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Economic Review of the Financial Regulation Agenda
Bibliography and Annexes

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

A reformed financial sector for Europe

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LIST OF ABBREVIATIONS

ABCP	Asset-Backed Commercial Paper
ABS	Asset-Backed Securities
AIF	Alternative Investment Funds
AIFMD	Alternative Investment Funds Managers Directive
ATM	Automated Teller Machine
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BRIC	Brazil, Russia, India and China
BRRD	Banking Recovery and Resolution Directive
CCP	Central Counterparty
CDO	Collateralised Debt Obligation
CDS	Credit Default Swap
CESEE	Central, Eastern and South Eastern Europe
CFTC	Commodity Futures Trading Commission
CGFS	Committee on the Global Financial System
CME	Chicago Mercantile Exchange
CNAV	Constant Net Asset Value
CNMV	Comisión Nacional del Mercado de Valores
CRA	Credit Rating Agency
CRD	Capital Requirements Directive
CRR	Capital Requirements Regulation
CRR/CRD IV	Capital Requirements Regulation and Capital Requirements Directive IV ("CRD IV package")
CSD	Central Securities Depository
CSDR	Central Securities Depositories Regulation
DGS	Deposit Guarantee Scheme
DGSD	Deposit Guarantee Scheme Directive
EURIBOR	Euro Interbank Offered Rate
EBA	European Banking Authority
ECB	European Central Bank
EFRAG	European Financial Reporting Advisory Group
EIOPA	European Insurance and Occupational Pensions Authority
ELA	Emergency Lending Assistance
EMIR	European Market Infrastructure Regulation
EMS	European Monetary System
EMU	Economic and Monetary Union
ESA	European Supervisory Authority
ESBC	European System of Central Banks
ESFS	European System of Financial Supervision
ESIS	European Standardised Information Sheet

ESM	European Stability Mechanism
ESMA	European Securities and Markets Authority
ESRB	European Systemic Risk Board
EP	European Parliament
EuLTIFs	European Long-Term Investment Funds
EuSEFs	European Social Entrepreneurship Funds
EuVECAs	European Venture Capital Funds
EUR	Euro
FCA	Financial Conduct Authority
FDI	Foreign Direct Investment
FDIC	Federal Deposit Insurance Corporation
FHFA	Federal Housing Finance Agency
FRAs	Forward Rate Agreements
FSA	Financial Services Authority
FSAP	Financial Sector Assessment Program
FSB	Financial Stability Board
FX	Foreign Exchange
GDP	Gross Domestic Product
G-SIB	Global Systemically Important Bank
HFT	High Frequency Trading
HLEG	High Level Expert Group
HQA	High Quality Assets
HQLA	High-Quality Liquid Assets
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IBORs	Interbank Offered Rates
ICS	Investor Compensation Scheme
IFRS	International Financial Reporting Standards
IMD	Insurance Mediation Directive
IMF	International Monetary Fund
ISDA	International Swaps and Derivatives Association
KID	Key Information Document
LAC	Loss Absorbing Capacity
LCR	Liquidity Coverage Ratio
LIBOR	London Interbank Offered Rate
LTRO	Long-Term Refinancing Operations
MAD	Market Abuse Directive
MAG	Macroeconomic Assessment Group
MAGD	Macroeconomic Assessment Group on Derivatives
MAR	Market Abuse Regulation
MAR/CSMAD	Market Abuse Regulation and Directive on Criminal Sanctions

MBS	Mortgage-Backed Securities
MCD	Mortgage Credit Derivative
MFI	Monetary Financial Institution
MiFID	Markets in Financial Instruments Directive
MiFIR	Markets in Financial Instruments Regulation
MMF	Money Market Fund
MPO	Monetary Policy Operation
MoU	Memorandum of Understanding
MS	Member State
MTF	Multilateral Trading Facilities
NAV	Net Asset Value
NFC	Non-Financial Corporation
NFPS	Non-Financial Private Sector
NPL	Non-Performing Loans
NSFR	Net Stable Funding Ratio
NYSE	New York Stock Exchange
OECD	Organisation for Economic Co-operation and Development
OTC	Over-the-Counter
OTF	Organised Trading Facility
PRIIPs	Packaged Retail and Insurance-based Investment Products
PAD	Payment Accounts Directive
PSD	Payment Services Directive
RCAP	Regulatory Consistency Assessment Programme
RMBS	Residential Mortgage-Backed Security
RoE	Return-on-Equity
ROSC	Reports on the Observance of Standards and Codes
RWA	Risk-Weighted Assets
SFT	Securities Financing Transaction
SIV	Structured Investment Vehicle
SMA	Single Market Act
SME	Small and Medium Enterprise
SRF	Single Resolution Fund
SRM	Single Resolution Mechanism
SSM	Single Supervisory Mechanism
SSR	Short-selling Regulation
T2S	Target 2 Securities
TBTF	Too Big To Fail
TIBOR	Tokyo Interbank Offered Rate
UCITS	Units in Collective Investment Undertakings
USD	US dollar
WACC	Weighted Average Cost Of Capital

VaR	Value-at-Risk
VNAV	Variable Net Asset Value

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ANNEX 1: REVIEW OF EXISTING STUDIES

This annex presents a literature review of the main quantitative impact studies on banking sector reform. It reviews those studies prepared by industry, public authorities and academics. While it only covers banking sector reform, focusing in particular on the Basel III reforms, a wider set of literature has been reviewed for the main report. The other (non-banking sector) studies are also referred to, where appropriate, within the relevant sections of the main report and listed in the bibliography.

Studies commissioned or carried out by the industry focus mainly on the private costs of regulation, such as costs on banks' profitability, loan volume and pricing. Few of them go further to translate these banking sector specific impacts into the wider effects on the economy as a whole. The public authority studies tend to focus more on social costs, often struggling to fully estimate the benefits. This is a reflection of the difficulties in quantifying (or even just measuring), the benefits of several fundamental measures[1], such as those to increase transparency. At present, it seems many benefits cannot be appropriately quantified, even by the most state of the art models.

In general, industry estimates tend to be more pessimistic than those undertaken by public institutions, in terms of the potential decline in the volume of lending and the short- and long-term decline in GDP. This is mainly due to the different economic assumptions, regulatory scenarios, forecasting methods and modelling techniques used. Many industry studies were estimated at a time when regulatory changes were still under discussion and not yet finalised. Most industry studies preserved their initial assumption of a swift implementation of all proposed changes under Basel III, despite the final agreement in Basel and its transposition in CRD IV providing for gradual implementation over a longer transitional period. It may therefore not be surprising that there is a wide range of results between industry and public authority studies.

Industry studies

The Institute of International Finance (IIF)[2] published a report on the cumulative impact of Basel III in September 2011. This report focuses on the transitional effects in the short- and medium term. It estimates the negative impact of new regulation in terms of credit and GDP dynamics. An econometric model (NiGEM), developed by the UK National Institute of Economic and Social Research, was used to estimate the impact on the economic activity. The IIF estimates a yearly GDP drop of 0.6 % from the trend for the Euro area over a period of five years (0.7 % in average for all countries included in the study) when measures are implemented in 2015. This drop is primarily triggered by an allegedly sharp decline in the growth of credit supply (up to 4 % in 2020 for the Euro area). According to the IIF, Basel III measures make credit not only more scarce, but also more expensive. Lending rates are projected to increase by 328bp for the period 2012-2019. The IIF study claims that there is a significant risk that the Euro area banking sector will not be able to fully meet the new liquidity

[1] See FSB (2013) for an overview of the measures.
[2] IIF is an industry association that represents more than 430 institutions headquartered in more than 60 countries.

requirements (LCR and NSFR). The IIF results are high compared to those from public institutions. An important assumption which may overstate costs is that increases in safety margins are only due to regulatory changes and not driven by market-adjustments. Moreover, the IIF focuses on only transitional costs and not long term effects in contrast to public institution's studies which also take the long-term effects into account.

PricewaterhouseCoopers coordinated a project (Project Oak) in 2010 undertaken by the six largest UK banks and the British Bankers Association (BBA) to estimate the impact of Basel III and associated reforms in the UK. The study claims that the UK banks have moved much more quickly than the resulting Basel III framework envisages. The estimated economic cost of reforms over a 20 year timeframe ranges between £600 billion and £1.5 trillion (using a multi-equation structural model with separate credit variables). This translates to roughly between 24 % and 104 % of the 2010 GDP. Comparing these economic costs to the simulated benefit of having the risk of a crisis occurring every 20 years, where the cost of a crisis represents 30 % of GDP, gives an indicative economic benefit for the reforms of £200 billion in present value terms.

Other private firms, such as **McKinsey and JP Morgan,** estimate the impact only on bank fundamentals and credit volume and pricing. They base macroeconomic impacts on projections derived from accounting identities and past bank data. The **McKinsey and JP Morgan** primarily look at the impact on the banking sector return-on-equity (RoE). They foresee a sharp decline, from 15 % to 9.7 % by 2012 (McKinsey) or from 13.3 % to 5.4 % in 2011 (JP Morgan), if the banking sector fully internalises the costs of the reform. The studies claim that at these reduced rates of profitability the banking sector would not be able to attract new capital. They assert this is primarily due to higher capital and liquidity requirements and the business model changes being mandated for the derivatives business.

KPMG (2013a, 2103b) has conducted studies on the impact of the new regulation on the banking sector for Belgium and Netherland for the time period 2013 to 2016. These quantitative assessments derive from accounting identities and concentrate on private costs. They look at the effects of regulation on banks' balance sheets and income statements for the following measures: CRD IV/Basel III, crisis management and bank resolution (incl. bail-in), deposit guarantee scheme (DGS) and the financial transaction tax (FTT). Special measures in each country, such as the financial stability contribution for the Belgium banks, are also included. In the baseline scenario, in which banks do not take any additional measures to comply with the new regulatory requirements, the estimates show large falls in bank profitability, and an expectation that they would still not be able to reach the regulatory targets by 2016. The studies suggest that in order to reach the targets, a mix of measures (e.g. structural net costs reduction of 10 %, re-pricing of debt and loans, extra fee business and a liquidity transformation of assets), is necessary - the costs of which would be around EUR 4.4 billion for the Belgian and EUR 3.3 billion for the Dutch banking sectors respectively. KPMG (2013c) also conducts a more qualitative study on the regulatory costs for German banks from 2010 to 2015. This study is based on a sampled survey of 20 German banks forming up to 60 % of the total assets in the German banking sector. The direct costs of regulation for the sample banks are about EUR 2.3 billion for 2010-2012 and EUR 2.9 billion for 2013-2015. These costs include not only the CRD IV package, but also EMIR and other regulatory measures.

Studies by public authorities and academics

The **Basel Committee on Banking Supervision (BCBS)** has coordinated work on estimation of the impact of Basel III among public institutions worldwide in 2009/2010. The Basel Committee established a **Macroeconomic Assessment Group (MAG)** to draft a unified impact report based on the estimation approaches taken by public entities in each country. The interim report issued in June 2010 draws on the preliminary results of several quantitative assessments prepared by central banks and regulators in 13 countries[3] plus the IMF, the ECB and the European Commission Services. The final MAG report was published in December 2010 and reflects the regulatory proposals as agreed by the Basel Committee in September 2010 by the group of Governors and Heads of Supervision (GHOS).

The **MAG study** focuses only on the transitional costs of stronger capital requirements. The estimates consider the macroeconomic response during an eight-year implementation period for a gradual increase in target capital ratios, so that both the quantity and quality expectations of new capital requirements are met. Overall, the MAG's estimates suggest a modest impact on aggregate output in the transition towards higher capital standards. Based on the unweighted median estimate across 97 simulations, the MAG estimated that increasing the target ratio of tangible common equity (TCE) to RWA, in order to meet the agreed minimum requirements and the capital conservation buffer, would result in a maximum decline in GDP of 0.22 % relative to baseline forecasts after 8 and ¾ years. Note that these results apply to any kind of increase of TCE. They do not discriminate by type of increased requirement, e.g. higher regulatory minima buffers, changes to the definitions of capital or risk-weighted assets, or voluntary decisions by banks to increase their capital buffers. The regulatory impact of increased TCE on the volume and the costs of lending in the interim MAG report is also less severe than projected by the industry (e.g. IIF). The median lending volume declines by a maximum 1.9 % for capital changes (TCE rising by one percentage point) and 3.2 % for liquidity changes (a 25 % increase in the liquid-to-total assets ratio) according to the MAG interim results. The median increase in lending spreads under the MAG scenario was 17 bps due to changes in capital requirements and 14 bps due to liquidity requirements.

A later **MAG study in 2011** estimated the impact of **higher capital requirements on global systemic important institutions (G-SIBs**) by scaling the impact of raising capital requirements on the banking system as a whole by the share of G-SIBs in domestic financial systems. The study finds that higher capital requirements on G-SIBs have only a moderate effect on economic activity. It estimates that raising the capital requirements for the top 30 potential G-SIBs by one percentage point over eight years, would lead to a reduction in GDP of 0.06 % below trend which would then be followed by a subsequent recovery, i.e. it will bounce back to the trend. The primary driver of this macroeconomic impact is an increase in lending spreads of 5bp–6bp from the build-up of capital buffers.

The work of the MAG on short-term effects of higher capital requirements was complemented by an assessment initiated by the **Basel Committee on the long-term**

[3] Australia, Brazil, Canada, France, Germany, Italy, Japan, Korea, Mexico, Netherlands, Spain, United Kingdom, United States

economic impact (LEI) of the proposed capital and liquidity reforms[4]. The LEI report, published in August 2010, concludes that the potential benefits of the bank regulatory reforms are large and outweigh the perceived costs. The regulatory benefits are expressed through a reduction in the probability of a crisis multiplied by potential losses once it occurs. The costs are expressed as steady state output losses, mainly related to higher lending rates, resulting from a higher overall cost of capital. The LEI report presents the potential costs/benefits as a median of estimations from thirteen different studies. Key assumptions are within this report are: a full pass-through of capital and funding costs to loan rates; no reduction in operating expenses; no increase in non-interest sources of income; no credit rationing; no changes in the cost of capital and debt arising from higher capital and liquidity ratios; a possible reduction in the liquidity requirements arising from compliance with the capital requirements; a 15 percent return-on-equity (ROE) that firms need to meet all the time; and a 100 bps yield difference between illiquid and liquid assets and long and short liabilities.

The report treats the macroeconomic costs of financial crises as either temporary, in which case the economy returns to its growth path, or permanent, where the economy eventually resumes its pre-crisis growth rate but remains on a lower growth path compared to a no crisis situation. The potential losses associated with banking crises range between 19 % (when only temporary effects are assumed) and 158 % (when large permanent effects are assumed) of the pre-crisis GDP levels. Assuming moderate permanent effect of a financial crisis, the potential costs would sum up to around 63 % of the pre-crisis GDP.

