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on Insurance Guarantee Schemes

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EUROPEAN COMMISSION
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JOINT RESEARCH CENTRE

PART II

METHODOLOGICAL REPORT

Insurance Guarantee Schemes: derivation of loss distributions and funding needs.

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For internal use by the European Commission
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1.1 Setting up an EU IGS covering cross-border activities (only branches)

This section analyses the case where an IGS covering all domestic activities and cross-border activities conducted under FPS is present in each Member State, supplemented by an additional scheme covering all cross-border activities excluding those conducted under the freedom to provide services. Under this option the total premiums covered are obtained by subtracting premiums from branches, both in EU/EEA[1] and in non-EU/EEA countries, from the total premiums under national supervision.

The funding needs for the additional cross-border IGS are obtained by adding up country-level differences between the funding needs based on the home state principle and the funding needs based on the domestic activity principle (including FPS activity).

[1] As explained in section **Error! Reference source not found.**, CEIOPS data do not provide separate data for cross-border activities within the EU and within the wider EEA. For this reason the EEA is taken as the basis for the calculations for this option.

1.1.1 Total insurance

Figure 0.1: IGS funding needs for the total insurance sector under a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches, for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average and cross-border IGS, countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%

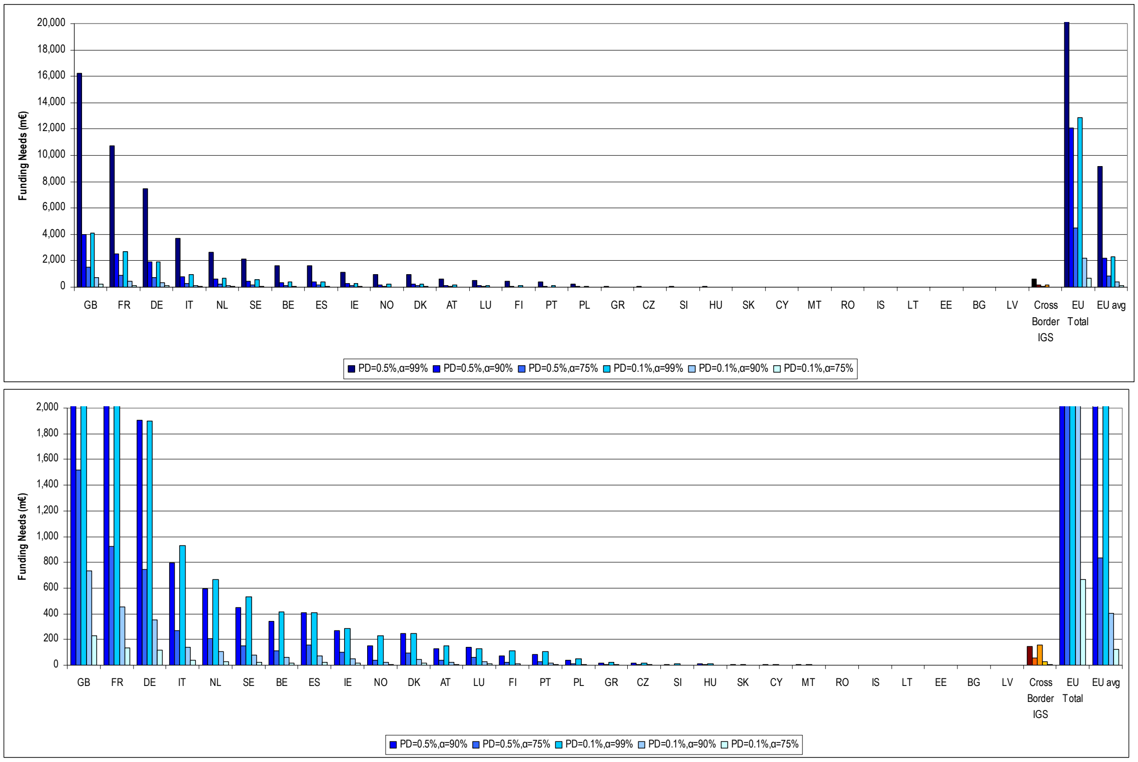


Figure 0.2: Absolute differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; total insurance sector; all EEA countries, countries in order of gross premiums written (the sum of all the differences at country level gives the funding need for the additional cross-border scheme)

