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Financial Activities Taxes

and Banks' Systemic Risk

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Abstract

The recent financial crisis has highlighted the risks posed by individual banks to the entire banking system. Next to the issue of determining individual contributions to systemic risk, the question of additional taxes on the financial sector has been debated. This paper uses SYMBOL, a micro-simulation model of the banking system, to estimate these individual contributions and compares them to the potential individual tax liabilities of banks under the assumption of a Financial Activity Tax.

Keywords: Taxation, Banks, Financial Activity Tax, Systemic Risk.

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1. Introduction

In September 2011, the European Commission (2011) has evaluated options regarding the introduction of a harmonized Financial Sector Taxation framework. Among these options, the European Commission considered a Financial Activities Tax (FAT). Originally proposed by the IMF (2010), the FAT is, in its simplest form, a tax on the sum of profit and remunerations of the financial sector. This tax has the features of being a good substitute for the VAT on the sector (as this later is exempted) and to present little distortions to the extent that it taxes rents of the sector. Three versions of the FAT can be considered. The first version, FAT1, defines the profit of financial institutions in cash-flow terms and adds the remunerations paid by the sector. FAT2 takes the same base for profit but only adds 'excessive' remunerations, i.e. those above a defined threshold. Finally, FAT3 takes as tax base the sum of cash-flow profit above a defined return on capital and 'excessive' remunerations.

At the same time, the banking sector is subject to various other regulatory proposals, aimed at strengthening the stability of the banking sector. In particular, the European Commission has put forward new rules for banks' capital requirements, transposing into EU legislation the recent Basel III Accord, and is going to present a novel framework for crisis management. The latter, among other things, foresees the implementation of Resolution Funds (RF) whose function is that of limiting contagion effects across banks and thus of ensuring that bank failures can not take place in an uncontrolled fashion that would destabilise the financial system.

In this context, it is important to investigate the contribution of banks to systemic risk and to see whether a Financial Activity Tax would be a good proxy for a fee that would mirror the individual contributions of banks to systemic risk. To this aim, the present contribution consists of an analysis, based on the banking system micro-simulation model SYMBOL , estimating the probability and magnitude of systemic losses deriving from banks' defaults, explicitly taking into account the effects of Basel capital requirements, Deposit Guarantee Schemes (DGS) and bank Resolution Funds (RF). SYMBOL also provides results for the contribution of individual banks to the risk of the banking sector as a whole, both in the case where contagion effects are controlled fully by DGS/RF (and the associated crisis management tools) and in the case when these tools are not completely effective in managing the effects of banking defaults. The analysis has been developed for 19 EU Member States using 2009 unconsolidated financial data for a sample of banks coming from Bankscope and augmented by further analysis by the European Commission's services, as well as integrations from Supervisory Authorities and/or Central Banks for some countries. Moreover, some ECB data have been used to complete or correct the dataset.

The remaining of this document develops as it follows. Section 2 introduces the SYMBOL model. Section 3 lists the main proposals on financial regulation incorporated in the SYMBOL analysis. Section 4 shows how SYMBOL has been used to obtain estimates of the banks' individual contributions to systemic expected losses. Section 5 contains some summary statistics of the results, examples for selected countries and information on how to read detailed results file..

2. The SYMBOL model

The SYMBOL model simulates individual bank credit losses for all banks in a banking system via a Monte Carlo simulation according to the Basel Foundation Internal Ratings Based (FIRB) function loss distribution and a correlation matrix. The loss distribution of each bank is calibrated to the credit risk implied by its regulatory capital requirement. The model can also simulate contagion via the interbank market, in order to capture systemic linkages between banks besides the fact that their assets are correlated.

Simulations are based on the following three steps:

(1) The average assets probability to default (PD) of each bank i $\hat{PD}_i$ is estimated. $\hat{PD}_i$ is obtained as the PD that allows the actual value of the capital requirement for that specific bank K_i (extracted from balance-sheet data) to be equal to its numerically calculated value obtained from the Basel FIRB formula, setting the other variables, i.e. loss given default (LGD), maturity (M) and size (S), to their standard values:

$$\hat{PD}_i : K\left(\hat{PD}_i \mid LGD = 0.45\; M = 2.5\; S = 50\right) = K_i$$

where $K_i\left(PD_{ik}, LGD_{ik}, M_{ik}, S_{ik}\right) = \sum_i C_{ki}\left(PD_{ki}, LGD_{ki}, M_{ki}, S_{ki}\right) \times A_{ki} \quad k = 1, \ldots, K$

is the sum of the capital allocation parameter (C_{ij}) of each exposure k of bank i multiplied by its amount A_{ki} .[1]

[1] see De Lisa et al., (2010) for a detailed explanation of all terms in this representation of the FIRB approach

$$C_{ik}\left(PD_{ik}, LGD_{ik}, M_{ik}, S_{ik}\right) = \left[LGD_{ik} \times \left[\sqrt{\frac{1}{1-R\left(PD_{ik}, S_{ik}\right)}}N^{-1}\left(PD_{ik}\right) + \sqrt{\frac{R\left(PD_{ik}, S_{ik}\right)}{1-R\left(PD_{ik}, S_{ik}\right)}}N^{-1}\left(0.999\right)\right] - PD_{ik} \times LGD_{ik}\right] \times$$

$$\times\left[1+\left(M_{ik}-2.5\right)B\left(PD_{ik}\right)\right]\times\left(1-1.5\times B\left(PD_{ik}\right)\right)^{-1}\times 1.06$$

where:

$$B_{ik}\left(PD_{ik}\right) = \left[0.11852 - 0.05478\ln\left(PD_{ik}\right)\right]^2$$

and

$$R_{ik}\left(PD_{ik}, S_{ik}\right) = 0.12\frac{1-e^{-50PD_{ik}}}{1-e^{-50}} + 0.24\left[1-\frac{1-e^{-50PD_{ik}}}{1-e^{-50}}\right] - 0.04\left[\frac{S_{ik}-5}{45}\right]$$

(2) The calibrated $\hat{PD}_i$ are then used to generate a set of correlated losses across all banks in the system. For each simulation *j*, calculate bank *i*'s losses L_{ij} performing a Monte Carlo simulation based on the following representation of the FIRB formula:

$$L_{ij}\left(z_{ij}, \hat{PD}_i\right) = \left[0.45\, N\left[\sqrt{\frac{1}{1-R\left(\hat{PD}_i, 50\right)}}N^{-1}\left(\hat{PD}_i\right) + \sqrt{\frac{R\left(\hat{PD}_i, 50\right)}{1-R\left(\hat{PD}_i, 50\right)}}N^{-1}\left(z_{ij}\right)\right] - 0.45\,\hat{PD}_i\right] \times$$

$$\left(1-1.5\,B\left(\hat{PD}_i\right)\right)^{-1}\times 1.06$$

Where

$i = 1,...,H$ banks

$j = 1,...,J$ simulations

$z_{ij} \sim N\left(0,1\right)\forall i, j$

$\mathrm{cov}\left(z_{ij}, z_{lj}\right) = 0.5\ \forall i \neq l$ (where *i, l* are bank indexes)

(3) Simulated losses of banks are then compared with their capital: whenever the losses of a bank exceed its capital, the bank is considered to default:

$$L_{ij}\left(z_{ij}, \hat{PD}_i\right) \geq CAP_i$$

These 'excess losses' $L_{ij}\left(z_{ij}, \hat{PD}_i\right) - CAP_i$ are recorded (when at least one bank defaults) as 'no contagion losses'. The simulation is stopped once at least 100,000 runs with at least one simulated default is obtained.