The probability of a financial crisis is derived through two different approaches: (1) reduced-form econometric models based on historical data; and (2) structural (credit risk type) models based on portfolio theory. The second approach resembles the methodology used in the Commission's SYMBOL estimations (see Annex 4). Based on these two approaches and assuming moderate permanent effects of a crisis, then the expected annual benefits of increasing only capital requirements by two percentage points from 7 % to 9 % of RWA would be around 1.62 % of the pre-crisis GDP. When in addition the NSFR is fully met, the annual expected benefits can add up to 1.82 % of the pre-crisis GDP.

The estimation of macroeconomic costs is normally based on various DSGE (Dynamic Stochastic General Equilibrium) type models, which is similar to the QUEST model used to estimate the costs for this report (see Annex 5). It is estimated that increasing capital requirements from 7 % to 9 % of RWA would reduce the long-run steady-state level of GDP by 0.18 % annually (and by 0.26 % when the NSFR is also met).[5] While these numbers represent a median of various different studies from different countries, the numbers for the Euro Area are similar. The net-benefits for the Euro Area sum up to 1.56 % of the pre-crisis GDP. More generally, the LEI reports positive net benefits for a broad range of minimum regulatory capital ratios imposed, even in scenarios when the financial crisis has only temporary effects.

[4] See "An assessment of the long-term economic impact of stronger capital and liquidity requirements", BCBS, August 2010. The report uses bank data that are not restricted to EU Member States.

[5] See BCBS (2010), "An assessment of the long-term economic impact of stronger capital and liquidity requirements", BIS. For the Euro area this numbers are slightly higher (see Table 7, LEI report). No changes in RWA is assumed.

The **European Parliament** published an impact assessment on the different measures within the CRD IV package in June 2011. This assessment evaluates the potential effects of the new capital requirements on the cost of capital and thereby on interest rates through three scenarios: (1) fixed return on equity and bank debt interest rates, (2) complete/incomplete pass-through of increased bank financing costs to bank customers, (3) Modigliani-Miller (MM) perspective on bank financing, assuming that bank financing costs does not change (100 % MM). In the first scenario bank funding rates are assumed to be constant due to the gradual implementation of reforms. The weighted average cost of capital (WACC) is calculated based on the changes in the shares of equity and debt in bank funding. A one percentage point increase in the capital requirements and the liquidity requirements will increase the WACC by 11.5 basis points. In the second scenario the report does not provide a conclusive finding on whether bank cost of funding will be fully transferred to customers. The increase in WACC will lead to a different response in the costs of credit depending on the credit demand elasticities. In the third scenario the study concludes that the WACC increase will be modest. The report by the European Parliament estimates the costs of CRD IV measures on economic output and growth. It finds a one percentage point increase in the capital requirement and the liquidity requirement will lead to a decrease in the GDP growth rate of 0.33 percentage points in the short run. This is breaks down into a decline in the GDP growth rate of 0.18 percentage points due to the increase in the capital requirement and 0.15 percentage points due to the increase in the liquidity requirements[6].

The **Organization for Economic Cooperation and Development (OECD)** provided estimates of the macroeconomic impact of the new Tier 1 and common equity standards in early 2011. OECD uses a simple banking model, where the transmission mechanism is the lending channel. This model assumes the increased costs of funding are directly passed through as an increase in the price (interest rates) of loans. Adjustments on operational costs are not considered. The bank discretionary buffer, which in practice a bank might decide to reduce in a new environment of higher capital requirements, is also kept constant. These assumptions tend to overstate the costs. To meet the capital requirements by 2019, the estimations show that the banks' lending spreads would increase by 54bp for the Euro area and about 50bp for the advanced economies (OECD 2011). The increase in lending rates would translate in 1.14 % decrease in GDP level for the Euro area and 0.73 % for the advanced economies after five years (OECD 2011).

In May 2012, the **UK Financial Services Authority (FSA)** published an empirical study on the impact of changes in prudential standards on economic activity. The total cost of the policy package was estimated at £4.9 billion or 0.38 % of yearly GDP and includes measures related to the FSA's capital requirement regime, CRD III, Basel III minimum requirements, capital conservation and countercyclical buffer, systemic institutions surcharge and the new liquidity coverage ratio. The key finding of this study is that short-run reductions in GDP are more than offset in the longer term as crises become rarer. This is in addition to the increase in financial stability related benefits to public welfare. The study finds the overall net impact on GDP to be

[6] The effects of more stringent liquidity requirements on output are calculated to be 25 % increase in the ratio of liquid asset to total asset. it is however, not clear how the exact calibration on liquidity requirements is applied.

positive, with a net benefit estimated to be £11.9 billion annually (or ranging between £4- 66 billion per year within a 90 % confidence interval).

In September 2012, **the International Monetary Fund (IMF)** published a working paper "Assessing the Cost of Financial Regulation" which assessed the costs of financial regulation in terms of an increased credit spread. The relatively low economic costs found in this study strongly suggest that the benefits will outweigh the costs of regulatory reforms in the long-term.

The IMF caution the approach taken in some other studies (e.g. IIF) that assume all increases in safety margins are due to regulatory changes, which may exaggerate the total cost of reforms. The IMF uses a relative simple model to estimate the increase in credit spreads required to accommodate the various reforms (capital and liquidity requirements, derivatives reforms). IMF assumes that credit providers need to charge for the combination of the cost of allocated capital, the cost of other funding, credit losses, administrative costs, and other miscellaneous factors. Cost estimates are provided for capital and liquidity requirements, derivative reforms, and the effects of higher taxes and fees.

The cumulative impact estimates break down as follows: a 19bp increase in cost of capital; 4bp increase in LCR; 10bp increase in NSFR; 6bp increase due to taxes; and 1bp due to derivative reforms[7]; all of which will be offset by a 9bp decrease in return on equity (ROE) and 2bp spread adjustment for overlaps. The total gross effect on the credit spread is an increase of 29bp. When other actions are taken into account, for example, expense cuts of 5 % and other aggregate adjustments for Europe, the credit spread additionally decreases by 8bp and 5bp respectively. Taking these together, the IMF estimates a total net increase in the credit spread of 17bp.

Sensitivity analysis performed on the cost estimates indicate that reasonable changes in the assumptions would not alter the conclusions dramatically. The results are broadly in line with previous studies, including the official BIS assessment of Base III (BCBS (2010), MAG (2010) and the OECD analysis by Slovik and Cournéde (2010).

In its approach, the IMF extends the methodologies of the public authority studies which lead to substantially lower net economic costs. The increase in the credit spreads are roughly a third to a half of those found in the BIS and OECD studies. The major difference stems from the fact that the IMF assumes greater impact from market forces on the safety margins, and as a result less regulatory effect. Industry actions through the end of 2010 suggest that these market reactions would have occurred even if no regulatory changes were contemplated. Another major difference from the previous public authority studies relates to the effect on credit prices and availability. However, the IMF recognises some limitations to its own analysis, including that: transition costs were not examined; a number of regulatory reforms were not modelled; subjective judgement was used in developing some estimates; the

[7] Derivatives reform will have different effects on banks depending on the size of the bank, the profitability of the business, and the structure of the derivative operations within the bank. Non-financial firms should benefit on the whole. Standardisation of trading should decrease the transaction costs. Securitization requirements, currently at 5 % of the total amount, may change. In addition, taxes and fees are estimated at 5.9 % and 8.8 % related to financial stability contribution and deposit insurance fee changes, respectively.

overall modelling approach is relatively simplistic; and that the regulatory implementation is assumed to be efficient and sensible.

In its consultation paper from August 2013 "Strengthening capital standards: implementing CRD IV", the **Bank of England (BoE)** estimated the impact of higher capital requirements coming from the CRD IV package for the period 2010 to 2021. The sample used for estimations includes 10 UK firms representing 64 % and 70 % of the UK banking sector in terms of total assets and lending activity. The BoE clearly states that the estimated numbers should only be indicative, as it is not possible to disaggregate the benefits of the CRD IV package in isolation from other measures taken in response to the crisis that affect deposit-takers' capital ratios. However, the measured benefits of actions taken since the crisis to raise capital ratios are estimated to be in excess of the assessed costs. Therefore, the BoE considers the CRD IV package to be net beneficial to the UK economy. Macroeconomic costs (using the NiGEM model) of higher capital requirements are estimated to be around £ 4.5 billion/year, while the benefits resulting from reducing the probability of a crisis are about £ 15.5/year. Note that these estimates underlie significant model and data uncertainty, which is demonstrated by their variability for different confidence intervals (e.g. for the 95 % confidence interval the net-benefits lie between a range of £ -2 billion and £23 billion / year).

For the UK economy, there have been additional studies on the impact of higher capital and liquidity requirements. **Barrell et al. (2009)** estimates using the NiGEM model that one percentage point rise in the target level of the capital adequacy ratio and in the liquidity ratio is found to reduce equilibrium output by around 0.08 per cent in the UK. Barrell et al. (2009) also provide a cost-benefit analysis of increased capital and liquidity standards. A three percentage point increase in the capital and liquidity ratios will produce long term net benefits that are worth 7 % of 2009 UK GDP.

In a working paper published by the Bank of England, **Miles et al. (2011)** link the capital asset pricing model (CAPM) and the MM theorem by showing that in the absence of systemic risk on bank debt the risk premium on bank equity should decline linearly with leverage. The authors find that the MM offset is about 45 % for UK banks. Miles et al. use a constant elasticity of substitution production function to assess the impact of higher capital requirements. If the UK banks are required to halve their leverage this translates into a long run decline in GDP of 0.15 %, or a fall of the present value of all future output by about 6 % of GDP.

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ANNEX 2: SUMMARY OF PROPOSED AND ADOPTED LEGISLATIONS

The following lists the main measures of the financial reform agenda, categorised into three groups:

- Response to the financial crisis—the measures that constitute the direct response to the financial crisis, as also agreed at international level as part of the G20 commitments;
- Banking Union—the measures to improve the operation of the economic and monetary union in the euro area by creating a Banking Union; and
- Other measures—the wider, additional measures taken to establish a stable, responsible and efficient financial sector that serves the real economy and contributes to economic growth.

Response to financial crisis

Date of COM proposal	*Short title*	*Status*	*Link to website*
Apr 2009	Hedge Funds & Private Equity ("AIFMD")	Completed	http://ec.europa.eu/internal_market/investment/alternative_investments/index_en.htm
Jul 2009	Remuneration & prudential requirements for banks ("CRD III")	Completed	http://ec.europa.eu/internal_market/bank/regcapital/index_en.htm
Sep 2010	Derivatives ("EMIR")	Completed	http://ec.europa.eu/internal_market/financial-markets/derivatives/index_en.htm
Jul 2010	Deposit Guarantee Schemes	Political agreement reached; pending final vote	http://ec.europa.eu/internal_market/bank/guarantee/index_en.htm
Nov 2008 June 2010 Nov 2011	Credit Rating Agencies	Completed	http://ec.europa.eu/internal_market/rating-agencies/index_en.htm
Jul 2011	Single Rule Book of prudential requirements for banks: capital, liquidity & leverage + stricter rules on remuneration and improved tax transparency ("CRD IV package")	Completed	http://ec.europa.eu/internal_market/bank/regcapital/index_en.htm
Oct 2011	Enhanced framework for securities ("MiFID II")	Political agreement reached; pending	http://ec.europa.eu/internal_market/securities/isd/mifid/index_en.htm

		final formal adoption	
Oct 2011	Enhanced framework to prevent market abuse ("MAD/R")	Political agreement reached; pending final formal adoption	http://ec.europa.eu/internal_market/securities/abuse/index_en.htm
Jun 2012	Prevention, management & resolution of bank crises ("BRRD")	Political agreement reached; pending final vote	http://ec.europa.eu/internal_market/bank/crisis_management/index_en.htm#maincontentSec4
Sep 2013	Shadow banking, including Money Market Funds	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/finances/shadow-banking/index_en.htm
2014	Prevention, management & resolution of financial institutions other than banks	Proposal to be presented by COM	

Banking Union

Date of COM proposal	*Short title*	*Status*	*Link to website*
Sep 2012	Single Supervisory Mechanism	Completed	http://ec.europa.eu/internal_market/finances/banking-union/index_en.htm
Jul 2013	Single Resolution Mechanism	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/finances/banking-union/index_en.htm

Other measures to enhance a stable, responsible and efficient financial sector

Date of COM proposal	*Short title*	*Status*	
July 2007	Risk-based prudential and solvency rules for insurers ("Solvency II")	Completed	http://ec.europa.eu/internal_market/insurance/solvency/latest/archive_en.htm
Sep 2009	Establishment of the European Supervisory Authorities (for banking, capital markets, insurance and pensions) & the	Completed	http://ec.europa.eu/internal_market/finances/committees/index_en.htm

	European Systemic Risk Board regulations		
Sep 2009	Proposal for a review of the Prospectus Directive	Completed	http://ec.europa.eu/internal_market/securities/prospectus/index_en.htm
July 2010	Investor Compensation Schemes	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/securities/isd/investor/index_en.htm
Aug 2010	Strengthened supervision of financial conglomerates (FICOD I)	Completed	http://ec.europa.eu/internal_market/financial-conglomerates/supervision/index_en.htm#maincontentSec2
Sep 2010	Short-Selling & Credit Default Swaps	Completed	http://ec.europa.eu/internal_market/securities/short_selling/index_en.htm
Dec 2010	Creation of the Single Euro Payments Area ("SEPA")	Completed	http://ec.europa.eu/internal_market/payments/sepa/index_en.htm
Jan 2011	New European supervisory framework for insurers ("Omnibus II")	Political agreement reached; pending final vote	http://ec.europa.eu/internal_market/insurance/solvency/latest/index_en.htm
Feb 2011	Interconnection of business registers facilitating cross-border access to information about EU companies	Completed	http://ec.europa.eu/internal_market/company/business_registers/index_en.htm
Mar 2011	Responsible lending (mortgage credit directive, MCD)	Completed	http://ec.europa.eu/internal_market/finservices-retail/credit/mortgage/index_en.htm
Oct 2011	Simplification of accounting	Completed	http://ec.europa.eu/internal_market/accounting/sme_accounting/review_directives/index_en.htm
Oct 2011	Enhanced transparency rules	Completed	http://ec.europa.eu/internal_market/accounting/non-financial_reporting/index_en.htm
Nov 2011	Enhanced framework for audit sector	Political agreement reached; approved by Parliament and endorsed in Coreper in April 2014	http://ec.europa.eu/internal_market/auditing/reform/index_en.htm

