed this as a process across the organisation so that it quickly becomes 'business as usual' without creating entire internal 'mini industries' in order to meet the requirements. In a global organisation with thousands of customers, potentially spread across diverse sectors and segments, this part is potentially the most critical, as it could prove both costly and damaging if unwieldy or inefficient processes are implemented.

The solutions

Putting measures in place in order to comply with IFRS 9 can be complex: but it needn't be the case.

Atradius CMO, Andreas Tesch, explains how trade credit insurance and outsourced collections can help businesses address the bad debt provisioning challenges of IFRS 9.

> *"We talk daily to Financial Directors the world over and IFRS 9 needn't be as much of a hurdle as businesses might suppose. We are here to help and our customers are positioned to benefit from three key parts of our offering. Trade credit insurance, debt collections and business intelligence can play a role in terms of robust reporting, forecasting and provisioning."*

Here's how.

Trade credit insurance: less risk, more value

Trade credit insured businesses enjoy the benefits of reduced risk via insurance and buyer ratings delivering the necessary buyer information for calculation of expected trade credit losses under IFRS 9. The combination saves

the company time – in most cases Atradius Credit Insurance customers can get a rating on their buyer in minutes through the Atradius Atrium customer portal – and can reduce the capital tied up in reserves as the amount at risk can be significantly reduced by the insurance.

Reduced bad debt reserve requirements

Trade credit insurance alone means that a business's debt provisions can be lower as the risk is transferred to the insurer, instantly putting a business in a stronger position. But there is also a clear additional benefit in partnering with a trade credit insurer for debt collection - which is something Atradius also offers as standard to trade credit insurance policyholders and as a stand-alone service for non-insured businesses. Being able to demonstrate strong success rates in your historical debt collections reduces 'loss given default' levels and subsequently the bad debt reserve requirement. So a business's position is strengthened considerably with an effective debt collection solution in place, once again, helping lower bad debt reserve requirements.

Business intelligence, the way you need it

This is perhaps the biggest hurdle for many companies faced with putting measures in place. Geography, diverse providers and methodologies, inconsistent models – they can all create a headache for the most prudent Financial Director struggling with multiple data sets based on a number of different parameters. Atradius's Buyer Ratings provide a snapshot of the likelihood of a buyer going into default.

This simple measurement tool is embedded in Atradius's trade credit insurance policy offering, and can be used to help businesses meet their IFRS 9 requirements, i.e. as one of the factors used in calculation of the expected trade credit loss. With real time intelligence on around 240 million businesses around the globe, there is a clear benefit to integrating Atradius solutions into a business's knowledge and reporting, rather than attempting to go it alone.

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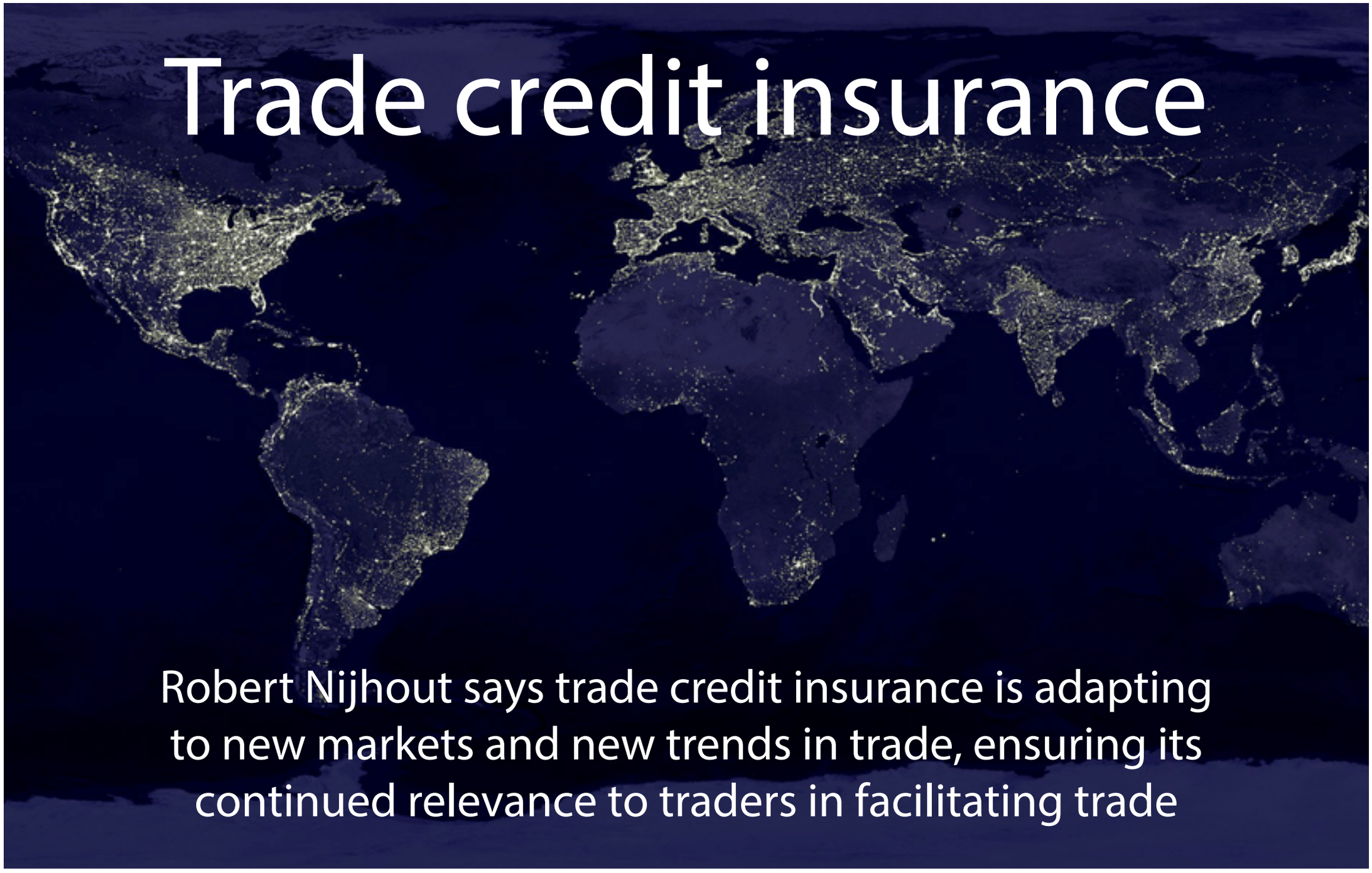
Conclusion

For businesses seeking a clear, simple route forward on IFRS9, one which streamlines process and alleviates the need to make choices from a multitude available, partnering with a trade credit insurer and collections agency has obvious advantages. Ultimately, these solutions could result in a major improvement in expected trade credit loss methodology and can have a positive impact on P&L volatility. There is also a benefit to having an independent external source, as it, increases the robustness of the entire process.

Andreas Tesch summarises:

> *"For finance teams faced with selecting from an abundance of models, methodologies and providers around the globe, our message is clear: talk to us first. We have what you need. The beauty of what we can offer is that we have the information required at our fingertips, ready for businesses to use in their own systems. We'll work with you to reduce complexity from the entire process, lower your provisioning requirements, save you time, and most importantly, give you one less thing to worry about."*



Trade credit insurance

Robert Nijhout says trade credit insurance is adapting to new markets and new trends in trade, ensuring its continued relevance to traders in facilitating trade

Trade credit insurance protects suppliers against the risk of unpaid receivables. It is a trade facilitator, insuring around 15% of global trade, as well as an instrument for hedging risks and preventing the risk of class claims.

Trade credit insurance is more than insurance:

- Banks lend more capital against insured receivables
- Trade credit insurance contributes to increased sales and supports in opening up new markets
- Trade credit insurance saves costs for information, analysis and collection
- Premiums are a tax deductible expense under IFRS
- Trade credit insurance improves the policy holder's credit rating

Policies normally insure all receivables whether these concern exports or domestic sales. Clients can opt for political risk cover, depending on the country. It is further possible to insure selected risks or single risks, as well as the risk that a manufacturer has in case a buyer goes bankrupt before the goods are delivered. This is particularly helpful in case of custom made goods. Although the majority of underwritten trade credit insurance risks concern short-term credit, there is an increase in private medium term cover which can go up to 5 or 7 years in some cases.

ICISA members, who account for more than 95% of the private global credit insurance market, insure around USD 3 trillion of exposure, against some USD 8B premium income. These totals refer to both export as well as domestic

transactions. In fact, the majority of insured business concerns trade between a buyer and a seller situated in the same country.

Backed by ample reinsurance capacity, underwriters are trying to attract and keep policyholders in an increasingly tough competitive environment. And as is the case in other sectors, competition often leads to lower rates, in spite of a risk environment that has stayed the same and in some cases has increased.

Market trends

This mismatch between risk and price is one of the current trends in trade credit insurance. Particularly in markets where the product is well known the average premium rate should be higher. It is a buyer's market and as long as capacity remains ample and risk appetite continues, this trend is not likely to change anytime soon.

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However, Western Europe and some Asian markets are experiencing a hardening of the market, although it is still too soon to call these markets hard. Competition not only comes from established players but also from a number of new market entrants.

In an industry where the entry level for new underwriters was always an obstacle as investments needed were very high due to complex IT support systems and information infrastructures, these hurdles are now much lower, thanks to great advances in IT support as well as dedicated specialist service providers that facilitate these requirements against acceptable costs.

On the reinsurance side new entrants continue to be announced. In spite of current consolidation in the sector, there remains a need to diversify and trade credit insurance is an attractive line to consider for many reinsurers.

Perhaps the most relevant market trend is the change in client's expectations compared to say a decade ago. Policy-holders are better informed, have more access to more data and information, and rightfully expect to get value for money.

This has created a change in how underwriters interact with their policyholders. Trade credit insurance has always been a product with frequent contact between the client and the insurer. The industry promotes this and while this communication has been streamlined, policyholders receive much more information now than they used to.

New products such as non-cancellable limits as well as pro-active information sharing by the underwriter have led to a closer relationship. The success of this is measured among others by retention rates. Policies are typically an-nual and renewed each year. It is the goal of every underwriter to retain as many policies as possible and retention levels of more than 90% in many cases are encouraging.

Claims

During the recent financial crisis, trade credit insurance proved its added value. Over EUR 9B in claims were paid in the course of two years on unpaid receivables that otherwise would not have been compensated. Many insured companies would not have survived had it not been for this trade credit insurance compensation.

Claim levels dropped sharply in 2010 but have been rising since. The claims ratio is currently at an acceptable level of around 45%, although this is expected to rise in the near future. A rise in claims is noted in Asia, and in particular in China. This is partly the result of a higher involvement in Asian trade by the sector. After years of very benign claims figures, an increase is to be expected in the region.

Solvency II

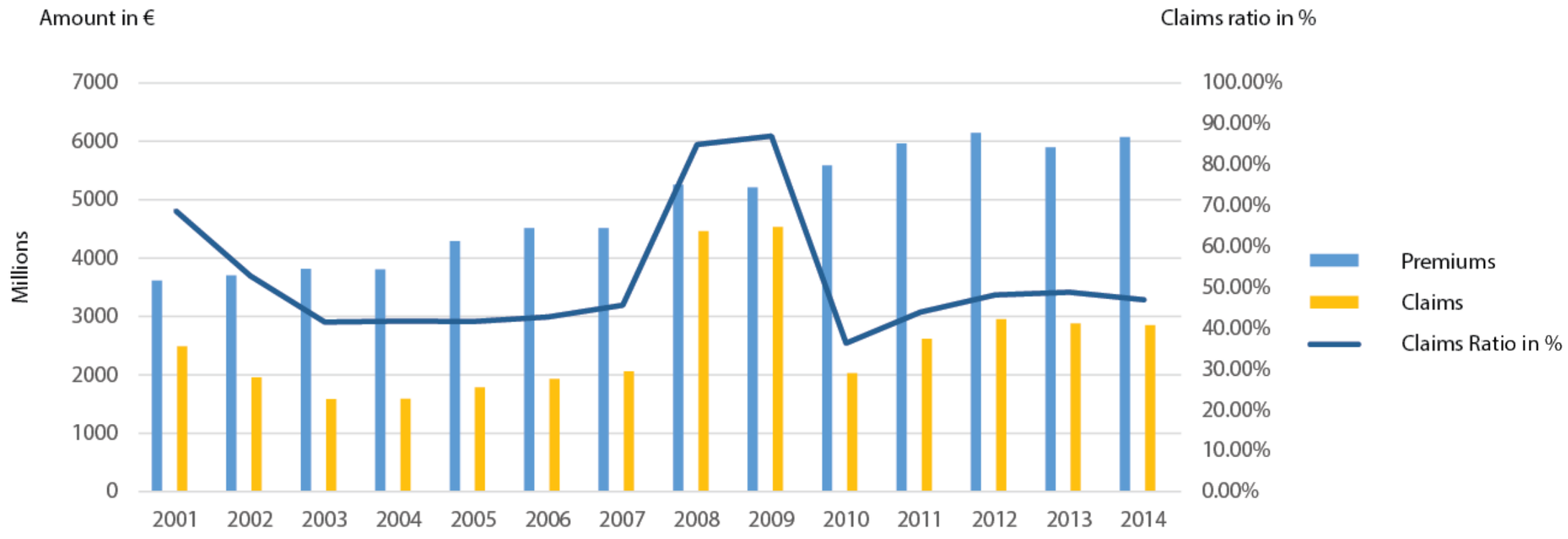
The most important market development at this moment is the introduction of the Solvency II regime in Europe. Solvency II is as important to insurers as Basle II and III are for banks. This introduction is arguable the biggest change in the TCI world for decades.

Despite a number of hurdles still to be taken, Solvency II will enter into force on the 1st of January 2016. But this will not be the end of the long journey that has led to this implementation date.

A little history

After 13 years of deliberations and alterations, companies have now less than 6 months to become Solvency II compliant. The implementation process was marked by delays and set-backs. Although the original Directive on Solvency II had already been approved in 2009, the Omnibus II Directive, containing a lot of modifications to the original Solvency II Directive, was only approved late 2013. Negotiations between Parliament, Commission and Council to reach a Trialogue agreement took quite a while and saw a couple of delays.

Chart 1. Trade credit insurance - premiums, claims and claims ratio ICISA members (excluding reinsurance members)



Source: ICISA

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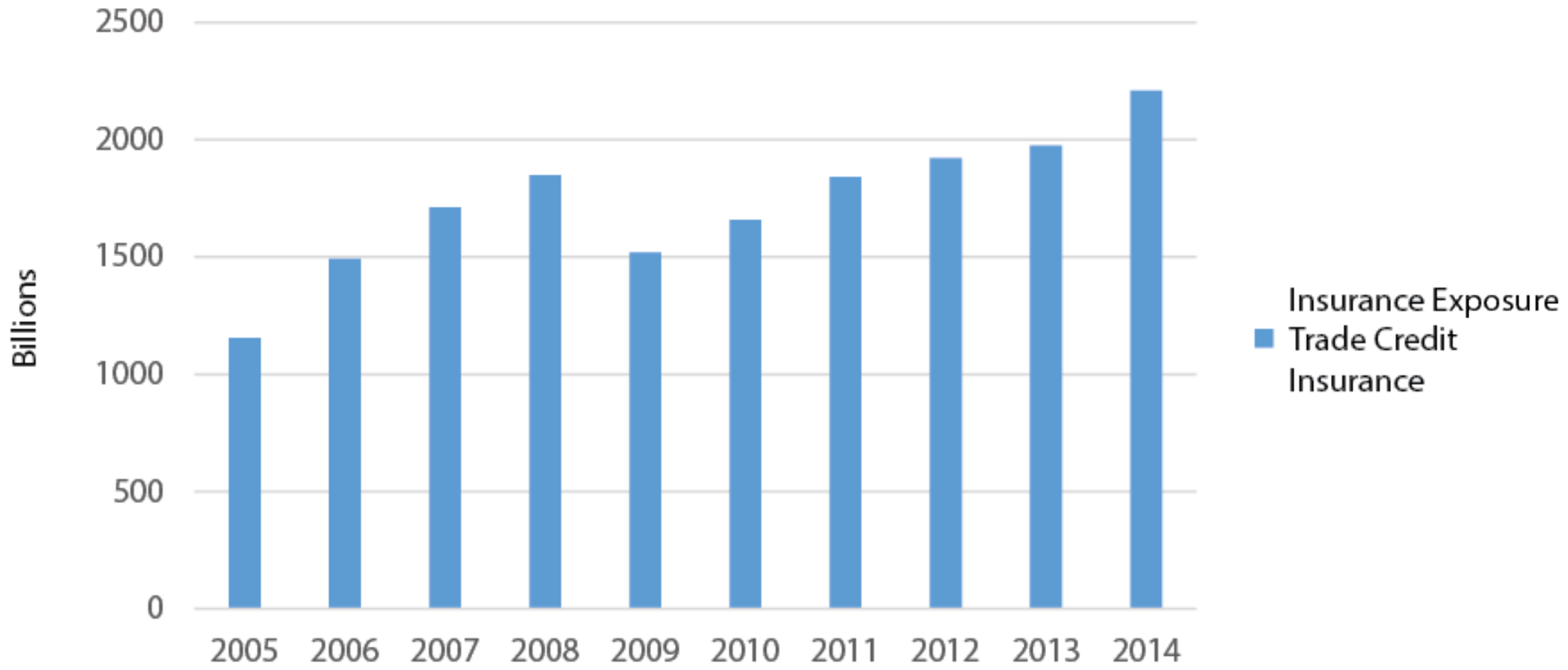
Chart 2. Trade credit insurance - insured exposure ICISA members (excluding reinsurance members)



Source: ICISA

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Not unimportantly, Omnibus II was further developed in light of the 2008 financial crisis and its aftermath, resulting in the introduction of detailed measures presumably leading to a more risk-averse approach to supervision. The further development of the Level 2 legislation based on the SII Directive was more or less frozen, but is now, finally, taken out of the fridge.

The latest draft now called Delegated Acts have been sent out to the Member States for their feedback before they will be presented to the European Parliament for approval. On the 1st of January 2016 Solvency II will enter into force. This implicitly means that some insurance companies in Europe will have to accelerate their efforts in order to be compliant by 2016, but most companies are already acting as if Solvency II was already in force.

A voyage through uncharted waters

An informal survey by ICISA among its members last year, showed that in terms of readiness for Solvency II most companies are only partly comfortable with the Solvency II regime. They feel comfortable with Pillar I (the quantitative part), despite the fact that not all details of the expected calculation methodology have been published. Compared to Pillar I, many companies feel less at ease regarding Pillar II (principles-based approach).

Regarding Pillar III (reporting to the Supervisors and the Market), delivering information to the Supervisors in an electronic format called Quantitative Reporting Templates (QRT), might seem to be a mundane topic, but simply approaching it as an IT challenge may turn out to be costly mistake.

Once SII has entered into force changes, amendments and recalibrations will take place. We can only hope that these future improvements will be more simplification. The complexity of Solvency II is of such an extent that only a few will have a comprehensive overview of the legislation among a sea of experts on parts of the directive. This can be particular challenging for top management as supervisors are demanding more and more from them in terms of

knowledge. Equally so, companies that in general consider Solvency II a merely administrative topic, only seen as a compliance issue, will miss out on a strategically important opportunity to overhaul the way they look at and manage different types of risk they encounter.

Overall, it is clear that Solvency II should be regarded as a strategically important project supervised at Management Board level and by no means as a compliance/IT project. If seen from the latter perspective a company will spend a lot of money without getting a decent return on its investment.

Catastrophic Risk concerns

The main concerns among members of ICISA are the still the Standard Formula in general and the Premium and Catastrophic Risk part in particular. This flawed formula could erroneously lead to regulatory undercapitalization of companies or in other words, failure to meet the new regulatory capital requirements. Consequences may be serious. It may force them to withdraw from certain markets, underwrite less risk or offer less coverage to their clients. Reduced return on capital may prevent investments or could force management to pull out certain lines of business.

An important area of focus is the definition of Cat Risk, the definition of recession risk and the split between frequency, large claims and recession claims.

There is also concern about two additional aspects. First of all the changes to the legislation, eg. calculation of Standard Formula, having become effective beginning of the year, could have an impact on the readiness of the industry, in particular as recalculations may result in unexpected results based on the enforced rewritten calculations. Secondly, it turns out that the principle-based approach still leaves room for legislation and entity specific interpretation, which may lead to misalignment of insurer interpretation with regulator interpretation.

Solvency II matter outside of the EU

Solvency II is not 'only' an EU affair, but it matters to the rest of the world as well. Other jurisdictions have or are introducing similar regimes. Many insurance companies are multinational operating in different jurisdictions, each with their own capital adequacy rules.

A situation can arise where capital adequacy rules differ or worse, conflict. This should be avoided and it is hoped that lawmakers consider existing regimes when drafting new capital adequacy rules.

Outlook

Trade credit insurance underwriters have concerns for the future. The political instability in parts of Europe and the Middle East are worrying. The same applies to the situation in Greece and in parts of Latin America.

There appears to be a rise in new protectionist regulations in some developing economies which is another reason for concern. There are wishes for better buyer information in Asia, especially in China. Effective insolvency legislation in countries in the MENA region that still lack this is also welcomed.

In spite of these concerns and wishes, the outlook is positive. Growth is expected in Asia, Europe, MENA and North America. Africa is also developing as a new market for trade credit insurance. Trade credit insurance adapts to new markets and new trends in trade, ensuring its continued relevance to traders in facilitating trade, which is the oil of the global economy. ■

Robert Nijhout is Executive Director of International Credit Insurance & Surety Association (ICISA)

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Atradius Credit Insurance offers credit management solutions that protect businesses against risks inherent in global trade. We spoke with Andreas Tesch, the Chief Market Officer of Atradius NV

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Please describe the history of Atradius

Atradius' history dates back to 1925 when the Nederlandsche Credietverzekering Maatschappij (NCM) was created to protect Dutch traders. Over the years the company has grown organically and through mergers and acquisitions of credit insurance, bonding, collections, reinsurance and information services companies across the world. In 1932, NCM became the official Dutch Export Credit Agency.

While acquisitions of complementary businesses accelerated in the late 20th Century, the 2001 merger of NCM and Gerling Credit Insurance, which had been formed in Germany in 1954, represented a major step forward in defining the shape of what in January 2004 became Atradius throughout the world. The business combination of Atradius and Crédito y Caución, the leading credit insurance and bonding company on the Iberian Peninsula is the most recent major addition to what is the second largest credit insurer worldwide.

With a uniform focus on making business to business (B2B) trade safer for businesses, no matter where they sell their products or services, Atradius has built a substantial network of offices and partner organisations that enable the company to deliver 'best in class service' across the world. 'We don't need to be the biggest to be the best credit insurer. Making our customers' experience the best we possibly can is our first priority.'

What range of solutions are provided by Atradius?

Our largest product offering is credit insurance. Essentially, this is insuring that, when selling on trade credit terms in a B2B transaction, the seller of goods or services is reimbursed for the products or services if the buyer does not pay.

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We are able to offer credit insurance coverage to companies through our own offices, partners and insurers in which we have an ownership interest in 50 countries covering sales to buyers across the world.

Our bonding offering includes Contract, Customs & Excise, Commercial and Payment Bonds. Atradius bonds protect the buyer of products or service in a contractual agreement against the risk that the seller does not perform in accordance with the contract.

Credit insurance is a basic concept that has been serving the world for more than 100 years. It is the backbone of trade, helping both buyers and sellers grow their companies

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Atradius Collections helps companies, both insured and uninsured by Atradius Credit Insurance, collect overdue invoices. Whether those outstanding debts are with domestic buyers or in foreign countries, we have a network of collectors and lawyers all over the world with expertise in local business and legal practices as well as the ability to operate in the local language and culture that can increase the likelihood of recovery.

AtradiusRe is one of the world's largest specialist credit insurance and bonding reinsurers serving customers on five continents for over 40 years.

Credit management information is available on millions of companies across the world. Our information services offering enables companies to make smarter decisions about who they offer trade credit to and how much trade credit they offer.

In Belgium, France and Luxembourg we also offer instalment credit protection against short and medium-term risks involved in multiple instalment agreements with private individuals and businesses (business-to-consumer).

What expertise does the group have?

Our strengths lie in credit management, more specifically underwriting and debt collection. Our underwriting enables our customers to make better decisions about how they use trade credit and protects them financially when those decisions result in payment default by their buyers. Our collections strengths lie in our ability to improve collection success through improving collection practices and in the actual collection of domestic and international debts which we can do while maintaining our customer's desired relationship with its debtor.

Atradius
Managing risk, enabling trade

In both underwriting and debt collection we have experienced teams across the world. However important to us is our customer service. All this is incomplete if we don't deliver top quality service and we strive to be best in class in this area as well as in credit insurance underwriting and collections.

How can you help SMEs and the smaller business?

The obvious benefits of credit insurance and bonding are reimbursement of unpaid invoices and protection against the failure of a contractor to fulfil its contractual obligations respectively. But one of the greatest values you receive is the underlying information and analysis of the risks that support the insurance decisions. This is often unrecognised, but can save SMEs money and can be one of the most powerful and useful benefits that an SME will receive.

Whether the customer is local or in another country, finding information about its creditworthiness and assessing whether and how much trade credit should be offered can be time consuming, expensive and challenging. Atradius has access to information on approximately 200 million businesses across the world and underwriters with years of expertise in analysing that information in combination with the other factors that can impact their payment.

This professional assessment gives companies more power to safely grow their business and can save them time and money. It creates a more stable financial environment for them to work in where their expenses are more predictable, their risk of loss is limited and the price of protection is often surprisingly inexpensive. Particularly when a policy can be tailored to focus more on the information or more on the insurance protection.

What kind of insurance strategy should a business develop?

Businesses should be looking for information or knowledge, protection, and stability in their insurance strategy. There are a number of insurance products, such as liability and fire, that are required of businesses, sometimes more for the protection of their customers and employees than for the business itself. Many of these insurance products are focussed on the somewhat rare but potentially expensive incidences. These are the purely protection oriented products.

Insurance products that are more information or knowledge focused can almost be looked at as business improvement tools. These are the tools that are often overlooked and underused because businesses believe they can do it themselves or that they are just another expense. Credit insurance falls into this category. In many cases, businesses have a far greater likelihood of suffering a loss from a payment default than they do from a fire or a workplace accident yet they are far less likely to protect themselves from payment defaults.

When building a business insurance strategy one should weigh the real cost of not being insured against the real financial benefits of insurance and the overall value and protection it provides in a range of reasonably potential situations. Measure the cost of the insurance against your historical losses for that risk, but consider the other benefits the insurance provides and calculate that value into its cost.

For instance what is the replacement cost of the loss and how will that impact your business. But also when looking at your sales, think about how the failure of that buyer to pay would impact the business. What is the cost and value of the information I will receive from the insurer versus if I try and gather it myself and will I be able to make better decisions with the additional knowledge. This is where many companies find that credit insurance saves them money.

Please provide an example of how you have provided solutions

I could provide you with a broad range of examples of how Atradius solutions have improved the lives of our customers.

We have a customer that found a new buyer, but could not find much information about that buyer's creditworthiness. We already had information on that buyer and were able to provide the protection our customer needed to offer trade credit right away. This is the case with hundreds of customers across the world, large and small, for which our credit insurance cover has enabled them to offer better terms to their buyers or grow more rapidly and securely, particularly with new buyers, through the use of Atradius credit insurance.

Another customer decided not to grant credit to a buyer after receiving information from us on that specific buyer. Six months later the buyer went into liquidation. Our customer avoided losses but its competitors did not. Our customer said this decision would have not been possible looking just at the latest financial data.

For some companies the information is more important than the insurance. A number of these companies have chosen to tailor their policies to focus more on the information portion of the policy providing them with the knowledge they need to make good decisions, while limiting their insurance spend by maintaining higher deductibles.

How do you see the sector developing?

Credit insurance is a basic concept that has been serving the world for more than 100 years. It is the backbone of trade, helping both buyers and sellers grow their companies. However its penetration rate is relatively low. To ex-

pand, the industry has to evolve with the world and find new ways to appeal to a constantly changing business environment. Not just in the way it markets itself, but in the way it serves businesses. This means new product variations that protect against new payment risks, new service offerings to ensure customers' receive what they need when they need it, constant technological advancements to keep pace with the customers' requirements and to find ways of meeting the needs of businesses that have not yet discovered the benefits of credit insurance. Businesses need to be able to make quick decisions and therefore consolidated sources of information, automation and flexible IT platforms, including 24/7 access to account information, will be mandatory in ensuring customers receive the best possible service. ■

Risk-based capital requirements for banks and international trade

Banu Demir Pakel, Tomasz Michalski and Evren Örs examine how Basel II capital requirements have affected trade finance

The negative impact of higher capital requirements under Basel II on the provision of trade finance has been cited as one of the factors behind the Great Trade Collapse. This article explores the adoption of the Basel II framework in Turkey in 2012 to investigate how a shock to the supply of trade-specific finance (in this case, letters of credit) affected firm-level exports. Changes in the cost of letters of credit affected Turkish firms' reliance on trade finance, but the regulatory shock did not affect firm-level export growth.

A shortage of trade finance, driven by a surge in the cost of its provision, has been listed as one of factors that contributed to the Great Trade Collapse. For instance, in 2009, the president of the World Bank at the time, Robert Zoellick, argued that 10-15% of the decrease in global trade during the Great Recession might be due to lower provision of finance for exports and imports under Basel II.[1] Similar fears have been raised for Basel III, which initially imposed a flat 100% credit conversion factor for traditional trade finance instruments.

International banking surveys conducted during the same period indicate that higher capital requirements under Basel II had a negative impact on banks' provision of trade finance (Asmundson et al. 2011). This is a very relevant topic, as approximately 90% of global trade relies on some form of trade finance (eg. Auboin 2009). Indeed, academic research shows that shocks to a country's banking sector have an impact on its exports (eg. Amiti and Weinstein 2011, Chor and Manova 2012, Paravasini et al. 2014). These findings are consistent with, but not direct evidence of, the hypothesis that banking shocks affect exports through their action on trade finance, as opposed to a more general bank lending channel that affects all firms, including those that are involved in international trade.

The question is whether, and to what extent, a shock to the supply of trade-specific finance affects exports, while controlling for the shocks propagating through the lending channel. Empirical investigation of this question is fraught with a number of difficulties. One problem is that exports or imports data, however detailed, typically lack information on the form of trade financing used. Another challenge is to find a setting where a shock to trade fi-

nance can be identified separately from possible shocks to other types of bank financing. Finally, the empirical setting used needs to differentiate changes that are due to shocks to trade financing from those that are due to demand factors for the underlying products.

In recent research, we try to shed additional light on this question by investigating whether changes in banks' risk-based capital requirements affect firm-level exports, after controlling for changes in other types of bank financing and product-demand factors (Demir et al. 2016). We do so by exploiting the mandatory adoption of the Basel II framework in its Standardized Approach by all banks in Turkey on 1 July 2012. This regulatory change affected the cost of holding letters of credit (LCs) by changing risk-weights used to adjust for counterparty-bank risk to meet the Basel-mandated capital requirements.

... the effect of a shock to the supply of trade finance on international trade may be more subtle than is suggested in the popular press

LCs are traditional international trade financing instruments that are issued by the importer's bank (issuing bank).[2] The importer's bank commits to make the payment to the exporter upon the verification of the fulfilment of the conditions stated in the LC. The importer sends the instrument to the exporter, who then presents it to its local bank, together with all required documents. The exporter can request that the LC be confirmed by its local bank. In this case, the exporter's bank (the confirming bank) also takes the responsibility of making payments if the importer's bank fails to transfer the payment on due date.

Our findings point to a composition effect: firms increased (decreased) their reliance on letters of credit when exporting to countries for whose banks the risk-weights (ie. the cost of LCs) decreased (increased) due to Basel II adoption. However, changes in risk-weights introduced by the Basel II framework did not affect the firm-level export growth.

Letters of credit and their treatment under the Basel II framework

The LC-issuing and confirming banks hold it as an off-balance sheet item, which creates a capital charge for both institutions. The related capital requirement is calculated by multiplying the nominal value of the LC by a credit conversion factor to obtain the on-balance sheet equivalent, and then, with a risk-weight to adjust for counterparty-bank risk exposure, and finally, with the minimum capital ratio.

To illustrate the change in the capital cost of holding an LC for a Turkish bank due to the adoption of the Basel II framework, consider an export transaction with a value of $1,000,000 backed by an LC issued by a non-OECD country-domiciled bank and with longer than three months of remaining maturity. Under the Basel I framework, holding this LC would cost the Turkish bank $120,000 (= $1,000,000 × 1.00 × 1.00 × 0.12) in capital, irrespective of the risk of the counterparty bank.

Under the Basel II framework, the capital cost would either (1) decline by 80% to $24,000 for highest-quality and high-quality rated counterparty banks; (2) drop by 50% for upper-medium or medium-grade rated or non-rated counterparty-banks; (3) remain equal to $120,000 for speculative rated counterparty-banks; or (4) increase by 50% to $180,000 for poor-quality rated counterparty-banks and others.[3] These risk-weight changes are non-negligible and could have important consequences for both the price of holding the LCs by the Turkish exporters' banks, which can also choose to ration such services.

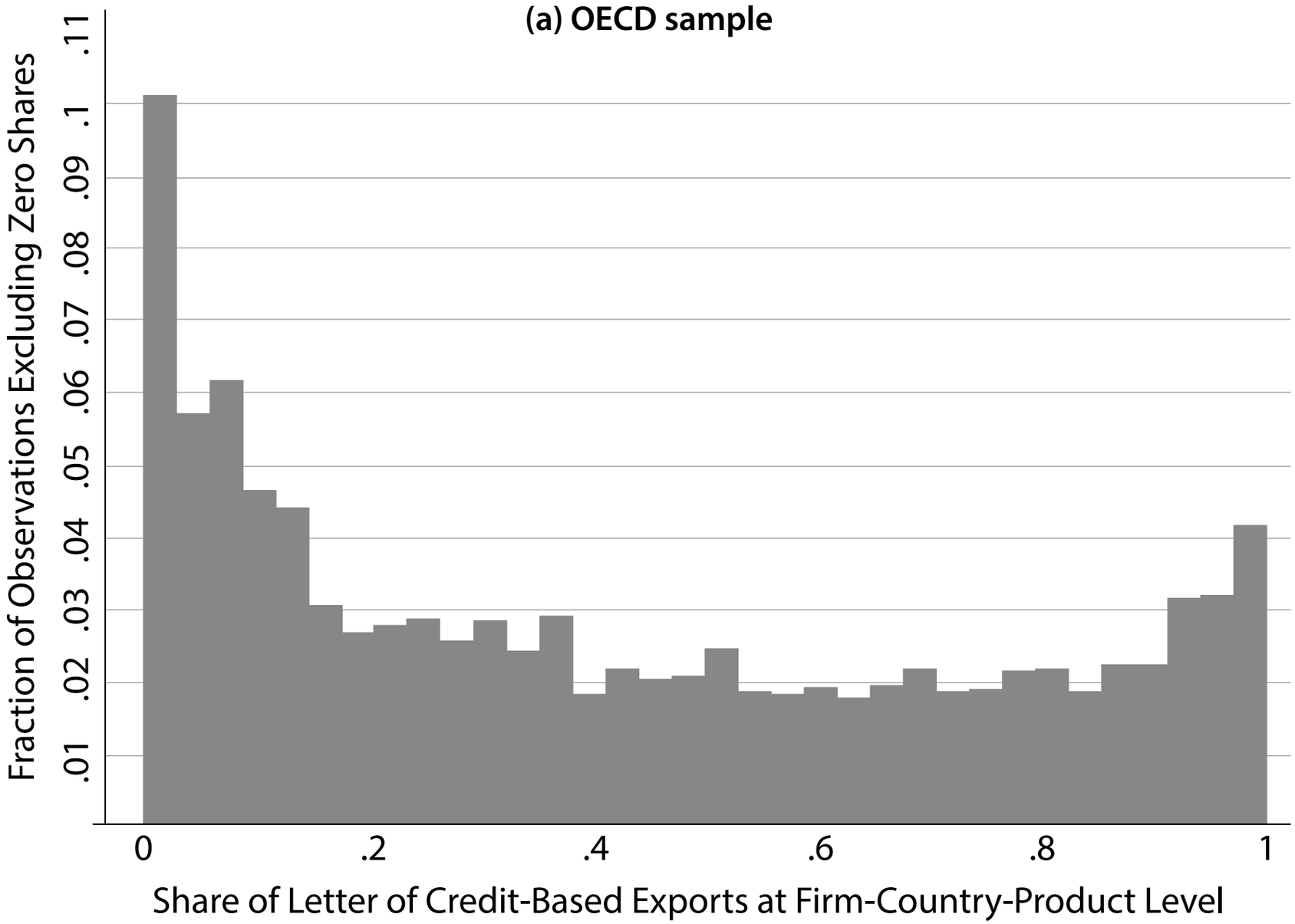
In our data, the share of Turkish exports backed by LCs is about 12%, which is comparable to the worldwide use of LCs in international trade as reported by Niepmann and Schmidt-Eisenlohr (2016). Nevertheless, there exists considerable heterogeneity in the use of LCs between OECD and non-OECD countries, as well as across transactions within each category (Figure 1).

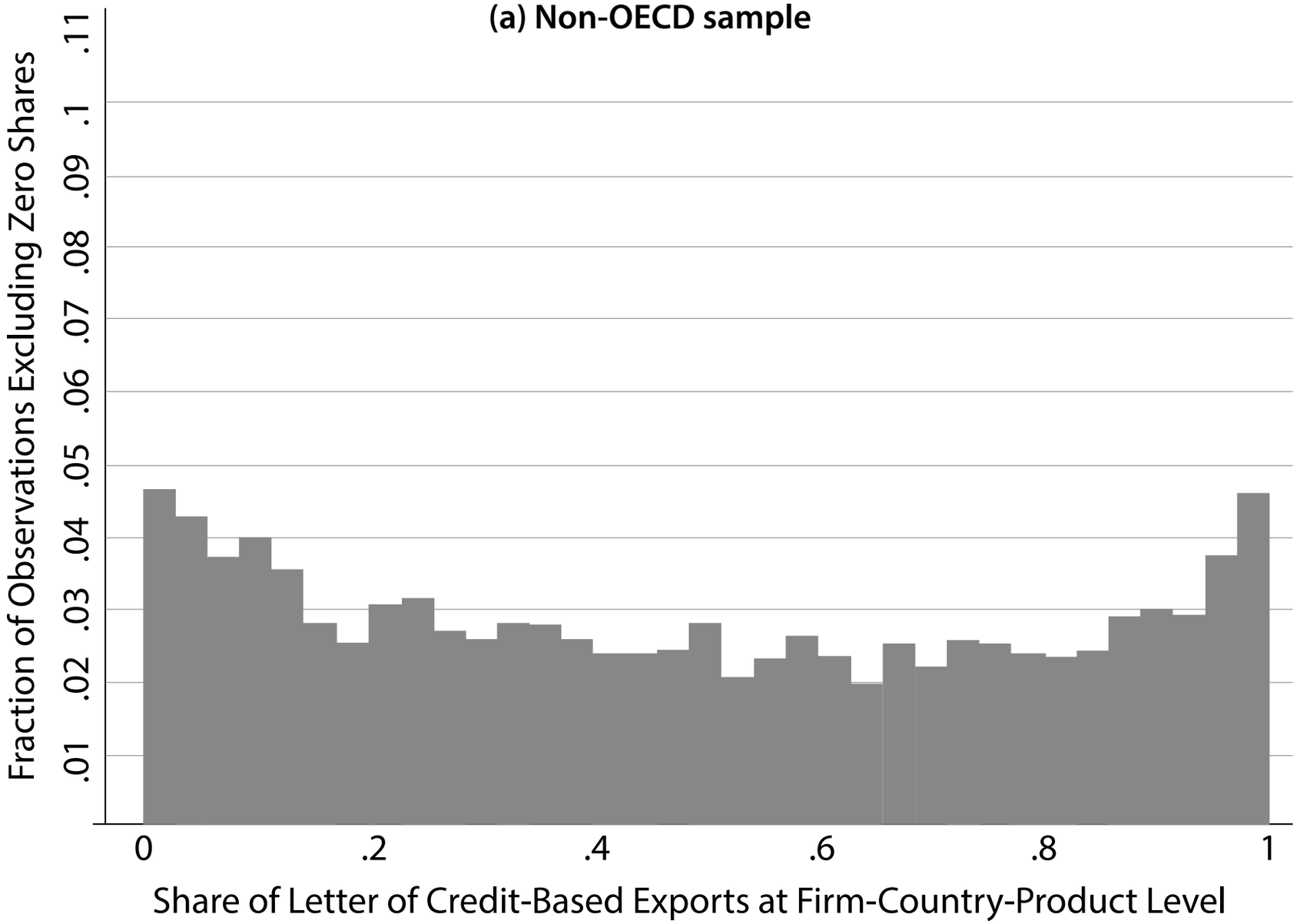
Effect of a shock to trade finance on exports

To identify the Basel II-induced effect of changes in the capital cost of holding an LC for a Turkish bank on exports, we compare the share of LC-backed exports of the same product and by the same firm across countries whose banks had, on average, differential changes in the counterparty risk-weights. Importantly, our analysis allows us to take into account the more general effects of Basel II on the provision of bank lending in the economy. Such effects could arise, for example, because higher risk-based capital standards may lead to less lending to all or some borrowers. If unaccounted for, the effects of changes in bank lending after the adoption of the Basel II might be wrongly attributed to risk-weight changes.

We find that when the Turkish banks' capital charges for holding LCs as off-balance sheet items are lowered (increased) following the adoption of the Basel II framework, the share of LC-backed exports to the associated destination countries increases (decreases). The implied risk-weight elasticity of the share of LC-backed exports varies

Figure 1. Pre-'treatment' (Basel II adoption) distribution of share of letter of credit-based exports at the firm-country-product level





Notes: Figure 1.a plots, for the OECD sample, the frequency distribution of the share of letter of credit-based exports at the firm-country-product level in the annual period preceding Basel II adoption on 1 July 2012 (ie. 1 July 2011 to 30 June 2012) after excluding observations for which the share of exports is zero. Figure 1.b does the same for the non-OECD sample. Source: Demir et al. (2016).

between -0.08 and -0.15. Importantly, we find no statistically discernable effect for the growth of exports: while firm-country-product level exports aggregated over all payment types appear to respond negatively (positively) to the associated risk-weight increases (decreases), the observed effects are not statistically significant.

Conclusion

Our results suggest that the effect of a shock to the supply of trade finance on international trade may be more subtle than is suggested in the popular press, inferred from banking surveys, or typically assumed in the trade finance literature. While risk-weight changes brought about by Basel II affect trade shares, the overall trade growth remains unaffected. Our empirical approach controls for many confounding factors, including changes in general bank-lending conditions.

Our findings suggest that while the pure trade finance (LC) channel may not be quantitatively significant, there are other channels through which bank financing could facilitate international trade. For instance, a shock to the availability of short-term bank credit could affect export performance due to working capital shortages or firms' reliance on such financing to purchase inputs for export production.

Second, the pure trade finance channel may become more significant during crises when firms are less likely to have access to trade credit extended by their trade partners or they face increased non-payment risk for their export sales. At the time of our quasi-natural experiment, Turkish banks were well capitalised with Basel II leading to a decrease in their risk-based capital ratios by 1.5% only, leaving the banking sector capitalised at roughly 15%.

Third, our result that the growth of firm-level exports remained unaffected by the changes in risk-weights introduced by the Basel II framework could be partly explained by regulatory arbitrage: firms and their banks might be

finding alternative ways to finance trade to avoid the costs of changes in bank capital requirements. ■

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1. Financial Times, 19 February 2009. Zoellick urges a global response.
2. Financing terms in international trade fall under three broad categories. Under open account terms, goods are delivered before a payment is made by the importer. Under cash-in-advance terms, the exporter receives the payment before ownership of the goods is transferred. Another widely-used financing method in international trade is documentary collection. Transactions on these terms are settled by banks through an exchange of documents. Although documentary collection terms do not involve a payment guarantee in case the importer defaults on payment, they serve the needs of both trade partners: the importer does not pay prior to shipment and the exporter retains ownership of the goods until the importer pays for the goods or accepts to pay at a later date. There is a recent, but growing body of academic literature that studies the choice of financing terms in international trade (eg. Schmidt-Eisenlohr 2013, Ahn 2014, Demir and Javorcik 2014, Antràs and Foley 2015).
3. For an LC issued by a bank located in an OECD country, the associated risk-weights either (i) increase by 150% (from 20% under Basel I to 50% under Basel II) for upper-medium or medium-grade rated or non-rated counterparty-banks, or (ii) stay constant at 20% for highest-quality and high-quality rated counterparty-banks.

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Making banks resolvable: the key to making resolution work

Andrew Gracie looks at resolution since G20 leaders put together the post-crisis financial reform agenda in 2009. He reviews where we are on the journey as well as what has been done and what is left to do

Introduction

Resolution has come a long way since G20 Leaders put together the post-crisis financial reform agenda in summits in London and Pittsburgh in 2009[1]. In some ways, it represented the most notable gap, and significant change in the pre-crisis regulatory architecture. Nearly ten years on, huge progress has been made in establishing effective resolution arrangements and the commitment to ending too-big-to-fail (TBTF) is undimmed.

The immediate priority in this effort was to put in place the necessary legal frameworks. Agreement in 2011 of Financial Stability Board (FSB) Key Attributes for Effective Resolution Regimes provided the international standards to ensure a consistent approach to the design of resolution regimes across G20 jurisdictions[2].

The UK now has in place a comprehensive bank resolution regime that is compliant with international standards and will remain so after Brexit. Similarly, for all advanced economies, there are now resolution regimes that are largely compliant with the Key Attributes in all the jurisdictions that are home to global systemically important banks (G-SIBs).

But the Key Attributes were about effective resolution regimes rather than resolvable firms – they defined a tool-kit but not how to use it; and a process for resolution planning for G-SIBs but not what would make a firm resolvable. Powers without resolvability leaves resolution authorities vulnerable.

Indeed, the moral for me of recent failures and near-failures is not that resolution is misguided and will not work, but that it will not work if firms are not regulated and supervised in a way that makes them resolvable.

This is the story of the last five years. We have focussed on organising firms in such a way that authorities' resolution powers can be used without significant adverse consequences for the rest of the financial system or the wider econ-

omy. This moves us progressively to where we want to be against risk appetite. And though we are not yet where we finally need to be, what has been done has already yielded significant benefits. For example rating agencies have largely removed government support uplifts to bank' credit ratings[3]. Where UK firms have come under stress, our resolution arrangements have been one factor that has helped secure recovery.

There is a famous Chinese proverb that notes a journey of a thousand miles begins with a single step. On the resolution journey there have been a lot of steps – in fact we could all be forgiven for feeling footsore – but the thousand-mile marker is coming into view

I want to review where we are on the journey: what has been done and what is left to do. I want to focus in particular on three topics:

(i) internal total loss-absorbing capacity (TLAC) or minimum requirements for eligible liabilities and own funds (MREL) and the underpinning it provides for cross-border co-operation;

(ii) bail-in mechanics – having required banks to maintain TLAC or MREL, we need, as resolution authorities, to be clear how we would use it; and

(iii) disclosure – resolution needs to be credible as well as feasible. With credibility comes market discipline ex ante and less disruption in a resolution (lower probability of default and loss given default in other words).

All three areas build on the core work of resolvability that has already been done, illustrating the point that the process is incremental and resolvability is not binary but progressive.

Resolvability of firms

Let me start then by reviewing what has already been done. I will focus on the standards and guidance coming from the FSB. It is true that they have been drawn up for application to G-SIBs in Crisis Management Groups (CMGs). But in our view, they are equally applicable to domestic systemically important banks (D-SIBs) or other firms where bail-in is the preferred resolution strategy, especially where firms operate cross-border.

The convergence at international level on bail-in as the appropriate strategy for large banks is itself significant. This transcends whether firms are single point of entry or multiple point of entry. And whether the bail-in is effected by use of a bail-in tool in an operating bank or by application of a bridge bank tool at holding company level. It rep-

resents the realisations that if we are to end TBTF we must have bail-ins instead of bail-outs so losses can fall on investors not on taxpayers. And that the bail-in must enable continuity in a firm's operations to avoid interruption to critical functions and to buy time for an orderly reorganisation of the firm to the extent necessary to deal with the problem that first caused the failure.

This shared understanding at FSB, and the desire to meet the goal set by G20 Leaders to end TBTF and the risk of taxpayer bail-outs as soon as possible, has driven a focus on seeking changes at firms so that they can be stabilised and enter resolution safely without disruption to critical functions. Hence the focus on two dimensions:

- Loss absorbency: firms need TLAC in the right amount (enough not only to absorb losses but to provide for recapitalisation so firms can continue to meet requirements for authorisation); in the right form (debt with residual maturity of a year and subordinated to operating liabilities to avoid breaches of the 'no creditor worse off than insolvency' (NCWO) safeguard or other challenges to the bail-in and at the same time to provide clarity to depositors that they are not likely to be bailed in); and in the right location (ensuring that resources are positioned within a group so that the key operating companies containing a firm's critical functions can be recapitalized immediately in resolution).As such, international agreement of the FSB's TLAC standard in 2015 represented a major milestone in moving towards ending TBTF[4].

- Continuity of critical functions: the second main dimension of stabilisation is to ensure continuity in a firm's operations in resolution. Part of this is legal – changing contractual arrangements so that entry into resolution does not result in widespread, disorderly termination, close-out or acceleration in financial contracts, provision of services or access to financial market infrastructures (FMIs). It is true that under the Key Attributes, resolution regimes include statutory powers to stay. But statutory stays may not be effective cross-border. And, anyway, repapering contracts helps to convey to counterparties that there will be continuity in reso-

lution and so reduce incentives to break for the exit. FSB has published guidance in this space for operational continuity in resolution and continuity of access to FMIs[5].

Perhaps the most notable effort has been FSB's work with industry to agree a protocol to International Swaps and Derivatives Association (ISDA) and other master netting agreements that addresses close-out risk in over-the-counter (OTC), derivative and repo transactions[6]. Agreement in 2014 of the universal protocol amongst G-SIBs, and subsequently of jurisdictional modular protocols for individual jurisdictions to bring in buy-side and non-G-SIB counterparties, is another major landmark in ensuring big international firms are resolvable[7]. The protocol is built around the premise that entry into resolution should not be classed as an event of default as long as a firm continues to perform.

This underscores the importance of funding to making resolution credible. FSB set out principles on funding in resolution in 2016 and just last week published for consultation guidance for use in CMGs on the liquid resources and liquidity management capabilities firms require to be adequately resolvable and how liquidity in firms might be bolstered in adverse cases by public backstops[8]. CMGs will use the guidance to draw up resolution funding plans setting out how, in order to achieve resolvability, liquidity and collateral should be held in a group across legal entities, currencies and locations.

We have made good progress in regulating these various FSB standards in the UK, either through Bank of England Policy statements or Prudential Regulation Authority (PRA) rules. UK banks have been given indicative MREL requirement to meet by 2020; they will have operational continuity arrangements in place in 2019 (alongside the implementation of ring-fencing); and they are already trading on protocol terms with buy-side firms as well as other G-SIBs. To the point that resolvability is progressive, the major UK banks on average now have total loss absorbency

of 23% measured against risk-weighted assets (RWAs) compared to an average end-state requirement of 28% (including buffers)[9].

As described, there is more to do in some of these areas. But increasingly the emphasis is on implementation and, with it, assurance – how we supervise firms against these regulatory requirements and hold them to account that identified barriers to resolvability are removed and stay removed. In describing the progress towards end-state resolvability, I want to pick out three areas that will be a focus in the period ahead.

(a) Internal MREL

The first is internal MREL. One lesson that the crisis brought home is that the distribution of resources within groups matters. While in life, firms might want to run themselves by business lines on a consolidated basis, failure and resolution occurs at legal entity level.

It is understandable then that since the crisis that there has been a discernible tendency for host authorities to hold onto more resources, capital and liquidity, or to force activity in branches into subsidiaries. The aim at FSB level with TLAC was to lean against this tendency towards fragmentation of international groups by providing comfort to authorities cross-border, not only that groups would have sufficient external TLAC to be resolvable but also that resources would be prepositioned as internal TLAC in material subsidiaries in host jurisdictions.

Previous international regulation of financial resources in groups has, like the Basel Accord, typically focussed more on the consolidated level. Now applying TLAC regulation at legal entity level has brought with it challenges.

One is timing: it is hard to roll out internal TLAC for a group until TLAC requirements are in place in all the jurisdictions relevant for the material subsidiaries. The Bank is in the middle of consulting on its internal MREL policy[10] but many other jurisdictions – notably the Banking Union, Switzerland and Japan – have still not set policy.

Another challenge is arithmetic: to the extent that there are financial dependencies between legal entities within a group the sum of solo RWAs is likely to be greater than consolidated RWAs. If a full TLAC requirement were applied to each subsidiary then the sum of the internal TLAC would exceed the consolidated TLAC requirement for the group as a whole.

This was addressed in the TLAC term sheet in two ways:

- by limiting internal TLAC only to subgroups and subsidiaries that are material to the group, accounting for more than 5% of RWAs or income. The logic there was that at that level failure of the material entity might trigger resolution of the group as a whole; problems for smaller entities, even those that might house functions that are critical to the host jurisdiction, should be more of a recovery matter.

- by including a provision that internal MREL for subgroups should be scaled in single point of entry (SPE) groups to 75-90% of the requirement that would apply to the subgroup on a standalone basis. The logic was that given the interdependence in the business models of SPE firms, prepositioning in this range would be sufficient to secure cooperation and deter hosts from ring-fencing, and home authorities from cutting off, foreign subsidiaries. Prepositioning of resources in this way will provide concrete underpinning for cooperation that goes beyond the paper commitments to cooperate in Memorandum of Understandings (MOUs), honoured in the breach in previous cross-border failures.

Even with these restrictions there may still be a sum of the parts problem in which the sum of TLAC requirements at solo level pushes up external requirements. If internal TLAC requirements are high they are also likely to stand in the way of holding a surplus at the top of the group that could provide flexibility in covering losses if they are concentrated in a particular part of a group.

Thus in our internal MREL policy our intention is first to consider setting internal MREL generally for the firm at the bottom of the 75-90% range[11]. But to set a higher requirement if we have doubts about: the home resolution strategy, the availability of a surplus at the top of the group or a lack of reciprocity in MREL-setting in other jurisdictions (that is others all set at the 90% end of the range). We expect to say more about surplus MREL and the form it should be held in to be readily available when we come to finalise our internal MREL policy next year.

Another important objective for us in setting policy on internal MREL is to avoid any distortion in the sequence of loss absorption between operating companies (OpCo) and the group holding company (HoldCo). We require UK banks to issue external MREL out of their HoldCos, structurally subordinated to liabilities at the OpCo. The issuance proceeds are then onlent to the OpCo as internal MREL broadly mirroring their external form, for example: Tier 2 could be onlent as Tier 2, AT1 as AT1 and senior debt out of HoldCo would be downstreamed as an internal debt instrument sitting senior to capital instruments but junior to operating liabilities in the OpCo.

We need to be sure that as losses are incurred in the operating company they are absorbed in an order that follows the OpCo creditor hierarchy and does not bypass certain instruments. The aim with a single point of entry bail-in strategy, as the name suggests, is only to put one entity at the top of the group into resolution, preferably a holding company which is only used for issuing capital instruments to the market and otherwise has no or limited operating liabilities.

Write down or conversion of internal MREL instruments via contractual triggers will then allow operating companies lower down the group to be recapitalised automatically without putting them into resolution. But legacy non-equity capital instruments in OpCos without the requisite contractual triggers could cut across this. We do not want these to be spared bearing losses for want of a trigger. And so, we are clear that such instruments should not count as MREL beyond 31 December 2021 and if not matured by then we will work with firms to remove them if they represent a barrier to the resolution strategy.

This is part of a larger effort to add to the credibility of resolution by being clear to debt investors and other stakeholders how a bail-in will work in practice. We want debt investors to be able to price risk effectively by being clear about where they rank in the creditor hierarchy and to give them confidence that we can stick to the hierarchy in applying losses and that we will not be picking winners and losers within a class. Counting as MREL senior debt issued out of operating companies without subordination looks like a recipe for undermining that confidence.

(b) Bail-in execution

We also want to be clear as a resolution authority how we will conduct the resolution in a way that preserves value and distributes it fairly, ensuring no creditor worse off protections are met. To that end, we have thought hard about the valuation capabilities we need firms to have so that we can value losses and recapitalisation needs in an effective and timely way. We have just consulted on a set of principle level requirements and expect to finalise policy in this space in the next few months[12].

We believe that the bail-in valuation for a large cross-border firm is not something that can be fixed over a weekend. Valuation on that timetable will inevitably tend to overshoot on the estimation of losses, not least because a significant driver of the valuation will be the reorganisation that follows the bail-in and the restructuring costs and disposal valuations associated with that.

Rather, it is our intention to take several months for the bail-in valuation to ensure that through an independent valuation process, losses as far as possible are bottomed out and tie back to the reorganisation plan for the surviving business. It will be critical to determine the net asset value that had been generated in the bail-in and the liability holders it should go to as compensation.

You may ask, what happens in the intervening period? From the perspective of the debt investor, our intention on entry to resolution is to take control of the shares in issue and immobilise all the other external MREL instruments

at the relevant international central securities depository (ICSDs) and central securities depository (CSDs). We will at the same time issue onto the bondholders accounts at the ICSDs a tradeable certificate of entitlement secured by the shares in issue. There will be as many classes of certificate as there are classes of claim. Once the valuation is complete and we have announced the terms of exchange, holders will present the certificates in exchange for whatever equity they are entitled to as compensation. The resulting shareholders will then vote in a new board and the firm will return to private sector control.

Issuing certificates of entitlement in this way will provide a mechanism for debtholders that do not want to, or due to their mandates, are not able to hold equity to trade out of their positions. And this will have an ancillary benefit for us of providing some sort of shadow market valuation of the firm.

But what about other liability holders – depositors, market counterparties, trade creditors etc. – during this interval?

Our aim with the announcement of the resolution is to send a strong signal to them that their claims are safe and that the operating companies they are transacting with will continue to perform.

Full conversion of internal MREL in the key operating companies around the group and a strong sense that the firm will have access to liquidity will contribute to that. To this end, the Bank has established new arrangements to clarify, first, that a firm in resolution would continue to have access to the ordinary central bank facilities in the Sterling Monetary Framework, subject to meeting the necessary eligibility criteria.

And second, those arrangements will be supplemented where necessary by a flexible Resolution Liquidity Framework, designed to provide liquidity, in sterling or foreign currency, in the necessary scale, for a sufficient period of time, and secured against a wide range of collateral to allow the firm to make the transition to market-based fund-

ing[13]. Sending a strong message in this way at the outset of the resolution will maximise the chances of stabilising the firm and if liability holders know their claims will be refinanced, reduce the risk of a further run.

This need for clarity is understood at international level. FSB has just published a consultation paper on bail-in execution addressing a number of issues I have described including valuation and exchange mechanics[14]. Not least there are important home-host dependencies that need to be addressed. After all, in a UK G-SIB resolution we will need to bail-in debt on both sides of the Atlantic, in the Depository Trust and Clearing Corporation (DTCC) as well as Clearstream and Euroclear. This includes working through with market regulators the securities law issues that will arise through a bail-in, ensuring that disclosure and listing requirements continue to be satisfied.

(c) Disclosure

The third and final area I want to address is disclosure. A recurrent theme of my remarks has been the importance of ex ante disclosure to making resolution credible and to realising the benefits of increased market discipline. We want debt investors to have the information they need to price risk and so support the proposals in the TLAC term sheet and Basel's Pillar 3 Framework that require banks to disclose the rank ordering of their liability structure at legal entity level.

As I have described, we want debtholders and other stakeholders to understand how we will use out resolution powers and so have published a document setting out our approach to resolution – otherwise known as the Purple Book[15]. The latest edition in October indicates how far we have come since we first published the Purple Book in 2014. But we have further to go.

It is our intention – which we indicated to the Treasury Select Committee in March – to publish summaries of the resolution plans for the major UK banks and our assessment of their resolvability. We will do this after the start of

2019 when ring-fencing, the first level of TLAC requirements and operational continuity in resolution arrangements are in place.

As an institution we want to be open and accountable. As a resolution authority we need to be for it to work.

There is a famous Chinese proverb that notes a journey of a thousand miles begins with a single step. On the resolution journey there have been a lot of steps – in fact we could all be forgiven for feeling footsore – but the thousand-mile marker is coming into view. ■

Andrew Gracie is Executive Director, Resolution Directorate, at the Bank of England

Endnotes

1. See FSB 'Declaration on Strengthening the Financial System – London Summit' (2009)
http://www.fsb.org/wp-content/uploads/london_summit_declaration_on_str_financial_system.pdf
and FSB 'Leaders' Statement the Pittsburgh Summit' (2009)
http://www.fsb.org/wp-content/uploads/g20_leaders_declaration_pittsburgh_2009.pdf
2. See FSB 'Key Attributes of Effective Resolution Regimes for Financial Institutions' (2014)
http://www.fsb.org/wp-content/uploads/r_141015.pdf
3. See S&P Global 'An Illustrative Rating Path for a Systemic Bank In A Bail-In Resolution' (2017)
http://images.ratingsinfo.standardandpoors.com/Web/StandardPoorsRatings/Illustrative%20Rating%20Path.pdf
4. See FSB 'Principles on Loss-Absorbing and Recapitalisation Capacity of G-SIBs in Resolution' (2015)
http://www.fsb.org/wp-content/uploads/TLAC-Principles-and-Term-Sheet-for-publication-final.pdf

5. See FSB 'Guidance on Arrangements to Support Operational Continuity in Resolution' (2015) http://www.fsb.org/wp-content/uploads/Guidance-on-Arrangements-to-Support-Operational-Continuity-in-Resolution.pdf and FSB 'Guidance on Continuity of Access to Financial Market Infrastructures (FMIs) for a Firm in Resolution' (2016) http://www.fsb.org/wp-content/uploads/Continuity-of-Access-to-FMIs-Consultation-Document-FINAL.pdf

6. See FSB 'Cross-Border Recognition of Resolution Action' (2014) http://www.fsb.org/wp-content/uploads/c_140929.pdf

7. See ISDA '2014 Resolution Stay Protocol' (2014) http://assets.isda.org/media/f253b540-25/958e4aed-pdf/, ISDA '2015 Universal Resolution Stay Protocol' (2015) http://assets.isda.org/media/ac6b533f-3/5a7c32f8-pdf/ and ISDA 'Resolution Stay Jurisdictional Modular Protocol UK (PRA RULE) Jurisdictional Module' (2016) http://assets.isda.org/media/f253b540-94/cd991d70-pdf/

8. See FSB 'Guiding Principles on the Temporary Funding Needed to Support the Orderly Resolution of a Global Systemically Important Bank ("G-SIB")' (2016) http://www.fsb.org/wp-content/uploads/Guiding-principles-on-the-temporary-funding-needed-to-support-the-orderly-resolution-of-a-global-systemically-important-bank-"G-SIB".pdf and FSB ' Funding Strategy Elements of an Implementable Resolution Plan' (2017) http://www.fsb.org/wp-content/uploads/301117-2.pdf

9. The Bank of England published loss-absorbing capacity requirements for major UK banks in 2016 shortly after responding to the Treasury Committee's inquiry into capital. See http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/treasury-committee/capital-and-resolution/written/69208.pdf

10 The Bank of England published a consultation paper on its approach to setting a minimum requirement for own funds and eligible liabilities (MREL) within groups on 2 October 2017. See https://www.bankofengland.co.uk/-/media/boe/files/financial-stability/resolution/internal-mrel-consultation-october-2017.pdf?la=en&hash=33594C3FB3C7F1D129033A-FE4E3A2BF20A4F9AA8

11. Our starting point for calibrating internal MREL for ring-fenced bank sub-groups would be 90%, with the possibility that this could be scaled down if there are sufficient readily deployable resources.
12. The Bank of England published a consultation paper on valuation capabilities to support resolvability on 17 August 2017. See https://www.bankofengland.co.uk/-/media/boe/files/financial-stability/resolution/boes-proposed-policy-on-valuation-capabilities-to-support-resolvability.pdf?la=en&hash=4044F91DF1DDE-7A131EA3186F66F304380553306
13. See Box 2 – the Bank's approach to providing liquidity in resolution in https://www.bankofengland.co.uk/-/media/boe/files/financial-stability/resolution/boes-approach-to-resolution.pdf?la=en&hash=8213BE00D67C4CADB948D-51FEBD164E136A70BE6
14. See FSB 'Principles on Bail-In Execution' (2017) http://www.fsb.org/wp-content/uploads/P301117-1.pdf
15. See the Bank of England's approach to resolution https://www.bankofengland.co.uk/-/media/boe/files/financial-stability/resolution/boes-approach-to-resolution.pdf?la=en&hash=8213BE00D67C4CADB948D51FEBD164E136A70BE6

This article is based on a speech given at the Risk Minds Conference, Amsterdam 4 December 2017

It pays to be paranoid: the importance of fiscal space

Richard Sharp explains why financial stability is important, discussing the risk to financial stability arising from UK indebtedness and explains why it now may be a matter of concern

Jeremy Bentham was a founder of utilitarianism whose precepts we in some way still follow in our cost-benefit analyses, he was a forerunner in understanding the importance of institutions of state embracing transparency. He cautioned that *"secrecy being an instrument of conspiracy ought never to be the system of a regular government"*. Consistent with Bentham's philosophy, the Governor of the Bank of England, Mark Carney, speaking in Liverpool recently, said *"we are helping to make discussions of the economy more accessible" and that "we are doing this to make the Bank more open and accountable"*.[1]

I serve as an external member of one of the Bank's policy-making committees, the Financial Policy Committee (FPC). I'm conscious that although we make decisions over peoples' lives we are, for practical purposes, unknown. Moreover, I am aware that although our mandate – the maintenance of financial stability in the United Kingdom – is of the utmost importance, few outside the Bank itself and the Treasury Select Committee are aware of the personal views individual members have.