This produces a wealth of synthetic market scenarios, distributed as implicitly defined by the Basel II Regulation, correlated between banks, and based on proxies of assets PD and actual values of the total capital of each bank considered. This is the starting point for testing contagion effects.

(4) To simulate contagion effects[2] in the absence of an effective intervention by resolution facilities,[3] exposures via the interbank market are used. Following James (1991), whenever a bank defaults, it is assumed that 40% of the amounts of its interbank debits 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 'infected' bank is proportional to its creditor exposure in the interbank market.[4] Whenever, with this additional loss the simulation shows that another bank's losses exceed its capital, that banks is also considered to default, and so on bank after bank until no additional bank defaults.

Therefore losses for each bank *i* in each *j* run become:

$L_{ij}^{c}\left(z_{ij}, P\hat{D}_i, IB\right) = L_{ij}\left(z_{ij}, P\hat{D}_i\right) + \sum_{l} D_l x_{il}$ where $l \neq I$, $D_l = 1$ if bank l defaulted, and zero otherwise and IB is the matrix of interbank exposures with elements x_{il}

Considering this, bank *i* defaults when $L_{ij}^{c}\left(z_{ij}, P\hat{D}_i, IB\right) \geq CAP_i$ and contagion is looped up to the cycle where no more banks default.

Finally, net losses $L_{nj}^{c}\left(z_{nj}, P\hat{D}_j, IB\right) - CAP_j$ are recorded (when at least one bank defaults).

Given that "contagion" results are based on the same starting seed in a random number generator and on the same simulation runs assures that differences in contagion results are only due to the effects of contagion.

Losses can then be aggregated over the entire population of banks to derive systemic losses, which are computed as the sum of the losses in excess of capital over the entire sample of

2 Only domestic contagion is included in the current version of SYMBOL.

3 In the "best case" scenario, a resolution fund operating in coordination with a liquidity facility is assumed to be able to neutralize contagion by absorbing a share of excess losses proportional to the size of a banks' interbank liabilities, while resolution and liquidity facilities are able to completely eliminate additional losses due to liquidation costs, fire sale effects and market congestion.

4 It is worth noting that contagion effects are sensitive to the two assumptions made: the 40% of interbank debits that are passed as losses to creditor banks in case of failure, and the criterion of proportionality used to distribute these losses across banks. A loss of 40% on the interbank exposure is coherent with the upper bound of economic research on this issue. See James (1991), Mistrulli (2007), Upper and Worms (2004). The use of a matrix of exposures proportional to interbank credits is dependent on the fact that a bank-to-bank interbank lending matrix is not yet available to the Commission; however sensitivity analysis conducted by the authors on this aspect points to the fact that the exact shape of the matrix is less important than total size of interbank market.

banks for both the “no contagion” and “contagion” cases. Therefore, for the j-th simulation run, the systemic loss is the sum of individual banks’ excess losses:

$$L_{Syst}(j) = \sum_{i=1}^{H} L(i, j) \, .$$

As in the current analysis we rely on a sample of banks (see annex A.1), distributions for the population of all banks in each Member State are finally obtained by rescaling the distributions proportionally according to the ratio of total assets in the sample and in the total banking sector in the MS.

Finally, ordering the runs allows us to draw a probability distribution of aggregate losses, while keeping a memory of exactly which banks participated in generating losses simulated in each run.

Calculating systemic risk contributions using SYMBOL

Our methodology for calculating systemi risk contributions of every institution is a variation of the one proposed by Praschnik and Principato (2001) and is such that expected yearly losses are directly proportional to total losses simulated for each bank in all simulation runs.

The contribution of bank *i* to systemic losses is defined as the expected yearly loss for this bank and is estimated as its average loss over the whole set of simulations, as it follows:

$$c(i) = \frac{\sum_{j=1}^{K} L(i, j)}{K}$$

Next, the percentage contribution of each individual bank to the systemic risk is thus:

$$pc(i) = \frac{c(i)}{\sum_{h=1}^{H} c(h)} \, .$$

It is also possible to focus the attention on the tail of the loss distribution and determine the contribution of each bank in causing losses higher than a certain threshold *T* (i.e. the contribution of a bank in determining systemic losses above the threshold *T*):[5]

[5] The contribution of a bank to aggregate losses below the threshold T can also be obtained considering the difference between average yearly contributions on the whole set of simulations and on the runs with losses above the threshold.

$$c(i)\big|_{>T} = \frac{\sum_{j=1}^{K}\left[L(i,j)\big|L_{Syst}(j) > T\right]}{K}$$

$$pc(i)\big|_{>T} = \frac{c(i)\big|_{>T}}{\sum_{h=1}^{H} c(h)\big|_{>T}}$$

3. Financial regulatory proposals incorporated in the analysis

The European Commission is currently presenting three distinct proposals on financial regulation. First, the European commission considers a Capital Requirements Directive proposal (CRD IV), aimed at adopting the new rules proposed in the Basel 3 accord, including new definitions of capital for regulatory purposes, a new set of capital requirements for tier1 and total capital as a proportion of Risk Weighted Assets (RWA) and the introduction of a capital conservation buffer of 2.5% of RWA. Second, on 12 July 2010, the Commission adopted a legislative proposal for a thorough revision of the Directive on Deposit Guarantee Schemes. It mainly deals with a harmonisation and simplification of protected deposits, a faster payout, and an improved financing of schemes, as well as a substantial enlargement of the coverage (up to EUR 100,000), as a consequence of their funding. Third, it considers a Directive proposal for an EU crisis management and banks resolution framework, including the creation of Resolution Funds in all MS.[6]

The main features of these three proposals have been incorporated in the SYMBOL analysis, in order to come up with figures based on the most possible comprehensive view of all changes, which are expected to impact the banking sector in the near future. To take into account the effects of the new Basel 3 rules on capital requirements, distributions of losses are generated under the hypothesis that banks hold a capital equal at least to 8% or 10.5% of their Risk Weighted Assets (i.e. excluding or including the presence of a mandatory capital conservation buffer).[7] In addition, a sensitivity analysis for alternative levels of capital requirements is presented. As far as Deposit Guarantee Schemes and Resolution Funds are

[6] See e.g. the Communication on Bank Resolution Funds COM(2010)254 http://ec.europa.eu/internal_market/bank/crisis_management/index_en.htm#funds

[7] Regarding Basel III, SYMBOL takes account at the moment of the consequences due to changes in the definition of capital and of Risk Weighted Assets in the trading book, securitization and counterparty risk, as well as the introduction of the capital conservation buffer. The leverage ratio and the new measures on liquidity can be possibly factored into the methodology used on the basis of how they modify contagion between banks via the interbank market. The analysis does for the moment also not include the effect of the stricter Tier1

concerned, instead, we base our working hypotheses on most recent version of these two proposals. In particular, the considered amount of funds available to DGS+RF purposes is the maximum between 1.5% of a country covered deposits and 0.3% of the amount of liabilities. Amounts of funds to be collected by the considered Member State are reported in last column of Table A.1. in the annex. [8]