Dec 2011	Creation of European Venture Capital Funds (EuVECAs)	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/investment/venture_capital/index_en.htm
Dec2011	Creation of European Social Entrepreneurship Funds (EuSEFs)	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/investment/social_investment_funds/index_en.htm
Mar 2012	Central Securities Depositaries	Political agreement reached; pending final vote	http://ec.europa.eu/internal_market/financial-markets/central_securities_depositories/index_en.htm
Jul 2012	Improved investor information for packaged retail and insurance-based investment products ("PRIIPS")	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/finservices-retail/investment_products/index_en.htm
Jul 2012	Strengthened rules on the sale of insurance products ("IMD II")	Political agreement reached, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/insurance/consumer/mediation/index_en.htm
Jul 2012	Safer rules for retail investment funds ("UCITS")	Political agreement reached; pending final vote	http://ec.europa.eu/internal_market/investment/ucits-directive/index_en.htm
Feb 2013	Strengthened regime on anti-money laundering	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/company/financial-crime/index_en.htm
Apr 2013	Non-financial reporting for companies	Political agreement reached; pending final vote	http://ec.europa.eu/internal_market/accounting/non-financial_reporting/index_en.htm
May 2013	Access to basic bank account / transparency of fees / switching of bank accounts	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/finservices-retail/inclusion/index_en.htm
Jun 2013	Creation of European long-term investment funds (EuLTIFs)	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/investment/long-term/index_en.htm#maincontentSec2
Jul 2013	New rules for innovative payment services (cards,	Proposal presented by	http://ec.europa.eu/internal_market/payments/framework/index_en.htm#psd2

	internet & mobile payments) & the interbank fees paid on card transactions ("multilateral interchange fees")	COM, but not yet adopted by the co-legislators	
Sep 2013	Regulation of Financial Benchmarks	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/securities/benchmarks/index_en.htm
Jan 2014	Structural reform of banks	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/bank/structural-reform/index_en.htm
Jan 2014	Securities financing transactions regulation	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/finances/shadow-banking/index_en.htm
2014	Revised rules for occupational pension funds ("IORP")	Proposal presented by COM, but not yet adopted by the co-legislators	http://ec.europa.eu/internal_market/pensions/directive/index_en.htm
2014	"Say on Pay" & increasing long-term shareholder commitment	Proposal to be presented by COM	

ANNEX 3: OVERVIEW OF REVIEW REPORTS REQUIRED IN KEY LEGISLATIONS

The reform measures include comprehensive review clauses on the application and impact of the respective measures two to five years after entry into force or application of the legislative act. This annex lists the different reports required under the legislations. It is not exhaustive and only covers a selection of reports to be produced under some of the key legislative measures during 2014 and 2016.[8] Other legislative measures also contain review clauses.

Basic legal text	Topic(s)	Deadline
CRR Regulation (EU) No 575/2013	Liquidity (Art. 8)	01/01/14
CRR Regulation (EU) No 575/2013	Cyclicality of capital requirements (Art. 502)	Bi-annually
CRA Regulation Regulation (EU) No 462/2013	Appropriateness of the development of a European creditworthiness assessment for sovereign debt (Art. 39b)	31/12/14
EMIR Regulation (EU) No 648/2012	Progress made by CCPs in developing technical solutions for the transfer by pension scheme arrangements of non-cash collateral as variation margins (Art. 85)	01/08/14
CRR Regulation (EU) No 575/2013	Covered bonds (Art. 502, 503), long-term financing (505), level of application (508), transferred credit risk (512, 513), large exposures (517), own funds (519)	31/12/14
CRR Regulation (EU) No 575/2013	Temporary stricter prudential requirements (Art. 459)	At least on an annual basis
CRD Directive 2013/36/EU	Disclosure (Art. 89), Pillar 2 (161), Central bank funding support measures (161)	31/12/14
CRR Regulation (EU) No 575/2013	Lending to SMEs (Art. 501)	Within 36 months after entry into force
CRD Directive 2013/36/EU	Benchmarking of internal models (Art. 78)	01/04/15
CRD Directive 2013/36/EU	Country by country reporting (Article 89)	31/12/14
CRD Directive 2013/36/EU	Diversity (Art.161)	31/12/16
CRA Regulation Regulation (EU) No 462/2013	Report in respect of the delegated powers in the CRA Regulation (Art. 38a)	At the latest 6 months before 1/6/15
MiFID II (political agreement, pending final formal adoption)	Assessment of the treatment of Central Banks and of the BIS (Art. 1(4g))	01/06/2015
EMIR Regulation (EU) No 648/2012	Application of EMIR (Art. 85), systemic importance of the transactions of non-financial firms in OTC derivatives contracts	18/08/15; 17/08/15
EMIR Regulation (EU) No 648/2012	Risk and cost implications of interoperability arrangement	Annual report
CRD Directive 2013/36/EU	Systemic risk (Art. 132)	31/12/15
CRR	Large exposures to shadow banking	31/12/15

[8] As a result, the table does not include, for example, the various reports required in Solvency II/Omnibus 2 starting in 2017.

Regulation (EU) No 575/2013	entities (Art. 395), investment firms (498, 508), large exposures (507), long-term investments (516), own funds (518)	
SSM (Council Regulation (EU) No 1024/2013) incl. amendment to EBA regulation (Regulation (EU) No 1022/2013)	Application of SSM Regulation; impact on internal market, governance arrangements in SSM and EBA (Art. 2 of Regulation No 1022/2013, Art. 32 of the SSM Regulation)	31/12/15
CRA Regulation Regulation (EU) No 462/2013	Report on steps taken to delete references to ratings and on alternative credit risk assessment tools	31/12/15
CRA Regulation Regulation (EU) No 462/2013	Report assessing disclosure on Structured finance instruments, conflicts of interest, rotation, remuneration, competition, contractual over-reliance on ratings, financial stability (Art. 39)	01/01/16
BRRD (political agreement, pending final vote)	Preventive recapitalizations (Art. 27)	01/01/16
MiFID II (political agreement, pending final formal adoption)	Assessment of the need for temporary exclusion of exchange traded derivatives from the scope of Article 28 and 29 (Art. 43(8))	30/06/2016
CRR Regulation (EU) No 575/2013	SMEs (501)	28/06/16
CRD Directive 2013/36/EU	Remuneration (Art. 161)	30/06/16
CRD Directive 2013/36/EU	Systemic risk (Art. 89, 132), governance (161)	31/12/16
CRR Regulation (EU) No 575/2013	Covered bonds (503), own funds (504), leverage ratio (511), counterparty credit risk (514, 515), extension of Basel I floor (500)	31/12/16; 01/01/17
CRA Regulation Regulation (EU) No 462/2013	Appropriateness and feasibility of a European CRA dedicated to assessing the creditworthiness of MS sovereign debt and/or a European credit rating foundation for all other credit ratings (Art. 39b)	*31/12/16*

ANNEX 4: QUANTITATIVE MODELLING OF BENEFITS

This annex has been prepared by the Joint Research Centre (JRC) of the European Commission (EC). It presents some estimations of potential benefits for public finances and macroeconomic benefits of implementing the Capital Requirement Directive IV (CRD IV) package and the Bank Recovery and Resolution Directive (BRRD) proposal. The methodology used in this section is the same in the BRRD impact assessment published in June 2012.[9]

The benefits of the new bank regulatory framework for public finances are measured as a decrease in the potential costs for public finances in the case of bank defaults when the above reforms are in place. More precisely, the costs are the losses of distressed banks as well as recapitalisation needs (i.e. capital injections solvent banks need to replace depleted capital in order to remain viable) beyond those covered by the available tools set up in the EU legislation (CRD IV package and BRRD).[10] These losses and recapitalisation needs were mostly covered by State aid during the recent financial crisis started. Results are calculated as an aggregate for the entire European Union 27 (EU 27)[11].

Macroeconomic benefits of introducing the CRD IV package and the BRRD arise from the fact that individual banks' increased capital and safety net tools determine a reduction in the probability of a systemic crisis (*Systemic PD* henceforth). This implies that expected costs of a crisis are reduced compared to a situation where CRD IV and BRRD are not in place.

The CRD IV package and BRRD are two pieces of EU legislation which aim to reduce the probability of future crises and also to set up tools which call shareholders and creditors to pay costs of a crisis in case of need. More specifically, the CRD IV package[12] is a package that entered into force in July 2013 which transposes into EU legislation the new global standards on bank capital (the Basel III agreement). The new CRD IV rules "tackle some of the vulnerabilities shown by the banking institutions during the crisis, in particular the insufficient quantity and quality of capital, resulting in the need for unprecedented support from national authorities. More specifically, Basel III rules raise both the quality and quantity of the regulatory capital base and enhance the way Risk Weighted Assets (RWA) are computed. The BRRD Proposal, published by the EC in July 2012 and for which an agreement among the EU decision-making institutions was reached in December 2013, ensures that banks' shareholders and creditors pay their share of costs in case of need (via the bail-in tool) and it sets up pre-funded national Resolution Funds (RF) to be used in

[9] See: http://ec.europa.eu/internal_market/bank/docs/crisis-management/2012_eu_framework/impact_assessment_final_en.pdf. and M. Marchesi, M. Petracco Giudici, J. Cariboni, S: Zedda and F. Campolongo "Macroeconomic cost-benefit analysis of Basel III minimum capital requirements and of introducing Deposit Guarantee Schemes and Resolution Funds", JRC Scientific and Policy Report, 2012, EUR 24603.
http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/28210/1/lbna24603enc.pdf

[10] In this exercise tools vary according to different regulatory scenarios and can include capital, bail-in, deposit guarantee schemes and resolution funds. See also Chapter 4.

[11] Data refer to 2012. Thus, Croatia was still not part of the Union.

[12] see European Parliament and Council, Directive 2013/36/EU of the 26 June, 2013

case bail-in is not sufficient. Moreover, it sets the rules clarifying the role of deposit guarantee schemes (DGS) in the resolution process.

Results in this annex are obtained using the SYMBOL model (Systemic Model of Banking Originated Losses), a simulation engine developed by the JRC, the Directorate General Internal Market and Services, academia, and experts on banking regulation (see De Lisa et al., 2011). Using selected balance sheet data as inputs and the loss distribution function of the Basel Foundation Internal Rating Based (FIRB) approach, it simulates losses within a banking system.[13] The SYMBOL model is also employed to estimate the *Systemic PDs* of occurrence of a systemic crisis for the macroeconomic benefits analysis.

The model can be run under alternative "counterfactual" specifications for the amount of Minimum Capital Requirement (MCR) and for the resolution tools in place, enabling to assess the effects of introducing the CRD IV package and BRRD. In particular, we simulate the effects of moving from a baseline scenario reflecting the situation at the inception of the crisis to alternative ones with improved capital (CRD IV implementation) and bail-in/resolution funds (BRRD introduction).

Benefits for public finances are measured by comparing residual losses (i.e. losses not covered by provisions, capital and safety net tools) in the baseline with those obtained under the alternative "reform" scenarios. Macroeconomic benefits are measured as the avoided expected shortfalls in GDP due to the decrease of the frequency of systemic crises (i.e. reduction of the *Systemic PD*). In this report a systemic banking crisis is defined as a situation where the amount of covered deposits[14] held in distressed banks (i.e. defaulted or undercapitalized) exceed a specified threshold, beyond which authorities would find it impossible to avoid the crisis from spreading into the real economy.

This annex is organized as follows. The next section outlines the SYMBOL model. The data and the regulatory scenarios are subsequently described. The following sections present estimated benefits for public finances and the macroeconomic benefits in terms of avoided costs. The last section concludes. Three appendices give more detail on technical aspects. Appendix 1 describes the preliminary steps for setting up the SYMBOL model. Appendix 2 gives details on the dataset employed. Appendix 3 gives technical details on the estimation of the cost of crisis employed in this annex.

SYMBOL

SYMBOL simulates the distribution of losses in excess of banks' capital within a banking system (usually a country) by aggregating individual banks' losses. Individual banks' losses are generated via Monte Carlo simulation using the Basel FIRB loss distribution function. This function is based on the Vasicek model (see Vasicek,

[13] SYMBOL is run separately for the 27 EU MS and results are then aggregated over the EU.

[14] Covered deposits are deposits protected under Directive 94/19/EC. In rough terms, they represent customer deposits below EUR 100 td . Data on the amount of eligible and covered deposits in EU countries have been estimated by the JRC using data collected from EU DGS and complemented by ECB data (see also Cannas et al., 2013a). These data are used in the current exercise to obtain covered deposits at single bank level starting from customer deposits. The coefficients applied are presented in Appendix 2.

2002), which in broad terms extends the Merton model (see Merton, 1974) to a portfolio of borrowers.[15] Simulated losses are based on an estimate of the average default probability of the portfolio of assets of any individual bank, which is derived from data on banks' MCR and Total Assets (TA).

For the purpose of the present exercise, each SYMBOL simulation ends when 100,000 runs with at least one default are obtained. The large number of runs ensures a sufficient degree of stability in the tail of the loss distributions. As a consequence, the model runs for a few millions of iterations for small countries and hundreds of thousands iterations for medium or large countries.

The model includes also a module for simulating direct contagion between banks, via the interbank lending market. In this case, additional losses due to a contagion mechanism are added on top of the losses generated via Monte Carlo simulation, potentially leading to further bank defaults (see also Step 4 below). The contagion module can be turned off or on depending on the scope of the analysis and details of the simulated scenario.

In addition to bank capital, the model can take into account the existence of a safety net for bank recovery and resolution, where bail-in, DGS, and RF intervene to cover losses exceeding bank capital before they can hit public finances.

Estimations are based on the following assumptions:

- SYMBOL approximates all risks as if they were credit risk; no other risk categories (e.g. market, liquidity or counterparty risks) are explicitly considered.

- SYMBOL implicitly assumes that the FIRB formula adequately represents (credit) risks that banks are exposed to.

- Banks in the system are correlated with the same factor (see Step 2 below);

- All events happen at the same time, i.e. there is no sequencing in the simulated events, except when contagion between banks is considered.