Why is financial stability important? Financial stability is essential for economic growth; the very perception of present and future financial stability encourages investment and therefore makes a vital contribution to national welfare. Hence, I am seeking to discuss the risk to financial stability arising from UK indebtedness; and to explain why that now, ten years after the global financial crisis, it may be a matter of concern. But before I speak about debt, let me give a brief overview of the FPC.

It was the global financial crisis which was the catalyst for the creation of the FPC. The UK's system to guard against financial instability which had been in existence before the crash – the 'Tripartite system' involving the Treasury, the Financial Services Authority (FSA) and the Bank of England – had demonstrably failed. The success of the Bank of England's independent control of monetary policy inspired the change which was deemed necessary: to place the tools and responsibility within a single institution – the Bank of England.

Within the Bank of England, the newly created Prudential Regulation Authority took over the FSA's responsibility for microprudential regulation and bank supervision. The Government also decided to locate within the Bank of England a sibling committee to the existing and successful Monetary Policy Committee (MPC): the Financial Policy Committee. Parliament has tasked it with identifying, monitoring and taking action to remove or reduce risks to the financial system, and, subject to that, supporting the Government's economic policies, including its objectives for growth and employment.

The MPC having been seen to benefit from the presence of external members, it was felt appropriate that the FPC should similarly include external members. I am one of those members, having been on the Committee since its for-

...we have a debt level which gives us limited capacity for national manoeuvre... The systemic health of the nation is now significantly stronger. But in extremis we may yet need national financial resilience

mal inception and now being midway through my second three-year term. In particular, external members should work towards preventing the presence of institutional group think.

This institutional group think was held to be one of the failures of the prior regulatory system. Hence, we have found that Parliamentarians have rightly challenged the external members, in particular, to be vigilant to avoid group think wherever possible and appropriate. In this context, I commend to you the recent remarks on group think and the inherent difficulties in balancing diversity with committee effectiveness made by Martin Taylor, a fellow external FPC member[2].

As Martin pointed out, a feature of the FPC enshrined in statute is that unlike the MPC it must seek wherever possible to make decisions by consensus. It logically follows from this that as a Committee we should seek to speak with one voice and to that end the sole spokesperson for the committee is the Chairman of the Committee: the Governor of the Bank of England. Hence my comments are not the view of the Bank, nor the view of the FPC – they are my personal opinions alone. I would like to emphasise this point.

It was Gordon Brown as Chancellor who decided some twenty years ago that the Bank should have independence. In his memoirs he writes *"the argument that convinced me independence was essential was a basic one – that for too long in Britain, political expediency had dominated economic decision making. Too often interest-rate decisions were made cynically for the here and now to deal with a political problem or in response to just one economic event. An operationally independent Bank would depoliticise the process. The long term would take precedence over the short term […] The overriding priority was to move Britain from its post-war stop-go economic volatility towards a new macroeconomic stability."*[3]

Since then, the Bank of England has built and cherished its credibility and trust. This trust rests on its impartial, apolitical approach to fulfilling its mandates. But while the monetary policy mandate operates within precise parame-

ters delivered by the Chancellor, inevitably given its nature, the financial stability mandate is vaguer and less objective. That said, we do know that the cost of the financial crises has been immense.

Had the UK economy grown at its pre-crisis trend, it would be 14% bigger than it is now (Chart 1). That is about £272 billion, somewhat larger than the size of the Scottish, Welsh and Northern Irish economies combined[4]. There should be no doubt: it pays to be vigilant.

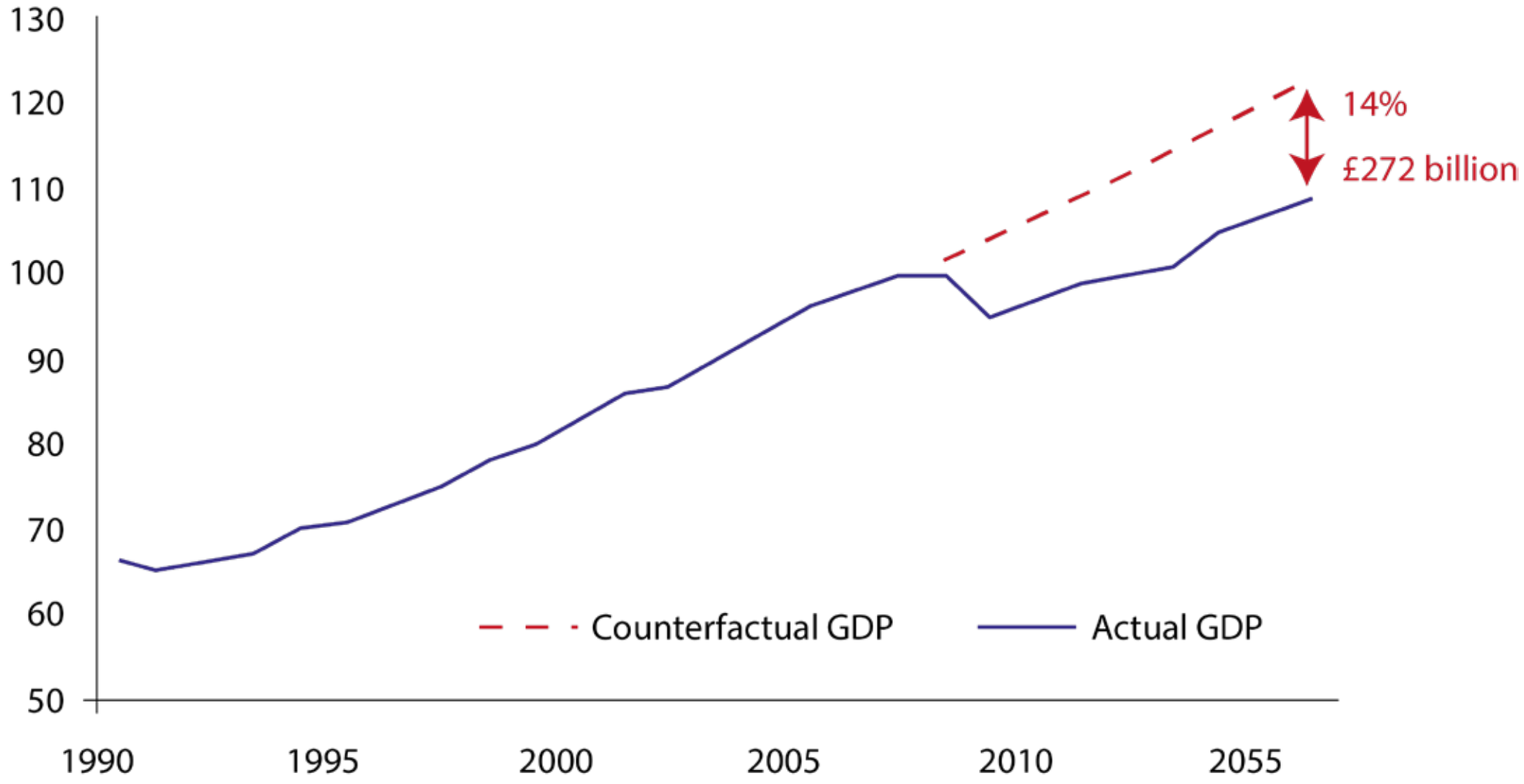
When considering financial stability risks and indebtedness, I entirely agree with Alan Blinder and Willem Buiter that central banks should *"stick to their knitting"* and avoid engaging in the political aspects of fiscal policy[5]. For my part, I fully recognise that it is not for a member of the FPC to get into these issues because they are for the Government to resolve.

But I do not regard it as beyond our remit to engage with the financial stability risks emanating from long-term fiscal strategies. As the wise Stanley Fischer admonished us at a conference celebrating the independence of the Bank: *"never say never"*[6]. In this light, it is not inappropriate for an FPC member to explore the implications of our debt position for the financial system's resilience to economic shocks or adverse market movements – just as it is for the Office for Budget Responsibility (OBR), which I will address later, to consider the risks to the UK's fiscal position.

The aftermath of the financial crisis shows just how valuable fiscal space – the capacity for the government to use fiscal policy in a crisis – can be. The FPC also contributes to the protection of fiscal space. For example, by raising the resilience of banks and putting their investors on the hook for losses we have replaced the risk of public bailout.

Why do I have concerns about the threat to our financial stability arising from our national indebtedness? For three reasons:

Chart 1. Actual UK real GDP and counterfactual GDP based on pre-crisis trend growth(a)



Sources: Bank of England, Institute for Fiscal Studies, Bank calculations.
(a) 2007 trend growth taken from the IFS '2007 Green Budget': 2.4%.

- First, the level of debt in the UK and across the world has increased considerably since the global financial crisis; in this context, given that the UK is a very open economy it is worth remembering that it is vulnerable to spillovers from the rest of the world. External financing and demographics present additional challenges.

- Second, a highly indebted government has less capacity to react to crises: we cannot assume that further shocks do not materialise; and, evidence demonstrates that fiscal space is a vital national resource to have available to counteract such a shock. Reducing fiscal space, therefore, means financial stability is harder to achieve.

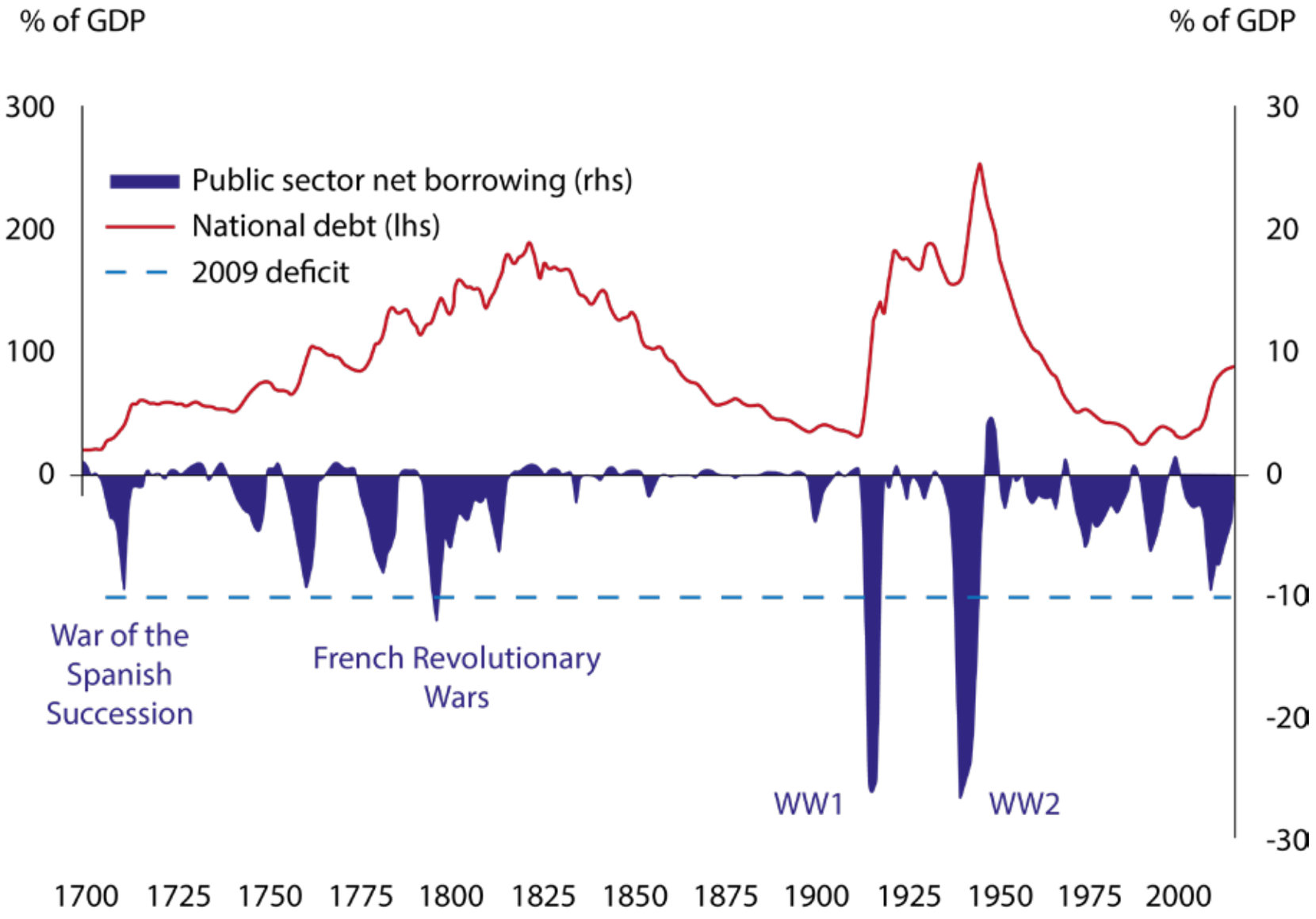
- Third, in seeking to address unsatisfactory real growth prospects, the need for spare debt capacity should not be underestimated. The uncertainty inherent in assessing financial stability risks also makes it difficult to get this trade-off right.

Debt in the UK and the world

Let us first look at national and international debt positions and how we got there. Historically, the UK has faced elevated levels of national debt measured against GDP as a result of wars, this being true in the 18th, 19th and 20th centuries (Chart 2). For example, after World War 2 debt exceeded 200% of GDP. The UK has typically addressed this challenge through inflation, ie. devaluing debt, and real economic growth, which has increased debt manageability. Interestingly, only a handful of years since WW2 actually showed a fiscal surplus, ie. 'paying off' debt.

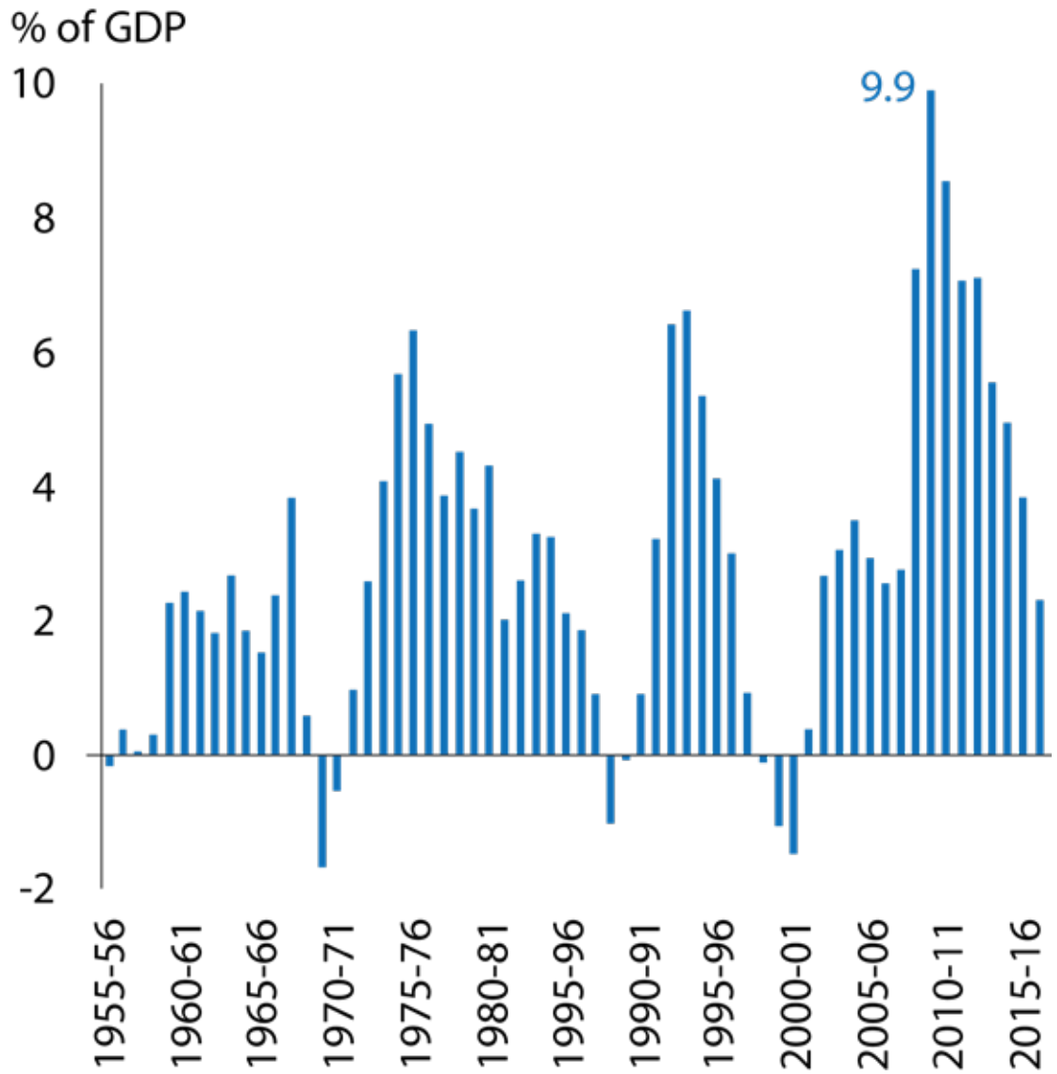
The global financial crisis led to UK net borrowing that was unprecedented in the post-war era: 9.9% of GDP in 2009 (Chart 3). Since the crisis cumulative incremental borrowing has amounted to over £1 trillion (Chart 4), leading to a debt-to-GDP level of 85.8% – that is just over £1.7 trillion – in the 2016/17 fiscal year[7]. What matters is the ability to serve this debt. Net debt interest payments of £35 billion per year at present are forecast to reach £42 billion in five

Chart 2. National debt and public sector net borrowing since 1700(a)(b)



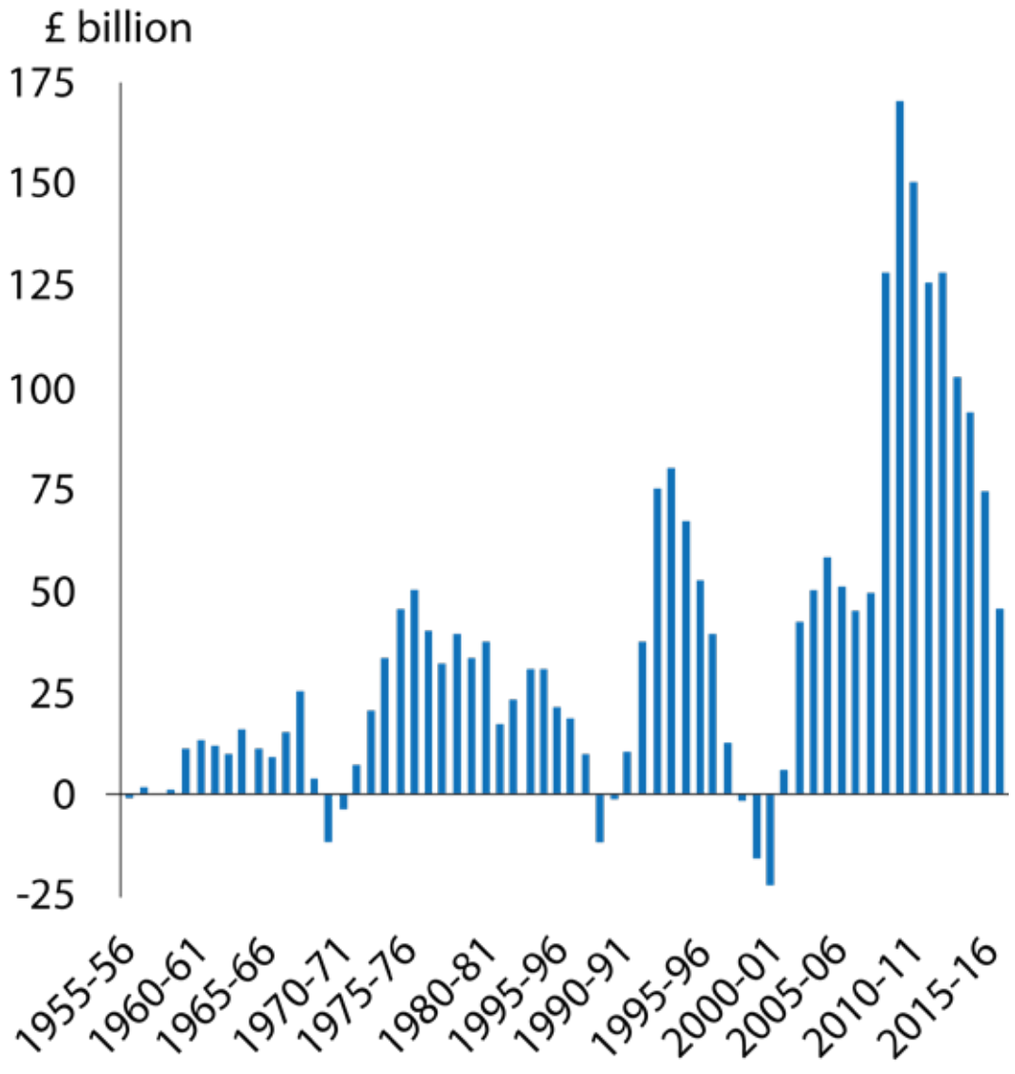
Source: Bank of England

Chart 3. UK net borrowing as per cent of GDP



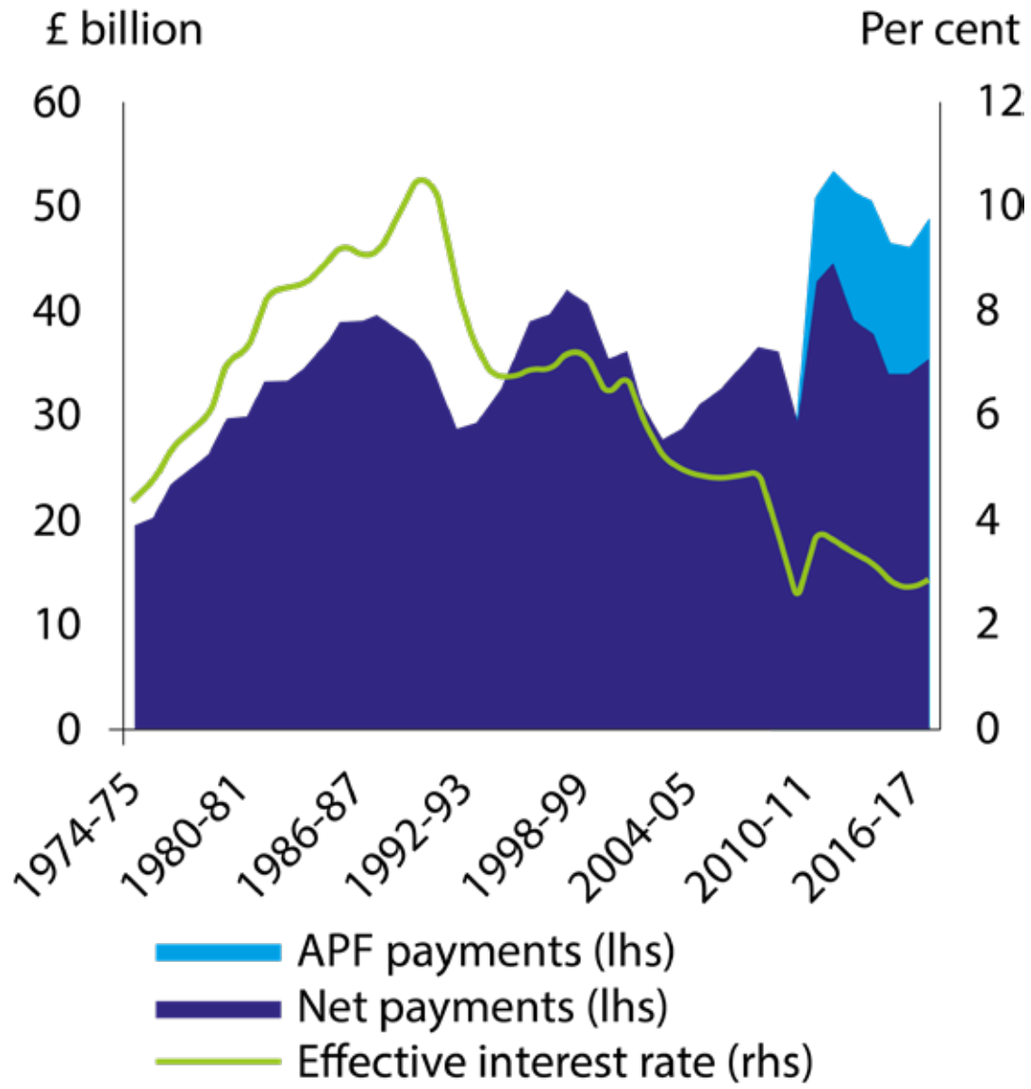
Source: Office for Budget Responsibility

Chart 4. UK net borrowing in £ billion (2016-17 prices)



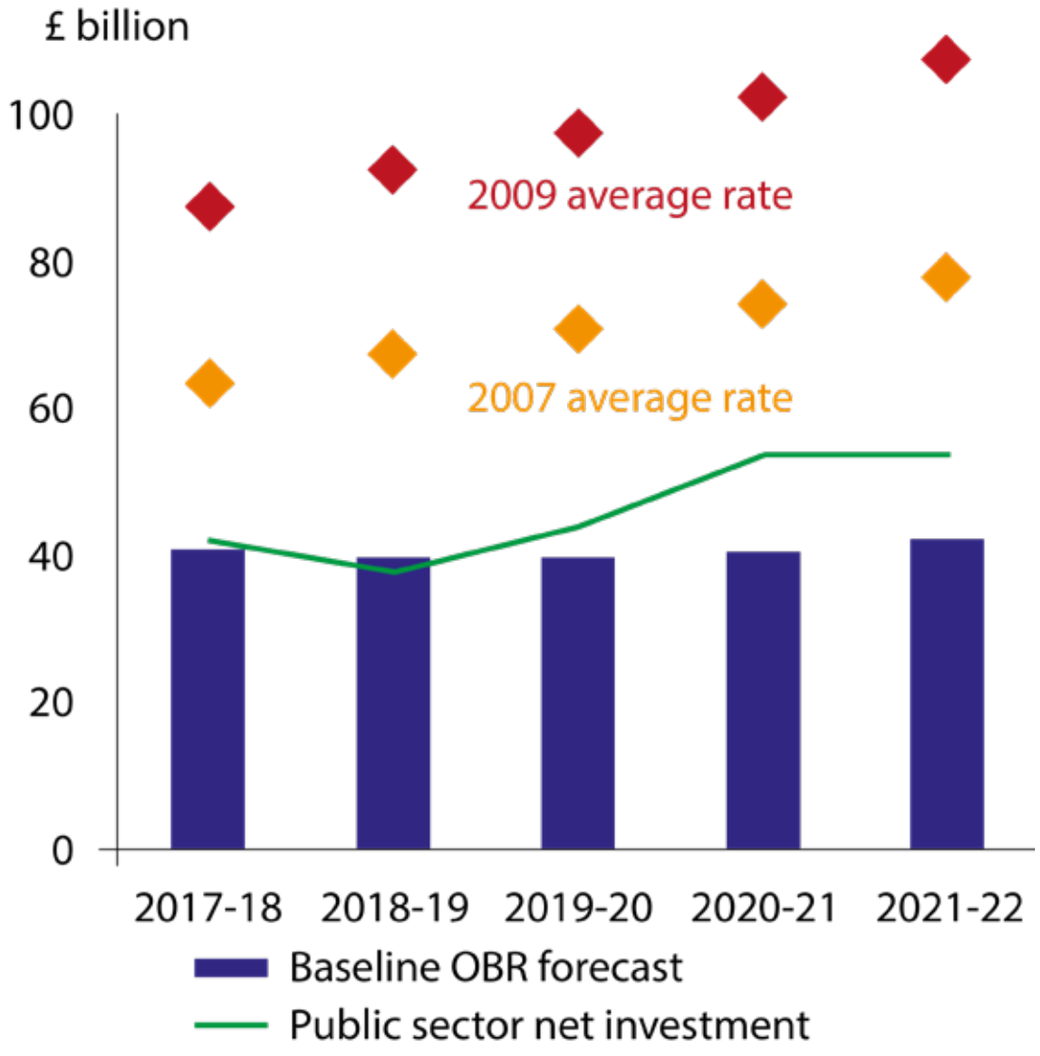
Source: Office for Budget Responsibility

Chart 5. Gross UK debt interest payments (2016-17 prices)(a)(b)



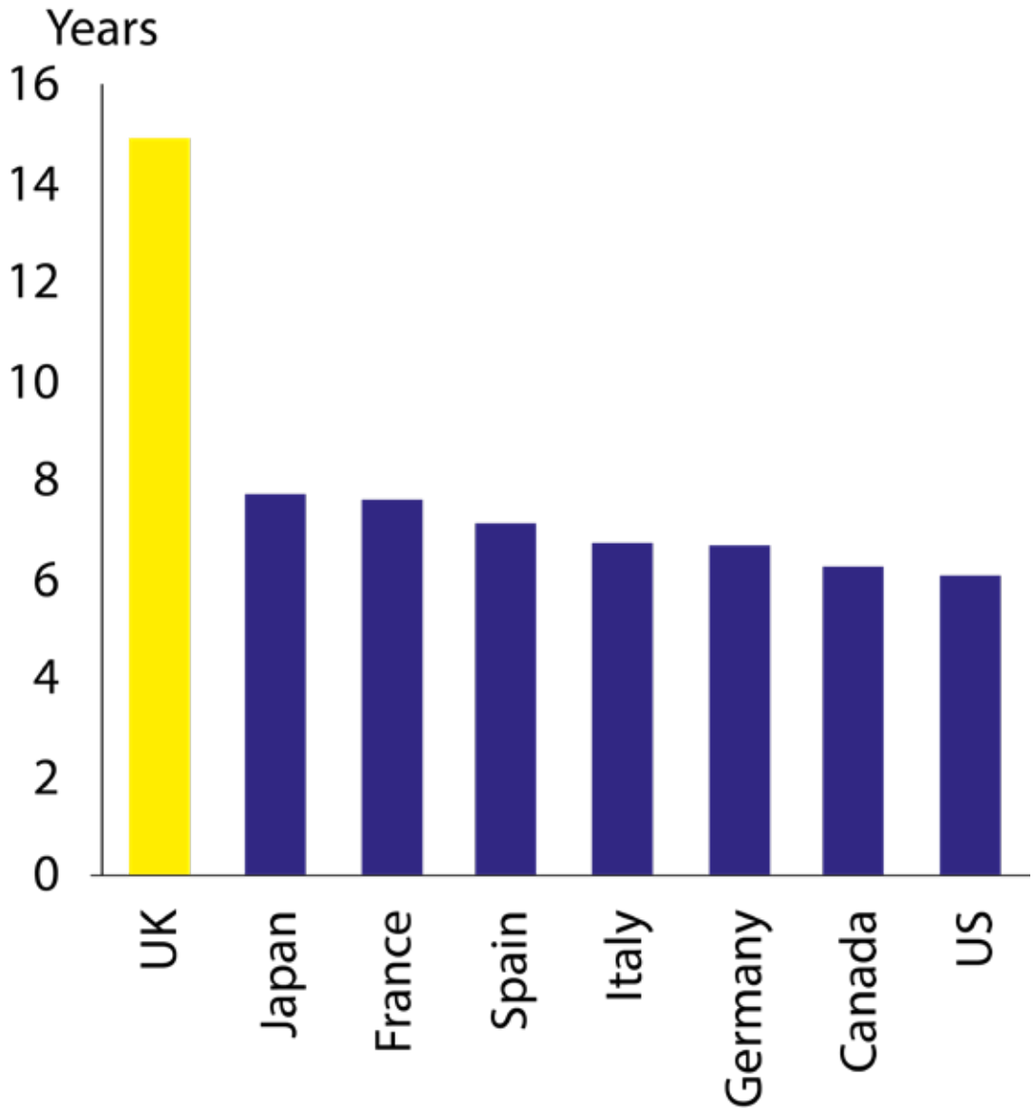
Source: Office for Budget Responsibility
(a) Gross interest payments are the sum of Asset Purchase Facility payments and net payments, as published by the OBR.
(b) The effective interest rate is the ratio of gross interest payment to total national debt.

Chart 6. Counterfactual UK net interest payment forecasts at 2007 and 2000 average interest rates(a)(b)



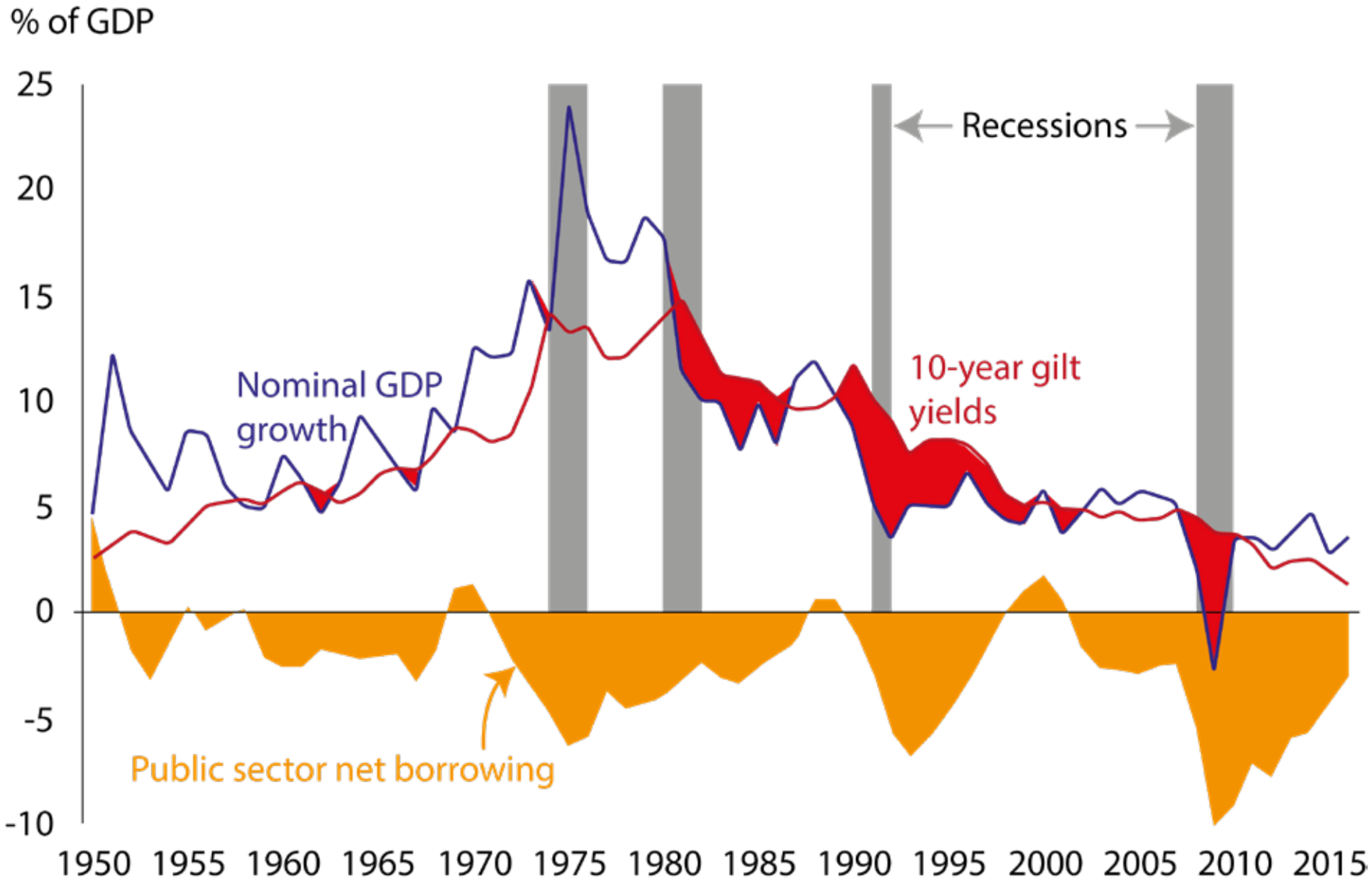
Source: Office for Budget Responsibility, Bank calculations
(a) Applies the average interest rate of the stock of national debt (debt repayment / total debt) in 2007 and 2000 to the OBR's forecast of future national debt. The average interest rate on the stock of national debt in 2007/8 was 4.9%; in 2000/1 it was 6.8%.
(b) Does not include payments to the Asset Purchase Facility.

Chart 7. Average term-to-maturity of government debt of selected countries (2016, or latest available)



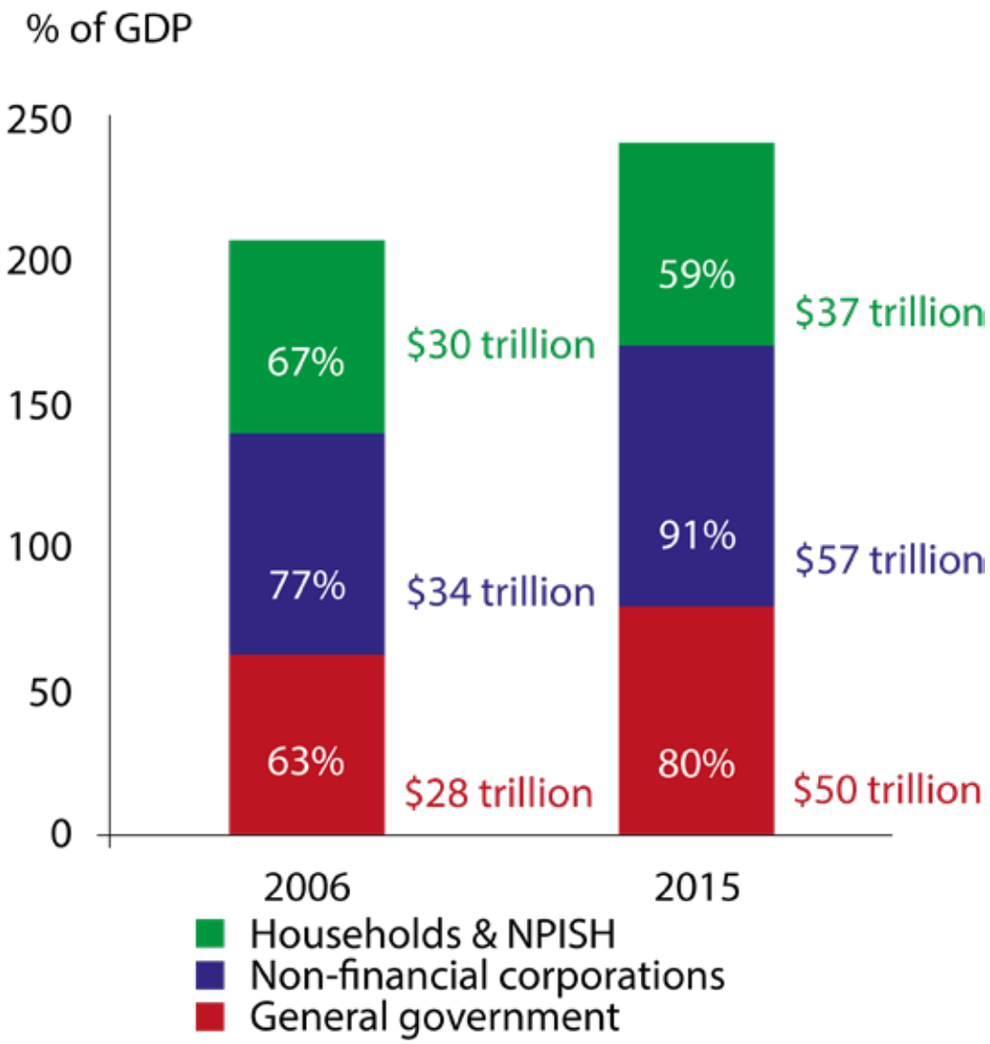
Source: Bloomberg L.P.

Chart 8. Nominal GDP growth and 10-year gilt yields(a)



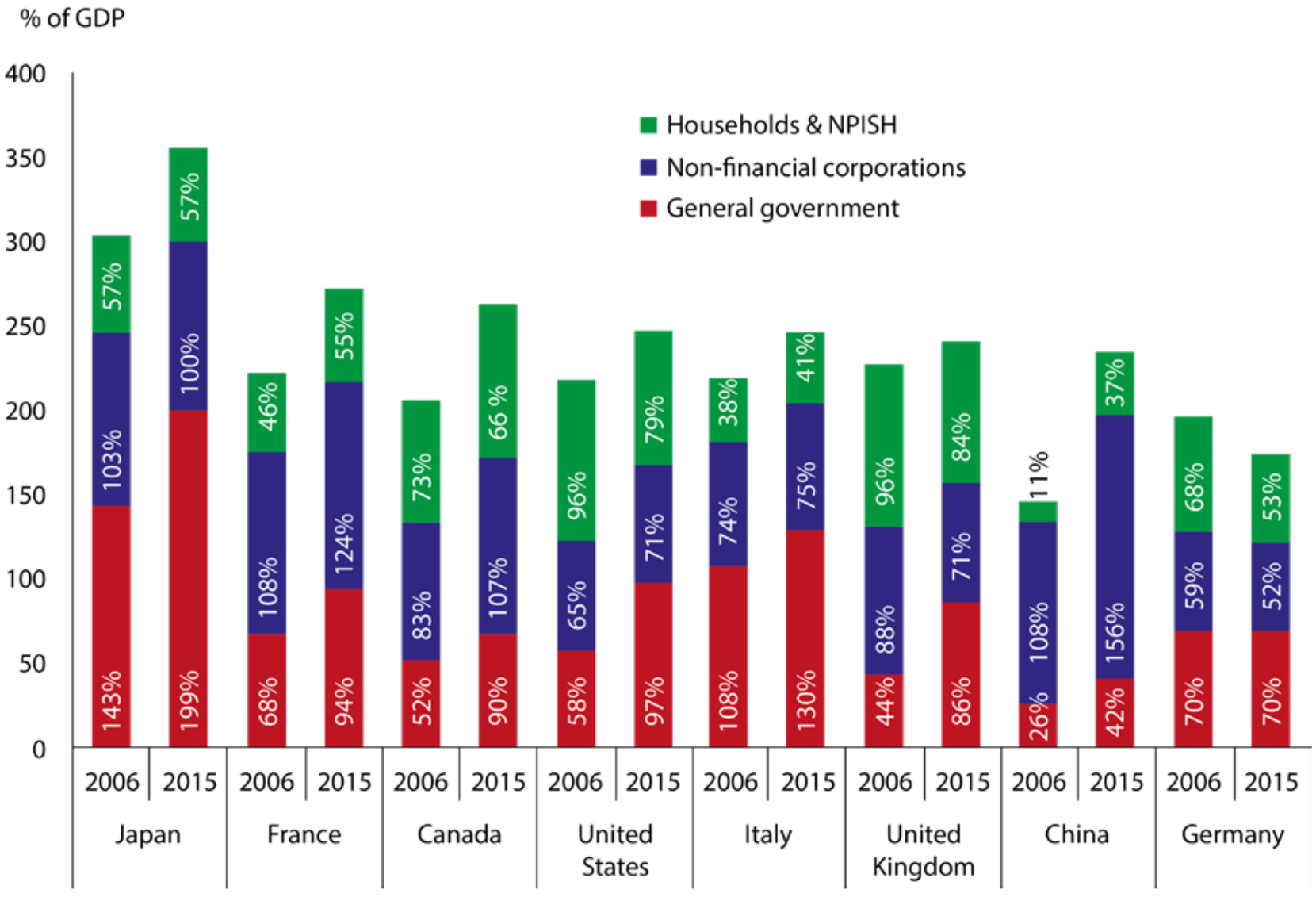
Source: Bank of England
(a) 'Recessions' (shown as shaded bars) are defined for the purpose of this chart as negative annual real GDP growth.

Chart 9. Global debt in 2006 and 2015(a)(b)



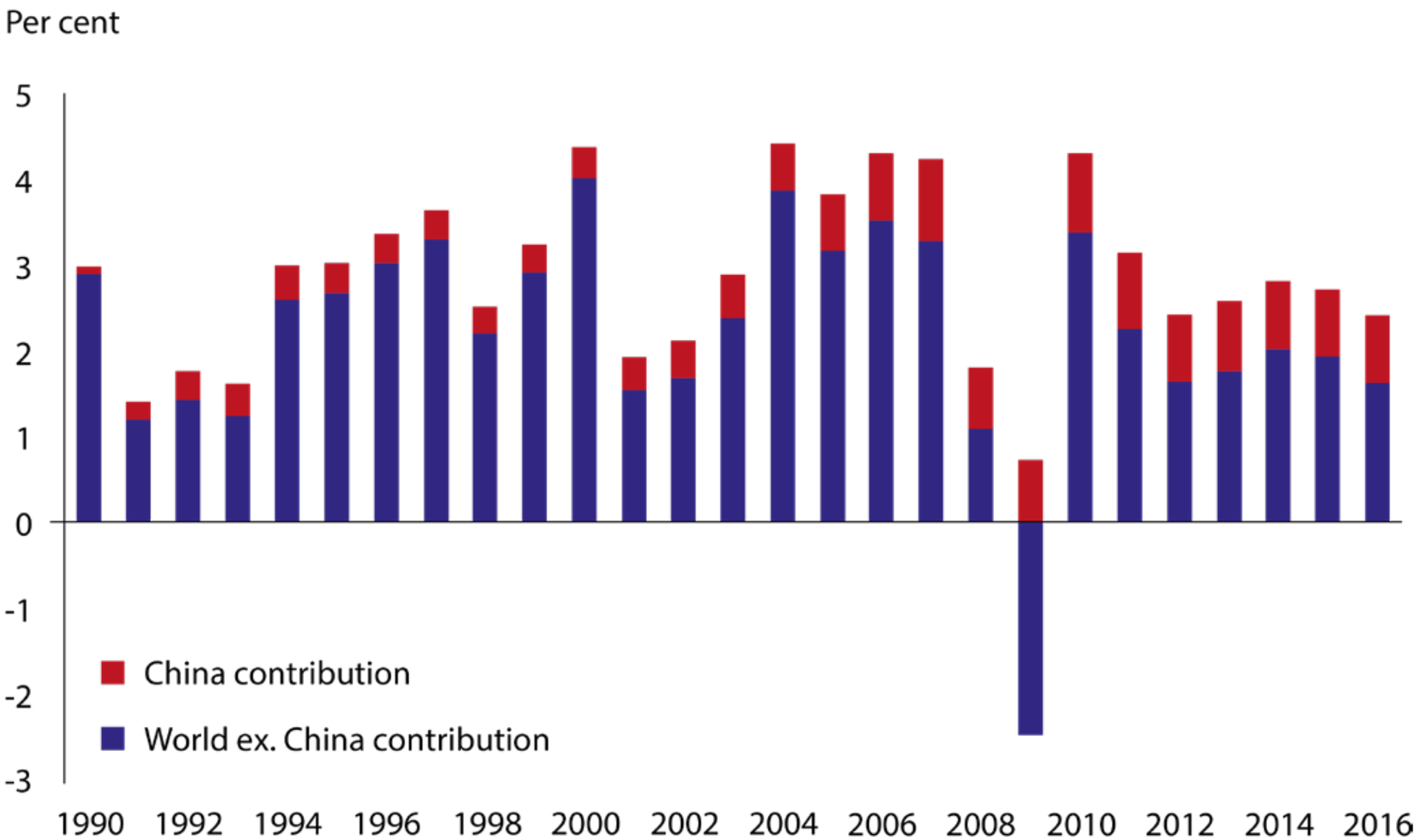
Source: BIS, World Bank, Bank calculations
(a) Includes all 42 countries reporting to the BIS, except India, South Korea and South Africa due to data limitations.
(b) NPISH: non-profit institutions serving households.

Chart 10. Debt position of G7 countries and China by sector(a)



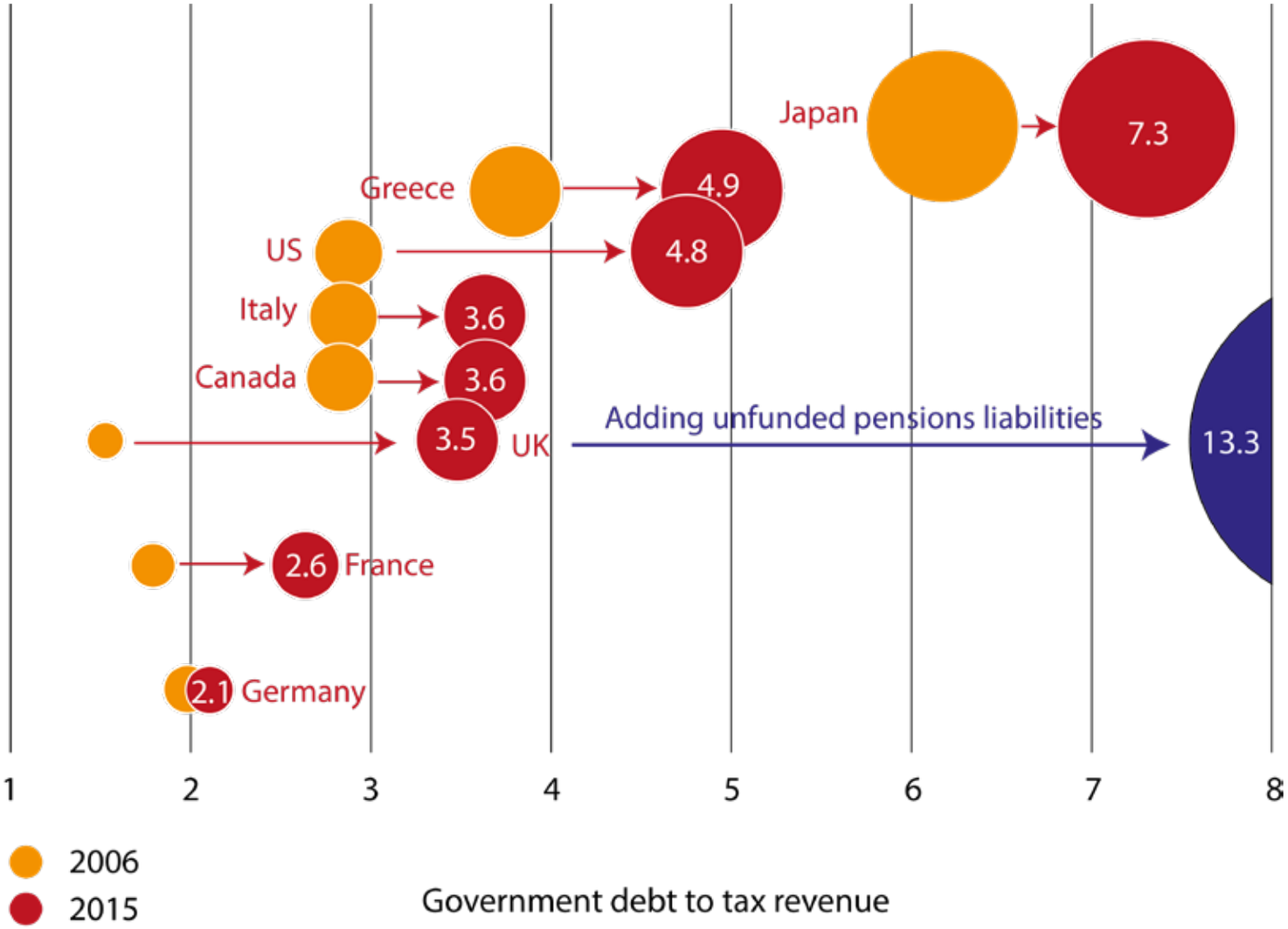
Source: BIS, World Bank, Bank calculations
(a) NPISH: non-profit institutions serving households.

Chart 11. World GDP growth(a)



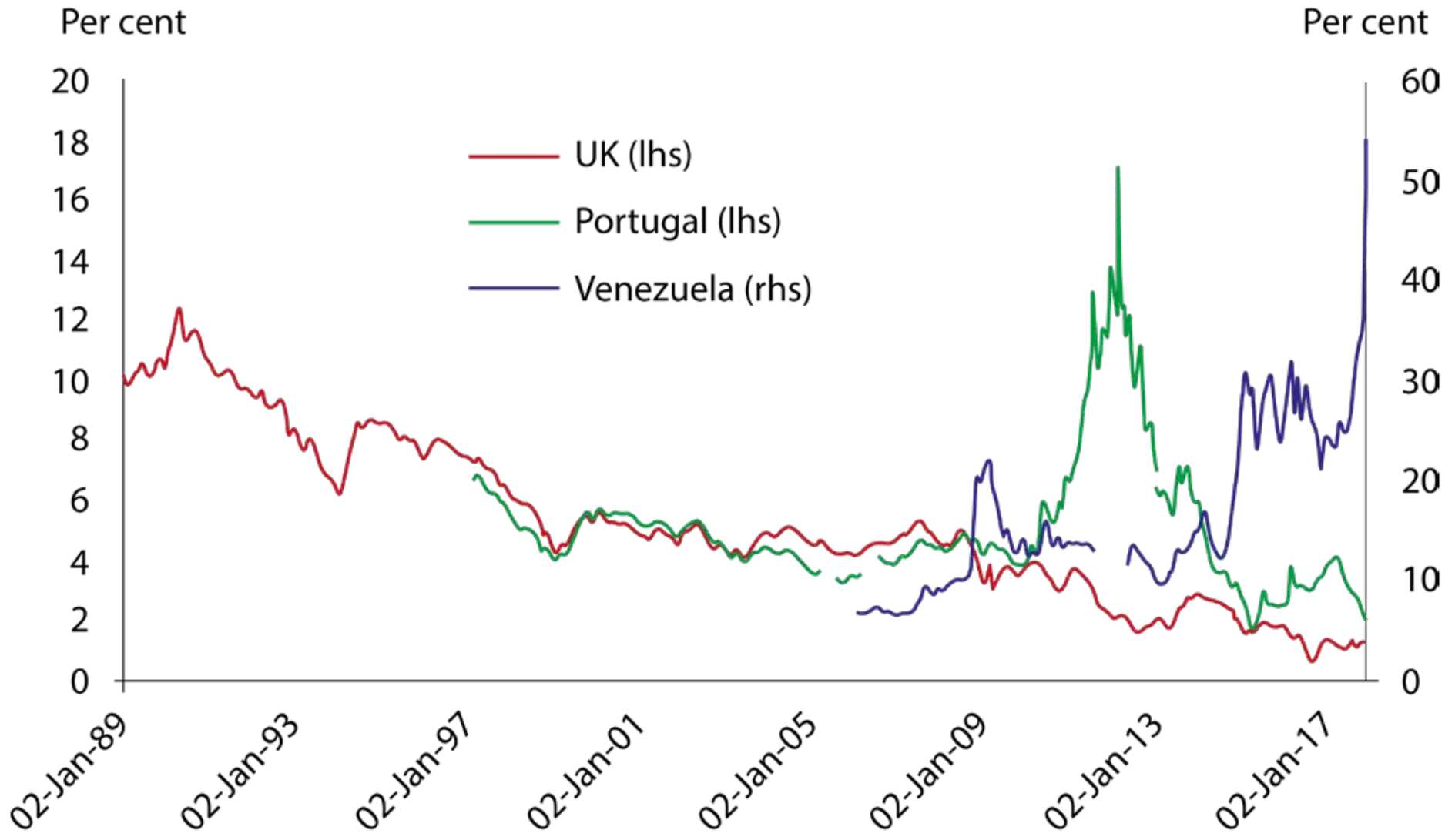
Source: World Bank
(a) At constant 2010 USD exchange rates.

Chart 12. Ratio of government debt to tax revenue from 2006 to 2015, G7 economies and Greece(a)



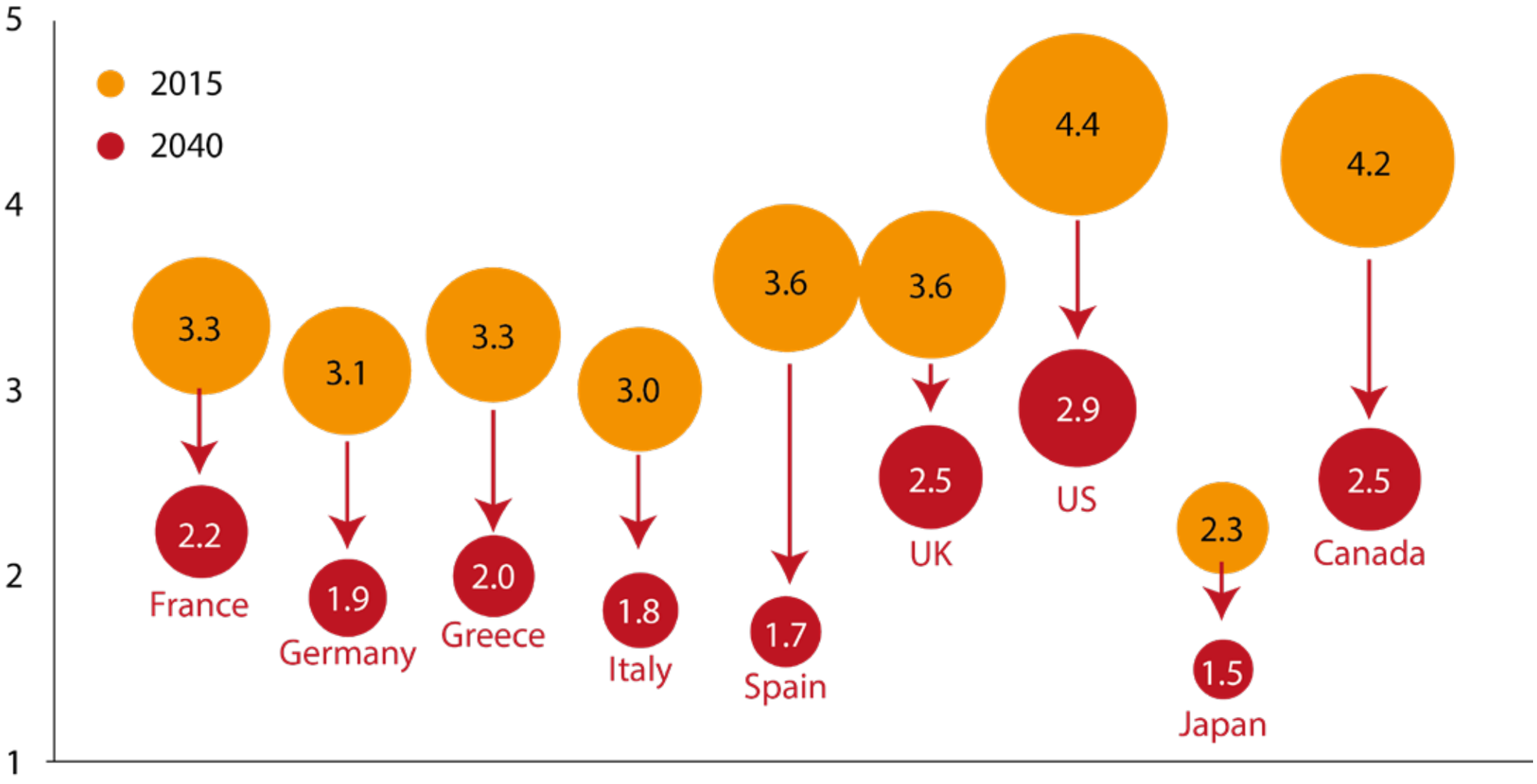
Source: ONS, OECD
(a) The blue circle shows the debt-to-tax ratio (inc. national insurance contributions) if 320% of unfunded contingent pension liabilities, as identified by ONS (2012), are added to the 2015 UK debt position.

Chart 13. 10-year government bond yields



Source: Bloomberg L.P.

Chart 14. Current and forecast old-age dependency ratios (working-age population relative to population of 65+ population)



Source: OECD

years' time[8]. Looking at the interest payments excluding the interest the Bank of England returns to the Government on the Bank's gilt holdings, shows that debt servicing costs over the last few years have been the highest for a generation – and that is despite the benefit of borrowing at historically low interest rates (Chart 5).

Flexing assumed interest rates is instructive. Chart 6 shows the OBR's forecast of net interest payments, assuming the average interest rate on the national debt was at the levels seen in 2007 and 2000: roughly 5% and 7% respectively. In these scenarios interest repayments would reach about £70 billion and £100 billion in today's money in 2021-22 based on the anticipated debt level at that time. To make this somewhat more tangible: at these interest rates, interest payments would considerably exceed the planned government spending on infrastructure, defined as total public sector net investment. To you and me, that's building schools, roads, houses, and hospitals, as well as investing in new equipment in the public sector, say for the NHS or national defence[9].

There are two factors that may mitigate the impact of any rise in interest rates in the UK. The first is that UK government debt has by far the longest average maturity among comparable developed countries (Chart 7). This means any increase in yields on newly issued bonds will take time to feed through to the average interest rate paid on total UK debt. If we assume yields returned now to those seen in 2000 – an increase of about 4 percentage points – debt repayments in 2021-22 would be about £55 billion in today's money.