4. Methodology

As a micro-simulation tool, SYMBOL can be used to simulate losses based on alternative settings attempting to capture the effects due to the implementation of regulatory propsals illustrated in previous section. These are represented via "regulatory settings" and "contagion situations". Combinations of "settings" and "situations" identify the following "scenarios", representing joint assumptions on the regulatory set-up and the development of a financial crisis. In the current analysis SYMBOL is run based on two alternative regulatory settings and two alternative contagion situations[9]:

The first setting regards the level of regulatory capital expressed as the minimum ratio of Capital to Risk Weighted Assets. Two different capital requirement settings are considered in order to evaluate the effects of the introduction or not of a mandatory "capital conservation buffer" for banks in Basel 3. In other words we distinguish between the situation where banks must hold a minimum capital equal to 8% of their Risk Weighted Assets (RWA) and the situation where a minimum capital conservation buffer of 2.5% is also put on top, so to reach at least a capital equal to 10.5% of RWA. The section on Sensitivity analysis will include additional requirement levels.

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constraints imposed by Basel III.

[8] Figures in the last column of table A.1 refers to the sample of banks considered. As rules on the determination of the total amounts of funds available to DGS and RF in each MS 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.

[9] On top of this, SYMBOL is also able to include the possibility of a "no bail-in" or a "bail-in" framework when DGS/RF absorbs losses. In the first case DGS/RF funds cover all non-equity creditors by absorbing losses of defaulted banks until funds are available; in the second case DGS/RF cover only insured depositors and inter-bank depositors (to avoid contagion), i.e. part of the losses would be absorbed by bondholders and depositors not eligible for insurance coverage. This distinction goes beyond the scope of this paper and is not considered here.

Next, the second setting regards the contagion situations. They represent polar extremes of the effectiveness of interventions during the crisis. In the "best" situation, funds and facilities are assumed to be able to work in such a way that no additional losses due to liquidity or "fire sale" effects are generated, so that only economic losses due to defaults in bank's portfolios need to be covered, i.e. contagion effects are not considered. In contrast, the "worst" situation funds and facilities intervene, but they are not able to avoid liquidity and "fire sale" additional losses and to completely stop contagion. In sum, two situations are considered: one where intervention is perfectly effective in blocking contagion, and one where interventions are only able to reimburse losses but are not able to prevent contagion. As mentioned above, the first scenario assumes that 40% of the losses are passed to creditors.

The combination of these hypothesis yields four possible "scenarios", represented in Table 1.

Table 1: Scenario definition

Scenario	**Capital Setting**		**Situations**	
	No Conservation Buffer, i.e. capital ≥ 8% RWA	**Conservation Buffer, i.e. capital ≥ 10.5% RWA**	**Contagion**	**No Contagion**
1	X		X	
2	X			X
3		X	X	
4		X		X

Scenario 1 represents the worst (most risky) scenario: banks hold at least a capital of 8% of RWA and DGS/RF are ineffective in blocking contagion. Scenario 2 is the alternative for which, while the minimum capital stays at 8% of RWA, DGS/RF are effective in blocking contagion (no contagion). Next, in Scenario 3 and Scenario 4 banks hold at least a capital of equal to 10.5% of RWA but they differ in that DGS/RF are ineffective in blocking contagion, in Scenario 3 while it is in Scenario 4.

For each of the scenarios, SYMBOL simulates excess losses for each individual bank in the sample. The sum of all of these losses is then used to generate the distribution of losses in each scenario. SYMBOL is further used to estimate the contribution of each bank to systemic losses. The individual bank's contribution is defined as the expected average yearly loss of this bank (over the whole set of SYMBOL simulations)[10]. A percentage contribution of each bank to the systemic risk is then obtained as the ratio of its individual contribution on the sum of individual contributions of all banks in each country.

5. Results

The following results are based on a total number of SYMBOL simulations so to obtain for each country 100,000 runs where at least one bank defaults. This high number of run is needed in order to guarantee that in the right tail of the distribution a sufficient number of points is sampled.

5.1 Distribution of excess losses

Tables 4-7 show some selected percentiles of the distribution of systemic losses under the various scenarios for all considered MS. Distributions presented in these tables refer to the bank populations and are therefore comparable across MS. The tables report the cumulative distribution function of systemic excess losses. For instance for Scenario 1 in Belgium we can read that systemic excess losses are below 69,445 m€ in 99.9% of the cases.

It is clear that losses decrease moving from Scenario 1 to Scenario 2, and from Scenario 3 to Scenario 4, depending on the fact that contagion between banks is considered (Scenario 1 and 3) or not (Scenario 2 and 4). Moreover losses decrease when moving from a minimum capital ratio of 8% (Scenario 1 and 2) to a minimum capital ratio of 10.5% (Scenario 3 and 4).

[10] Contributions are calculated by excluding the more extreme events above the 99.999th quantile, in order to exclude the influence of events in the leftmost tail which could be suffering excess variance due to undersampling.

***Table (4)**: Estimated distributions of systemic excess losses in Scenario 1- Million Euro (Capital ≥ 8% RWA, Contagion)*

	90	95	96	97	98	99	99.5	99.9	99.95	99.99	99.995	99.999
BE	-	-	-	-	-	-	-	69,445	75,203	88,009	94,148	110,907
BG	-	-	-	-	-	-	-	56	144	451	830	1,817
DK	-	-	-	-	-	1	57	12,190	18,116	59,049	66,486	85,445
DE	-	11	25	54	128	436	1,255	321,017	388,965	464,719	494,974	575,736
GR	-	-	-	-	-	-	158	3,499	5,720	14,362	19,065	29,247
ES	-	-	-	-	2	146	1,348	14,860	30,581	79,267	105,814	164,196
FR	-	-	-	24	181	1,585	5,955	39,357	92,949	223,088	261,608	346,929
IE	-	-	-	-	-	-	787	68,848	77,334	91,954	97,964	113,956
IT	-	16	34	76	186	592	1,438	6,889	11,013	30,447	41,798	74,748
CY	-	-	-	-	-	-	-	19,573	21,463	23,632	24,464	26,382
LV	-	-	-	-	-	-	2	110	201	847	1,371	2,597
LU	-	-	-	-	-	-	-	50,776	60,553	74,228	77,739	85,326
MT	-	-	-	-	-	-	-	52	182	800	1,101	2,904
NL	-	-	-	-	-	-	5	24,275	129,948	157,113	168,784	198,370
AT	-	-	-	3	19	99	414	8,767	14,296	36,686	44,584	60,661
PT	-	-	-	-	-	-	67	6,924	12,988	23,435	27,773	37,992
FI	-	-	-	-	-	-	-	380	24,983	31,519	34,826	43,503
SE	-	-	-	-	-	-	-	69	9,780	58,346	65,067	79,655
UK	-	-	-	-	0	46	323	185,759	292,365	353,069	382,369	449,315

Table (5)*: Estimated distributions of systemic excess losses in Scenario 2 - Million Euro (Capital ≥ 8% RWA, No Contagion)*

