The Potential Impact of Banking Crises on Public Finances: An Assessment of Selected EU Countries Using *SYMBOL*

by

Francesca Campolongo, Massimo Marchesi, and Riccardo De Lisa*

This paper presents an application of the SYMBOL model, which was recently developed by the European Commission. In this application, we assess the potential impact of a crisis in the banking sector on public finances in four EU Member States chosen as examples. Results show that two Member States have a relatively higher probability of being in a situation where government finances have to cover losses generated in the banking system.

JEL Classification: G21, G22

Keywords: Financial crisis, Public finance, Systemic risk, Contagion risk, Bank default, Deposit insurance, Resolution fund

* F. Campolongo is Head of the Financial Crisis Task Force at the European Commission Joint Research Centre, Massimo Marchesi is Administrator at the European Commission, Directorate General Internal Market and Services, Financial Stability Unit, and Riccardo De Lisa is a Professor of Economics of Financial Intermediaries at the University of Cagliari, Italy. The article was released in October 2011. This work is published on the responsibility of the Secretary-General of the OECD. The opinions expressed and arguments employed herein are those of the authors and do not necessarily reflect the official views of the Organisations or of the governments of its member countries.

1 Introduction

The recent financial crisis has shown some of the limits of current financial-system regulation. In view of this, European regulators and supervisors, as those in the rest of the world, have started a thorough revision of the main instruments of financial regulation, *i.e.* minimum capital requirements, banks deposits insurance, the banks crisis management framework.

These regulatory revisions have been supported by wide-ranging and deep analysis. The objective of these efforts clearly is to adopt regulatory changes on the basis of robust evidence produced by new and sound methodologies. In particular, the Joint Research Centre of the European Commission, jointly with DG-Internal Market and academia, have developed a new model named SYMBOL (SYstemic Model of Banking Originated Losses) to analyse banking crises and to serve as the main tool in the assessment of the impact of regulatory changes.[1] In particular, SYMBOL allows one to estimate potential bank losses within a Basel 2 compliant framework. The model explicitly considers potential losses arising from contagion effects in the interbank market.

This model can be applied to assessing the impact of a single regulatory measure or for evaluating the cumulative impact of a package of regulatory interventions. This aspect permits one to properly assess the impact of complex and numerous legislative initiatives, and calibrate regulatory changes accordingly. By assessing cumulative effects, regulators are more likely to detect the presence of double-regulation or regulatory overlaps.

SYMBOL also allows one to analyse the effects of regulation by adopting a macro perspective. In fact, the model estimates banking system losses by using a bottom-up approach to aggregate individual banks losses. Thus, the macro perspective of regulation can jointly be assessed with the micro perspective.

SYMBOL is being used by the Commission Services to prepare various so-called impact assessments of EC regulatory proposals intended to enhance financial stability and prevent future crises, such as the Capital Requirement Directive Proposal (EC 2010), the Crisis Management Framework Proposal, and the Comprehensive Evaluation of Financial Market Regulatory Reforms.

In addition to these impact assessments, SYMBOL has been recently applied to assessing the significance of banking crises on various financial phenomena, i.e. the stability of government finances. The recent financial crisis has shown that the balance sheets of governments and of banks are strongly interconnected and can affect each other in both directions. It is therefore important to take into account the potential consequences of the financial sector's condition of the financial sector on government finances. The present paper thus complements the analysis in Estrella and Schich (2011), which focuses on the effect running from the governments to the banks.

This paper presents the results of applying the SYMBOL model to assessing public finance sustainability in a banking system crisis.[2] The remainder of this paper is organized as follows. Section 2 presents the methodology. Section 3 explains the data used in the analysis and section 4 presents the results using the example of four European Member States (chosen for illustrative purposes). Section 5 concludes.

2 Methodology

SYMBOL involves two steps. First, an estimation of the default probability for the assets of any individual bank, based on the Basel FIRB loss-distribution function. Second, an estimation of the distribution of aggregate losses by country, on the basis of the individual banks' asset-default

probability[3].

Once the aggregate bank loss estimates are obtained, it is possible to extrapolate and estimate the potential risk to public finances deriving from defaults in the banking sector. The underlying assumption used is that losses generated in the banking system are first covered by banks' capital. Whenever that capital is insufficient, losses are assumed to be covered by the various tools available in the financial safety net. The losses that cannot be absorbed by these tools are assumed to be covered, where possible, by governments (as has been the case in the current financial crisis).