The second factor to consider is that higher yields may be associated with higher economic growth, making debt more manageable. Chart 8 maps nominal GDP growth and 10-year gilt yields since the 1950s. What becomes immediately apparent is that rising interest rates have historically been associated with higher nominal GDP growth. In fact, nominal GDP growth had been higher than the government's borrowing cost until 1980. This has helped to reduce the very high post-war debt-to-GDP ratio.

But the picture since then has looked different: though the trend has been one of falling yields, they have frequently been above nominal GDP growth for prolonged periods, especially after recessions when borrowing needs were highest. So, even though economic growth and yields tend to move up or down together, we cannot necessarily assume that higher yields will always be compensated for by higher growth.

Turning to the global picture, total pre-crisis government debt, which was then approximately $28 trillion, had risen to $50 trillion by 2015. Unfortunately economic growth has not kept pace: total government debt stood at 63% of global GDP in 2006 and by 2015 had risen to approximately 80% (Chart 9). This increase is in contrast to household debt: whereas household debt was fuelling the asset bubble and debt fragility leading up the global financial crisis, it has declined since the crash as a proportion of GDP. The picture varies by country (Chart 10). Perhaps particularly interesting in this context is China as it was largely Chinese growth that supported the world economy during and after the financial crisis, contributing around 30% of world GDP growth since the crisis (Chart 11). Total debt in China, private and government, has increased more than in any G7 country since the crisis – up until 2015 this had grown to $25 trillion. The FPC has identified this rapid growth as a risk to financial stability[10].

I have focused so far on debt as a percentage of GDP, which is how it is usually cast. But this may mask differences in different countries' ability to raise tax revenues. Chart 12 shows that the debt burden has increased significantly as percentage of annual tax revenues. The UK went from the lowest debt-to-income ratio in our peer-group of G7 countries to middle of the pack. It may be worth noting that on this metric, we, and most other G7 countries, are in debt positions similar to reported Greek national debt in 2006.

Naturally, borrowing rates may not stay low. Though forward rates indicate that market interest rates are expected to stay low for some time, we need to recall that markets can be wrong in their assessments. Countries that need to sell debt externally are particularly exposed to the risk of a loss of financial credibility, consequent rising market risk

premia, and a market driven spiral into debt unsustainability. As an example of this, it is worth recalling that it was only five years ago that Portugal was threatened by interest rates of 14 percent – even though the ECB's risk-free interest rate was then at record lows (Chart 13).

Even countries that borrow a negligible amount of money from abroad, such as Japan, face challenges that could test debt sustainability. The demographic shift of an ageing and shrinking population attacks government budgets on two fiscal flanks: simultaneously reducing tax revenue and increasing expenditure. The 'old age dependency ratio' – the proportion of the working age population to the elderly – is forecast to decline in all major advanced economies (Chart 14). Using the latest numbers available, accounting for our pension payments as a contingent liability adds 320 percentage points to the UK debt-to-GDP ratio[11].

Fiscal space

Evidence has demonstrated, and broadly economists agree, that fiscal intervention has a positive multiplier effect immediately after an economic shock. This seems intuitive considering that unemployed resources are readily available to stimulate economic growth. Astute fiscal intervention should have a positive effect in engaging those available, but unemployed, resources to stimulate GDP growth. This is especially the case if monetary policy is constrained[12]. Paul Krugman, for example, has repeatedly made this argument eloquently and convincingly[13].

At the Jackson Hole Economic Symposium this year, Auerbach and Gorodnichenko provided an empirical underpinning to the logical theory that fiscal stimulus can be valuable in a recession. They find that compared to the baseline of no stimulus, debt-financed fiscal expansion in a crisis can sufficiently stimulate GDP to lead to a lower ex-post debt-to-GDP ratio. Note the stress on 'crisis'; they do not find a similar effect in normal times[14].

Following this line of thought, it makes sense that entering a crisis with sufficient fiscal space can have a sizeable impact in protecting an economy. Romer and Romer in a paper examined how the scale of monetary and fiscal pol-

icy space affects the aftermath of the crisis. *"The decline in output is less than 1 per cent when a country possesses both types of policy space but almost 10 per cent when it has neither"* they write[15].

However it is by no means a universally accepted hypothesis that the long-term effect of fiscal intervention is positive. The respected and authoritative economist Robert Barro for example alerts us to the risk that the negative fiscal multiplier associated with debt repayment can outweigh the positive multiplier effects of the initial expenditure. Barro's seminal work on Ricardian Equivalence implies that the fiscal multiplier associated with deficit spending is reduced even in the short term as the private sector makes cutbacks in anticipation of future higher taxes – in this view, deficit spending has the same effect on overall growth as raising taxes by the same amount[16].

That said, the balance of economists, including Barro, debate a fiscal multiplier between zero and one for debt-financed stimulus outside of crises. It tends to be higher in relatively closed economies with small automatic stabilisers, such as the US, than in open economies with larger automatic stabilisers, such as the UK[17].

The effectiveness of fiscal stimulus may also be impaired when debt is already high, reducing the fiscal multiplier. Research at the European Central Bank and the IMF, for example, suggests that the higher debt-to-GDP ratios, the less effective any additional stimulus becomes[18]. This is intuitive: the private sector is more likely to cut consumption and investment the more worried it is about high government debt levels. This intuition is further supported by Coenen *et al*, who find that the more persistent stimulus becomes the less effective it is relative to short-term fiscal measures[19].

More generally, we are all familiar with the work of Reinhart and Rogoff regarding the effect of the level of debt on growth. Notwithstanding its statistical reworking, it continues to highlight that the debt overhang when national debt-to-GDP hits 90 per cent has the potential to undermine economic growth. Further work focused on the EU

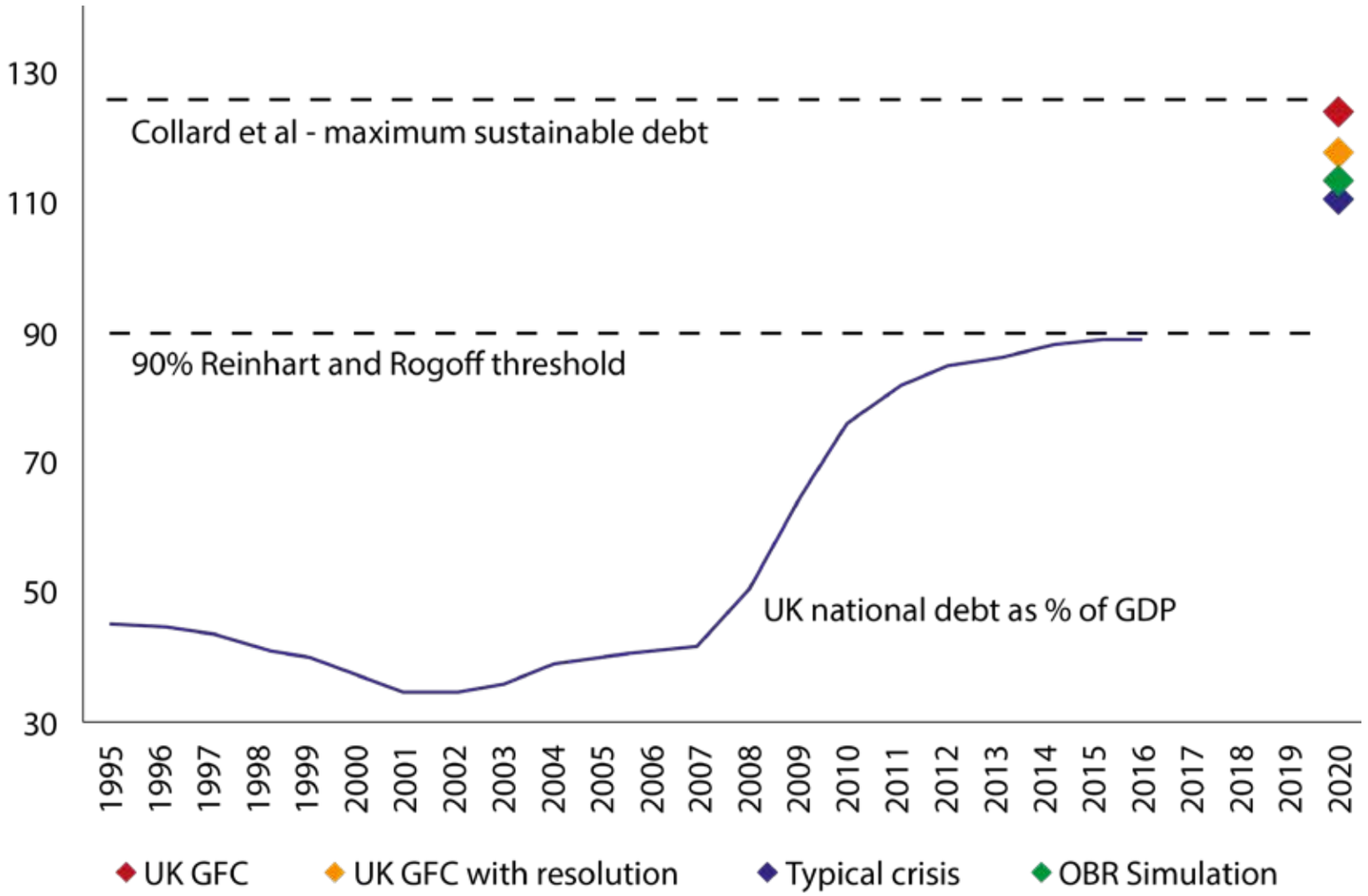
finds a similar 'turning point'. Mencinger *et al "calculated that the debt-to-GDP turning point, where the positive effect of accumulated public debt inverts into a negative effect, is roughly between 80% and 94% for the 'old' member states"*[20]. All else equal, lower economic growth undermines financial stability as banks find it harder to build capital, borrowers to repay loans, and investors seek higher yields, and therefore riskier investments.

Collard *et al* (2015) go one step further than Reinhart and Rogoff, and propose a framework to estimate a country's maximum sustainable debt: the point at which the government debt position does not just become a drag on growth but becomes unstable. For the UK, they estimate a maximum debt-to-GDP ratio of 126%. Moody's use a similar framework to assess fiscal space[21]. It is instructive to put this into the context of the impact of debt on financial crises: the £1 trillion of borrowing since the financial crisis I mentioned earlier – though not all due to the crisis – would exhaust the vital fiscal space Collard *et al* suggest the UK currently possesses (Chart 15).

Let me turn now to the OBR. In order to ensure that the banking system in the UK is resilient and capable of withstanding an economic shock, the FPC has instituted a process of stress testing the banks and the banking system. The OBR, similarly established as an impartial and independent entity, has conducted a similar exercise with respect to the UK macroeconomy[22]. In fact, it used the Bank of England's annual stress test for banks for this purpose. In July this year the OBR highlighted a number of issues which it suggests the Government may want to consider when managing its fiscal risks. These are consistent with the concerns I am raising:

- The more vulnerable starting fiscal position;
- The need to prepare for near-inevitable future shocks;
- And, the challenges of doing so in an environment they refer to as 'austerity fatigue'.

Chart 15. Potential impact of another financial crisis on the debt-to-GDP ratio



Sources: Eurostat, Office for Budget Responsibility, National Audit Office, Laeven and Valencia (2012)
(a) 'UK GFC' adds the debt incurred since the financial crisis; 'UK GFC with resolution' adds the debt incurred since the financial crisis less the cost of government bank bail-outs; 'Typical crisis' adds the cost of a typical crisis as found in Laeven and Valencia (2012); 'OBR Simulation' adds the impact of the OBR's fiscal stress test.

Quantitatively, in the OBR's fiscal stress test the national debt is nearly £600 billion higher than under its baseline forecast in five years' time. This would lead to a debt-to-GDP ratio of 114%, well above the Reinhart and Rogoff 90% threshold, and not far away from Collard *et al's* estimated maximum debt sustainability ratio.

Uncertainty

Though the OBR's stress test can give us an idea of the magnitude of the fiscal space that may be needed in the future, it cannot predict the source, magnitude or timing of future shocks. The current environment makes this, and macroeconomic policy making generally, particularly challenging. Globally, leading central bankers acknowledged uncertainty. Last month, for example, Janet Yellen, the chair of the Federal Reserve, observed that current levels of inflation were *"a surprise"*[23]. And even in China, the Governor of the People's Bank of China, Zhou Xiaochuan, has recently raised the risk of a *"Minsky moment"* flagging uncertainty with respect to Chinese asset values.

In early 2016, we entertained Nicholas Taleb at the Bank of England to discuss the risks of unanticipated, rare events – fat-tail events. As he said at that time, we need to accept that conventional statistical tools cannot be relied on to predict tail events as they may lead to the wrong conclusions and risk assessment. Earlier in this piece I said it paid to be vigilant. Taleb commented that, indeed, *"it pays to be paranoid"*[24].

The financial crisis illustrates the risk of ignoring fat tails: for example, some claimed they were seeing market movements so rare their models predicted it's more likely to win the lottery 20 times in a row than to experience the losses that befell them[25]. To paraphrase Wilde, this looks more like collective carelessness than misfortune. The FPC, of course, is charged with being careful.

I'm certainly conscious that markets are at the present pointing to limited volatility; and options markets do not point to any national debt tail risk. But benign markets can deceptively extinguish paranoia and unfortunately, as

we should certainly remember and Keynes famously said, markets can remain *"irrational a lot longer than you and I can remain solvent"*. So, I'm now taking the liberty of ignoring benign present market conditions.

This is with good reason. As a financial practitioner for well over 30 years, uncertainty is no surprise to me – for example, when I started in finance Venezuela was a AAA credit! Let me remind you of the definition of a AAA rating: *"An obligor […] has extremely strong capacity to meet its financial commitments"*[26]. Venezuela is now in default.

Moreover, I've seen some of the smartest brains in finance destroy capital on failed investments as a result of unforeseen and unforeseeable events. Hence, as a policy maker concerned with financial stability, it is important to me that we recognise that the UK's debt levels may be stretched given the risk that unexpected shocks may materialise.

To my mind low market interest rates and a persistent excess of global liquidity could be creating an illusion of readily available spare national debt capacity; a point of view which one unanticipated shock could challenge. The global financial crisis taught us that fragilities can be more real than apparent and that global spillovers means that broadly shared systemic fragilities can lead to disastrous contagion and amplification.

We are all, inevitably, victims of our own history and I recall for my part, not only the economic crisis of ten years ago but also the economic crisis of the 1990s, and the economic crisis of 1976 when the UK, being described as *"bust"*, had to borrow emergency funding from the IMF[27].

Before the crisis of 1976 there had been a consensus that a highly interventionist approach to economic management would provide sustainable growth. The financial crisis in 1976 led to an acknowledged need for what can only be described as a policy U-turn away from Keynesian debt-driven policies to ensure prosperity[28].

Following the 1976 crisis, there had been until the global financial crisis a relatively unqualified victory of the capitalist free-market model to generating prosperity[29]. Then the global financial crisis threw old certainties into doubt. We all know that now the quest for global prosperity and real growth is presenting policy challenges.

In this context it is worth noting that many brilliant economists are offering wildly different solutions[30]. Some of these include advocating debt-financed government expenditure, for example infrastructure, as a mechanism to address secular stagnation. It is not for me to adjudicate on this debate. But our shared experience of crises should lead us to recognise that high-conviction policymaking in an uncertain economic environment is perilous. The uncertainty which Janet Yellen and Zhou Xiaochuan acknowledge as policy makers, permeates the macroeconomic environment and should influence our risk-taking calculus as we consider macroeconomic policies to generate growth.

In this context, the challenge to the financial stability policymaker is to assess the cost of losing valuable fiscal space to promote financial stability if any debt-financed expenditure fails to produce the promised growth. Unfortunately the OBR evidence indicates that at present our national resilience is fragile and as such our margin for error is small.

Conclusion

In summary, my argument has been that fiscal space is a vital national asset, and that financial stability considerations should lead us to prioritise protecting it. The UK has addressed the global financial crisis by incurring a cumulative additional debt of £1 trillion since 2008 amounting to 53% of current GDP. Our successful ability to dampen the recessionary effects was inherent in the fact that we evidently have been able to maintain financial credibility and a superior credit rating during this challenging period.

Within the broad sweep of factors affecting fiscal sustainability, the UK has both strengths and weaknesses: we are heavily indebted and some way away from a fiscal position capable of restoring our pre-crisis debt-to-GDP ratio. We

are suffering from anaemic growth notwithstanding low spare capacity in the economy. Moreover, we have a persistent trade deficit leading to the need to be capable of attracting foreign capital to maintain a stable financial system. On the other hand our debt has a very long maturity, we control our currency, we are not as demographically challenged as some other countries, the rule of law underpins a strong institutional capability incorporating independent monetary policy decision making. And, importantly, we are an open democracy which attracts FDI.

The FPC is charged with monitoring risks to financial stability. Quite frankly it is relatively easy to address visible systemic vulnerabilities; it is of course much harder to address the unknown unknowns. What does seem to me to be apparent is that we have a debt level which gives us limited capacity for national manoeuvre. Financial stability being essential for growth, the FPC has been working hard to address the financial vulnerabilities exposed by the crash. The systemic health of the nation is now significantly stronger. But *in extremis* we may yet need national financial resilience.

The FPC's remit is to monitor and protect financial stability. It is not for the FPC or for an FPC member to assess the specific fiscal policies of the day. My comments should only be considered as contributing to the discussion of fiscal strategies in ensuring that, as one evaluates such strategies, it is important to remain aware of the fact that if we lose our fiscal space, financial stability is jeopardised. ■

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Endnotes
1. Carney (2017)

2. Taylor (2017)
3. Brown (2017)
4. As measured at gross value added (GVA). GVA + taxes equals GDP. ONS (2016)
5. Buiter (2015) and Alan Blinder's presentation at the Riksbank in 2016.
6. Fischer (2017)
7. See the OBR's Economic and Fiscal Outlook – November 2017.
8. Ibid.
9. House of Commons Library (2017). Public sector net investment is net of depreciation – ie. wear and tear – of the existing capital stock.
10. Financial Stability Report (2017)
11. Numbers as of 2010. ONS (2012)
12. DeLong and Summers (2012)
13. See, for instance, https://krugman.blogs.nytimes.com/2015/09/15/keynesianism-explained/
14. Auerbach and Gorodnichenko (2017)
15. Romer and Romer (2017)
16. Barro (1974). Ricardian Equivalence holds under the assumption – inter alia – that taxes are non-distortionary. It also leaves open what the money is spent on, eg. to stimulate demand or increase potential supply. This means deficit spending under Ricardian Equivalence per se does not have a fiscal multiplier associated with it, as it depends on what the money is spent on.
17. See Batini et al (2014) for a review of the literature.
18. Ilzetzki et al (2011), and Nickel and Tudyka (2013).
19. Coenen et al (2012)
20. Mencinger et al (2015)
21. Moody's (2011)

22. Office for Budget Responsibility (2017)
23. Yellen (2017)
24. A video of Nassim Taleb's presentation can be found here.
25. Financial Times (2007) for the claim; see Dowd et al (2008) for the comparison to the lottery.
26. Standard & Poor's (2017)
27. Roberts (2016)
28. As the Prime Minister at the time, James Callaghan, admitted: "We used to think that you could spend your way out of a recession and increase employment by cutting taxes and boosting Government spending. I tell you in all candour that that option no longer exists, and that in so far as it ever did exist, it only worked on each occasion since the war by injecting a bigger dose of inflation into the economy, followed by a higher level of unemployment as the next step."
29. Seldon, Arthur (2004)
30. See, for example, Larry Summer's blog on the on-going debate in the economics profession.

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Article based on a speech given at University College London, on Thursday 30 November 2017.

From the consumer to the commercial world – how AI is driving intelligent payments

We are entering an exciting new age with business able to proactively anticipate future trends, Russell Bennett writes

The world of banking and financial services is still seen as one of the more conservative sectors of the economy today but if organisations operating across these marketplaces want to drive competitive edge and business advantage in the future, they can no longer afford to ignore the consumer-driven pull towards the use of artificial intelligence (AI). People are used to these technologies in their everyday lives. They are used to smart software telling them what they want to buy next even before they realise it themselves.

Today, it's increasingly vital that banks, financial services organisations and financial departments within enterprises are all in touch with these trends. They need to start looking at the benefits that analytics and other predictive technologies can bring them. Their employees and customers will expect them to do so.

The good news is we are starting to see the use of AI growing in the commercial finance environment now. So far, use cases have mainly been around streamlining operational processes.

Take the introduction of digital expenses platforms and integrated payments tools, both of which have the potential to significantly improve a business's approach to how it manages cash flow. By having an immediate oversight, through live reporting of all spending from business cards and invoice payments, as well as balances and credit limits across departments and individuals, businesses can foresee potential problems more quickly and react accordingly – and they can go beyond this too. All these services become even more powerful when combined with technologies like machine learning, data analytics and task automation.

We are also seeing growing instances of AI and automation being used to streamline payment processes in banks. Cards can be cancelled, or at least suspended, quickly and easily and without the need to contact the issuing bank, while invoices can also be automated, to streamline business payments. This means businesses can effectively keep

hold of money longer and at the same time pay creditors more quickly. Moving beyond straightforward invoice processing, intelligent payments systems can be deployed to maximise this use of company credit lines automatically.

Looking ahead, we see a raft of applications for AI in the payments management field around analysing data with the end objective of spotting anomalies in it. With the short and frequent batches of payments data used within most enterprises today, it is unlikely that even the best trained administrator would be able to spot transactions that were out of the normal pattern. The latest AI technology could be used here to tease out anomalies and pinpoint unusual patterns or trends in spending that could then be investigated and addressed.

They also have the potential to shape the way that payments are made in the future. One of the hottest topics currently under discussion across the commercial payments sector is the thorny issue of integrated intelligent pay-

We are also seeing growing instances of AI and automation being used to streamline payment processes in banks

ments. How can enterprises use the latest available artificial intelligence technology to work out the best possible payment option for each individual transaction?

Accounts payable teams will soon need to be able use payments platforms to assess not only how much working capital they have on their corporate cards and what rates they have on their purchasing cards but also what the most sensible choice for payment method would be for each payment, be it BACs, wire, cheques or even just old-fashioned accounts payable.

Indeed, there is likely to soon be a case for this kind of technology to effectively 'fit in', in process terms, between the accounts payable department, and the payment itself, helping the business decide what makes best sense for them as a payment methodology based on the business rules and existing deals that they have in place today.

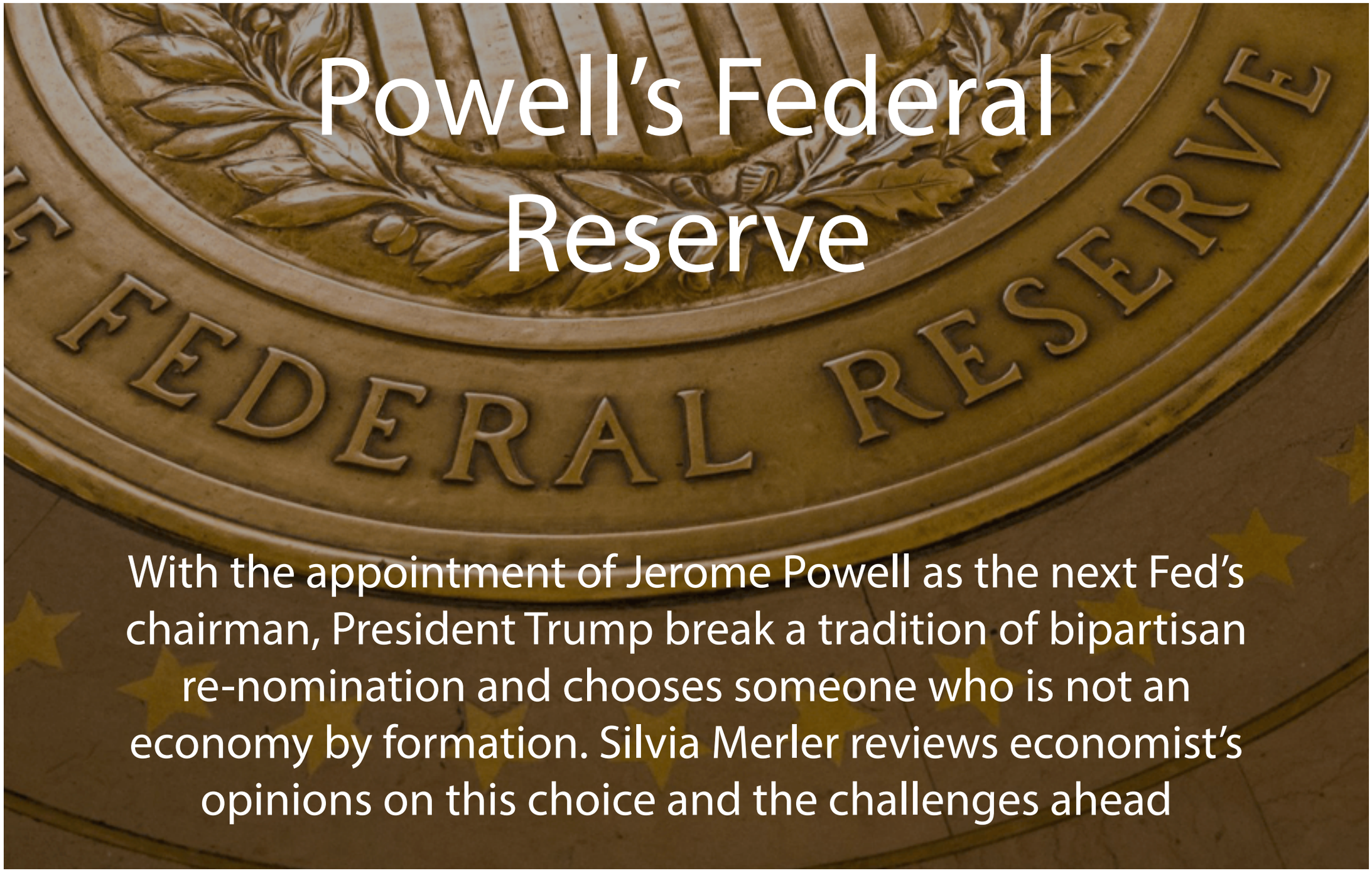
Future prospects

We also see a raft of applications for AI in the payments management field around analysing data with the end objective of spotting anomalies in it. With the short and frequent batches of payments data used within most enterprises today, it is unlikely that even the best trained administrator would be able to spot transactions that were out of the normal pattern. The latest AI technology could be used here to tease out anomalies and pinpoint unusual patterns or trends in spending that could then be investigated and addressed.

While this area remains in its infancy within the banking and financial services sector, with technology advancing, financial services organisations and the enterprise customers they deal with will in the future will be well placed to make active use of AI that will help clients track not just what they have been spending historically but also to predict what they are likely to spend in the future.

AI will ultimately enable businesses to move from reactive historical reporting to proactive anticipation of likely future trends. We are entering an exciting new age. ■

Russell Bennett is chief technology officer at Fraedom



Powell's Federal Reserve

With the appointment of Jerome Powell as the next Fed's chairman, President Trump break a tradition of bipartisan re-nomination and chooses someone who is not an economy by formation. Silvia Merler reviews economist's opinions on this choice and the challenges ahead

Kenneth Rogoff argues that with the appointment of Jerome Powell as the next Fed Chair, Donald Trump has made perhaps the most important single decision of his presidency. It is a sane and sober choice that heralds short-term continuity in Fed interest-rate policy, and perhaps a simpler and cleaner approach to regulatory policy. Powell will face some extraordinary challenges at the outset of his five-year term. By some measures, stock markets look even frothier today than they did in the 1920s and with today's extraordinarily low interest rates, investors seem ever more willing to assume greater risk in search of return.

At the same time, despite a strongly growing US and global economy, inflation remains low, which has made it difficult for the Fed to normalize policy interest rates so that it has room to cut them when the next recession hits, which it inevitably will. Rogoff identifies three areas that will be important for the Fed going forward. First, given that monetary policy is the first and best line of defence against a recession, an urgent task for the new chair is to develop a better approach. Second, bank regulation is also part of the Fed's mandate, and the costs of compliance with Dodd-Frank financial-reform legislation will be an important topic. Third, the threat to the Fed's independence posed by a president seemingly intent on challenging all institutional norms.

Joseph Stiglitz wonders whether Trump has captured the Fed. President Trump chose a non-economist a time when the Fed will face great challenges, as it reverts to more normal policies. Higher interest rates could give rise to market turmoil, as asset prices undergo a significant 'correction', and many are expecting a major downturn in the next five years. While the Fed's tool kit has been greatly expanded in the last decade, the Fed's low interest rates and huge balance sheet – and the possibly massive increase in debt, should Trump get his tax cuts – would challenge even the best-trained economist.

Most importantly, there has been a bipartisan (and global) effort to depoliticize monetary policy. Even in the absence of direct politicization, the Fed always faces a problem of 'cognitive capture' by Wall Street. That's what hap-

pened when Alan Greenspan and Ben Bernanke were in charge and the consequences were the greatest crisis in three quarters of a century, mitigated only by massive government intervention. The Trump administration seems to have forgotten what happened less than a decade ago, or it would be difficult to explain its efforts to rescind the 2010 Dodd-Frank regulatory reforms, designed to prevent a recurrence. Fortunately, it appears that Powell recognizes the importance of well-designed financial regulations.

Scott Summer writes on the *Washington Post* that there are a few reasons to be concerned about this appointment. The past four Fed chairs have all been economists, with a deep understanding of monetary policy. Putting a lawyer in charge of the Fed is roughly analogous to naming an economist to be chief justice of the Supreme Court. First, there's much more to monetary policy than adjusting interest rates, which is why we should want a highly qualified

Going forward, it will be interesting to see how Republicans in the House and Senate proceed

specialist to lead the central bank. Even many economists can get confused by the connection between interest rates and monetary policy, but the problem is even more severe among non-economists.

The last non-economist to serve as Fed chair was G William Miller. Interestingly, his problems were quite similar to what experienced during the financial crisis, but in the opposite direction. Miller thought that to fight the high inflation of the time it was enough to keep interest rates high, but rates were high because of inflation. Another concern is that Powell believes the Fed should focus not just on macroeconomic stability, but should also try to prevent financial market excesses. Many economists are sceptical of this view — for good reason. In 1929, the Fed tightened policy to try to stop a stock market bubble, tipping the economy into the Great Depression. In the long run, a stable macroeconomic environment is most conducive to a stable financial system. Financial excesses are better addressed through regulation, not the blunt instrument of monetary policy.

Tim Duy writes on *Bloomberg* that the next Fed Chair will contend with a slow-growth economy. The recent pace of growth exceeds the Fed's estimated longer-run pace of 1.8 percent. Given that the Fed believes the economy is operating at or somewhat beyond full employment, a sustained 3 percent pace would stretch capacity too far and generate excessive inflationary pressures. To counter these forces, the Fed anticipates continue tightening of policy, on the order of 100 basis points between now and the end of next year.

The next Fed chair will need to deftly handle the transition to a slower-growth economy. One big challenge will be gauging the pace of any slowdown. During the early stages of an expansion, the picture told by most economic data is usually one of stronger growth. As the expansion matures and slows, however, the data become more muddle and this shift could be misinterpreted as a recessionary signal. At the same time, the transition to slower growth could leave the economy more vulnerable to negative shocks and actual recession, making it all the more important that the Fed is able to switch from tightening to easing should the need arise.

Moreover, the Fed may face a different challenge. It may be that companies operating near capacity take the plunge and expand their operations, boosting growth. Alternatively, Congress may manage to agree on a substantial tax cut, supporting consumer spending. Or, with the economy already operating above full employment, more inflationary pressures exist than currently evident. These circumstances might require a more aggressive pace of rate hikes. And then there is the possibility of an acceleration of productivity growth, which, in turn, would boost the Fed's estimate of the longer-run growth rate and could place policy makers in a tricky position because, in the near term, it might argue for a slow pace of rate increases, but over the longer run we would expect faster productivity growth to push the neutral rate higher.

Glenn Hubbard writes on the *FT* that the appointment of Powell is just the start. The Trump administration's ability to make a number of key Fed appointments brings an opportunity — and the responsibility — to ask far-reaching questions about the central bank's mission. Under Paul Volcker, the Fed grappled with how to tame destructive inflation. During the tenure of his successor, Alan Greenspan, it asked how fast the economy could grow without igniting inflation. The central bank led by Ben Bernanke explored how to stem the economic effects of financial instability.

Under Janet Yellen, the Fed still struggles with how to exit ultra-loose monetary policy as the economy expands at a rate consistent with many estimates of potential gross domestic product growth and full employment. The Federal Reserve board shaped by Trump and Powell now faces three big questions about what a 'normal' monetary policy looks like in today's economic environment, what the scope of the Fed's role in financial regulation should be, and how it can safeguard the independence of monetary policy in a hostile political climate.

Tho Bishop at Mises Wire argues that with the nomination of Powell the 'swamp wins again'. Donald Trump gets what he wanted, a 'low interest rate person' who also happens to be a 'Republican.' Bishop believes that Powell's

nomination serves as a particularly useful illustration of how little has changed in Washington since the Bush Administration. The administration has signaled that its plans to form a policy consensus with its remaining Fed choices – as opposed to opening FOMC meetings into some truly spirited debate.

Going forward, it will be interesting to see how Republicans in the House and Senate proceed. For years now, House Financial Services Committee Chairman Jeb Hensarling has been pushing Fed reform which would have included requiring the Fed to adopt rule-based monetary policy. While this would have complemented the nomination of John Taylor or Kevin Warsh, Powell has made it clear that he opposes such limits being placed on the Fed. Going forward, we should expect to see the Fed continue slow normalization of its balance sheet.

Whether the Fed continues with its projected interest rate hike in December may itself depend on Congress. The legislature's knack for kicking the budgetary can down the road as led to yet another 'fiscal cliff' scenario at the end of the year. While we can be ensured that outcome will be more spending (and more debt), the bout of yet another round of arbitrary drama may give the Fed enough of an excuse to follow their lead and hold off until 2018. ■

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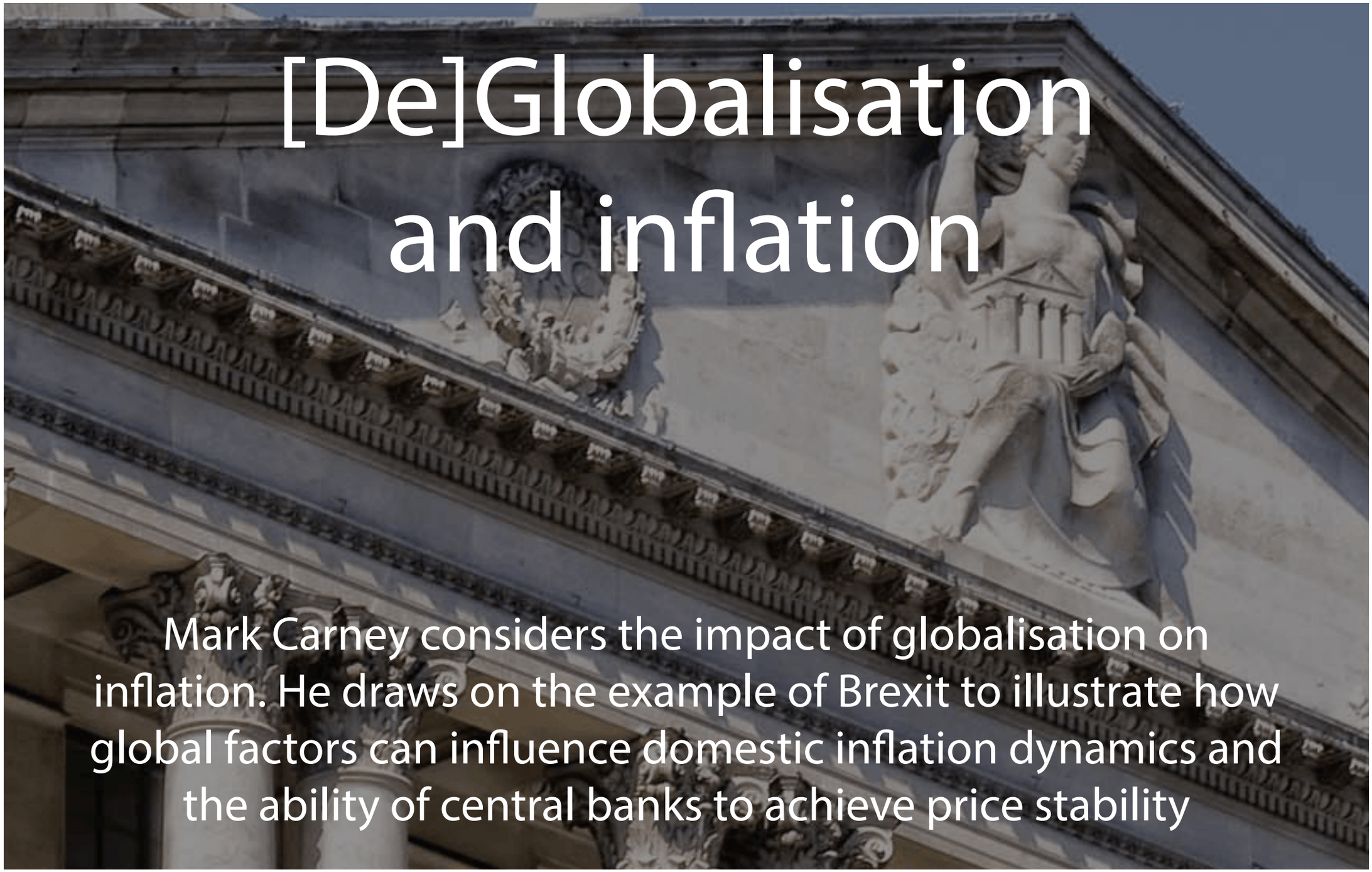


[De]Globalisation and inflation

Mark Carney considers the impact of globalisation on inflation. He draws on the example of Brexit to illustrate how global factors can influence domestic inflation dynamics and the ability of central banks to achieve price stability

Introduction

During his term as Managing Director of the International Monetary Fund, Michel Camdessus oversaw the second great wave of globalisation. The Berlin Wall fell, capital controls were liberalised, the euro was constructed, and China prepared to join the WTO. Product and financial markets became increasingly integrated, with trade growing at an annual rate of 10% and capital flows of 20%. The effective global labour force doubled, and more than a billion people were lifted out of poverty.

Central banks are now grappling with one consequence of such enormous achievements – the impact of globalisation on inflation. All central banks must consider the cyclical relationship between global slack and domestic inflation; the degree to which secular forces from globalisation affect local inflation dynamics; and how global factors influence the stance of domestic monetary policy itself. And now some central banks may need to consider the implications for price stability if the process of globalisation were to slow or go into reverse.

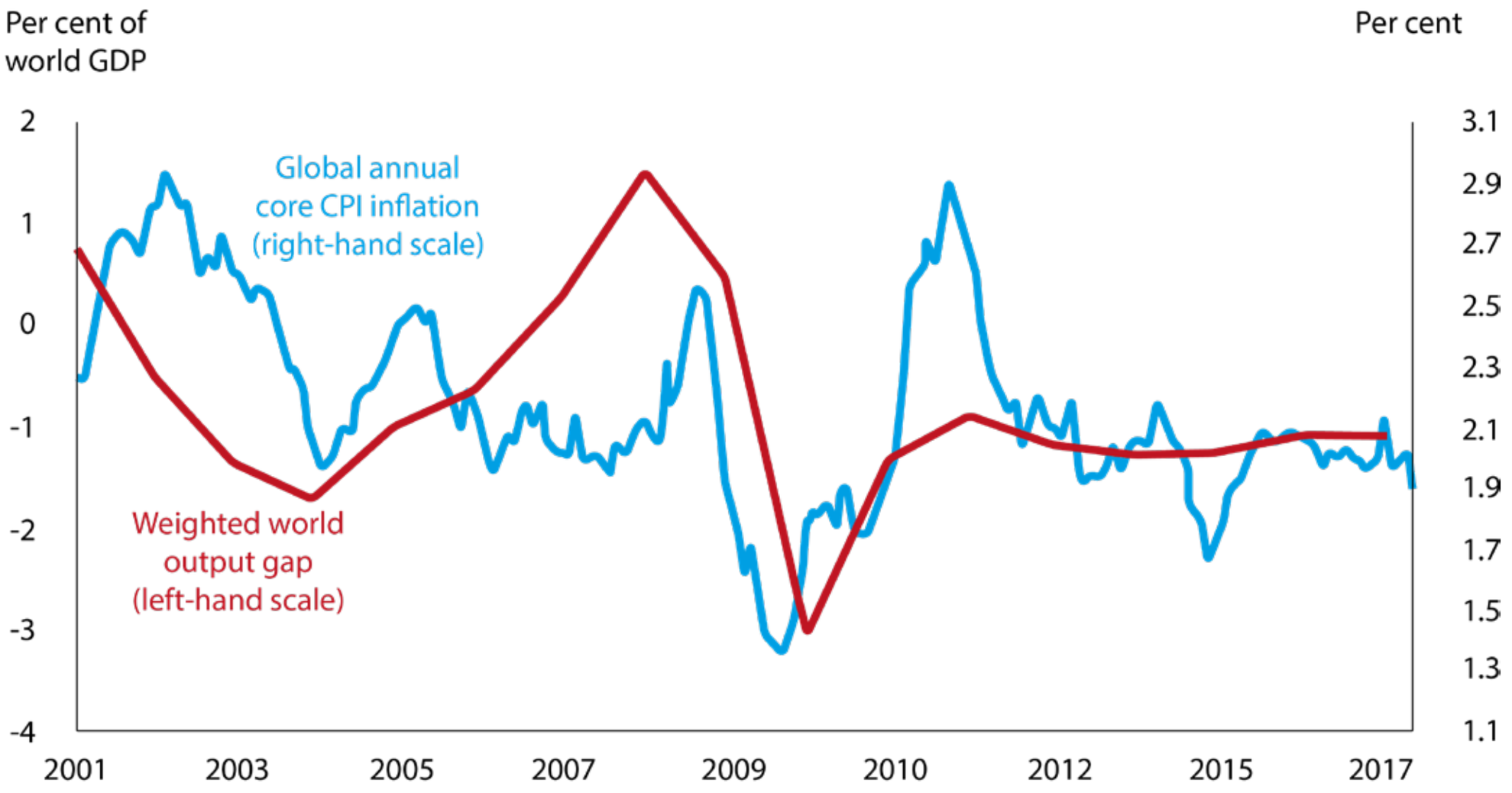
These issues are particularly relevant to the Bank of England as the UK inflation outlook will be importantly influenced for some time by a process of de-integration under Brexit. I would like to draw on this example to illustrate how global factors influence domestic inflation dynamics and the ability of central banks to achieve price stability.

Globalisation and inflation

While the global Phillips Curve appears alive and well (Chart 1), globalisation has been accompanied by a weakening in the relationship between domestic slack and domestic inflation (Chart 2),[1] and by a corresponding strengthening in the relationship between global forces and domestic prices.

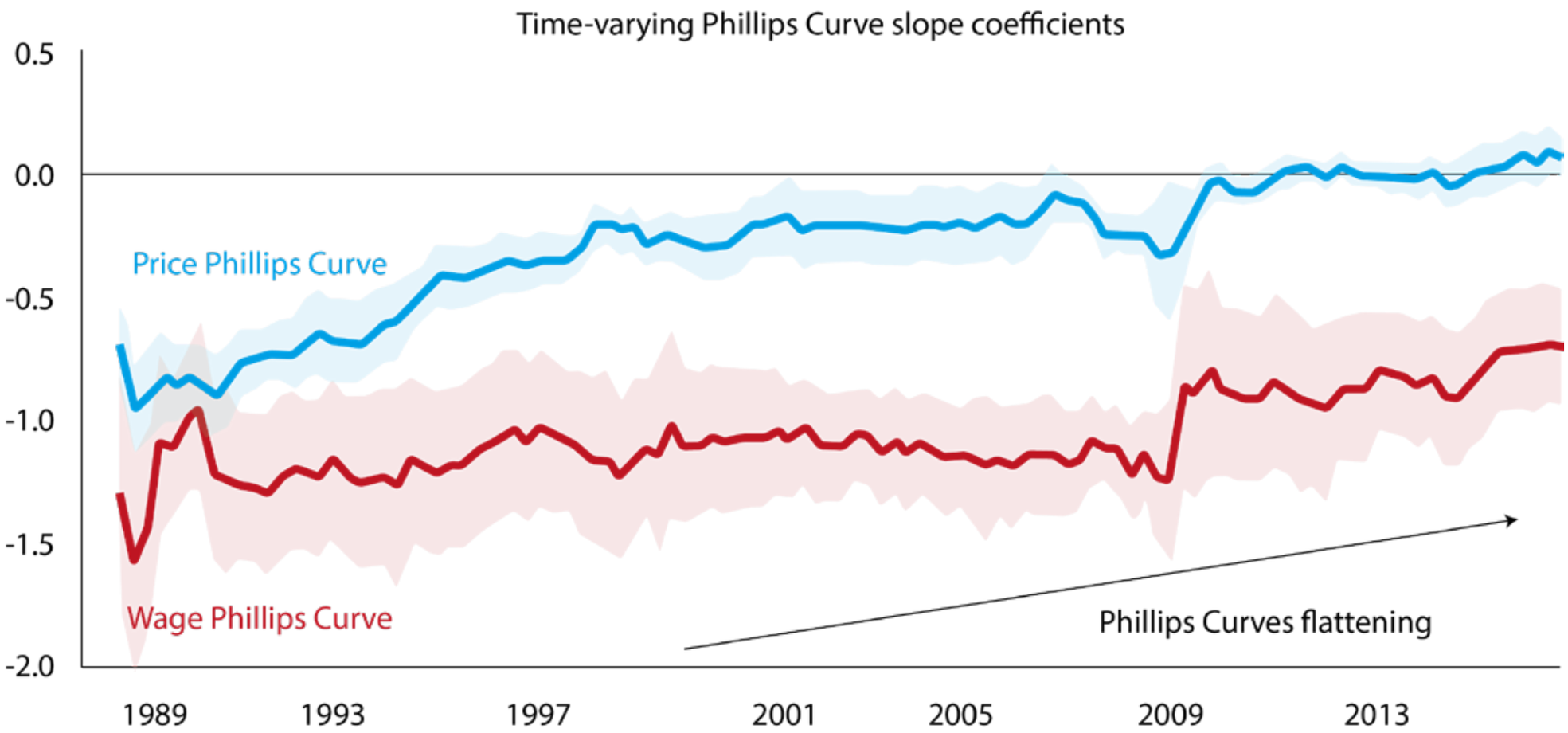
With correlations of headline CPI inflation rates as elevated today as during the first oil shock (Chart 3a), some contend that global forces have become dominant – a conviction reinforced by the 'missing disinflations' in the wake

Chart 1. Global price Phillips Curve?



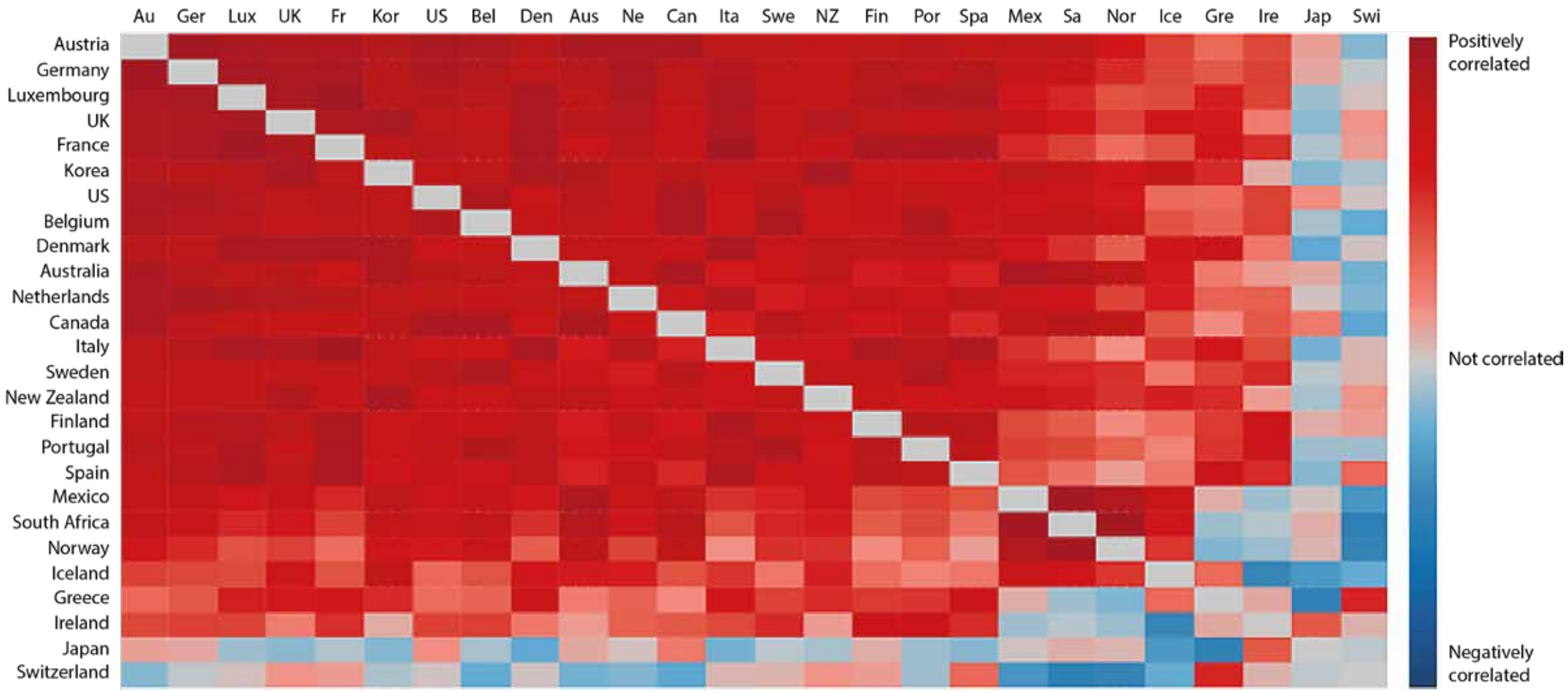
Notes: Average world output gap and global core CPI inflation (PPP-weighted).
Sources: CEIC, IMF, ONS, Thomson Reuters Datastream and Bank calculations.

Chart 2. Price and wage Phillips Curves have flattened throughout globalisation



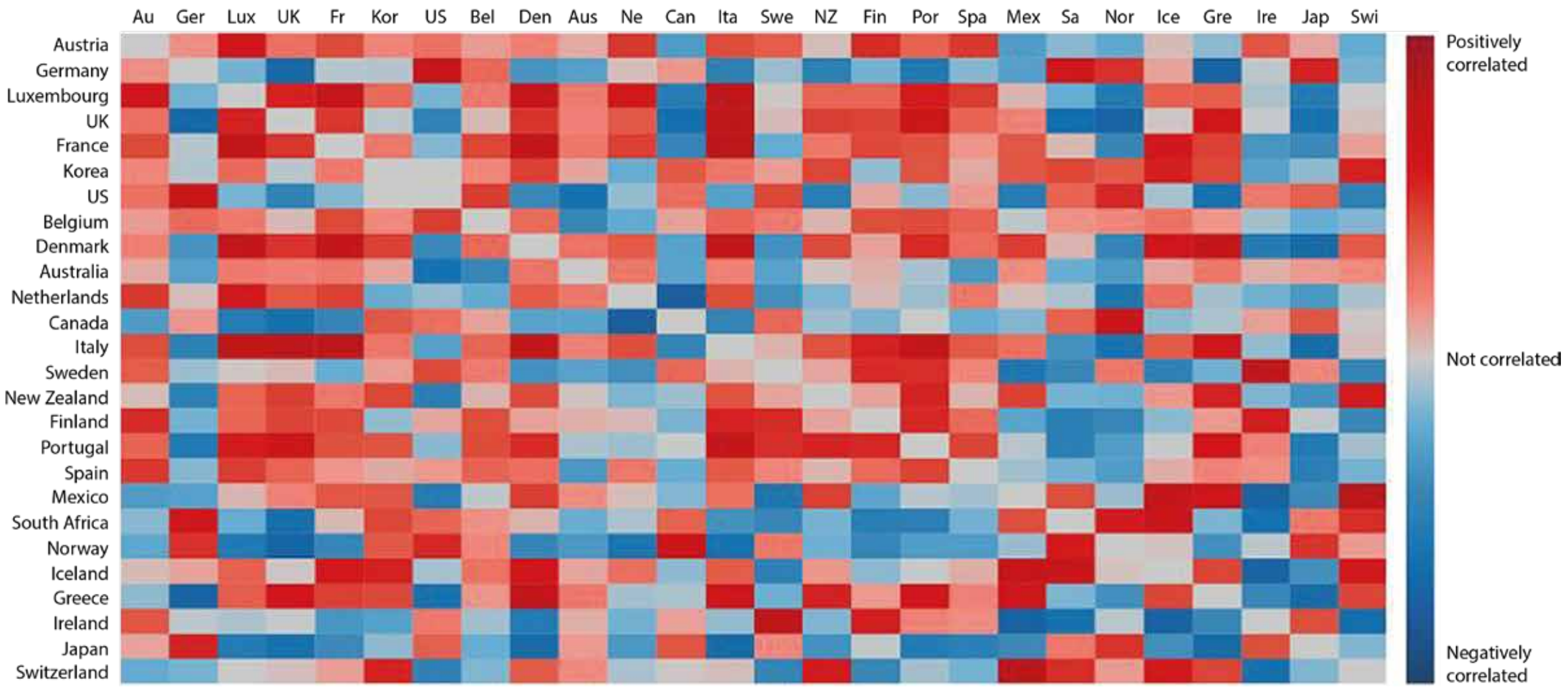
Source: BIS 87th Annual Report.

Chart 3a. Superficially strong evidence of a global inflation cycle



Notes: Correlations calculated using quarterly data on annual inflation rates.
Sources: Thomson Reuters Datastream, National Sources and Bank calculations.

Chart 3b. Core inflation rates exhibited little co-movement post-crisis



See notes and sources to Chart 3a.

of the global financial crisis[2, 3] and by the current series of wage puzzles in advanced economies[4]. There are even suggestions that monetary policy frameworks should be overhauled – potentially lowering the inflation target – in response globalisation's growing impact[5].

Some perspective is required. Wage puzzles in advanced economies can be partly solved by recognising that post-crisis structural reforms have lowered natural rates of unemployment, by broadening measures of labour market slack to include involuntary underemployment, and by acknowledging that weak wages are one consequence of sustained poor productivity growth[6].

The biggest determinants of the UK's medium-term prosperity will be the country's new relationship with the EU and the reforms that it catalyses

More broadly, the recent high correlations of headline inflation rates have been driven by very large global shocks including the financial crisis and the commodity super cycle. Core inflation rates have actually exhibited little co-movement but rather have varied with (divergent) underlying economic conditions (Chart 3b).

Central banks have (thus far) been able to maintain their monetary sovereignty, achieving their mandates by offsetting the secular disinflationary forces from global integration.

None of this, however, is to downplay current challenges of maintaining price stability in the face of global forces. The combination of the growing contestability of markets and prolonged synchronised weak demand may be restraining wage expectations. Moreover, technological changes, particularly those which could globalise markets for many services, may extend and deepen trend global disinflation. And, the global financial cycle could exacerbate the challenges of returning domestic inflation to target, particularly given the proximity of interest rates to the effective lower bound.

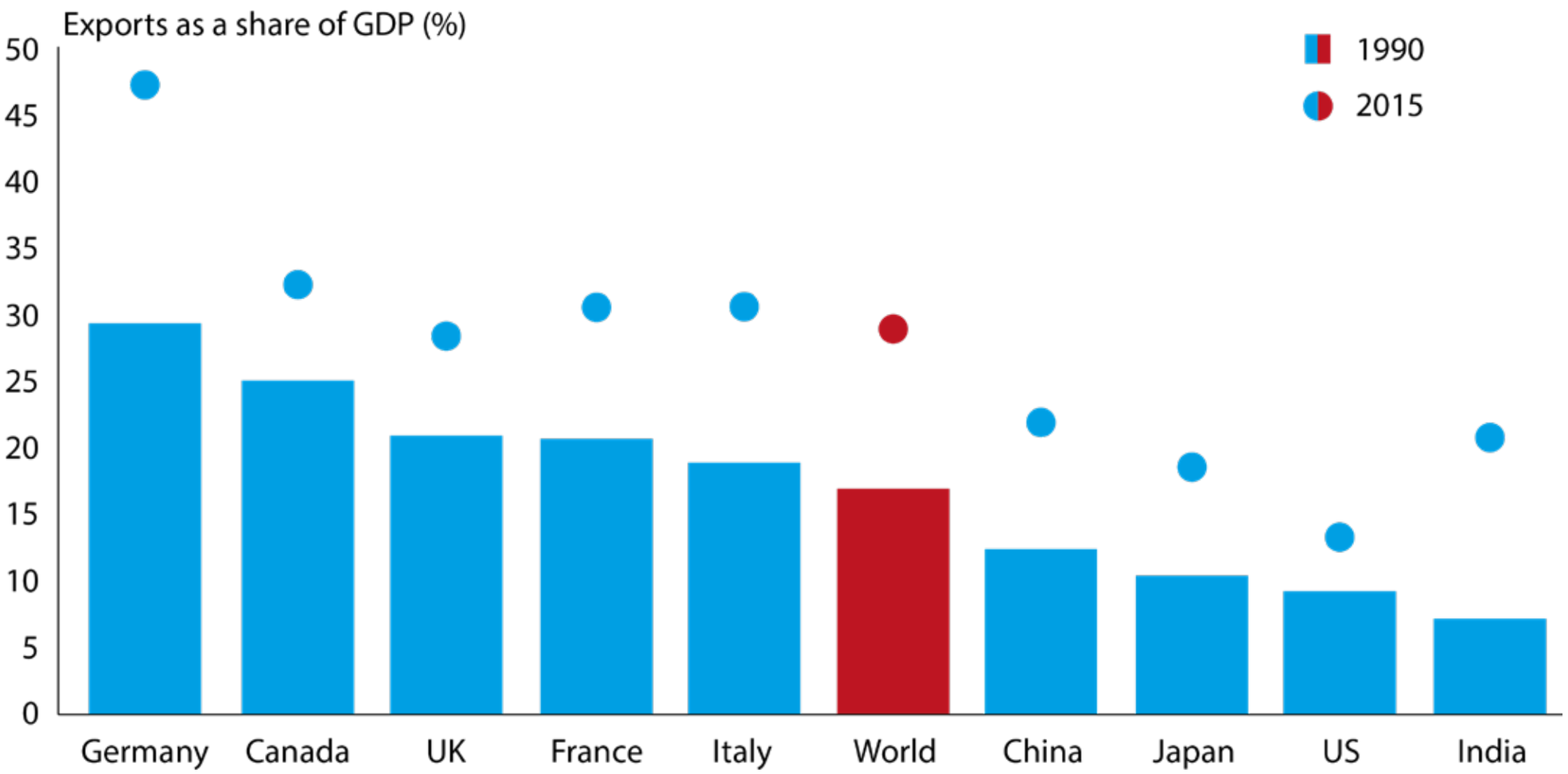
Charting a path for monetary policy in this environment thus requires a nuanced understanding of how globalisation both affects inflation and influences the stance of monetary policy. It is to these I will now turn.

Global influences on domestic inflation

In a closed economy, inflationary pressures depend on developments in domestic costs, which in turn depend on domestic spare capacity, or the balance of domestic supply and demand.

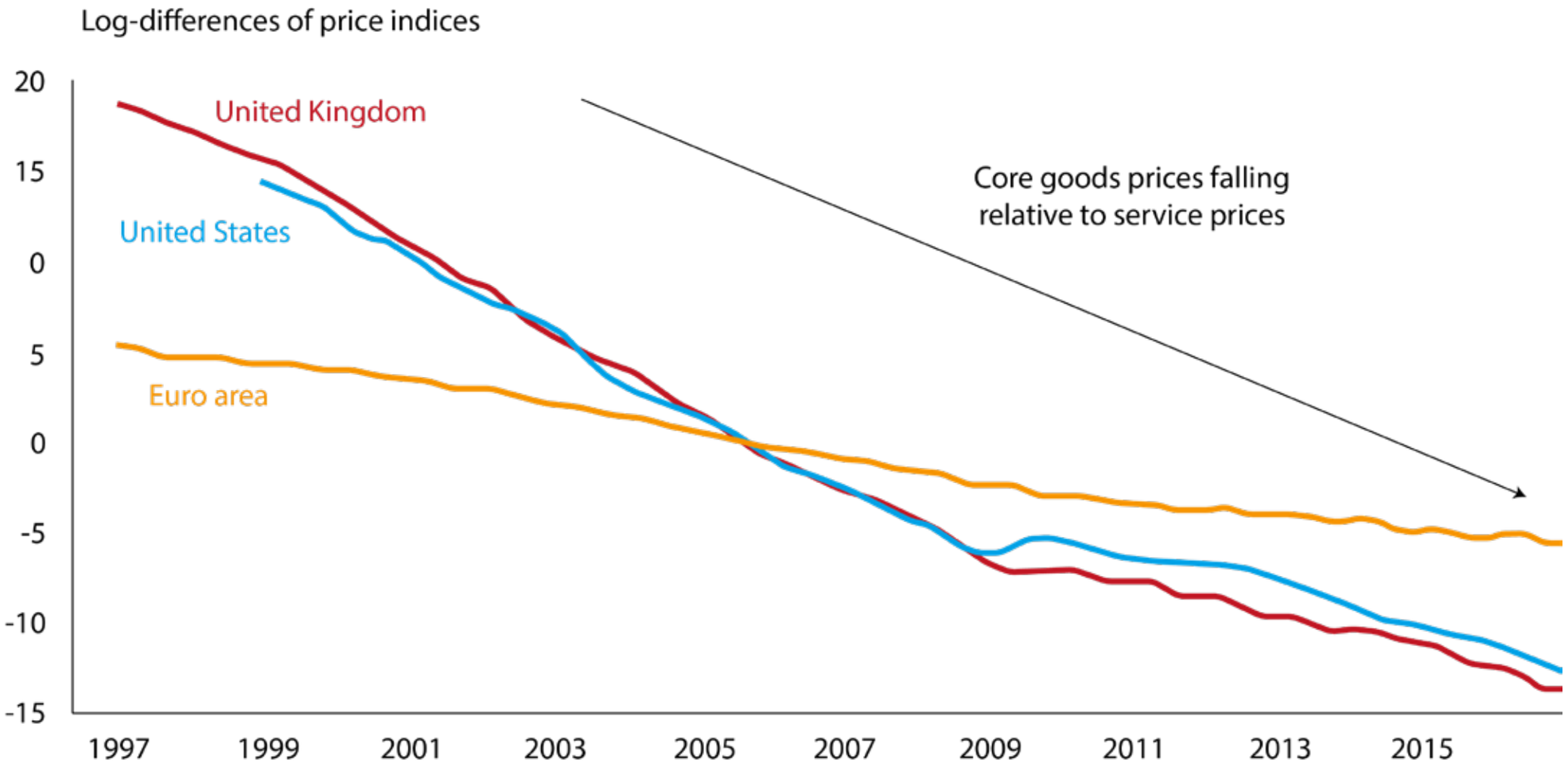
Opening up the economy changes this relationship in three ways. Most straightforwardly, external demand exerts pressure on domestic resource utilisation and therefore domestic inflation. The importance of this channel has steadily increased for most of the past half century (Chart 4)[7].