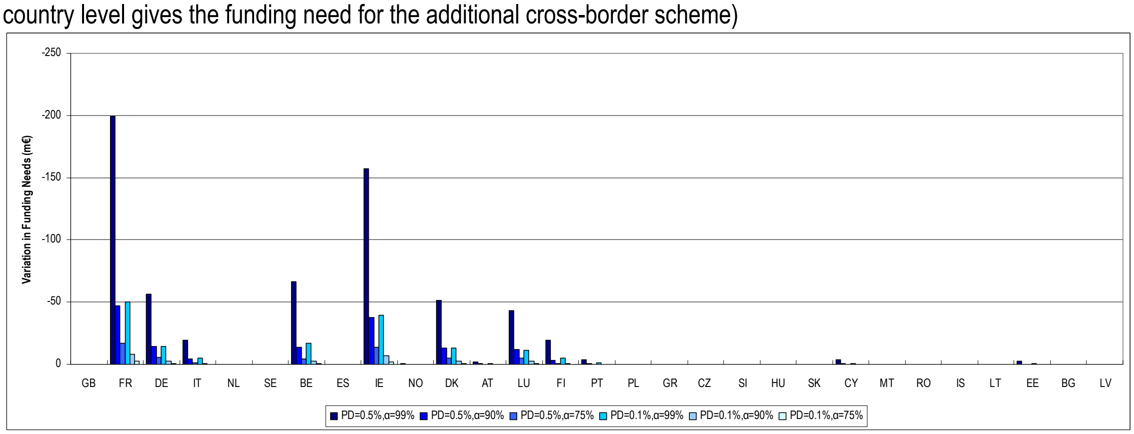


Figure 0.3: Relative differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; total insurance sector; all EEA countries, countries in order of gross premiums written

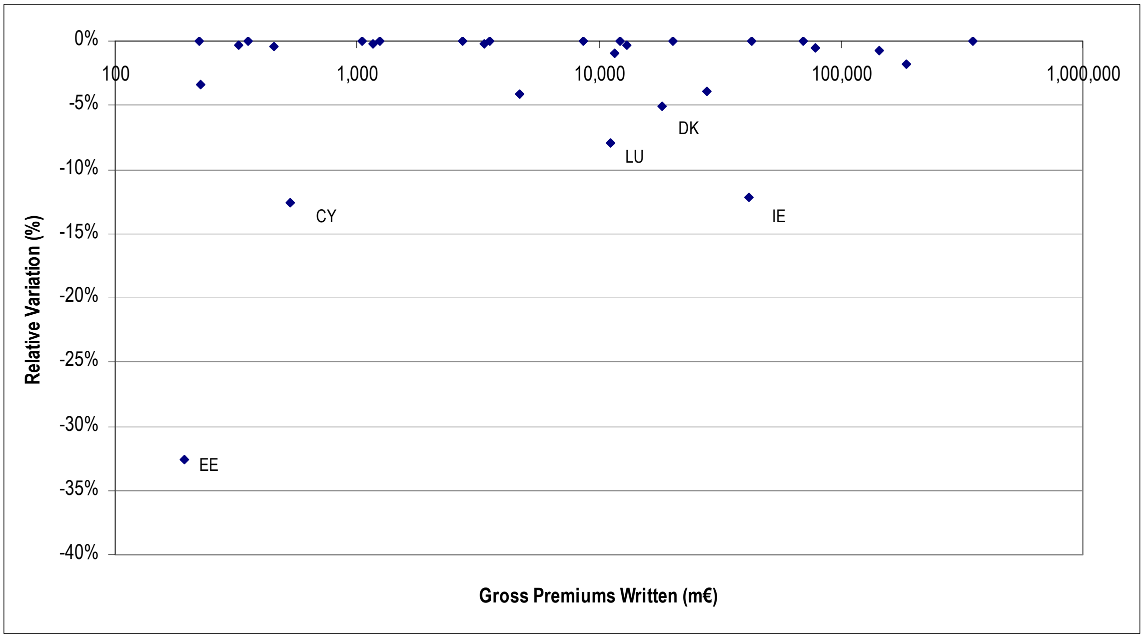
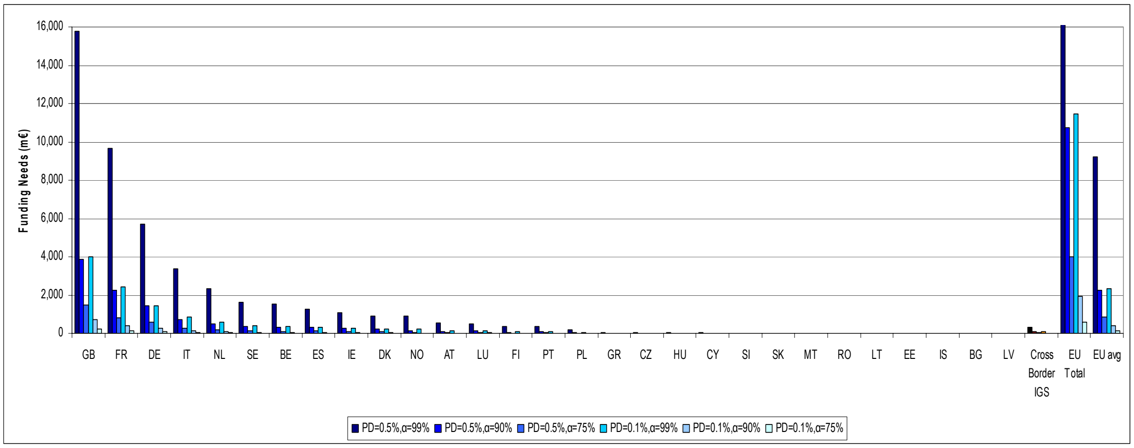