The sequence assumed in the analysis is that when losses from obligors materialize, they are first covered by a bank's own capital, which is defined as the sum of the minimum capital required by regulation plus any excess capital. In case that capital is not sufficient, the bank defaults, so that Deposit Guarantee Schemes (DGS) and/or Bank Resolution Funds (BRF) are called upon to intervene. The DGS aim at protecting depositors, while the BRF aim at ensuring an orderly resolution of failing banks, blocking spill-over effects and preventing contagion (Schich and Kim, 2010). In the event that the DGS/BRF funds are not sufficient to absorb the losses, it is assumed that the losses are transferred onto the government finances, as has often been the case in the current financial crisis.

The SYMBOL model estimates the probability that public finances will be hit by bank losses. It also estimates the amount of funds that should be injected into the banking system through public interventions when the protections provided by existing financial safety net tools have been exhausted[4].

Different legislative settings, reflecting different possible regulatory scenarios are considered.[5] Each scenario is derived by making an assumption about four factors: i) the amount of minimum regulatory capital that banks have to hold; ii) the existence (or not) of DGS/BRF; iii) the existence (or not) of bail-in arrangements; and iv) the existence (or not) of contagion effects between banks. Any combination of these four factors, determines a different scenario. For instance, the scenario that depicts the current situation is derived from the following assumptions: a minimum regulatory capital equal to 8% of the Risk Weighted Assets, as set by Basel III; the existence of some DGS/BRF and of bail-in arrangements, but the absence of an BRF mechanism that is effective in blocking contagion.

In general, the four factors can be determined as follows:

i. The amount of minimum regulatory capital that banks have to hold depends on whether Basel II or Basel III are assumed to be in place, and on the application of the Basel III conservation buffer. Three possible situations are considered: (1) Banks are compliant with Basel II and hold enough capital to fulfill their 2009 capital requirements. This buffer is not enough when applying the new capital definition proposed in Basel III. (2) Banks have recapitalized to meet the new Basel III requirements (Basel Committee, 2009, 2010*a*, 2010*b*, 2010*c*; CEBS 2010) which impose a minimum regulatory capital equal to 8% level of Risk Weighted Assets. (3) Banks have recapitalized to meet the Basel III extended requirement and hold, in addition, a capital conservation buffer so that their minimum capital ratio reaches 10.5%.

ii. As regards DGS/BRF, two possible situations are considered: (1) DGS and BRF are in place, so that part of the losses are absorbed by these two entities; or (2) they are not in place.

iii. As regards bail-in arrangements, two situations are considered: (1) "bail-in" or (2) "no bail-in". The two situations differ with respect to the assumption regarding the existence of a legal framework able to ensure that some of the losses of defaulted banks can be effectively bailed-in. In particular, in the "bail-in" setting, bondholders and non-covered depositors[6] are assumed to absorb bank losses that are beyond the scope of intervention by the DGS/BRF. In the "no bail-

in" setting, it is assumed that DGS/BRF are unable to intervene in a selective way, so that they end up also covering the exposure of the bondholders and the non-covered depositors of the defaulting banks[7].

iv. Two possible situations regarding contagion are considered: (1) contagion takes place; or (2) contagion is prevented by the effective functioning of BRF arrangements.

Five different scenarios are presented that reflect different possible combinations of the assumptions regarding the four factors listed above. The five scenarios are presented in Table 1, with scenario 1 representing the highest public-finance risk and scenario 5 the lowest.

Table 1. Definition of scenarios considered

	Capital Setting			DGS/BRF Setting		Bail in		Contagion	
Scenario	*Basel II*	*Basel III 8%*	*Basel III 10.5%*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*
1	X				X			X	
2		X		X			X	X	
3		X		X			X		X
4		X		X		X			X
5			X	X		X			X

Source: European Commission (2011).

Scenario 1 represents the situation at the beginning of the crisis. Scenario 2 represents the situation as of now, with some elements of Basel III introduced but without a functioning BRF to prevent contagion. Scenario 3 represents the situation in which a BRF is introduced, and we assume here that the BRF is effective in eliminating contagion. Scenario 4 is like scenario 3, but with the successful implementation of bail-in. Scenario 5 is like scenario 4, but with all banks increasing their capital to comply with the countercyclical buffer.

3 Data

SYMBOL estimates the probability distribution of individual bank losses based mainly on two major sources of information: i) publicly available financial statements; and ii) publicly available regulatory capital requirements imposed by the national regulators from which it is possible to estimate the implied average probability of default of a bank's asset/loan portfolio.

