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Macroeconomic cost-benefit analysis of Basel III minimum capital requirements and of introducing Deposit Guarantee Schemes and Resolution Funds

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Abstract

A simple methodology first presented by the Bank of England is coupled with the JRC SYMBOL model to estimate the macro-economic impact of setting banks Minimum Capital Requirements (MCR) at different levels in a set of EU countries.

The proposed methodology allows estimating macro-economic costs and benefits on the basis of two pieces of information: first, how different levels of capitalization modify the probability of a systemic banking crisis (SystemicPD) and, second, the level of recapitalization implied by the introduction of the new Basel III definition of capital and RWA, and the application of various (increased) levels of MCR.

Regarding the probability of a systemic banking crisis, the SYMBOL model is employed to estimate the reduction in the SystemicPD that derives from implementing the new Basel III definitions in order to meet the different considered levels of MCR.

Recapitalization estimates are obtained combining information on the 2009 levels of capital from publicly available banks' balance sheets with information on the impact of introducing Basel III contained in the Quantitative Impact Study conducted by CEBS and the Basel Committee.

The methodology is applied to 7 EU Member States using 2009 data for a large sample of banks contained in Bankscope and augmented by further analysis of Commission Services, as well as integrations from Supervisory Authorities. Moreover, ECB data has been used to complete or adjust the dataset.

The same methodology is also used to evaluate the macro-economic impact of introducing a Deposit Guarantee Scheme / Resolution Fund (DGS/RF) on top of MCR.

Keywords: Regulatory capital, resolution framework, Basel regulation, systemic crisis, systemic risk, macro-economic cost-benefit analysis, financial contagion

1. Introduction

A simple methodology first proposed by the Bank of England¹ is used in this work to estimate the macro-economic impact of setting banks minimum capital requirements at different levels in a set of EU countries. Minimum capital requirements tested range from 6.5% to 15% of the Risk-Weighted Assets (RWA), under the Basel III definition of capital.

The methodology employed allows estimating macro-economic costs and benefits on the basis of - essentially - two pieces of information: first, how different levels of capitalization modify the probability of a systemic banking crisis (*SystemicPD*)² and, second, the level of recapitalization implied by the introduction of the new Basel III definition of capital and RWA, and the application of various (increased) levels of MCR.

Regarding the probability of a systemic banking crisis, the SYMBOL model³ is employed to estimate the reduction in the *SystemicPD* that derives from implementing the new Basel III definitions (of RWA and of eligible capital) in order to meet the different considered levels of MCR.

Recapitalization estimates are obtained combining information on the 2009 levels of capital from publicly available banks' balance sheets with information on the impact of introducing Basel III contained in the Quantitative Impact Study conducted by CEBS (now EBA) and the Basel Committee.⁴ As far as Minimum Capital Requirements (MCR) are concerned: banks are considered as obliged to meet Basel II MCR, which are satisfied by their 2009 capital without any need for recapitalization,⁵ or they can be considered as obliged to recapitalize in order to meet MCR based on new and stricter definitions of Risk Weighted Assets (RWA) and eligible capital as set under Basel III.

The analysis has been developed for 7 EU Member States⁶ using 2009 data for a large sample of banks contained in *Bankscope* and augmented by further analysis of Commission Services, as

¹ Bank of England (2010), "Financial Stability Report", (Issue 27) Box7, <http://www.bankofengland.co.uk/publications/fsr/2010/fsr27.htm>

² See section 4.1 for the definition of *SystemicPD* used in the analysis.

³ The SYMBOL model (SYstemic Model of Banking Originated Losses) has been jointly developed by the JRC, DG MARKT, and experts of banking regulation, for technical details see: De Lisa R, Zedda S., Vallascas F., Campolongo F., Marchesi M. (forthcoming), *Modelling Deposit Insurance Scheme Losses in a Basel 2 Framework*, Journal of Financial Services Research. DOI 10.1007/s10693-010-0097-0.

Online First" available at: <http://www.springerlink.com/content/v533117121lk423m/>

⁴ We estimate banks' capital ratios under Basel III stricter definitions of eligible capital and RWA by using official balance sheet data for each bank and applying some corrective factors representing the average changes in RWA and capital for each country and banks' group. The Basel Committee and CEBS have published average variations in bank capital ratios due to the implementation of Basel III. In this report, we have used the country-level confidential data on the estimated variation in banks' capital ratios which underlie published figures. See Basel Committee of Banking Supervision (2010), *Results of the comprehensive quantitative impact study*, <http://www.bis.org/publ/bcbs186.pdf> and Committee of European Banking Supervisors (2010), *Results of the comprehensive quantitative impact study*, <http://www.eba.europa.eu/cebs/media/Publications/Other%20Publications/QIS/EU-QIS-report-2.pdf>

⁵ In this case banks' capital is calculated based on the 2009 publicly reported capital by banks and on the basis of an estimate of the effects of applying the new Basel III definitions of capital and Risk Weighted Assets (RWA), without any recapitalization by banks.

⁶ Analyzed countries are Germany, Ireland, Spain, France, Italy, Portugal and the United Kingdom. Results

well as integrations from Supervisory Authorities.⁷ Moreover, ECB data has been used to complete or adjust the dataset.⁸

The same methodology used to estimate the macro-economic costs and benefits of different levels of MCR is also used to evaluate the macro-economic impact of introducing a Deposit Guarantee Scheme / Resolution Fund (DGS/RF) on top of MCR. The impact of a DGS/RF is, in particular, analysed for the level of MCR for which the net macro-economic benefit of MCR is maximised.

The remaining of this work is structured as follows. Section 2 presents the Bank of England methodology. Section 3 presents the estimation of macroeconomic costs of setting MCR at various levels. Section 4 focuses on the benefits side: first it describes how the SYMBOL model can be employed to estimate *SystemicPDs*; then it presents the macroeconomic benefits of setting MCR at various different levels. Section 5 presents the net macroeconomic costs/benefits that arise at various MCR levels. Section 6 discusses the effects of introducing a DGS/RF on top of optimal MCR, i.e. of MCR that maximise net macroeconomic benefits. The last section concludes introducing a graphical representation of the results obtained.