Chart 4. External demand has steadily increased in importance



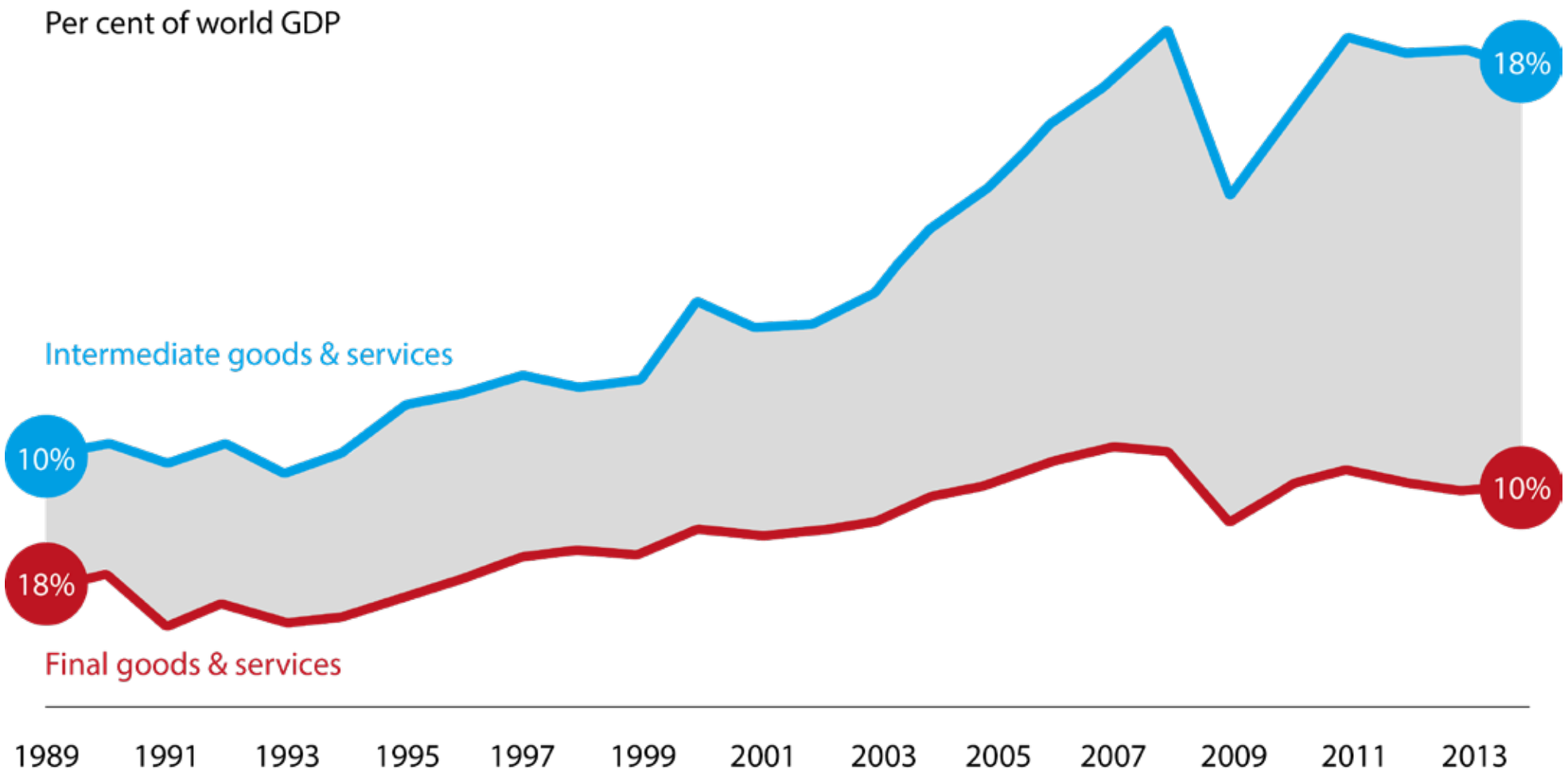
Sources: IMF and Bank calculations.

Chart 5. Sustained, cumulative relative price shock in goods accommodated through higher services price inflation



Notes: Six-month average of the log-difference between core goods prices (excludes food and energy) and services prices (series indexed; 2005 = 100). The US series uses PCE price indices.
Sources: Thomson Reuters Datastream, national sources and Bank calculation.

Chart 6. The development of global value chains has boosted trade in intermediates



Notes: Imports and GDP are in current US dollars.
Sources: Johnson and Noguera (forthcoming), Powell (2016), World Input-Output Database (2016 release) and BIS.

Next, in an open economy, prices of imports affect domestic inflation both directly – through the final goods and services bought by households – and indirectly – through the prices of imported intermediates used in the production of final goods and services in the consumption basket.

For years the direct effect has imparted a steady disinflationary bias. The integration of lower-cost producers into the global economy acts like an increase in potential supply for advanced economies, raising the level of spending that is consistent with inflation at target[8]. Thus far, this disinflationary effect has mostly affected the prices of goods[9] (Chart 5), as trade in goods has been liberalised to a much greater extent than services[10]. Monetary policy makers in advanced economies have responded by accommodating relatively higher services price inflation in order to meet their inflation objectives. For example, in the UK core goods prices fell an average of 0.3% over the past two decades, services prices rose by an average of 3.4% and total CPI inflation was on average at target[11].

Globalisation has also led to a dramatic increase in the use of imported intermediates in domestic production. The ICT revolution has made a great unbundling of production into global value chains possible, and large wage differentials have made doing so profitable. Intermediate goods trade has represented 80% of the increase in total trade over the past two decades (Chart 6), driving up the value added of imports as a share from 10% of exports in 1990 to around 20% in 2015[12].

This expansion in global value chains has led to greater synchronisation of producer price inflation across countries[13]. And it has increased the sensitivity of domestic inflation to global inflationary pressures while reducing its responsiveness to changes in domestic slack[14]. Research by the BIS indicates that a doubling in the share of imported intermediates in GDP causes the importance of global factors for domestic inflation to double as well[15]. Consistent with that, research at the Bank of England indicates that each 1 percentage point increase in the import intensity of

consumption reduces the sensitivity of inflation to domestic slack by 1 per cent, and that the strength of this effect varies with the ease with which producers can switch between imported intermediates and domestic alternatives[16].

Monetary policy makers must take the effects of intermediate trade into account since, unlike commodity shocks, import price changes take time to work through supply chains into final goods prices and therefore affect inflation at the policy-relevant horizon[17].

Labour markets provide a third channel through which globalisation affects domestic inflation. To be clear, globalisation is far from the only factor that has been affecting labour markets in recent decades – and arguably, as work by the IMF and others has shown[18], technological progress has played a more significant role. Technology, not globalisation, is estimated to be the main reason why labour's share of income has been falling across advanced economies.

But that does not mean global effects are absent. The doubling of the effective global labour pool represents a huge, positive supply shock for the global economy. It has encouraged the shift of the production of goods and services that use lower-skilled labour intensively to countries with an abundance of lower-skilled workers – predominantly emerging market economies – while production of goods and services requiring more highly skilled labour has concentrated in countries with a greater share of higher skilled labour – predominantly advanced economies. The growing ability to split production components and tasks through global value chains has amplified this effect[19].

Globalisation has also increased the contestability of labour markets, weakening the extent to which slack in domestic labour markets influences domestic inflationary pressures[20]. That is, the increased ease with which activities can be off-shored or domestic vacancies filled by sourcing workers from abroad may have reduced the relative

bargaining power and wage expectations of workers. While it is difficult to measure precisely, available evidence suggests that contestability effects could be significant[21]. Greater openness appears to have reduced the sensitivity of wages to domestic labour market conditions[22] and led to growth in domestic unit labour costs (ULCs) becoming more closely tied to global ULC growth[23].

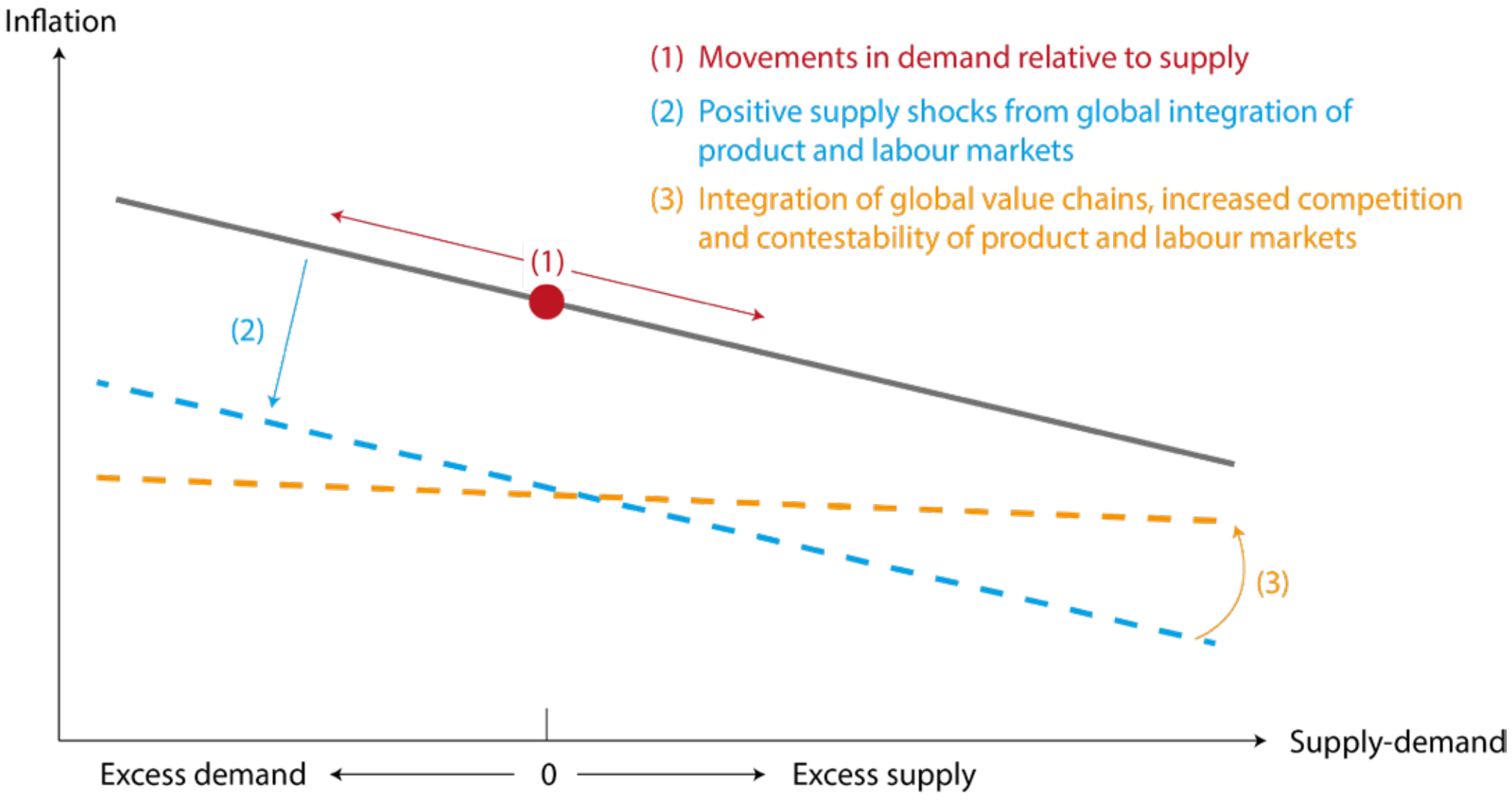
Overall, the greater global supply of labour has lowered the relative wages of lower-skilled workers in advanced economies. While this reduces inflationary pressures in the economy as a whole it has contributed to a long and painful period of adjustment for lower-skilled workers[24]. The secular disinflationary effects from this steady integration of additional workers into the global labour market need to be taken into account in addition to the cyclical inflationary pressures from changes in labour market slack.

The various channels through which globalisation affects the relationship between domestic slack and inflation can be illustrated using the Phillips Curve (Figure 1).

Changes in external demand will cause a shift along the Phillips Curve, as domestic companies adjust capacity utilisation in response (1). The series of positive supply shocks from increased product and labour market integration cause parallel shifts down in the Phillips Curve (2). These downward shifts will persist as long as integration continues. This may take a while, not least because the advent of digital platforms may extend these processes to a much broader range of goods and services markets[25]. The domestic economy needs to be run with tighter spare capacity to accommodate these disinflationary effects.

The increased competitive forces from globalisation (both actual and contestable) have also acted through product and labour markets to decrease the responsiveness of inflation to domestic slack, flattening the Phillips Curve slope (3).

Figure 1. Effects of globalisation on the Phillips Curve



Monetary policy must take all these effects into account and, on balance, run the domestic economy with tighter spare capacity in order to accommodate them.

Global influences on the stance of monetary policy

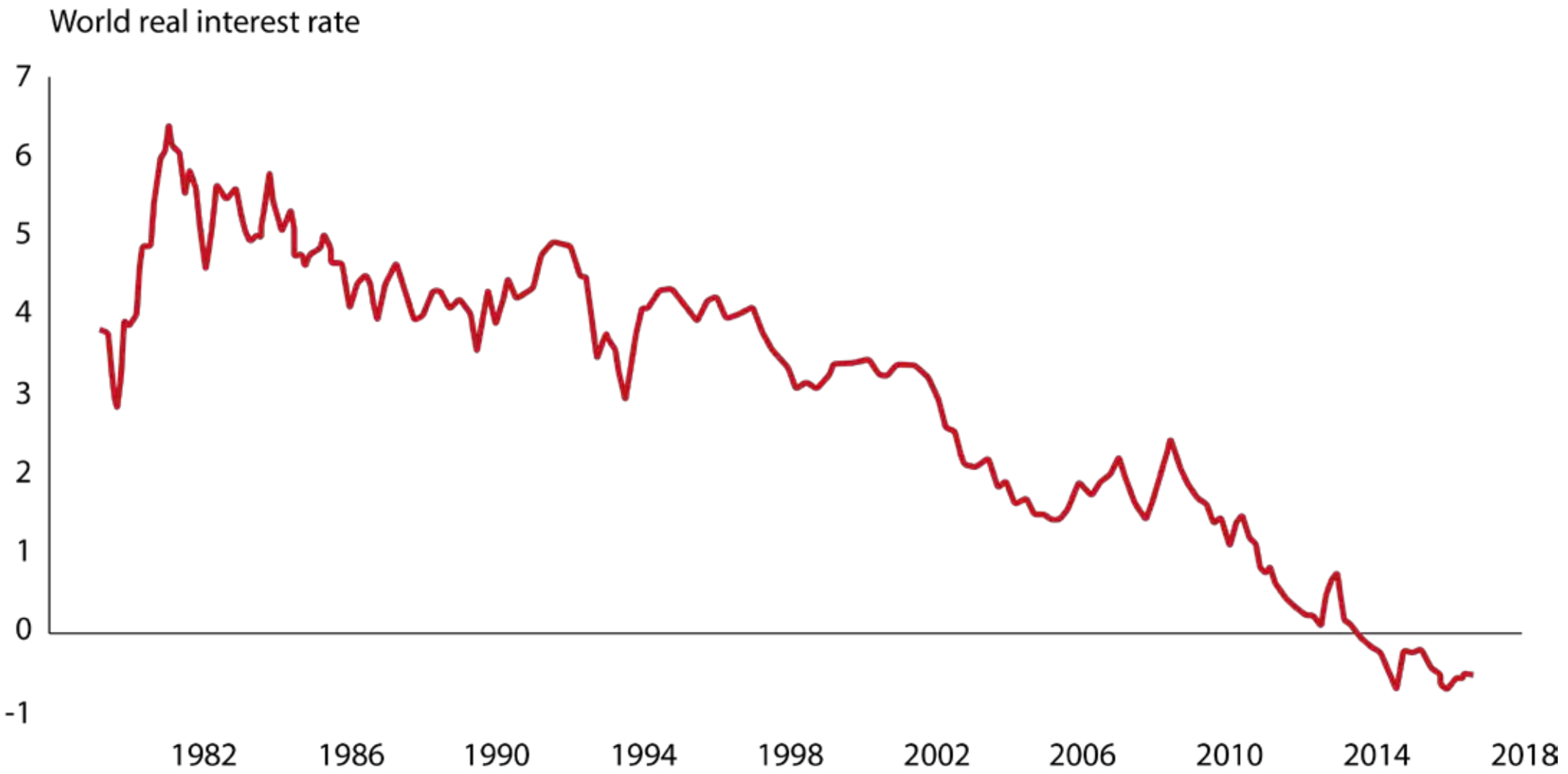
Just as global factors affect the relationship between domestic slack and inflation, they influence the monetary policy setting needed to achieve the inflation target. In particular, global integration affects the transmission mechanism of domestic monetary policy, the degree of spillovers from foreign monetary policies, and the equilibrium rate of interest itself.

For the past thirty years, a number of profound forces in the world economy has pushed down on the level of world real interest rates by as much as 450 basis points (Charts 7 and 8)[26]. These forces include the lower relative price of capital (in part as a consequence of the de-materialising of investment), higher costs of financial intermediation (due to financial reforms), lower public investment and greater private deleveraging[27]. Two other factors – demographics and the distribution of income – merit particular attention[28].

Bank research estimates that the increased retirement savings as a result of global population ageing and longer life expectancy have lowered the global real interest rate by around 140 basis points since 1990 and they could lead to a further 35 basis point fall by 2025[29]. The crucial point is that these effects should persist after the demographic trends have stabilised because the stock, not the flow, of savings is what matters[30].

By changing the distribution of income, the global integration of labour markets may also lower global R*. The changes in relative wages in advanced economies have shifted income towards skilled workers, who have a relatively higher propensity to save. Rising incomes in emerging market economies may be reinforcing that effect as saving rates are structurally higher in emerging market economies, reflecting a variety of factors including different social safety regimes[31].

Chart 7. Global long run real interest rates have fallen over the past 30 years



Source: Rachel, L and Smith, T (2015), ibid.

Chart 8. Secular drivers pushing down long-run equilibrium real interest rate

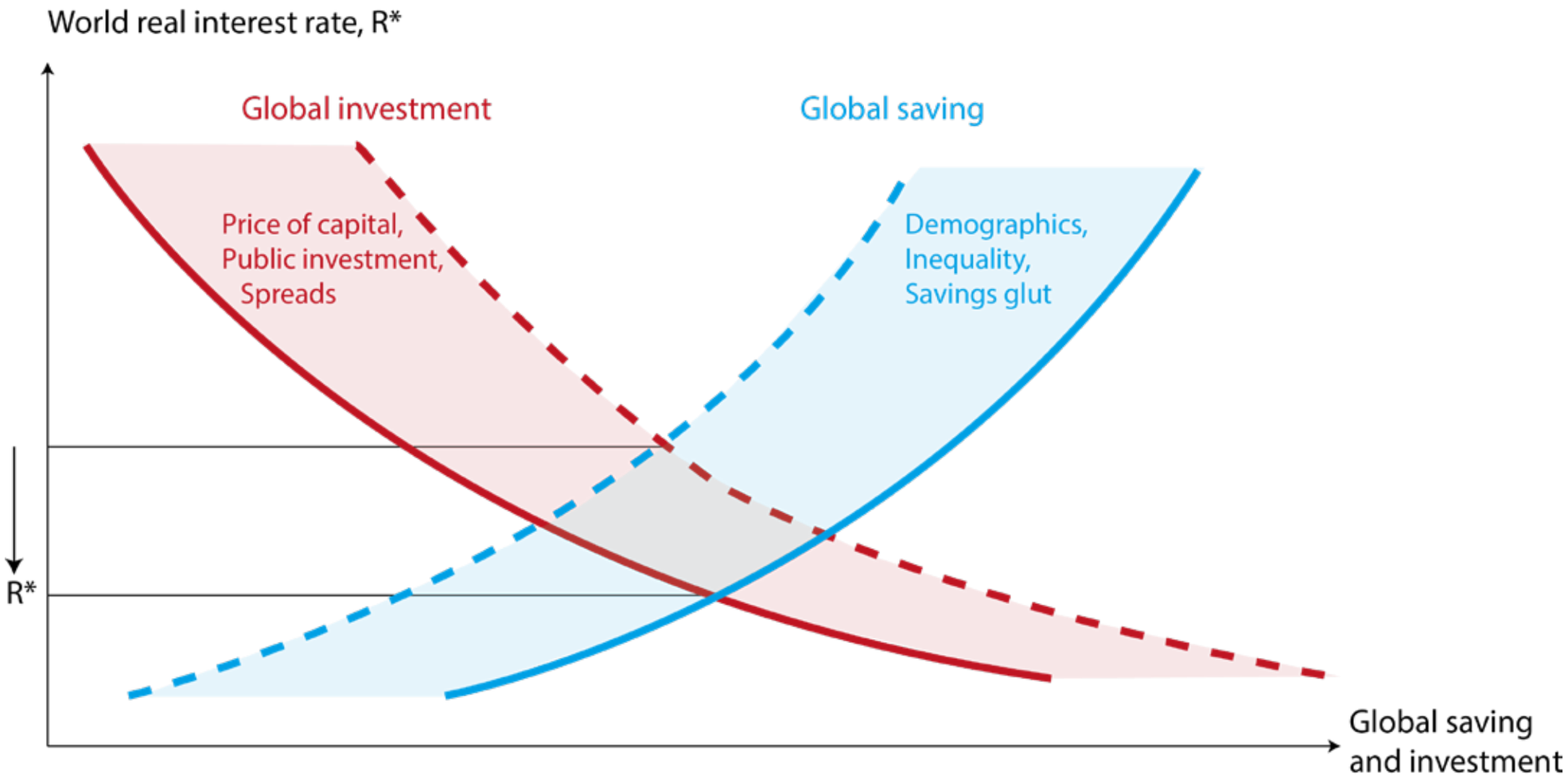
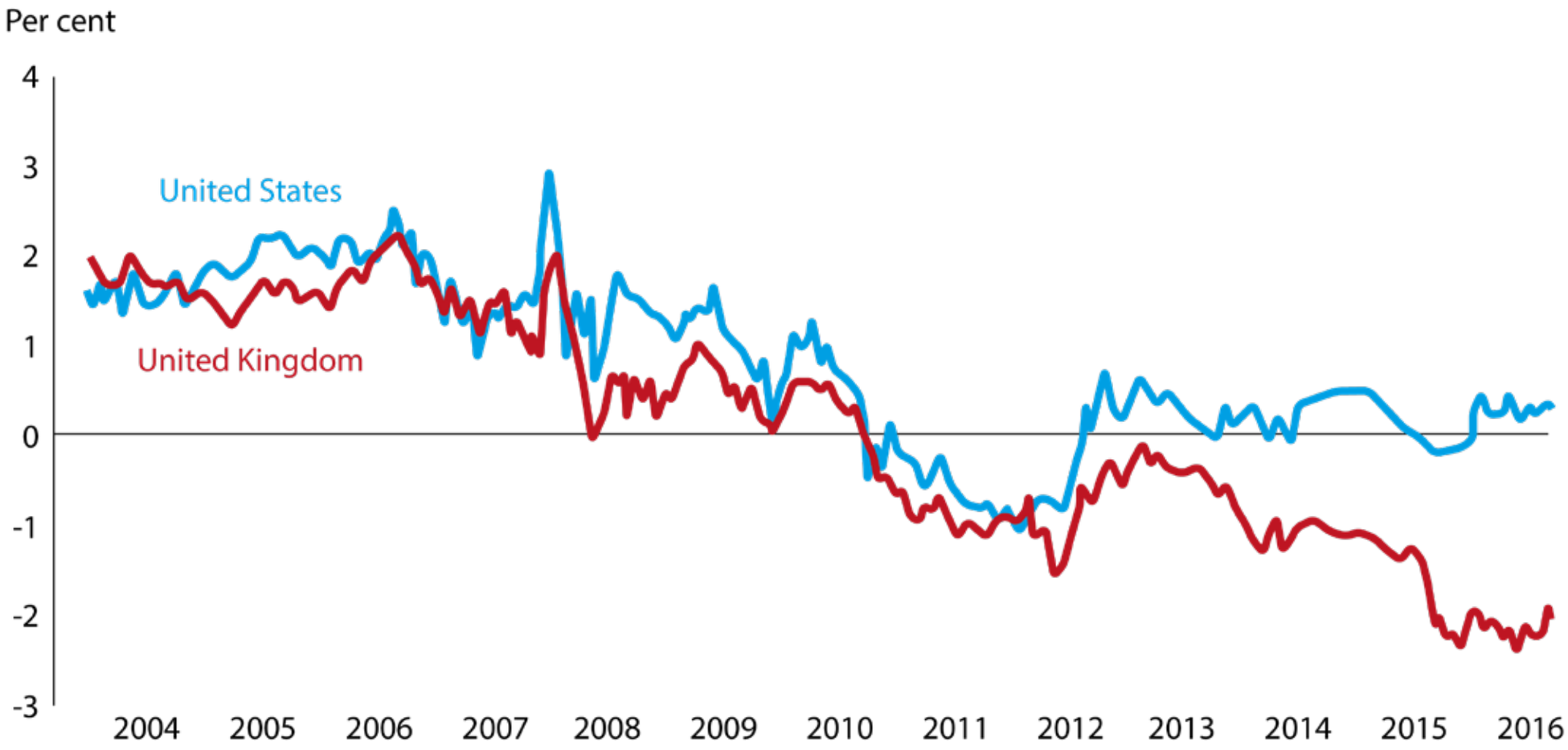
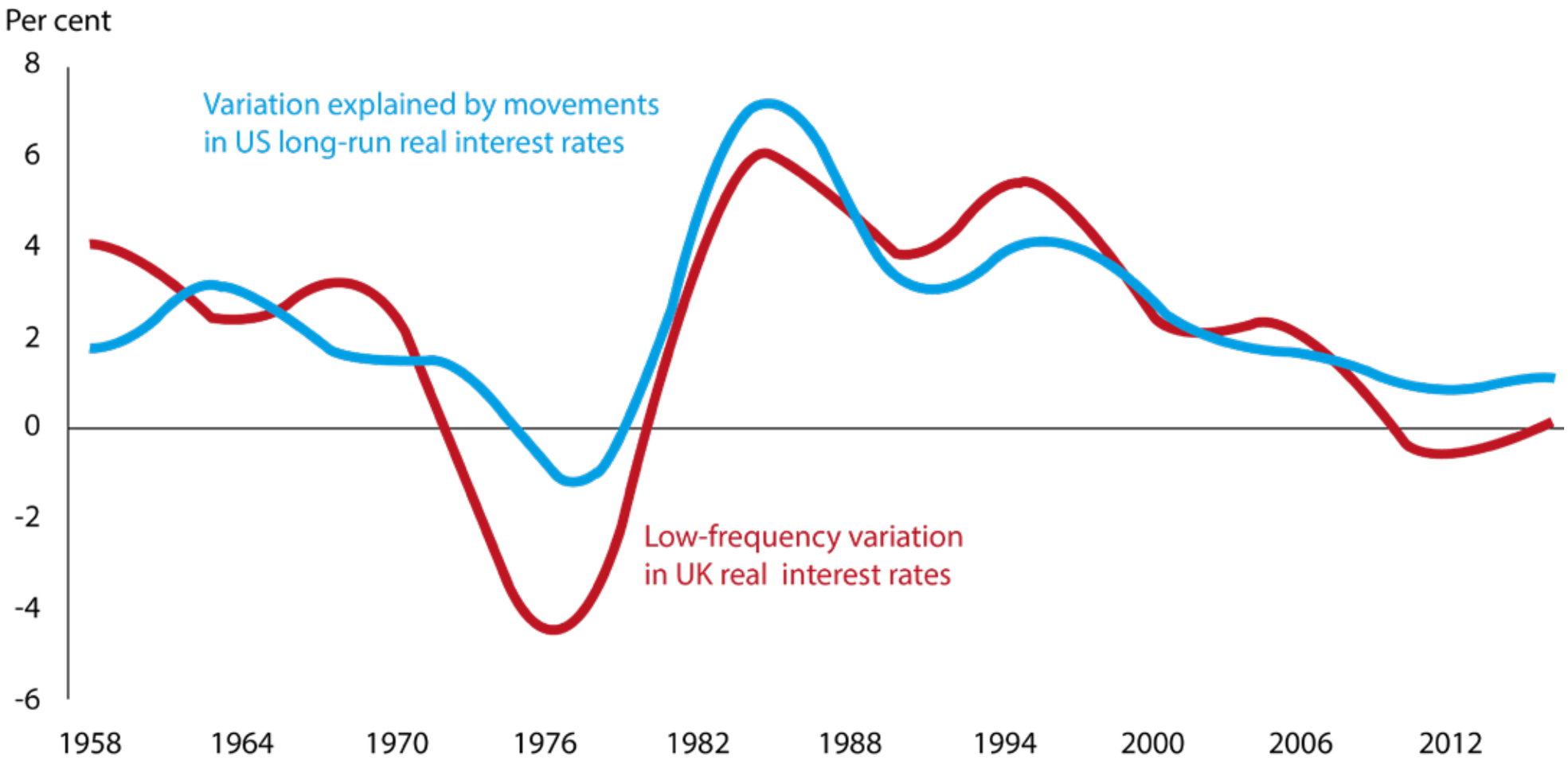


Chart 9. Close co-movement of long-run interest rates at high frequency…



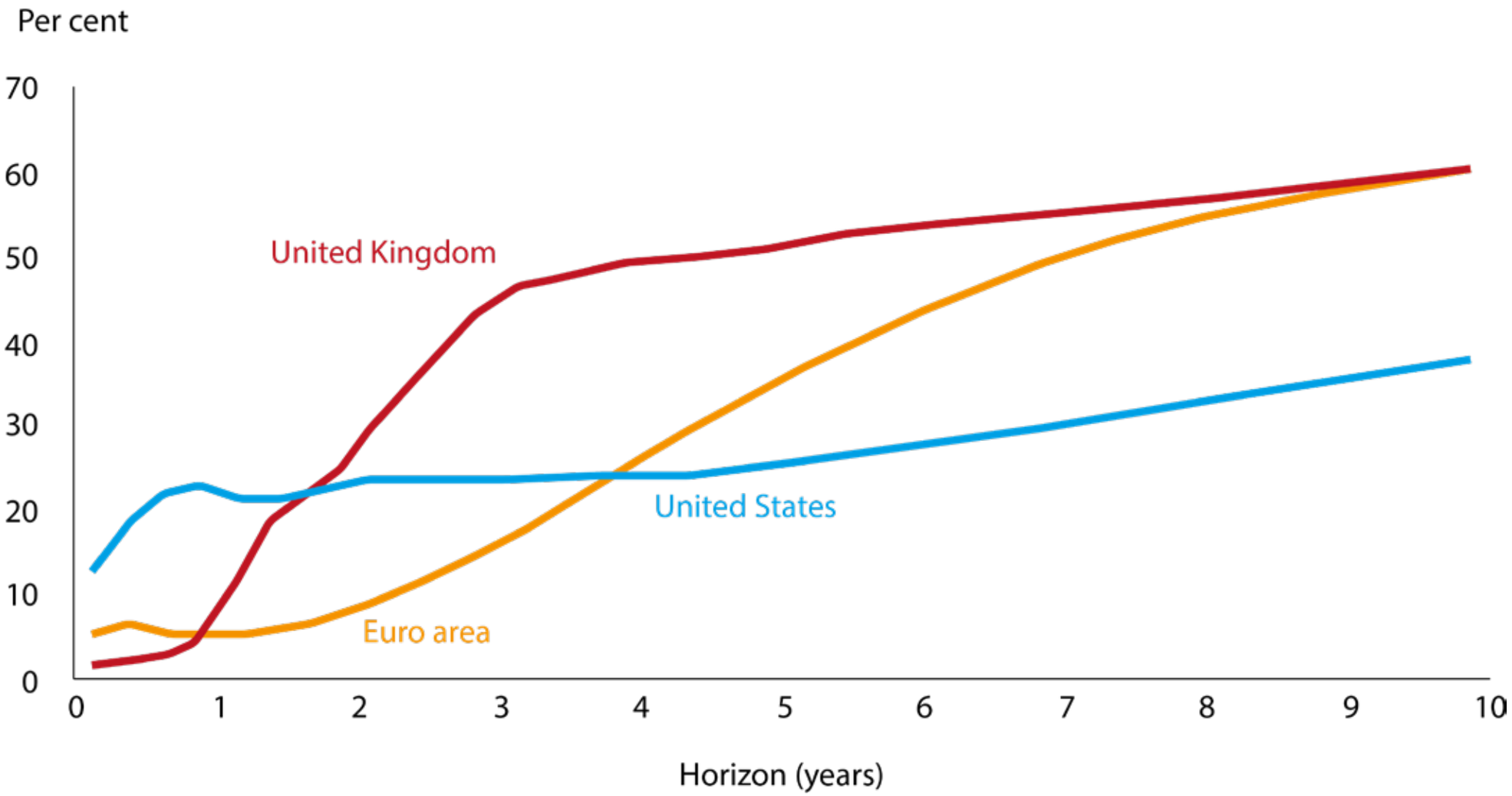
Notes: 10-year real bond yields derived from inflation swaps.
Sources: Bloomberg and Bank calculations.

Chart 10. …and at low frequency



Notes: UK long-run equilibrium real interest rate and fitted values obtained from simple regression on US long-run equilibrium real interest rate.
Sources: Bloomberg and Bank calculations.

Chart 11. Majority of long-horizon variation in UK equilibrium rates explained by international factors



Notes: Forecast error variance decomposition from a vector error correction model, share not explained by domestic R.*
Sources: Holston, K, Laubach, T and Williams, JC (2016), ibid.

The high mobility of capital across borders means that returns to capital will move closely together across countries, with any marked divergences arbitraged[32].

As a consequence, global factors are the main drivers of domestic long-run real rates at both high and low frequencies (Charts 9 and 10). For example, Bank of England analysis suggests that about 75% of the movement in UK long-run equilibrium rates is driven by global factors (Chart 10)[33]. Estimates by economists at the Federal Reserve deliver similar results (Chart 11)[34].

Global factors also influence domestic financial conditions and therefore the effective stance relative to the shorter-term equilibrium rate of monetary policy, r*.

The presence of borrowers and lenders operating in multiple currencies and in multiple countries creates multiple channels through which developments in financial conditions can be transmitted across countries[35]. For example, changes in sentiment and risk aversion can lead to international co-movement in term premia, affecting collateral valuations and so borrowing conditions.

Work by researchers at the Bank of England, building on analysis by the IMF[36], shows that a single global factor accounts for more than 40% of the variation in domestic financial conditions across advanced economies. For the UK, which hosts the world's leading global financial centre, the relationship is much tighter, at 70%.

Highlighting the openness of the UK economy and financial system, a third of the business-cycle variation in the UK policy rate can be attributed to shocks that originate abroad[37].

One important channel of global spillovers is of course monetary policy. In coming years, it is reasonable to expect

Table 1. G4 net asset issuance still low in 2017

$billion	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Asset purchases	-61	1,756	451	670	642	1,756	1,254	1,312	1,799	1,338
Bond issuance	2,936	2,664	3,534	2,486	2,263	1,753	1,525	1,093	1,286	1,527
Net issuance	2,997	908	3,083	1,816	1,622	-3	270	-219	-513	189

Notes: G4 here are the UK, EA, US and Japan. Bond issuance refers to annual changes in the stock of the general government debt. Agency debt is also included for the US. Asset purchases refer to total amount of bonds purchased by the central banks. Annual asset purchases are obtained by summing net monthly purchases over corresponding 12 months. Monthly flows are converted into US dollars by using an average monthly exchange rate.
Sources: ECB, Bank of England, Federal Reserve, Bank of Japan, SIFMA, Thomson Reuters Datastream and Bank calculations.

global term premia to rise as net asset purchases could shift significantly from the situation during the past four years when all net issuance within the G4 was effectively absorbed (Table 1).

The Fed's widely trailed intention to reduce gradually its holdings of US Treasuries could ultimately have significant effects on financial conditions globally. Although the precise degree and timing of this effect are subject to considerable uncertainty, the direction is clear: reducing the stock of purchased assets should increase the term premium for US treasuries (due to both portfolio balance and signalling effects).

Fed staff recently estimated that balance sheet normalisation could ultimately lead to a 75 basis point rise in the 10-year term premium[38]. According to the July Primary Dealer Survey, the median expected rise in the 10-year US Treasury yield over the next two years due to a reduction in the balance sheet is around 30 bps (with an interquar-

tile range of 20-50bps). Whatever happens, Bank analysis suggests that around two-thirds of changes in US term premia will spill over into the UK over time[39].

Should the Monetary Policy Framework be adjusted?

In summary, global demand has become more important for pressures on domestic capacity (ie. movements along the Phillips Curve) and global integration along all dimensions – labour, final goods and services, and intermediates – acts as a series of positive supply shocks that impart sustained disinflationary pressures (ie. shifting the Phillips Curve downwards and flattening it).

And just as global factors affect the relationship between domestic slack and inflation, they have made it more difficult for central banks to set policy in order to achieve their objectives. Major secular forces have lowered the equilibrium rate of interest, meaning that central banks have had to use unconventional tools in order to provide stimulus. At the same time, open and integrated markets have reduced central banks' control over their domestic financial conditions.

In the wake of such disinflationary challenges some have argued that monetary policy frameworks should be overhauled. For example, Claudio Borio recently suggested that the secular disinflationary effects from continued global integration could dominate increased cyclical inflationary pressures from a smaller global output gap as the recovery progresses[40]. In keeping with BIS traditions, Borio encourages central banks to lean into the wind, accepting lower inflation outcomes, for both macroprudential reasons and to accommodate the positive global supply shock[41].

In my view, the bar for changing monetary policy frameworks should be very high. Consider the Bank of England. We have a wide range of macroprudential tools that allow monetary policy to be the last line of defence against

financial stability risks. Our monetary policy remit from HM Government gives the MPC the necessary constrained discretion to respond flexibly to real shocks, including from globalisation, while maintaining the primacy of price stability. More generally, to the extent there is 'good deflation' from globalisation, it exists in parallel with lingering risks of an old-style, Fisher debt deflation which could be very bad indeed.

I am also mindful that central banks have generally been able to achieve their objectives and that, with the strengthening and broadening global expansion, cyclical forces should ease constraints on central banks. In addition, as demand in a number of major economies rotates from consumption towards investment[42] (Chart 12) and as fiscal policies become less contractionary[43], short-term equilibrium real interest rates should rise everywhere. This means that a static monetary policy stance becomes more expansionary all else equal.

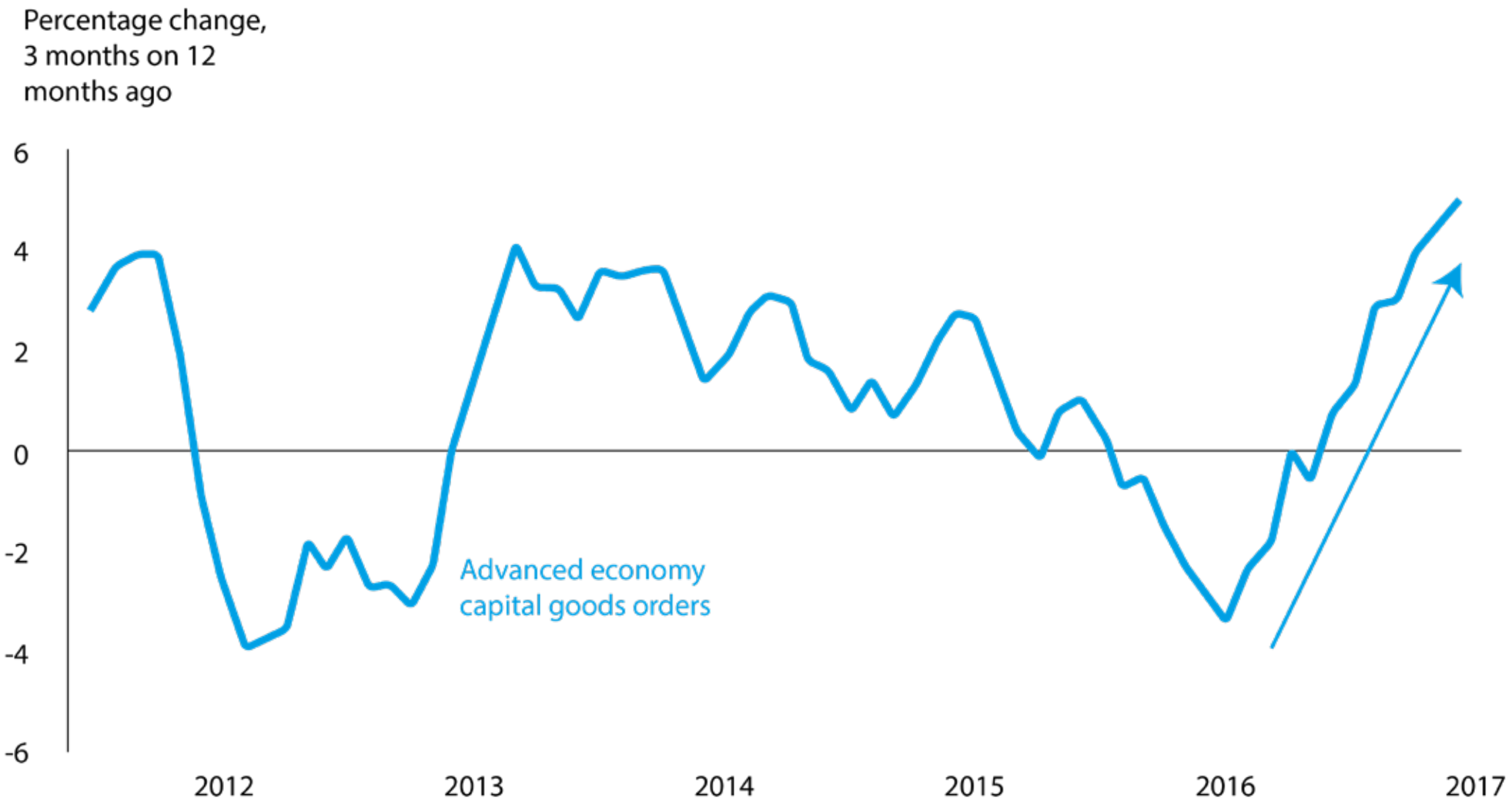
That said, I would caution that the persistence of major secular factors pushing down on the long-run global equilibrium real rates still means that policy rates can be expected only to rise a limited extent at what can be expected to be a gradual pace, settling at levels significantly below those seen pre-crisis.

Brexit: de-globalisation and inflation

The UK is a highly open economy. Its trade, particularly with the EU, is an important determinant of domestic inflationary pressures. Pass through of imported inflation (including from persistent exchange rate changes) is significant and can materially influence inflation over the policy horizon. And UK financial conditions are influenced by foreign developments to a greater extent than in other major economies.

The UK has begun the process of redefining its relationship with its largest trade and investment partner. To be clear, the intention is not to turn inwards but rather to increase openness over time. In particular, the UK government's objective is a *"comprehensive, bold and ambitious free trade agreement with the European Union."* Leaving the

Chart 12. Strong capital goods orders point to demand rotating towards investment



Sources: Thomson Reuters Datastream and Bank calculation.

EU is intended to enhance the UK's ability to strike trade and investment agreements with a wide range of countries beyond those covered by virtue of its membership of the EU.

But Brexit is an example of *reculer pour mieux sauter*[44]. That's because any reduction in openness with the EU is unlikely to be immediately compensated by new ties of a similar magnitude with other trade partners. And even if new agreements with other partners could be struck instantaneously, the reorientation of business relationships will take some time.

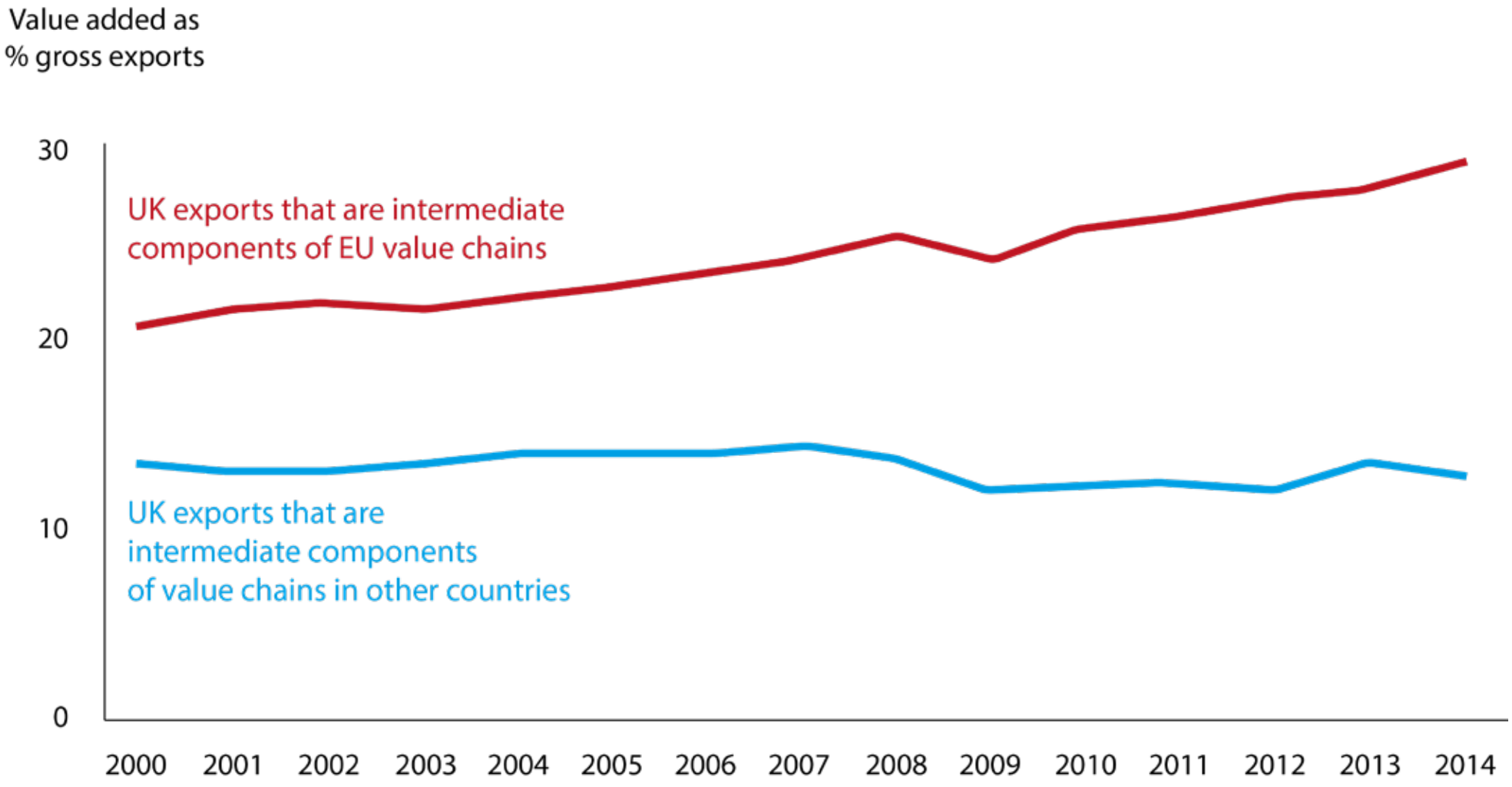
This makes Brexit, relative to the experience of the past half century, unique. It will be, at least for a period of time, an example of de-globalisation not globalisation. It will proceed rapidly not slowly. Its effects will not build by stealth but can be anticipated.

Let me turn to those effects. The first is the obvious disinflationary impact of Brexit given that the EU takes 44% of UK exports. Whatever is negotiated, in terms of both the final arrangements and the transition to them, the most important influence on demand in the short run will be the degree of access to the single market since the UK runs a 1.5% trade surplus in services and a 5% trade deficit in goods[45].

External demand for UK exports will also reflect the extent to which UK firms can maintain their positions in EU-based global supply chains. The proportion of UK exports that are intermediate components of EU value chains has increased from about 1/5th of exports in 1995 to about 1/3rd in 2014 (Chart 13)[46]. Increasingly, the UK doesn't so much export to Europe as through Europe; it is a supplier of components to final goods that are exported beyond the continent[47].

Retaining some of these positions may be challenging as evidence indicates that trade in intermediates appears to be more sensitive to trade costs such as tariffs. Given that proximity also appears to be more important for trade in

Chart 13. UK increasingly integrated in onward EU supply chains



Notes: The chart shows how much of the value added by the UK in exports to the EU/other countries that is subsequently re-exported.
Sources: Credit Suisse and World Input-Output Database (2016 release).

intermediates than for trade in final goods[48], international substitutes for European buyers of UK intermediates, as well as European suppliers of intermediates into UK supply chains, may be more difficult to source.

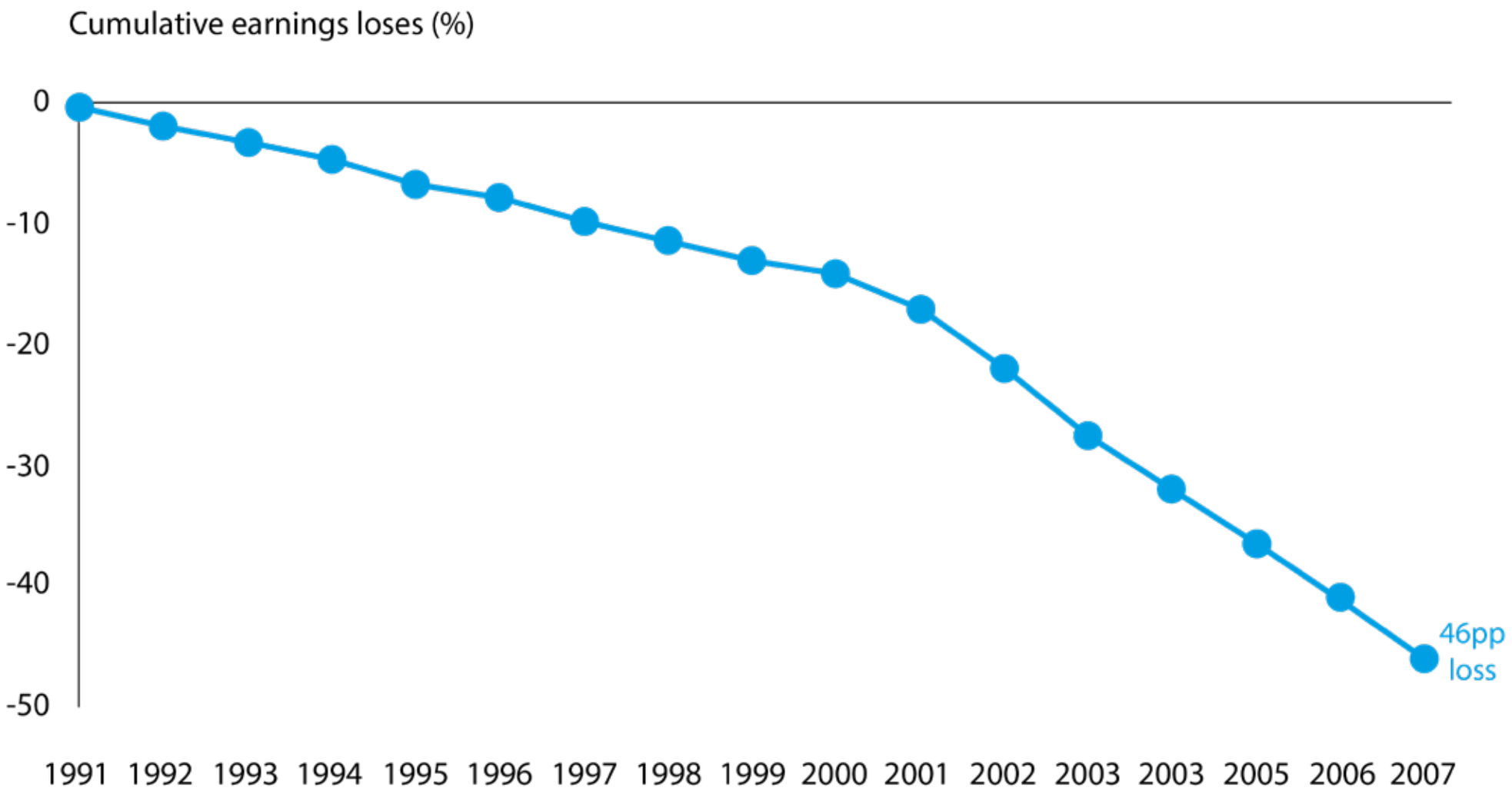
These effects and the experience of the past 30 years prompt the question: if globalisation is disinflationary, won't Brexit be inflationary?

Certainly, this process of de-integration can be expected to steepen the Phillips Curve given disruptions to inbound value chains from Europe and reduced contestability of UK labour and product markets. In addition, the reallocation of capital to suit new trade arrangements will take time, weighing on growth of the economy's supply capacity while it proceeds. Moreover, any increase in tariffs on UK imports, or increases in the cost of imports due to broader access restrictions, would cause the Phillips Curve to shift up temporarily as those higher costs are passed through the supply chain.

These inflationary effects may be reinforced by developments in the labour market. As in other advanced economies, the expansion in global labour supply has forced a painful period of adjustment for the most exposed workers in the UK (who are not always the lowest skilled) (Chart 14)[49]. This reduces inflationary pressures in the economy as a whole.

Higher levels of migration in the UK have not, however, been associated with significant reductions in overall wage growth and therefore inflation[50]. Bank research suggests a 0.5% increase in labour supply (equivalent to a rise of around 330,000 in net migration) typically reduces inflation by only around 0.1 percentage points[51]. This is because the effects of changes in migration on the supply of labour are largely balanced by corresponding changes in demand.

Chart 14. Relative wages of workers exposed to global labour markets squeezed



Notes: The chart shows the estimated loss in earnings since 1991 for a worker at a company in the manufacturing sector with a high exposure to rising competition relative to a worker with a low exposure, expressed as a share of their annual earnings in 1991.
Source: Professor David Autor, 'Economic and political consequences of China's rise for the United States: lessons from the China Shock', IFS Annual Lecture 2017, 22 June 2017.

This means that any reduction in net migration after Brexit could therefore ultimately have only a modest impact on prices in general equilibrium. Over a shorter horizon, however, abrupt decreases in migration could result in shortages in some sectors that have become reliant on migrant labour, and contribute more materially to inflationary pressures.

In addition, the ease with which UK employers have been able to source labour from abroad and move operations offshore as a result of globalisation may have weighed on wage growth – though the size of such contestability effects is difficult to judge. To the extent that such effects have operated, any restrictions on labour that result from Brexit – both effective and actual – should steepen the wage Phillips Curve, increasing the sensitivity of domestic wages to domestic labour market slack (moving in the opposite direction to the rotation shown by (3) in Figure 1 above).

UK potential supply capacity itself is also likely to be lower as some capacity tied to Europe becomes obsolete. The reduction and reorientation of trade is likely to weigh on productivity for some time through a loss of comparative advantage and the disruption of supply chains as companies in the UK shift from supplying customers in the EU to customers in the rest of the world. Empirical estimates suggest a 20% reduction in trade tends to drag on productivity by around 5% in the long run[52]. The actual impact will depend on how quickly any lost access to European and third country markets (via European trade deals) can be replaced. In this regard, the UK Prime Minister's discussions in Canada today are potentially significant.

With respect to the exchange rate, the effects of imported inflation are particularly important to UK inflation dynamics, given both the openness of its economy, the low degree of home currency invoicing[53] and the relatively slow but significant pass through of large, persistent exchange rate moves.

Around 60% of persistent movements in sterling tend to be passed through into import prices and those changes in import prices are fully – if gradually – passed through into consumer prices. The total import content of final consumer goods and services is close to 30%, of which around half is due to the use of imported intermediates in production. A 10% change in the exchange rate would therefore be expected to increase import prices by 6% and the level of consumer prices by 1.6% eventually. About half of the increase in import prices is passed through within the first year, with full pass-through taking around four years to complete. In other words, in the UK, large exchange rate moves create price dynamics that are relevant to the policy horizon[54].

Post Brexit, sterling will reflect changes in the UK's terms of trade, supply capacity and relative income. The market has already anticipated some of these effects. Whether it ultimately appreciates or depreciates upon Brexit will depend on the terms of the final deal relative to market expectations at the time.

Turning finally to the policy implications, it is critical to recognise that Brexit represents a real shock about which monetary policy can do little. Monetary policy cannot prevent the weaker real incomes likely to accompany the move to new trading arrangements with the EU, but it can influence how this hit to incomes is distributed between job losses and price rises. And it can support UK households and businesses as they adjust to such profound change.

On balance, the de-integration effects of Brexit can be expected to steepen the Phillips Curve and to be inflationary. At present, the main question concerns the extent to which this adjustment has been brought forward.

Such timing issues are one reason why the MPC has consistently stressed that the implications of Brexit for monetary policy would not be automatic. The inflation outlook will balance the inflationary effects of the exchange rate, imported inflation due to higher tariffs and a steeper Phillips Curve from supply chain and labour market impacts,

with the disinflationary impacts of reduced EU demand for UK goods and services, adverse effects on spending, including business investment, from the anticipation of lower growth[55], and any effects of uncertainty on domestic demand. The timing and scale of all these effects is of course subject to tremendous uncertainty.

The MPC's remit specifies that, in exceptional circumstances such as Brexit, the Committee must balance any trade-off between the speed at which it intends to return inflation sustainably to the target and the support that monetary policy provides to jobs and activity.

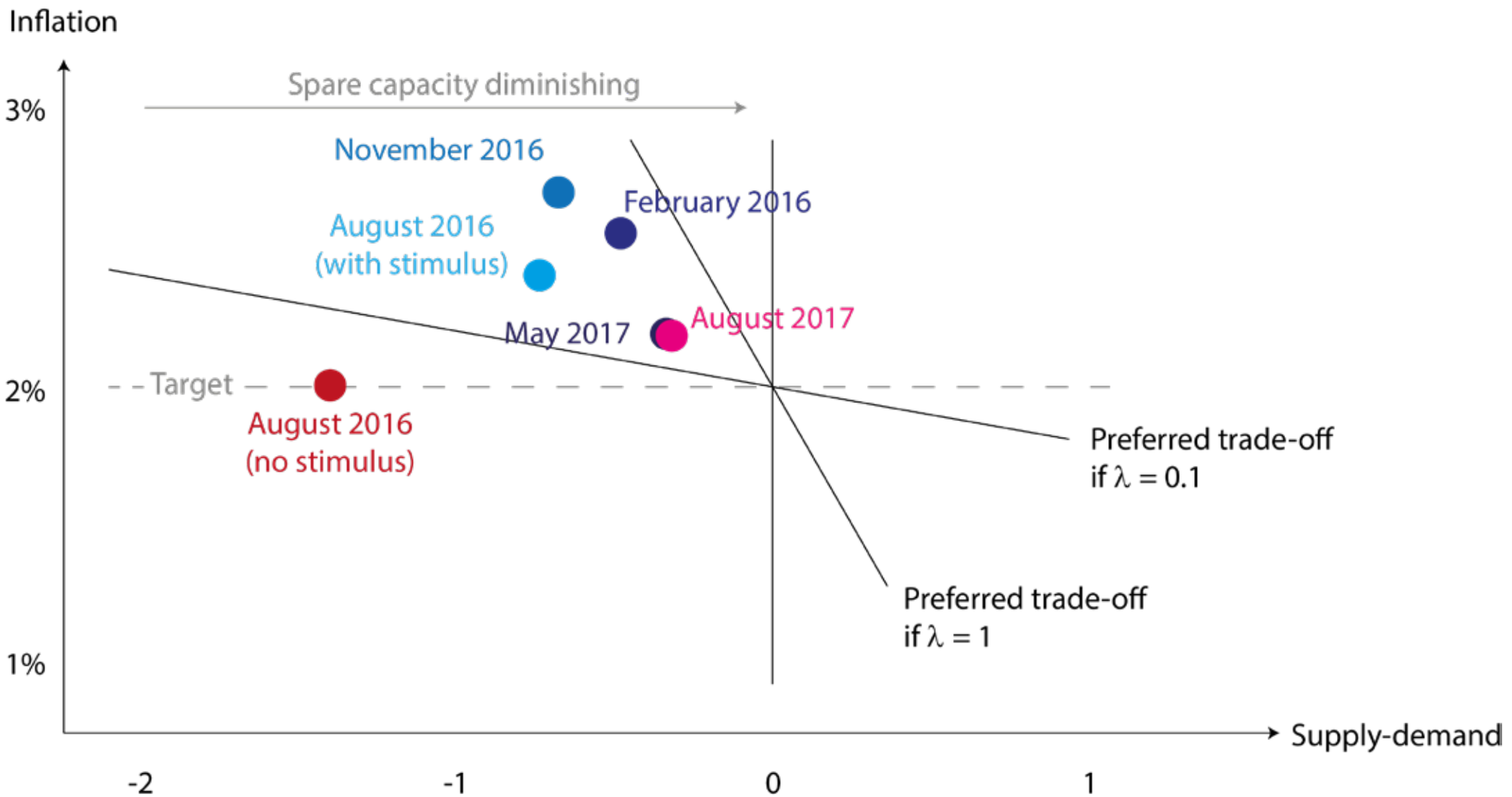
That is why immediately following the referendum the Bank of England announced a series of monetary and financial measures to support the economy. These measures were calibrated to balance the trade-off that emerged immediately after the referendum between ensuring a sustainable return of inflation to target and supporting jobs and growth (Chart 15).

This stimulus is working. Credit is widely available, the cost of borrowing is near record lows, the economy has outperformed expectations, and unemployment has reached a 42-year low. As a consequence, the trade-off between inflation and spare capacity is diminishing.

UK households, businesses and financial markets have reacted at different speeds and to varying degrees to the prospects for the UK's departure from the EU. In general, some of the disinflationary shock to demand has been deferred, not least because the UK has not yet left the EU, while most of the inflationary channels have begun to appear.

Financial markets, particularly sterling, marked down the UK's relative prospects quickly and sharply. The sterling ERI has depreciated by around 20% since the Brexit process became a possibility. UK focused equities have under-

Chart 15. Trade-off that emerged after the referendum has diminished



performed global advanced economy equities by around 30pp since the Referendum (in common currency terms) and UK long-run real yields are down by 60bp compared to those for the US.

Households looked through Brexit-related uncertainties initially. But more recently, as the consequences of sterling's fall have shown up in the shops and squeezed their real incomes, they have cut back on spending, slowing the economy.

Businesses have been somewhere in between. Since the referendum, they have invested much less aggressively than usual in response to an otherwise very favourable environment (strong external environment, low cost of capital, favourable rates of profitability and limited spare capacity).

The balance of these effects has lead overall UK growth to slow in the first half of 2017, even as growth in the rest of the G7 was picking up, and UK growth looks set to remain weaker than the G7 average until mid2018. The UK has experienced underperformance only twice in the past three decades: once in the depths of the financial crisis and once following the collapse of the Lawson Boom of the late 1980s.

On the supply side, the process of leaving the EU is beginning to be felt. Brexit-related uncertainties are causing some companies to delay decisions about building capacity and entering new markets. Prolonged low investment will restrain growth in the capital stock and increases in productivity. Indeed, if the MPC's current forecast comes to pass, the level of investment in 2020 is expected to be 20% below the level which the MPC had projected just before the referendum. Net migration has also fallen by 25% since the Referendum.

As a result of these factors and the general weakness in UK productivity growth since the global financial crisis, the supply capacity of the UK economy is likely to expand at only modest rates in coming years.