The main data source is Bankscope, a proprietary database of banks' financial statements produced by the private company Bureau van Dijk. The dataset covers a representative sample of banks in most EU countries. When needed and when possible, data are integrated with public information on banks' financial statements released by supervisory authorities and/or central banks. In addition, ECB data have been used to complete or adjust the dataset.

The analysis is presented here for four EU countries, as examples. Table 2 provides some information on the sample data used for the analysis. The year of reference is 2009. The first column of the Table shows the coverage of the samples, expressed as the percentage of total assets of the banks in the samples and an estimate of the total assets for the entire population of banks in each Member State. The latter is obtained from the 2010 ECB EU banking structures publication, and it is computed as the amount of total assets for all banks minus total assets of bank branches abroad.

Table 2. Description of the sample used for SYMBOL simulations

	Sample as % of bank population	Total assets	Total liabilities	Total interbank debt	Total interbank credit	Total covered deposits	Total capital
Germany	64.19%	4 648 331	4 415 620	1 086 016	790 975	1 093 841	232 711
Ireland ([1])	101.91%	1 221 181	1 155 789	276 738	148 729	147 145	65 392
Portugal	66.49%	323 762	297 421	43 561	34 505	82 952	26 342
Sweden	52.37%	455 355	422 301	97 604	122 872	75 383	33 054

Note: In Million Euros unless indicated otherwise. Data as of year-end 2009.

Source: European Commission (2011).

4 Results

Aggregate loss distributions computed using SYMBOL can be used to assess the sustainability of government finances with respect to defaults in the banking system generated by credit risk.

Table 3 presents selected percentiles of the probability distribution for the costs to government finances, starting from the last decile. Note that, in order to facilitate the comparison between countries, costs have been expressed as a percentage of GDP (data from 2009), and the distributions of banking system losses are rescaled on the basis of the size of the samples used (see Table 2).

Results can be interpreted as follows. For example, under scenario 1, with 99% probability, the cost to the German government deriving from a bank crisis is not higher than 0.02% of GDP.

Figure 1 shows the probabilities that public finances will be hit by losses deriving from bank defaults, by looking at the probability of having any loss occurring in any of the five scenarios.

This indicator shows that, for example, both in the previous regulatory situation (scenario 1) and in the current one (scenario 2,) Ireland and Portugal have a relatively high probability of being in a situation where government finances have to cover losses generated in the banking system.

However, this indicator does not give any information on the *size* of the loss that might hit public finances: it may well capture situations where there are minor defaults occurring and relatively small losses to be absorbed.

Information on the size of the losses can be extracted from Table 3. In particular, it may be worthwhile to look at the size of the losses that some countries may have to face under the current regulatory scenario, and how the situation could improve by setting in place regulatory tools.

For instance, the case of Ireland shows that there is a probability, although relatively low (at 0.1%), that in the current regulatory setting (scenario 2) the government may have to face a loss higher than 40.982% of GDP, which is a substantial loss likely to be due to the effects of contagion among banks.

The same Table shows that the introduction of regulatory tools, and in particular of a Bank Resolution Fund that is effective in eliminating contagion, would drastically reduce the size of the loss,