2. Methodology

The methodology employed is a variation of the methodology presented in the Bank of England's "2010 Financial Stability Report".⁹ This approach allows estimating the macro-economic benefits and costs of imposing the obligation on banks to recapitalize in order to comply with different levels of (increased) MCR. Costs and benefits are expressed as a percentage of GDP, and represent the present value of an infinite stream of costs and benefits deriving from the setting of various different levels of (higher) MCR for banks.

Benefits of increased MCR arise from the fact that individual banks' increased capital is able to absorb losses originated by banks' obligors to a higher extent; and this determines a reduction in the probability of a systemic crisis (*SystemicPD* henceforth).¹⁰ In particular, macro-economic benefits are calculated by multiplying the reduction in the *SystemicPD* obtained under any given level of MCR times the total (avoided) costs of a systemic banking crisis, and then computing the net present value.

Total costs of a systemic banking crisis are estimated based on the assumption that the banking crisis is going to cause an initial reduction in GDP, which can be split between a part which has a temporary effect and a part whose effect is permanent. 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.¹¹ Total (avoided) costs of the crisis are

⁷ are presented on an aggregate basis using weighted averages on GDP.
The EC requested data to Supervisory Authorities and/or Central Banks of all involved MS. Data have been provided only by Ireland.

⁸ Annex A contains aggregated data by country on samples of banks used in the analysis.

⁹ See footnote 1

¹⁰ The *SystemicPD* under each different minimum capital requirement setting, and depending on the presence/absence of a DGS/RF, is obtained using the SYMBOL model as presented in Section 4.

¹¹ In other words, a systemic banking crisis is assumed to induce a permanent level shift in the growth path of GDP. The split (67% and 33%) between temporary and permanent effects is in line with the median result of the models analysed by the BCBS (Basel Committee on Banking Supervision (2010c), An assessment of

defined as the net present value of the sum of the of these two components. The real interest rate used for the discount factor to calculate this present value is $i = 2.5\%$.¹²

The initial reduction in GDP due to a systemic banking crisis are estimated based on the observed shortfalls on trend GDP in the countries considered in the analysis.¹³ Results of the estimates of total (avoided) costs of a crisis are presented in Table 1.

Table 1: GDP change in 2009, estimated initial (avoided) cost of a systemic banking crisis, and estimated total (avoided) cost of a systemic banking crisis.

Country	2009 GDP change	Initial cost of a systemic banking crisis (% GDP)	Total (avoided) cost of a systemic banking crisis (% GDP)
GDP weighted average	-4.26%	-5.49%	91.88%

Benefits are, more precisely, given by the following equation:

Equation 1

$$Benefits = \Delta SystPD \cdot InitCost \cdot \underbrace{(TempShare \cdot DF_N + (1 - TempShare) \cdot DF_\infty)}_{NPV \text{ of avoided losses}} \cdot DF_\infty$$

where:

$\Delta SystPD$ = variation in the probability of a systemic banking crisis (due to the introduction of various levels of higher MCR);

$InitCost$ = initial cost of systemic banking crisis (see column 2 of Table 1);

$TempShare$ = share of the initial costs which are temporary in nature (67% in this analysis);

¹² the long-term economic impact of stronger capital and liquidity requirements, <http://www.bis.org/publ/bcbs173.pdf>. The split used by the Bank of England is, instead, 75% and 25%. It is important to note that the present analysis assumes that the reduction in GDP and its shortfall on trend GDP are solely due to the systemic banking crisis. The GDP variation at 2000 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 (DG ECFIN), available at http://ec.europa.eu/economy_finance/db_indicators/ameco/index_en.htm

¹³ The initial cost of a systemic banking crisis is considered as the 2009 shortfall on trend 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 1.2% for western European countries (for more details on the estimation procedure, see D'Auria F., Denis C., Havik K., Mc Morrow K., Planas C., Raciborski R., Röger W. and Rossi A. (2010), *The production function methodology for calculating potential growth rates and output gaps*, Economic Papers 420, European Commission Directorate General for Economic and Financial Affairs).

DF_N = N -years rent discount factor, defined as $DF_N = (1+i) \left(1 - \frac{1}{(1+i)^N} \right)$ (with $N = 5$ in this analysis, i being the discount rate equal to 2.5%, leading to a discount factor of 4.76);

DF_∞ = permanent rent discount factor, defined as $DF_\infty = \frac{1+i}{i}$, (i being the discount rate equal to 2.5%, leading to a discount factor of 41).

The term in parentheses multiplied by *InitCost* represents the total (avoided) costs of a systemic banking crisis (see column 3 of Table 1). In order to obtain the benefits of higher MCR, these total (avoided) costs are multiplied by the variation in the probability of a systemic banking crisis ($\Delta SystPD$) due to (higher) MCR times once again the permanent rent discount factor (DF_∞), as the reduction in *SystemicPD* ($\Delta SystPD$) is considered to apply every year in the future, originating a permanent stream of benefits.

Turning now at the macro-economic costs of the various MCR levels, the methodology adopted in the present analysis is composed of the following steps and assumptions:

- 1) Total recapitalization needs are estimated. In particular, first the level of capital under the new Basel III definitions of eligible capital and of RWA is estimated. Then, it is assumed that only banks that, under the new definitions, possess a capital ratio lower than the minimum required need to recapitalize, and that they raise just enough capital to reach the MCR. For each level of MCR considered, aggregate required recapitalisation per country is calculated as the sum of all additional capital required by those banks that need to recapitalize in the country.¹⁴
- 2) When banks need to raise additional capital to meet newly introduced higher MCR, they are assumed to substitute debt with equity. Costs generated by this change in the composition of banks' liabilities are obtained by multiplying the increase in capital due to the need to recapitalize times the difference between the cost of equity and the average cost of debt for banks.¹⁵
- 3) Banks pass on to non-financial firms the newly generated costs they have to face on their funding. This is achieved by increasing lending spreads.
- 4) Non-financial firms face an increase in their cost of funding, but they do not change their leverage in response to lending spreads.
- 5) The increase in the cost of funding for non-financial firms results, in a decrease in their investments and thus into a permanent reduction in GDP. A calibrated Cobb-Douglas production function is used to transform increased funding costs for non-financial firms into a decline in GDP.¹⁶

¹⁴ The original Bank of England methodology, as well as other analyses in the literature, does not rely on micro-level data on banks' capital. As a consequence, it implicitly assumes that banks always hold exactly the minimum required level of capital. On the contrary, in this analysis banks that have a capital ratio higher than the minimum required are considered for their actual level of capital.