The latest indicators are consistent with UK demand growing a little in excess of the diminished rate of potential supply growth, and the continued erosion of what is now a fairly limited degree of spare capacity. If anything, recent developments suggest that the remaining spare capacity in the economy is being absorbed a little more rapidly than had been expected, and that inflation remains likely to overshoot the 2% target over the next three years.

The MPC's reaction function is clear. The continued erosion of slack lessens the trade-off that the MPC is required to balance and, all else equal, reduces the MPC's tolerance of above-target inflation.

As the Committee stated last week, if the economy continues to follow a path consistent with the prospect of a continued erosion of slack and a gradual rise in underlying inflationary pressure then, with the further lessening in the trade-off that this would imply, some withdrawal of monetary stimulus is likely to be appropriate over the coming months in order to return inflation sustainably to target.

The case for a modest monetary tightening is reinforced by the possibility that global r* may be rising, meaning that monetary policy has to move in order to stand still.

Any prospective increases in Bank Rate would be expected to be at a gradual pace and to a limited extent, and to be consistent with monetary policy continuing to provide substantial support to the economy.

There remain considerable risks to the UK outlook, which include the response of households, businesses and financial markets to developments related to the process of EU withdrawal. The MPC will respond to these developments as they occur insofar as they affect the behaviour of households and businesses, and the outlook for inflation.

Conclusion

Before the great wave of globalisation, a series of major institutional reforms increased the transparency and accountability of central banks. The enhanced monetary policy credibility that this brought resulted in a marked drop in inflation and sizable reduction in the sensitivity of inflation to changes in slack. By driving greater competition, increased globalisation has reinforced the effectiveness of these reforms[56].

Monetary policy makers, including the MPC, drew on this credibility during the financial crisis, keeping inflation expectations anchored in the face of deflationary pressures from both home and abroad.

Regardless of how external influences on inflation evolve in future, the institutional framework of the Bank of England, which is currently celebrating its 20th anniversary of independent monetary policy, leaves the MPC well equipped to deliver price stability.

The biggest determinants of the UK's medium-term prosperity will be the country's new relationship with the EU and the reforms that it catalyses. Many of the adjustments needed to move to that new equilibrium are real in nature, and are not in the gift of monetary policymakers. But monetary policy can help build the foundations for lasting prosperity by achieving the inflation target in a way that helps smooth real adjustment in the economy and supports jobs in the wake of very large external forces. This is the best contribution the MPC can make to the good of the people of the United Kingdom. ■

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Endnotes

1. As summarised by the slope coefficients in price and wage Phillips Curves. The wage and price Phillips Curves had already flattened during the 1970s and '80s, most likely linked – as Rogoff argued – to the institutional reforms made to monetary policy during that period. The finding of flattening Phillips Curves has been widely documented. For example, Blanchard, O, Cerutti, E and Summers, L (2015), 'Inflation and Activity – Two Explorations and their Monetary Policy Implications', NBER Working Paper No. 21762, find that the median Phillips Curve slope of 20 advanced and emerging economies fell by more than half between the mid-1970s and the mid-1990s, from around 1 to around 0.3.

2. See, for example, Chapter 3 of the IMF's WEO April 2013, 'The dog that didn't bark: has inflation been muzzled or was it just sleeping?'.

3. One explanation put forward for this, unrelated to globalisation, is that companies facing liquidity constraints maintained prices at higher levels than they would otherwise have done in order to preserve cash flows and remain in operation. See Gilchrist, S, Schoenle, R, Sim, J and Zakrajšek, E (2017), 'Inflation dynamics during the financial crisis', American Economic Review, Vol. 107, No. 3, pages 785-823. Consistent with this, analysis by Bank staff found that UK businesses with weaker balance sheets increased their margins by more at the height of the crisis than those with healthier balance sheets.

4. For example, as documented by the Bank for International Settlements (BIS) in their 87th Annual Report, 2017. See also Draghi, M (2017), 'Accompanying the economic recovery', introductory speech at the ECB Forum on Central Banking 2017 and Danninger, S (2016) 'What's up with US wage growth and job mobility', IMF Working Paper 16/122.

5. For example, as suggested by Claude Borio, 'How much do we really know about inflation?', Presentation on the BIS 87th Annual Report, 25 June 2017.

6. See, for example, the boxes on pages 18-20 of the February 2017 Inflation Report and page 29 of the May 2014 Inflation Report. The solutions to these puzzles are also likely to involve some factors unrelated to globalisation. For example, one explanation put forward for missing dis-inflation is that companies facing liquidity constraints maintained prices at higher levels than they would otherwise have done in order to preserve cash flows and remain in operation (see Gilchrist,

S, Schoenle, R, Sim, J and Zakrajšek, E (2017), ibid). Consistent with this, analysis by Bank staff found that UK businesses with weaker balance sheets increased their margins by more at the height of the crisis than those with healthier balance sheets).

7. The slowing of trade growth since the financial crisis largely reflects the rotation of global growth to countries with less import intensive demand, notably the US and EMEs, as well as the declining import intensity of final domestic demand in China as the composition of growth there rotates towards consumption and services.

8. This positive supply shock comes about because the availability of cheap imports improves advanced economies' terms of trade – the price of exports relative to that of imports. For more detail on this channel, see 'Globalisation and Inflation', speech given by Charles Bean at the LSE, 24 October 2006.

9. Abdih, Y, Balakrishnan, R and Shang, B (2016) 'What is keeping US core inflation low?', IMF Working Paper No. 16/124.

10. For example, barriers to services trade are estimated currently to be up to three times higher than those for goods trade. See 'A fine balance', speech by Mark Carney at the Mansion House, 20 June 2017.

11. Headline CPI inflation averaged 1.9% over this period.

12. See Auer, R, Borio, C and Filardo, A (2017), 'The globalisation of inflation: the growing importance of global value chains', BIS Working Paper No. 602.

13. Auer, R, Levchenko, A and Sauré, P (2017), 'International inflation spillovers through input linkages', NBER Working Paper No. 23246. A shock that raises inflation by 1 percentage point in the rest of the world is found to raise domestic producer price inflation by (PPI) 0.2pp on average across the countries in the sample. The size of the effect varies significantly across countries, however; the UK is a little below average.

14. This depends, of course, on whether the good/service in the supply chain is sold on to become a final good/service in the same country or exported.

15. This is true both across countries and over time. See Auer, R, Borio, C and Filardo, A (2017), ibid.

16. See Cesa-Bianchi, A, Kindberg-Hanlon, G, Nelson, B and Thwaites, G, Bank of England, forthcoming. The speed at which changes in import prices are passed through to final goods is likely to differ across products. For example, for the

UK, consumer food and energy prices appear to respond more quickly than the prices of other goods and services. In part, that appears to be because margins at each point in the supply chain are tight. For food, it also partly reflects the fact some imported food is already the final consumption good – ie. the supply chain is short.

17. See Goldberg, L and Campa, J (2010), 'The sensitivity of the CPI to exchange rates: distribution margins, imported inputs, and trade exposure', The Review of Economics and Statistics, Vol. 92, Issue 2, pages 392-407.

18. See 'Understanding the downward trend in labour income shares', Chapter 3 of IMF WEO April 2017.

19. These effects – an example of factor price equalisation (Samuelson, 1948) – have been well documented for example by Autor, D, Dorn, D and Hanson, G (2015), 'Untangling Trade and Technology: Evidence from Local Labour Markets', The Economic Journal, Vol. 125, No. 584, pages 621-46. Bank staff analysis, using OECD data, suggests this mechanism has operated widely, with a range of countries seeing strong growth in non-tradeable employment compensate for declines in sectors most exposed to international labour substitution.

20. This channel also increases the role of the exchange rate in determining inflationary pressures, since it will affect the home-currency value of the wage workers from abroad would earn by relocating and therefore their willingness to move.

21. For example, for the US, Blinder, A (2009) 'How many US jobs might be offshorable?' World Economics Volume 10 Issue 2, estimates that the potential to offshore service sectors jobs may have lowered wages by up to 14%. Arseneau, D and Leduc, S (2011), 'Threatening to offshore in a search model of the labor market' build contestability into a two-country model and find it can reduce wages by up to 5% in the source country.

22. Rotunno, L and Wood, A (2016), 'Wage inequality and skill supplies in a globalised world', Aix-Marseille School of Economics Working Paper.

23. BIS 87th Annual Report, ibid.

24. As noted above, technological changes have played a greater role in driving down the relative wages of less skilled workers.

25. If and when global integration stops progressing, this shift down in the Phillips Curve would reverse.

26. Rachel, L and Smith, T (2015), 'Secular drivers of the global real interest rate', Bank of England Working Paper No. 571.

27. It is sometimes claimed that the equilibrium real rate depends on the (expected) rate of growth, but this is an oversimplification. The entire distribution of growth rates matters: not only the mean, but also the volatility, asymmetry and fatness of the tails. See 'Real interest rates and risk', speech by Gertjan Vlieghe at the Society of Business Economists' Annual conference, 15 September 2017.
28. For a discussion of the wider implications of these forces, see 'Debt, Demographics and the Distribution of Income: New challenges for monetary policy', speech given by Gertjan Vlieghe at the London School of Economics, 18 January 2016.
29. Lisack, N, Sajedi, R and Thwaites, G, 'Demographics and the real interest rate', forthcoming.
30. Although retirees dis-save, they also tend to retain relatively high wealth during their retirement, so as the share of the population in retirement increases the stock of savings will remain elevated even as the flow of savings falls.
31. As Ben Bernanke noted, a 'savings glut' from emerging economies developed in the run-up to the crisis (see remarks on 'The Global saving glut and the US current account deficit', 10 March 2005). Global labour market integration could also have lowered the equilibrium real interest rate because households in EMEs are relatively risk averse, and this has increased global risk aversion as wealth has shifted from AEs to EMEs; see Hall, RE (2016), 'The role of the growth of risk-averse wealth in the decline of the safe real interest rate, NBER Working Paper No.22196.
32. Of course, various frictions to complete capital mobility – including home bias, borrowing constraints because securities are imperfect substitutes and incomplete risk sharing across countries – will yield some divergence.
33. Applying the recently-developed technique for estimating low-frequency co-movement in Mueller, U and Watson, M (2015), 'Lowfrequency econometrics', NBER Working Paper No. 21564,'using data since the 1950s.
34. Holston, K, Laubach, T and Williams, JC (2016), 'Measuring the natural rate of interest: International trends and determinants', Journal of International Economics, Vol. 108, Supplement 1, pages S59-S75.
35. Hélène Rey has been a key proponent of the importance of such channels. See, for example, Miranda-Agrippino, S and Rey, H (2015), 'World asset markets and the global financial crisis', NBER Working Paper No. 21722.
36. IMF Global Financial Stability Report 2017, Chapter 3.

37. Cesa-Bianchi, A and Sokol, A 'The international credit channel of US monetary policy and credit shocks', forthcoming.
38. Bonis, B, Ihrig, J and Wei, M (2017). 'The Effect of the Federal Reserve's Securities Holdings on Longer-term Interest Rates' FEDS Notes. Washington: Board of Governors of the Federal Reserve System, 20 April 2017.
39. This analysis uses the IMF's Flexible System of Global Models, a semi-structural model of the global economy that captures international trade and financial linkages.
40. Borio, Presentation on the BIS 87th Annual Report, ibid.
41. Some have argued that inflation targets should be raised. The claimed benefits from doing so may rely excessively on the relationship between the inflation target and inflation expectations in a deflationary environment and in proximity to the lower bound on interest rates.
42. The contribution of investment to world GDP growth has picked up to 0.7pp in 2017 Q1 from an average of 0.3pp during 2016 / Investment has contributed 70% to the pickup in world GDP growth between 2016 Q1-Q3 and 2016 Q4-2017 Q2.
43. The global fiscal structural balance narrowed by 2.5% of world GDP between 2010 and 2014 but has widened by around 0.5% since then.
44. Literally: stepping back in order to jump better.
45. The ultimate impact of Brexit on EU demand for UK exports depends on the extent to which UK access to EU markets resembles being a member of the customs union for goods and the single market, which covers trade in goods and services as well.
46. World input-output database. See also Credit Suisse, 'Brexiting the supply chain', European Economics Research 11 August 2016.
47. The share of UK intermediate exports to the EU for which the final product remains in the EU has fallen by 6% since 1995.
48. Both these findings are reported in Miroudot, S, Lanz, R and Ragoussis, A (2009), 'Trade in intermediate goods and services', OECD Trade Policy Papers, No. 93.

49. Pessoa, J (2016), 'International competition and labour market adjustment', CEPR Discussion Paper No. 1411. Bank research replicating the work of Autor et al, ibid, finds that areas in the UK with a high exposure to Chinese competition have experienced large falls in manufacturing employment, with offsetting rises in non-manufacturing employment.
50. The largest effects are for lower-skilled workers in services industries. See Nickell, S and Saleheen, J (2015), 'The impact of immigration on occupational wages: evidence from Britain', Bank of England Staff Working Paper No. 574.
51. See the box on pages 30-31 May 2015 Inflation Report.
52. See Feyrer (2009), 'Trade and Income -- Exploiting Time Series in Geography', NBER Working Paper No. 14910.
53. See Gopinath, G (2016), 'The International Price System,' Jackson Hole Symposium Proceedings. Gopinath finds that international prices measured in the currency of invoicing are not very sensitive to changes in exchange rates. So if a large share of a country's imports is invoiced in a foreign currency, changes in its exchange rate will mostly show up in changes in the domestic currency price of imports – in other words, pass-through will be higher. For the UK, Gopinath finds that just under half of imports are invoiced in US dollars.
54. There is evidence of threshold effects in exchange rate pass-through. Pass-through of bilateral exchange rate movements that are larger than 5% is around four times larger than that of changes smaller than 5%. See Lewis, J (2016), 'What can Big Data tell us about the pass-through of big exchange rate changes?', Bank of England Staff Working Paper No. 579.
55. Blanchard, O, Cerutti, E and Summers, L (2015), ibid.
56. A point made by Ken Rogoff; see 'Globalization and global disinflation', Economic Review, Federal Reserve Bank of Kansas City, Issue Q IV, pages 45-78. In technical terms, Rogoff uses the Barro-Gordon inflationary bias framework to show that the increased competition that results from greater global integration reduces the central bank's incentive to generate surprise inflation by: (i) reducing the wedge between the "efficient" level of output – that which would be produced if there were no nominal or real frictions in the economy – and the "natural" level of output – that which would be produced if there were only no nominal frictions – through reduced monopoly power in both the product and labour markets); and (ii) increasing price flexibility. Arguably, the increases in central bank transparency and accountability that

have occurred over the past couple of decades have reinforced this decline in inflation bias.

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Fintech and cross-border payments

Dong He analyses how financial regulation and central banking will need to respond to the acceleration of progress in fintech

The IMF has been carefully studying the trends in fintech, and my colleagues and I have gathered some initial thoughts about the way that the financial realm is likely to change. We've also been weighing how financial regulation and central banking will need to respond.

Those of you who would like to explore our reasoning in deeper detail may enjoy reading the two Staff Discussion Notes that we published in the last couple of years—entitled, *Virtual Currencies and Beyond: Initial Considerations* and *Fintech and Financial Services: Initial Considerations*.

However, to gauge the IMF's most recent analysis, a speech last month, at the Bank of England, by the IMF's Managing Director—Christine Lagarde—analyzed potential challenges posed by fintech innovations to central banking. With her uplifting tone, the Managing Director argued that we have the capacity to shape a technological and economic future that works for all. We have a responsibility to make it work. And it's up to us to adopt the right policies.

In this piece—focusing on implications of fintech for cross-border payments—I'll explore three broad areas[1]:

First, a sketch of the economic framework on how fintech applications will affect financial services and the market structure.

Second, the current landscape of cross-border payments, and the possible evolution of cross-border payment systems; and

Third, the role of central banks, themselves, and the possible reasons for them to issue their own digital currencies.

The organization of financial services—a general framework

At the outset, let's consider an overall economic framework, which will help us assess the impact that fintech might have on the financial sector, and help us envision how regulation should respond.

Technology can affect the attributes—for instance, speed, security, and transparency—of new services, as well as the organization of service providers—termed market structure. Technological progress can promote the development and adoption of new services especially when targeted at unmet user needs—what we might call the 'gap'

... technology has the promise to improve cross-border payments, including by offering better and cheaper services, and lowering the cost of compliance with AML/CFT regulation

or 'shortcomings' of services. The bigger the shortcoming, the greater the incentive for firms to improve services as permitted by technological advances, and the faster users' adoption of such services.

Technology can also affect the market structure of service providers. Will new technologies merely increase the profits and the efficiency of established players, or will they have deeper repercussions? Specifically, will they (i) reduce the need for financial intermediaries; (ii) push intermediaries to change their internal structures (possibly leading to partnerships and acquisitions); or (iii) induce the entry of new intermediaries while displacing older ones?

Technology may affect the factors shaping intermediaries. Technology can alter the market imperfections that are pervasive across the financial system, which underpin the need for trusted intermediaries. It can reduce asymmetric information (limited knowledge of one's counterparties to a transaction), facilitate the matching of parties to a transaction, and reduce transaction costs. Technology can also affect the incentives for intermediaries to be horizontally or vertically integrated (offer multiple services to end-users, as does a universal bank, or acquire upstream suppliers). Finally, technology can alter barriers to entry for new intermediaries to compete against incumbents.

The current and future landscape of cross-border payments

Now let's apply this framework to cross-border payments. This is an area especially ripe for change, and could benefit from new technologies. There are significant shortcomings in today's system—stemming in part from technological limits, and in part from a highly concentrated market structure.

It may seem surprising, but cross-border payments are very different from domestic payments. The future could be different—as a simple analogy will suggest. Before the internet, sending so-called 'snail mail' domestically was fundamentally different from sending mail internationally. Pricing was significantly different; the infrastructure was

different; and the handling of cross-border mail required international agreements on payment sharing, packaging, tracking, handling and other processes.

In the age of the internet, however, there is no distinction between a message going to a domestic or foreign recipient: Both of them require, simply, a single click. A package is just a package—and we may soon recognize that a payment is just a payment, wherever it's going.

When making cross-border payments, various types of users—whether they're households, or small enterprises, or large corporations—all put special emphasis on low cost, security, convenience, predictability, and transparency—the assurance that intermediaries will preserve the confidentiality of their information.

Shortcomings of cross-border payments

The shortcomings of cross-border payment services are substantial. Cross-border transfers are costly and cumbersome. Moreover, services are opaque; the price paid for cross-border payments is not transparent, nor known at the time of initiating the transaction in most cases. Finally, sending money across borders is slow. Payments can be routed through many banks before they reach their destination, causing delays and incurring fees. These shortcomings arise from technology, regulation, and market structure.

Market structure

Existing intermediaries benefit from high barriers to entry; each segment of the payments chain remains highly concentrated. In many cases, barriers stem from high fixed and sunk costs required to interface with users, comply with regulation, build trust in services, and operate large back-offices in the case of correspondent banks. In addition, size matters for these institutions to manage liquidity and counterparty risk. Finally, network externalities are

prevalent in messaging—and also in settlement, where netting bilateral positions lowers costs, and access to multiple counterparties facilitates transactions.

Against this background, how could fintech innovations reshape the cross-border payments landscape? To what extent might new technologies reduce service shortcomings, and alter market structure by favoring market platforms over intermediaries, reshaping business plans and firm boundaries, or encouraging entry? And how should regulation respond? While one can only speculate, to some degree, on potential outcomes, much will depend on the scenario for technology adoption.

Three scenarios could be considered, each centered on DLT-based applications. In increasing order of potential disruption, applications might target the areas of: (i) back-end processes; (ii) compliance; and (iii) means of payment.

Back-end processes

DLT could be applied to various processes in cross-border payments. For example, correspondent banks could participate in a shared permissioned DLT platform to automate the tracking of payments, and to optimize liquidity and risk management.

Gains would be most evident in efficiency, with little impact on market structure. In theory, lower fixed back-office costs would diminish economies of scale, spurring new entry—possibly by new types of service providers. However, many of the other barriers to entry to correspondent banking would remain.

End-users may still benefit. Payments settled through correspondent banks would become more transparent and traceable. However, the impact on speed and costs for the end-user is unclear. Correspondent banks may remain oligopolistic and thus unlikely to pass on cost savings.

Compliance

DLT, when combined with other technologies, has the potential to significantly lower the cost of compliance. In particular, know-your-customer utilities and digital identity can facilitate information-sharing and help reduce the cost of compliance, including with respect to AML/CFT regulation and sanctions-related controls. However, the use of new technologies in the field of compliance may be limited by broader issues, including the extent to which regulation would allow financial institutions to outsource customer due diligence.

Market structure would not be left unscathed. Digital identities could allow end-users to switch more easily between service providers, thereby reducing the economies of scope extracted by intermediaries from proprietary information on customer profiles. Such a development would depend on the willingness of existing service providers to share such information, unless they are required to do so by regulation.

New compliance technologies could benefit end-users, but privacy and security issues may arise. Services would probably become cheaper and more inclusive. However, DLT-based applications for compliance could raise concerns over privacy and the security of personal information maintained on the ledger. In addition, the security of digital identities will be an important issue to address (for instance, if a digital identity were stolen and misused by a third party).

Means of payment

DLT can be used to underpin an entirely new means of payment. This is already happening with the emergence of virtual currencies. These means of payment are tokens that are exchanged electronically between market participants, much like cash, over a permissionless (open) or permissioned (fully private or consortium) DLT-based network. The use of these systems effectively shifts payments from accounts-based systems to token-based systems.

Two applications of DLT as a means of payment are relevant for cross-border payments; the first involves a privately run hub-and-spoke payments network. Users exchange fiat money into a virtual currency (DLT-based tokens) held in digital wallets through ATM machines, point of sales terminals, online interfaces, or other means (the spokes). These tokens are then transferred, possibly across borders, over the virtual currency's secure network (the hub) to the payee's digital wallet. Finally, tokens are exchanged into foreign fiat money, as desired, through the same means as above (spokes again).

The implications for market structure are significant; pressure would grow to shorten the traditional payments chain. Messaging and settlement either in central bank money or through correspondent banks would no longer be needed. In the capturing and distributing segments, instead, virtual currency exchanges and wallet providers would compete for customers, potentially taking significant business away from other players.

From the end-user's perspective, the attributes of payment services offered by hub-and-spoke networks look attractive—despite three important caveats. Cross-border payments could become significantly faster, more traceable, and easier to use. Payments could also become cheaper and more secure.

But here are the three caveats:

The first caveat is: the potentially erratic valuation of virtual currencies introduces risks and could limit the adoption of hub-and-spoke networks, at least for large-value payments. In their current form, virtual currencies are not likely to be adequate stores of value given the volatility in their exchange rates to fiat money.

The second caveat is: a lack of trust in hub-and-spoke networks could erode their value. Just as trust is needed in the authenticity of a paper bill in traditional token-based payment systems, trust in the hub-and-spoke solution

is also essential. That is truly vital, for three reasons. One: counterparties need to have legal certainty regarding the transfer of ownership of the virtual currency. Two: counterparties need to have trust in the stability and security of the technology underlying the virtual currency. This also implies trust in the issuance rule (or backing) for the virtual currency. Three: users need to trust the security of the virtual currency exchanges and wallet providers needed to enter and manage hub-and-spoke transactions. Users may be concerned with the security of their data, and the ability of others to access their wallets. Regulators may then need to consider regulatory approaches to virtual currency exchanges and wallet providers that would sufficiently protect consumers, and address AML/CFT concerns.

The third caveat is: the lack of interoperability among networks could keep prices of hub-and-spoke payments high. If networks are not interoperable, network externalities could be strong, and providers could take advantage of market power to charge high fees. Regulation aimed at addressing anti-competitive concerns could help alleviate this outcome.

Central bank digital currencies

Let me now turn to a second possible avenue for DLT application to be used as a means of payment: Central banks could offer their own digital currencies.

A Central Bank Digital Currency—let's call it, in shorthand, a CBDC—would not be a parallel currency. It would merely be a digital form of central bank money that can be exchanged in a decentralized manner. In other words, it can be transferred or exchanged peer-to-peer, directly from payer to payee without the need for an intermediary.

Such a CBDC would be exchanged at par with the central bank's other liabilities (its cash and reserves)—either through banks or directly at the central bank.

Why issue a Central Bank Digital Currency?

The balance of benefits and costs surely needs further study—but central banks might consider introducing CBDCs for various reasons. Efficiency considerations provide a first reason. Efficiency arguments for CBDCs are based on countering the monopoly power that strong network externalities might confer on one or a few private operators in the payments system or private virtual currencies, or on the inability to ensure the full stability and safety of privately coded and maintained currencies. In addition, a CBDC could overcome the coordination failure involved in any inability to agree on a single new technological standard for electronic payments. In terms of stability, a DLT-based CBDC could also be more secure and resilient than current settlement systems which are exposed to single point of failure risk.

From a retail point of view, gradually replacing notes and coins with a CBDC entails savings on the costs of maintaining and replacing notes and coins for the state. It may also significantly reduce transaction costs for individuals and small enterprises that have little or costly access to banking services in some countries or regions; and it may facilitate financial inclusion. In addition: By facilitating small-value payments, it could boost the adoption and efficiency of the new, decentralized, service economy.

Monetary-policy considerations provide a second reason. The introduction and potential proliferation of private virtual currencies might threaten to erode the demand for central-bank money and the transmission mechanism of monetary policy. A CBDC may forestall such private virtual currencies or relegate them to a secondary role in the payments system.

Another monetary policy consideration is that replacing cash, except possibly for costly-to-store small denomination notes, with a CBDC could allow the central bank to lower interest rates well into negative territory when nec-

essary to fulfill its mandate. However, this potential benefit has to be balanced by the important consideration that central banks will need to respect social preferences for the form of money.

What kind of CBDC?

In making the decision about whether to issue a CBDC, central banks should also consider: Precisely what type of digital currency should they issue?

In terms of basic design, the CBDC would presumably respect the following requirements: it would be issued in the same unit of account as fiat money; it would be a liability of the central bank and would be exchanged at par with its other non-equity liabilities—mainly cash and commercial bank reserves.

Other characteristics of CBDCs, however, would differentiate them from commercial-bank reserves in one or several ways. Importantly, whether interest is paid on a CBDC or not has important and differing implications for the transmission and effectiveness of monetary policy, as well as for financial stability. A non-interest-bearing CBDC would be a better substitute for cash than for bank deposits, an interest-bearing one for bank deposits. The latter may affect the transmission mechanism and financial stability more than the former.

The central bank would have to make decisions relative to distribution. The basic questions are how and to whom it would distribute its digital currency. The last issue concerns the choice of technology used to support the CBDC. The form and broad design of the CBDC eco-system will eventually reflect the development and maturing of fintech technologies.

These technological and organizational choices raise several questions, such as: can the chosen technology be made secure, and can speed be maintained? What does it imply as to who bears the costs of operating, maintaining,

and developing the digital currency? Should it be the central bank, or could private sector participation be possible, so that the central bank can remain a catalyst as opposed to a full-scale operator?

These are among the many questions that the introduction of CBDCs raise about the nature and regulation of the financial system, the conduct of monetary policy, and the role of the central and commercial banks in the economy. Many of these questions are political and complex. This would seem to warrant a gradual approach to introducing CBDCs, if at all, building on experience, and on evolving and maturing financial technologies.

Conclusion

As fintech innovations gather pace, boundaries are blurring between intermediaries, markets, and new service providers. Barriers to entry are changing, being lowered in some cases but increased in others, especially if the emergence of large closed networks reduces opportunities for competition; but trust remains essential. And technology has the promise to improve cross-border payments, including by offering better and cheaper services, and lowering the cost of compliance with AML/CFT regulation.

Amid a landscape of change, one thing is certain. As our Managing Director, Madame Lagarde, said in her recent Bank of England speech: *"To make things smoother – at least a bit – we need dialogue… Between policymakers, investors and financial-services firms – and between countries."*

We at the IMF are ready to work constructively on the task of reshaping the cross-border payments landscape – aiming to ensure that down-side risks are minimized, and that the economy can capture the full value of fintech's promise. ■

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This article is based on a speech given at the IMF Ripple – Central Bank Summit, Carnegie Hall, New York, November 1, 2017

Endnotes

1. This speech is based on "Fintech and Financial Services: Initial Considerations", IMF Staff Discuss Notes No.17/05.

Rethinking financial stability

Andy Haldane explains how the financial crisis has been a prompt for a complete rethink of financial stability and policies for achieving it

Introduction

When it comes to financial stability, the theme 'rethinking macroeconomic policy' could hardly be more appropriate. The global financial crisis has been the prompt for a complete rethink of financial stability and policies for achieving it. Over the course of the better part of a decade, a deep and wide-ranging international regulatory reform effort has been underway, as great as any since the Great Depression.

On cost grounds alone, a systematic rethink and reform of regulatory standards has been fully justified. While the costs of the global financial crisis are still being counted, it seems likely they will be the largest since at least the Great Depression. Two approaches are typically used to gauge these costs of crisis: the cumulative loss of output relative to its trend and the cumulative fiscal costs of supporting the financial system[1]. Let's take these in turn.

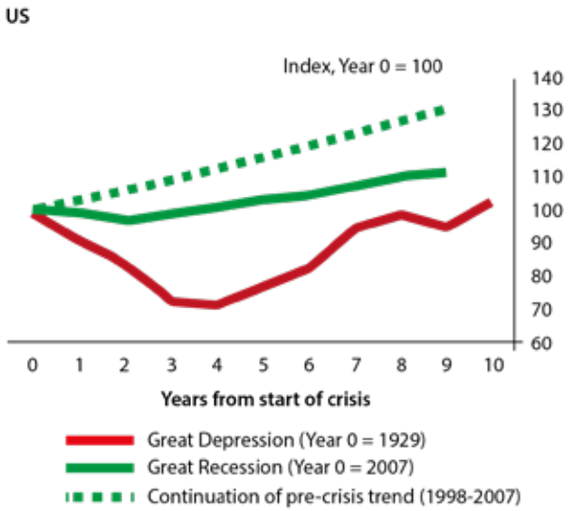
Chart 1 looks at the path of output relative to a simple measure of its pre-crisis trend in the US, UK, France and Germany after the Great Depression of 1929 and the Great Recession of 2008. In either case, it is debatable whether estimated 'pre-crisis trends' were sustainable, as they may have been artificially inflated by credit booms. Nonetheless, it is clear that the output losses from both crises, relative to pre-crisis trends, have been extremely large and long-lasting.

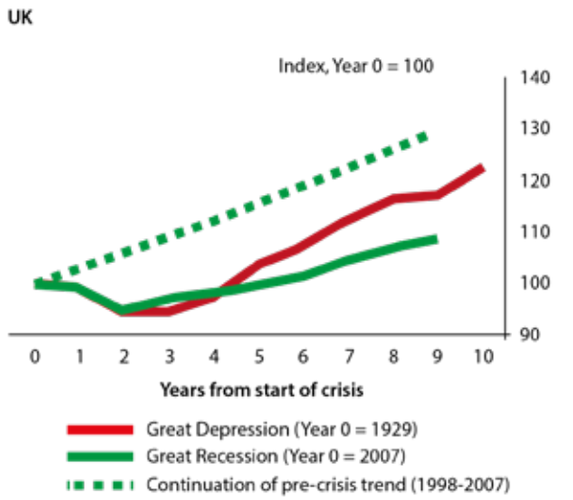
In the US, the level of output is currently around 13% below a continuation of its pre-crisis trend. Ten years into the Great Depression, output was around 28% below its pre-crisis trend. Even if not quite on the scale of the 1930s, the global financial crisis has imposed a huge opportunity cost on US citizens. In the UK, the losses since the Great Recession, currently at around 16% of pre-crisis GDP, are larger than in the US and indeed larger than those that followed the Great Depression. The crisis opportunity costs for UK and euro-area citizens have been the highest for at least a century[2].

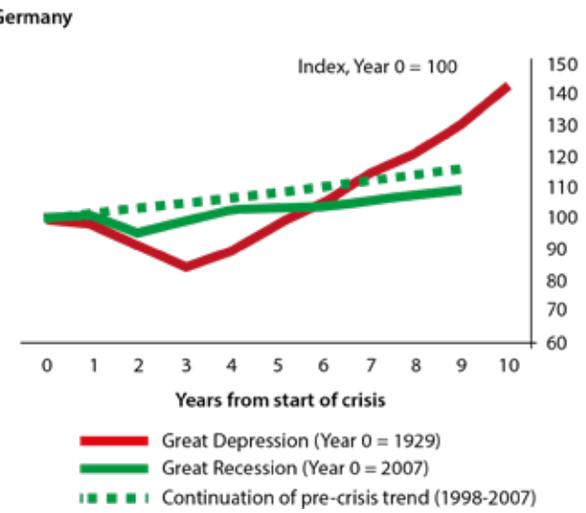
Much the same picture emerges if we look at measures of the fiscal cost of crisis. Again, there are a number of methods for gauging this cost. But one simple metric is to look at the pattern of government debt-to-GDP ratios after the Great Depression and Great Recession, recognising that the larger part of the debt sustainability cost of crisis typically arises from the denominator shrinking than from the numerator rising. Chart 2 plots these debt-to-GDP ratios, again for the US, UK, France and Germany.

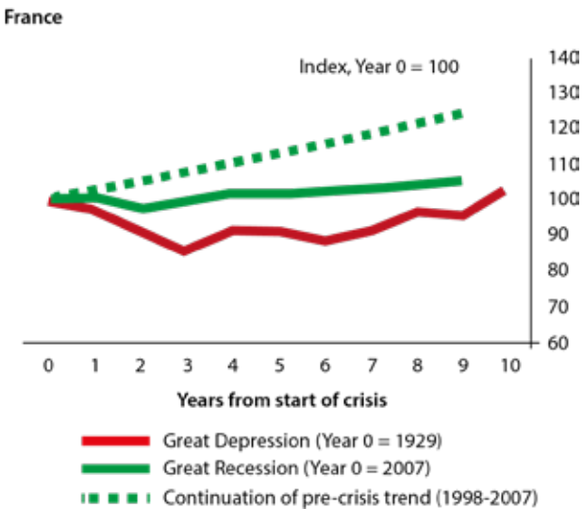
Financial regulation has undergone a fundamental rethink and reform since the global financial crisis... that has resulted in a financial system which is more resilient than in the past

Chart 1. Level of real GDP in the Great Recession and Great Depression



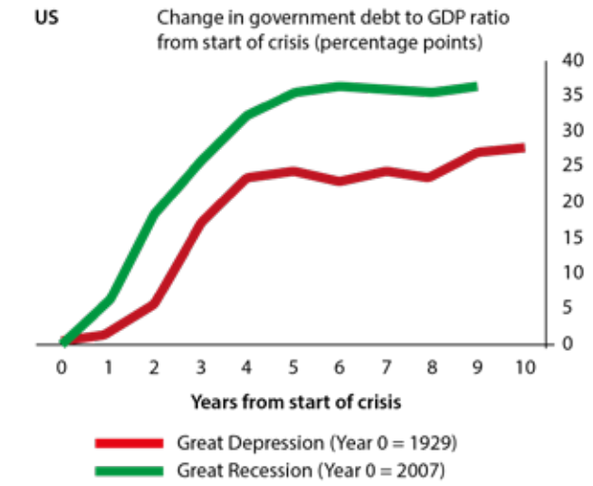


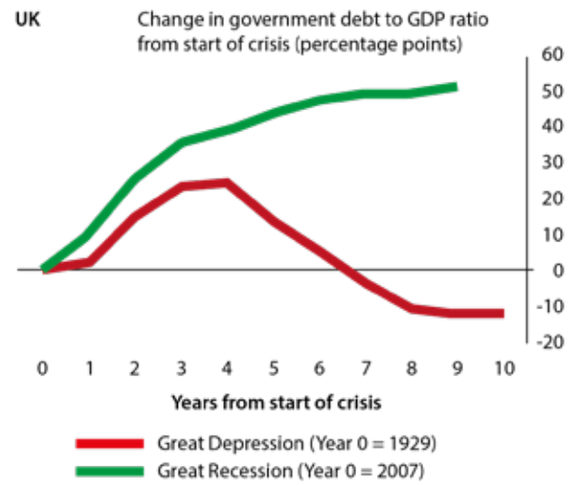


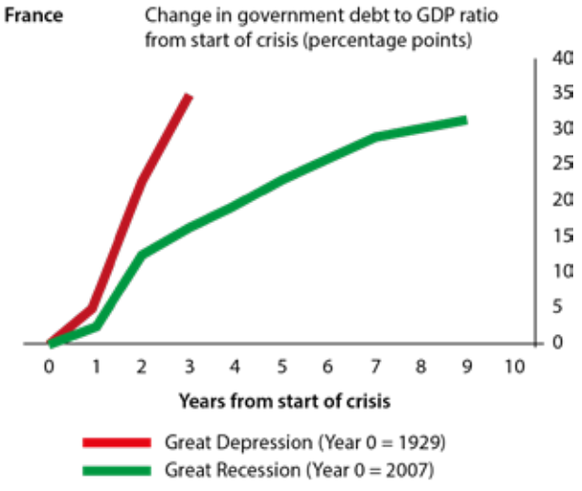


Sources: ONS, Bank of England 'Millennium of Data' (2017), IMF WEO, Maddison Historical GDP Data and Bank calculations.
Notes: 'Continuation of pre-crisis' trend is a simple extrapolation of GDP beyond 2007 using the average GDP growth from 1998 to 2007 for each country.
The strong rebound in GDP growth for Germany following the Great Depression will partly reflect the armament period in the run-up to World War II.

Chart 2. Government debt to GDP ratio in the Great Recession and Great Depression







Sources: Bank of England 'Millennium of Data' (2017), IMF Historical Public Debt Database and Bank calculations. Notes: Data for French government debt between 1934 and 1948 is not available in the IMF dataset.

It suggests that, in the decade after the Great Depression, levels of government debt relative to GDP had increased by around 28 percentage points in the US, 9 percentage points in Germany, but actually declined in the UK. Since the Great Recession, levels of debt relative to GDP have increased by, on average, 28 percentage points for the same set of countries. The fiscal cost of the Great Recession, at least on this metric, is larger than during the Great Depression.

It is against this backdrop that policymakers internationally have engaged in a deep and wide rethink, rewrite and reform of the global regulatory rules of the game. Wide, reflecting the multi-faceted nature of the problems, market failures and market frictions exposed within the financial system during the crisis. Deep, reflecting the severity of the hit to balance sheets, risk appetite and economic activity that the crisis has inflicted and continues to inflict.

The next section reviews these regulatory reform efforts and their impact on bank balance sheets and market metrics of banking risk. With a number of reforms yet to be fully enacted, it is too soon to be reaching definitive conclusions. Nonetheless, some of the key questions thrown up by these regulatory reforms - conceptual, empirical and practical - are now reasonably clear. We also have almost a decade's worth of additional evidence and research on which to draw when assessing these issues.

The following sections discuss some of those issues, drawing on new research and evidence: the calibration of regulatory standards, balancing the costs and benefits of tighter regulation; the overall system of financial regulation, balancing underlaps and overlaps, simplicity and complexity, discretion and rules; the impact of reforms on incentives in the financial system, in particular incentives to avoid regulation; and the evolving role of macroprudential regulation in safeguarding stability of the financial system.

The financial system is dynamic and adaptive. So any financial regulatory regime will itself need to be adaptive if it is to contain risk within this system. In the terms used by Greenwood *et al* (2017), resilience needs to be 'dynamic'.

As past evidence has shown, too rigid a regulatory system will soon become otiose. And there are already calls, in some quarters and in some countries, for a rethink and rewrite of regulatory rules on which the ink is barely dry[3]. This poses both opportunities and threats.

The opportunities arise from the need to keep the regulatory framework fresh and agile. With the best will in the world, no one could say with certainty how the far-reaching and interwoven reforms to regulation over the past decade will precisely land. Judging how the financial system might adapt to future trends in financial technology is even harder to predict. As new evidence, incentives and innovation arise in the financial system, the opportunity is created for regulators to learn and adapt the regulatory framework (Carney, 2017a).

Equally, there are also threats to financial stability from any process of change. History is replete with examples of regulatory standards being diluted or dismantled in the name of enhancing the dynamism of the financial system and the economy. To follow this course unthinkingly would risk repeating regulatory mistakes from the past, recent and distant. Only ten years on from the biggest crisis in several generations, there are already some eerie echoes of those siren voices. With that in mind, we conclude with some thoughts on issues which might be fruitful for future research on regulatory policy.

International regulatory reform

There are already a number of detailed accounts of the regulatory reforms undertaken by international policymakers over the past decade (Carney (2017b), Duffie (2017), FSB (2017a), Greenwood *et al* (2017), Sarin and Summers (2017), Yellen (2017)). The following is a summarised and simplified account of the state of play. It partitions reform efforts into their microprudential and macroprudential components, recognising that the two often overlap and are usually mutually reinforcing in their impact.

We focus here squarely on international banking regulation. We do not cover insurance regulation or international accounting standards. We do not discuss regulatory reforms undertaken nationally, such as the 'Volcker Rule' in the US (Financial Stability Oversight Council (2011)) and the 'Vickers proposals' in the UK (Independent Commission on Banking (2011)). Nor do we discuss international reforms of market infrastructure – for example, clearing – and financial market instruments (FSB (2017b)). Finally, we do not cover changes to banks' large exposures regime and a range of pay and governance reforms.

Microprudential reform

Under the umbrella of Basel III, international reform of microprudential regulation has focused on four key areas: capital, leverage, liquidity and resolution. Taking these in turn:

Reform of risk-based capital standards has focused on increasing the quantity and quality of capital held by banks against their asset exposures. Minimum regulatory requirements for banks' 'core' (common equity) capital have been raised from 2% under Basel II to 4.5% under Basel III, even for the smallest banks. And allowable deductions to core capital have been reduced. On quality of capital, the types of financial instrument eligible as loss-absorbing capital (including for Tier 1) have been tightened considerably. For example, certain hybrid capital instruments are no longer eligible, as they were shown during the crisis to be incapable of absorbing loss in situations of stress (Tucker (2013), Moody's (2010)).

These reforms to capital standards have, encouragingly, been implemented in full by nearly all countries internationally (FSB (2017a)). Comparing regulatory capital, pre- and post-reform, is not straightforward. But taking together changes in both the quantity and quality of capital, it has been estimated that Basel III raised risk-based capital standards for globally systemic banks by a factor of around ten (Cecchetti (2015)).

One of the new elements of the Basel III package was to supplement risk-weighted capital standards with a risk-unweighted leverage ratio. Because this measure does not require banks or regulators to form a judgement on the riskiness of banks' assets, it is in principle simpler, more transparent and less subject to risk-weight arbitrage (Haldane and Madouros (2012)). Indeed, those were among the reasons a number of countries, including the US and Canada, had a leverage ratio regime ahead of the crisis[4]. The Basel III leverage ratio, set at a minimum level of 3% Tier 1, is due to be implemented internationally by 2018.

A second new element of the Basel III package was to augment solvency with liquidity-based standards. Banks' liquidity has long been a pre-occupation of the Basel Committee (Goodhart (2011)). But it took wholesale liquidity runs on the world's largest banks during the crisis to provide the impetus for internationally-agreed liquidity standards. Under Basel III, these take the form of a liquidity coverage ratio (LCR), designed to ensure banks have sufficient high-quality liquid assets to meet their 30-day liquidity needs; and a net stable funding ratio (NSFR), designed to ensure banks' funding profiles are sustainable. The LCR has been implemented in full in most countries; the NFSR is due for implementation by 2018[5].

During the crisis, a crucial missing ingredient from the financial regulatory architecture was found to be the ability to wind up financial institutions in an orderly fashion – that is, while minimising disruption to financial markets and the economy and without exposing tax-payers to risk (FSB (2014)). A number of measures have been taken or are in progress to fill this gap, including the introduction of more effective national resolution regimes for financial firms and greater cross-border co-operation and co-ordination when dealing with international banks in situations of stress (FSB (2017c)).

Another element is to ensure banks have sufficient loss-absorbing liabilities which can be 'bailed-in' in the event of failure, to prevent losses being shouldered by tax-payers. The Financial Stability Board has agreed standards for such Total Loss-Absorbing Capacity (TLAC) for global systemically-important banks (G-SIBs). These standards are to

be phased-in over coming years, to reach a minimum level of 16% from 2019, and 18% from 2022, of the resolution group's risk-weighted assets, as well as 6% and 6.75% on a leverage exposure basis, respectively.

Macroprudential reform

These new or augmented microprudential standards have been supplemented with a set of new macroprudential measures. These focus on safeguarding the stability of the financial system as a whole (Tucker (2009), Bank of England (2009, 2011)). The most significant of these reforms have focused on three areas: macroprudential capital buffers; stress-testing; and shadow banks.

Historically, capital standards have been static requirements. As part of Basel III, a new time-varying component of banks' capital was added – the counter-cyclical capital buffer (CCyB). This recognises that risks to the financial system vary over the credit cycle, typically being highest at its peak and lowest at its trough. The CCyB aims to counteract somewhat that time-varying risk profile, with additional capital required during the upswing which can be released during the downswing. There is international reciprocity in the setting of the CCyB to reduce incentives for cross-border arbitrage (BCBS (2010a)). The framework has been implemented in most jurisdictions.

Similarly, one of the key lessons of the crisis was that some institutions impose greater degrees of risk on the system because of their size, complexity or interconnectedness (FSB (2010)). Basel III recognises the need for these systemically-important firms to carry a structurally higher capital requirement, currently of up to 3.5%, to help mitigate the additional risk they bring to the system. These capital add-ons apply to the 30 designated global systemically-important banks (G-SIBs) and the roughly 160 domestic systemically-important banks (D-SIBs), to be phased-in between 2016 and 2019.

Stress tests were used by regulators before the crisis to assess whether banks had sufficient capital to withstand an adverse tail event. But these tests tended to be neither comprehensive nor transparent. In 2009, the US authorities

undertook a comprehensive stress test of the major US banks and published the results. For banks failing the test, regulatory restrictions on their behaviour were imposed. For some people, this marked the turning point for the US financial system. A comprehensive annual stress-testing exercise is now undertaken in the US[6]. More recently, the US has been joined by the UK and the EU, among others[7].

Finally, one of the striking features of the pre-crisis financial system was the emergence of the so-called 'shadow' banking system. In the US, on some definitions, this grew to exceed in size the conventional banking system (Pozsar *et al* (2010)). Since the crisis, reform efforts have focused on two areas. First, specific reforms have been enacted to sectors which, during the crisis, were found to contain fault-lines - for example, Money Market Mutual Funds (IOSCO (2012)). Second, a framework has been put in place by the FSB to define and measure shadow banking entities, to publish data on them to enhance market discipline and to help authorities identify, and develop policy tools for mitigating, the risks they might pose (FSB (2013a)). The FSB have recently put forward a package of recommendations to address structural vulnerabilities from the asset management sector (FSB (2017d)).

Supporting this package of regulatory reforms, micro- and macroprudential, have been initiatives to boost the quantity and quality of reporting by financial institutions. These should help in pricing institution-specific risk by financial markets and ratings agencies. Notable initiatives have included: enhanced Pillar 3 disclosures by banks, covering all aspects of the regulatory reform agenda; and the work of the Enhanced Disclosure Task Force (EDTF), a private sector group established by the FSB. Over time, this has led to increased compliance with the EDTF disclosure template (Chart 3).

Balance sheet impact

So what has been the impact of these regulatory reform measures on banks' overall resilience? One simple set of resilience metrics focusses on bank balance sheet measures of solvency and liquidity. Comparisons of international

banks' balance sheets are made difficult by changes over time in both the definitions of variables and the sample of banks. We consider a panel of international banks, designated as either global systemically-important (G-SIB) by the FSB in 2016, or domestic systemically-important (D-SIB). This gives a panel of 30 G-SIBs and about 160 D-SIBs[8]. For each bank, we consider two solvency-based metrics (leverage and risk-weighted capital) and two liquidity-based metrics (a simple liquid asset ratio and the ratio of loans to deposits). These measures do not map precisely to Basel definitions[9].

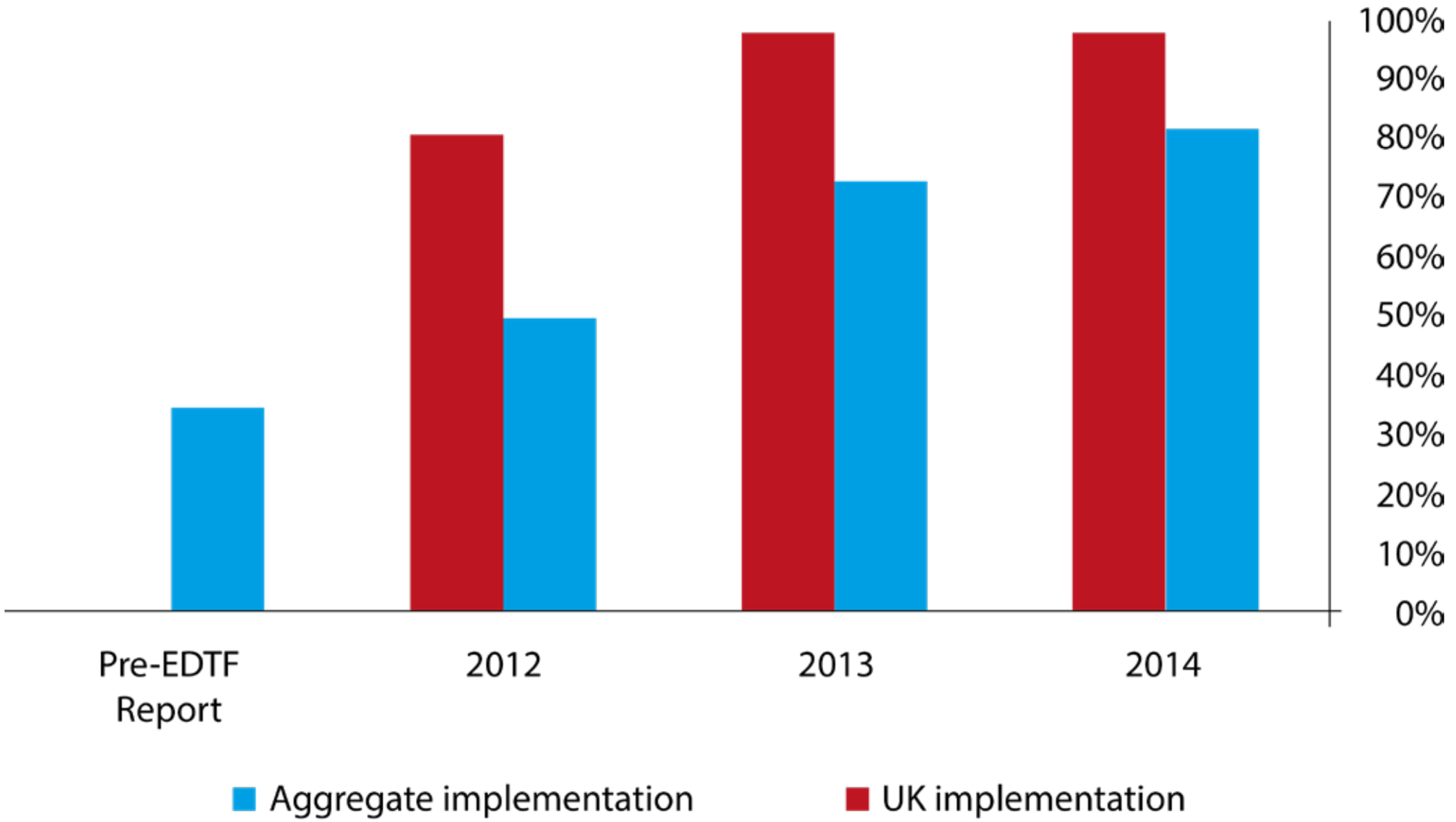
Chart 4 looks at a measure of banks' Tier 1 risk-weighted capital ratios. For both G-SIBs and D-SIBs in our sample, these have risen significantly over the past decade, almost doubling from around 7-8% to around 13-14%. A very similar picture emerges for leverage ratios (Chart 5). These have also roughly doubled over the past decade, from around 3% to around 6%. On these metrics, there has been a material strengthening in solvency-based standards among systemically-important banks over the past decade. This is also the case for measures of TLAC (see Chart 6 for a sample of UK banks).

Liquidity metrics show a similar pattern of improvement. For example, liquid asset ratios - high-quality liquid assets as a fraction of the total balance sheet – have risen from around 6% in 2008 to more than 8% (Chart 7), though the increase is more muted for D-SIBs. Meanwhile, the ratio of loans to deposits (LTD) has also improved, with lending backed by a larger share of stable sources of funding than before the crisis (Chart 8).

Market-based metrics

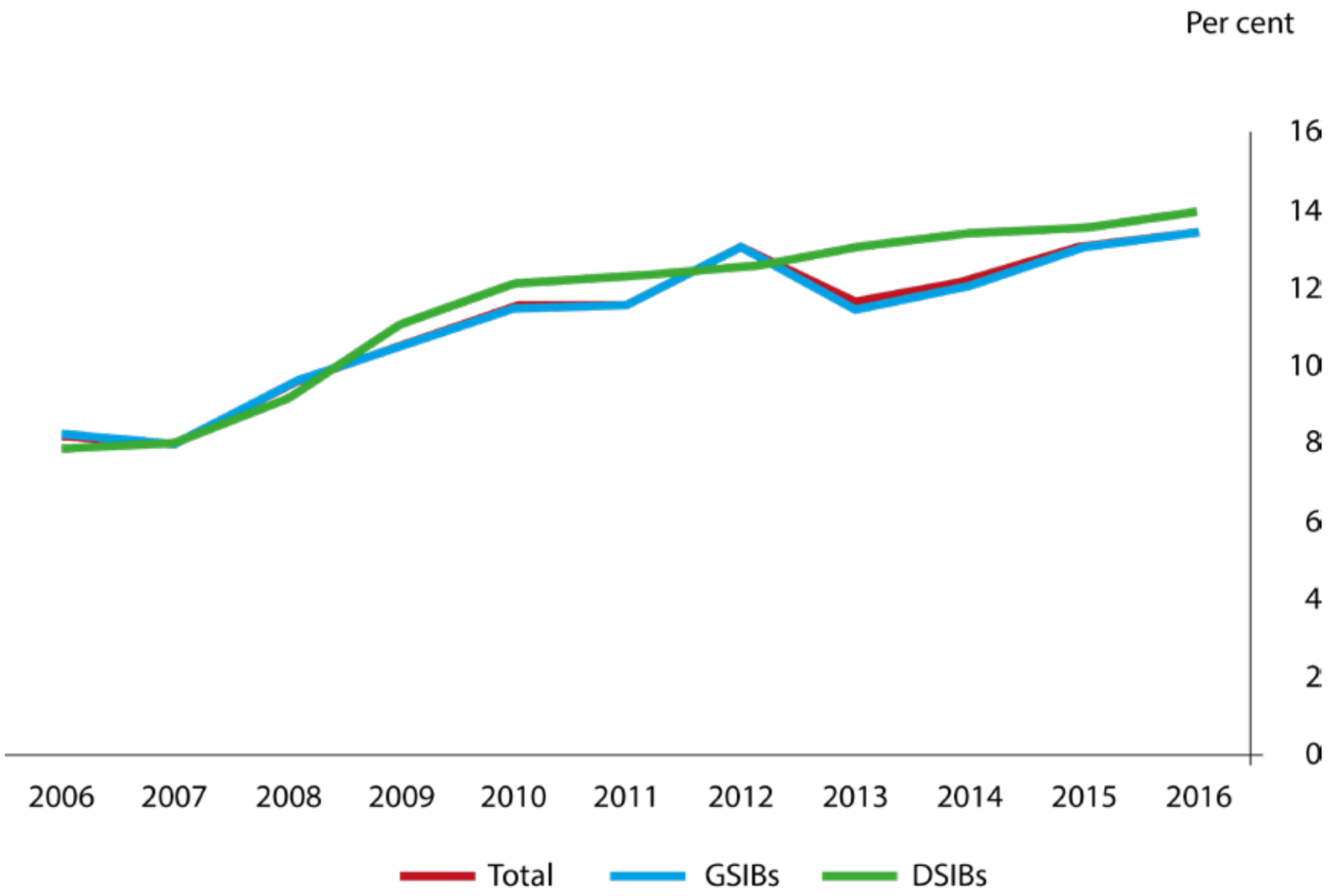
A second set of metrics of bank solvency and liquidity focus on financial market perceptions of bank risk. There are a wide variety of potential such metrics, each with their own imperfections, including measures of default such as CDS spreads, bond yields and ratings; measures of volatility, such as option-implied volatilities; and measures of profitability, such as price-earnings ratios. These are summarised and evaluated in Sarin and Summers (2016).

Chart 3. Compliance with EDTF disclosure



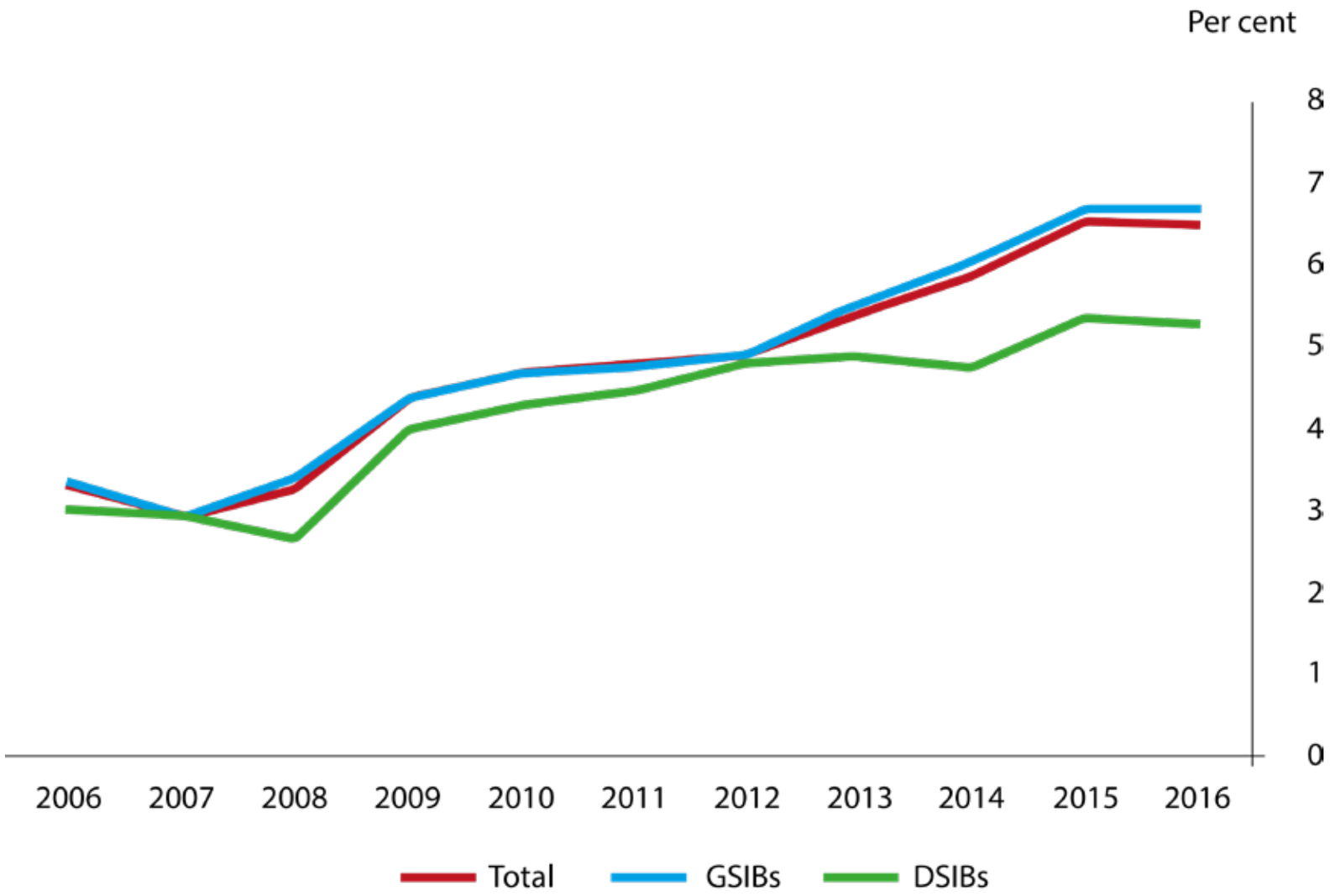
Sources: Progress reports of the Enhanced Disclosure Task Force from 2013, 2014, and 2015; Bank calculations

Chart 4. G-SIB and D-SIB Tier 1 capital ratios



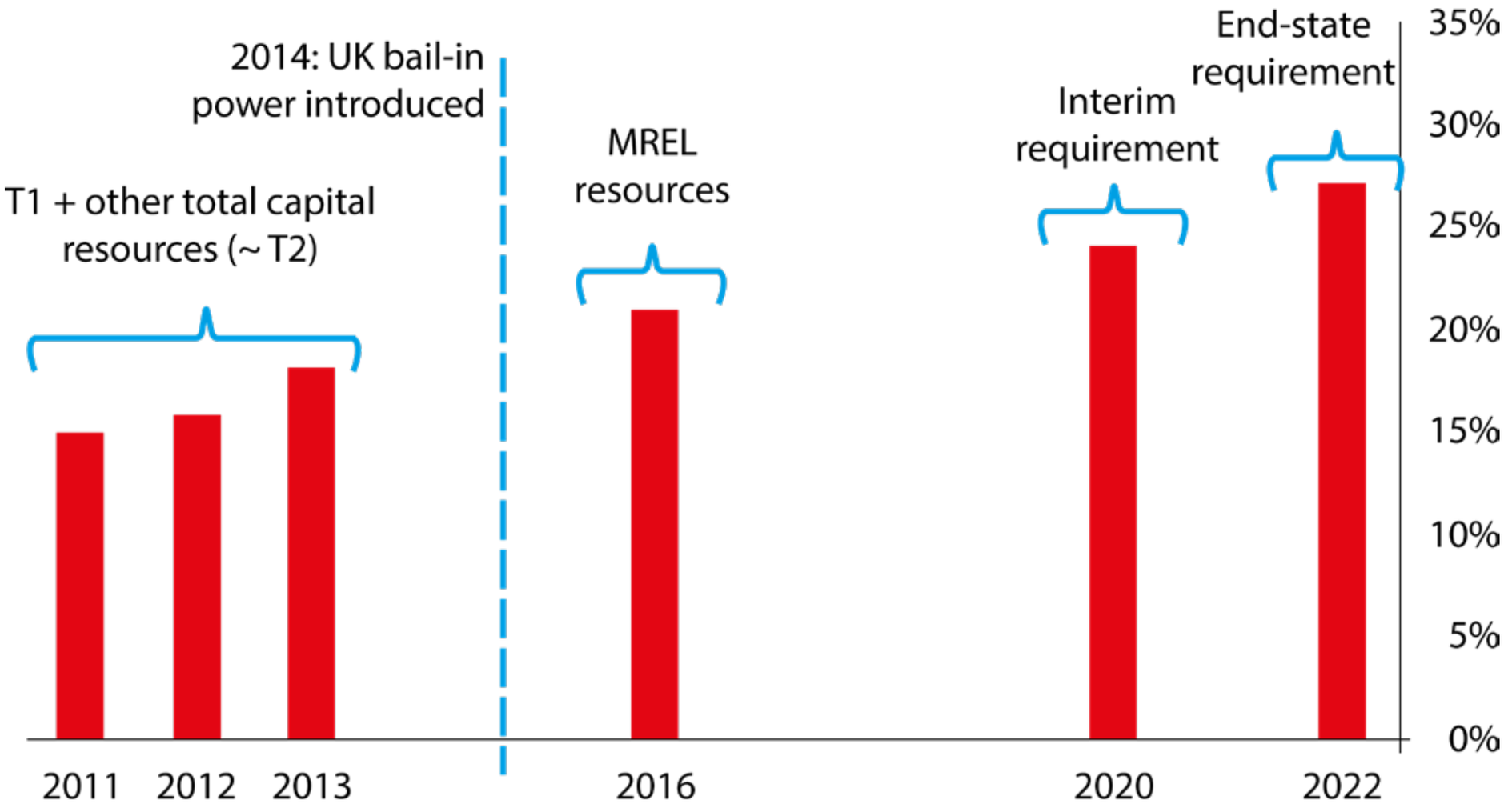
Sources: S&P Capital IQ and Bank calculations
Notes: Weighted average based on a sample of 189 banks which are systematically important as of 2016. Yearly is defined as the fiscal year of reporting of the individual banks. Tier 1 Capital Ratio = Tier 1 Capital/Risk Weighted Assets

Chart 5. G-SIB and D-SIB leverage ratios



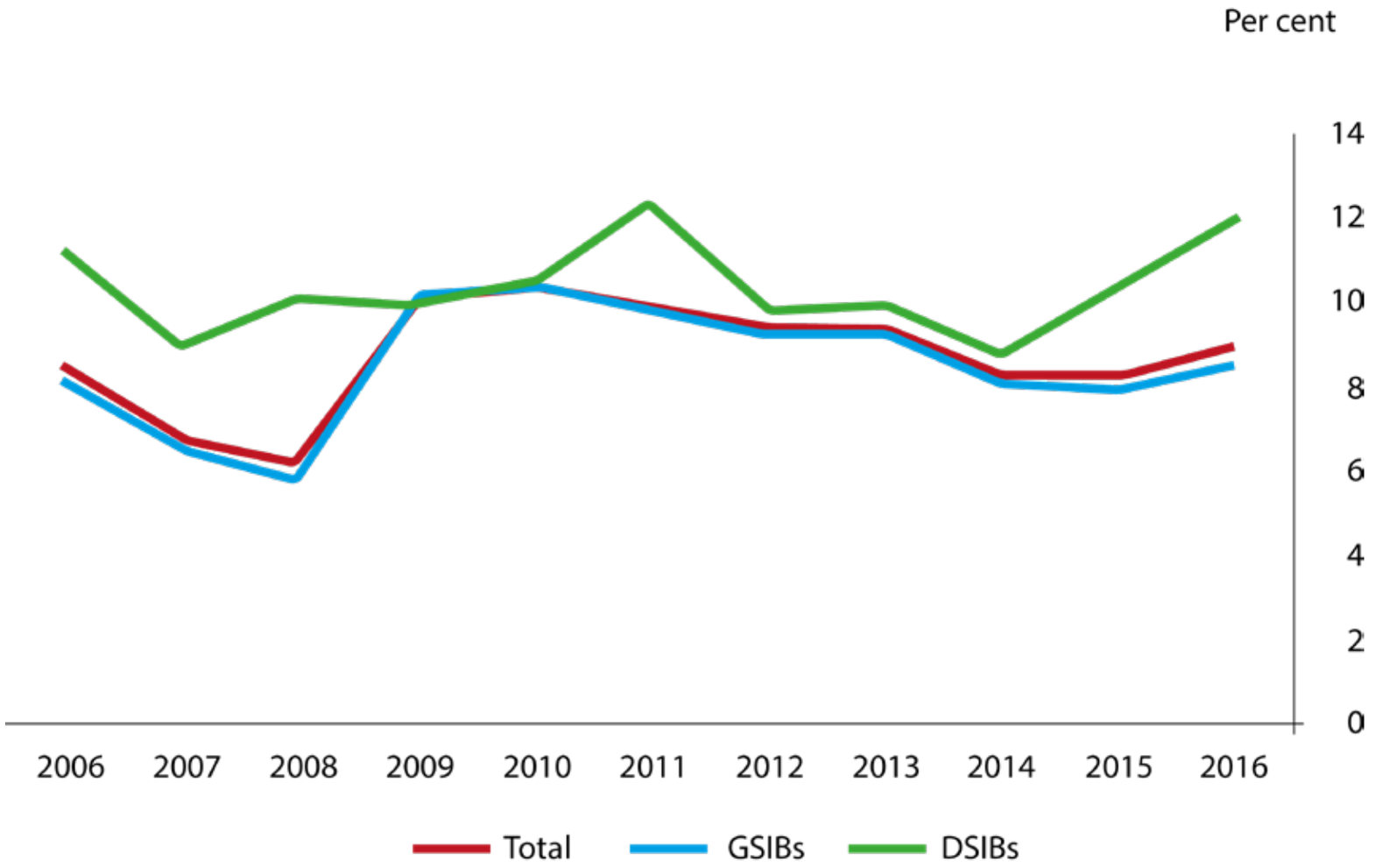
Notes: Weighted average based on a sample of 189 banks which are systematically important as of 2016. Yearly is defined as the fiscal year of reporting of the individual banks.