	90	95	96	97	98	99	99.5	99.9	99.95	99.99	99.995	99.999
BE	-	-	-	-	-	-	-	3,626	6,813	15,926	20,747	34,157
BG	-	-	-	-	-	-	-	38	79	225	309	545
DK	-	-	-	-	-	1	49	1,698	3,464	10,191	14,051	26,281
DE	-	11	24	53	125	405	1,074	5,716	10,620	34,282	49,025	98,660
GR	-	-	-	-	-	-	106	1,897	3,217	6,995	8,948	14,842
ES	-	-	-	-	2	117	902	7,424	11,999	28,101	37,829	60,990
FR	-	-	-	23	166	1,182	4,251	19,393	30,235	63,643	83,061	132,007
IE	-	-	-	-	-	-	337	4,291	6,764	13,939	17,927	28,407
IT	-	16	34	74	180	560	1,340	5,854	9,313	22,234	31,288	51,638
CY	-	-	-	-	-	-	-	111	339	1,284	1,797	3,142
LV	-	-	-	-	-	-	1	60	107	253	327	556
LU	-	-	-	-	-	-	-	618	1,505	4,505	6,040	9,796
MT	-	-	-	-	-	-	-	16	118	455	636	1,129
NL	-	-	-	-	-	-	5	2,304	7,237	25,386	34,589	58,693
AT	-	-	-	3	18	86	279	2,134	3,603	7,639	9,533	15,123
PT	-	-	-	-	-	-	51	2,684	4,642	9,858	12,512	19,359
FI	-	-	-	-	-	-	-	144	1,809	8,125	11,336	19,874
SE	-	-	-	-	-	-	-	66	1,965	9,983	14,103	25,154
UK	-	-	-	-	0	43	269	8,136	18,270	53,579	72,394	128,850

Table (6)*: Estimated distributions of systemic excess losses in Scenario 3- Million Euro (Capital ≥ 10.5% RWA, Contagion)*

	90	**95**	**96**	**97**	**98**	**99**	**99.5**	**99.9**	**99.95**	**99.99**	**99.995**	**99.999**
BE	-	-	-	-	-	-	-	15,509	63,852	79,753	86,050	102,517
BG	-	-	-	-	-	-	-	55	143	449	808	1,813
DK	-	-	-	-	-	-	17	1,525	12,677	53,523	61,735	80,107
DE	-	6	16	38	95	318	917	12,370	370,337	455,300	484,531	565,109
GR	-	-	-	-	-	-	-	1,382	2,940	8,065	11,175	20,790
ES	-	-	-	-	0	65	471	10,507	24,720	65,275	85,791	141,078
FR	-	-	-	1	45	330	1,373	14,891	28,204	95,974	157,523	260,554
IE	-	-	-	-	-	-	-	8,699	46,159	77,618	84,660	101,801
IT	-	-	2	11	40	204	636	4,056	7,281	22,128	33,045	56,190
CY	-	-	-	-	-	-	-	19,359	21,371	23,585	24,427	26,320
LV	-	-	-	-	-	-	-	52	128	597	968	2,279
LU	-	-	-	-	-	-	-	757	52,376	71,921	75,799	83,630
MT	-	-	-	-	-	-	-	5	147	760	1,051	2,827
NL	-	-	-	-	-	-	-	9,773	72,722	151,571	163,275	192,763
AT	-	-	-	-	9	60	211	2,322	4,555	17,751	31,780	53,248
PT	-	-	-	-	-	-	-	2,143	5,351	14,086	18,440	28,193
FI	-	-	-	-	-	-	-	4	1,058	29,373	32,648	41,363
SE	-	-	-	-	-	-	-	45	8,710	53,712	62,356	77,536
UK	-	-	-	-	-	9	96	38,574	166,950	306,174	337,066	401,732

Table (7)*: Estimated distributions of systemic excess losses in Scenario 4 - Million Euro (Capital ≥ 10.5% RWA, No Contagion)*

	90	**95**	**96**	**97**	**98**	**99**	**99.5**	**99.9**	**99.95**	**99.99**	**99.995**	**99.999**
BE	-	-	-	-	-	-	-	1,001	4,076	12,938	17,701	30,398
BG	-	-	-	-	-	-	-	37	78	223	306	543
DK	-	-	-	-	-	-	16	981	2,470	9,083	12,975	24,947
DE	-	6	16	38	93	301	809	4,885	9,623	33,852	47,704	100,895
GR	-	-	-	-	-	-	-	767	1,776	5,184	7,069	11,801
ES	-	-	-	-	0	56	383	5,057	9,368	25,575	34,404	57,558
FR	-	-	-	1	44	307	1,148	10,230	18,085	45,269	60,498	99,316
IE	-	-	-	-	-	-	-	2,016	4,120	10,610	14,284	24,026
IT	-	-	2	11	40	196	597	3,514	6,251	17,605	25,427	43,833
CY	-	-	-	-	-	-	-	107	330	1,274	1,794	3,116
LV	-	-	-	-	-	-	-	30	66	199	272	496
LU	-	-	-	-	-	-	-	308	751	3,006	4,453	8,105
MT	-	-	-	-	-	-	-	3	88	432	610	1,112
NL	-	-	-	-	-	-	-	1,642	5,586	22,034	30,741	54,775
AT	-	-	-	-	9	55	172	1,288	2,383	5,954	7,825	13,101
PT	-	-	-	-	-	-	-	638	2,133	6,912	9,297	15,739
FI	-	-	-	-	-	-	-	3	433	5,988	9,166	17,731
SE	-	-	-	-	-	-	-	44	893	8,735	12,617	23,363
UK	-	-	-	-	-	8	89	2,330	7,835	37,386	54,891	105,561

5.2 Results for individual contributions to systemic losses

Tables 8-11 show some selected percentiles of the distribution of individual percentage contributions to systemic losses. They illustrate individual contributions for the whole set of cases (i.e. without considering cases where losses exceed or are below the amount of funds available to DGS/RF). Figures should be read as in the following example. For Scenario 1 in Belgium the yearly expected loss is lower than 0.9134% for 75% of the banks in the sample. Average yearly individual contributions are usually much higher than the median, suggesting that there are few banks contributing most to the systemic risk.

This is a not surprising results as bigger banks (less numerous) tend to relatively contribute more to higher systemic losses, while smaller banks (more numerous) tend to relatively contribute lower systemic losses.