¹⁵ The Modigliani-Miller theorem does not hold in the considered specification as the cost of equity and debt are not considered to change due to a modification in banks' leverage. The introduction (even partly) of the Modigliani-Miller theorem reduces the increase in banks' funding costs due to higher MCR. For how the partial or total application of the MM theorem affects costs, see Equation 2.

¹⁶ The Bank of England methodology is basically that of a static framework, where reactions by banks and

Costs are in particular given by the equation:

Equation 2

$$\text{Costs} = \underbrace{\frac{\Delta CAP \cdot (ROE - r(1 - tax_{bank})) \cdot (1 - MM)}{Assets}}_{\text{Variation in banks' funding costs}} \cdot \underbrace{\frac{Assets}{TotLoans} \cdot [(1 - tax_{firm}) \cdot leverage]}_{\text{Variation in banks' spreads (due to recapitalisation needs)}} \cdot \underbrace{\frac{\varepsilon_{CoC}^y}{CostOfCapital} \cdot DF}_{\text{Variation in non-financial firms' cost of capital}}$$

where:

ΔCAP = banks' recapitalization required;

$Assets$ = banks' assets

ROE = banks' required Return on Equity;

r = average interest rate on bank debt;

tax_{bank} = banks' tax rate;

$TotLoans$ = Loans of banks to non-financial firms;

MM = Modigliani-Miller effects (0% in this analysis);

tax_{firm} = non-financial firms' tax rate;¹⁷

$leverage$ = banks' lending share of firms financing;

$CostOfCapital$ = current cost of capital/funding for non-financial firms;

ε_{CoC}^y = elasticity of GDP to cost of capital, obtained as $\varepsilon_{CoC}^y = \frac{\varepsilon_C^y}{(1 - \varepsilon_C^y)}$, ε_C^y being the elasticity of GDP to capital (30% in this analysis).

The first ratio in Equation 2 is the variation in the funding costs (i.e. the variation in the WACC, the Weighted Average Cost of Capital) for banks due to the need to recapitalise to reach any required MCR level. The multiplication between the first and the second ratio estimates the variation in banks' lending spreads due to their need to recapitalise. The multiplication by the term in square brackets allows transforming this variation into an increase in non-financial firms' cost of capital/funding. The elasticity of GDP to non-financial firms' cost of capital, given by ε_{CoC}^y , divided by non-financial firms cost of capital translates this increase in non-financial firms

¹⁷ firms to increased capital costs are not taken into consideration.
Tax rates for banks and firms are set equal to estimated corporate tax rates in each country.

costs of capital into a decline in GDP. The last term, DF_{∞} is used to pass from an annual cost (as GDP declines) to the net present value of an infinite stream of such annual costs. Table 2 presents the model parameters assumed for the estimation of macro-economic costs and benefits.

Table 2: Model parameters used applying the Bank of England cost-benefit framework.

Country	Banks' required return on equity	Bank's average interest rate on debt	Cost of capital for firms	Corporate tax rates ¹⁸	Discount factor	Output GDP elasticity of capital	Leverage (bank lending share of firms' financing) ¹⁹	Bank loans to firms in 2008 (billion €) ²⁰
DE	10%	5%	10%	30.00%	2.5%	30%	56.8%	3,229
IE				7.60%			47.4%	481
ES				34.00%			46.6%	1,986
FR				29.10%			31.5%	2,290
IT				31.50%			57.8%	1,808
PT				22.60%			47.4%	282
UK				22.20%			52.6%	5,118

¹⁸ For the applied tax rates see country chapters of European Commission European Commission (2010), *Taxation trends in the European Union*, http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/tax_structures/index_en.htm.

¹⁹ For a study on leverage performed on six EU MS see De Socio A. (2010), *La situazione economico-finanziaria delle imprese italiane nel confronto internazionale*, Questioni di Economia e Finanza n.66, Banca d'Italia (http://www.bancaditalia.it/pubblicazioni/econo/quest_ecofin_2/QF_66/QEF_66.pdf). For IE, and PT the EU average has been used. It should be noted that data refer to overall leverage, not just bank debt leverage. As we currently have no access to the share of bank loans in total corporate debts we take the most unfavourable hypothesis and assume that non-bank debt is negligible. This has the effect of amplifying the impact of increases in banking spreads on firm's cost of capital, resulting in a higher estimate of costs of increases in banks' cost of capital.

²⁰ See Table 6 in ECB *EU Banking Structures* 2010, <http://www.ecb.int/pub/pdf/other/eubankingstructures201009en.pdf>

3. Macroeconomic costs under different minimum capital requirements

The analysis is performed for 7 different recapitalisation scenarios. In the first and baseline scenario, called Basel II, banks are considered to be obliged to meet Basel II MCR, which are satisfied by their 2009 capital without any need for recapitalization. Their capital and RWA are, however, considered according to the new Basel III Accord definitions of eligible capital and RWA.²¹ In the six other scenarios, MCR are introduced where banks recapitalise (if needed) to respect the various MCR levels considered, as detailed in Table 3.

Table 3: MCR scenarios.

Scenario name	BII	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
Capital and RWA definition	Basel III	Basel III	Basel III	Basel III	Basel III	Basel III	Basel III
Minimum capital requirement (% RWA)	none	6.50%	8%	10.50%	12%	13.50%	15%

Total recapitalization needs (i.e. compared to the Basel II baseline scenario) in each country are shown in Table 4. They are obtained as the sum of recapitalisation needs for individual banks with a level of capital below the minimum required according to the Basel III definitions of eligible capital and RWA. Banks holding a capital above the MCR do not need to recapitalise and, therefore, do not change their level of capital.²²

The last column in Table 4 indicates instead the recapitalization need implied by an increase in capital equal to 1% of RWA. On its basis, it is possible to express in Table 5 the recapitalization needed in the various countries in the different scenarios considered as a percentage of banks' RWA.