Chart 6. Major UK banks' regulatory capital, MREL resources and requirements, % RWA (2011-2022)



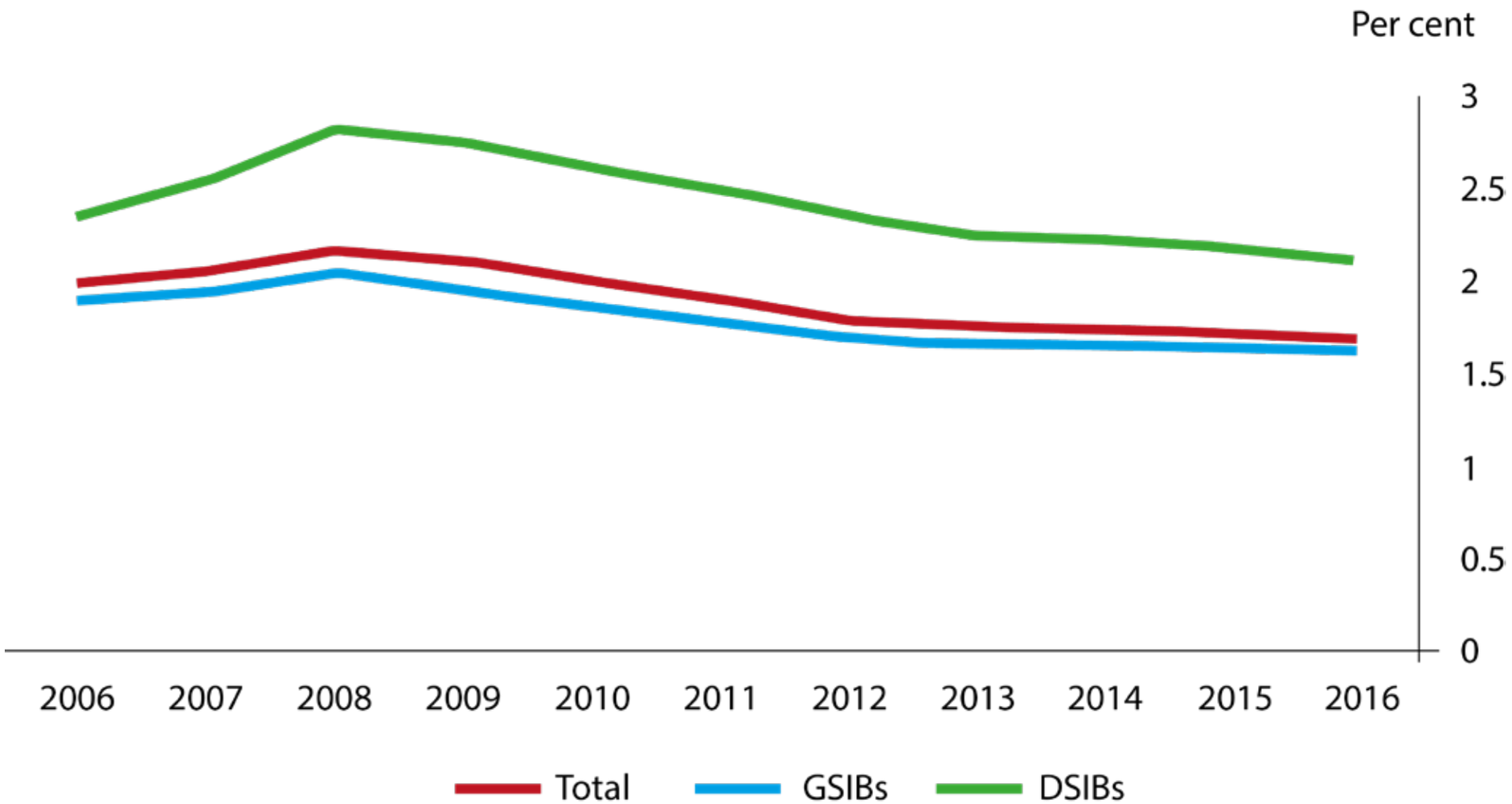
Sources: FSA regulatory returns, MREL+ returns, Bank calculations

Chart 7. G-SIB and D-SIB high-quality liquid assets (liquid asset ratio)



Sources: S&P Capital IQ and Bank calculations
Notes: Weighted average based on a sample of 189 banks which are systematically important as of 2016. Yearly is defined as the fiscal year of reporting of the individual banks. Liquid Asset Ratio = (Cash equivalents + government securities)/Total assets

Chart 8. G-SIB and D-SIB loan-to-deposit ratio



Sources: S&P Capital IQ and Bank calculations
Notes: Weighted average based on a sample of 189 banks which are systematically important as of 2016. Yearly is defined as the fiscal year of reporting of the individual banks. Loan to Deposit Ratio = Loans granted by a bank/Stable deposits received. Stable deposits are assumed to be a constant share of total deposits.

Chart 9 plots a measure of default – CDS spreads – for a panel of G-SIBs. It shows a familiar pattern of pre-crisis under-pricing of risk; a rapid re-pricing of default risk during the crisis; and a subsequent partial unwind. CDS spreads today sit roughly midway between their pre-crisis and mid-crisis averages. Bank bond spreads and ratings tell a similar story. Assuming pre-crisis banking risk was materially under-priced, this evidence is consistent with regulatory reform having boosted the resilience of the global banking system.

At the same time, measures of bank volatility and profitability have seen fewer signs of recovery. Chart 10 plots a measure of the price-to-book ratio of G-SIBs and D-SIBs. This currently lies well below its historic average and little different than unity. Put differently, if we used a measure of banks' capital ratios using the market rather than the book value of their equity, this would suggest a far smaller degree of improvement in measured bank solvency and resilience (Chart 11), though the effect is less pronounced for D-SIBs.

Sarin and Summers (2016) reconcile these market movements by appealing to the shifts in the franchise value of banks. Improved solvency standards have decreased the perceived default risk of banks. But coincident with lower risk are lower returns to banks' activities, due to the combined effects of stricter regulation, misconduct fines, low levels of interest rates and increased competition. This leaves banks a riskier proposition for equity investors than before the crisis, as the residual claimant on profits. But, by and large, improved solvency standards have reduced risk among bond-holders and depositors in banks.

'By and large' because, accompanying these changes in banks' capital standards, has been a move towards putting losses from default onto bond-holders. This can be seen in the evolution of the implied 'support ratings' given to banks by rating agencies. In 2010, holders of the major UK banks' debt enjoyed around 4 notches of implied ratings uplift owing to expectations of government support (Chart 12). By 2016, that had fallen to less than one notch of support. A similar pattern is evident among other global banks.

Calibrating regulatory standards

Is the calibration of these new regulatory standards too tough, too lax or just right? That has been among the most animated of the regulatory debates over the past decade. One standard for comparison is historical experience. There has been a significant evolution in the levels of both capital and liquidity ratios of the major banks over the past century. Chart 13 plots a measure of the leverage ratio for the UK and US banking systems over a long historical sweep[10], while Chart 14 plots a simple measure of the liquidity ratio for UK banks over the past half-century (see also Jordà *et al* (2017)).

Both solvency and liquidity ratios have exhibited a long, downwards drift. Between the end of the 19th century and the troughs prior to the financial crisis, leverage ratios fell by around three quarters in the US and the UK. Liquid asset ratios among UK banks underwent an even larger fall in less than half the time. Given the scale of these falls, even with the regulatory reforms of the past decade, levels of capital and liquidity in the banking system are at levels significantly below those 100 and 50 years ago, respectively.

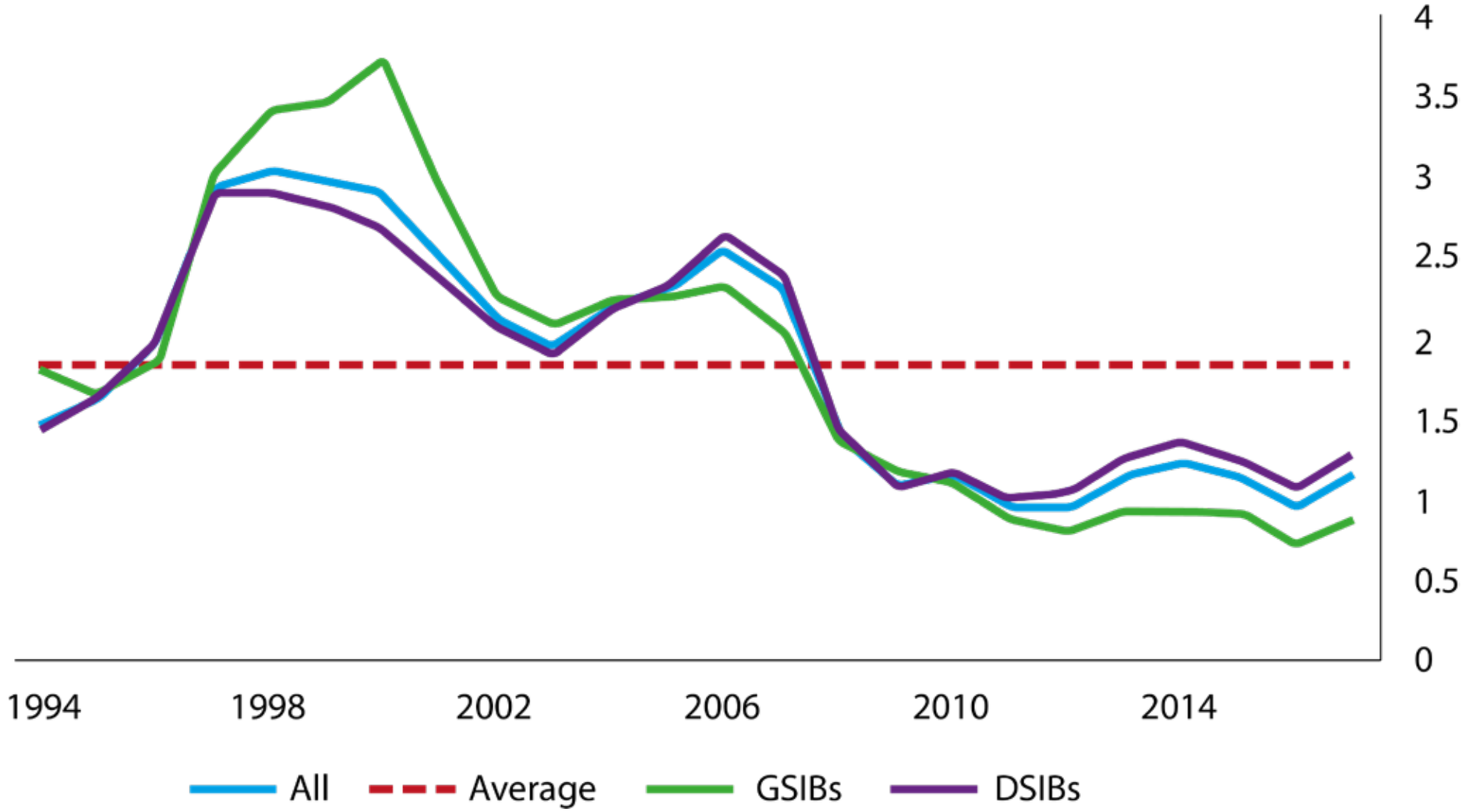
On the face of it, this gives grounds for questioning whether even these revamped regulatory standards are sufficient to withstand likely future shocks. We should, however, probably be cautious about jumping too quickly to that conclusion. Over the past century, there has been significant change in the structure of the financial system, including in the structure, scale and scope of financial regulation and the safety net. Those changes could mean that simple, historical comparisons of regulatory standards are misleading.

Admati and Hellwig (2013) provide a comprehensive and lucid account of the case for higher capital standards. Their argument centres on the fact that the impact of higher capital standards on banks' overall cost of capital needs to take account of the lower risk that arises from this shift - the Modigliani-Miller offset (Modigliani and Miller (1958)). It needs also to distinguish between any private costs to banks from tighter regulation and the social benefits this confers, with the latter the key public policy yardstick.

Chart 9. CDS spreads for G-SIBs

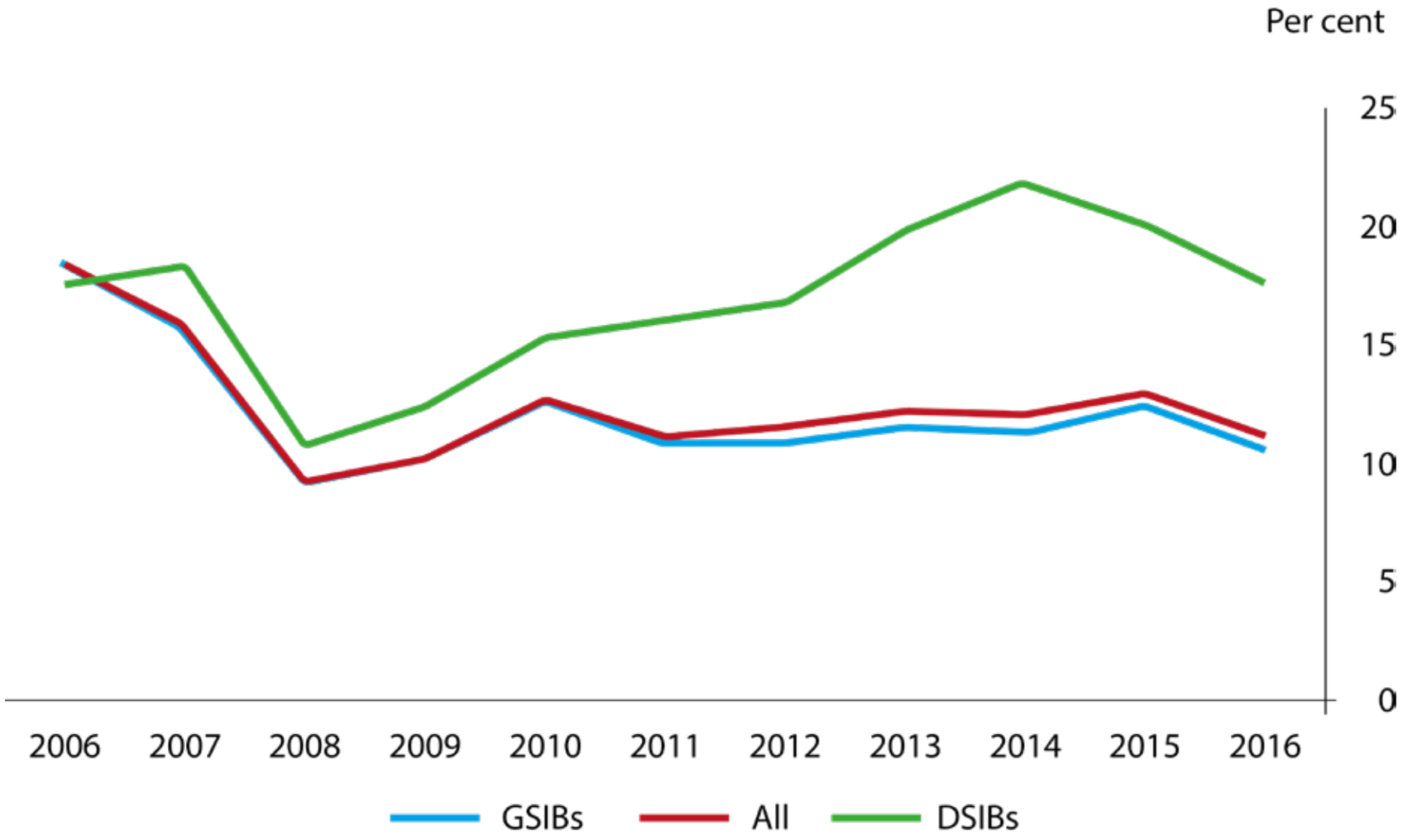
Sources: Bloomberg; Bank calculations
Notes: Weighted average of 22 banks designated as G-SIBs as of 2016

Chart 10. G-SIB and D-SIB price-to-book ratio



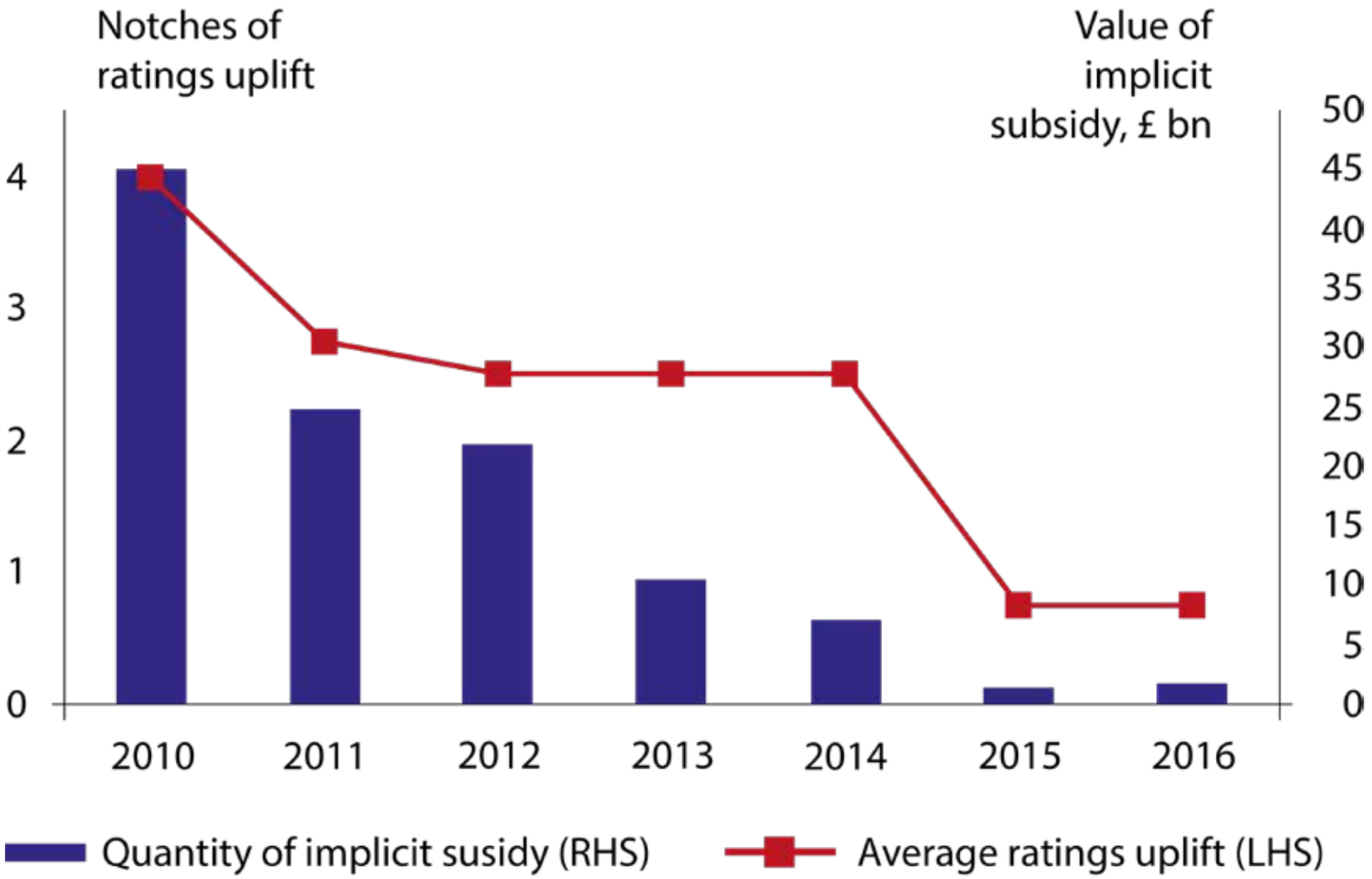
Sources: Bloomberg; Bank calculations
Notes: Sample of 103 G-SIBs and D-SIBs designated as G-SIBs/D-SIBs as of 2016

Chart 11. Capital ratio using market value of equity



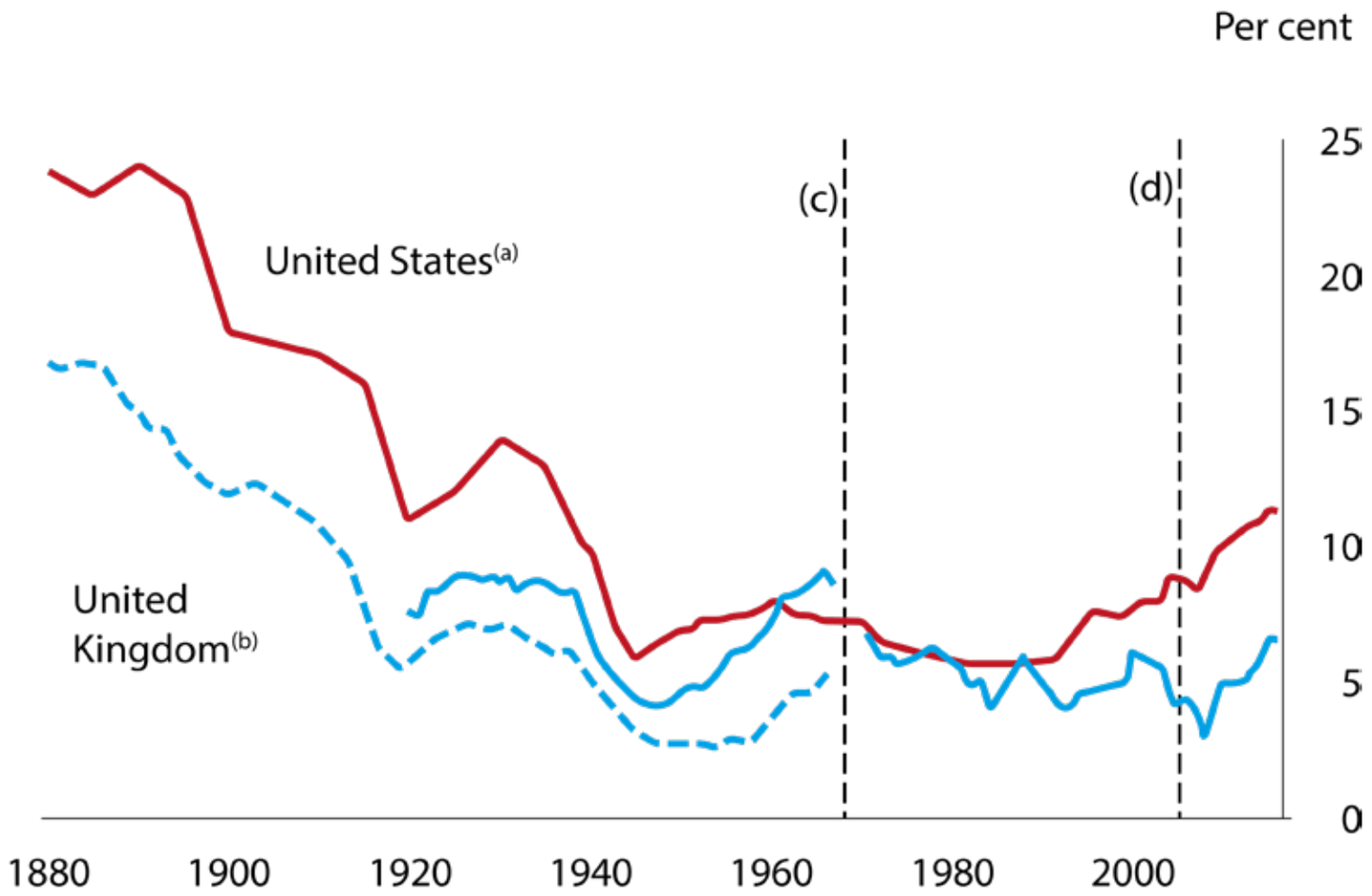
Sources: S&P Capital IQ, Bloomberg, and Bank calculations.
Notes: Weighted average based on a sample of 189 banks which are systematically important as of 2016. Yearly is defined as the fiscal year of reporting of the individual banks. Market-based Capital Ratio = Market Capitalisation/Risk Weighted Assets

Chart 12. Estimates of implicit subsidy



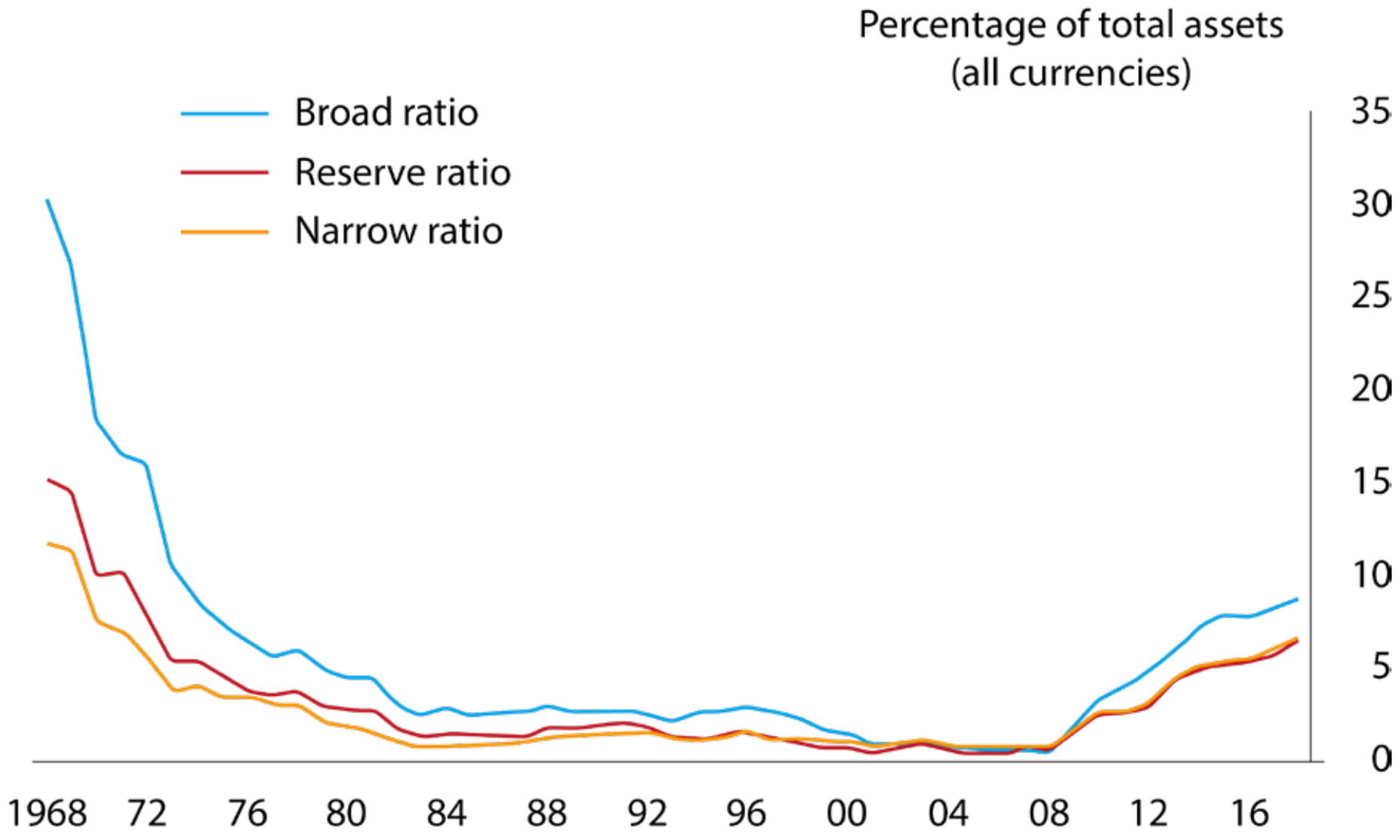
Sources: Moody's, Bank of America and Bank calculations.
Notes: Includes Barclays, HSBC, LBG and RBS. Calculated by multiplying the spread between indicative bonds at standalone and supported credit ratings by the volume of ratings-sensitive liabilities; end-year data. Published in: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/treasury-committee/capital-and- resolution/written/69208.pdf

Chart 13. Long-run UK and US leverage ratios



Sources: United States: Berger, A, Herring, R and Szegö, G (1995), 'The role of capital in financial institutions', Journal of Banking and Finance, Vol 19(3-4), pages 393-430; SNL and Bank calculations. United Kingdom: Sheppard, D (1971), The growth and role of UK financial institutions 1880-1962, Methuen, London; Billings, M and Capie, F (2007), 'Capital in British banking', 1920-1970, Business History, Vol 49(2), pages 139-162; BBA, published accounts; FPC core indicators and Bank calculations
Notes: (a) US data show equity as a percentage of assets (ratio of aggregate dollar value of bank book equity to aggregate dollar value of bank book assets). SNL data from 1996 on, based on accounting definition of equity.
(b) UK data on the capital ratio show equity and reserves over total assets on a time-varying sample of banks, representing the majority of the UK banking system, in terms of assets. Prior to 1970 published accounts understated the true level of banks' capital because they did not include hidden reserves. The solid line adjusts for this. 2009 observation is from H1. Data from 2010 onwards is based on the simple leverage ratio published by the FPC (as of September 2017) as one of its core indicators for the countercyclical capital buffer.
(c) Change in UK accounting standards.
(d) International Financial Reporting Standards (IFRS) were adopted for the end-2005 accounts. The end-2004 accounts were also restated on an IFRS basis. The switch from UK GAAP to IFRS reduced the capital ratio of the UK banks in the sample by approximately 1 percentage point in 2004.

Chart 14. Long-run UK liquidity ratio (sterling liquid assets relative to total holdings of UK banking sector)



Sources: Bank of England and Bank calculations.
Notes: Data for building societies are included from 2010 onwards. Prior to this, data are for UK banks only. Data are end-year except for 2017 where end-July data are used. Broad ratio defined as Cash + Bank of England balances + money at call + eligible bills + UK gilts. Reserve ratio proxied as Bank of England balances + money at call + eligible bills. Narrow ratio defined as Cash + Bank of England balances + eligible bills.

When it came to re-calibrating regulatory standards for capital and liquidity after the crisis, international regulators engaged in a detailed, quantitative exercise which sought to weigh these social costs and benefits of tighter regulation, drawing on existing empirical evidence. The Long-Term Economic Impact (LEI) study, published by the Basel Committee in 2010, is a useful starting point for discussion of the appropriate calibration of regulatory standards (BCBS (2010b)).

The main conclusion from this work was that, under conservative assumptions about likely economic costs, there were positive economic benefits to society from a sizeable increase in the capital banks were required to maintain. The study did not settle on an optimal level of bank capital. But the results presented were consistent with societal benefits peaking at a Tier 1 risk-weighted capital ratio of between 16-19%[11]. This is north of most global banks' current capital ratios.

The range of published estimates in the LEI study reflected different assumptions about the persistence of the effects of crises on GDP, an area of particular empirical uncertainty in the academic literature. A contemporaneous study by Miles *et al* (2013) concluded that optimal capital requirements were likely to be higher – perhaps around 20% - if account was taken of the offsetting risk and cost of capital effects of higher solvency standards (the Modigliani-Miller offset).

It is useful to revisit the calibration in the LEI study in the light of subsequent research. A little notation may be useful to organise this evidence. Suppose the aim of policy is to keep output in the economy, y, as close as possible to its trend growth path, $\bar{y}$. The objective for the authorities is then to minimise a loss function, which can be written as:

$$L=(y_t-\bar{y}_t)^2$$

Let's simplify further and assume two factors can cause output to deviate from its trend: first, higher capital requirements, k, which act to reduce output each period by δ; and second, the occurrence of a financial crisis which, with probability y, leads to a discrete drop in output of Δ. That is:

$$y_t=\bar{y}_t-\delta k-y(k)\Delta(k)$$

This captures the view that higher bank capital could reduce credit supply, and hence economic activity, in the near term. But by making the financial system more resilient to future shocks, it may also reduce the tail risk of bad macroeconomic outcomes.

Both probability and severity of crises are influenced negatively by the level of bank capital, with the relationship likely to be convex ($y'(k)<0, y''(k)>0, \Delta'(k)<0, \Delta''(k)>0$) – that is to say, one would expect a one percentage point increase in the capital ratio to have a larger dampening impact on the probability and severity of crisis when banks are close to their regulatory minima than when capital buffers are plentiful.

In this stylised set-up, the marginal condition that defines optimal bank capital is:

$$\delta=-\Delta\frac{\delta y}{\delta k}-y\frac{\delta\Delta}{\delta k}$$

Optimal capital is higher the lower is δ, the economic cost of a marginal increase in capital requirements; the greater are y and Δ, the likelihood and severity of crises; and the greater are $\frac{\delta y}{\delta k}$ and $\frac{\delta\Delta}{\delta k}$, the marginal effects of capital

on the likelihood and severity of crises. So what have we learned over the past decade about the likely magnitude of these parameters?

The benefits of higher capital requirements

The assumptions underpinning the marginal benefits of higher capital in the LEI study were as follows: banking crises occur, on average, once every 20-25 years; the median estimate of the cumulative discounted costs of a crisis is around 60% of annual pre-crisis GDP; each percentage point increase in the capital ratio reduces the probability of a banking crisis by a smaller amount, ranging from 1.4% to 1% (for a capital increase from 10% to 11%) to 0.4% to 0.3% (for a capital increase from 14% to 15%); and, finally, the level of bank capital has no impact on the severity of crisis.

Since the LEI report, a rich seam of the literature has emerged on the determinants of crises and their severity (Δ). Some of the most illuminating pieces of this research have drawn on evidence from a long historical time-series and across multiple countries (for example, Jordà *et al* (2013), Taylor (2015)). The key findings are as follows.

First, credit booms are probably the single most important determinant both of the likelihood of crises and of economic performance in the recovery after them (Schularick and Taylor (2012), Jordà *et al* (2013)). A sustained 1 percentage point increase in the credit-to-GDP ratio raises the probability of crisis from 4% to around 4.3% per year. It also raises the severity of a crisis, with real GDP per capita almost 1% lower after five years[12].

Colleagues at the Bank of England have considered whether it is the level of credit, or its growth, prior to a crisis that matters most for subsequent economic performance (Bridges *et al* (2017)). They find that credit growth has historically been a significant predictor of crisis severity, whereas the level of indebtedness appears less important.

Second, not all forms of credit are equal. In the post-WWII era, mortgage credit growth has been the dominant driver of financial crisis risk. And growth in mortgages, rather than in other forms of credit, is the key determinant of the drag in the recovery phase from crisis (Jordà *et al* (2017)). Third, asset prices are also important with 'leveraged bubbles' – synchronised house price and mortgage credit booms - particularly dangerous (Jordà *et al* (2015)).

Taken together, this evidence is consistent with the probability (y) and output costs of credit crises (Δ) being at least as large as assumed in the original LEI study, perhaps larger, given the still-high levels of the credit-to-GDP ratio in most countries, and the monetary and fiscal space available to the authorities at present relative to the average of the past – a recent paper by Romer and Romer (2017) presents evidence that this factor is a significant determinant of crisis severity. The still-accumulating output losses during the recovery phase from this time's crisis would also point in this direction (Chart 14).

What role does higher bank capital play in reducing the likelihood of financial crises ($\frac{\delta y}{\delta k}$) or their severity ($\frac{\delta \Delta}{\delta k}$)? At least for the likelihood of crisis, subsequent evidence has tended to be rather ambiguous. Historical evidence, using aggregate economy-wide covariates, has reached the perhaps surprising conclusion that bank capital ratios have virtually no predictive power for the occurrence of financial crises in major advanced economies (Jordà *et al* (2017)). That is, $\frac{\delta y}{\delta k}$ is indistinguishable from zero. This result holds both in the full sample (1870-2013) and in the post-WWII period.

Micro-econometric studies on the link between bank failure and bank capital have found a more tangible relationship, however. For example, Vazquez and Federico (2015) find that US and EU banks with stronger pre-crisis capital and structural liquidity positions were less likely to fail. Berger and Bouwman (2013) report a similar finding using a longer-run data set of US banks. And a recent study by IMF economists finds that risk-based capital ratios in the range 15-23% would have been sufficient to absorb losses in the vast majority of past advanced economy banking crises (Dagher *et al* (2016))[13].

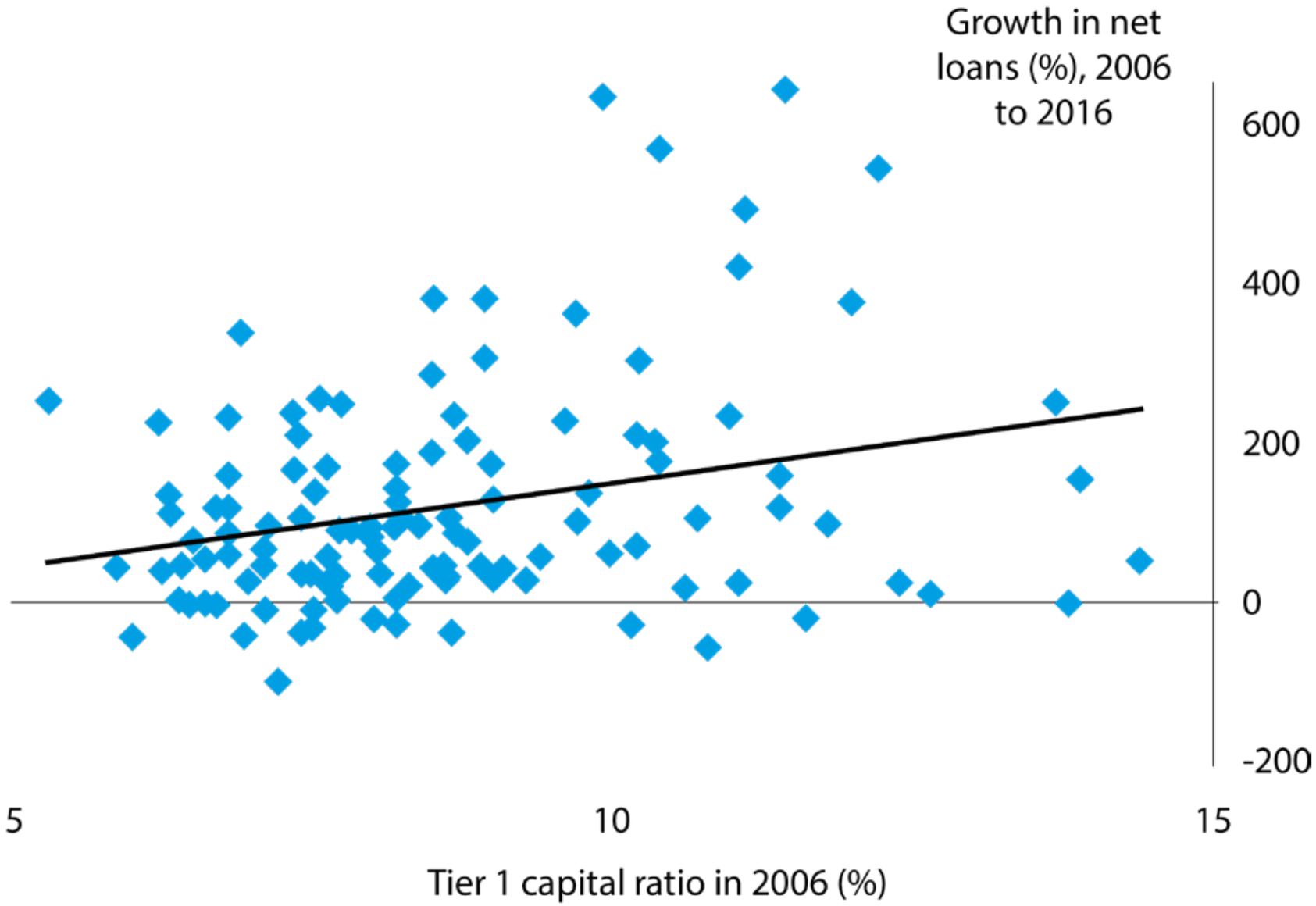
At the time of the Basel Committee's study, there was little evidence on the impact of bank capital on the severity of crises ($\frac{\delta y}{\delta k}$), which is why this channel was ignored in the quantitative calibration. That has since changed. Jordà *et al* (2017) find that, while bank capital does not prevent a crisis from occurring, it matters for the pain suffered in its aftermath. They find that real GDP per head is 5 per cent higher 5 years after the onset of a crisis-related recession if bank capital is above its historical average when the crisis hits.

The benefits of capital in reducing the severity of crisis are also borne out by experience since the crisis. Chart 15 plots international banks' capital ratios prior to the crisis against their subsequent lending growth. The relationship has a statistically significant upward slope. Banks that entered the crisis with higher capital have, on average, been better able to continue their lending. On average, each extra 1 percentage point of pre-crisis capital boosted banks' cumulative lending over the subsequent decade by over 20%.

This finding is corroborated by micro-econometric evidence. Carlson *et al* (2013) find that US banks with higher pre-crisis capital ratios had stronger loan growth in its aftermath, with the effect particularly pronounced at lower capital ratios. Cornett *et al* (2011) and Kapan and Minoiu (2013) report that banks relying more heavily on stable sources of funding, such as core deposits and equity capital, continued to lend relative to other banks during the crisis. And Jimenez *et al* (2014) find that, in periods of economic weakness, loan applications were less likely to be rejected by Spanish banks that were well-capitalised.

A recent paper by Bank of England colleagues identifies a distinct channel through which bank capital affects crisis severity (Tracey, Schnittker and Sowerbutts (2017)). They use banks' misconduct fines as a novel instrument to identify exogenous negative bank capital shocks. They find that banks respond to such shocks by relaxing their lending standards, as measured by the loan-to-value and loan-to-income ratios on new mortgages. This is likely to increase their vulnerability to future shocks, increasing crisis severity.

Chart 15. Individual banks' 2006 capital positions and 2006-2016 lending growth



Sources: S&P Capital IQ and Bank calculations.

This evidence suggests that some of the benefits of higher capital requirements may have been understated in the original LEI study, with implications for the range of optimal capital requirements. For example, if we assumed that every percentage point of extra capital increased the level of real GDP each period in the aftermath of a crisis by 0.1% – broadly consistent with the evidence here - this would raise optimal capital requirement by around 2 percentage points, other things equal[14].

Working in the opposite direction, however, have been developments in resolution arrangements and new standards for TLAC. No account was taken of these in the LEI study. But if TLAC can be credibly bailed-in, including for systemically-important institutions, this would tend to reduce both the likelihood and severity of future crises[15]. It may also discipline banks' management, avoiding them taking excessive risks in the first place. Some studies suggest this market discipline effect could be material, reducing the likelihood of a financial crisis by as much as 30% (Afonso et al (2015), Brandao-Marques *et al* (2013)).

Colleagues at the Bank of England (Brooke *et al* (2015)) have estimated that, if these measures of the beneficial incentive effects of TLAC and credible resolution regimes are correct, and if increased resolvability in addition reduces the cost of crises by around 60%[16], then optimal capital ratios for the UK banking system could be up to 5 percentage points lower than would otherwise be the case.

A recent study by economists at the Federal Reserve Board (Firestone *et al* (2017)) also considers the impact of improved resolution arrangements. They use estimates from Homar and van Wijnbergen (2016) to model a reduction in the expected duration of crises from such arrangements. Overall, they find that optimal capital levels for the US banking system can range from 13% to 25%.

The costs of higher capital requirements

The costs of higher bank capital requirements arise from potentially tighter credit supply conditions. Banks may ad-

just to the need to fund themselves with more equity by tightening lending rates and restricting loan volumes. The LEI study assumed that each percentage point increase in the capital ratio would raise loan spreads by around 13 basis points. That translated into a fall in GDP of around 0.1% relative to trend[17].

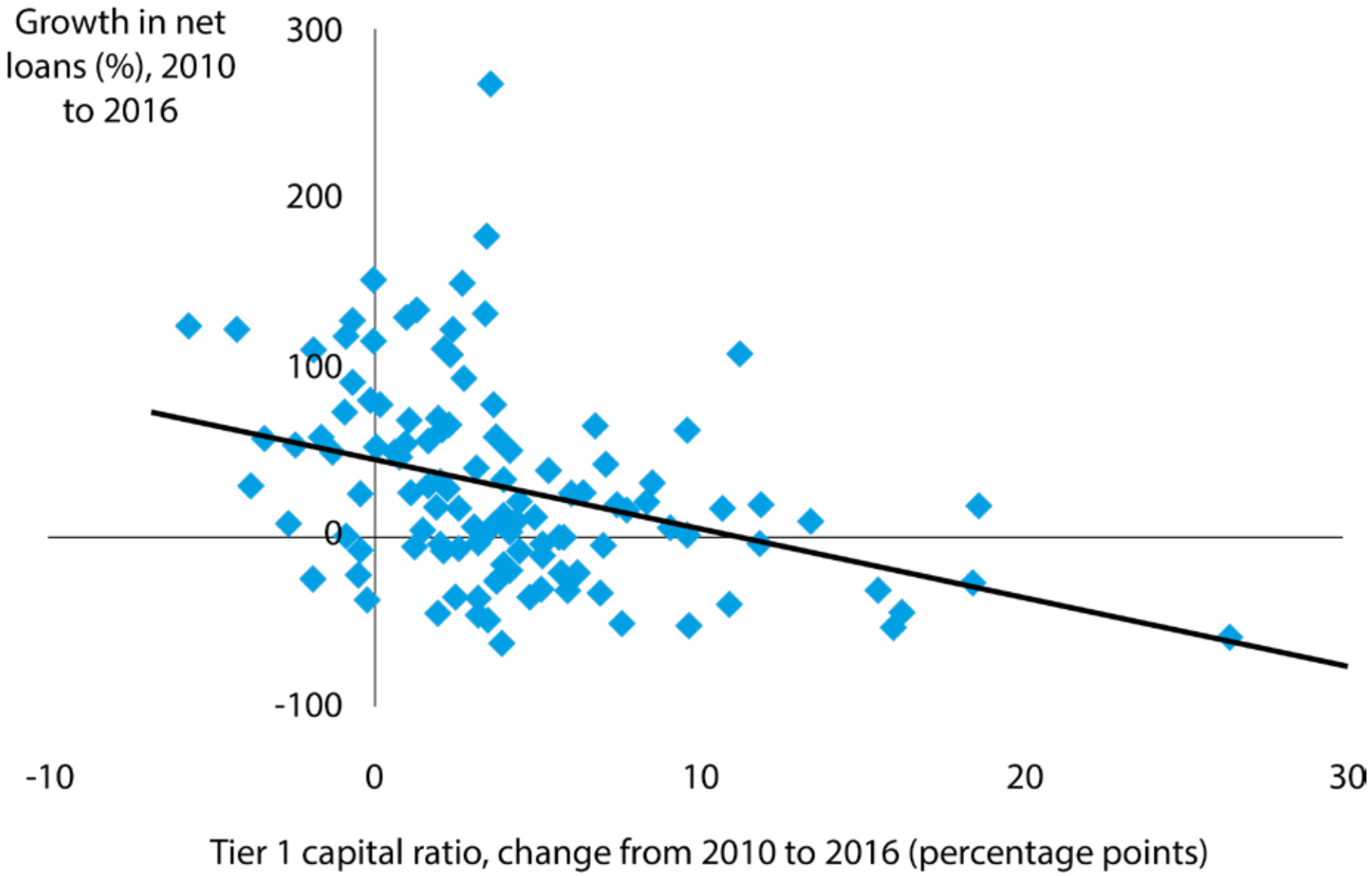
What have we learned about these costs since the LEI study? Cecchetti (2014) documents how banks have adjusted their balance sheets and credit provision since the introduction of Basel III. He finds that banks increased their capital ratios significantly, by over 4 percentage points on average, across his sample. Net interest margins and profitability fell. But with the exception of European banks, banks' assets increased, their lending spreads narrowed, lending standards eased, and the ratio of bank credit-to-GDP went up.

A recent paper from the BIS (Gambacorta and Shin (2016)) reaches a similar conclusion. It finds that banks with higher unweighted capital ratios have tended to have higher loan growth, with each one percentage point increase being associated with higher subsequent lending growth of 0.6 percentage points per year. This evidence is consistent with the macroeconomic costs of higher bank capital being lower than assumed in the Basel LEI study. Indeed, taken at face value, it would suggest there have been virtually no costs of achieving higher levels of capital across the global banking system, at least among most global banks.

While credit conditions have clearly improved since the crisis, it is possible that the recovery in lending might have been stronger still had capital requirements risen by less. To begin to analyse that question, Chart 16 compares the *change* in bank capital since Basel III was introduced with subsequent lending growth among a panel of large international banks. On average, lending growth has been positive over this period, consistent with Cecchetti (2014).

But credit growth has also tended to be statistically significantly lower among banks that have seen the largest increase in their capital ratios. On average, banks that have increased their capital ratios by an extra one percentage point have provided 4% less in cumulative credit since Basel III was introduced (3.5% less if we exclude European

Chart 16. Change in bank capital and lending growth, 2010-2016



Sources: S&P Capital IQ and Bank calculations.

banks). This is very similar to the estimates used by the FSB's Macroeconomic Assessment Group (2010), which reported a range of estimates from -0.7% to -3.6%.

There are of course different possible interpretations of this negative relationship. Banks facing weak macroeconomic conditions may simply have seen a reduction in loan demand and responded by maintaining higher capital buffers on a voluntary basis. To parse these conflicting interpretations, we turn to recent econometric evidence on the impact of higher capital requirements.

Aiyar *et al* (2014, 2016) find that shifts in required capital had large negative effects on UK banks' lending decisions. De-Ramon *et al* (2016) report a similar finding, noting that this has, if anything, increased since the crisis. Bahaj *et al* (2016) find that, in times of credit expansion, higher required capital has only a minimal effect on lending. But when credit growth is weak, higher required capital can result in a large reduction in lending. This echoes previous research which has found that banks reduce lending in response to negative capital shocks (Peek and Rosengren (1995)).

Lower lending was one cost of higher equity considered in the LEI study. A second potential cost, not considered by the LEI study, was the potential for falls in market liquidity in core financial markets - for example, securities financing markets such as repo. This could potentially raise the cost of capital for users of these markets. Market commentary in recent years has often laid the blame at the leverage ratio. This, it is argued, has led some dealer-banks to reduce their inventory holdings and market-making capacity, thereby reducing secondary market liquidity in some markets.

There are of course a variety of other reasons why banks' willingness to make markets, and why market liquidity more generally, might have been affected by the crisis – for example, reduced risk appetite and increased counter-

party risk. Moreover, it was plausibly the case that pre-crisis liquidity may have been too plentiful and too cheap in some financial markets, so some correction in the quantity and pricing of liquidity was to be expected, and indeed was potentially desirable, from a welfare perspective.

Research at the Bank of England has sought to identify the impact of leverage ratio requirements on the functioning of UK government bond ('gilt') and gilt repo markets, using transaction-level data (Bicu *et al* (forthcoming))[18]. It does find some causal impact of the leverage requirement on various metrics of liquidity, a worsening that is particularly acute at quarter-ends. Significantly, the banks most constrained by the leverage ratio reduced their activity in financial markets most.

At the same time, however, dealers unaffected by the leverage ratio requirement also reduced their liquidity provision and, if anything, by more. This suggests factors other than the leverage ratio may have been at work in curtailing liquidity in these markets. It also leaves open the question of whether the correction in liquidity, even if privately costly, came at any social cost. Baranova, Liu and Shakir (2017) assess the costs that could arise from regulation which affects market liquidity at different levels of stress. They find higher costs in benign conditions, but substantial benefits in situations of stress as dealers make markets for longer.

Overall implications for optimal capital

How do these research findings tilt the optimal bank capital calculus relative to the LEI study? Table 1 summarises the evidence. They are a mixed bag. On the benefits side, there is now stronger evidence on the costs of credit booms and the role of capital in constraining the severity of the downturn in the aftermath of these booms. It also suggests that the costs of raising extra capital are no larger, and may well be smaller, than originally anticipated. This strengthens the hand of macroprudential authorities when tightening capital requirements during a credit boom. Other things equal, it would also increase quantitative estimates of banks' optimal capital ratio.

On the other side of the ledger, the LEI study did not anticipate two factors. First, the role of TLAC in augmenting banks' capital base in situations of stress, potentially reducing the probability and severity of crises. Second, higher capital requirements could impose liquidity-related costs on the financial system, though their scale (and whether they are a social cost) remains open for debate. These arguments, in particular around resolution, have been used by policymakers in some countries, including the UK, when coming the view that capital requirements should be lower than in the original LEI study. For example, having assessed all the factors and evidence within Table 1, the Bank of England's Financial Policy Committee judged that the appropriate structural level of Tier 1 equity in the system would be 13 ½% of risk-weighted assets (Bank of England (2015c)).

The system of financial regulation

Regulatory reform has tended to progress crisis by crisis, market failure by market failure, regulatory standard by regulatory standard. This is not especially surprising, given the nature of the policy design process. Nonetheless, if we put together the various pieces of recent regulatory reform, we find a fundamentally different regulatory jigsaw, or system of financial regulation, than in the past.

One important dimension of that new architecture is the significantly larger number of regulatory rules or constraints that now operate. On top of risk-based capital standards have been added regulatory rules for liquidity, leverage and loss-absorbing capital. In other words, we have moved from a system of largely uni-polar regulation to multi-polar regulation (Haldane (2015)). Some individual parts of the regulatory rulebook - such as the use of internal ratings-based risk weights - also remain complex.

The new regulatory architecture has also introduced measures which are likely to make for a greater degree of regulatory discretion. The authorities in the US, UK and euro area have moved to annual stress-testing exercises in which the stress scenario, modelling framework, success criteria and regulatory response are each subject to significant

Table 1. Overall implications of research findings for optimal capital

	Impact on optimal capital
Benefits:	
Likelihood and severity of crises	⇧
Impact of capital on probability of crises	⇨
Impact of capital on severityof crises	⇧
Impact of TLAC and resolution regimes on probability and severity of crises	⇩
Costs:	
Impact of capital on credit conditions and growth	⇨
Impact of capital on market liquidity (leverage ratio) in normal conditions	⇩

degrees of regulatory discretion. Regulators internationally are also now setting a CCyB requirement, which is also set in a largely discretionary fashion.

In short, the new regulatory framework involves a larger number of regulatory constraints, many of which are individually complex, operating with a greater degree of regulatory discretion than in the past. Some have questioned whether this system may be too complex (for example, Admati and Hellwig (2011)). And some of the recent debate on regulatory reform in the US also raises those same concerns (US Department of the Treasury (2017)).

There are several different dimensions to regulatory complexity. Much has already been written on the complexity of individual rules or regulatory constraints and the associated potential for regulatory arbitrage (Haldane and Madouros (2012), Aikman *et al* (2014), Behn, Haselmann, and Vig (2016)). The Basel Committee's Task Force on Simplicity and Transparency are looking into these questions at a practical level. We do not explore those issues further here.

Instead, we focus on two other dimensions of the system of financial regulation: (i) the number of regulatory constraints; and (ii) the extent of discretion around each individual regulatory rule.

(i) The number of regulatory constraints

Although the post-crisis architecture places many regulatory constraints on banks, the key going-concern constraints are risk-weighted capital requirements (RWCR), the leverage ratio (LR), the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). We assess these four constraints, recognising that other aspects of the regulatory system might also impose binding constraints on banks. For example, stress testing can be interpreted as holding banks to a different RWCR standard and a potentially different overall capital calibration (Greenwood et al (2017)).

Some have recently contended that this multi-constraint system of financial regulation might be over-identified, with potentially distortionary implications for banks' business models and behaviour. For example, Greenwood et al (2017) argue that it may be distortionary and unnecessary to have multiple, independent constraints on banks' behaviour. And Cecchetti and Kashyap (2016) suggest that the LCR and NSFR are strongly overlapping in their impact, so that both may not be needed.

These are well-reasoned critiques of the new regulatory framework whose messages should be analysed carefully when evaluating the new framework. They are just the sort of academic challenge to regulatory orthodoxy which was so missing in the pre-crisis period. Nonetheless, it is also worth reminding ourselves why and how such a multiple-constraint framework was arrived at in the first place. At a conceptual level, three arguments could be used to justify such a multi-pronged approach.

First, banks are subject to multiple sources of risk or balance sheet fault-line. Historical experience suggests they fail for a variety of different reasons. To misquote Tolstoy, while sound banks tend all to be alike, unsound banks tend to be unsound in their own way. At least in principle, this could point to the need for different types of regulatory constraint to counter different balance sheet fault-lines: one instrument for each market failure. This is, if you like, the Tinbergen Rule as it applies to financial regulation (Tinbergen (1952)).

Second, uncertainty as well as risk is pervasive in the financial system. These Knightian (1921) uncertainties have multiple sources - measurement of the risks banks face, how contagion propagates across the financial system and how regulatory actions affects behaviour, to name but three. A portfolio of regulatory tools can be seen as a means of offering insurance against these uncertainties. This is, if you like, the Brainard Rule as it applies to financial regulation (Brainard (1967)).

Third, any individual regulatory constraint creates incentives for banks to respond in ways which may seek to avoid or arbitrage the rules. In the next section, we discuss how having multiple regulatory constraints might mitigate this risk. In this section, we discuss the conceptual case for multiple regulatory constraints before presenting some new empirical evidence. Table 2 summarises some of the key arguments.

Capital and leverage

The objective of the capital framework is to ensure banks have sufficient capital to absorb unexpected losses and continue lending in situations of stress. RWCRs oblige banks to assign granular risk weights to their assets. If true risk of an asset can be estimated accurately – it is a 'known known' - then the RWCR is typically better suited than the LR to guarding against solvency risk (Gordy (2003)). Greenwood *et al* (2017) conclude *"the social optimum can be implemented with a single requirement that each bank maintain a sufficient ratio of equity to risk-weighted assets, provided the risk weights are chosen appropriately".*

The last part of this sentence is, however, an important proviso. One key question is whether risks in the financial system are likely to be known with sufficient certainty that they can be estimated meaningfully and accurately. Based on historical experience, that assumption cannot be taken for granted when it comes to estimating financial risks. As discussed by Aikman *et al* (2014), there are at least three reasons for this.

First, assigning probabilities is particularly difficult with rare, high-impact events, such as financial crises or the failure of a large financial institution. Degrees of freedom are small in number, historical precedents rarely exact and causal mechanisms imperfectly understood. This means estimated default probabilities, and losses given default, are often highly imprecise. Indeed, that is (one reason) why model-based estimates of the same underlying risks can differ so significantly across banks (BCBS (2014a)).