Table (8)*: Distributions of individual banks' percentage contributions – whole – Scenario 1 (Capital ≥ 8% RWA, Contagion)*

	Selected percentiles							
	10	**25**	**50**	**75**	**90**	**95**	**99**	**average**
BE	0.002%	0.004%	0.028%	0.913%	17.114%	26.165%	37.960%	4.348%
BG	0.088%	0.301%	1.632%	4.737%	9.147%	16.741%	26.803%	4.167%
DK	0.000%	0.001%	0.005%	0.027%	0.182%	3.045%	26.629%	1.010%
DE	0.000%	0.001%	0.003%	0.008%	0.026%	0.058%	0.599%	0.068%
GR	0.142%	0.364%	0.890%	7.138%	17.358%	23.152%	35.977%	6.250%
ES	0.002%	0.005%	0.031%	0.164%	1.181%	2.924%	10.899%	0.699%
FR	0.003%	0.007%	0.028%	0.076%	0.576%	2.373%	9.518%	0.513%
IE	0.001%	0.016%	0.308%	3.534%	8.187%	17.686%	37.861%	4.167%
IT	0.002%	0.007%	0.026%	0.092%	0.349%	0.631%	3.974%	0.211%
CY	0.008%	0.208%	0.677%	8.559%	12.251%	23.464%	40.798%	6.667%
LV	0.226%	0.830%	2.715%	7.783%	8.321%	8.740%	23.851%	4.762%
LU	0.033%	0.154%	0.512%	1.360%	3.874%	5.862%	20.351%	1.786%
MT	0.038%	0.332%	1.017%	10.744%	34.341%	41.674%	47.540%	10.000%
NL	0.017%	0.048%	0.087%	0.210%	23.006%	33.675%	37.494%	4.762%
AT	0.011%	0.025%	0.053%	0.137%	0.645%	2.592%	6.262%	0.578%
PT	0.071%	0.198%	0.875%	2.514%	29.067%	36.573%	39.515%	7.143%
FI	0.002%	0.010%	0.225%	1.718%	22.116%	56.991%	84.891%	11.111%
SE	0.001%	0.002%	0.005%	0.018%	0.041%	0.550%	33.224%	1.515%
UK	0.001%	0.003%	0.017%	0.085%	1.124%	1.689%	31.696%	1.177%

***Table (9)**: Distributions of individual banks' percentage contributions – whole – Scenario 2 (Capital ≥ 8% RWA, No Contagion)*

	Selected percentiles							
	10	**25**	**50**	**75**	**90**	**95**	**99**	**average**
BE	0.008%	0.021%	0.043%	0.166%	23.184%	32.645%	35.847%	4.348%
BG	0.131%	0.501%	2.734%	4.650%	10.449%	16.067%	18.769%	4.167%
DK	0.000%	0.003%	0.018%	0.077%	0.548%	6.285%	31.063%	2.000%
DE	0.001%	0.003%	0.011%	0.031%	0.071%	0.135%	0.988%	0.068%
GR	0.220%	0.466%	1.579%	7.014%	20.000%	22.997%	28.445%	6.250%
ES	0.001%	0.004%	0.035%	0.172%	0.673%	4.323%	12.865%	0.699%
FR	0.005%	0.009%	0.049%	0.116%	0.431%	2.943%	11.152%	0.513%
IE	0.001%	0.011%	0.063%	3.745%	17.668%	20.717%	22.478%	4.167%
IT	0.002%	0.008%	0.029%	0.103%	0.385%	0.683%	3.018%	0.211%
CY	0.229%	0.647%	1.562%	6.651%	20.914%	28.957%	33.957%	6.667%
LV	0.004%	0.558%	1.162%	4.521%	9.904%	18.763%	33.093%	4.762%
LU	0.024%	0.051%	0.185%	0.679%	2.339%	3.914%	81.659%	3.509%
MT	0.029%	0.047%	0.370%	3.515%	43.160%	47.023%	50.114%	10.000%
NL	0.096%	0.139%	0.212%	0.993%	18.788%	19.327%	44.608%	4.762%
AT	0.029%	0.062%	0.110%	0.260%	0.846%	1.698%	8.996%	0.578%
PT	0.072%	0.170%	0.680%	3.892%	29.531%	31.945%	32.939%	7.143%
FI	0.010%	0.041%	0.238%	1.170%	21.719%	58.092%	87.190%	11.111%
SE	0.004%	0.007%	0.016%	0.040%	0.109%	0.202%	36.629%	1.515%
UK	0.003%	0.008%	0.029%	0.155%	1.108%	5.754%	18.616%	1.177%

***Table (10)**: Distributions of individual banks' percentage contributions – whole – Scenario 3 (Capital ≥ 10.5% RWA, Contagion)*

	Selected percentiles							
	10	**25**	**50**	**75**	**90**	**95**	**99**	**average**
BE	0.005%	0.010%	0.041%	0.942%	13.634%	29.188%	38.789%	4.348%
BG	0.089%	0.306%	1.571%	4.779%	8.808%	16.832%	27.039%	4.167%
DK	0.000%	0.002%	0.007%	0.034%	0.224%	2.494%	35.705%	1.010%
DE	0.000%	0.001%	0.003%	0.008%	0.026%	0.057%	0.591%	0.068%
GR	0.255%	0.522%	0.867%	8.410%	20.655%	27.048%	27.090%	6.250%
ES	0.002%	0.006%	0.039%	0.213%	1.263%	3.261%	11.691%	0.699%
FR	0.006%	0.013%	0.061%	0.159%	0.574%	2.086%	10.608%	0.513%
IE	0.003%	0.021%	0.355%	3.761%	8.019%	19.072%	36.437%	4.167%
IT	0.002%	0.009%	0.022%	0.082%	0.369%	0.686%	4.399%	0.211%
CY	0.008%	0.196%	0.593%	8.579%	12.325%	23.575%	40.906%	6.667%
LV	0.246%	0.995%	3.331%	6.822%	12.498%	12.857%	15.706%	4.762%
LU	0.045%	0.163%	0.556%	1.468%	3.937%	6.282%	19.045%	1.786%
MT	0.047%	0.371%	1.152%	12.214%	38.087%	39.816%	41.199%	10.000%
NL	0.021%	0.052%	0.087%	0.207%	19.462%	35.147%	39.320%	4.762%
AT	0.021%	0.043%	0.096%	0.217%	1.075%	3.078%	10.269%	0.578%
PT	0.084%	0.119%	0.887%	2.793%	27.985%	35.289%	39.041%	7.143%
FI	0.003%	0.018%	0.381%	1.705%	22.438%	56.716%	84.138%	11.111%
SE	0.001%	0.002%	0.006%	0.022%	0.047%	0.571%	33.389%	1.515%
UK	0.001%	0.004%	0.020%	0.083%	1.388%	2.109%	30.037%	1.177%

Table (11): *Distributions of individual banks' percentage contributions – whole – Scenario 4 (Capital ≥ 10.5% RWA, No Contagion)*

	Selected percentiles							
	10	**25**	**50**	**75**	**90**	**95**	**99**	**average**
BE	0.014%	0.038%	0.077%	0.298%	21.963%	28.825%	38.473%	4.348%
BG	0.133%	0.480%	2.657%	4.708%	10.611%	15.466%	18.847%	4.167%
DK	0.001%	0.004%	0.025%	0.096%	0.653%	5.496%	20.681%	1.010%
DE	0.001%	0.004%	0.012%	0.033%	0.077%	0.135%	0.689%	0.068%
GR	0.374%	0.699%	1.295%	9.460%	17.537%	21.832%	27.339%	6.250%
ES	0.001%	0.006%	0.049%	0.253%	1.011%	3.686%	12.897%	0.699%
FR	0.008%	0.018%	0.095%	0.215%	0.508%	2.573%	8.555%	0.513%
IE	0.001%	0.023%	0.132%	5.040%	16.762%	17.201%	23.586%	4.167%
IT	0.003%	0.010%	0.026%	0.089%	0.378%	0.743%	3.521%	0.211%
CY	0.249%	0.607%	1.031%	6.788%	20.986%	29.266%	35.300%	6.667%
LV	0.006%	0.722%	1.696%	6.593%	14.880%	15.714%	20.751%	4.762%
LU	0.041%	0.086%	0.314%	1.140%	3.497%	4.871%	25.737%	1.786%
MT	0.036%	0.057%	0.438%	4.128%	43.342%	46.326%	48.714%	10.000%
NL	0.118%	0.172%	0.258%	1.005%	22.946%	23.706%	37.104%	4.762%
AT	0.032%	0.076%	0.149%	0.340%	0.901%	2.303%	10.630%	0.578%
PT	0.090%	0.185%	0.643%	5.452%	27.921%	30.767%	32.690%	7.143%
FI	0.017%	0.072%	0.404%	2.017%	22.950%	56.717%	83.730%	11.111%
SE	0.005%	0.009%	0.020%	0.052%	0.141%	0.261%	36.910%	1.515%
UK	0.003%	0.010%	0.036%	0.227%	1.681%	4.490%	19.557%	1.177%