Table 0.1: Summary of relative difference between funding needs at country level when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; EU average and minimum, median and maximum across all EEA countries; total insurance sector

MIN		MEDIAN		MAX		EU avg
-32.62%	EE	-0.29%	LT	0.00%	GB	0.11%

1.1.2 Life insurance

Figure 0.4: IGS funding needs for the life business line under a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches, for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average and cross-border IGS, countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



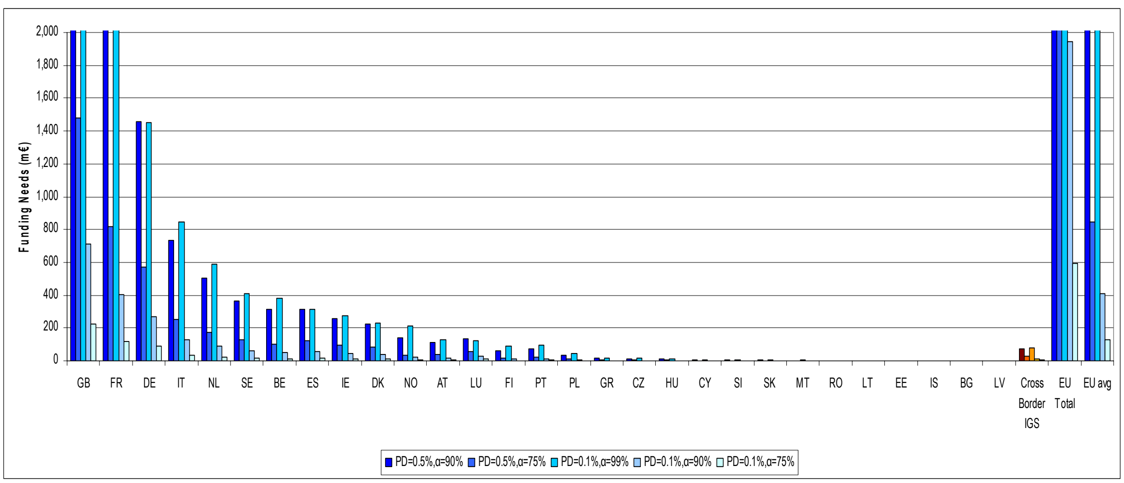


Figure 0.5: Absolute differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; life business line; all EEA countries, countries in order of funding needs (the sum of all the differences at country level gives the funding needs for the additional cross-border scheme)