Table 4: Recapitalization needs when moving from the baseline scenario to the other MCR scenarios. (billion €).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%	BIII Δ1%
GDP weighted average	2.63	11.84	46.90	76.03	109.84	144.81	21.75

Table 5: Recapitalization needs when moving from the baseline scenario to the other MCR scenarios (as a % of RWA).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	0.15%	0.56%	2.17%	3.49%	5.03%	6.62%

²¹ In other words, while banks do not need to recapitalize under Basel II rules, they might result to be under-capitalized under the new definitions of capital of Basel III

²² To obtain recapitalization needs for the entire banking system in each country, total recapitalization needs for the sample of banks in each country are rescaled on the basis of the share of total assets in the sample relative to the entire population (see Annex A for detailed figures on samples used in each country).

These recapitalization needs produce the variations in banks' cost of funding, lending spreads and in non-financial firms' cost of capital shown in Table 6, Table 7 and Table 8 (see Equation 2 above for details on calculations).

Table 6: Variation in banks' funding costs when moving from the baseline scenario to the other MCR scenarios (bps).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%	BIII Δ1%
GDP weighted average	0.4	1.5	5.8	9.3	13.4	17.7	2.67

Table 7: Variation in lending spreads when moving from the baseline scenario to the other MCR scenarios (bps).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%	BIII Δ1%
GDP weighted average	1.0	3.7	12.7	20.2	28.8	37.7	5.57

Table 8: Variation in non-financial firms cost of capital when moving from the baseline scenario to the other MCR scenarios (bps).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%	BIII Δ1%
GDP weighted average	0.3	1.1	3.8	6.1	8.9	11.7	1.8

The yearly costs in the various recapitalization scenarios, as presented in Table 9, are obtained by multiplying the variations in the cost of capital of Table 8 by the constant elasticity of GDP to the cost of capital and dividing by non-financial firms cost of capital.

Table 9 Yearly costs when moving from the baseline scenario to the other MCR scenarios (%GDP)

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%	BIII Δ1%
GDP weighted average	0.01%	0.05%	0.16%	0.26%	0.38%	0.50%	0.07%

From yearly costs it is possible to obtain, as shown in Table 10, the net present value of an infinite stream of these yearly costs.

Table 10: NPV of costs when moving from the baseline scenario to the other MCR scenarios (%GDP).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%	BIII Δ1%
GDP weighted average	0.55%	1.93%	6.72%	10.78%	15.59%	20.57%	3.22%

Other recent studies have performed a costs-benefit analysis of increasing the level of MCR for banks.²³ In Table 11 we report available results, for comparison purposes.

Table 11: Estimated impacts of a 1% increase in banks' capital ratios, literature overview.

	Area of analysis	Δ banks' funding costs (bps)	Δ lending spreads (bps)	Δ firms' cost of capital (bps)	Yearly costs (% GDP)	Costs NPV (% GDP)
BIII Δ1%	EU-7	2.7	5.6	1.83	0.08%	3.22%
BIII Δ1% with QUEST par. ²⁴ 0%MM (50%MM)	EU-7	5.2 (2.45)	10.8 (5.4)	3.56 (1.78)	0.15% (0.08%)	6.25% (3.13%)
QUEST 0%MM (50%MM)	EU			1.78 (1.6)	0.26% (0.12%)	10.34% (4.75%)
BCBS (2010b), median effect ²⁵	World	13			0.09%	3.69%
Bank of England ²⁶	UK				0.10%	4.10%
Barrell et al. ²⁷	OECD-14		18		0.08%	3.28%
Kashyap et al. 100% MM ²⁸			2.5		0.01%	0.45%
Miles et al. ²⁹ 45%MM			6	3.4	0.05%	2.1%
Slovik, Cournède (2011) ³⁰	Euro Area	9.4	14.3	1.6	0.06%	2.46%
EU Parl study ³¹	EU	6			0.18%	7.38%

²³ For reviews see, for instance EEAG (2011), *The EEAG Report in the European Economy* "Taxation and Regulation of the Financial Sector", CESifo, 147-169. <http://www.cesifo-group.de/portal/page/portal/ifoHome/B-politik/70eeagreport>, and Independent Commission on Banking (2011) *Interim Report: Consultation on Reform Options (Vickers report)*, <http://s3-eu-west-1.amazonaws.com/htcdn/Interim-Report-110411.pdf>

²⁴ Banks' RoE = 14.3%, Average cost of banks' debt = 2.5%

²⁵ BCBS (2010), *An assessment of the long-term economic impact of stronger capital and liquidity requirements*, Basel Committee on Banking Supervision, Bank for International Settlements, Basel 2010, www.bis.org/publ/bcbs173.pdf.

²⁶ Bank of England (2010), *Financial Stability Report*, London 2010, www.bankofengland.co.uk/publications/fsr/2010/fsrfull1006.pdf.

²⁷ Barrell, R., David, E.P., Fic, T., Holland, D., Kirby, S. Liadze, I. (2009), *Optimal regulation of bank capital and liquidity: how to calibrate new international standards*: <http://www.fsa.gov.uk/pubs/occpapers/op38.pdf>

²⁸ Kashyap, S. and S. Hanson (2010), *An Analysis of the Impact of "Substantially Heightened" Capital Requirements on Large Financial Institutions*, University of Chicago.