- The only contagion channel is the interbank lending market. SYMBOL assumes that each bank is linked with all others and uses a criterion of proportionality to distribute additional contagion losses: the amount of losses distributed to each bank is determined by the share of its creditor exposure in

[15] The Basel Committee permits banks a choice between two broad methodologies for calculating their capital requirements for credit risk. One alternative, the Standardised Approach, measures credit risk in a standardised manner, supported by external credit assessments. The alternative is the Internal Rating-Based (IRB) approach which allows institutions to use their own internal rating-based measures for key drivers of credit risk as primary inputs to the capital calculation. Institutions using the Foundation IRB (FIRB) approach are allowed to determine the borrowers' probabilities of default while those using the Advanced IRB (AIRB) approach are permitted to rely on own estimates of all risk components related to their borrowers (e.g. loss given default and exposure at default). The Basel FIRB capital requirement formula specified by the Basel Committee for credit risk is the Vasicek model for credit portfolio losses, default values for all parameters except obligors' probabilities of default are provided in the regulatory framework. On the Basel FIRB approach, see Basel Committee on Banking Supervision, 2005, 2006 and 2010 rev. 2011.

the interbank market (for more details and references see also the description of SYMBOL steps below).

We continue this section detailing steps/assumptions of SYMBOL and the way safety net tools are introduced into the framework.

Steps of SYMBOL

- **STEP 1**: Estimation of the Implied Obligors' Probability of Default (IOPD) of the portfolio of each individual bank.

  The model estimates the average IOPD of the portfolio of each individual bank using its total MCR[16] declared in the balance sheet by numerical inversion of the Basel FIRB formula for credit risk. Individual bank data needed to estimate the IOPD are banks' RWA and TA, which can be derived from the balance sheet data. All other parameters are set to their regulatory default values. Appendix 1 gives additional technical details on the FIRB formula for the interested reader.

- **STEP 2**: Simulation of correlated losses for the banks in the system.

  Given the estimated average IOPD, SYMBOL assumes that correlated losses hitting banks can be simulated via Monte Carlo using the same FIRB formula and imposing a correlation structure among banks (with a correlation set to *R*=50 %). This correlation exists either as a consequence of the banks' common exposure to the same borrower or, more generally, to a particular common influence of the business cycle[17]. In each simulation run *j*, losses for bank *i* are simulated as:

$$L_{i,j} = LGD \cdot N\left[\sqrt{\frac{1}{1-R}}N^{-1}(IOPD_i) + \sqrt{\frac{R}{1-R}}N^{-1}(\alpha_{i,j})\right]$$

  where *N* is the normal distribution function, $N^{-1}(\alpha_{i,j})$ are correlated normal random shocks, and $IOPD_i$ is the average implied obligors' probability of default estimated for each bank in Step 1. *LGD* is the Loss Given Default, set as in Basel regulation to 45 %.

- **STEP 3**: Determination of the default event.

  Given the matrix of correlated losses, SYMBOL determines which banks fail. As illustrated in Figure 1, a bank default happens when simulated obligor portfolio losses exceed the sum of the expected losses (EL) and the total actual capital (K) given by the sum of its MCR plus the bank's excess capital, if any :

$$L_{i,j} \geq EL_i + K_i$$

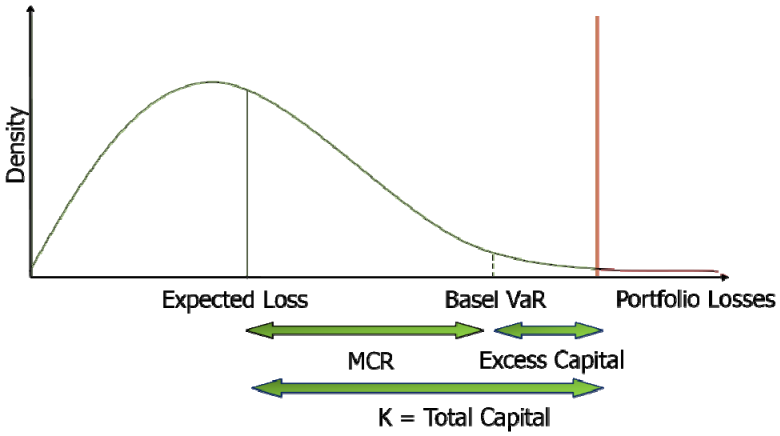
[16] Banks must comply with capital requirements not only for their lending activity and credit risk component. Banks assets are in fact not only made up of loans, and there are capital requirements that derive from market risk, counterparty risk, and operational risk, etc. The main assumption currently behind SYMBOL is that all risk can be approximated as credit risk.

[17] The choice of the 50 % correlation is based on Sironi and Zazzara, 2004. A discussion and a sensitivity check on this assumption can be found in De Lisa et al., 2011.

The green-shaded area in Figure 1 represents the region where losses are covered by provisions and total capital, while the red-shaded one shows when banks default under the above definition. It should be noted that the probability density function of losses for an individual bank is skewed to the right, i.e. there is a very small probability of extremely large losses and a high probability of losses that are closer to the average/expected loss. The Basel Value at Risk (VaR) corresponds to a confidence level of 0.1 %, i.e. the MCR covers losses from the obligors' portfolio with probability 99.9 %. This percentile falls in the green-shaded area as banks generally hold an excess capital buffer on top of the MCR.

Data needed for determining the default event for each bank is its level of total capital.

Figure 1: **Individual bank loss probability density function**



- **STEP 4** (Optional): Contagion mechanism.

  SYMBOL can include a direct contagion mechanism since the default of one bank can compromise the solvency of its creditor banks, thus triggering a domino effect in the banking system. SYMBOL focuses on the role of the interbank lending market in causing contagion. In fact, the failure of a bank is assumed to drive additional losses on the others equal to 40 % of the amounts of its total interbank debts.

  As bank-to-bank interbank lending positions are not publicly available, an approximation is needed to build the whole matrix of interbank linkages. It is assumed that the more a bank is exposed in the interbank market as a whole, the more it will suffer from a default in the system. In particular, contagion losses are apportioned to all other banks proportionally to their interbank loans. A default driven by contagion occurs whenever these additional contagion losses and losses generated via Monte Carlo exceed the bank's available capital. This contagion mechanism stops when no additional bank defaults.

  The magnitude of contagion effects depends on the two assumptions made: first the 40 % interbank debits that are passed on as losses to creditor banks in case of failure, and, second, the criterion of proportionality used to distribute these losses

across banks. [18] A loss of 40 % of the interbank exposure is consistent with the upper bound of economic research on this issue, see e.g. James, 1991, Mistrulli, 2007 and Upper and Worms, 2004. A sensitivity test has been developed in Zedda et al., 2012 in order to test whether variations in the structure of the interbank positions systematically change the magnitude of contagion. The test shows that increasing the concentration of interbank linkages does not relevantly affect the results.

Data needed to simulate contagion is the amount of interbank debts and credits for each individual bank.

- **STEP 5**: Aggregated distribution of losses for the whole system.

  Aggregate losses are obtained by summing losses in excess of capital plus potential recapitalisation needs of all distressed banks in the system (i.e. both failed and undercapitalised banks) in each simulation run.

  In order to compute losses hitting public finances, we consider the amount of funds necessary to recapitalize all banks to an 8 % level of RWA. This is done because of two main reasons: first, this is the level of minimum capitalization under which a bank is considered viable under Basel rules and the minimum level to which banks were recapitalized by public interventions in the past crisis; second, even if under the newly agreed provisions that allow the European Stability Mechanism (ESM) to directly recapitalize banks which have capital ratios between 4.5 % and 8 %,[19] this funding will still be coming from public sources.

  On the other hand, in order to estimate macroeconomic benefits and to be conservative in the estimation of benefits, we consider a recapitalisation to 4.5 % of the RWA of each bank. This is based on the assumptions that banks below this level, if not bailed out, would not be able to access any source of new capital and should thus be considered as equivalent to a defaulted bank in terms of systemic consequences. Similarly, banks which are above this level could possibly issue new equity on the markets and, in the worst case, resort to ESM direct recapitalization. It also has to be noted that considering only banks which are severely undercapitalised as having systemic consequences implies a more conservative estimate of the benefits because the probability of a systemic crisis is lower than in the 8 % recapitalization case.[20]

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[18] In formula, if a bank *j* fails, losses due to contagion on bank *k* equal to: $L_k^{Contagion} = 40\% IB_j^- \frac{IB_k^+}{\sum_{h \neq j} IB_h^+}$

where IB^- and IB^+ are respectively the interbank debts and credits of a bank. This is equivalent to a so-called *maximum entropy* estimation of the interbank matrix.

[19] According to the agreement reached in June 2013, banks with a capital below 4.5 % of RWA would have to receive help from their own government before the ESM can step in via direct recapitalisation. ESM direct bank recapitalisation instrument http://www.eurozone.europa.eu/media/436873/20130621-ESM-direct-recaps-main-features.pdf

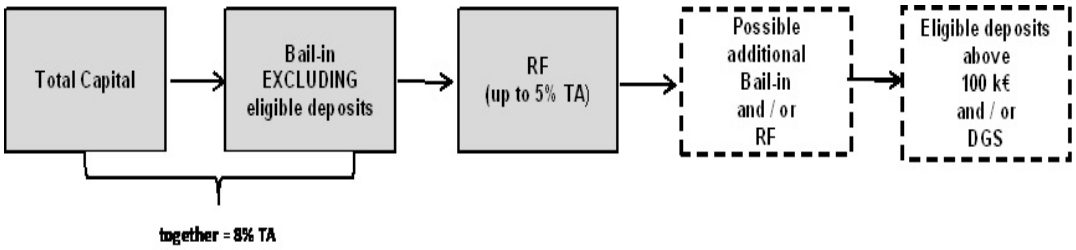
[20] In particular considering a minimum capitalisation ratio equal to 8 % for determining the *Systemic PD* would imply counting towards determination of *Systemic* PD also banks which are undercapitalised by extremely small amounts.

In addition, the model estimates the distribution of covered deposits held in distressed banks (i.e. defaulted and/or needing recapitalisation). This distribution is used to measure the probability of a systemic crisis. This is defined as a crisis where the total of covered deposits held by banks in distress exceed a certain threshold, assumed to be equal to 3 % of the GDP.[21,22]

Implementation of safety net tools

Safety net tools modelled in SYMBOL include bail-in, RF and DGS. These tools are assumed to intervene to cover simulated losses and recapitalization needs, hence protecting public finances. The tools' order of intervention, reflecting the position agreed by the European Parliament, the Council and the EC in December 2013 (see European Parliament and Council, 2013), is sketched in Figure 2. Under the bail-in tool, a minimum amount of losses, equal to 8 % of total liabilities plus own funds (here measured by total assets) needs to be covered by shareholders and unsecured creditors (first two boxes in Figure 2) before other tools can intervene. Then, only in exceptional circumstances the RF can contribute to the resolution (Article 38 of the text agreed) in order to exclude or partially exclude an eligible liability or class of eligible liabilities, absorbing losses up to 5 % of the total assets of the failing bank (third box Figure 2). The total size of RF ex-ante funds equals 1 % of the country-level amount of covered deposits (Article 93). After this, the order of intervention of the remaining tools is subject to the discretion of the resolution authority. For instance the additional bail-in tool could be used (i.e. all other unsecured creditors, if available, could be written down) and/or the residual RF could be called to cover losses above 5 % total liabilities (including own funds) after all unsecured, non-preferred liabilities, other than eligible deposits, have been written down or converted in full (Article 38(3cab)). Eligible deposits (above EUR 100 td) and/or the DGS could also intervene as the last tools (Article 98(a)).[23]

Figure 2: **Order of intervention of the safety net tools**.



Only the first three tools (grey boxes in Figure 2) are considered in this modelling exercise, due to the following reasons:

[21] The GDP is taken from the AMECO dataset by the European Commission Directorate for Economic and Financial Affairs. 3 % of the GDP in terms of covered deposits loosely corresponds to a situation where banks holding assets equal to 20 % of GDP are in distress. This is also almost equivalent to situations where banks holding a share of 5 % of total assets in the banking system are in distress.

[22] Macro-economic benefits are measured using the reduction in the expected costs of a systemic crisis (i.e. the product of its costs and the reduction in its probability) due to the implementation of CRD IV and BRRD. See the section on macro- economic benefits below.

[23] The total size of DGS funds which can be used in resolution is 0.4 % of covered deposits (according to Article 99(10)) "the liability of the DGS shall not be greater than the amount equal to 50 % of the target funding level prescribed for the DGS under applicable Union law", which is 0.8 % of the aggregated covered deposits).

- There is discretionary decision given to the resolution authority to call additional RF intervention above the cap of 5 % of TA (see in Fig. 2 the dotted boxes).

- The amount of additional unsecured debt above the minimum required to comply with the 8 % threshold is not available on a bank-by-bank level and it is likely that the current level of unsecured funding will change due to the implementation of the bail-in tool.

Though not directly considered in the exercise, the additional tools in the dashed boxes of Figure 2 will in practice contribute to further reduce losses. In terms of implementation, in the BRRD scenario it is imposed that all banks hold an amount of capital and bail-in-able liabilities which is needed to trigger the RF intervention, equal to 8 % of total assets.[24] RF is also assumed to absorb losses up to the 5 % of total assets maximum. Moreover, the model assumes that the BRRD tools are, by themselves, sufficient to ensure the orderly resolution of banks and prevent contagion in the system. In practice, to the extent that structural reform is deemed necessary to facilitate orderly resolution for the large banks, the modelled BRRD impacts partly reflect structural reform benefits.

Data

Unconsolidated balance sheet data

The main data source for SYMBOL simulations is Bankscope, a proprietary database of banks' financial statements produced by Bureau van Djik. The dataset covers a quite large sample of banks in 27 EU countries (about 3,000 banks). The data used is as end of 2012. European Central Bank (ECB) data on aggregated banks' total assets per country (see Appendix 2) are used as the statistical population, in order to calculate the sample coverage ratio. This is defined as the share of aggregated total assets in the sample of banks compared to ECB aggregated total assets per country.

To maximize the sample size, robust imputation procedures of missing data have been applied in order to input missing data for capital variables (see Cannas et al., 2013b for more technical details).

Table 1 presents the aggregated sample amounts of selected SYMBOL input variables. Sample data for individual MS are presented in Appendix 2. It should be noted that capital levels and RWA as used in the simulations are modified with respect to current balance sheet data and are therefore different from the ones presented in Table 1. These modifications reflect an estimation of the impact of different capital and RWA definitions, as detailed in the description of the regulatory scenarios below. The last two columns compare the total assets in the sample with the total assets from the population of banks obtained from ECB data. The second to last column shows that our sample covers roughly 72 % of these total assets.

[24] We refer to the sum of capital and bail-in-able liabilities as Loss Absorbing Capacity (LAC) The choice to define a threshold on the TA is in line with the approach agreed by EU institutions in December 2013

Table 1: **Sample used for SYMBOL simulations (aggregated amount of selected variables, data as of December 2012)**.