5.3 The FAT

To calculate the profit part of the Financial Transaction Tax, we would ideally have a Cash-Flow financial statement. This is not available to us. Nevertheless, we can use the information contained in the unconsolidated financial statements of banks as available in ORBIS.[11] The profit part of the FAT base is computed as a R+F (i.e. Real + Financial transactions) base by adapting accounting profit to cash-flow profit.[12] The labour costs part is the costs of personnel. As for the IMF's computation, the FAT1 is the sum of these two parts, the FAT2 takes the same cash-flow profit definition and 12% of labour costs[13] and the FAT3 limits the

[11] Orbis is a database on financial statements of companies published by Bureau Van Dijk. Note that the sample can be biased towards large banks as financial information could be harder to obtain for smaller banks. Our version of Orbis contains 7,343 banks and 3,609 insurance companies for the EU27 (not of all with exploitable financial information). For many banks, several variables necessary to compute FAT revenues are missing. In this case, they are estimated in the following way: for companies for which consolidated statements are available in Orbis, the missing variable of interest is replaced by the one from the consolidated statements, adjusted by the ratio of total assets between unconsolidated and consolidated statements. If the information is still missing, the same procedure is applied using country- level information on banking structures from the ECB publication "EU Banking Sector Stability" of September 2010.

[12] This is done by starting with the profit and loss before tax and distribution, subtracting the dividends received from subsidiaries (i.e. applying an exemption to avoid double-taxation), adding the change in (non- equity) liabilities, subtracting the change in assets, except for change in cash hold and investment in subsidiaries.

[13] This is estimated to be 40% of the wage differential in the UK between the top 25 percent of earners in the financial sector and the top 25 percent earners in the rest of the economy. The 40% is based on the study by Philippon and Reshed (2009) for the US who find that between 30% and 40% of the wage differential is rent. See Keen et al (2010), page 138. Note that Egger et al. (2012) found evidence of a wage premium in the financial sector which amounts to about 43% in the OECD.

cash-flow profit to what excesses 15% of total equity and adds it to 12% of the labour costs. It is important to note that the first two methods allow a loss-relief between the profit and the labour parts of the base, while the last method essentially put a ceiling of zero on the profit part. Hence, the base of a risk-taxing FAT could in theory be larger than the base for the other two methods. In all cases, an illustrative rate of 5% is applied to the base for 2009.

Table 2 provides the coefficient of correlations between the three types of FAT and the four scenarios of systemic risk. Several messages stand out. First, when contagion is not avoided, all versions of FAT perform in about the same way. Second, when contagion can be avoided, FAT1 is more aligned to risk and provides the best incentive. This is not completely surprising as capital requirement require more equity when banks take more risks. If more risky activities produce high profits, part of them might be needed to remunerate the higher capital required. It shall be stressed that FAT3 rests on the hypothesis that high returns are due to higher risks. While this could be true, other factors may trigger higher returns such as a lack of competition or more efficient production methods (e.g. superior knowledge of markets, a more productive workforce, mean management structures). In this latter case, the tax could be a tax on talent rather than a tax on high risk. In practice, Adrian and Brunnermeier (2010) find that the contribution of an individual institution to systemic risk is correlated with leverage, the relative size and maturity mismatch. As indicated in Table 2, FAT1 is the option that is best correlated with size, as measured by total assets. Finally, increasing capital requirement from 8% to 10.5% unambiguously increases the correlation between the contribution to FAT and the contribution to systemic risk. This reveals the fact that higher capital requirements are able to contain the part of the risks that are not necessarily linked to the size of the institution (e.g. leverage), increasingly leaving the remaining risk to be linked to size only.

Table 2: **Correlation between individual contributions to FAT and Systemic Risk**

Scenarios	**FAT1**	**FAT2**	**FAT3**
Scenario 1: Contagion - 8%	0.492	0.457	0.441
Scenario 2: No Contagion - 8%	0.516	0.328	0.265
Scenario 3: Contagion – 10.5%	0.561	0.533	0.515
Scenario 4: No Contagion – 10.5%	0.570	0.387	0.327
Total assets	0.708	0.541	0.443

Note: taking FAT revenues adjusted for relocation and elasticities effects provide very similar results. All correlations are significant at the 1% level.

6. Conclusions

The recent financial crisis has highlighted the potential contributions of banks, in particular large ones on systemic risks. Several regulatory measures – among which a strengthening of capital requirements and of funding of Deposit Guarantee Schemes - are currently being considered to minimise this risk and its consequences for both public finances and economic growth, in particular given the possibility of contagion of failing banks to other financial institutions.

At the same time, several options on how to increase the contribution of the financial sector to the cost of the crisis have been at the political agenda. One of the possible desired features of such a tax could be its ability to curb risk and/or to be in relation with the risk posed by individual institutions to the whole financial system. The Financial Activities Tax (FAT), in its various versions, as been recently discussed by the IMF and the European Commission.

This paper uses the SYMBOL model to estimate the contribution of each bank to systemic losses under alternative scenarios of capital requirements and (absence of) contagion. In parallel, we compute FAT liabilities for individual banks under three designs of the tax and look at correlations between those liabilities and individual contributions to systemic risk. The broader version of the FAT (FAT1) is found to be the one that would be best correlated with individual risk, especially when there is no contagion. This is mainly due to the fact that FAT1 is the design that is best correlated with the size of the institution which appears to be a major determinant of its impact on aggregate risk, the more so the higher the level of capital requirements.