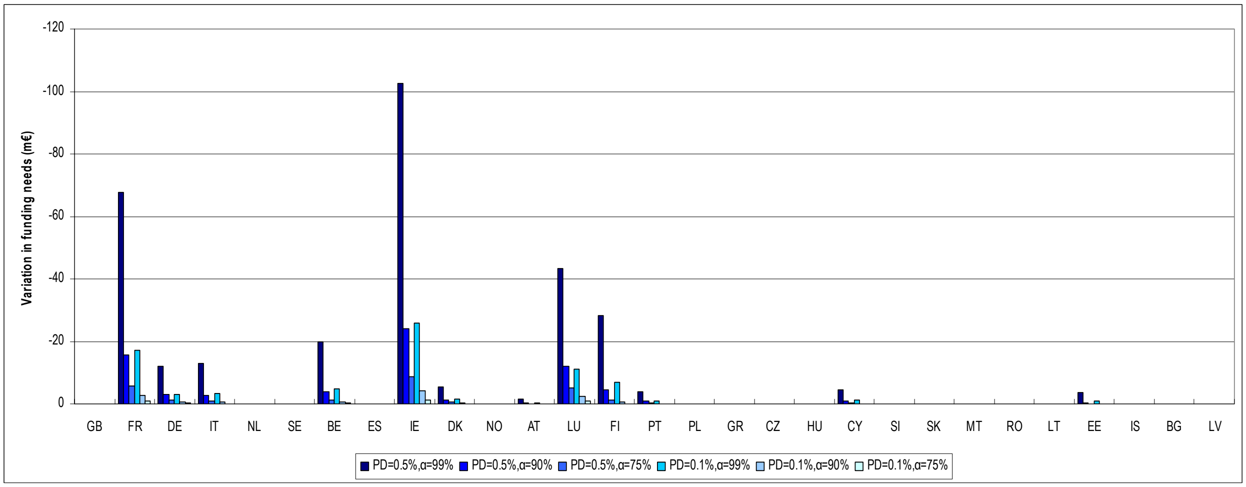


Figure 0.6: Relative differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; life business line; all EEA countries; countries in order of gross premiums written

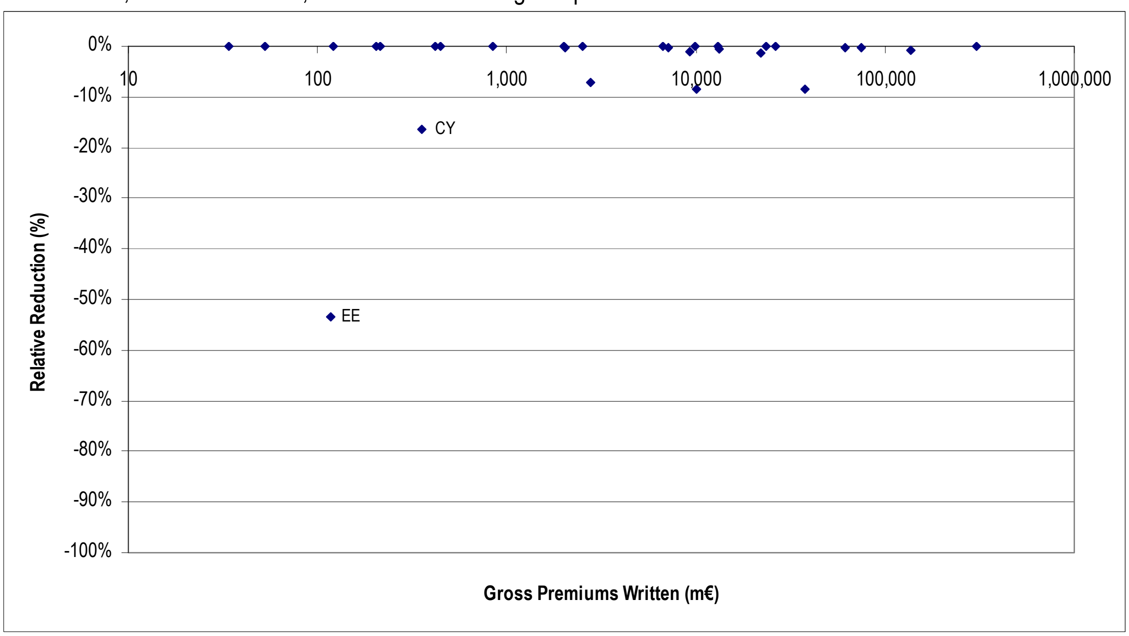
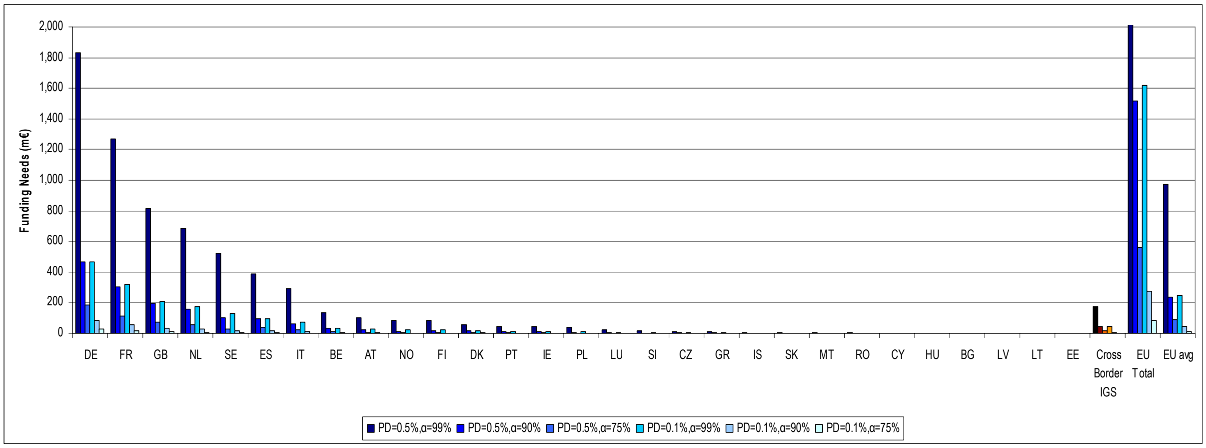