	SYMBOL sample									ECB
	Banks	G1(**) Banks	Total Assets	RWA	Customer Deposits	IB Credits (*)	IB Debts (*)	Capital	Coverage Ratio	total assets
Total EU-27	2,956	67	29,368	10,514	10,950	4,374	4,907	1,720	72%	40,875

Source: Bankscope, ECB and JRC estimations.
(*) Following the methodology adopted in the Impact assessment of BRRD Proposal, a correction factor for the volume of interbank debts/credits has been applied to the following MS to correct for the inclusion of some classes of debt certificate. The same correction factors as in the BRRD Impact Assessment have been applied.
(**) In this exercise G1 banks are those with Tier1 Capital larger than EUR 3 billion.

Capital and RWA adjustment

Among many other issues, the crisis has shown that the quality of banks' capital was poor and that banks' risks weights were not adequately calibrated under Basel II. Basel III rules aim to tackle these problems (see Basel Committee on Banking Supervision, 2010 rev 2011). In order to assess the benefits of such improvements for EU public finances and their macro-economic impacts, it is therefore necessary to estimate the effects of these definition changes on capitalisation levels.

To properly estimate the effects of introducing Basel III (and thus CRD IV), we make use of the results of the Basel III monitoring exercise run by the European Banking Authority (EBA) (see European Banking Authority, 2013 and Committee of European Banking Supervisors, 2010). The aim of the EBA exercises, which started in 2009 and since then have been regularly updated,[25] is to assess and monitor the impact on a specific sample of EU banks of the new capital standards foreseen in the Basel III Accord.

In particular we use the average reduction in the capital ratio and average increase in the RWA from the monitoring exercise (see Table 2 differentiating between G1 and G2 banks).[26] These adjustments reflect the more stringent definition of capital as well as the new RWA rules,[27] as foreseen in the Basel III Accord. The table should be read as follows: if a G1 bank has capital and RWA in 2012 equal to $K(2012)$ and $RWA(2012)$, its capital and RWA under the new Basel III rules be:

$$K^{adj}(2012) = K(2012) \cdot 0.71$$

$$RWA^{adj}(2012) = RWA(2012) \cdot 1.128.$$

[25] The last published update makes use of bank data as of end 2012, see European Banking Authority, 2013.
[26] In the current exercise G1 banks are those whose Tier1 capital is larger than EUR 3 billion.
[27] From the change in the capital ratio and the change in the RWA one can estimate the change in capital.

In other words, the amount of capital of good quality (i.e. capable of absorbing losses) under Basel II is lower than under Basel III. In the same way, RWA under Basel II were not adequately reflecting some risks faced by the banks.

We will refer to these adjustments as QIS adjustments.

Table 2: **EU average capital and RWA change by banking group due to the CRD IV implementation**.

	G1 banks	G2 banks
RWA 2012 - $QIS^{RWA}(2012)$	1.128	1.102
Capital 2012 - $QIS^{k}(2012)$	0.71	0.76

Source: EBA Basel III monitoring exercice JRC estimation

Regulatory scenarios

In order to measure the benefits of introducing the CRD IV package and the BRRD, SYMBOL is run under various scenarios, aiming to reflect the introduction of improved regulation on capital standards and of resolution tools.

The baseline scenario is meant to proxy the situation where banks comply with Basel II rules, in terms of lower quality of regulatory capital and lower level of the MCR (MCR equal to 8 % of RWA) with respect to what is foreseen in the CRD IV package (i.e. 10.5 % of RWA). The alternative scenarios introduce CRD IV rules in Scenario 1, leading to improved quality and quantity of capital, and bail-in and RF tools (in addition to the CRD IV package) in Scenario 2.

SYMBOL is run considering contagion among banks in the baseline scenarios and in Scenario 1. This aims to represent the fact that without BRRD being implemented, the regulatory setting does not assure that contagion is stopped. The aim of BRRD is, among others, to prevent contagion. Thus in Scenario 2 contagion is not allowed.

One crucial issue for determining the benefits is the treatment of actual capital above the MCR. We will refer to this additional capital on top of MCR as the capital buffer. Banks might hold these buffers because they want to hold a "cushion" of capital above regulatory minima, or they might hold it for reasons that may not be related to regulation and/or as part of a transition towards the CRD IV rules.

Intuitively, not considering the buffers may lead to an overestimation of the benefits, since this implies an assumption that, solely due to CRD IV package, all banks move from 8 % RWA to 10.5 % RWA as a result of the rules: in reality there are banks which already hold an actual capital between 8 % RWA and 10.5 % RWA, or even above the MCR as in CRD IV package. However, considering currently existing buffers in the baseline may lead to an underestimation of the benefits, since it is not certain that banks currently holding a buffer will not maintain its size above the 10.5 % RWA new minimum. Moreover, to the extent that the analysis focuses on the adjustment to the new capital levels as of 2012, looking at actual buffers may ignore some of the adjustment that has already taken place prior to 2012.

It is very difficult to univocally determine the sign of the bias, since the reaction of the banks to CRD IV is not predictable *a priori* and it is hard to discern if banks are already in a transition toward the higher capital level required by CRD IV or not. For these reasons we run each scenario twice, with and without the buffers, and we build ranges of benefits using these alternative assumptions.

The scenarios implemented are displayed in Table 3, with more detail provided below.

Table 3: **Summary of the regulatory scenarios**

Scenario label	CAPITAL			BRRD		Contagion
	CRDIV	Minimum Capitalisation	Additional Capital Buffers	Bail-in	RF	
	Definition	Ratio		(LAC % TA)		
Baseline no buffers	N	8%	N	N	N	Y
Baseline buffers	N	8%	Y	N	N	Y
Secenario 1, no buffers	Y	10.50%	N	N	N	Y
Secenario 1, buffers	Y	10.50%	Y	N	N	Y
Secenario 2, no buffers	Y	10.50%	N	8%	maximum 5% TA	N
Secenario 2, buffers	Y	10.50%	Y	8%	maximum 5% TA	N

- **Baseline scenario: No CRD IV, contagion**. This scenario aims to represent the situation where banks comply with Basel II rules as it was before the crisis. The regulatory capital available to each bank depends on whether buffers are considered or not:

  No buffers: $K_{NoBuff}^{Base} = 8\% \cdot RWA(2012)$

  Buffers: $K_{Buff}^{Base} = \max[K(2012) \cdot QIS^{K}(2012), 8\% \cdot RWA(2012)]$

  In the first case (no buffers), it is assumed that banks hold exactly the MCR foreseen in Basel II, with the RWA measured under Basel II rules. Any capital buffer above this MCR is not considered. Data show that the large majority of the banks comply with the minimum 8 % RWA requirement when the adjustment is applied to the actual level of capital. Therefore the QIS adjustment for capital is not applied in the no buffers case. Applying the QIS correction would lead to an artificial overestimation of the benefits of CRD IV and BRRD.

  In the second case (buffers), we also consider any eventual buffer above the MCR. To take into account the possibility that part of the capital is not of good quality we correct the *current* level of capital using the QIS adjustment.

  JRC tested the impact of the QIS adjustment on the level of 2012 total capital: the analysis shows that the vast majority of banks (roughly 98 %) already have capital level larger than 8 % RWA after applying the QIS adjustment.

- **Scenario 1: CRD IV, contagion.** This scenario aims to measure a framework as if CRD IV rules were applied to banks balance sheet as of December 2012. All banks are assumed to hold a total capital $K^{CRD\ IV}$ at least equal to the minimum of 10.5 % RWA foreseen by CRD IV package. Also the new Basel

III definitions of capital and RWA are employed. Thus, the regulatory capital for each bank in Scenario 1 is computed without and with capital buffers as:

No buffers: $$K_{NoBuff}^{CRDIV} = 10.5\% \cdot RWA(2012) \cdot QIS^{RWA}(2012)$$

Buffers: $$K_{Buff}^{CRDIV} = \max\{K(2012) \cdot QIS^{K}(2012); 10.5\% \cdot RWA(2012) \cdot QIS^{RWA}(2012)\}$$

where $QIS^{RWA}(2012)$ is the EBA adjustment introduced in Table 2.

In the first case the RWA are increased using the QIS correction to represent the impact of the new CRD IV rules on their measurement. Any capital buffers above the 10.5 % RWA that banks might hold are not considered.

In the second case banks keep any buffer above the MCR that may remain after applying the QIS adjustment to their *current* levels of capital.

Note that the model does not capture the impact of the new buffers introduced in the CRD IV package other than the capital conservation buffer.

- **Scenario 2: CRD IV, bail-in and RF, no contagion.** This scenario aims to measure the benefits of the BRRD rules combined with the CRD IV package. This scenario considers the bail-in tools that impose a LAC equal to 8 % of total assets, and the intervention of RF up to a maximum of 5 % TA. Total RF funds are equal to 1 % of country-aggregate covered deposits. The safety net tools are assumed to block any contagion mechanism via the interbank market. As discussed above, the use of remaining tools is subject to discretionary choices of the resolution authority and thus not further considered in this specific scenario.

  Moreover, when reading results, it should be kept in mind that two extreme situations are compared: a full contagion mechanism via the interbank market versus a zero-contagion one. In the first case the model could overestimate losses since all banks are potentially exposed to the failure of others and no reaction mechanism is modelled to stop this domino effect.[28] In the second case it is assumed that the BRRD is capable to completely prevent direct contagion, and the model does not allow for indirect contagion dynamics.

Table 8 of Appendix 2 shows the regulatory capital and RWA for the scenarios analysed, computed as described above.

In all scenarios the average implied obligor default probability (IOPD) is estimated assuming a MCR equal to 8 % of RWA under CRD IV definition of RWA, i.e. RWA are increased using the results of the EBA monitoring exercise:

$$MCR = 8\% \cdot RWA(2012) QIS^{RWA}(2012)$$

[28] The use of a proportionality assumption to spread contagion across a full network of interbank connections could actually tend to dampen contagion for low levels of aggregate losses, and to amplify it for higher levels of losses.

The level of 8 % is kept constant through the scenarios as the additional 2.5 % of capital required under Basel III represents a capital conservation buffer, while the capital requirement proper remains 8 % of RWA.[29]

Results

Benefits for public finances

SYMBOL is run for 27 EU MS using data as of December 2012. Results are rescaled from the sample of banks to the population of banks in each MS, using the sample ratio shown in the last column in Table 1. The outputs of SYMBOL are simulated distributions of losses in excess of capital plus recapitalization needs. These distributions are aggregated first at MS level and then at EU level.

We make use of data on State Aid to the financial sector during the recent crisis (2008-2012) to calibrate the model in order to reproduce similar events. The total amount of recapitalisation measures in the period 2008-2012 is roughly EUR 410 billion (see DG Competition state aids Scoreboard[30]). Moreover, banks went on the markets to raise additional capital to face their distress: the cumulated issuance of equity in the markets in the same period amounts to roughly EUR 130 billion,[31] leading to a total of EUR 540 billion. A total of roughly EUR 180 billion was also provided to the financial sector via asset relief during the same period (see DG Competition state aids Scoreboard). These figures lead to an estimate of total losses and recapitalisation needs due to the crisis of up to EUR 590 billion.

As in the current financial crisis contagion was limited thanks to bail-outs and state aids, to calibrate the SYMBOL output we focus on a no CRD IV scenario, without contagion.[32] A loss compatible with the figure above is observed at percentile 99.95 % (about EUR 670 billion) of the distribution of losses plus 8 % recapitalisation needs.[33]

In Table 4 below we present the benefits for public finances of introducing CRD IV package and BRRD. As already discussed above, these benefits are computed on the distribution of losses plus 8 % recapitalisation needs. Benefits are measured as the relative decrease in the losses moving from the baseline scenario to the alternative ones, at percentile 99.95 %.

[29] Literally, under the FIRB approach, RWA are obtained as 12.5 times the capital requirement, to be calculated using the model.

[30] Box 3.4.1: State aid measures and central bank support. Some of this new equity will have been subscribed by government and would thus be already included in other measures. On the other hand, no estimate is available for the amount of retained earnings.

[31] Source: DG ECFIN Bank Watch 206 21/03/2014

[32] In practice the capital is the same as the one of the Baseline Scenario, but contagion is not considered.

[33] While part of the issuance of new equity could be driven by regulation and not by crisis losses, and asset relief could not entirely constitute a loss, one should also take into account that banks also issued subordinated debt, retained earnings and that there exists most probably hidden losses still not accounted.

Table 4: **Losses for public finances under the various scenarios and estimated benefits of introducing CRD IV and BRRD.**

	Losses plus 8% recapitalisation needs (% GDP)			Benefits: relative decrease in losses from	
	Baseline (Basel II)	Scenario 1 (CRD IV)	Scenario 2 (CRD IV and BRRD)	Baseline to Scenario 1	Baseline to Scenario 2
Buffers	19.10%	14.87%	1.49%	22.15%	92.21%
No Buffers	25.55%	17.24%	1.49%	32.55%	94.17%

The results can be summarized as follows:

- Moving from baseline to Scenario 1 the decrease in potential costs for public finances is between 22 % and 33 %, depending on whether we account for buffers or not. In absolute terms, the gross benefits (without considering the costs of regulation) would be between EUR 0.5-1.1 trillion. This result should be read by taking into account the following key assumptions: (i) there is no intervention from government to stop contagion, as instead it was the case in the current crisis[34] and (ii) no other tool than capital (CRD IV) is used to absorb losses.

- Moving from baseline to Scenario 2, where the contagion is stopped, reduction of potential costs for public finances is between 92 % and 94 % (in absolute terms roughly EUR 2.3 trillion and EUR 3 trillion respectively). Also here the result should be read taking into account that supervisors have additional tools – and the flexibility on how to use them – to absorb potential residual losses beyond those covered in Scenario 2, including (i) additional bail-in of unsecured debt that banks can hold on top of the 8 % minimum, (ii) the use of additional RF funds, on top of the 5 % cap set in the BRRD, (iii) bail-in of eligible non-covered deposits and only when other means deployed the (iv) DGS intervention. Moreover, it is assumed that the BRRD is effective in resolving banks, including the large banks for which structural reform may be necessary to achieve resolution.

Macroeconomic benefits

The estimation of macroeconomic benefits relies on a stylized methodology similar to the one also used by the Bank of England, 2010. This approach allows estimating macroeconomic benefits on the basis of two pieces of information: first, how the implementation of the CRD IV package and the BRRD may reduce the probability of a systemic crisis (*Systemic PD*) and, second, the (avoided) potential costs associated with a banking crisis, measured as the present value of deviations from baseline trend GDP.

Estimations are based on the following assumptions:

[34] Losses in baseline range between EUR 2.5 and 3.3 trillion. We observe that in baseline contagion takes place, hence the losses cannot be compared with those observed in the recent crises when contagion was stopped by State aid.