Figure 1: simulated losses as share of GDP

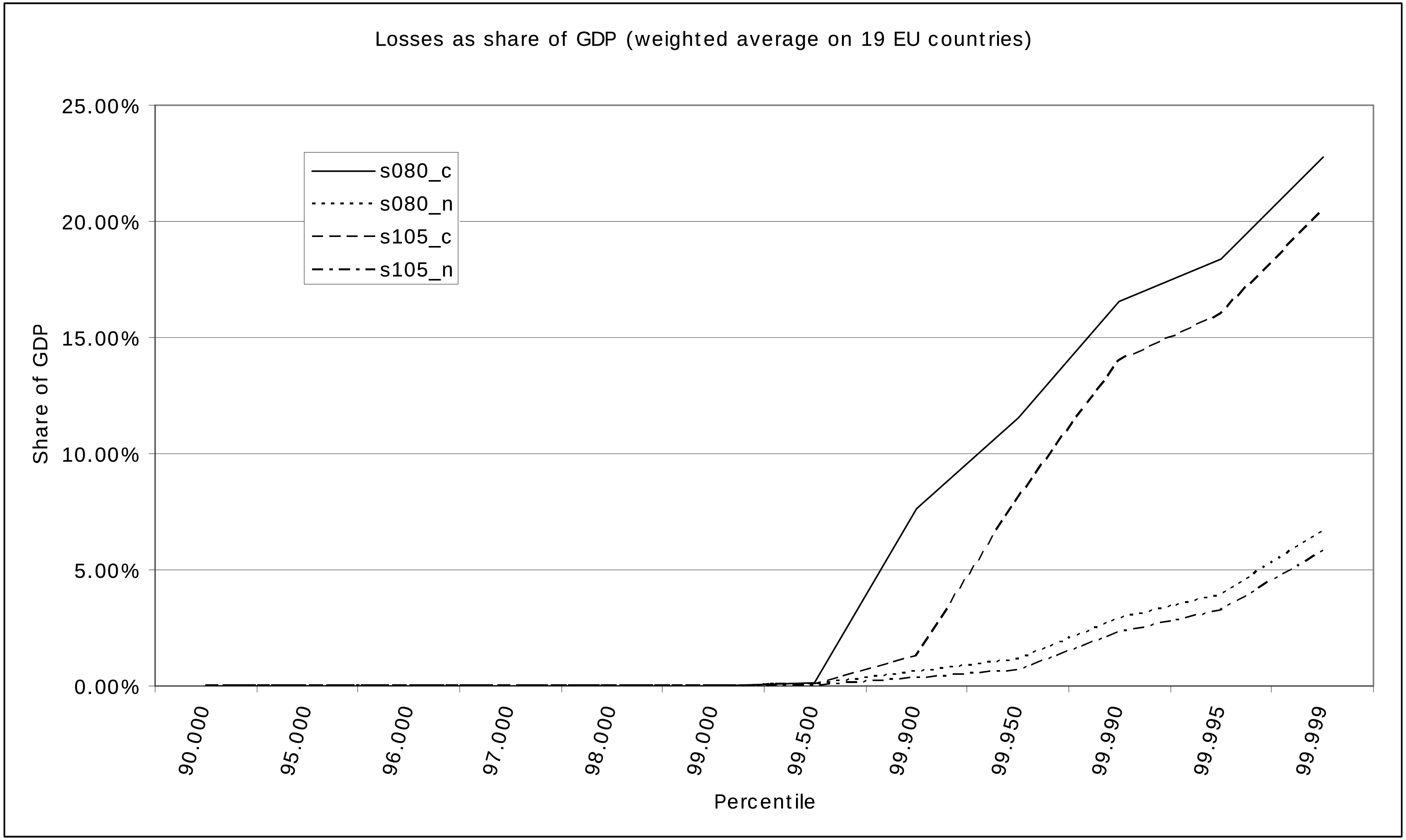


Figure 2: approximate concentration curve, scenarios 1 and 2

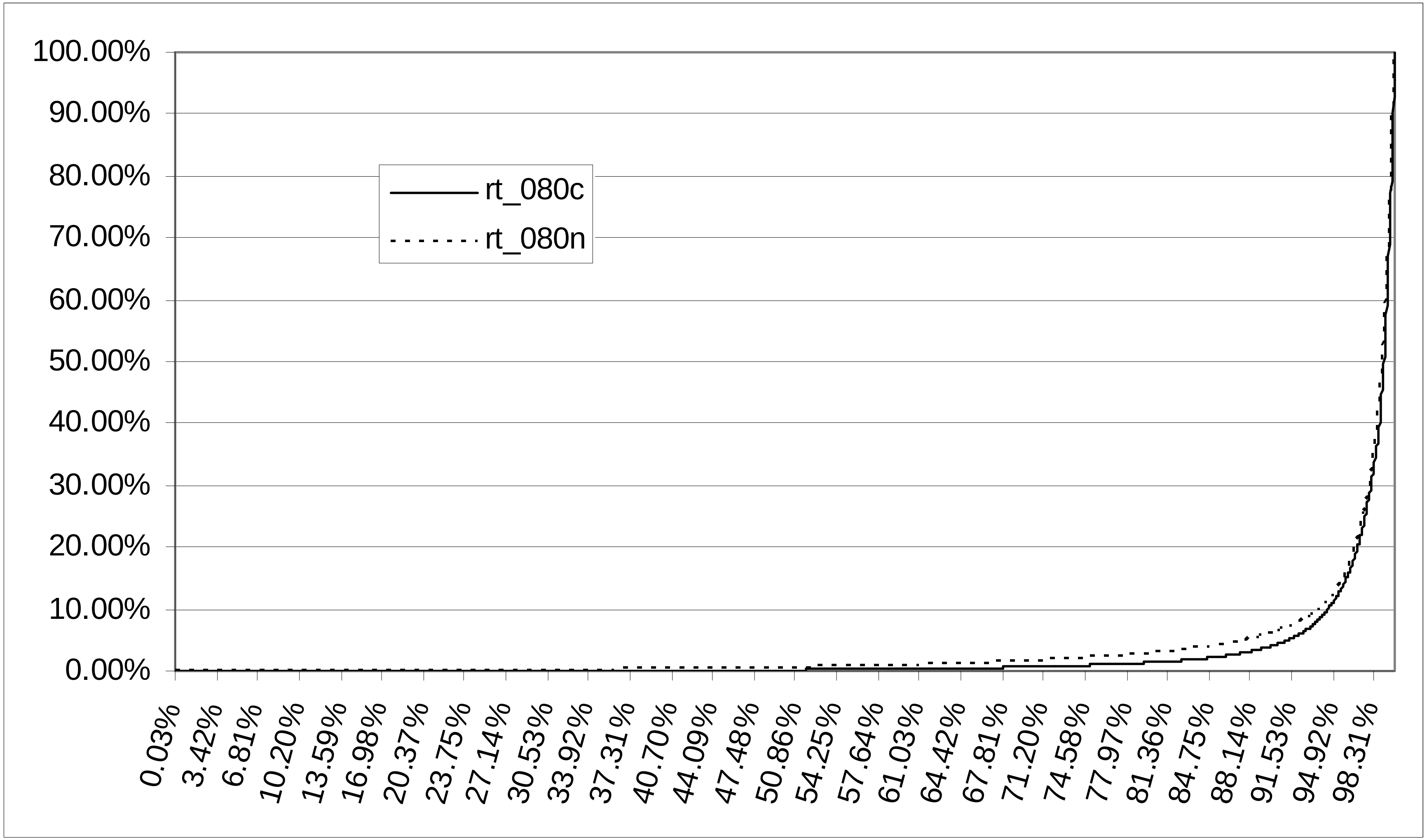
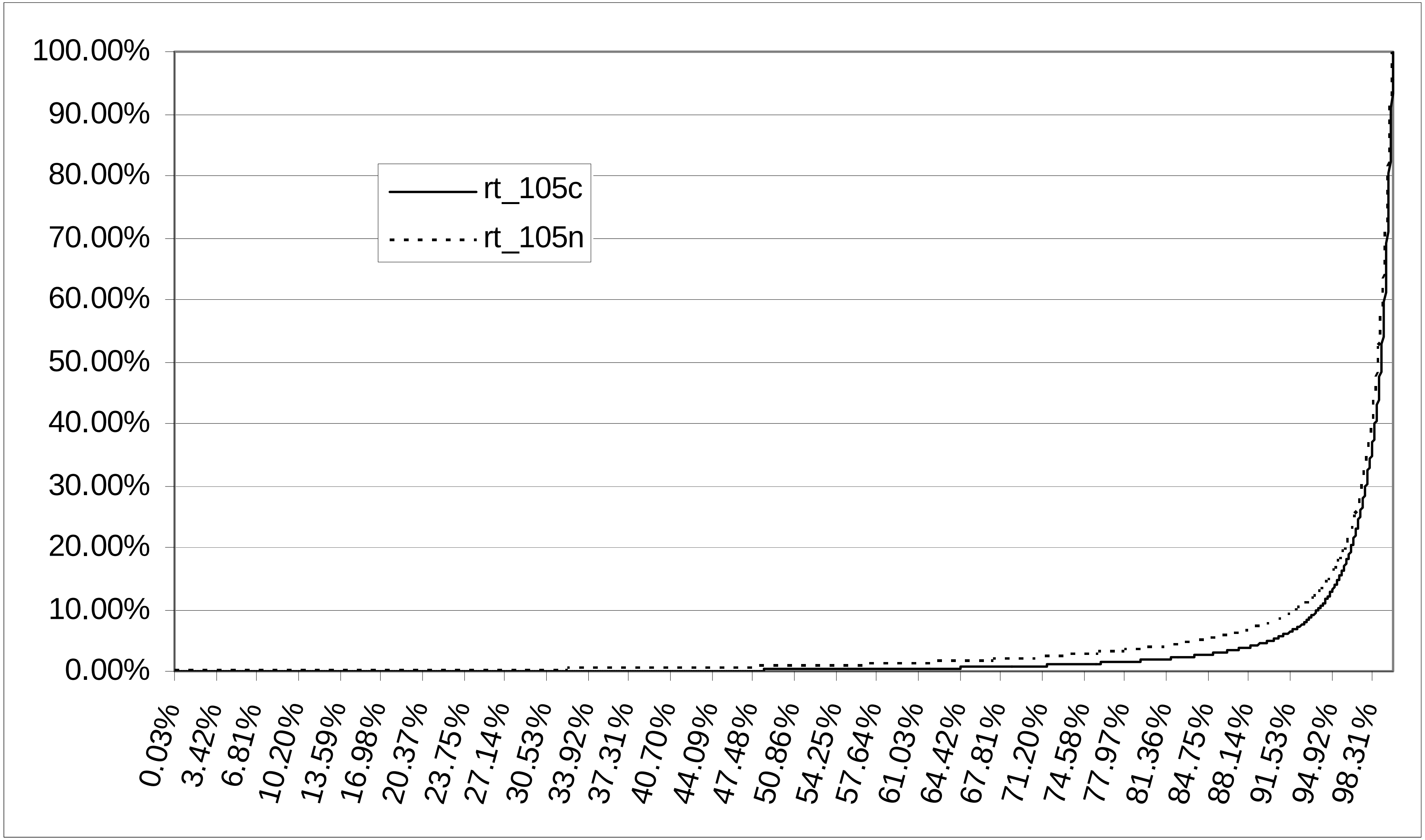