Table 0.2: Summary of relative differences between funding needs for national IGS when moving from the home state principle to a domestic activity regime supplemented by an additional cross-border IGS covering branches only; EU average and minimum, median and maximum across all EEA countries; life business line

MIN		MEDIAN		MAX		EU avg
-53.39%	EE	-0.01%	PL	0.00%	GR	0.37%

1.1.3 Non-life insurance

Figure 0.7: IGS funding needs for the non-life business line under a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches, for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average and cross-border IGS, countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



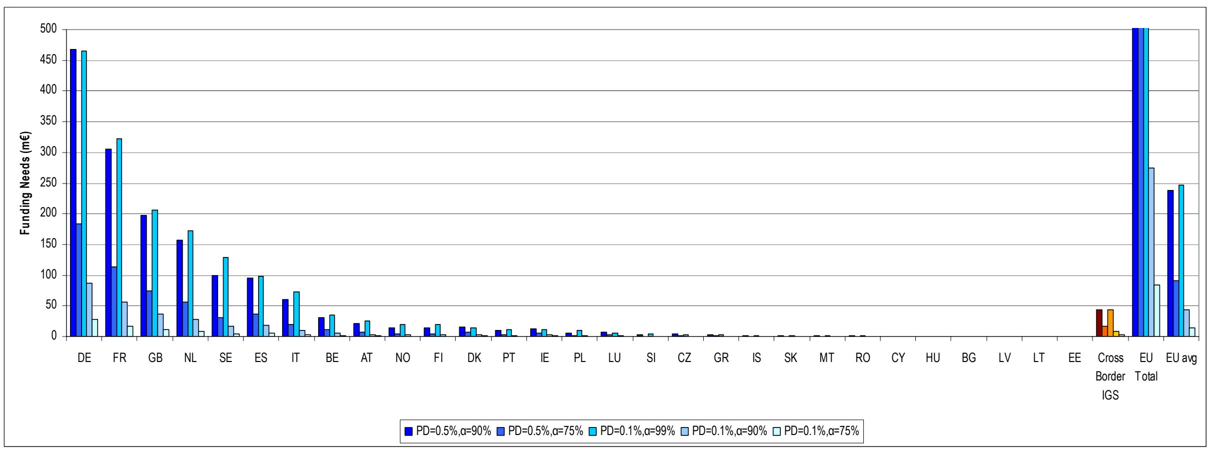


Figure 0.8: Absolute differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; non-life business line; all EEA countries; countries in order of gross premiums written (the sum of all the differences at country level gives the funding need for the additional cross-border scheme)