- A systemic crisis is defined as a crisis where the total amount of covered deposits held in distressed banks (i.e. defaulted and undercapitalized up to 4.5 % RWA) exceeds a certain threshold, assumed to be equal to 3 % of GDP.

- It is assumed that the reduction in GDP and its shortfall on trend GDP are solely due to the systemic banking crisis.

- The initial cost of a systemic banking crisis is assumed to be the drop in GDP from 2008 to 2009 plus the lost trend growth of GDP. Trend GDP is the GDP that would have been observed in 2009 if economies would have grown at their potential growth rate for this period. This rate is currently estimated at an average equal to 1.96 %[35] for European countries (see D'Auria et al., 2010).

- The drop in the GDP due to the crisis is assumed to be partly a temporary effect and in part a permanent loss. In particular in this analysis, 67 % of the initial GDP reduction due to the crisis is assumed to be reabsorbed in 5 years, while the remaining 33 % is assumed to be a permanent loss.36 (In other words, a systemic banking crisis is assumed to induce a permanent level shift in the growth path of GDP. See Appendix 3 for details.)

- The real discount rate used for the discount factors to calculate present values is i=2.5 %.

In practical terms, to obtain macro-economic benefits, the following steps have been implemented:

1. The initial cost of a banking crisis is estimated using data on the recent crisis and is assumed to be the variation in GDP from 2008 to 2009,[37] plus the lost trend growth of GDP (see first and second columns in Table 5 below):

$$InitialCost = 2009\ GDP\ change + trend\ on\ GDP.$$

2. The total (avoided) cost of a systemic banking crisis is the net present value of the initial costs considering the permanent and temporary effects (see third column in Table 5):

$$Total\ (avoided)\ cost = InitialCost \cdot [TempShare \cdot DF_N + (1 - TempShare) \cdot DF_\infty]$$

where: $TempShare$ is the share of the initial costs which are temporary in nature (67 %); DF_N is the *n*-years rent discount factor, defined as $(1+i) \cdot \frac{1-(1+i)^{-n}}{i}$ with

[35] GDP weighted average of growth rate.
[36] This is also roughly in line with the split used by the Bank of England, 2010 which is, instead, 75 % and 25 %.
[37] The GDP variation at 2005 market prices (2009 versus 2008) is taken from AMECO, the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs.

n = 5, which is equal to 4.76; DF_∞ is the permanent rent discount factor, defined as $\frac{1+i}{i}$ which is equal to 41.

Table 5: **GDP change from 2008 to 2009, estimated initial (avoided) cost of a systemic banking crisis and estimated total (avoided) cost of a systemic banking crisis[38].**

	2009 GDP change	Initial cost of a systemic banking crisis (% GDP)	Total (avoided) cost of a systemic banking crisis (% GDP)
EU GDP weighted average	-4.49%	5.90%	98.59%

3. The yearly benefits are obtained as the total (avoided) cost times the reduction in the *Systemic PD* estimated in SYMBOL, when moving from the baseline scenario to the alternative regulatory scenarios (see first and second row in Table 6 below):

$$YearlyBenefits = \Delta SystPD \cdot Total(avoided)cost,$$

where $\Delta SystPD$ is the reduction *Systemic PD*.

4. Total macro-benefits are finally obtained applying the permanent rent discount factor (DF_∞) to the yearly benefits, as the reduction in *Systemic PD* is considered to apply every year in the future, originating a permanent stream of benefits (see third row in Table 6 below):

$$Benefits = YearlyBenefits \cdot DF_\infty$$

Table 6: **Estimation of macroeconomic benefits**

			Baseline vs Scenario 1	**Baseline vs Scenario 2**
1	Reduction in the *Systemic PD* when moving from the baseline scenario in p.p.	Buffers	0.58 p.p.	1.18 p.p.
		No Buffers	2.99 p.p.	3.83 p.p.
2	Yearly benefits when moving from the baseline scenario to the alternative scenarios. (% GDP)	Buffers	0.51%	1.07%
		No Buffers	2.98%	3.81%
3	Net present value of benefits when moving from the baseline scenario to the alternative scenarios (% GDP).	Buffers	20.75%	44.01%
		No Buffers	122.31%	156.39%

The results can be summarized as follows:

[38] The estimate of total (avoided) costs of a systemic crisis is lower than the median cumulative impact estimated by models allowing for a permanent effect reported in the Basel Committee on Banking Stability 2010 Long Term Economic Impact exercise, which is 158 % (https://www.bis.org/publ/bcbs173.pdf Table 1). The Bank of England also uses a cost of the crisis equal to 138 % in its 2010 paper cited above, obtained by employing the same methodology employed here to calculate the cost of crisis, based on an initial cost of 10 % of GDP and a permanent share of 25 %

- Moving from baseline to Scenario 1 the reduction in *Systemic PD* ranges from 0.6 % to 3 % depending on whether buffers that banks hold on top of the MCR are considered or not. The yearly macroeconomic benefits of introducing CRD IV are between 0.5 % and 3 % of GDP and the net present value of benefits ranges from 21 % to 122 %.

- Moving from baseline to Scenario 2 the reduction in *Systemic PD* ranges from 1 % to 4 %. The yearly macroeconomic benefits of introducing CRD IV package are between 1 % and 4 % of GDP and the net present value of benefits ranges from 44 % to 156 %.

JRC performed the estimation of macroeconomic benefits considering also a lower total avoided cost of a systemic banking crisis equal to 50 %, instead of 98.6 % used above (as presented in table 6). Results are presented in Table 7 and show that considering a lower cost of crisis, the benefits are halved but remain substantial. In particular, the most conservative benefit estimation – calculated with the lower cost of crisis assumption and counting capital buffers – gives an yearly GDP benefit of 0.59 % when moving from the baseline to scenario 2.

Table 7: **Estimation of macroeconomic benefits with 50 % costs of crisis.**

		Baseline vs Scenario I	**Baseline vs Scenario II**
Reduction in the Systemic PD when moving from the baseline scenario in p.p.	Buffers	0.58 p.p.	1.18 p.p.
	No Buffers	2.99 p.p.	3.83 p.p.
Yearly benefits when moving from the baseline scenario to the alternative scenarios. (% GDP)	Buffers	0.29%	0.59%
	No Buffers	1.50%	1.92%
Net present value of benefits when moving from the baseline scenario to the alternative scenarios (% GDP).	Buffers	11.87%	24.10%
	No Buffers	61.35%	78.61%

Conclusions

This annex presents estimates of the benefits of introducing strengthened rules for capital requirements (CRD IV package) and safety net tools (bail-in and resolution fund as foreseen in BRRD).

Two different aspects have been considered when measuring benefits: (i) the decrease in losses left uncovered by available tools, which may potentially hit public finances, and (ii) the macroeconomic benefits due to reduction in the probability of occurrence of a systemic banking crisis.

The exercise has been conducted using the SYMBOL model, a simulation engine developed by the EC JRC, the Directorate General Internal Market and Services, academics and experts on banking regulation (see De Lisa et al., 2011).

Being based on a statistical model, results are estimates and they are sensitive to model assumptions. In particular, banks are described through an average risk measure of the portfolios they hold, and their resilience to shocks is assessed via the amount of their total capital. The model simulates the situation at one fixed point in time (end of the year). Moreover, the scenarios simulates extreme situations, like a full-contagion mechanism (where all banks in a country are affected by the default of

others), or zero-contagion (where no spill-over take place). The reality most probably lies in between these two extremes.

It has been assumed that the capital requirements are not enough to completely absorb losses in a severe crisis and to avoid contagion, while the introduction of the resolution tools set up in the BRRD can effectively stop it. The model has been run separately for the EU 27 MS using 2012 data from Bankscope for a sample of roughly 3,000 EU banks.

Benefits of introducing CRD IV package and BRRD have been assessed running SYMBOL for alternative scenarios. The baseline scenario reflects the situation where the Basel II is in still in place; Scenario 1 introduces CRD IV increased quality and quantity of regulatory capital; Scenario 2 implements some of the tools set up in BRRD according to the agreement reached in the trilogue in December 2013 (a minimum bail-in to trigger RF intervention and RF funds up to a maximum of 5 % TA for each distressed bank).

Results show that the introduction of CRD IV package leads to a relative reduction in potential costs for public finances between 22 % and 33 %, depending on whether buffers that banks hold on top of the MCR are considered or not. When the BRRD tools (bail-in and resolution fund) are considered, contagion is stopped and the relative reduction in losses increases up to 92 %-94 %. Extra tools could become available to reduce losses further. As they are discretionary and depend on the judgement of supervisors they have not been considered in the present exercise. These tools include (i) full bail-in of unsecured debt; (ii) the full use of resolution fund; (iii) bail-in of eligible non-covered deposits (above EUR 100 000) and eventually, in the extreme case, DGS intervention.

The yearly macroeconomic benefits of introducing the CRD IV package are about 0.5 % of GDP (Scenario 1) if buffers that banks hold on top of the MCR are fully considered (and only counting adjustment from 2012). Introducing the BRRD tools, i.e. bail-in and resolution fund, on top of the CRD IV package raise these benefits to 1.1 % of GDP (Scenario 2).

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Appendix 1: Estimation of the IOPDs – Technical details

For each exposure *l* in the portfolio of bank *i*, the FIRB formula derives the corresponding capital requirement needed to cover unexpected losses[39] over a time horizon of one year, with a specific confidence level equal to 99.9 % (see Figure 1):

$$CR_{i,l} = \left[LGD \cdot N\left(\sqrt{\frac{1}{1-\rho}} N^{-1}(PD_l) + \sqrt{\frac{\rho}{1-\rho}} N^{-1}(0.999) \right) - PD_l \cdot LGD \right] \cdot M(PD_l)$$

where PD_l is the default probability of exposure *l*, ϱ is the correlation among the exposures in the portfolio, *LGD* is the Loss Given Default[40] and M(PD_i) a maturity adjustment

$$\rho = 0.12 \frac{1-e^{-50PD}}{1-e^{-50}} + 0.24 \left(1 - \frac{1-e^{-50PD}}{1-e^{-50}}\right)$$

and

$$M = \frac{1.06}{1 - 1.5\left(0.11856 - 0.05478 \cdot ln(PD)\right)^2}$$

MCR of each bank is obtained summing up the capital requirements for all exposures:

$$MCR_i = \sum_l CR_{i,l} \cdot A_{i,l}$$

where $A_{i,l}$ is the amount of the exposure *l*.

The average IOPD of a bank's asset portfolio can be derived as

$$IOPD_i: CR(IOPD_i) \cdot \sum_l A_{i,l} = MCR_i$$

where MCR_i and **Error!** are the minimum capital requirement and the total assets of the banks, publicly available in the balance sheet.

.[39] Banks are expected to cover their Expected Losses on an ongoing basis, e.g. by provisions and write-offs. The Unexpected Loss, on the contrary, relates to potentially large losses that occur rather seldom. According to this concept, capital would only be needed for absorbing Unexpected Losses.
[40] Set in Basel regulation equal to 45 %.

Appendix 2: The SYMBOL database

Description of the sample

Table 8 presents values of some selected variables used in SYMBOL simulations aggregated per MS. The third from last column of the table shows the sample ratio, i.e. the share of total assets that the sample covers compared to the ECB data (second to column). The sample ratio is used to move from the sample-based figures to an estimate of the country's population.[41]

Table 8: **Selected Bankscope variables for the sample of banks used for SYMBOL simulations** (the last columns show ECB aggregate total assets by country (foreign branches excluded) and coverage ratio for SYMBOL input sample)

	SYMBOL sample									ECB total assets	Share of covered deposits (***)
	Banks	G1(**) Banks	Total Assets	RWA	Customer Deposits	IB Credits (*)	IB Debts (*)	Capital	Sample Ratio		
BE	21	2	531	166	276	108	115	28	54 %	978	43 %
BG	17	0	34	25	26	2	2	4	81 %	42	63 %
CZ	16	0	120	55	80	13	13	9	69 %	174	53 %
DK	75	3	726	243	217	57	112	51	66 %	1,099	63 %
DE	1540	6	5,336	1,632	2,365	828	976	276	66 %	8,124	50 %
EE	2	0	8	6	6	1	1	1	62 %	13	49 %
IE	5	4	319	200	143	95	108	35	41 %	779	41 %
GR	6	0	30	25	21	1	4	4	8 %	397	60 %
ES	87	5	1,686	1,085	763	137	332	125	50 %	3,388	43 %
FR	174	15	6,886	2,323	2,002	790	779	325	89 %	7,753	70 %
IT	463	9	2,698	1,026	878	94	217	249	68 %	3,954	32 %
CY	3	0	10	7	9	2	0	0	8 %	118	50 %
LV	19	0	24	16	16	5	4	3	98 %	24	34 %
LT	8	0	18	12	12	2	4	2	96 %	19	50 %
LU	53	2	506	178	178	172	168	37	87 %	582	14 %
HU	13	1	37	21	19	4	8	4	36 %	104	50 %
MT	7	0	8	4	6	1	1	1	15 %	55	25 %
NL	22	3	1,786	701	631	445	277	119	75 %	2,390	52 %
AT	178	0	290	127	130	38	40	20	30 %	971	53 %
PL	34	2	237	163	158	7	31	24	69 %	345	37 %
PT	14	2	216	138	90	28	51	18	42 %	515	50 %
RO	15	0	57	35	34	1	13	6	69 %	83	43 %

[41] see http://www.ecb.europa.eu/stats/money/aggregates/bsheets/html/outstanding_amounts_2013-10.en.html and a recent work of D. Schoenmaker http://ec.europa.eu/economyfinance/publications/economicpaper/2013/pdf/ecp496en.pdf

SI	15	0	35	28	20	1	9	3	69 %	51	63 %
SK	9	0	41	25	30	1	2	4	74 %	55	53 %
FI	8	0	89	34	37	18	10	6	16 %	545	57 %
SE	66	3	609	184	241	141	79	36	55 %	1,110	53 %
UK	86	10	7,029	2,056	2,563	1,382	1,550	332	98 %	7,205	42 %
Total	**2,956**	**67**	**29,368**	**10,514**	**10,950**	**4,374**	**4,907**	**1,720**		**40,875**	

Source Bankscope, ECB, JRC elaborations.
(*) Following the methodology adopted in the Impact assessment of BRRD Proposal, a correction factor for the volume of interbank debts/credits has been applied to the following MS to correct for the inclusion of some classes of debt certificate. The applied correction factors are the same as in the BRRD impact assessment (see appendix 4, Table 1, p.183).
(***) The share of covered deposits is taken from Cannas et al. 2013a and is an estimate based on data collected from EU DGS and ECB data.