Table 2. Assessment of the relative suitability of Basel III standards to address selected forms of risk

Risk	First Best Mitigant	Second Best Mitigant	Less Effective Mitigants
Microprudential solvency risk – 'true' asset risk	**RWCR:** Requires loss absorbing capital to cover solvency risks. If risk can be measured and risk weights can be chosen appropriately, this allows for the greatest level of granularity.	**LR:** Provides loss absorbing capacity but does not include any risk granularity by design.	**LCR & NSFR:** Neither ratio attempts to mitigate the risk of losses.
Microprudential solvency risk – 'unknown' asset risk under Knightian uncertainty	**LR:** Effective when risks are unknowable and cannot pinpoint particular asset classes of concern, especially in the face of limited historical data or fat- tailed loss distributions.	**RWCR:** Provides loss absorbing capacity but may perform less well out-of-sample and vulnerable to model risk (IRB approach) or miscalibration of risk weights (standardised approach).	**LCR & NSFR:** Neither ratio attempts to mitigate the risk of losses.
Vulnerability to risk shifting arbitrage	**RWCR:** High degree of granularity reduces the scope for risk-shifting	**LCR & NSFR:** Standardised assumptions mitigate some scope to shift risk but also allow some scope for distortion if weights are miscalibrated.	**LR:** Greatest scope for distortion through risk shifting because of lack of risk sensitivity.
Vulnerability to gaming	**LR:** Lack of granularity and degrees of freedom minimises gaming opportunities.	**LCR and NSFR:** Small number of modelled assumptions offer some safeguard against gaming.	**RWCR:** High degree of freedom offered to banks increases incentives for gaming, especially under IRB approach.

Table 2. Assessment of the relative suitability of Basel III standards to address selected forms of risk *cont*.

Risk	First Best Mitigant	Second Best Mitigant	Less Effective Mitigants
Rapid and unsustainable balance sheet expansion	**RWCR:** Requires banks to raise capital to support credit creation, regardless of asset composition.	**NSFR:** Limits reliance on short and medium- term wholesale funding to support balance sheet expansion.	**RWCR:** Susceptible to expansion into assets with low measured risk. Places no constraint on debt funding. **LCR:** 30-day time horizon only limits the expansion funded by very short-term liabilities.
Sudden withdrawal of funding due to firm-specific or short-lived market-wide loss of credibility	**LCR:** Assures available buffer of liquid assets to meet immediate outflows enabling survival of first stages of run/ preparation for resolution if appropriate.	**NSFR:** Reduces runnable fraction of liabilities, thus decreases ex-ante risk of being exposed to a run, but does not directly ensure bank has a buffer of usable short- term liquidity.	**RWCR & LR:** Higher capital should in principle help banks retain funding, but does not provide a cushion if a run occurs.
Sustained loss of funding due to market-wide liquidity stress leading to slow- burn insolvency	**NSFR:** Matches liquidity of assets against stability of liabilities to ensure bank is broadly resilient to a medium-term funding run.	**LCR:** Assures available buffer of liquid assets to meet immediate outflows, but not that maturity transformation is sustainable beyond 30-day horizon.	R**WCR & LR:** Require small fraction of liabilities to be non-runnable equity but a small amount relative to illiquid assets.
Crystallisation of systemic liquidity risk leading to a fire sales, liquidity hoarding, and/or a contraction in lending	**NSFR:** Reduces banks' vulnerability to medium- term liquidity risks and hence the probability of them being required to deleverage rapidly in periods of stress to shore up their liquidity position.	**LCR:** Reduces reliance on the most unstable short-dated liabilities. Risk that banks liquidating buffers to meet outflows in a stress could exacerbate a fire sale.	**RWCR & LR:** Do not directly mitigate the likelihood of deleveraging due to liquidity problems.

Second, the behaviour of complex, interconnected financial systems can be very sensitive to small changes in initial conditions and shocks. That might be because these systems exhibit multiple equilibria, with path-dependency or hysteresis. Or it may reflect network feedback effects propagating financial contagion. Complex systems exhibit tipping points, with small changes in parameter values capable of moving the system from stability to collapse (Anderson and May (1992), Gai and Kapadia (2010), Gai, Haldane and Kapadia (2011)). In complex webs, the failure of two identical-looking banks can have very different implications for financial system stability. The radical uncertainty in such complex webs generates emergent behaviour which can be near-impossible to predict, model and estimate (Haldane (2016)).

Third, because they contain human actors whose beliefs about the future shape their behaviour today, financial systems are particularly prone to instabilities and sunspots. If financial market participants are driven by crowd psychology, emotion and narratives, as much as by economic fundamentals and rational calculation, then risks are unlikely to be well captured by standard models (Tuckett and Taffler (2008), Tuckett (2011), Shiller (2017), Bailey *et al* (2016)). These risks are likely to be highly non-linear, heavily state and time-dependent and thus significantly fat-tailed.

In a world of such Knightian uncertainty, it may be difficult to estimate risk weights on individual assets with any degree of precision. Indeed, attempts to do so may result in 'over-fitting', increasing the potential fragility of these model estimates out-of-sample. In uncertain settings, simpler weighting schemes have been found, in a variety of different environments, to offer a better defence against 'unknown unknowns' (Gigerenzer (2014)). For example, a 1/N or unweighted asset allocation heuristic (Benartzi and Thaler (2001)), which allocates an equal amount of wealth to each of the assets in one's portfolio, has been found to outperform more complex strategies such as Markowitz's (1952) mean-variance optimisation in out-of-sample tests, unless the sample size is very large[19]. That

logic is one rationale for the use - and, in some settings, predictive superiority – of the LR in capturing solvency risks. It is a variation of the Brainard (1967) portfolio argument.

In this vein, Aikman et al (2014) conduct simulations which demonstrate how simple methods, akin to a leverage ratio, can sometimes dominate complex, risk-weighted approaches to calculating banks' capital requirements when guarding against solvency problems out of sample. This is more likely when the underlying risks are themselves fat-tailed. While complex approaches can appear to perform better in-sample, simpler approaches may be more robust to out-of-sample structural shifts and fat tails, the like of which we have seen in past financial crises, from railways in the 19th century to subprime mortgages in the 21st.This problem is not unique to banks. Stress tests can reduce reliance on banks' own models. But they then still rely on regulators' risk models, which may be vulnerable to similar issues, especially if they are formulated in an excessively granular manner (Hale *et al* (2015)).

Liquidity and funding

Historically, most banks failures are precipitated by insufficient liquidity. Due to maturity transformation, banks are vulnerable to a sudden withdrawal of funding due to bank-specific or market-wide losses of credibility. In such circumstances, banks will be more robust if they have a buffer of high-quality liquid assets allowing them to meet outflows, survive the first stages of a bank run and, if necessary, giving the authorities time to prepare for resolution. The Basel III LCR was designed and calibrated with these considerations in mind.

But excessive maturity transformation can also create risks over longer horizons. This highlights the importance of funding metrics which consider the overall extent to which illiquid assets are supported by unstable sources of funding. If banks are running a high degree of structural maturity transformation, this increases the risk of failure. While one could envisage a range of possible structural funding metrics, including a loan-to-deposit ratio, the Basel III NSFR is designed with these risks in mind.

The NSFR speaks directly to a market failure that arises from a market-wide loss of wholesale funding, the like of which was exhibited during the crisis. In this way, it may potentially reduce the probability of damaging asset fire-sales, liquidity hoarding and contractions in lending which may otherwise result. The NSFR is also likely to complement the leverage ratio in acting as a brake on too-rapid balance sheet expansion. The leverage ratio ensures that any such expansion is supported by higher capital. The NSFR ensures any such expansion is supported by more stable funding sources.

None of this is to suggest that these risks could not be met with a different, and perhaps smaller, set of regulatory constraints. Cecchetti and Kashyap (2016) have recently argued that the LCR or NSFR may be redundant as one of the constraints is always slack in their simplified bank balance sheet model. Put differently, the existing system of financial regulation may be over-identified. On the other hand, the horizon for assessing banks' liquidity risk may matter. In particular, the LCR and NSFR may complement each other to the extent there are differences in asset liquidity and funding stability at different maturities and that these differences evolve over the cycle.

An empirical assessment of regulatory metrics

There are conceptual reasons why a portfolio approach to regulatory design, with a small, complementary set of constraints, may have merit in a robust control sense: addressing the different risks facing financial institutions and providing insurance against various uncertainties. Ultimately, however, the extent of over-identification, and any costs it might impose, will depend on the empirical distribution of shocks to banks and the state of their balance sheets at the time. To that we now turn, based on crisis experience.

Any counter-factual empirical exercise is subject to huge caveats. Nonetheless, it is revealing to consider experience during the crisis to see what this revealed about the risks banks faced and how different regulatory constraints might have handled them. For example, recent research has found the leverage ratio and structural funding metrics

performed well in predicting bank failure during the crisis (Huang and Ratnovski (2009), Demirguc-Kunt *et al* (2010), Bologna (2011), Arjani and Paulin (2013), Vazquez and Federico (2015)). And Lallour and Mio (2016) find that the NSFR had significant discriminatory power in identifying failing banks during the crisis, after controlling for banks' solvency ratios.

This line of research typically deploys regression approaches which weight together the information across different indicators. Here we adopt a somewhat different approach. Specifically, we consider how effective various combinations of regulatory constraints would have had been in identifying banks which subsequently failed during the crisis (the 'hit rate'), while at the same time avoiding incorrectly signalling stress among banks which survived (the 'false alarm rate').

To do this, we exploit a dataset on the pre-crisis balance sheet characteristics of global banks developed by Aikman *et al* (2014). The dataset includes almost all global banks which had more than $100 billion in assets at end-2006 – 116 banks in total across 25 countries. A range of balance sheet metrics are proxied at consolidated (group) level for each of these banks at end-2006. Restricting attention to those banks for which data are available to compute all of risk-weighted capital ratios, leverage ratios and NSFRs reduces the sample to 76 banks. If we focus on risk-weighted capital ratios, leverage ratios and loan-to-deposit (LTD) ratios (as a simplified proxy for the NSFR which captures the ratio of retail loans to retail deposits) the sample size is 96 banks[20].

These banks can be divided into those that 'survived' and those that 'failed' between 2007 and the end of 2009. The definition and classification of failure follows Laeven and Valencia (2010), supplemented by additional judgement in a few instances[21]. To fix ideas, suppose that banks are subject to a single regulatory metric – the leverage ratio. And using this metric, suppose that we set a cut-off threshold consistent with a particular calibration of that regulatory standard – a leverage ratio of 3%.

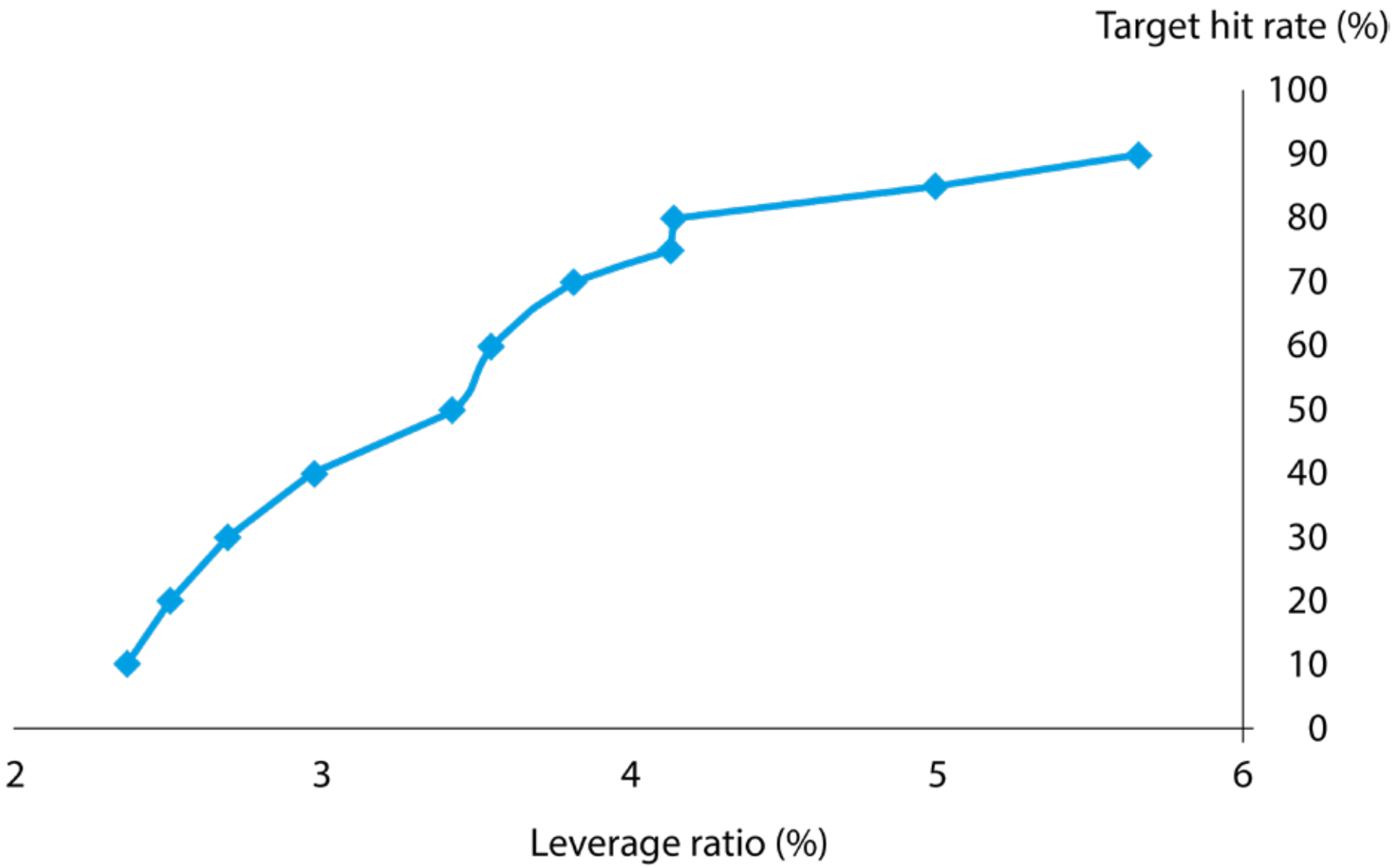
One can identify banks which operated below that standard at a point in time. We define the 'hit rate' as the number of banks which had a leverage ratio below 3% at the end of 2006 and subsequently failed during the crisis, relative to the total number of banks that failed. And we define the 'false alarm rate' as the number of banks with a leverage ratio below 3% which survived, relative to the total number of banks that survived. If a 3% leverage ratio could perfectly discriminate, its hit rate would be 100% and false alarm rate 0%.

Now suppose that we have flexibility over the cut-off threshold necessary to achieve a particular hit rate, x. At the same time, we wish to minimise false alarms. As the leverage ratio cut-off increases, the hit rate and false alarm rate must both go up. The key question is by how much each goes up – the relative balance of marginal benefits and marginal costs of hits and false alarms – as the leverage ratio cut-off increases.

Charts 17 and 18 plot this for the 76-bank sample. Chart 17 plots the settings of the leverage ratio needed to achieve particular target hit rates. Chart 18, meanwhile, plots what is referred to as the 'receiver operating characteristic' (ROC) curve. Using the sequence of cut-off thresholds for the leverage ratio from Chart 17, this plots the sequence of associated hit rates and corresponding false alarm rates at different settings of the leverage ratio, alongside the 45 degree line which corresponds to the performance of a completely uninformative metric.

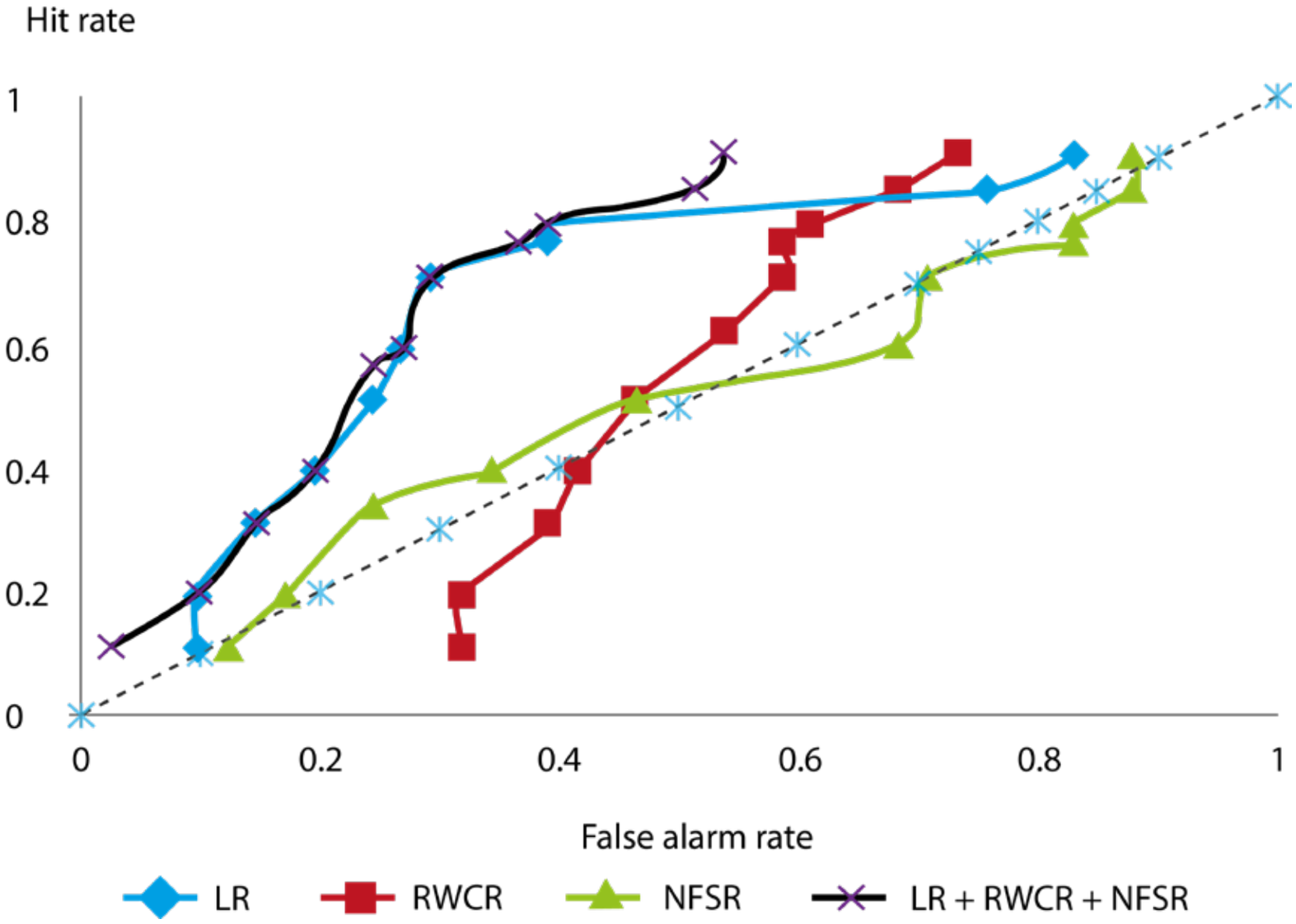
Two points are clear from these charts. First, it is possible to achieve relatively high hit rates of up to 70% at relatively modest calibrations of the leverage ratio of under 4% and with relatively low false alarm rates of around 30%. This suggests that, with the benefit of hindsight and abstracting from definitional changes which affect the interpretation of specific numbers, a leverage ratio of around 4% before the crisis would not have been met by around 70% of banks which subsequently ended up failing. It served as a decent signal of subsequent failure.

Chart 17. Leverage ratio as a function of the target hit rate



Sources: Buckmann, M, Kapadia, S, Kothiyal, A and Bank calculations.

Chart 18. Receiver operating characteristic (ROC) curves for individual and combined regulatory tools (76 bank sample with NSFR)



Sources: Buckmann, M, Kapadia, S, Kothiyal, A and Bank calculations.

Clearly, such banks might still have failed during the crisis even with a leverage ratio of above 4%. But the low false alarm rate at that calibration, corresponding to the observation that most banks which survived the crisis had a leverage ratio of above 4% going into it, indicates that such a constraint may have helped to curtail their risk-taking, as measured by their leverage ratio, and reduced their likelihood of failure.

Second, to achieve high hit rates of above 80%, both the calibration of the leverage ratio and the false alarm rate increase sharply. Achieving a 90% hit rate with a leverage ratio alone requires its calibration to be boosted to around 5.7%. Even then, it comes at the cost of a high false alarm rate of over 80%. In other words, the balance of marginal benefits to costs becomes notably less positive when using a singular instrument if policymakers have a low tolerance for failure. That matters if, for example, the costs of higher capital requirements increase non-linearly (Greenwood *et al* (2017)).

These points are also evident if we assess individually the performance of the RWCR and NSFR. Chart 18 and Table 3 below show that hit rates of 80 or 90% can only be achieved with high false alarm rates and stringent calibrations of these metrics. Overall, each metric individually does somewhat worse than the leverage ratio in balancing hit and false alarm rates. And similar results hold when the loan to deposit (LTD) ratio is considered instead of the NSFR in the wider sample (Chart 19).

Now suppose that the regulator can draw on more than one regulatory metric – for example, a LR, RWCR and NFSR. This now requires the setting of three cut-off thresholds and so gives more degrees of freedom. But the objective otherwise remains the same, namely achieving a particular hit rate for signalling bank failures while minimising false alarms. Chart 18 and Table 4 show the results from these multi-constraint simulations.

At a target hit rate of 70%, a portfolio of regulatory measures does little better than the leverage ratio on its own in signalling bank stress. At targeted hit rates of over 80%, however, that picture changes. The ROC curve for the

Table 3. Target hit rate, calibration of individual regulatory tools and resulting false alarm rate

Target Hit Rate (%)	LR Calibration	False Alarm Rate for LR Calibration (%)	RWCR Calibration	False Alarm Rate for RWCR Calibration (%)	NSFR Calibration	False Alarm Rate for NSFR Calibration (%)
70	3.82	29.3	8.61	58.5	0.99	70.7
75	4.14	39.0	8.66	58.5	1.05	82.9
80	4.15	39.0	8.71	61.0	1.06	82.9
85	5.00	75.6	9.04	68.3	1.12	87.8
90	5.66	82.9	9.83	73.2	1.17	87.8

Table 4. Target hit rate, calibration of individual and combined regulatory tools and resulting false alarm rate

Target Hit Rate (%)	LR Calibration	RWCR Calibration	NSFR Calibration	False Alarm Rate for Combined Regulation (%)
70	3.82	5.52	0.63	29.3
75	3.80	5.52	0.72	36.6
80	4.15	5.52	0.63	39.0
85	3.71	5.52	0.83	51.2
90	4.07	5.53	0.83	53.7

regulatory portfolio lies to the left of all those corresponding to individual metrics. In other words, it is possible to achieve lower false alarm rates, for the same hit rate, when multiple regulatory metrics are used. The calibration of each metric in the portfolio is also less stringent than the calibration for each metric individually.

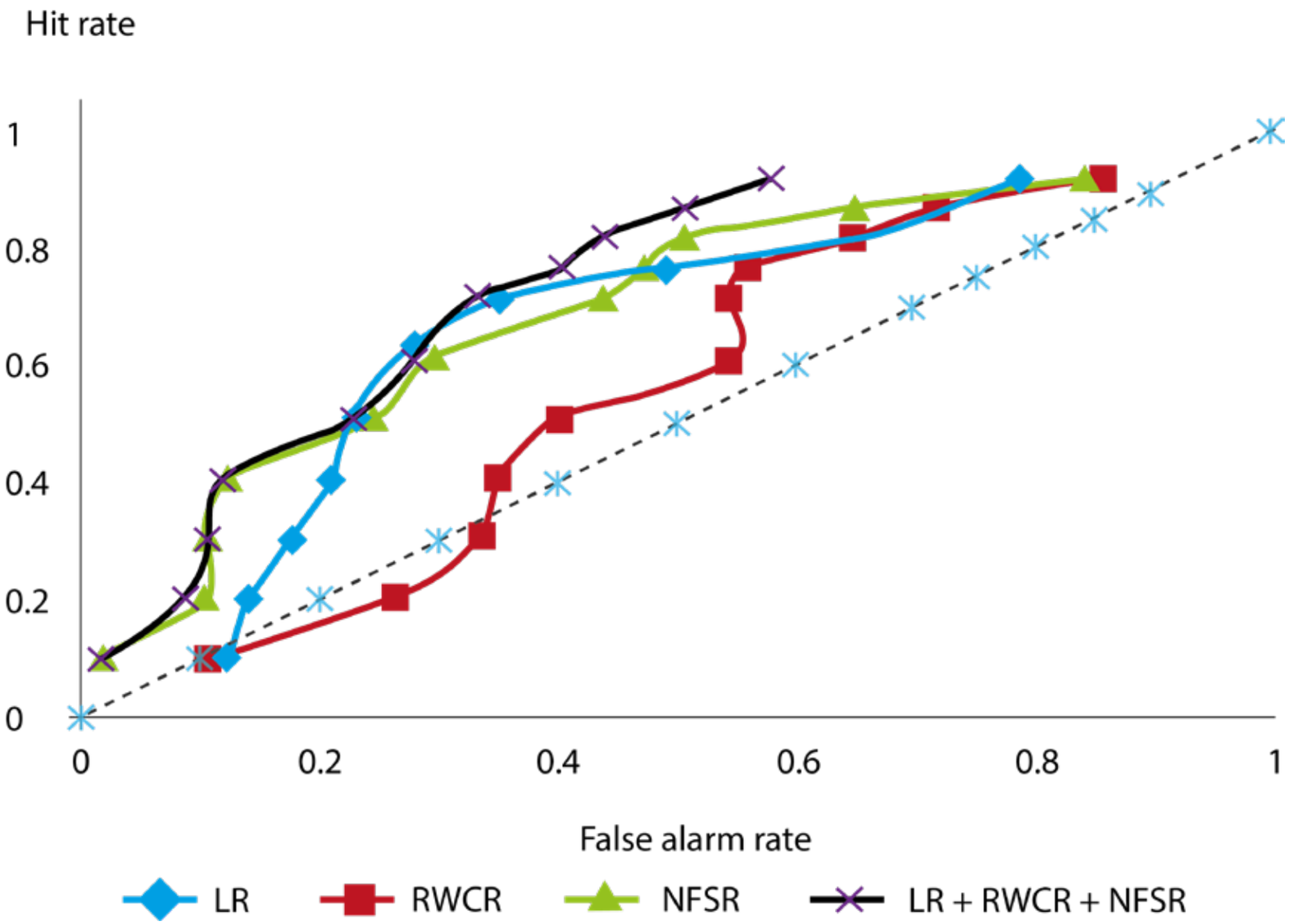
These results hold when comparing any pair of regulatory metrics with individual metrics – a higher hit rate per false alarm rate, with less stringent calibrations. It also holds even more strongly in the wider 96-bank sample when the LTD ratio is considered instead of the NSFR (Chart 19). This suggests that, at least in this sample, imposing a small number of regulatory constraints can achieve the same hit rate as any singular constraint, but at a materially lower societal and regulatory cost, as measured by levels of capital and liquidity and/or regulatory false alarms.

Intuitively, these results broadly accord with the conceptual discussion. A regulatory portfolio can help when insuring against multiple sources of risk and myriad sources of uncertainty. It also accords with what we know from various individual case studies of bank failure during the global financial crisis: some banks failed because they were over-leveraged, others because their assets were excessively risky, others still because they undertook too much maturity transformation.

Because these fault-lines were, for some banks, reasonably well-correlated – their risk management was poor across all dimensions – individual regulatory metrics performed fairly well in identifying these banks prior to them failing. But some banks' risk-management failings were singular, not plural. Their risk blind-spots were idiosyncratic and uncorrelated. By using a portfolio of regulatory stress metrics, it is possible to isolate those banks which were risk-management outliers in one, but not all, dimensions.

Consider two very different banks which failed during the global financial crisis. American bank Countrywide had a leverage ratio of 7.7% and a risk-weighted capital ratio of 11.6% at the end of 2006. Even if capital regulation had

Chart 19. ROC curves for individual and combined regulatory tools (96 bank sample with LTD)



Sources: Buckmann, M, Kapadia, S, Kothiyal, A and Bank calculations.

been much tougher in 2006, it may not have been required to raise capital. But its NSFR was just 0.76, indicative of the structural liquidity risk it was undertaking. By including the NSFR in the suite of regulatory metrics, it would have been possible to capture the risks that Countrywide was undertaking without resorting to materially more stringent capital regulation.

By contrast, Belgian bank KBC Group had an NSFR of 1.12, above the current indicative regulatory standard. For that time, it also had a reasonable risk-weighted capital ratio of 8.7%, well above the median capital ratio in the sample. But its leverage ratio was 3.5%. A system of regulation excluding the leverage ratio would have been unable to capture risks of the type KBC Group was undertaking prior to the crisis.

The message from this counterfactual exercise, for all its obvious imperfections, is that multiple regulatory metrics may have helped historically in capturing the multiple dimensions of risk and uncertainty exhibited by banks pre-crisis. With the benefit of hindsight, multiple metrics would have helped identify most failing banks, without either high false alarm rates or potentially punitive calibrations of regulatory standards. While the exercise is based solely on survival and failure of banks during the global financial crisis, it highlights how a small regulatory portfolio beats, counterfactually, a single stock in (systemic) risk and (capital) return terms.

As Greenwood *et al* (2017) argue, multiple regulatory constraints come at a cost by curtailing business models and thus reducing diversity in the financial system. Excessive homogeneity of the financial system can create systemic risks (Haldane (2009a), Wagner (2010)). How much it does so is, however, a matter of degree. If regulatory constraints act as control bounds on structurally defective business models, that strengthens the financial system, even if (indeed, precisely because) it constrains diversity. Empirical evidence suggests this latter effect dominated during the recent crisis.

(ii) Discretion versus rules

The new architecture has introduced measures which are likely to make for a greater degree of supervisory or policymaker discretion in the setting of regulatory standards. This arises, most obviously, in the application of supervisory judgement to certain risks that banks face, to stress-testing and to macroprudential policy. Multiple regulatory rules have been augmented with considerable supervisory discretion. Viewed in the round, this new regulatory regime could reasonably be described as 'constrained discretion'. Regulatory rules provide the constraint within which policymakers exercise discretion.

In its broad contours, this new regulatory framework has some similarities with the prevailing monetary policy framework in a number of countries (Bernanke and Mishkin (1997)). These regimes have been found to be an effective way of balancing the pre-commitment necessary to avoid policy time-consistency problems with the flexibility necessary to respond to unforeseen circumstances (Arestis and Mihailov (2009), Borio (2010)). Equally, as in the monetary policy sphere, there is a question about whether this new regulatory regime strikes the right balance between regulatory rules and the degree of discretion with which they are operated. The time-inconsistency problem that pervades the debate over the balance between rules and discretion in monetary policy (Kydland and Prescott (1977), Barro and Gordon (1983)) is arguably even more acute for prudential policy.

This is partly because adverse crisis outcomes are highly non-linear and costly, making it more difficult to pre-commit to avoiding forbearance and bail-out. The low probability of crises may also mean that policymakers are insufficiently tough in tackling financial sector risks when times are good and memories of previous crises distant (Reinhart and Rogoff (2009), Malmendier and Nagel (2011), Gennaioli *et al* (2015)). This can create political pressures to relax regulations to support shorter-term goals.

Public choice theory (Olson (1965)) would also suggest that lobbying pressure is likely to be more acute for regulatory policy than for monetary policy. The private costs of regulation are borne strongly by narrow, but powerful,

interest groups in the financial industry. And while higher than target inflation is quickly observable, it may be very difficult to judge in real time that regulation is insufficiently stringent given the difficulties of quantifying the probability of future financial crises.

These arguments point to the need for strong institutional frameworks, supported by clear mandates, objectives and instruments, to deliver financial stability policy. Indeed, on conceptual grounds, the need for such a framework appears to be at least as strong, if not stronger, than for monetary policy. They also support the case for clarity in the *application* of these regulatory policies.

Not least given its newness, there may be further to go clarifying the motivation behind macroprudential interventions and the circumstances which might justify different macroprudential instruments - in short, in defining and refining the macroprudential policy reaction function. The UK's Financial Policy Committee has made some progress in this area, most notably in setting out its strategy for using the countercyclical capital buffer (Bank of England (2016a)). A discussion of the principles underlying the UK's approach to macroprudential policy can be found in Brazier (2017a).

The benefits of pursuing this path are clear from monetary policy experience (Brazier (2015)). Increasing the predictability of policy can enhance the ex-ante signalling and expectations channels of regulatory policy, as has been achieved in relation to monetary policy (Bernanke and Mishkin (1997)). It enhances ex-post accountability to stakeholders, political and societal. And it reduces the potential behavioural biases otherwise associated with discretionary decision-making and which have been found in the past to affect discretionary regulatory policy, including regulatory capture (Dal Bó (2006)) and defensive decision-making (Gigerenzer (2014)).

At the same time, there is clearly a balance to be struck. As Greenwood *et al* (2017) argue, strict rules-based systems are likely to be arbitraged and exploited by banks. For example, recent theoretical work and experimental evidence

suggests remuneration contracts can be restructured to recreate the excessive risk-taking incentives that new rules seek to reduce (Thanassoulis and Tanaka (2017), Harris *et al* (forthcoming)).

These arguments make it difficult to specify strict regulatory rules for all seasons. They point to the need for a forward-looking, horizon scanning approach with scope for supervisory judgement and macroprudential discretion (BCBS (2017)). This does not, however, obviate the potential benefits from seeking, over time, to specify clearer mandates and regulatory reaction functions, especially on the macroprudential front.

Incentives and arbitrage

The empirical exercise in the previous section looked at how a set of regulatory standards, applied counterfactually, might have done in spotting stress among a set of banks. Plainly, any such counterfactual exercise is subject to significant caveats. The most important of these is that it cannot take account of how changes in the regulatory regime might themselves have reshaped risk-taking incentives at the time. This Lucas Critique plainly looms large in the field of financial regulation.

Financial regulation, like any tax, is very likely to change the behaviour of the party subject to it. This is neither surprising nor, necessarily, undesirable. Indeed, sometimes it is the precise purpose of the regulation in the first place. For example, average risk weights on assets held in the trading book have increased by 45% across a sample of major UK banks between 2006 and 2013. Partly in response, trading books have shrunk by, on average, 24% across these banks and by 45% across the world's G-SIBs. This was an intended, and probably desirable, behavioural response to a necessary recalibration of regulatory standards.

That is not to say, however, that all behavioural adjustments are either exactly as intended or desirable. This is particularly the case when these responses seek to avoid regulation entirely – so-called regulatory arbitrage. Risk, like

energy, does not disappear into the ether. It is typically conserved, at least to some degree. In response to tighter financial regulation, risk is likely to change shape or location, often both.

This is not just a conceptual point. The history of financial regulation can be seen as an on-going, evolutionary race to adjust regulatory rules to limit avoidance incentives (Haldane (2013)). The first Basel Accord ('Basel I') was a direct response to cross-border regulatory arbitrage. Basel II came largely as the result of standardised approaches to risk measurement being arbitraged. And Basel III came in part as a response to both risk models, and the Basel framework itself, being arbitraged. This race has been characterised as *"bloodhounds in pursuit of greyhounds"* (Eichengreen (2009)). Regulators need both to learn from past experience and to anticipate future opportunities for avoidance (Woods (2017)).

The arbitrage problems faced by the bloodhounds were well-exemplified in the run-up to the global financial crisis. These included the migration of activity and risk to unregulated 'shadow banks' (Adrian and Ashcraft (2012)); the hard-wiring of rating agency risk assessments into the regulatory engine (Edmonds (2016)); the payment of bank CEOs in common equity encouraging 'gambling for resurrection' (IMF (2014)); and the implicit subsidies conferred on 'too-big-to-fail' institutions, encouraging them to become larger and more complex and connected still (FSB (2013b)).

Another example of these incentive effects came in the area of capital regulation. Whichever risk-weighting scheme is in place, it is likely to give rise to incentives to adjust asset positions to maximise profits. For example, if the regulatory constraint takes the form of a leverage ratio there are incentives to alter the composition of assets towards those with higher risk weights – though the evidence on such 'risk-shifting' is mixed (Sheldon (1996), Furlong (1988)). Contrarily, if assets are risk-weighted and determined by banks' internal models, there are incentives to lower modelled risk weights over time (Mariathasan and Merrouche (2014)). In short, when setting capital standards for banks, there is a *two-sided* incentive problem.

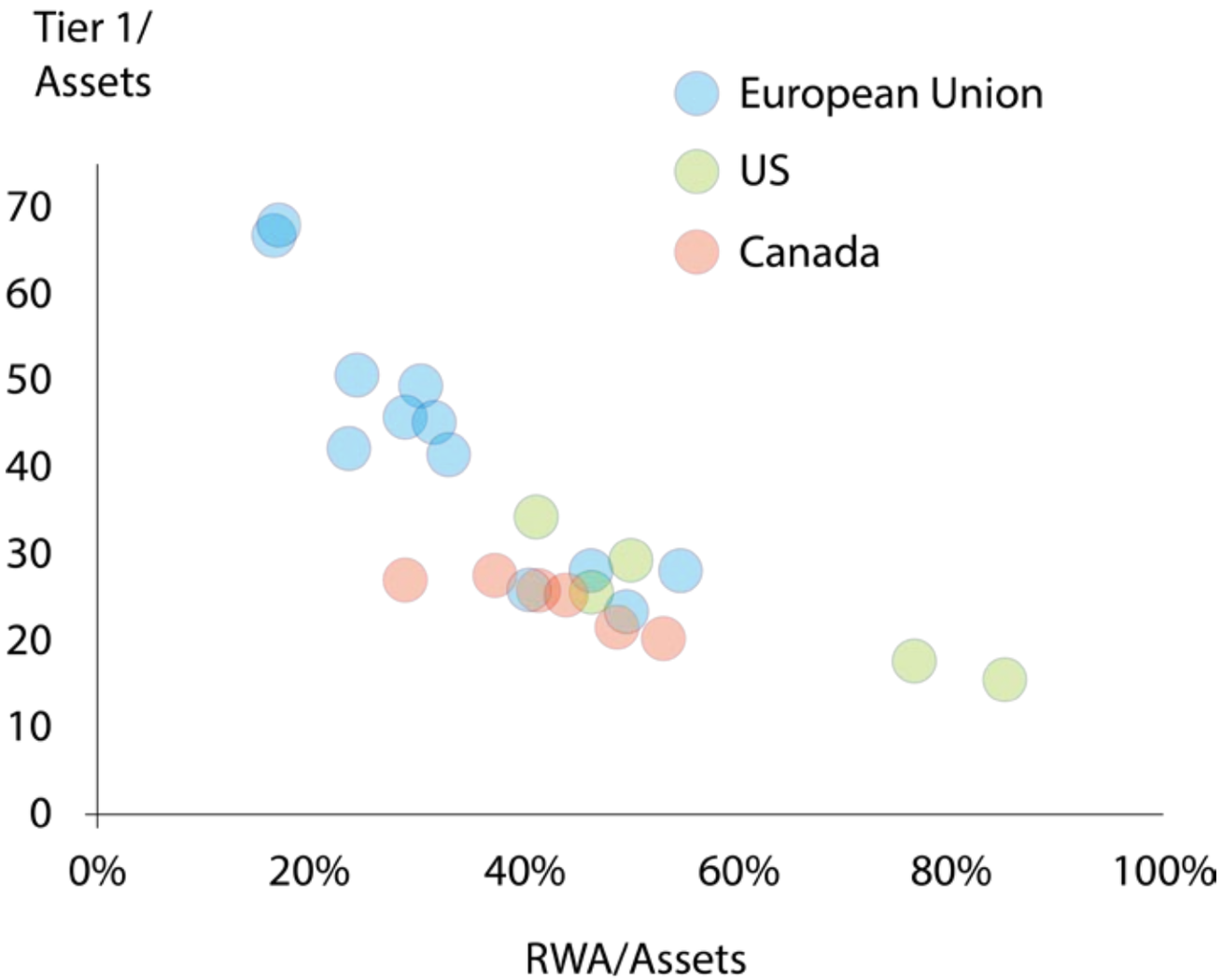
Pre-crisis, both incentives were at play, albeit to differing degrees in different parts of the global financial system. In the US, where a leverage ratio was in operation and often the binding constraint, there were incentives for banks to seek higher-risk assets rather than expand balance sheets (Chart 20). In Europe, without a leverage ratio but with risk-based capital standards, there were incentives for banks to expand balance sheets and shade downwards risk weights. Canadian banks' incentives sat somewhere in between.

Some recent studies have looked at these behavioural shifts in greater detail. During the euro-area crisis, banks increased their exposure toward higher risk government bonds, which carried no capital requirement (Acharya and Steffen (2015)). And following the Lehman crisis, German banks reduced their corporate lending less when the capital requirement was set under the standardised approach (Behn, Haselmann, Wachtel (2016)). In the UK, higher risk mortgages shifted towards lenders whose capital requirements were less risk-sensitive after the introduction of Basel II (Benetton *et al* (2017)).

Recent research has considered how the leverage ratio announcement affected behaviour among a panel of over 650 European banks (Acosta-Smith *et al* (2017)). It finds a significant increase in risk-taking among those banks for whom the new regime was a binding constraint. This risk-taking was greater, the further these banks were from meeting the new 3% threshold: banks with leverage ratios of 1.5%, 2% and 2.5% were found to increase their risk-taking by 3.4, 2.3 and 1.1 percentage points of risk-weighted assets respectively. This is clear empirical evidence of the risk-shifting channel at work.

This is only, however, one side of the risk equation. There were two mitigating factors on the other side. First, a rise in the leverage ratio also boosts these banks' capital. Once translated into default probabilities, Acosta-Smith et al (2017) find that the second effect swamps the first: a one percentage point rise in the leverage ratio raises the odds

Chart 20. Average 2007 risk weights, leverage and capital ratios of major EU, US and Canadian banks(a)(b)



Sources: Bloomberg, FDIC, annual reports.
(a) Data as of end-2007. Sample includes Bank of America, Barclays, BMO, BNP Paribas, BONY, CIBC, Citigroup, Crédit Agricole, Credit Suisse, Deutsche Bank, HBOS, HSBC, JPM, Lloyds, NBC, RBC, RBS, Santander, Scotiabank, Société Générale, State Street, TD, UBS, UniCredit, Wachovia, Wells Fargo.
(b) Canadian and US banks' balance sheet size is adjusted for IFRS.

ratio (on banks being in distress versus safe) through risk-shifting by 1-3.5%. But the reduction in the odds ratio from lower leverage is close to 40-50%.

Second, the leverage regime is not a replacement for the risk-weighted capital regime but an addition to it. The capital regime places an automatic upper-bound on the extent to which banks can increase their risk-weighted assets. In other words, the capital ratio regime places constraints on incentives to risk-shift. Conversely, the leverage ratio can serve as an effective constraint on incentives to game or shade risk weights. Risk-taking incentives are, in effect, book-ended by the leverage and capital constraints.

From an incentives perspective, if regulatory arbitrage incentives are two-sided, so too should be the constraints needed to straightjacket that behaviour. That is another way of rationalising the 'multi-polar' regulatory regime operating internationally. When it comes to calibration, this means leverage and capital ratios need to be jointly determined to prevent incentives skewing in one or other direction. This is the approach in the UK when setting capital and leverage constraints (Bank of England (2015a)).

There are other means of constraining adverse incentives. Incentives to game risk weights can be constrained by imposing floors and/or by using standardised approaches for certain categories of assets[22]. Some countries already make use of such approaches, including the US, the UK, Germany, France and Spain. The stress-testing regimes operating in a number of countries are also a way of cross-checking, and backstopping, the models used by banks. In a world of uncertainty as well as risk, having this portfolio of approaches for dealing with avoidance incentives - some discretionary, others rule-like - makes sense.

Evidence on the incentive effects of financial regulation is almost always drawn from looking at banks' experience either side of a change in policy. By then, however, any unintended or undesirable consequences of this change will

already have been felt. Regulatory policy is in a perpetual catch-up loop, the bloodhounds in pursuit of the greyhounds.

In an ideal world, it would be possible to gauge in advance how a regulatory change may reshape incentives, in particular risk-taking or regulatory-avoiding incentives. One approach to doing so is to use experimental methods. Experiments have previously been used to examine how different pay structures affect loan officers' risk assessment and lending decisions (Cole, Kanz and Klapper (2015)). They have also been used to examine the effect of specific interventions on behaviour in other areas of public policy (Halpern (2015)).

Recently, the Bank of England has conducted a lab experiment to assess how the design of pay regulation may affect risk-taking behaviour and project search effort (Harris *et al* (forthcoming)). Specifically, the experiment was designed to examine how caps on bonuses and 'malus' (bonuses that are not paid out if, for example, performance falters in subsequent years) might affect individuals' risk choices and efforts to seek out the best projects.

The experiment showed evidence that, while both schemes tend to reduce risk-taking, they could be arbitraged relatively easily by introducing absolute or relative performance targets. There was also some evidence that a bonus cap might reduce incentives to search for good projects.

The Bank of England is considering extending this experimental approach to a wider range of policy design questions and a wider range of financial market participants - risk-takers and risk-managers. In principle, this approach might provide some early indications of how new regulation might reshape risk incentives, including arbitrage incentives, which could help in recrafting regulation before it is introduced.

Macroprudential policy

One of the greatest intellectual errors made in the run-up to the crisis was a classic 'fallacy of composition': it was assumed that the resilience of individual financial institutions was both a necessary and sufficient condition to ensure the resilience of the financial system as a whole. Events during the crisis, and subsequent theoretical and empirical work, has shown that the resilience of individual firms is neither necessary nor sufficient for the mitigation of systemic risk (Masera (2014), Crockett (1996)).

Out of this intellectual vacuum, a new framework for regulation has been born – macroprudential regulation. This explicitly recognises the links that might tie together individual nodes in the financial system. These might arise from correlated asset exposures, the type of which has historically emerged during the upswings and downswings of the credit cycle (Aikman *et al* (2015)). Or they might emerge from financial exposures, on- or off-balance sheet, between intermediaries operating in the global financial web (Haldane and May (2011), Arinaminpathy, Kapadia and May (2012)).

Over the past decade, a lot has been written in the area of macroprudential policy (Galati and Moessner (2013), Aikman *et al* (2013), Freixas *et al* (2015)). A sizeable number of countries are now undertaking macroprudential policy in some shape or form. Table 5 provides a rough summary of current international macroprudential practices (for a more comprehensive overview, see Cerutti *et al* (2017)). By any historical metric, however, macroprudential policy remains a fledgling framework. Understandably, many of its key facets remain contentious. And the macroprudential policies put in place internationally so far are more notable for their differences than their similarities. This is providing a diverse body of case law.

We discuss two key aspects of this framework: its appropriate objectives; and the choice of instruments.

Table 5. Current international macroprudential tools (taken from Grace, Hallissey and Woods (2015))

Country	Instrument used
Poland	Series of measures to limit FX-lending incl. higher DSTI ratios for FX-loans, higher risk weights for FX-loans. Borrowers can only borrow same currency as income (Jan 14).
Canada	80% LTV cap with mandatory mortgage insurance, capped 25 year loan term, maximum total debt service ratio of 44%. Time varying. Canada has taken four macroprudential policy measures since 2008 to tighten to these requirements.
New Zealand	Proportionate LTV cap at 80% (2013), temporary restriction. Core funding ratio of 75% in 2010.
Sweden	85% LTV cap (2010). Higher capital for mortgages (2013). 1% CCB on domestic exposures (2015). 3% SRB and 2% Pillar 2 for 4 systemic banks (2015)
UK	Proportionate LTI cap at 4.5 times. 0.5% counter-cyclical capital buffer from June 2017, with expectation of increasing to 1%.
Australia	Increase in risk weights for self-verified mortgages and non-prime home loans in 2004.
Norway	LTV cap of 90% (Mar 2010), reduced to 85% (Dec 2011). Countercyclical capital buffer of 1% from June 2015. 2% capital buffer for systemically-important institutions (July 16) and systemic risk buffer of 3% (June 14).
Korea	LTV cap (2002), differentiated by property type, adjusted counter-cyclically. DTI cap (2005), differentiated by property type, adjusted counter-cyclically. Macroprudential Stability Levy (MSL) (2011), price-based tax on banks' non-core foreign currency liabilities.
Croatia	A wide range of instruments including changes to reserve requirements, higher risk weights and liquidity requirements on foreign currency exposures.

Table 5. Current international macroprudential tools (taken from Grace, Hallissey and Woods (2015)) *cont*.

Country	Instrument used
Hong Kong	LTV cap (1990s), differentiated by property and borrower type, adjusted counter-cyclically, in conjunction with mortgage insurance. DTI cap.
Singapore	LTV cap for 1st (80%), 2nd (50%), subsequent (40%), and non-individual (20%) mortgages and mortgages with a long term (from 2013). Mortgage servicing requirement of 30% (2013).
Switzerland	Counter-Cyclical Capital buffer on real estate exposures (Feb 2013).
Finland	90% LTV cap; 95% for FTBs, based on fair value of all collateral.
Ireland	Higher RW for higher LTV residential mortgages and on CRE lending (2006/7).
Netherlands	LTV cap of 100% by 2018 (Aug 2011). Systemic risk buffer for large banking groups.
Spain	Rules-based dynamic provisioning introduced in 2000.

Objectives of macroprudential policy

The Bank of England entered the debate on the potential role of macroprudential policy in a discussion paper published in 2009 (Bank of England (2009)). That paper cast the debate on the potential objectives of such a regime as a choice between 'protecting banks from the cycle' and 'protecting the economy from the banks'. Macroprudential policy could focus narrowly on building resilience in the financial system in a dynamic way, so that it was better able to absorb large adverse shocks. Or it could pursue the broader and bolder objective of smoothing the swings in debt and asset prices associated with the financial cycle.

The subsequent academic literature has usefully refined how we think about these goals of a macroprudential regime. One fruitful strand has focused on the pecuniary externalities generated by fire-sales in asset markets (Lorenzoni (2008), Jeanne and Korinek (2010), Bianchi and Mendoza (2010), Benigno *et al* (2013)). Collateralised borrowing leads to externalities because individual borrowers do not internalise the fact that increasing debt in good times raises the likelihood they will be forced to sell assets following adverse shocks, pushing prices lower, tightening collateral constraints and exacerbating downturns.

These feedback and amplification loops can mean that private borrowing in good times is greater than a social planner would choose, facing the same constraints. That is the theory. Experience during the crisis tends to support the importance of these transmission channels. When highly-levered banks were forced to sell illiquid assets at highly discounted prices, this lowered valuations further and tightened constraints for other banks (Brunnermeier (2009)). This contributed to the depth and duration of the economic downturn.

Another strand of the literature has examined whether unlevered investors may also be prone to this fire-sale mechanism. This is a question of rising importance given the rapid growth in open-ended investment funds since the crisis. In Feroli *et al* (2014), asset managers are motivated by their relative ranking. This generates a feedback

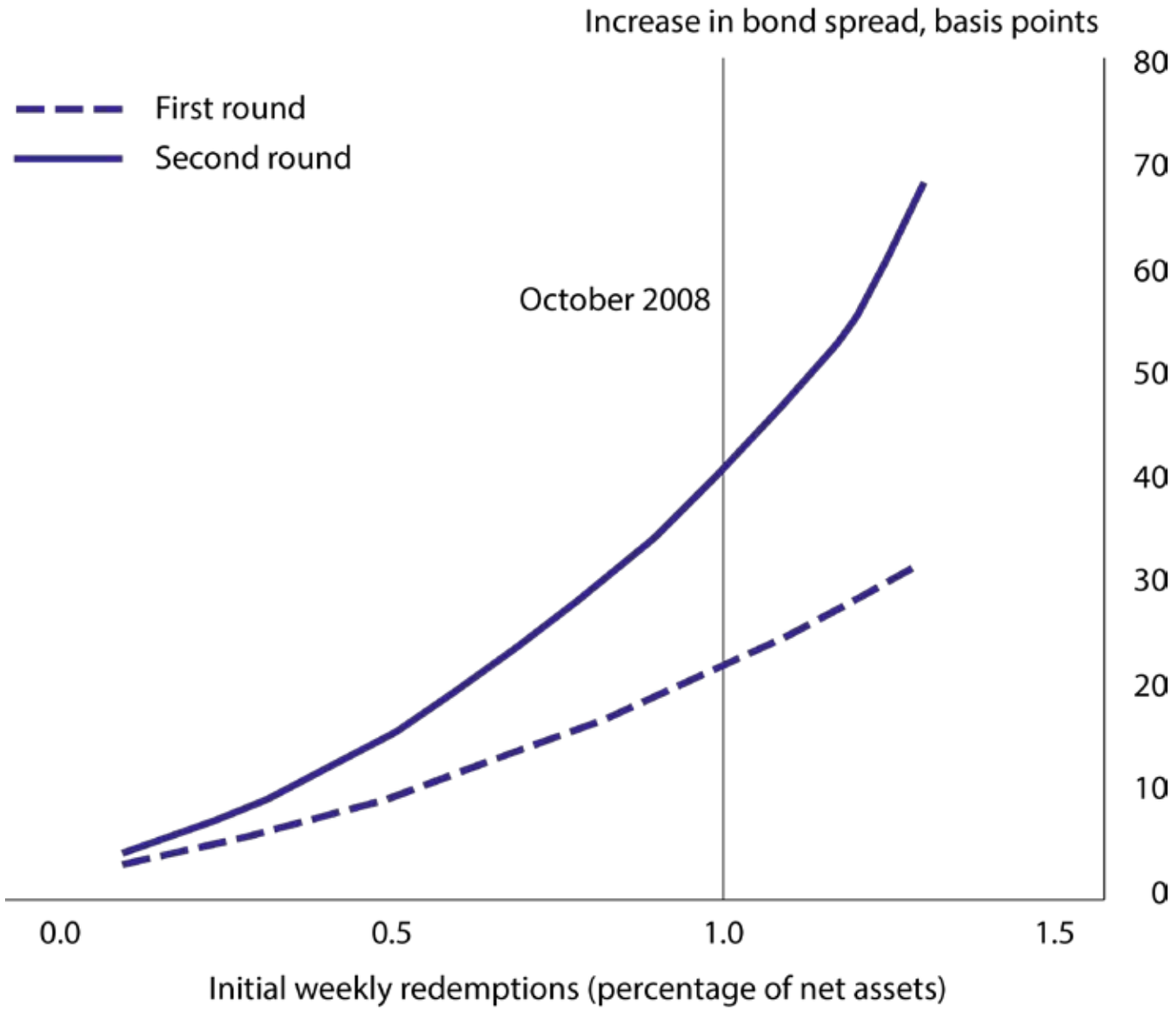
loop in which falling asset prices incentivise further selling for fear of diverging from the pack (Morris and Shin (2016), Vayanos and Woolley (2013)). This channel is amplified if investors perceive there to be a first-mover advantage in withdrawing funds, generating 'run-like' behaviour (Goldstein, Jiang and Ng (2017), Chen, Goldstein and Jiang (2010), Morris, Shim and Shin (2017)).

A recent paper by Bank of England colleagues (Baranova *et al* (2017)) provides a framework for quantifying the risks posed by investment funds in corporate bond markets (see also Ceterolli *et al* (2016)). In their model, investors act pro-cyclically, withdrawing funds when corporate bond prices fall and causing investment funds to make a first-round of asset sales. Dealers provide liquidity, but require a further fall in price as compensation. This leads to further redemptions and further asset sales, amplifying the fall in price. Chart 21 shows that this amplification effect can be quantitatively significant: weekly redemptions from bond funds of 1% of total net assets, similar to the level observed at the peak of the crisis, increase the liquidity premium in bond spreads by 40 basis points. Moreover, redemptions of as little as 1.3% of total assets exhaust the dealer's capacity to intermediate trades, leading to a market 'freeze'.

In a similar spirit, Braun-Munzinger *et al* (2016) develop an agent-based model of the corporate bond market comprising a market maker, fund traders and fund investors. They find that funds pursuing similar trading strategies can exacerbate price movements and contribute to the pro-cyclicality of financial markets. Additionally, the growth of passive investments may have both positive and negative effects on volatility: they decrease yield volatility on average, but can increase the likelihood of large dislocations after shocks.

While this fire-sale mechanism applies most directly to financial intermediaries with marked-to-market balance sheets, and funds that can be redeemed at short notice, a similar dynamic can operate if there are forced sales by owners of, or investors in, real estate who are credit-constrained borrowers. This, too, can drive prices lower in a

Chart 21. Estimated increase in the liquidity component of corporate bond spreads under different levels of initial redemptions (taken from Baranova et al (2017))



feedback loop. Some of these mechanisms were in play recently among UK real estate investment vehicles following the EU referendum result (Bank of England (2016b)).

A related, but distinct, mechanism through which financial frictions can affect the wider economy is through aggregate demand externalities. In Korinek and Simsek (2016), credit-constrained households de-lever sharply when an adverse shock hits. If the shock is large enough, the resulting fall in aggregate demand can push the economy into a liquidity trap with interest rates constrained at the effective lower bound. In this environment, macroprudential policies that slow the build-up of household leverage *ex-ante* can be welfare-improving in avoiding this outcome. Farhi and Werning (2016) also offer a model of macroprudential policy in the face of aggregate demand externalities.

Another strand of the literature emphasises behavioural sources of pro-cyclicality. For example, powerful narratives, such as a collective belief in a 'new paradigm', might manifest themselves in over-exuberance in the financial system (Tuckett (2011), Shiller (2017)). Myopia about risk might also drive excessive risk-taking, especially as memories of past financial crises fade (Guttentag and Herring (1986), Herring (1998), Haldane (2009b), Gennaioli, Schleifer and Vishny (2012)). And such behaviour might be amplified by contracts that reward short-term performance excessively and by herding in financial markets (Avery and Zemsky (1998), Lakonishok *et al* (1992), Bikhchandani and Sharma (2001)). Aikman, Nelson and Tanaka (2015) show how reputational concerns and peer benchmarking can drive credit cycles.

The case for macroprudential interventions to address build-ups in leverage also has empirical support. Mian and Sufi (2010) argue that the persistence of the decline in US GDP after the crisis was caused by excessive household leverage. Jordà *et al* (2013) report that credit booms not only increase the likelihood and severity of financial crises, but also make normal recessions more painful. A one standard deviation increase in 'excess credit' results in real GDP per capita being 1.5% lower five years after a normal recession[23]. Bunn and Rostom (2015) find that more high-

ly indebted groups of households made larger cuts in spending following the financial crisis. And Bailey *et al* (forthcoming) exploit Facebook data to identify how social interactions can drive contagious risk-taking in the US housing market.

In summary, the market failures associated with fire-sale externalities and behavioural tendencies which can drive short-termism provide a strong case for a macroprudential regulator with an objective of preserving the dynamic resilience of the financial system, both among banks and, prospectively, among non-banks. No less compelling, however, is the evidence, both micro and macro, linking credit booms to aggregate demand externalities. That, in turn, provides a rationale for pre-emptive macroprudential interventions to avoid excessive inflation of credit and asset prices in the first place.

Instruments of macroprudential policy

The Bank of England's second public foray into the macroprudential policy debate was a 2011 discussion paper on elements of the macroprudential toolkit (Bank of England (2011)). That paper described 12 distinct macroprudential tools (see also CGFS (2010, 2012), Hanson *et al* (2011) and ESRB (2015) for discussions of macroprudential instruments). The majority of these targeted different aspects of banks' balance sheets including: the countercyclical capital buffer (CCyB); sectoral capital requirements (SCRs); leverage ratio buffers; dynamic provisions; and liquidity buffers.

Other potential macroprudential instruments included those aimed at influencing lending standards - for example, through setting loan to value limits (LTV), loan to income limits (LTI) or margining requirements on collateralised borrowing in financial markets. A third set of potential instruments focused on making market infrastructures more resilient and improving financial market practices – for example, by mandating central clearing, through trading venue design and through enhanced disclosure requirements.

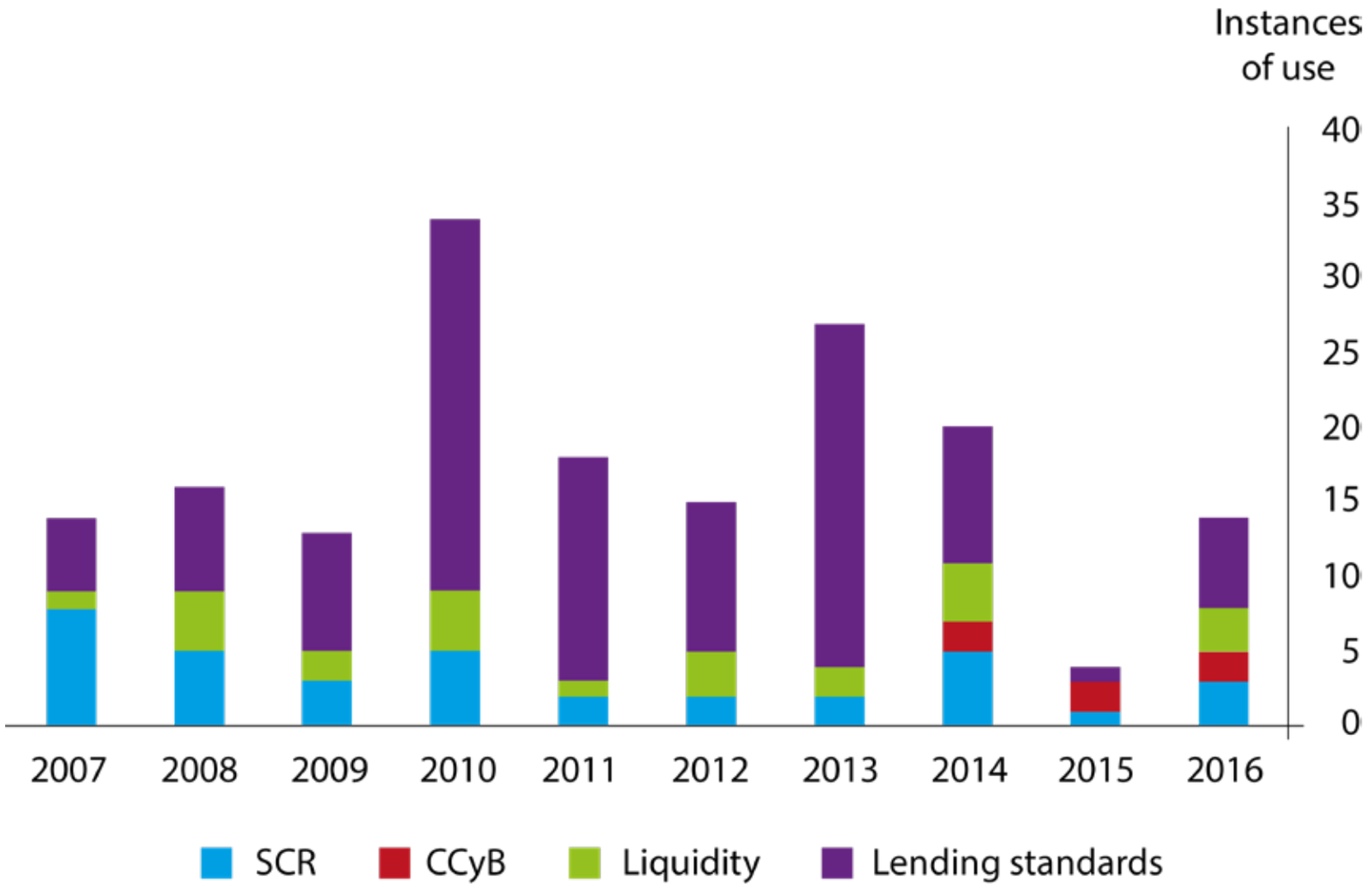
So how has thinking on macroprudential instruments moved forward in the period since? Chart 22 documents the use of different types of macroprudential tool over the past decade in a panel of advanced economies[24]. Perhaps contrary to expectations, the majority of interventions have fallen into the 'lending standards' category, a group that includes LTI and LTV requirements. By numbers, such actions account for around two-thirds of overall macroprudential actions over the period since 2010.