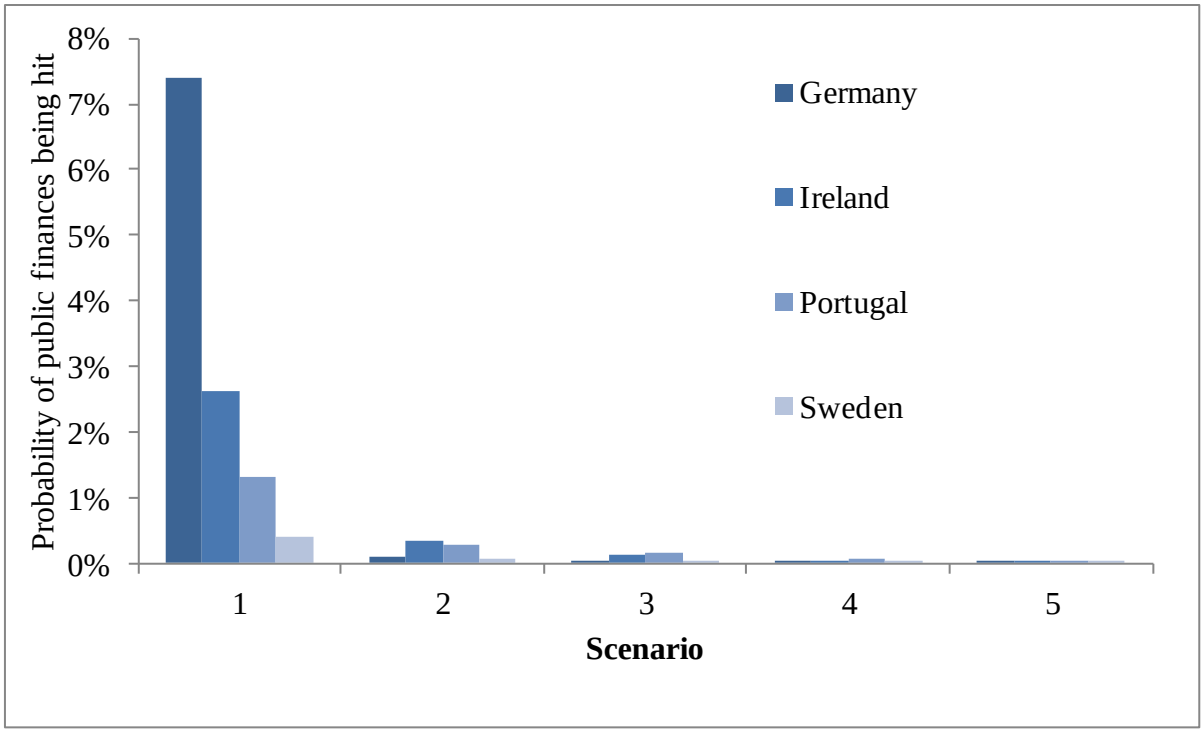
which in scenario 3 amounts to 0.544% of GDP.

Table 3. Selected percentiles: distribution of the costs to public finances (as % of 2009 GDP)

	Germany					Ireland				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
90	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
95	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
97	0.002%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
99	0.020%	0.000%	0.000%	0.000%	0.000%	42.772%	0.000%	0.000%	0.000%	0.000%
99.25	0.032%	0.000%	0.000%	0.000%	0.000%	45.089%	0.000%	0.000%	0.000%	0.000%
99.5	0.056%	0.000%	0.000%	0.000%	0.000%	47.733%	0.000%	0.000%	0.000%	0.000%
99.75	0.132%	0.000%	0.000%	0.000%	0.000%	52.199%	3.380%	0.000%	0.000%	0.000%
99.9	13.550%	12.086%	0.000%	0.000%	0.000%	56.525%	40.982%	0.544%	0.000%	0.000%
99.925	14.970%	13.494%	0.000%	0.000%	0.000%	57.941%	43.253%	1.154%	0.000%	0.000%
99.95	16.363%	14.920%	0.000%	0.000%	0.000%	59.921%	46.297%	2.093%	0.000%	0.000%
99.975	17.897%	16.461%	0.000%	0.000%	0.000%	63.253%	50.599%	3.911%	0.053%	0.000%
99.99	19.497%	18.081%	0.124%	0.000%	0.000%	67.974%	55.454%	6.587%	1.024%	0.294%
99.995	20.763%	19.343%	0.739%	0.000%	0.000%	71.657%	59.219%	9.085%	1.930%	1.138%
99.999	24.052%	22.712%	2.810%	0.711%	0.759%	81.953%	69.237%	15.650%	4.312%	3.376%
		Portugal				Sweden				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
90	0.000%	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%
95	0.000%	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%
97	0.000%	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%
99	0.011%	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%
99.25	0.039%	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%
99.5	0.682%	0.000%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%
99.75	3.235%	0.585%	0.000%	0.000%	0.000%	0.00%	0.00%	0.00%	0.00%	0.00%
99.9	8.547%	3.116%	0.593%	0.000%	0.000%	0.02%	0.00%	0.00%	0.00%	0.00%
99.925	9.954%	4.392%	1.057%	0.000%	0.000%	2.27%	1.41%	0.00%	0.00%	0.00%
99.95	11.560%	6.724%	1.758%	0.136%	0.000%	3.34%	2.48%	0.00%	0.00%	0.00%
99.975	13.830%	9.809%	3.029%	0.660%	0.025%	5.49%	4.64%	0.91%	0.00%	0.00%
99.99	16.659%	12.940%	4.861%	1.416%	0.722%	19.93%	19.08%	2.55%	0.52%	0.35%
99.995	19.062%	15.521%	6.440%	2.068%	1.318%	22.23%	21.37%	3.96%	1.08%	0.88%
99.999	24.947%	21.600%	10.514%	3.749%	2.927%	27.22%	26.36%	7.74%	2.60%	2.37%

Source: European Commission (2011).