Regulatory capital and risk-weighted assets under different scenarios

Table 9 shows the regulatory capital and RWA for the scenarios analysed, computed as described above starting from 2012 balance sheet data. For each country, amounts are referred to the sample, while the Total EU has been calculated by means of the sample to population ratio (see third from last column in Table 8).

Table 9: Regulatory capital and RWA in the various scenarios, 2012 data

	Regulatory capital no CRD IV (bn€)		Regulatory capital CRD IV (bn€)		RWA CRD IV
Country	**No buffers**	**Buffers**	**No buffers**	**Buffers**	**(bn€)**
BE	15	20	20	20	186
BG	2	3	3	3	27
CZ	5	7	6	7	61
DK	22	37	29	37	272
DE	145	204	190	214	1811
EE	1	1	1	1	7
IE	18	25	24	25	225
GR	2	2	3	3	28
ES	98	94	128	134	1219
FR	208	237	273	273	2598
IT	92	181	120	187	1145
CY	1	0	1	1	8
LV	1	2	2	2	17
LT	1	1	1	1	14
LU	16	27	21	28	198
HU	2	3	2	3	23
MT	0	1	0	1	5
NL	63	85	83	87	788
AT	11	15	15	16	140
PL	14	18	19	20	181

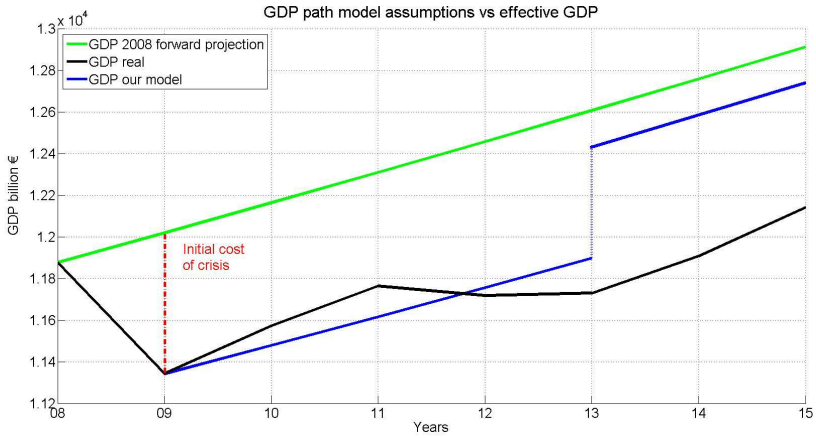
PT	12	13	16	16	154
RO	3	5	4	5	38
SI	2	2	3	3	31
SK	2	3	3	3	27
FI	3	4	4	4	38
SE	17	26	22	26	207
UK	185	237	243	244	2314
Total Sample	**941**	**1,252**	**1,235**	**1,366**	**11,761**
Total EU	**1,386**	**1,822**	**1,820**	**2,023**	**17,330**

Source Bankscope,EBA QIS exercise, JRC calculations.

Appendix 3: Technical details on the estimation of the cost of crisis

In the macro-benefit analysis, the initial cost of a systemic banking crisis is estimated following a stylized approach previously used also by the Bank of England (2010)[42]. Using this methodology the cost is based on the initial drop in GDP at the onset of the crisis, i.e. from 2008 to 2009: part of this fall is assumed to be temporary in nature, and part of it is assumed to be a permanent fall in the level of GDP. In particular, actual GDP after the crisis is assumed to stay below pre-crisis trend GDP for 5 years, after five years from the inception of the crisis, 67 % of the initial drop in GDP is absorbed, while the remaining 33 % is a permanent level shift.[43] Taking the present value of the differences from pre-crisis trend GDP based on a 2.5 % discount rate, the cost of the crisis is estimated to be 98.64 %.[44]

Figure 3: **GDP paths**



Source: AMECO database, JRC elaboration, D'Auria et al. (2010)

In Figure 3, the green line is the 2008 GDP projected forward at average growth rates in the pre-crisis period. The growth rate is estimated at an average equal to 1.2 % for western European countries (for more details on the estimation procedure, see D'Auria et al. (2010)).[45] The black line is the actual or forecast real GDP path as from AMECO. The blue line is the GDP as estimated in our stylized model.

Our projection for GDP path in case of crisis, seems to be in line with actual data, based on the Leven and Valencia (2013) measure of the cost of a crisis, which is based on cumulated losses for the crisis year and the three subsequent years. To calculate this indicator with actual data from the current crisis, we add up the yearly differences between the 2008 GDP projected forward at average growth rates in the pre-crisis period (green line) and the real GDP 2009-2012 (black line) to get a cost of the crisis of about 23 % under the Laeven and Valencia indicator. Instead, estimating this cost with our model, we obtain 24 %. As Laeven and Valencia estimate that the

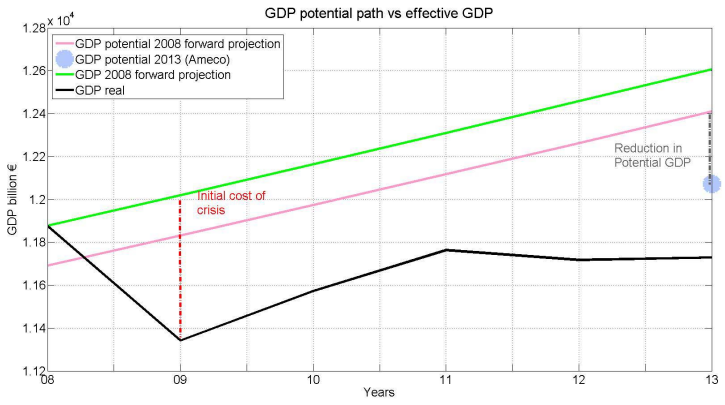
[42] see BoE (2010), Box 7.
[43] In the Bank of England paper referred above, 75 % and 25 % are used, based on an initial fall of GDP of 10 %. See later for a discussion on the permanent part.
[44] This estimate is obtained by using data on individual EU countries GDP growth rates weighted by GDP 2008 at constant prices. AMECO figures for EU-27 GDP slightly differ as they use a different weighting scheme.
[45] Actual trend growth rates for all countries from the same publication are used to obtain the figure.

typical cost of a crisis in advanced countries should be equal to 32 % for the first four years, we could also hypothesize that the current crisis is a "mild" crisis, and that a larger impact of the "typical" crisis could be used in the context of a cost-benefit analysis.

We also note that the hypothesis of assuming a permanent level shift in GDP is compatible with the analyses developed by Economic and Financial Affairs (ECFIN 2009 and ECFIN 2013). In particular in the latter publication, scenarios developed in 2009 for the GDP path after the crisis are tested and it results that a permanent loss in GDP has been realized.[46]

JRC tested the robustness of the assumptions regarding the share of the permanent loss on a set of alternative assumptions. Looking at the AMECO database, the difference between GDP potential 2013 and forward projection of GDP potential 2008 at pre-crisis trend growth can be considered as an estimation of the permanent loss ('Reduction in Potential GDP' in Figure 4). This permanent loss is around 58 % of the initial cost of crisis leading to a present value of total avoided cost of around 150 %. The overestimation of the permanent effect could be due to a decrease in real GDP from 2011 to 2012.

Figure 4: **GDP potential paths**



Source: AMECO database, JRC elaboration, D'Auria et al. (2010)

Finally, we also tested what would be the impacts of including or excluding the output gap 2008 from the estimate of the initial impact of the crisis. If we consider the output gap, the initial cost of crisis would be lower because in 2008 the real GDP was higher than the potential one. However, the permanent effect observed in absolute terms in 2013 would remain constant, and therefore the permanent part would be more than 33 % of the initial cost considering the output GAP, thus leading to a higher cost of crisis.

Our estimation of the total cost including the closing of the output GAP as part of the initial costs and based on a permanent effect of 33 % can therefore be seen as a lower bound. We have decided to be conservative in the estimation of crisis costs because in

[46] Also, according to the same publications, the pre-crisis growth path should be considered an over-estimate of the long term trend due to the pre-crisis boom conditions. Accordingly, we use estimates developed in 2009 and 2010, which reflect a more realistic long term outlook.

this exercise they are positively correlated with the macro-benefits – i.e. the approach seeks to ensure that benefits are not overestimated.

ANNEX 5: QUANTITATIVE MODELLING OF COSTS

This annex presents QUEST results on the macroeconomic effects of bank regulation. The following measures are analysed: Increasing capital requirements, introducing a bank resolution mechanism (BRF) and a bail in scheme. The focus of these calculations is on the social cost of increased capital requirements from CRD IV as well as the major tools (Bail-in and resolution fund) in the Bank Recovery and Resolution Directive.

There is a controversy concerning the cost of bank regulation. Industry representatives (IIF 2010) have claimed that the increase in the capital requirement increases funding costs for banks because they have to use more equity to fund loans. This in turns increases capital costs for investors and slows down growth. This statement has been contested by some academic economists (e.g. Admati et al. (2011)), who make reference to the Modigliani Miller (MM) theorem (1958) which stipulates that the structure of corporate financing does not matter (if one disregards tax and subsidy considerations which may affect debt and equity differently) because a change in the composition of corporate liabilities only distributes the risk which must be borne by shareholders. Under the assumption that the change in capital requirements does not change the riskiness of bank operations, an increase in capital requirements leads to a proportional decline in the equity premium, because the same risk is distributed over a larger equity base.

This cost assessment follows a middle ground between these two extreme opposite views, a position which has been adopted by other policy institutions which have conducted macroeconomic assessments such as the Bank of International Settlements (BIS (2010a, 2010b, 2010c) or the Bank of England (Miles et al. (2013). We present two scenarios which closely follow the assumptions made by these two institutions. In a first scenario we follow the BIS assessment and assume that stronger bank regulation does not lead to an increase in the risk premium on bank equity (i. e. leaves long run funding costs for banks unchanged) (i.e. 0 % MM offset). In a second scenario we follow the BoE assessment and allow for a 50 % MM offset. That there is a significant, but not a full MM effect seems to be the outcome of the empirical literature. The empirical evidence in Miles et al. (2013) and Kashyap et al. (2010) shows indeed that there is a systematic relationship between bank capitalisation and the equity premium. The risk premium effect is such that it offsets about 50 % of the increase of funding costs implied by a funding cost calculation where the equity premium is kept unchanged. That there is no or not a full MM offset can be justified in case there is an implicit bail out guarantee for banks. In this case, increasing bank capital effectively shifts insurance provided by the government to shareholders. Thus, the degree in which MM holds depends (inversely) on the stringency in which there is perceived to be a bail-out guarantee for banks.

This note is organised as follows. Section 1 and 2 briefly describes the model and the calibration. Section 3 presents the results for the individual measures and the cumulative impact. Section 4 shows results from a simple cost benefit analysis.

QUEST model with financial sector

We modify a closed economy version of the QUEST model,[47] which has been calibrated to the EU aggregate economy by adding a banking sector with bank capital. In order to allow for a meaningful financial intermediation function of banks we disaggregate the household sector into savers and borrowers (entrepreneurs). In order to ensure a positive share of loans in the balance sheet of entrepreneurs it is assumed that they have a higher rate of time preference. In this case, solvency of entrepreneurs requires that banks restrict lending by imposing a collateral constraint. This specification closely follows Kiyotaki and Moore (1997).

Savers:

We follow van den Heuvel (2008) and assume that savers maximise an intertemporal utility function with consumption, liquidity services provided by deposits and leisure as arguments. Savers can hold wealth either in the form of government bonds, bank deposits or bank equity and receive interest income from bonds and deposits and dividends. Savers require an equity premium on bank stocks. Savers also offer labour services to entrepreneurs and receive wage income.

Entrepreneurs:

Enterpreneurs are assumed to maximise an intertemporal utility function over entrepreneurial consumption, subject to a budget constraint a capital accumulation constraint and a collateral constraint. They make pricing, labour demand, investment and financing decisions and use a Cobb Douglas production function.

Banks:

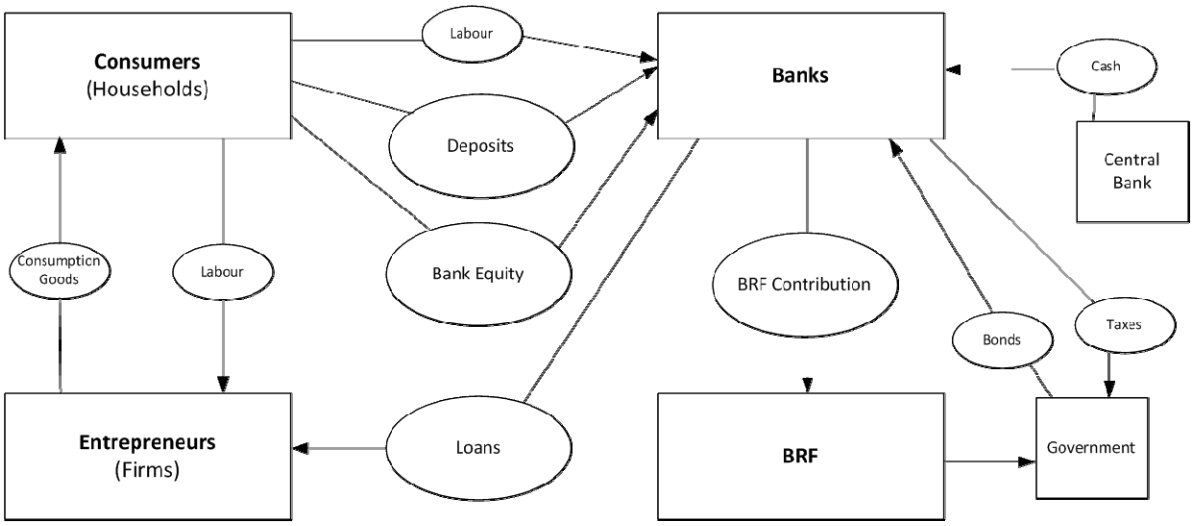
Provide loans to entrepreneurs and demand deposits from saver households. They maximise the present discounted value (PDV) of dividends or the stock market value of the bank subject to a capital and liquidity requirement constraint. The capital requirement demands from banks that the ratio of deposits to loans should not exceed a certain target ratio. Concerning liquidity requirements, banks are asked to hold liquid assets as a fixed share of loans. This imposes an opportunity cost for banks since liquid assets (government bonds and assets) yield a lower return. Banks can increase capital either by issuing new shares or via retained earnings. Both strategies yield identical results.

Monetary and fiscal policy:

The central bank follows a Taylor rule. Fiscal policy is constrained by a budget constraint. Government debt is held by saver households and banks (for liquidity purposes). Figure 1 summarises the economic linkages between the various sectors in a flow chart.