²⁹ Miles D., Yang J., Marcheggiano G. (2011), *Optimal Bank Capital*, External MPC Unit Discussion paper No. 31: revised and expanded version, Bank of England, <http://www.bankofengland.co.uk/publications/externalmpcpapers/extmpcpaper0031revised.pdf>

³⁰ Slovik P., Cournède B. (2011), *Macroeconomic Impact of Basel III*, OECD Economic Department Working Papers, No 844, OECD Publishing, <http://www.oecd-library.org/docserver/download/fulltext/5kghwnhkkjs8.pdf?expires=1311763661&id=id&accname=guest&checksum=B2A5654CA0003A5337E702720D080C92>

³¹ European Parliament (2011), *CRDIV – Impact Assessment of the Different Measures within the Capital Requirements Directive IV*, <http://www.europarl.europa.eu/activities/committees/studies/download.do?language=en&file=41211#search=%20CRD%20IV%20>

4. Macroeconomic benefits

As already mentioned in Section 2, benefits of increased MCR arise from the fact that individual banks' increased capital is able to absorb losses originated by banks' obligors to a higher extent. This translates in fact into a reduction in the *SystemicPD*. Macro-economic benefits are calculated by multiplying the reduction in the *SystemicPD* for any given level of MCR times the total (avoided) costs of a systemic banking crisis (last column of Table 1), and then computing the net present value.

4.1. Estimation of the probability of a systemic banking crisis with the SYMBOL model

The SYMBOL model is used to estimate the variation in the *SystemicPD* due to the introduction of different MCR levels.

Starting from micro data on banks' MCR and total capital, SYMBOL allows estimating the aggregated distribution of losses³² and liquidity shortfalls³³ originated by defaults in the banking system and potentially hitting society and the economy.

To this aim, SYMBOL operates in two steps: the first step is the estimation of a average default probability for the assets of any individual bank, by means of the features of the Basel FIRB (Foundation Internal Ratings Based) loss distribution function; the second step is the estimation – via a Monte Carlo simulation - of the distributions of aggregate losses and liquidity shortfalls by country, on the basis of individual banks' default probabilities. SYMBOL simulations are run by allowing for contagion effects between banks.³⁴

In order to estimate the variation in the *SystemicPD*, a definition of systemic banking crisis is needed. In the present work a systemic banking crisis is defined as a situation where aggregate liquidity shortfalls due to bank defaults exceed a certain threshold, beyond which public authorities find it difficult to intervene by injecting liquidity and therefore would have a hard time in trying and avoiding that the crisis spreads further.

The threshold for a systemic banking crisis in any country is assumed to be equal to 3% of its GDP.³⁵ This threshold is loosely in line with the average effective expenditures faced by EU

³² Losses are defined as losses in excess of banks' capital, i.e. as (extra-)losses of defaulted banks.

³³ Liquidity shortfalls are defined as the total amount of insured deposits held by defaulted banks. They represent the liquidity problem potentially caused by a reimbursement of depositors of defaulted banks and of a bank run. Insured deposits are defined as deposits which are entitled to be repaid by a Deposit Guarantee Scheme in case of a bank failure. Insured deposits are obtained for each bank by considering total deposits from non-banking customers, and then applying two correction factors at country level: one to obtain the share of deposits eligible for coverage (equal to the share of non-banking financial corporations deposits in each country) and one to obtain from this amount the total of deposits which are entitled to coverage (equal to the share of eligible deposits which are estimated to be under the minimum coverage threshold, set at € 100.000)

³⁴ Whenever a bank defaults, it is in particular assumed that 40% of the amounts of its interbank debts are passed as losses to creditor banks and distributed among them. Losses are distributed following a criterion of proportionality: the portion of loss absorbed by each bank is proportional to the share of its creditor exposure in the interbank market. A default driven by contagion effects takes place whenever with this additional loss any new bank default. The contagion process is considered until no new additional bank defaults.

³⁵ The GDP is taken from the AMECO dataset by the European Commission Directorate for Economic and Financial Affairs, http://ec.europa.eu/economy_finance/db_indicators/ameco/index_en.htm

countries in the last financial crisis. It also coincides with the deficit limit in the European Stability and Growth Pact. This threshold is finally also a prudent estimation for 2009 of the fiscal space that was available to EU governments before public finances would get under tension according to financial analysts. In fact, market analysts commonly identify a condition of tension on public finances when the ratio, defined as the share of government interest payments on government tax revenues, gets beyond 10%.³⁶ In 2009, the average “fiscal space” before hitting this 10% threshold was some 2% of GDP for EU Member States.

The *SystemicPDs*, obtained applying these thresholds to the distribution of liquidity shortfalls for the considered countries, are presented in Table 12 for all MCR scenarios.

Table 12: Probability of systemic banking crisis under the various MCR scenarios.

	BII	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	0.62%	0.55%	0.42%	0.20%	0.13%	0.09%	0.06%

Table 13 reports the reduction in the *SystemicPD* when moving from the baseline scenario Basel II to any of the other scenarios

Table 13: Reduction in the SystemicPD when moving from the baseline scenario BII to the other MCR scenarios (in percentage points).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	0.07%	0.20%	0.42%	0.49%	0.54%	0.56%

Results can be presented also in marginal terms. Table 14 shows the reduction in the *SystemicPD* normalised per point of RWA recapitalisation in each scenario.

Table 14: Reduction in the SystemicPD normalised per point of RWA recapitalisation in the various MCR scenarios.

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	0.32%	0.30%	0.15%	0.05%	0.03%	0.02%

³⁶ See for example the article "The grim rater" of 4th May 2010 issue of The Economist.

4.2 Macroeconomic benefits under different minimum capital requirements

Following the approach proposed by the Bank of England, benefits are estimated multiplying the reduction in the *SystemicPD*, moving from the baseline scenario Basel II to any of the other MCR scenarios, times the total (avoided) costs on the economy when a systemic crisis hits it (presented in Table 1), and then computing the net present value. Table 15 presents the net present value of benefits as a percentage of GDP. Corresponding yearly benefits are reported in Table 16. Corresponding yearly marginal benefits normalised per point of RWA recapitalisation are reported in Table 17. Results of Table 15 and of Table 17 can be compared with results obtained by the Basel Committee, which are presented in Table 18.

Table 15: Net present value of benefits when moving from the baseline scenario BII to the various MCR scenarios (% GDP).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	3.14%	7.22%	14.34%	16.75%	18.41%	19.42%

Table 16: Yearly benefits when moving from the baseline scenario BII to the various MCR scenarios. (% GDP).

	BIII 6.5%	BIII 8%%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	0.08%	0.18%	0.35%	0.41%	0.45%	0.47%

Table 17: Yearly marginal benefits normalised per point of RWA recapitalisation (% GDP).