Figure 1. Probability of public finances being hit by losses deriving from bank defaults



Source: European Commission (2011).

I. Conclusions

This paper presented an application of the SYMBOL model, recently developed by the European Commission, to assess the potential impact of bank crises on public finances in four EU Member States: Germany, Ireland, Portugal and Sweden. SYMBOL allows the estimation of aggregate bank losses that potentially might have to be absorbed by government finances, as occurred in recent years.

Results show that two Member States have a relatively higher probability of being in a situation where government finances have to cover losses generated in the banking system. Moreover, it shows that regulatory tools, such as the introduction of Bank Resolution Funds, may substantially improve the situation.

The SYMBOL model has already being used by the European Commission to support various legislative proposals on banking regulation.

The model will be further developed: for example, its geographical coverage will be extended to include other EU countries.

Notes

1. The seminal work on SYMBOL has been published in De Lisa *et al.* (2010).

2. This paper widely refers to recent research work by the European Commission to assess the sustainability of public finances in the EU. Results of this research are published in the European Commission report *Public Finance in EMU 2011*.

3. For more details see De Lisa *et al.* (2010).

4. The assumption is made that the total amount of funds available for DGS and BRF is the higher of 1.5% of covered deposits and 0.3% of total non- equity liabilities of the banking system, in any EU Member State.

5. The SYMBOL model is a flexible tool that allows changing the underlying assumptions so to be compliant with different regulatory settings.

6. Depositors covered by DGS are only eligible depositors up to 100,000 EUR. Non-eligible depositors are, for example, credit institutions, other financial institutions, insurances and pension funds.

7. Note that in the "No Bail-In" scenario the potential for dynamic moral hazard problems arising from the coverage of the losses of all bank creditors by DGS and BRF is currently not considered. Note also that in the bail-in setting, once the DGS/BRF funds are exhausted, the State intervenes to absorb within the same modalities as the DGS/BRF, *i.e.* not absorbing losses hitting the bondholders and the non-covered depositors.

References

Basel Committee on Banking Supervision (2009), *International framework for liquidity risk measurement, standards and monitoring*, consultative document; http://www.bis.org/publ/bcbs165.pdf .

Basel Committee on Banking Supervision (2010*a*), *Governors and Heads of Supervision agreement on Basel Committee capital and liquidity reform package*; http://www.bis.org/press/p100726/annex.pdf

Basel Committee on Banking Supervision (2010*b*), *Group of Governors and Heads of Supervision higher global minimum capital standards*, http://www.bis.org/press/p100912.pdf?noframes=1

Basel Committee on Banking Supervision (2010*c*), *Results of the comprehensive quantitative impact study*, http://www.bis.org/publ/bcbs186.pdf

Committee of European Banking Supervisors, CEBS, (December 2010), *Results of the comprehensive quantitative impact study*, http://www.eba.europa.eu/cebs/media/Publications/Other%20Publications/QIS/EU-QIS-report-2.pdf

De Lisa, R. et al. (2010), "Modelling Deposit Insurance Scheme Losses in a Basel 2 Framework", *Journal of Financial Services Research*, DOI: 10.1007/s10693-010-0097-0 Online First™

Estrella, A. and S. Schich (2011), "Sovereign and Banking Sector Debt: Interconnections OECD *Financial Market Trends*, October; www.oecd.org/daf/fin .

European Commission (2010), *Impact Assessment: Accompanying Document to the Proposal for a Directive of the European Parliament and of the Council on Deposit Guarantee Schemes* [recast], Commission Staff Working Document SEC(2010) 834/2, http://ec.europa.eu/internal_market/bank/docs/guarantee/20100712_ia_en.pdf

European Commission (2011), "Potential Impact of the Balance Sheet Situation of the Banks on Public Finance*"*, in: *Public Finance in EMU*, p. 141-150; http://ec.europa.eu/economy_finance/publications/european_economy/2011/pdf/ee-2011-3_en.pdf

Schich, S. and B-H Kim (2010), "Systemic Financial Crises: How to Fund Resolution", OECD *Financial Market Trends*, Volume 2010, Issue 2; http://www.oecd.org/dataoecd/16/16/46681329.pdf .