At the other end of the spectrum is the CCyB. That has only been used by 6 countries to date. This is surprising given that it is the only tool that has a well-defined operating framework internationally and which includes jurisdictional reciprocity. A potential explanation is that the Basel guidelines suggest the buffer should be activated when excess credit growth threatens an increase in system-wide risk. The majority of advanced countries have not come close to experiencing aggregate credit booms in the post-crisis period.

When it comes to assessing the efficacy of these tools, it has largely been a case of 'learning by doing'. Cerutti *et al* (2017), Kuttner and Shim (2013), Crowe *et al* (2013) and Boar *et al* (2017) provide evidence on the impact of tools using cross-country panel studies. Aikman et al (forthcoming) and Banerjee and Mio (2017) study the UK's experience with the CCyB and with macroprudential liquidity actions respectively. And He (2013) considers the impact of the HKMA's use of LTV limits. Overall, however, the evidence base on the transmission of macroprudential tools remains fairly slim.

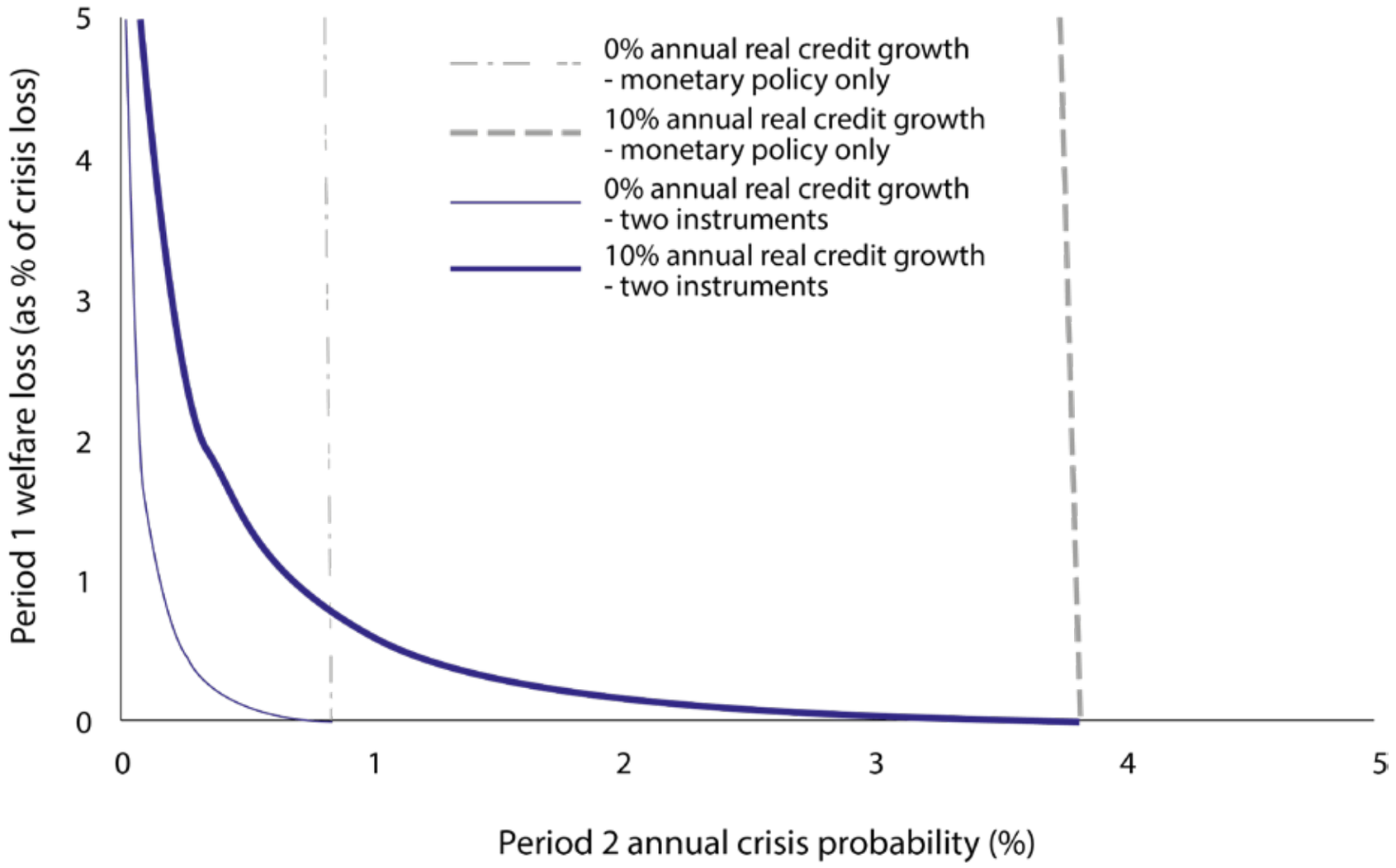
There is also relatively little guidance from the literature on tool strategy, selection and interaction. One exception is work assessing the role of monetary policy in leaning against financial cycles. A paper by the Federal Reserve Board (Ajello *et al* (2016)) analyses the costs and benefits of using interest rates to lean against vulnerabilities in the financial system. In the baseline calibration of their model, the costs of using monetary policy in this way are large relative to the benefits: the optimal adjustment in interest rates in the face of financial stability risks is in the order of 3 basis points.

Chart 22. Usage of key macroprudential tools since 2010



Sources: National central bank websites, IMF, European Commission Shim et al 2013, ESRB and MDB.
Note: This chart documents the use of the CCyB, sectoral capital requirements (SCR), liquidity-based tools, and lending standards (including loan to income and loan to value ratio limits) over the period 2007-2017. Countries included: Australia; Brazil; Canada; China; France; Germany; India; Italy; Japan; Korea; Netherlands; Norway; Singapore; Spain; Sweden; Switzerland; United Kingdom; United States.

Chart 23. Intertemporal trade-off with monetary policy and the CCyB (taken from Aikman, Giese, Kapadia, & McLeay (forthcoming))



While the adjustment to interest rates can be larger – up to 75 basis points - if alternative assumptions are made about cost of crises and the sensitivity of crisis risk to monetary policy, the calibrations required to deliver these outcomes are extreme. Svensson (2017) argues that the costs of using interest rates to lean against financial crisis risk are likely to be greater still if one takes into account that doing so will make the economy weaker at the point a crisis strikes and hence might actually worsen its severity.

Aikman *et al* (2016) analyse empirically the joint non-linear dynamics of credit, financial conditions and monetary policy in the United States. They find that the transmission mechanism of monetary policy to long-term yields is blunted in high credit states. This suggests that attempts to lean against the wind with monetary policy when credit is already elevated may be futile. Filardo and Rungcharoenkitkul (2016), by contrast, find benefits from using monetary policy to 'lean' when the evolution of financial imbalances is extremely persistent. But the general consensus is against deploying monetary policy, at least in an activist way, for financial stability purposes given its limited efficacy and potential real-economy costs.

One recent paper that addresses issues of CCyB strategy is Aikman, Giese, Kapadia and McLeay (forthcoming). Developing Ajello *et al*'s (2016) approach, the authors study an economy in which policymakers face a trade-off between stabilising inflation and output today versus keeping a lid on financial stability risks which threaten a crisis tomorrow. The optimal strategy is to adjust the CCyB in line with forward-looking indicators of crisis risk – credit growth in their model – but to relax (tighten) the CCyB relative to this plan if output is below (above) its target level. This strategy dramatically improves the inter-temporal trade-off facing a policymaker relative to the case where monetary policy is the only tool (Chart 23). Indeed, this is consistent with the Bank of England MPC's guidance that monetary policy should be the 'last line of defence' in the presence of financial stability risks (Bank of England (2013)).

The dashed lines show the steep trade-off facing a policymaker with a monetary policy tool only. Attempts to reduce the crisis probability with higher interest rates entail significant costs for current output and inflation. The solid lines show how this trade-off improves when the CCyB is added to the instrument set, even under conservative assumptions about the impact of the CCyB on the economy's productive capacity. The variation in the CCyB required to deliver these benefits can be large. Given the historical distribution of shocks, the standard deviation of the CCyB is around 2 percentage points.

A final strand of the literature has analysed whether the presence of macroprudential policy gives rise to coordination problems with monetary policy. For example, De Paoli and Paustian (2017) study a non-cooperative game between monetary and macroprudential authorities and find coordination problems to be significant following cost-push shocks in cases where objectives do not overlap. But they also find that a leadership structure in which macroprudential policy moves first – or is varied at a lower frequency than monetary policy given that financial vulnerabilities build slowly – mitigates these coordination problems.

Future research and policy

Financial regulation has undergone a fundamental rethink and reform since the global financial crisis. By most accounts and on most evidence, that has resulted in a financial system which is more resilient than in the past, better equipped to head-off market frictions and failures of various kinds, better attuned to various adverse incentive effects, and better able to safeguard risks which imperil the financial system as a whole. It is a regime of 'constrained discretion', comprising a portfolio of regulatory measures calibrated, albeit roughly, to equate societal costs and benefits. That's the easy bit.

The hard bit is what happens next. Not least given the scale of regulatory change over the past decade, this new regulatory framework will plainly need to adapt in the period ahead in the light of the new evidence, experience

and incentives associated with operating it. This paper has discussed some of those issues. From a potentially very long list, we conclude by highlighting some of the areas where we think further research and practical exploration might be useful in the future debate on regulatory reform[25].

(a) *Optimal levels of capital*: one of the most animated, on-going areas of regulatory debate is whether capital standards have been appropriately calibrated. Relative to the pre-crisis LEI study, current levels of capital requirements in most countries are below that calibration. The single most important reason for that is because the LEI study did not take into account the potential impact of non-equity sources of capital, specifically TLAC, in reducing the impact and probability of crisis. The key question, then, is whether these instruments prove to be as loss-absorbing in future situations of stress where bail-in becomes necessary. This issue is particularly relevant when it involves systemically-important institutions or sets of institution, when the costs of bailing-in (and bailing-out) are large and lumpy. At this early stage, the jury must still be out. On the one hand, historical evidence on bailing-in different types of notionally loss-absorbing bank liabilities in situations of systemic stress has not been encouraging, reflecting the acuteness of the time-consistency problem facing the authorities in these cases. On the other, new statutory resolution arrangements are much stronger than ever previously, and statutory TLAC requirements are now prescribed in advance. This means next time could plausibly be different. Given its importance to the overall capital calibration, this issue deserves further empirical and theoretical consideration.

(b) *Multi-polar regulation*: the new regulatory framework is a different beast than its predecessors in terms of the number, complexity and discretionary nature of the constraints it imposes. There are good conceptual and empirical grounds for such a portfolio approach in insuring against future risks and, in particular, uncertainties. And from a risk- and uncertainty-averse social welfare perspective, even a marginally over-identified system might, in general, be preferable to a marginally under-identified one, if recent crisis experience is any guide. Indeed, that is the essence of robust control. Ultimately, however, the past is another country.

There are legitimate questions to answer about whether multiple regulatory constraints could lead to excessive homogeneity and inefficiency in the financial system. And arbitrage is an ever-present threat, even with multiple regulatory metrics. This is an area where further research and practical experience with operating the new regime will be essential in gauging whether there is scope for streamlining, provided the resulting regulatory regime remains robust to the radical uncertainty that necessarily affects any complex, adaptive system such as finance[26].

(c) *Models of financial stability*: in a world of monetary, macroprudential and microprudential policy, all having an impact on the economy and on the financial system, there is an increased onus on developing quantitative frameworks which enable us to understand their impact, individually and collectively, and their interaction (Bank of England (2015b)). That calls for models able to capture quantitatively monetary, financial and regulatory channels of transmission and the feedback mechanisms between them. Progress has been made, in particular since the crisis, in developing macro-models with an explicit financial sector which can capture rich, two-way feedbacks between the economy and financial system (for example, Brunnermeier *et al* (2012), Brunnermeier and Sannikov (2014)). There has been progress, too, in developing models of systemic risk which assign macroeconomic factors, and within-system feedbacks, a prominent role (Greenwood *et al* (2014), Cont and Schaanning (2017)). Yet we are still probably in the foothills when developing a unified framework for bringing these factors together in one place, a framework that could capture the rich feedback and amplification mechanisms that operate in practice and a model which could then serve as a test-bed for each of the three arms of policy. Indeed, it could be that a single, Holy Grail, framework is infeasible or indeed undesirable.

(d) *Future of stress-testing*: bank stress testing has evolved considerably since the financial crisis and is now a cornerstone of the regulatory regime in many jurisdictions. The direction of travel necessary to enrich these tests, and to make them truly macroprudential, is to incorporate feedback effects that can amplify the actions of individual institutions at the system-wide level (Demekas (2015), Brazier (2015), Tarullo (2016)) – feedbacks, for instance, that

result from fire-selling assets, hoarding liquidity and counterparty risk[27]. A natural consequence is that we might need to extend the field of vision for such simulations to include non-bank parts of the financial system. Non-bank sources of systemic risk proved to be potent during the crisis, in particular among shadow banks. As regulation has squeezed the banking system, there has been further migration of financial activity into the shadows, particularly within Europe. What was once credit and funding risk on the balance sheets of banking firms is metamorphosing into market and liquidity risk on the balance sheets of funds and investment vehicles of various types (Stein (2013)). Understanding these risks calls for new and enhanced surveillance tools. Systematic, market-wide stress simulations might be needed to capture new market and liquidity risks and their propagation across different financial institutions and markets (Brazier (2017b)). The same considerations apply to key pieces of the financial infrastructure, in particular central counterparties (Cœuré (2017), Duffie (2017)). As a potentially new 'too big to fail' entity, they too need to be stress-tested and their resolution plans agreed and implemented. This is a whole new risk-management agenda, where work has only just begun in earnest.

(e) *Market-based finance*: the emergence of a large and diverse shadow banking system, both prior to the crisis in the US and subsequent to it elsewhere around the world, plainly poses both considerable opportunities and potential threats to financial stability. So-called market-based finance provides the financial system with a second, non-bank, engine on which to fly which could be beneficial in a diversity sense. Nonetheless, it also gives rise to potentially new sources of systemic risk and contagion, as risks change shape and location. The FSB has made significant progress in progressing the regulatory debate on such matters (FSB (2017e)). Certainly, these trends carry implications for both the conduct of regulation and for central bank procedures. A world of greater market and liquidity risk may call for different sets of regulatory instrument than the bank-based solvency and liquidity metrics of Basel III. Market-based instruments, such as margin requirements, may have a greater role to play (see, for example, ESRB (2017)). It may also call for different types of market intervention by central banks – different markets, different instruments, different counterparties. The crisis has already seen a mini-revolution in the design of liquidity facilities

by central banks. As the financial system changes shape, it seems plausible to think that further change could be necessary. If so, that change would benefit from further research on the costs and benefits of the extended regulatory and central bank safety net.

(f) *The macroprudential policy framework*: as a still-fledgling framework, there are a wide range of questions still surrounding the macroprudential framework. There is no settled, practical approach to defining the breadth of objectives of a macroprudential regime. Should the potential for aggregate demand externalities associated with a debt overhang in the household sector, for instance, fall under the purview of a macroprudential authority? Nor, in the main, is there any settled approach to defining the appropriate set of macroprudential instruments, whether for banks or especially for non-banks, or the optimal strategy for their use to address emerging vulnerabilities. If household debt externalities are within scope, is it better to deal with this risk by restricting mortgage lending directly via loan to income or loan to value limits, or by adding a macroprudential overlay to risk weights on mortgages (Turner (2017))? This lack of a settled approach has some benefits, in making for a diverse range of cross-country experiences. This is giving rise to a period of 'learning by doing' among regulators. It does, however, come at some cost. A regime without especially well-defined objectives is likely to suffer greater problems of time-inconsistency. It may also increase uncertainty among outside participants about the likely regulatory policy reaction function. The direction of travel, over time, probably needs to be towards somewhat clearer constraints, and somewhat more circumscribed discretion, if macroprudential regimes are to be effective, robust and transparent.

(g) *Political economy of financial regulation*: the scope and range of regulatory responsibilities assigned to central banks and regulators have expanded materially during the course of the crisis. Accompanying that, some of the new regulatory requirements and practices put in place are quite discretionary in nature, including stress-testing and some other macroprudential measures. A number involve regulators making overtly distributional choices, for example around access to credit. This takes central banks and regulators more explicitly into the political-economy

realm than at any time in their recent (and perhaps distant) history. It has probably also contributed to some people questioning the appropriate scope of central banking, its degree of independence from the political process and from wider society and appropriate accountability mechanisms. There is a debate to be had, an analytical debate, about the appropriate degree of discretion to confer on regulators, to ensure they retain the flexibility they need to respond to events while ensuring their decisions are clear, transparent and unpolluted by behavioural biases and time-inconsistency problems. There are also interesting issues to explore about how regulators explain and account for their decisions to wider society, particularly when they have strongly distributional consequences. This is clearly unfinished business.

(h) *The contribution of the financial system to the economy and to society*: one of the striking features of the past several decades has been the rising share of financial services in measures of economy-wide value-added and, in tandem, rising financial sector balance sheets as a fraction of GDP in a number of economies. Sometimes this goes by the name 'financialisation'. There are good reasons to think increasing financial depth is a natural feature of economies as they grow and develop. Indeed, there is a fairly well-established literature quantifying the boost to growth and productivity which arises from financial depth, especially for developing countries (Levine *et al* (2000)). Latterly, however, the question has been asked whether it is possible to have too much of a good thing. Some have asked why the cost of financial intermediation continues to rise and what this might signal about the efficiency of financial services as an industry (Friedman (2009), Philippon (2015)). Others have pointed to a possible U-shaped relationship between measures of financial depth and productivity and growth (Cecchetti and Kharroubi (2012), Heil (2017)). These questions have an important bearing on the contribution the financial system makes to the economy and to society. They are also meta-questions for regulatory policy. They warrant further research.

(i) *Financial stability implications of FinTech*: technologically-enabled innovation in financial services, or FinTech, has grown rapidly in recent years. The FSB's recent report contains a useful taxonomy of such innovations (FSB (2017f)).

With this development comes the promise of greater consumer choice, improved access to credit for some borrowers, and greater efficiency and productivity in the traditional intermediary sector. There are also potential resilience benefits from increasing diversity in the provision of financial services (Carney (2017a)). While the sector is probably too small at present to pose a threat to financial stability, there is ample historical experience of risks emerging rapidly in fast-growing sectors if left unchecked. Such future risks might include: conventional vulnerabilities associated with excessive use of leverage and maturity, liquidity and credit transformation; the emergence of new highly-interconnected entities; and cyber and other operational risks. There is also the potential for these developments to make traditional universal banks less resilient, if they are forced to rely on less stable funding sources, for example. A challenge for policymakers is to ensure that the regulatory regime, and the wider policy framework – including the scope of central banks' liquidity facilities – adapts to keep pace with these developments (Lagarde (2017)).

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Endnotes

1. For example, Hoggarth, Reis and Saporta (2001).

2. Figures in this paragraph calculate a continuation of pre-crisis GDP using the average growth rate of output in the 10 years preceding the crisis.

3. For example, Calomiris (2017), Greenwood et al (2017), Duffie (2017).

4. And a number of countries, including the UK, introduced leverage ratio capital requirements in the aftermath of the crisis.
5. For LCR, see BCBS (2013a): http://www.bis.org/publ/bcbs238.pdf; for NSFR, see BCBS (2014b): http://www.bis.org/bcbs/publ/d295.htm
6. The Comprehensive Capital Analysis and Review or CCAR.
7. Dent and Westwood (2016) includes a comparison of international concurrent stress-testing practices.
8. These banks have been identified based on publicly available lists of systemically-important firms:
• The Financial Stability Board's list of G-SIBs as of 21 November 2016.
• O-SIIs notified to the European Banking Authority as of 25 April 2016.
• US bank holding companies (BHCs) subject to the Federal Reserve's annual Comprehensive Capital Analysis and Review (CCAR) as of March 2014.
• Banks designated as systemically-important financial groups by the Swiss National Bank.
• The four major banks in Australia.
• The five largest banks in Canada.
These include bank holding companies as well as their primary operating companies where applicable, as well as foreign subsidiaries that are explicitly designated as systemically-important for a particular country.
9. The data are from the Standard and Poor's Capital IQ database.
10. Chart 13 is not directly comparable with Chart 5 because it is based on a different definition of leverage and sample of banks.
11. These figures are expressed in terms of current definitions of capital and risk-weighted assets. The mapping from the estimates reported in the LEI report and those above are due to Brooke et al (2015).
12. This echoes and extends findings from earlier research by Borio and Lowe (2002), Borio and Lowe (2004) and Drehmann, Borio and Tsatsaronis (2011), which found credit gap measures to be key determinants of crisis risk.
13. Relatedly, Demirguc-Kunt et al (2010) and Beltratti and Stulz (2012) find that poorly capitalised banks had lower stock

returns during the financial crisis. And Boyson et al (2014) find that banks that entered the recent financial crisis with higher capital were less likely to see their funding dry up during the crisis.

14. This calculation is based on the marginal condition for optimal capital reported earlier. We parameterise the crisis probability and severity functions as follows: $y = exp(\beta_0 + \beta_1 k)/(1 + exp(\beta_0 + \beta_1 k))$; $\Delta = \theta_0 + \theta_1 k$. *The model is calibrated to deliver an optimal capital ratio of around 18% when* $\theta_1 = 0$, *ie. the LEI case. We achieve this by setting* $\delta = 0.1$, $\beta_0 = 0.5$, $\beta_1 = -0.2$, *and* $\theta_0 = 10$, *that is to say, a crisis reduces the level of GDP by 10% relative to baseline. If instead we set* $\theta_1 = -0.1$, *such that each percentage point increase in capital reduced the GDP hit in a crisis by 0.1%, the optimal capital ratio increases to over 20%.*

15. See Cunliffe (2017) and Bank of England (2017) for discussion of resolution.

16. This estimate is based on the difference in the estimated cost of crises across their sample depending on whether they occurred under more or less credible resolution regimes.

17. Admati and Hellwig (2013) have forcefully questioned the basis for assuming such costs, given that standard finance theory would predict that the cost of debt and equity funding for a bank will decline in response to an increase in its capital position.

18. See the Financial Policy Committee's June 2016 Financial Stability Report (pp 27-33) for an assessment of market liquidity in UK markets more broadly. The Securities and Exchange Commission's Report to Congress contains a detailed assessment of the impact of Basel III and the Volcker Rule on liquidity in US Treasury and corporate debt markets (SEC (2017)).

19. For example, DeMiguel et al (2007) find that, for a sample threshold of N = 25, complex rules outperform simple ones only for sample sizes of in excess of 3,000 months (250 years) of data.

20. The dataset also includes a liquid asset ratio but this is a relatively poor proxy for the liquidity coverage ratio (LCR), so we exclude consideration of the LCR from this analysis.

21. Because very few banks technically defaulted during the crisis, but many would have without significant government intervention, the definition of failure is necessarily somewhat judgemental. Beyond clear-cut cases of default or national-

isation, Laeven and Valencia (2010) define banks to have failed if at least three of the following six conditions were present: (i) extensive liquidity support (5 percent of deposits and liabilities to non-residents); (ii) bank restructuring costs (at least 3 percent of GDP); (iii) partial bank nationalisation (eg government recapitalisation); (iv) significant guarantees put in place; (v) significant asset purchases (at least 5 percent of GDP); (vi) deposit freezes and bank holidays. Aikman et al (2014) discuss where the classification of failure departs from Laeven and Valencia (2010).

22. See BCBS (2016): http://www.bis.org/bcbs/publ/d362.pdf and BCBS (2013b): http://www.bis.org/publ/bcbs258.pdf

23. Defined as the rate of change of aggregate bank credit (domestic bank loans to the nonfinancial sector) relative to GDP, relative to its mean, from previous trough to peak.

24. We would like to thank Karam Shergill and Rhiannon Sowerbutts for collecting these data.

25. See also, Calomiris (2017), Duffie (2017), Greenwood et al (2017).

26. FSB (2017e), for example, describes a Policy Evaluation Framework to achieve efficient resilience.

27. For example, the results of the Bank of England's 2014 stress test found that risk-weight procyclicality was a significant contributor to the change in capital ratios in the stress test scenario (Bank of England (2014)).

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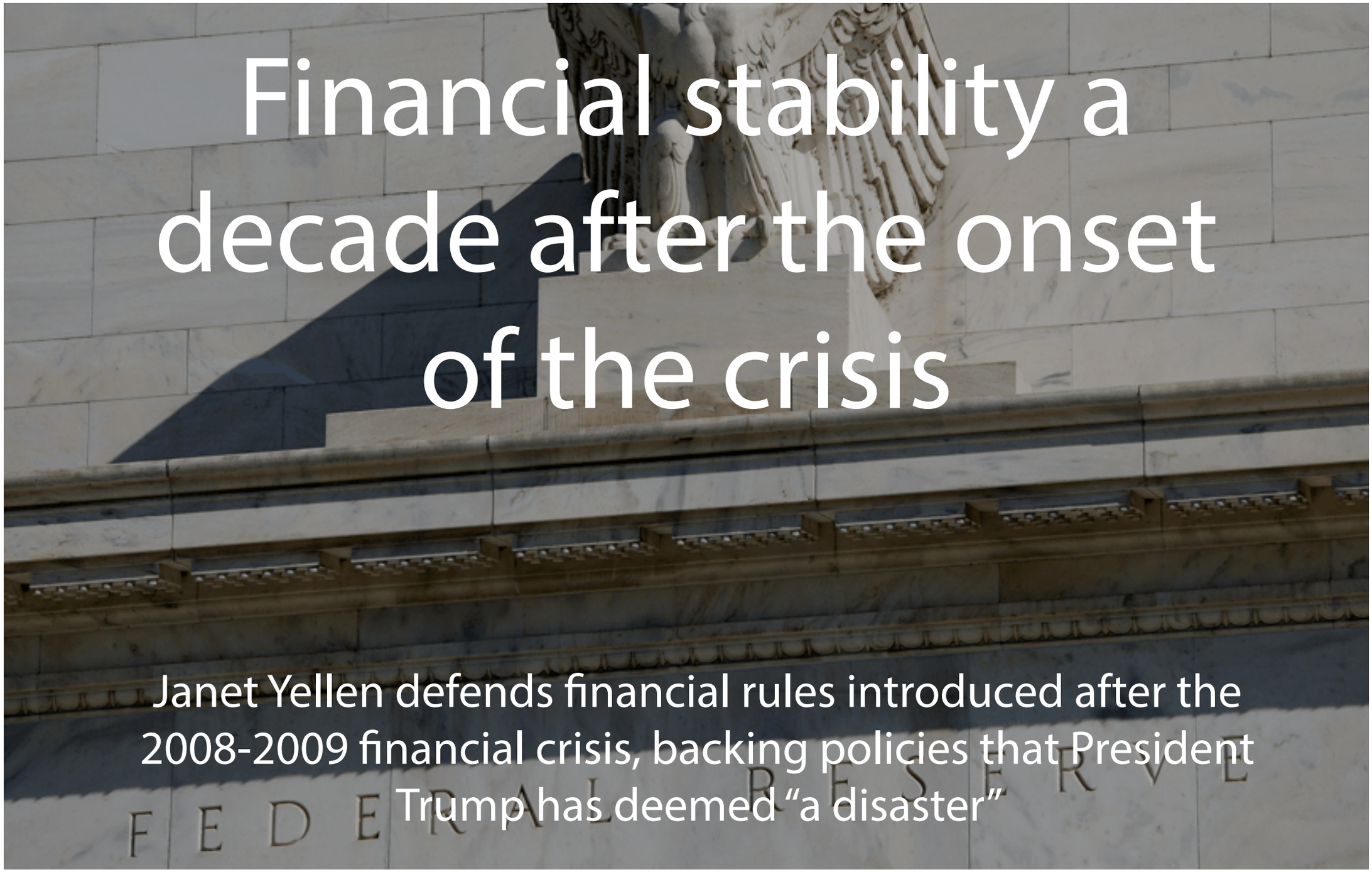
Financial stability a decade after the onset of the crisis



Janet Yellen defends financial rules introduced after the 2008-2009 financial crisis, backing policies that President Trump has deemed “a disaster”

A decade has passed since the beginnings of a global financial crisis that resulted in the most severe financial panic and largest contraction in economic activity in the United States since the Great Depression. Already, for some, memories of this experience may be fading - memories of just how costly the financial crisis was and of why certain steps were taken in response. I will look back at the crisis and discuss the reforms policymakers in the United States and around the world have made to improve financial regulation to limit both the probability and the adverse consequences of future financial crises.

A resilient financial system is critical to a dynamic global economy. A well-functioning financial system facilitates productive investment and new business formation and helps new and existing businesses weather the ups and downs of the business cycle. Prudent borrowing enables households to improve their standard of living by purchasing a home, investing in education, or starting a business. Because of the reforms that strengthened our financial system, and with support from monetary and other policies, credit is available on good terms, and lending has advanced broadly in line with economic activity in recent years, contributing to today's strong economy[1].

At the same time, reforms have boosted the resilience of the financial system. Banks are safer. The risk of runs owing to maturity transformation is reduced. Efforts to enhance the resolvability of systemic firms have promoted market discipline and reduced the problem of too-big-to-fail. And a system is in place to more effectively monitor and address risks that arise outside the regulatory perimeter.

Nonetheless, the scope and complexity of financial regulatory reforms demand that policymakers and researchers remain alert to both areas for improvement and unexpected side effects. The Federal Reserve is committed to continuing to evaluate the effects of regulation on financial stability and on the broader economy and to making appropriate adjustments.

I will start by reviewing where we were 10 years ago. I will then walk through some key reforms our country has put in place to diminish the chances of another severe crisis and limit damage during times of financial instability. After reviewing these steps, I will summarize indicators and research that show the improved resilience of the US financial system-resilience that is due importantly to regulatory reform as well as actions taken by the private sector. I will then turn to the evidence regarding how financial regulatory reform has affected economic growth, credit availability, and market liquidity.

... if we keep this lesson fresh in our memories... we have reason to hope that the financial system and economy will experience fewer crises and recover from any future crisis more quickly

Developments 10 years ago

The US and global financial system was in a dangerous place 10 years ago. US house prices had peaked in 2006, and strains in the subprime mortgage market grew acute over the first half of 2007[2]. By August, liquidity in money markets had deteriorated enough to require the Federal Reserve to take steps to support it[3]. And yet the discussion here at Jackson Hole in August 2007, with a few notable exceptions, was fairly optimistic about the possible economic fallout from the stresses apparent in the financial system[4].

As we now know, the deterioration of liquidity and solvency within the financial sector continued over the next 13 months. Accumulating strains across the financial system, including the collapse of Bear Stearns in March 2008, made it clear that vulnerabilities had risen across the system.

As a result, policymakers took extraordinary measures: the Federal Open Market Committee (FOMC) sharply cut the federal funds rate, and the Federal Reserve, in coordination with the Treasury Department and other agencies, extended liquidity facilities beyond the traditional banking sector, applying to the modern structure of US money markets the dictum of Walter Bagehot, conceived in the 19th century, to lend freely against good collateral at a penalty rate[5]. Still, the deterioration in the financial sector continued, with Fannie Mae and Freddie Mac failing in early September[6].

But the deterioration from early 2007 until early September 2008-already the worst financial disruption in the United States in many decades-was a slow trickle compared with the tidal wave that nearly wiped out the financial sector that September and led to a plunge in economic activity in the following months. Not long after Fannie and Freddie were placed in government conservatorship, Lehman Brothers collapsed, setting off a week in which American International Group, Inc. (AIG), came to the brink of failure and required large loans from the Federal Reserve to

mitigate the systemic fallout; a large money market fund 'broke the buck' (that is, was unable to maintain a net asset value of $1 per share) and runs on other money funds accelerated, requiring the Treasury to provide a guarantee of money fund liabilities; global dollar funding markets nearly collapsed, necessitating coordinated action by central banks around the world; the two remaining large investment banks became bank holding companies, thereby ending the era of large independent investment banks in the United States; and the Treasury proposed a rescue of the financial sector.

Within several weeks, the Congress passed-and President Bush signed into law-the Emergency Economic Stabilization Act of 2008, which established the $700 billion Troubled Asset Relief Program; the Federal Reserve initiated further emergency lending programs; and the Federal Deposit Insurance Corporation (FDIC) guaranteed a broad range of bank debt[7]. Facing similar challenges in their own jurisdictions, many foreign governments also undertook aggressive measures to support the functioning of credit markets, including large-scale capital injections into banks, expansions of deposit insurance programs, and guarantees of some forms of bank debt.

Despite the forceful policy responses by the Treasury, the Congress, the FDIC, and the Federal Reserve as well as authorities abroad, the crisis continued to intensify: the vulnerabilities in the US and global economies had grown too large, and the subsequent damage was enormous. From the beginning of 2008 to early 2010, nearly 9 million jobs, on net, were lost in the United States. Millions of Americans lost their homes. And distress was not limited to the US economy: global trade and economic activity contracted to a degree that had not been seen since the 1930s. The economic recovery that followed, despite extraordinary policy actions, was painfully slow.

What the crisis revealed and how policymakers have responded

These painful events renewed efforts to guard against financial instability. The Congress, the Administration, and

regulatory agencies implemented new laws, regulations, and supervisory practices to limit the risk of another crisis, in coordination with policymakers around the world.

The vulnerabilities within the financial system in the mid-2000s were numerous and, in hindsight, familiar from past financial panics. Financial institutions had assumed too much risk, especially related to the housing market, through mortgage lending standards that were far too lax and contributed to substantial overborrowing. Repeating a familiar pattern, the 'madness of crowds' had contributed to a bubble, in which investors and households expected rapid appreciation in house prices. The long period of economic stability beginning in the 1980s had led to complacency about potential risks, and the buildup of risk was not widely recognized[8].

As a result, market and supervisory discipline was lacking, and financial institutions were allowed to take on high levels of leverage. This leverage was facilitated by short-term wholesale borrowing, owing in part to market-based vehicles, such as money market mutual funds and asset-backed commercial paper programs that allowed the rapid expansion of liquidity transformation outside of the regulated depository sector. Finally, a self-reinforcing loop developed, in which all of the factors I have just cited intensified as investors sought ways to gain exposure to the rising prices of assets linked to housing and the financial sector. As a result, securitization and the development of complex derivatives products distributed risk across institutions in ways that were opaque and ultimately destabilizing.

In response, policymakers around the world have put in place measures to limit a future buildup of similar vulnerabilities. The United States, through coordinated regulatory action and legislation, moved very rapidly to begin reforming our financial system, and the speed with which our banking system returned to health provides evidence of the effectiveness of that strategy. Moreover, US leadership of global efforts through bodies such as the Basel

Committee on Banking Supervision, the Financial Stability Board (FSB), and the Group of Twenty has contributed to the development of standards that promote financial stability around the world, thereby supporting global growth while protecting the US financial system from adverse developments abroad. Preeminent among these domestic and global efforts have been steps to increase the loss-absorbing capacity of banks, regulations to limit both maturity transformation in short-term funding markets and liquidity mismatches within banks, and new authorities to facilitate the resolution of large financial institutions and to subject systemically important firms to more stringent prudential regulation.

Several important reforms have increased the loss-absorbing capacity of global banks. First, the quantity and quality of capital required relative to risk-weighted assets have been increased substantially[9]. In addition, a simple leverage ratio provides a backstop, reflecting the lesson imparted by past crises that risk weights are imperfect and a minimum amount of equity capital should fund a firm's total assets. Moreover, both the risk-weighted and simple leverage requirements are higher for the largest, most systemic firms, which lowers the risk of distress at such firms and encourages them to limit activities that could threaten financial stability[10].

Finally, the largest US banks participate in the annual Comprehensive Capital Analysis and Review (CCAR)-the stress tests. In addition to contributing to greater loss-absorbing capacity, the CCAR improves public understanding of risks at large banking firms, provides a forward-looking examination of firms' potential losses during severely adverse economic conditions, and has contributed to significant improvements in risk management.

Reforms have also addressed the risks associated with maturity transformation. The fragility created by deposit-like liabilities outside the traditional banking sector has been mitigated by regulations promulgated by the Securities and Exchange Commission affecting prime institutional money market funds. These rules require these prime

funds to use a floating net asset value, among other changes, a shift that has made these funds less attractive as cash-management vehicles. The changes at money funds have also helped reduce banks' reliance on unsecured short-term wholesale funding, since prime institutional funds were significant investors in those bank liabilities. Liquidity risk at large banks has been further mitigated by a new liquidity coverage ratio and a capital surcharge for global systemically important banks (G-SIBs). The liquidity coverage ratio requires that banks hold liquid assets to cover potential net cash outflows over a 30-day stress period. The capital surcharge for U.S. G-SIBs links the required level of capital for the largest banks to their reliance on short-term wholesale funding[11].

While improvements in capital and liquidity regulation will limit the reemergence of the risks that grew substantially in the mid-2000s, the failure of Lehman Brothers demonstrated how the absence of an adequate resolution process for dealing with a failing systemic firm left policymakers with only the terrible choices of a bailout or allowing a destabilizing collapse. In recognition of this shortcoming, the Congress adopted the orderly liquidation authority in Title II of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) to provide an alternative resolution mechanism for systemically important firms to be used instead of bankruptcy proceedings when necessary to preserve financial stability.

The orderly liquidation authority contains a number of tools, including liquidity resources and temporary stays on the termination of financial contracts, that would help protect the financial system and economy from the severe adverse spillovers that could occur if a systemic firm failed. Importantly, any losses incurred by the government in an Orderly Liquidation Authority resolution would not be at the expense of taxpayers, since the statute provides that all such losses must be borne by other large financial firms through subsequent assessments. In addition, the Congress required that the largest banks submit living wills that describe how they could be resolved under bankruptcy[12]. And the Federal Reserve has mandated that systemically important banks meet total loss-absorbing ca-

pacity requirements, which require these firms to maintain long-term debt adequate to absorb losses and recapitalize the firm in resolution. These enhancements in resolvability protect financial stability and help ensure that the shareholders and creditors of failing firms bear losses. Moreover, these steps promote market discipline, as creditors - knowing full well that they will bear losses in the event of distress - demand prudent risk-taking, thereby limiting the problem of too-big-to-fail.

Financial stability risks can also grow large outside the regulated banking sector, as amply demonstrated by the events of 2007 and 2008. In response, a number of regulatory changes affecting what is commonly referred to as the shadow banking sector have been instituted. A specific example of such risks, illustrative of broader developments, was the buildup of large counterparty exposures through derivatives between market participants and AIG that were both inappropriately risk-managed and opaque. To mitigate the potential for such risks to arise again, new standards require central clearing of standardized over-the-counter derivatives, enhanced reporting requirements for all derivatives, and higher capital as well as margin requirements for noncentrally cleared derivatives transactions[13].

Another important step was the Congress's creation of the Financial Stability Oversight Council (FSOC). The council is responsible for identifying risks to financial stability and for designating those financial institutions that are systemically important and thus subject to prudential regulation by the Federal Reserve. Both of these responsibilities are important to help guard against the risk that vulnerabilities outside the existing regulatory perimeter grow to levels that jeopardize financial stability[14].

The financial system is safer

The evidence shows that reforms since the crisis have made the financial system substantially safer. Loss-absorb-

ing capacity among the largest banks is significantly higher, with Tier 1 common equity capital more than doubling from early 2009 to now[15]. The annual stress-testing exercises in recent years have led to improvements in the capital positions and risk-management processes among participating banks. Large banks have cut their reliance on short-term wholesale funding essentially in half and hold significantly more high-quality, liquid assets. Assets under management at prime institutional money market funds that proved susceptible to runs in the crisis have decreased substantially. And the ability of regulators to resolve a large institution has improved, reflecting both new authorities and tangible steps taken by institutions to adjust their organizational and capital structure in a manner that enhances their resolvability and significantly reduces the problem of too-big-to-fail.

The progress evident in regulatory and supervisory metrics has been accompanied by shifts in private-sector assessments that also suggest enhanced financial stability. Investors have recognized the progress achieved toward ending too-big-to-fail, and several rating agencies have removed the government support rating uplift that they once accorded to the largest banks. Credit default swaps for the large banks also suggest that market participants assign a low probability to the distress of a large US banking firm. Market-based assessments of the loss-absorbing capacity of large US banks have moved up in recent years, and market-based measures of equity now lie in the range of book estimates of equity.

To be sure, market-based measures may not reflect true risks - they certainly did not in the mid-2000s - and hence the observed improvements should not be overemphasized[16]. But supervisory metrics are not perfect, either, and policymakers and investors should continue to monitor a range of supervisory and market-based indicators of financial system resilience.

Economic research provides further support for the notion that reforms have made the system safer. Studies have demonstrated that higher levels of bank capital mitigate the risk and adverse effects of financial crises[17]. Moreo-

ver, researchers have highlighted how liquidity regulation supports financial stability by complementing capital regulation[18]. Economic models of the resilience of the financial sector - so called top-down stress-testing models - reinforce the message from supervisory stress tests that the riskiness of large banks has diminished over the past decade[19]. Similarly, model-based analyses indicate that the risk of adverse fire sale spillovers across banks or broker-dealers have been substantially mitigated[20].

Is this safer system supporting growth?

I suspect many would agree with the narrative of my remarks so far: the events of the crisis demanded action, needed reforms were implemented, and these reforms have made the system safer. Now - a decade from the onset of the crisis and nearly seven years since the passage of the Dodd-Frank Act and international agreement on the key banking reforms - a new question is being asked: have reforms gone too far, resulting in a financial system that is too burdened to support prudent risk-taking and economic growth?

The Federal Reserve is committed individually, and in coordination with other US government agencies through forums such as the FSOC and internationally through bodies such as the Basel Committee on Banking Supervision and the FSB, to evaluating the effects of financial market regulations and considering appropriate adjustments. Furthermore, the Federal Reserve has independently taken steps to evaluate potential adjustments to its regulatory and supervisory practices. For example, the Federal Reserve initiated a review of its stress tests following the 2015 cycle, and this review suggested changes to reduce the burden on participating institutions, especially smaller institutions, and to better align the supervisory stress tests with regulatory capital requirements[21].

In addition, a broader set of changes to the new financial regulatory framework may deserve consideration. Such changes include adjustments that may simplify regulations applying to small and medium-sized banks and enhance resolution planning[22].

More broadly, we continue to monitor economic conditions, and to review and conduct research, to better understand the effect of regulatory reforms and possible implications for regulation. I will briefly summarize the current state of play in two areas: the effect of regulation on credit availability and on changes in market liquidity.

The effects of capital regulation on credit availability have been investigated extensively. Some studies suggest that higher capital weighs on banks' lending, while others suggest that higher capital supports lending[23]. Such conflicting results in academic research are not altogether surprising. It is difficult to identify the effects of regulatory capital requirements on lending because material changes to capital requirements are rare and are often precipitated, as in the recent case, by financial crises that also have large effects on lending.

Given the uncertainty regarding the effect of capital regulation on lending, rulemakings of the Federal Reserve and other agencies were informed by analyses that balanced the possible stability gains from greater loss-absorbing capacity against the possible adverse effects on lending and economic growth[24]. This ex ante assessment pointed to sizable net benefits to economic growth from higher capital standards - and subsequent research supports this assessment[25]. The steps to improve the capital positions of banks promptly and significantly following the crisis, beginning with the 2009 Supervisory Capital Assessment Program, have resulted in a return of lending growth and profitability among US banks more quickly than among their global peers.

While material adverse effects of capital regulation on broad measures of lending are not readily apparent, credit may be less available to some borrowers, especially homebuyers with less-than-perfect credit histories and, perhaps, small businesses. In retrospect, mortgage borrowing was clearly too easy for some households in the mid-2000s, resulting in debt burdens that were unsustainable and ultimately damaging to the financial system.

Currently, many factors are likely affecting mortgage lending, including changes in market perceptions of the risk associated with mortgage lending; changes in practices at the government-sponsored enterprises and the Federal Housing Administration; changes in technology that may be contributing to entry by nonbank lenders; changes in consumer protection regulations; and, perhaps to a limited degree, changes in capital and liquidity regulations within the banking sector. These issues are complex and interact with a broader set of challenges related to the domestic housing finance system.

Credit appears broadly available to small businesses with solid credit histories, although indicators point to some difficulties facing firms with weak credit scores and insufficient credit histories[26]. Small business formation is critical to economic dynamism and growth. Smaller firms rely disproportionately on lending from smaller banks, and the Federal Reserve has been taking steps and examining additional steps to reduce unnecessary complexity in regulations affecting smaller banks[27].

Finally, many financial market participants have expressed concerns about the ability to transact in volume at low cost-that is, about market liquidity, particularly in certain fixed-income markets such as that for corporate bonds. Market liquidity for corporate bonds remains robust overall, and the healthy condition of the market is apparent in low bid-ask spreads and the large volume of corporate bond issuance in recent years. That said, liquidity conditions are clearly evolving. Large dealers appear to devote less of their balance sheets to holding inventories of securities to facilitate trades and instead increasingly facilitate trades by directly matching buyers and sellers. In addition, algorithmic traders and institutional investors are a larger presence in various markets than previously, and the willingness of these institutions to support liquidity in stressful conditions is uncertain.

While no single factor appears to be the predominant cause of the evolution of market liquidity, some regulations may be affecting market liquidity somewhat. There may be benefits to simplifying aspects of the Volcker rule, which

limits proprietary trading by banking firms, and to reviewing the interaction of the enhanced supplementary leverage ratio with risk-based capital requirements. At the same time, the new regulatory framework overall has made dealers more resilient to shocks, and, in the past, distress at dealers following adverse shocks has been an important factor driving market illiquidity. As a result, any adjustments to the regulatory framework should be modest and preserve the increase in resilience at large dealers and banks associated with the reforms put in place in recent years.

Remaining challenges

So where do we stand a decade after the onset of the most severe financial crisis since the Great Depression? Substantial progress has been made toward the Federal Reserve's economic objectives of maximum employment and price stability, in putting in place a regulatory and supervisory structure that is well designed to lower the risks to financial stability, and in actually achieving a stronger financial system. Our more resilient financial system is better prepared to absorb, rather than amplify, adverse shocks, as has been illustrated during periods of market turbulence in recent years. Enhanced resilience supports the ability of banks and other financial institutions to lend, thereby supporting economic growth through good times and bad.

Nonetheless, there is more work to do. The balance of research suggests that the core reforms we have put in place have substantially boosted resilience without unduly limiting credit availability or economic growth. But many reforms have been implemented only fairly recently, markets continue to adjust, and research remains limited. The Federal Reserve is committed to evaluating where reforms are working and where improvements are needed to most efficiently maintain a resilient financial system.

Moreover, I expect that the evolution of the financial system in response to global economic forces, technology, and, yes, regulation will result sooner or later in the all-too-familiar risks of excessive optimism, leverage, and ma-

turity transformation reemerging in new ways that require policy responses. We relearned this lesson through the pain inflicted by the crisis. We can never be sure that new crises will not occur, but if we keep this lesson fresh in our memories - along with the painful cost that was exacted by the recent crisis - and act accordingly, we have reason to hope that the financial system and economy will experience fewer crises and recover from any future crisis more quickly, sparing households and businesses some of the pain they endured during the crisis that struck a decade ago. ■

Janet L Yellen is Chair of the Federal Reserve

Endnotes

1. Over the 12 quarters ending in the first quarter of this year, borrowing by the nonfinancial business sector increased at an annual rate just above 6 percent, on average, and borrowing by households and nonprofit institutions rose at an annual rate of 3-1/4 percent, on average; the corresponding average pace of increase in nominal gross domestic product was 3-3/4 percent. Over the same period, lending by private depository institutions advanced at an annual rate of nearly 6-1/2 percent.

2. A contemporaneous perspective on subprime mortgage market developments at this time is provided in Ben S Bernanke (2007), "The Subprime Mortgage Market," speech delivered at the Federal Reserve Bank of Chicago's 43rd Annual Conference on Bank Structure and Competition, Chicago, May 17.

3. On August 17, 2007, the Federal Reserve Board reduced the primary credit rate at the discount window by 50 basis points and announced a change to the Reserve Banks' usual practices to allow the provision of term financing for as long as 30 days, renewable by the borrower. The changes were announced to remain in place until the Federal Reserve deter-

mined that market liquidity had improved materially. See Board of Governors of the Federal Reserve System (2007), "Federal Reserve Board Discount Rate Action," press release, August 17.

4. The proceedings from the 2007 conference are instructive about the range of views regarding housing-related developments preceding the acute phase of the financial crisis. See Federal Reserve Bank of Kansas City (2007), "Housing, Housing Finance, and Monetary Policy," proceedings of an economic policy symposium (Kansas City: FRBKC).

5. For a discussion of the correspondence between the steps taken by the Federal Reserve and those suggested by Walter Bagehot in the 19th century, see Brian F Madigan (2009), "Bagehot's Dictum in Practice: Formulating and Implementing Policies to Combat the Financial Crisis," speech delivered at the Federal Reserve Bank of Kansas City's annual economic symposium, Jackson Hole, Wyo., August 21.

6. A timeline of developments in the United States over the financial crisis is available on the Federal Reserve Bank of St. Louis's website at https://www.stlouisfed.org/financial-crisis/full-timeline. The failure of Fannie Mae and Freddie Mac is marked by the decision of the Federal Housing Finance Agency (FHFA) to place Fannie Mae and Freddie Mac in government conservatorship on September 7, 2008. Links to documents outlining the actions taken around this time are available on the FHFA's website at https://www.fhfa.gov/Media/PublicAffairs/Pages/Conservatorship-of-Fannie-Mae-and-Freddie-Mac.aspx.

7. In the fall of 2008, the three largest investment banks were (in alphabetical order) Goldman Sachs, Merrill Lynch, and Morgan Stanley. Merrill Lynch agreed to be acquired by Bank of America, and the remaining two firms became bank holding companies.

8. The notion that popular sentiment may contribute to mispricing of assets--for example, the power of the madness of crowds--is attributed to Charles Mackay (1841), Memoirs of Extraordinary Popular Delusions and the Madness of Crowds (London: Richard Bentley). A more modern perspective, and one using a phrase as memorable as the madness of crowds, is provided by Robert J Shiller (2016), Irrational Exuberance, 3rd ed. (Princeton, NJ: Princeton University Press). The notion that economic stability can generate a buildup of imbalances that subsequently contributes to instability is presented in Hyman P Minsky (1974), "The Modeling of Financial Instability: An Introduction," in Modeling and Simulation, Vol. 5, Part

1, proceedings of the Fifth Annual Pittsburgh Conference (Pittsburgh: Instrument Society of America), pp. 267-72. A related discussion of how financial excesses often precede downturns (and even panics) is provided in Charles P Kindleberger and Robert Z Aliber (2005), Manias, Panics, and Crashes: A History of Financial Crises, 5th ed. (Hoboken, NJ: John Wiley & Sons).

9. These improvements encompass a number of changes. The regulatory requirements for capital have been increased and focus on Tier 1 common equity, which proved more capable of absorbing losses than lower-quality forms of capital. The role of bank internal models in determining risk-weighted assets also has been significantly constrained in the United States. In addition, exposures previously considered off balance sheet have been incorporated into risk-weighted assets.

10. The Federal Reserve Board, the FDIC, and the Office of the Comptroller of the Currency adopted a final rule to strengthen the leverage ratio standards for the largest, most interconnected US banking organizations on April 8, 2014. Under the final rule, covered bank holding companies must maintain a leverage buffer of 2 percentage points above the minimum supplementary leverage ratio requirement of 3 percent, for a total of 5 percent, to avoid restrictions on capital distributions and discretionary bonus payments (see Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation, and Office of the Comptroller of the Currency (2014), "Agencies Adopt Enhanced Supplementary Leverage Ratio Final Rule and Issue Supplementary Leverage Ratio Notice of Proposed Rulemaking," joint press release, April 8). The Federal Reserve approved a final rule imposing risk-based capital surcharges on the largest, most systemically important US bank holding companies on July 20, 2015; in connection with the final rule, the Board issued a white paper describing the calibration of the risk-based capital surcharges (see Board of Governors of the Federal Reserve System (2015), "Federal Reserve Board Approves Final Rule Requiring the Largest, Most Systemically Important US Bank Holding Companies to Further Strengthen Their Capital Positions," press release, July 20).

11. Moreover, the Federal Reserve's Comprehensive Liquidity Analysis and Review, in which supervisors analyze the liquidity risks and practices at large banks, has promoted improvements in liquidity-risk management. The US banking agencies also have proposed a net stable funding ratio (NSFR) to help ensure that large banks have a stable funding profile over a one-year horizon, and we are working toward finalization of the NSFR.

12. In addition to these steps, the Board issued another proposal to make G-SIBs more resolvable in May of last year (see Board of Governors of the Federal Reserve System (2016), "Federal Reserve Board Proposes Rule to Support US Financial Stability by Enhancing the Resolvability of Very Large and Complex Financial Firms," press release, May 3). This proposed rule would impose restrictions on G-SIBs' qualified financial contracts--including derivatives and repurchase agreements (or repos) - to guard against the rapid, mass unwinding of those contracts during the resolution of a G-SIB. The proposed restrictions are a key step toward G-SIB resolvability because rapidly unwinding these contracts could destabilize the financial system by causing asset fire sales and toppling other firms.

13. One area in which regulations have shifted to a lesser degree in the United States is that of time-varying macroprudential tools, in which regulatory requirements are adjusted to address changes in vulnerabilities that may affect the financial system. For example, US regulatory authorities have adopted rules that allow use of the countercyclical capital buffer, but other time-varying tools are limited in the United States. This issue is discussed in, for example, Stanley Fischer (2015), "Macroprudential Policy in the US Economy," speech delivered at "Macroprudential Monetary Policy," 59th Economic Conference of the Federal Reserve Bank of Boston, Boston, October 2.

14. For example, the FSOC contributed, through its identification process, to the development of the Securities and Exchange Commission reforms affecting money market funds. The FSOC has also designated four firms as systemically important-AIG, GE Capital, Prudential, and MetLife. GE Capital chose to shrink, adjust its business model, and reduce its footprint in short-term wholesale funding markets-and hence reduce a source of systemic risk. These actions caused the FSOC to subsequently remove its designation as systemically important last year-illustrating how the designation process allows both identifying systemic firms and removing such designations when appropriate.

15. The increase in Tier 1 common equity among bank holding companies has been sizable, especially for the largest banks. If the largest banks are defined as either the eight US global systemically important banks or the US bank holding companies that participated in the CCAR in 2017 (and for which data are available for 2009:Q1), Tier 1 common equity has more than doubled in dollar terms and relative to risk-weighted assets from the first quarter of 2009 to the most recent observations.

16. For example, Natasha Sarin and Lawrence Summers have reviewed market-based measures of bank equity and related measures of bank risks and concluded that such measures have not improved since the mid-2000s. This assessment may understate the improvement in fundamental risk within the banking sector, as it takes the elevated valuations and low assessment of default risk implied by market prices during the earlier period as indicative of fundamentals. Despite these shortcomings, their analysis is a useful reminder of the importance of considering both regulatory metrics and assessments implied by market prices. See Natasha Sarin and Lawrence H. Summers (2016), "Understanding Bank Risk through Market Measures (PDF)," Brookings Papers on Economic Activity, Fall, pp. 57-109.

17. For example, see the review of evidence in Simon Firestone, Amy Lorenc, and Ben Ranish (2017), "An Empirical Economic Assessment of the Costs and Benefits of Bank Capital in the US (PDF)," Finance and Economics Discussion Series 2017-034 (Washington: Board of Governors of the Federal Reserve System, April). Some research is less supportive of the role of bank capital in limiting the risk of financial crises but suggests that higher levels of bank capital limit the economic costs of a financial crisis (for example, Òscar Jordà, Björn Richter, Moritz Schularick, and Alan M. Taylor (2017), "Bank Capital Redux: Solvency, Liquidity, and Crisis," NBER Working Paper Series 23287 (Cambridge, Mass.: National Bureau of Economic Research, March)). Some of the differences in findings across studies may be due to the degree to which the studies incorporate data from different countries and over different periods, as researchers disagree over the extent to which comparisons across countries or periods appropriately account for other factors that differ across such dimensions.

18. For example, Charles AE Goodhart, Anil K Kashyap, Dimitrios P Tsomocos, and Alexandros P Vardoulakis (2013), "An Integrated Framework for Analyzing Multiple Financial Regulations," International Journal of Central Banking, supp. 1, vol. 9 (January), pp. 109-43; and Gazi I Kara and S Mehmet Ozsoy (2016), "Bank Regulation under Fire Sale Externalities (PDF)," Finance and Economics Discussion Series 2016-026 (Washington: Board of Governors of the Federal Reserve System, April).

19. For example, researchers at the Federal Reserve Bank of New York have developed a top-down stress-testing model, and simulation results from the model suggest that the resilience of the US banking system has improved since the crisis;

see Beverly Hirtle, Anna Kovner, James Vickery, and Meru Bhanot (2014), "Assessing Financial Stability: The Capital and Loss Assessment under Stress Scenarios (CLASS) Model (PDF)," Staff Report 663 (New York: Federal Reserve Bank of New York, February; revised July 2015).

20. For example, see Fernando Duarte and Thomas Eisenbach (2013), "Fire-Sale Spillovers and Systemic Risk (PDF)," Staff Report 645 (New York: Federal Reserve Bank of New York, October; revised February 2015).

21. In response to the Federal Reserve's review and other information, the Board finalized a rule adjusting its capital plan and stress-testing rules, effective for the 2017 cycle, on January 30, 2017. The final rule removes large and noncomplex firms from the qualitative assessment of the Federal Reserve's CCAR, reducing significant burden on these firms and focusing the qualitative review in CCAR on the largest, most complex financial institutions. More generally, changes to improve regulatory and supervisory practices related to stress testing by reducing unnecessary burden while preserving resilience are under consideration. Possible changes have been discussed in Daniel K Tarullo (2016), "Next Steps in the Evolution of Stress Testing," speech delivered at the Yale University School of Management Leaders Forum, New Haven, Conn., September 26.

22. An overview of a set of principles that may guide such adjustments is discussed by Jerome H Powell (2017), "Relationship between Regulation and Economic Growth," statement before the Committee on Banking, Housing, and Urban Affairs, US Senate, June 22. In addition, the Federal Reserve Board has continued to engage in international efforts to assess the effects of reforms and possible adjustments; in this context, the FSB has developed a framework for the post-implementation evaluation of the effects of the Group of Twenty financial regulatory reforms; see Financial Stability Board (2017), Framework for Post-Implementation Evaluation of the Effects of the G20 Financial Regulatory Reforms (PDF) (Basel, Switzerland: FSB, July).

23. The related literature is sizable. An early contribution is Ben S Bernanke and Cara S Lown (1991), "The Credit Crunch," Brookings Papers on Economic Activity, no. 2, pp. 205-47. Research finding a sizable negative relationship between capital requirements and lending includes Shekhar Aiyar, Charles W Calomiris, and Tomasz Wieladek (2014), "Does Mac-

ro-Prudential Regulation Leak? Evidence from a UK Policy Experiment," Journal of Money, Credit and Banking, vol. 46 (s1; February), pp. 181-214. Research finding little relationship between lending and capital ratios (outside financial crises) includes Mark Carlson, Hui Shan, and Missaka Warusawitharana (2013), "Capital Ratios and Bank Lending: A Matched Bank Approach," Journal of Financial Intermediation, vol. 22 (October), pp. 663-87. Research suggesting that higher capital levels may increase lending includes Leonardo Gambacorta and Hyun Song Shin (2016), "Why Bank Capital Matters for Monetary Policy (PDF)," BIS Working Papers 558 (Basel, Switzerland: Bank for International Settlements, April).

24. For example, see Basel Committee on Banking Supervision (2010), An Assessment of the Long-Term Economic Impact of Stronger Capital and Liquidity Requirements (PDF) (Basel, Switzerland: BCBS, August); and Macroeconomic Assessment Group (2010), Interim Report: Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements (PDF) (Basel, Switzerland: MAG, August).

25. The ex ante studies from the Basel Committee and the Macroeconomic Assessment Group referenced in note 24 pointed to sizable net benefits from higher capital requirements. More academic research pointing to similar conclusions using macroeconomic models (and typically focused on model-specific measures of economic welfare) includes Michael T Kiley and Jae W Sim (2014), "Bank Capital and the Macroeconomy: Policy Considerations," Journal of Economic Dynamics and Control, vol. 43 (June), pp. 175-98; Laurent Clerc, Alexis Derviz, Caterina Mendicino, Stephane Moyen, Kalin Nikolov, Livio Stracca, Javier Suarez, and Alexandros P Vardoulakis (2015), "Capital Regulation in a Macroeconomic Model with Three Layers of Default," International Journal of Central Banking, vol. 11 (June), pages 9-63; and Juliane Begenau (2016), "Capital Requirements, Risk Choice, and Liquidity Provision in a Business Cycle Model," unpublished paper, Harvard Business School, September. Subsequent analyses, albeit ones that follow similar approaches, also suggest that there are net benefits to higher capital standards. One example is the analysis by Firestone, Lorenc, and Ranish, "An Empirical Economic Assessment," in note 17. Another is Ingo Fender and Ulf Lewrick (2016), "Adding It All Up: The Macroeconomic Impact of Basel III and Outstanding Reform Issues (PDF)," BIS Working Papers 591 (Basel, Switzerland: Bank for International Settlements, November). Indeed, this research points to benefits from capital requirements in excess of those adopted, a con-

clusion also reached in Wayne Passmore and Alexander H von Hafften (2017), "Are Basel's Capital Surcharges for Global Systemically Important Banks Too Small? (PDF)" Finance and Economics Discussion Series 2017-021 (Washington: Board of Governors of the Federal Reserve System, February).

26. This conclusion is consistent with, for example, the findings in Federal Reserve Banks (2017), 2016 Small Business Credit Survey: Report on Employer Firms (PDF) (New York: Federal Reserve Bank of New York, April).

27. As I have discussed previously, the Federal Reserve has been considering improvements through a number of work streams. For example, the Federal Reserve and the other banking agencies have recently completed the Economic Growth and Regulatory Paperwork Reduction Act (EGRPRA) review. Under EGRPRA, the federal banking agencies are required to conduct a joint review of their regulations every 10 years to identify provisions that are outdated, unnecessary, or unduly burdensome. The Federal Reserve viewed this review as a timely opportunity to step back and identify ways to reduce regulatory burden, particularly for smaller or less complex banks that pose less risk to the US financial system. I discussed preliminary emerging themes from this review in Janet L Yellen (2016), "Supervision and Regulation," statement before the Committee on Financial Services, US House of Representatives, September 28. For the final EGRPRA report to the Congress, see Board of Governors of the Federal Reserve System, Office of the Comptroller of the Currency, Federal Deposit Insurance Corporation, and National Credit Union Administration (2017), Joint Report to Congress: Economic Growth and Regulatory Paperwork Reduction Act (PDF) (Washington: Federal Financial Institutions Examination Council, March).

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