	BIII 6.5%	BIII 8%%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	0.28%	0.25%	0.13%	0.05%	0.03%	0.02%

Table 18: Estimated yearly marginal benefits of increasing banks' capital ratio, literature overview.

Capital as % of RWA	Marginal reduction in the <i>SystemicPD</i>	Implied marginal benefit of increasing capital ratio, % of GDP, BCBS (2010b)	
		Based on mean avoided losses of 106% of GDP	Based on median avoided losses of 63% of GDP
7.00%	2.60%	2.76%	1.64%
8.00%	1.60%	1.70%	1.01%
9.00%	1.10%	1.17%	0.69%
10.00%	0.50%	0.53%	0.32%
11.00%	0.40%	0.42%	0.25%
12.00%	0.30%	0.32%	0.19%
13.00%	0.20%	0.21%	0.13%
14.00%	0.10%	0.11%	0.06%
15.00%	0.10%	0.11%	0.06%

Source: EEAG (2011)³⁷ table 5.2, based on BCBS LEI report,³⁸ table A2.2

³⁷ See footnote 23

Comparing the figures of Table 15 and Table 17 with these figures, it can be observed that our approach results in lower reductions in the *SystemicPD* per point RWA recapitalisation, and consequently lower yearly benefits. This difference can be explained considering that the definition of what constitutes a systemic banking crisis is very different in the two studies.

5. Macroeconomic costs-benefits analysis

Comparing costs and benefits as presented in Section 3 and 4, it is possible to estimate net benefits of increasing MCR and determine MCR optimal levels.

Net benefits when moving from the baseline scenario Basel II to any of the considered other MCR scenarios are obtained subtracting costs of Table 10 from benefits of Table 15. They are presented in Table 19.

Table 19: Net present value of net benefits when moving from the baseline scenario BII to the various MCR scenarios (%GDP).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	2.59%	5.29%	7.62%	5.97%	2.82%	-1.15%

The MCR increase scenario optimizing the amount of net benefits can be seen to correspond to the 10.5% MCR (i.e. an 8% MCR plus a capital conservation buffer).

In Table 20 yearly marginal net benefits (i.e. net yearly benefits normalised per point of RWA recapitalisation) are presented. These are obtained subtracting yearly marginal costs per point of RWA recapitalisation in Table 9 from yearly marginal benefits per point of RWA recapitalisation in Table 17.

Table 20: Yearly marginal net benefits normalised per point of RWA recapitalisation (% GDP).

	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average	0.21%	0.17%	0.05%	-0.03%	-0.05%	-0.06%

It is possible to see from this table that marginal net benefits go to zero somewhere between the 10.5% and 12% recapitalization scenarios, pointing to the fact that the marginal benefits and marginal costs curves cross somewhere between these two points.

6. Introducing deposit guarantee schemes and resolution funds on top of optimal minimum capital requirements

Having determined the optimal MCR level in the analysis above, the effect of introducing DGS/RF is now investigated.

DGS/RF are, in particular, assumed to hold a joint ex-ante amount of funds equal to the highest between 1.5% of banks' covered deposits and 0.3% of banks' non-equity liabilities, as specified in Table 21.³⁹

Table 21: Size of DGS/RF available funds (billion €).

DGS/RF funds (b€)	
DE	31.31
IE	3.42
ES	10.65
FR	22.27
IT	9.55
PT	1.69
UK	16.65

For all scenarios where a DGS/RF is in place, we distinguish between a "best case" and a "worst case". In the "best case" the DGS/RF is assumed to be able to completely block contagion⁴⁰ between banks to the extent that money is available for interventions.⁴¹ Moreover, all banks for which the DGS/RF intervenes are assumed to generate no liquidity shortfalls. This scenario is also referred to as a "No Contagion" scenario. In the "worst case", instead, banks for which the DGS/RF intervenes are still assumed to generate no liquidity shortfalls; however, the DGS/RF is supposed as not able to stop contagion between banks.⁴² This scenario is also referred to as a "Contagion" scenario.

The presence of the DGS/RF generates two new sets of *SystemicPDs*, for the "No Contagion" and the "Contagion" scenarios, and a single set of costs, obtained via adding the DGS/RF funds in Table 21 to recapitalization needs in each MCR scenario, previously shown in Table 4.

³⁹ As rules on the determination of the total amounts of funds available to DGS/RF in each Member State are still under negotiation in the Council and the European Parliament, any rule adopted in the present study for simulation purposes can not reflect the final form of the rule as it will eventually be implemented. It was therefore chosen to calibrate funds available to DGS/RF on the basis of SYMBOL. In particular, preliminary SYMBOL results allows concluding that a calibration as the one considered would be effective and efficient, as it would ensure public finances to be hit in less than 0.05% of the cases.

⁴⁰ As specified above, for all scenarios where only variations in MCR are considered, SYMBOL simulations are run by allowing for contagion effects between banks.

⁴¹ SYMBOL generates losses using a distribution with no interbank contagion while funds in the RF last, and then reverts to using the distribution with contagion effects once the funds are exhausted. This implies that for all cases where the DGS/RF is exhausted, the most unfavorable assumption is considered in the calculation of regulation benefits, and the DGS/RF is therefore assumed to generate the smallest possible saving in terms of liquidity shortfalls given its loss-absorbing capacity.

⁴² Technically, losses are generated using the distribution with contagion effects, but until the DGS/RF has sufficient funds to absorb losses, defaulting banks do not generate any liquidity shortfalls.

The new *SystemicPDs* are reported in Table 22. Comparing these *SystemicPDs* with those of Table 12 (*SystemicPD* for each scenario in absence of DGS/RF), we see that the presence of DGS/RF reduces the *SystemicPD* in both cases (with and without contagion). In the no contagion case, this fact is obviously linked to the capacity the DGS/RF has to block contagion between banks. In the contagion case, instead, the reduction in the *SystemicPD* can be explained by recalling that, although not able to block contagion between banks, the DGS/RF absorbs losses generated by defaulted banks and, doing so, it avoids that these banks generate liquidity shortfalls.