[47] See Ratto et al (2008) for technical details of the model.

Figure 1: **Sector linkages in QUEST III**



Data and calibration

All parameters describing behaviour of the non-financial sector are taken from Ratto et al. (2009). We calibrate the model such that it can replicate the ratio of Tier1 capital to risk weighted assets. Since we only model an aggregate banking sector, we focus on the consolidated balance sheet of the EU banking sector. Based on ECB (2013), total assets amounted to EUR 35.5 trillion in 2012 (based on the ECB data). We distinguish between three asset categories, loans, government bonds and other assets, with risk weights of 60 %, 3 % and 70 % respectively. Total loans were 19.8 Trio. Euro in 2012. We assume that the share of government bond holdings in total assets in the EU is identical to the share in the EA, namely 8.5 % (or 3.0 trio Euro). Other assets amount to 12.7 Trio Euro.

As we are interested in measuring the costs of moving from Basel II to Basel III/CRD IV our starting point is the assumption that bank capital is 8 % of risk weighted assets in 2012, so that our estimate for consolidated tier1 bank capital is 1.68 Trio. Euro. The spread between loan rate and the deposit rate is set to 250BP and the rate of return on bank equity is set at 10 %. We assume that the spread between the loan rate and bank funding cost is entirely due to variable costs related to managing loans and deposits and not due to cost price margins.

Scenarios

We analyse the following regulatory measures similar to the scenarios for the benefits' estimations:

- **Scenario 1**: Increase of bank capital from 8 % to 10.5 % of risk weighted assets. (Immediate increase in 2014).

- **Scenario 2**: Bail in regulation implemented in 2016, resulting in an increase in the deposit rate of 15BP and the bank resolution fund of 77 Bio Euro phased in over 10 years and starting in 2016. In the model, this has the same effects as an increase in the capital requirement. The increase in capital requirement is calculated as follows: The BRF increases bank capital by 4.6 % (over 10 years, which is the time span to build the BRF). This increases the share of bank capital in risk weighted assets from 8 % to 8.37 %. Here it is assumed that the BRF increases bank capital and riskless bank assets (government bonds) by 77 Bio Euro. The increase of bank capital requirements from 8 to 10.87 % reduces total leverage (total assets/bank capital) of the banking system from 21.3 to 15.7.

We compare this result against the baseline (business as usual) scenario which is characterised by an unchanged capital requirement of 8 %, no bail in regulation and the absence of a bank resolution fund.

In scenario 1 and 2 we calculate the effects of increasing the capital requirement only under two alternative assumptions about the evolution of the bank equity risk premium, namely no change in the risk premium (zero MM offset) and a 50 % MM offset. In scenario 3 and 4 we calculate the joint effect of all three measures again under the two alternative assumptions about the MM offset. Concerning the MM offset we follow Miles et al (2013), they define a 50 % MM offset as a situation where the RoE is adjusted in such a way that the loan rate only increases by 50 % of the rate when the risk premium is kept unchanged. Miles et al., estimate this offset rate by using data on UK banks. In addition we assume that the bail-in also reduces the riskiness of bank capital. Given the MM offset definition, a 100 % MM offset would yield zero macroeconomic costs.

Results

In this section simulation results for scenario 1 and 2 with MM zero offset and 50 % are presented. The only transmission mechanism in the model is the credit channel. Banks shifts the higher funding costs onto the non- financial private sector in the form of higher loan rates (when MM does not fully apply). This increases capital costs for firms which partly finance their investment with loans. The cost increase related to higher capital requirements is partly offset by a reduction of the deposit rate for banks since the demand shift of banks away from deposits lowers the deposit rate. However, this effect is relatively small (a reduction of the deposit rate of about 2bp). A distinction must be made between the short and the long-term effects of the regulatory measures. An increase in capital requirement leads to a gradual reduction of output, which is linked to a slightly slower growth of capital and potential output (table 1). The same logic holds for the costs related to the resolution fund.

With bail-in, the short-term adjustment is slightly more complicated. Since the bail-in is announced to be implemented in 2016, it leads to an upward adjustment of consumption already in the first year, because households anticipate a lower savings rate (in deposits) and want to smooth consumption over time.

Capital buffers vs. no buffers

In line with the estimations of benefits, costs are estimated for two cases, with and without capital buffers, i.e. the actual capital that banks might hold above the MCR. Banks might hold these buffers because they want to hold a "cushion" of capital above regulatory minima, or they might hold it for reasons that may not be related to regulation and/or as part of a transition towards CRD IV rules.

Intuitively, not considering the buffers, i.e. the RWA increases by 2.5 percentage points (from 8 % to 10.5) for all banks, is a conservative estimation of costs. In reality, already hold capital above the regulatory minimum requirements, so they require less adjustment to the new minimum capital ratios. Not counting those existing buffers could overestimate the costs that can be attributed to regulation. However, the "no buffer" assumption may be deemed justified because using actual capital data as of 2012 may otherwise not account for any costs incurred in the transition before that date and in expectation of the higher capital requirements. Also considering the existing buffers in the baseline may lead to an underestimation of the cost, since it is not certain that banks currently holding a buffer will not maintain its size above the 10.5 % RWA new minimum. Given considerations, the *c*osts are estimated for both cases, with and without the buffers, but more weight is given to the result without capital buffers to be conservative and not underestimate the costs.

Results for GDP

Tables 1 to 4 present estimation results for the conservative case, when no buffers are considered. On average, assuming 50 % MM offset, increasing capital requirements from 8 % to 10.5 % of RWA has a negative impact on the level of GDP (expressed as deviation from the output trend per year) by 0.13 % in the long term (table 2). Note that the costs are twice as high (0.27 % of EU GDP per year) without any MM offset (Table 1). In the second scenario that includes additional tools, i.e. bail-in and the introduction of the resolution funds, the results are as follows: the long-term deviation from the output trend equals 0.34 % EU GDP per year when 50 % MM offset is assumed. In the most conservative case, when no MM offset is assumed, the costs are 0.69 % of EU GDP per year. When capital buffers are considered in the estimations (see Appendix), the annual costs amount to 0.28 % of EU GDP when 50 % MM is assumed and to 0.55 % of GDP without the MM offset.

Results for other macroeconomic variables

Table 3 and 4 illustrate that investment is particularly sensitive to the different MM applicability assumptions. For 2020, investment is estimated to fall by 2.53 % below baseline, if the MM assumption does not hold and by 1.40 % below its baseline under the 50 % MM assumption. The long term impact on investment varies from -2.08 % with zero MM offset to -1.00 % with 50 % MM offset. This shows that any negative impact of higher capital requirements on investment is mitigated over the long run. As the cost of capital increases and firms shift to using more own resources to fund their investment projects, they reduce leverage and the rate of firm loan default decreases.

The bank credit risk goes down and the risk premium on the loan interest rate over the risk-free rate declines[48].

The impact of increased capital requirements on employment is less pronounced than the impact on GDP and investment. Under the most plausible assumption (i.e. partial applicability of MM), employment falls 0.08 % below the baseline on average in the long term.

The positive effect on consumption in the short term can be explained as follows: capital costs for firms increase, which lowers investment and thus aggregate demand. This lowers the real interest rate (e. g. because inflation goes down and the central bank can lower the policy rate, because of excess capacity in the economy). The declining interest rates reduce savings of households and increase consumption. This is only a temporary effect and in the medium to long run the level of consumption declines (0.27 % in the long term when 50 % MM offset applies).

The stock of loans decreases as a result of changes in bank regulation, unless there is a 100 % MM offset in which case there is no macroeconomic impact. Disintermediation occurs because banks pass increased marginal costs on to customers through higher lending rates and stricter collateral constraints, and in this process they ration credit. The volume of loans is between 0.20 % below the baseline in 2020 and 0.34 % below the baseline in the long term in the case when only the capital requirement is modelled (with a 50 % MM offset). The volume of loans falls more as additional regulatory changes are implemented: in the long term loans are 0.86 % below the baseline when the BRRD measures are implemented.

Table 1: Increasing capital requirement from 8 % to 10.5 % (zero MM offset)

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	-0.05	-0.05	-0.06	-0.08	-0.12	-0.27
Investment	-0.68	-0.97	-1	-1.02	-0.99	-0.81
Consumption	0.09	0.17	0.16	0.13	0.07	-0.21
Volume of loans	-0.14	-0.32	-0.36	-0.34	-0.41	-0.69
Loan rate	-6.08	-3.42	17.94	10.09	9.38	10.13
Employment	-0.07	-0.05	-0.04	-0.05	-0.05	-0.03

[48] The model does not explicitly include firm defaults on their loans from the banking sector. Providing for bank credit risk could produce an explicit result for this mitigation.

Table 2: Increasing capital requirement from 8 % to 10.5 (50 % MM offset)

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	-0.02	-0.02	-0.03	-0.04	-0.06	-0.13
Investment	-0.34	-0.48	-0.5	-0.51	-0.49	-0.40
Consumption	0.05	0.08	0.08	0.07	0.03	-0.11
Volume of loans	-0.07	-0.16	-0.18	-0.17	-0.2	-0.34
Loan rate	-3.01	-1.69	8.88	5	4.65	5.02
Employment	-0.04	-0.02	-0.02	-0.03	-0.02	-0.02

Table 3: Increasing capital requirement from 8 to 10.5 % (zero MM offset), resolution fund (EUR 77 billion), bail in (deposit rate up by 15bp)

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	0.01	-0.08	-0.15	-0.18	-0.28	-0.69
Investment	-0.71	-1.83	-2.51	-2.58	-2.53	-2.08
Consumption	0.2	0.33	0.39	0.38	0.21	-0.54
Volume of loans	-0.01	-0.24	-0.62	-0.85	-1	-1.75
Loan rate	-12.9	-9.36	-0.01	17.53	23.31	26.14
Employment	0.03	-0.09	-0.15	-0.12	-0.12	-0.08

Note: Resolution fund is phased in from 2016 to 2026. Bail-in starts in 2016.

Table 4: Increasing capital requirement from 8 to 10.5 % (50 % zero MM offset), resolution fund (EUR 77 billion), bail in (deposit rate up by 15bp)

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	0.04	-0.05	-0.11	-0.11	-0.17	-0.34
Investment	-0.23	-1.1	-1.68	-1.65	-1.4	-1.00
Consumption	0.11	0.19	0.25	0.24	0.1	-0.27
Volume of loans	0.07	-0.03	-0.36	-0.58	-0.59	-0.86
Loan rate	-6.33	-4.46	-8.85	12.53	15.37	12.57
Employment	0.06	-0.06	-0.13	-0.09	-0.07	-0.04

Note: Resolution fund is phased in from 2016 to 2026. Bail in starts in 2016.

Conclusion

QUEST gives a rough estimate of the macroeconomic costs of certain bank sector reforms, and the results are subject to significant modelling uncertainty. First, the transmission mechanism is based only on the lending channel. Secondly, there is a high uncertainty related to the MM offset (but zero MM offset is unlikely to be a realistic assumption). Third, these results are sensitive to the degree of substitution between capital and labour. In QUEST, a Cobb Douglas production function is used with adjustment cost for labour and capital. This technology implies a low elasticity of substitution (below one) in the short run but an elasticity of substitution equal to one in the long term. The BoE study assumes a long run elasticity of substitution which is equal to 0.5. Also note that the employment effects of the bank regulation measures are very small and contribute little to the fall in output[49]. This is the case because wages adjust to a decline in labour productivity, as implied by a fall in the capital stock, which stabilises employment. Moreover, as we are only interested in the effects of the regulatory measures, any changes the bank capital for other reason than those related to regulation are not considered.

Current macro models are not capable of properly incorporating effects of regulation on (excessive) risk taking of banks. Therefore, only a very limited cost benefit analysis can be provided. Nevertheless, it is instructive to compare the cost estimate obtained from QUEST with the benefits estimated via SYMBOL (as per annex 4). This is done in boxes 4.2.5 and 6.4.1, which show that the estimated benefits exceed the costs. This is also consistent with the findings in other studies (e.g. BIS (2010) and Miles (2013)).

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APPENDIX

In the following estimations results for the case with capital buffers are presented.

Table 1: Increasing capital requirement from 8 % to 10.5 % (zero MM offset), considering actual capital buffers

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	-0.02	-0.02	-0.03	-0.04	-0.05	-0.12
Investment	-0.31	-0.44	-0.45	-0.46	-0.44	-0.37
Consumption	0.04	0.08	0.07	0.06	0.03	-0.10
Volume of loans	-0.06	-0.14	-0.16	-0.15	-0.18	-0.31
Loan rate	-2.73	-1.53	8.06	4.54	4.22	4.56
Employment	-0.03	-0.02	-0.02	-0.02	-0.02	-0.01

Table 2: Increasing capital requirement from 8 % to 10.5 % (50 % MM offset), considering actual capital buffers

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	-0.01	-0.01	-0.01	-0.02	-0.03	-0.06
Investment	-0.16	-0.22	-0.23	-0.23	-0.22	-0.18
Consumption	0.02	0.04	0.04	0.03	0.02	-0.05
Volume of loans	-0.03	-0.07	-0.08	-0.08	-0.09	-0.16
Loan rate	-1.38	-0.77	4.08	2.3	2.14	2.30
Employment	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01

Table 3: Increasing capital requirement from 8 to 10.5 % (zero MM offset)
Resolution fund (77 Bio), Bail in (deposit rate up by 15bp)

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	0.04	-0.05	-0.12	-0.13	-0.22	-0.55
Investment	-0.35	-1.33	-2	-2.06	-2.02	-1.66
Consumption	0.15	0.25	0.31	0.31	0.17	-0.43
Volume of loans	0.06	-0.07	-0.43	-0.68	-0.79	-1.40
Loan rate	-9.74	-7.56	-9.45	12.29	18.45	20.85
Employment	0.07	-0.06	-0.13	-0.1	-0.1	-0.07

Table 4: Increasing capital requirement from 8 to 10.5 % (50 % zero MM offset)
Resolution fund (77 Bio), Bail in (deposit rate up by 15bp)

	2014	2015	2016	2017	2020	Long-term average 2030-2150
Impact on macro variables (deviation from baseline in bp for loan rate, in % for other variables)						
GDP	0.06	-0.03	-0.09	-0.09	-0.13	-0.28
Investment	0.01	-0.77	-1.36	-1.34	-1.16	-0.83
Consumption	0.08	0.14	0.2	0.21	0.09	-0.23
Volume of loans	0.12	0.09	-0.23	-0.47	-0.48	-0.71
Loan rate	-4.72	-3.81	-16.22	8.47	12.38	10.46
Employment	0.09	-0.04	-0.11	-0.07	-0.06	-0.03