Figure 3: approximate concentration curve, scenarios 3 and 4



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

***Table A.1**: Description of the samples used for the simulations, data as of end 2009*[14].

	Number G1 Banks	Number G2 Banks	Sample % Population[15]	Total Assets (m€)	Total Liabilities (m€)	Total Interbank Debt[16] (m€)	Total Interbank Credit[17] (m€)	Total Covered Deposits (+) (m€)	Total Capital Requirements (8% RWA) (m€)	Total Capital (m€)	DGS/RF funds[18] (+) (m€)
BE	3	20	82.26%	878,336	829,934	184,888	160,678	260,890	23,413	48,401	2,516
BG(*)	0	24	94.77%	34,383	29,614	6,521	6,521	14,074	2,239	4,769	223
DK	3	96	71.05%	756,678	708,878	143,362	92,279	118,179	23,749	47,800	2,168
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
GR	3	13	71.42%	322,714	295,667	43,441	20,313	135,758	16,781	27,047	1,511
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
IE(*)	5	19	101.91%	1,221,181	1,155,789	276,738	148,729	147,145	44,121	65,392	3,488
IT	8	465	81.81%	2,827,051	2,556,174	188,375	195,958	476,963	97,416	270,876	7,816
CY (*)	0	15	80.80%	107,446	100,436	53,067	53,067	22,661	4,883	7,011	537
LV(*)	0	21	72.65%	19,088	17,037	5,943	2,609	3,995	1,127	2,050	58
LU	1	55	68.35%	465,539	441,916	169,984	161,827	103,441	11,485	23,622	1,321
MT	0	10	43.83%	18,076	16,225	5,222	2,689	6,893	760	1,851	58
NL	4	17	78.02%	1,680,455	1,600,687	319,699	398,659	314,059	46,903	79,768	5,091
AT	1	172	29.88%	306,457	282,380	50,382	39,692	71,381	14,656	24,077	860
PT	3	11	66.49%	323,762	297,421	43,561	34,505	82,952	17,704	26,342	1,121
FI	1	8	78.36%	290,500	275,621	54,361	79,820	48,998	7,968	14,879	1,024
SE	3	63	52.37%	455,355	422,301	97,604	122,872	75,383	16,356	33,054	1,314
UK	7	78	73.97%	4,278,074	4,074,946	743,978	691,049	464,241	110,757	203,129	12,313

Notes: (*) Source is Central Bank or Supervisory Authority; (+) Estimated.

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[14] Year 2009 is the latest year available in *Bankscope* and, even more importantly, 2009 is the year on which the Basel and the CEBS committee have based their Quantitative Impact Study exercises for the foreseen change on banks' capital and RWA when moving from Basel II to Basel III.

[15] The sample of banks covered in each Member States represents the indicated percentage of total assets for any Member State as shown for 2009 in the 2010 ECB EU banking structures publication, computed as the amount of total assets for all banks minus total assets of branches from abroad. European Central Bank (2010), *EU banking structures*, http://www.ecb.int/pub/pdf/other/eubankingstructures201009en.pdf

[16] 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: GR (56.5%), FR (39.1%), IT (26.9%), LU (79.8%), and AT (48.4%). The correction factors employed have been estimated using the 2010 ECB *Banking Sector Stability*, Table 11a.

[17] Data on interbank credits was not available for BG and CY so equality of interbank debits and credits has been assumed.

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

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Abstract

The recent financial crisis has highlighted the risks posed by individual banks to the entire banking system. Next to the issue of determining individual contributions to systemic risk, the question of additional taxes on the financial sector has been debated. This paper uses SYMBOL, a micro-simulation model of the banking system, to estimate these individual contributions and compares them to the potential individual tax liabilities of banks under the assumption of a Financial Activity Tax.

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