Table 22: *SystemicPD under the various MCR scenarios and DGS/RF.*

	<i>DGS/RF - No Contagion</i>						
		BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average		0.06%	0.05%	0.03%	0.02%	0.01%	0.08%
	<i>DGS/RF- Contagion</i>						
	BII	BIII 6.5%	BIII 8%	BIII 10.5%	BIII 12%	BIII 13.5%	BIII 15%
GDP weighted average		0.19%	0.15%	0.08%	0.05%	0.03%	0.21%

Given these *SystemicPDs*, the analysis proceeds as described above; however, in this case, since we are interested in assessing the effect of introducing a DGS/RF on top of optimal capital requirements, results are presented in Table 23 only for the scenario corresponding to optimal minimum capital requirements of 10.5%.

Table 23: *Additional net present value of net benefits of introducing a DGS/RF on top of optimal MCR (GDP%).*

	No Contagion	Contagion
GDP weighted average at 10.5% MCR	3.43%	1.50%

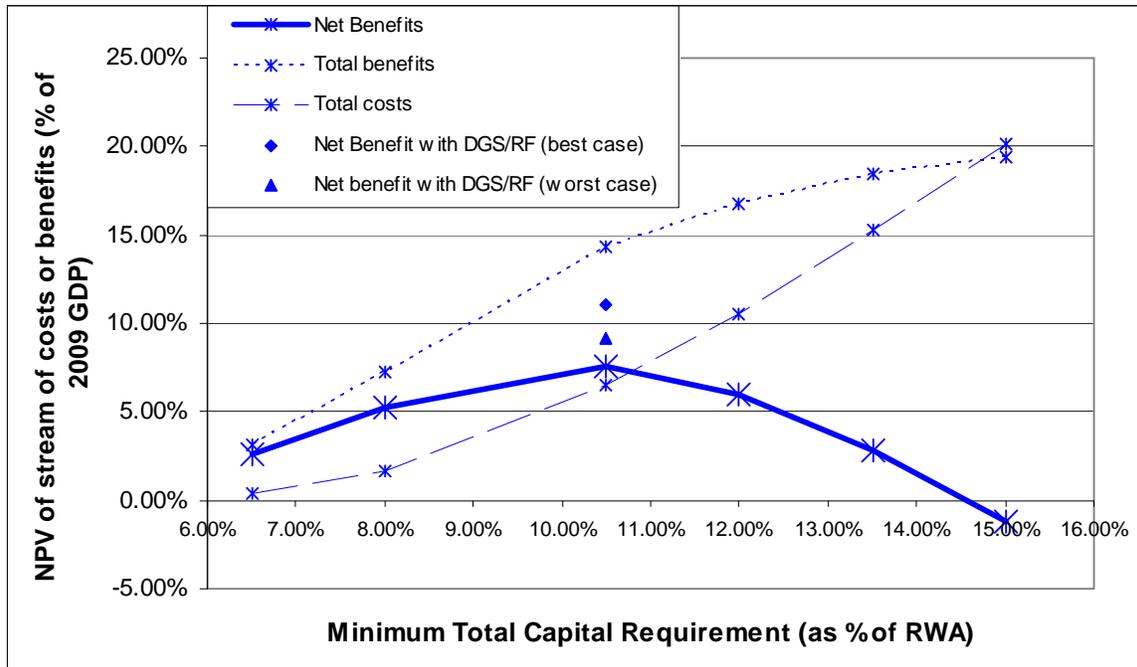
7. A graphical representation of macro-economic cost and benefit curves

By plotting the net present value of costs and benefits on a graph, cost-benefits curves for all considered countries can be developed. The EU-7 weighted average benefit and cost NPV curves are presented in Figure 1.

Each point in the curve represents a determined level for bank's MCR. On the x -axis one reads the MCR as % of the RWA. The y -axis plots the NPV of costs (dashed curve), benefits (dotted curve) and net benefits (solid curve) corresponding to choosing any minimum capital requirement level.

The optimal MCR lies at the point where the net benefits curve has its maximum. In the figure the NPV of the net benefits of introducing a DGS/RF on top of MCR are also plotted (triangles). The effects of DGS/RF are shown for the level of minimum capital corresponding to the optimum for the analysed countries (i.e. 8% or 10.5% of the RWA).

Figure 1: EU-7 weighted average of costs and benefits NPV (increased minimum capital requirements and introduction of a DGS/RF) - %GDP (e.g. 0.4 = 40% of GDP).



For the weighted average over the seven EU considered countries, the optimal MCR lies around 10.5% RWA. The introduction of a DGS/RF produces net benefits in both the no-contagion and the contagion case.

ANNEX A: Description of the sample of banks for the SYMBOL simulations

The following steps have been followed to build the samples used in the analysis:

1. 2009 data for the seven countries have been extracted in local currency from the Bankscope database and converted to Euro by using official exchange rates from Eurostat.
2. the data have been cleaned by deleting observations considered as non-plausible or missing basic information.
3. companies that are holdings, real estate and mortgage, or which equity to assets ratio was lower than 1% (as a proxy for investment banks) have been excluded from the sample and all consolidated statements have been dropped.
4. the following '*known relationships*' have been applied in order to fill in part of the missing values:
 - (a) capital requirement = 8% * RWA
 - (b) total regulatory capital = solvency ratio * RWA
 - (c) regulatory Tier 1 capital = Tier 1 ratio * RWA
5. missing data have been also filled in using data from consolidated statements for the same company by applying the same ratios (e.g. solvency ratios, Tier 1 ratio, etc). At the end of this filling in process, the '*known relationships*' have been again applied with several loops.
6. the remaining missing data have been filled in by using ECB data on the same ratios.⁴³ First we have applied these ratios to missing observations and then we have applied again the '*known relationships*' with several loops.

⁴³ See Tables 11a and 12a in ECB *Banking Sector Stability Report* 2010.

Table A.1 presents aggregated information about the most relevant variables for the samples of banks used in the analysis.