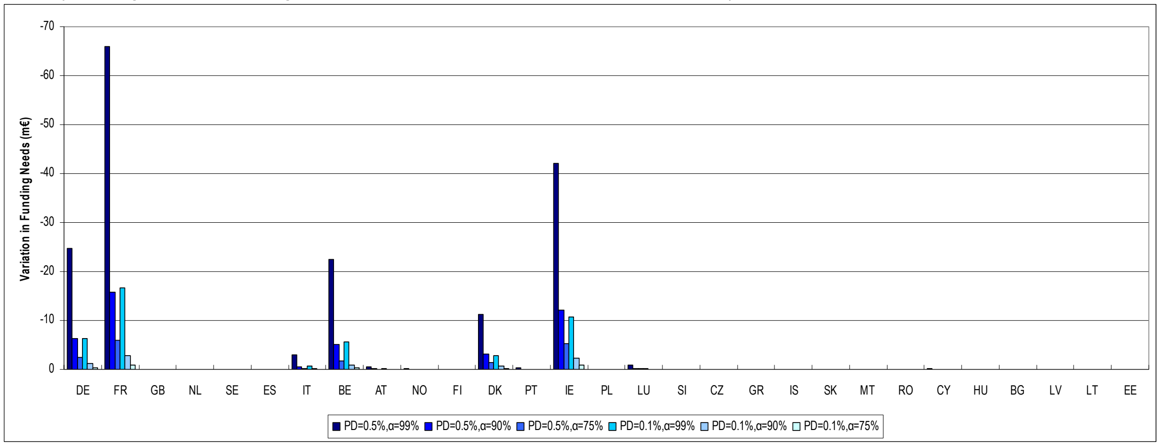


Figure 0.9: Relative differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; non-life business line; all EEA countries; countries in order of gross premiums written

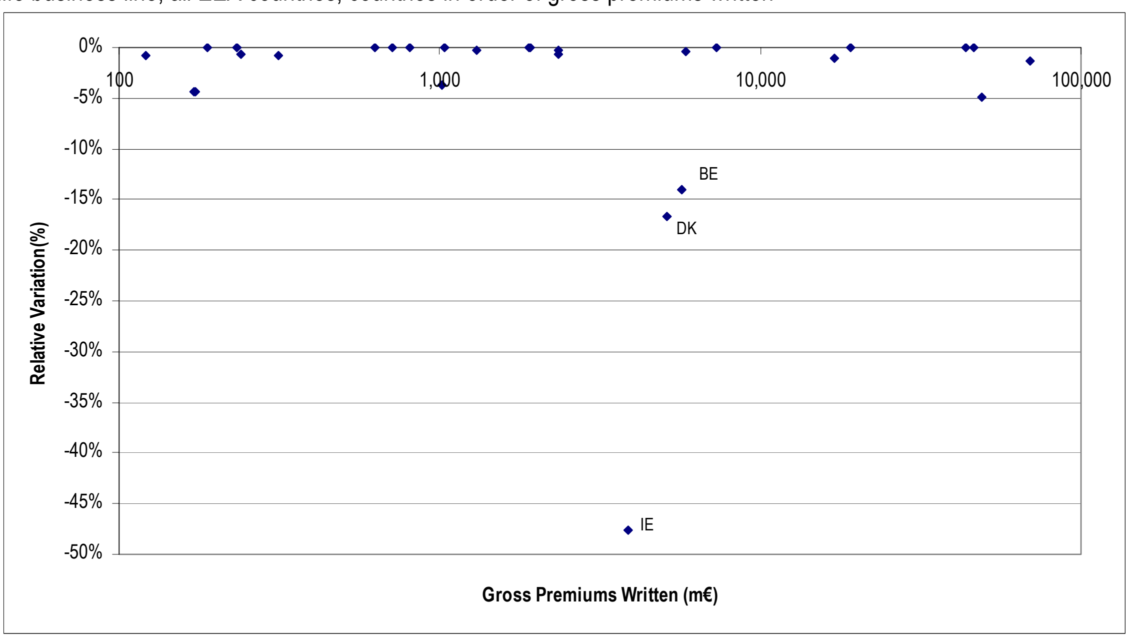


Table 0.3: Summary of relative difference between funding needs at country level when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; EU average and minimum, median and maximum across all EEA countries; non-life business line