Table A.1: Description of the **samples** used for the **SYMBOL** simulations. The third column shows the coverage of the sample, defined as the share of assets in the sample respect to the assets of the population of banks in a country.⁴⁴

	Number G1 Banks ⁴⁵	Number G2 Banks	Sample % Population	Assets (m€)	Non-equity Liabilities (m€)	Interbank Debt ⁴⁶ (m€)	Interbank Credit (m€)	Covered Deposits (m€)	MCR (8% RWA) (m€)	Total Capital (m€)	DGS/RF funds ⁴⁷ (m€)
DE	6	1476	64.19%	4,648,331	4,415,620	1,086,016	790,975	1,093,841	125,452	232,711	20,096
IE(*)	5	19	101.91%	1,221,181	1,155,789	276,738	148,729	147,145	44,121	65,392	3,488
ES	8	135	73.95%	2,370,807	2,188,636	348,780	226,113	542,332	115,565	182,171	7,874
FR	17	178	102.59%	7,191,608	6,817,107	842,666	779,727	1,550,504	245,024	374,500	22,850
IT	8	465	81.81%	2,827,051	2,556,174	188,375	195,958	476,963	97,416	270,876	7,816
PT	3	11	66.49%	323,762	297,421	43,561	34,505	82,952	17,704	26,342	1,121
UK	7	78	73.97%	4,278,074	4,074,946	743,978	691,049	464,241	110,757	203,129	12,313

Source: Bankscope, (*) Supervisory Authority and/or Central Bank

⁴⁴ Total assets for the population of banks in a country are estimated using ECB data reported in the 2010 *Banking Sector Stability report*.

⁴⁵ Group 1 banks are banks that have Tier 1 capital in excess of 3 billion €. All other banks are Group 2 banks.

⁴⁶ A correction factor for the volume of the interbank debt/credit has been applied to the following MS, to correct for the inclusion of some classes of debts certificates: FR (39.1%), IT (26.9%). The correction factors employed have been estimated using the 2010 ECB *Banking Sector Stability Report*, Table 11a.

⁴⁷ The amount of funds for DGS/RF purposes is rescaled on the size of the sample (column 3 in Table A.1).

ANNEX B: Impact of a different parametrization

In order to test the robustness of the results to different parameterizations, we also calculate the results based on the parameters estimated or used to calibrate the QUEST model, the official DSGE model of the Commission.

In particular, leaving everything else identical to the analysis presented above, we change the cost of equity to a ROE of 14.3% and the cost of bank bonds to 2.5%.

Moreover, as QUEST incorporates a 50% Modigliani-Miller effect we add that to the calculations as well.

This leads to changes in costs as depicted in the following table

	BIII 6.50%	BIII 8%	BIII 10.50%	BIII 12%	BIII 13.50%	BIII 15%	BIII Δ1%
Variation in banks' funding costs (bps).	0.3	1.3	5.3	8.6	12.4	16.3	2.45
Variation in lending spreads (bps).	1.0	3.6	12.4	19.7	28.1	36.7	5.40
Variation in non-financial firms cost of capital (bps).	0.32	1.09	3.76	6.01	8.67	11.43	1.78
Yearly costs (% GDP).	0.01%	0.05%	0.16%	0.26%	0.37%	0.49%	0.08%
NPV of costs (% GDP).	0.56%	1.91%	6.60%	10.56%	15.24%	20.09%	3.13%
NPV of net benefits (%GDP).	2.58%	5.31%	7.73%	6.19%	3.17%	-0.67%	

As it can be seen, the results basically do not change, due to the fact that the higher spread between the costs of equity and long term bonds is compensated by the introduction of the Modigliani-Miller effect.

The optimal choice of MCR remains at 10.5% even when, under this parametrization, the Modigliani-Miller effect is reduced to 25% (yielding a net benefit of 4.4%).

The additional aggregate benefit of introducing a DGS/RF on top of a 10.5% MCR remains positive in both cases.

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Title: **Macroeconomic cost-benefit analysis of Basel III minimum capital requirements and of introducing Deposit Guarantee Schemes and Resolution Funds**

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Abstract

The present work proposes a new methodology to estimate the reduction in the probability of occurrence of a systemic banking crisis entailed by the implementation of the Basel III framework for banking regulation. This is achieved by making use of the SYMBOL model (SYstemic Model of Banking Originated Losses) jointly developed by the JRC, DG MARKT, and experts of banking regulation (see De Lisa et al., 2010) that estimates, given Basel capital requirements, the losses and liquidity shortfalls deriving from banks' defaults.

A systemic banking crisis is defined in this work as a situation where liquidity shortfalls are higher than a certain threshold, beyond which public authorities would find it difficult to intervene by injecting liquidity and therefore would have hard time in trying and avoiding that the crisis spreads further. In particular, we assume that the threshold for a systemic banking crisis in any country corresponds to 3% of its Gross Domestic Product (GDP). Given this definition, the probability of a systemic banking crisis is derived from the distribution of liquidity shortfalls affecting the banking system due to banks' default.

The reduction in the probability of a systemic banking crisis deriving from the adoption of Basel III is obtained by running the SYMBOL model under alternative scenarios for banks' capital, in particular considering the estimated change in banks' capital requirements induced by Basel III.

The macro-economic impact of implementing Basel III is also estimated coupling the results of the SYMBOL model with a cost-benefit framework proposed by the Bank of England (2010), which estimates the net gains of tightening capital requirements as a percentage of a country's GDP. Benefits arise from the expected fall in GDP (that follows a banking systemic crisis) avoided thanks to a reduction in the probability of having a systemic banking crisis; costs derive instead from the increase in lending rates introduced by banks as a reaction to the tighter Basel III capital requirements that in turn induce a decrease in non-financial firms' investments and a drop in GDP.

The proposed approach is applied to representative samples of banks from a few European countries: France, Germany, Ireland, Italy, Spain, and the United Kingdom. Our main results are as follows: first, regarding the effect of Basel III on the probability of a systemic banking crisis, we find that its reduction considerably depends on the initial level of banks' capital and on the level of recapitalization of banks that follows the implementation of Basel III; second, regarding the macro-economic impact of Basel III, we find that the net benefits of implementing Basel III are always positive and almost always larger in the scenario where the capital conservation buffer is introduced.

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