MIN		MEDIAN		MAX		EU avg
-47.66%	IE	-0.27%	NO	0.00%	GB	-1.26%

1.1.4 Summary of statistics at EU level

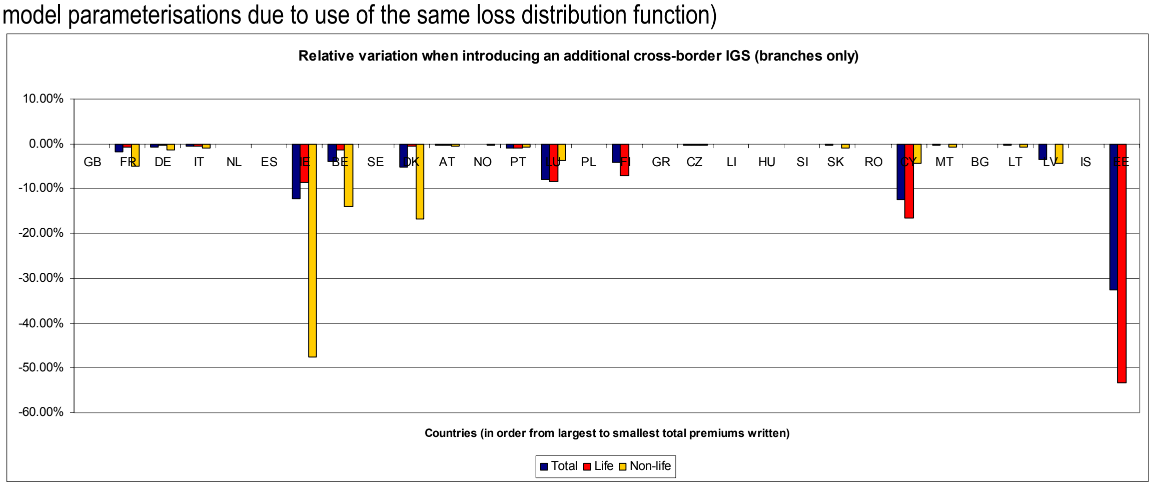
Table 0.4: Average funding needs at EU level under a domestic plus FPS activity regime, excluding cross-border activity conducted via branches; under different probabilities of default and confidence levels; weighted averages by gross premiums written, for the total insurance sector and the life and non-life business lines (in m€)

	PD = 0.5%			PD=0.1%		
α →	75%	90%	99%	75%	90%	99%
Total insurance (EU)	837	2 219	9 136	126	405	2 313
Life (EU)	844	2 238	9 215	127	408	2 333
Non-life (EU)	91	238	973	14	44	246

Table 0.5: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; under different probabilities of default and confidence levels for the total insurance sector and the life and non-life business lines (in m€)

		PD = 0.5%			PD=0.1%		
	α →	75%	90%	99%	75%	90%	99%
Total insurance (EU)	Funding needs under home	4 529	12 213	51 477	673	2 209	13 001
	Funding needs under domestic + FPS	4 474	12 065	50 852	665	2 182	12 843
	Relative variation	- 1.21%	-1.21%	- 1.22%	-1.21%	-1.21%	-1.21%
	Funding needs for cross-border IGS	55	148	626	8	27	158
Life (EU)	Funding needs under home	4 010	10 833	45 751	595	1 958	11 554
	Funding needs under domestic + FPS	3 985	10 763	45 445	592	1 945	11 477
	Relative variation	- 0.64%	-0.65%	- 0.67%	-0.63%	-0.64%	-0.67%
	Funding needs for cross-border IGS	26	70	306	4	13	77
Non-life (EU)	Funding needs under home	580	1 559	6 577	86	282	1 660
	Funding needs under domestic + FPS	562	1 515	6 406	84	274	1 616
	Relative variation	- 2.97%	-2.80%	- 2.60%	-3.09%	-2.88%	-2.62%
	Funding needs for cross-border IGS	17	44	171	3	8	43

Figure 0.10: Relative difference between funding needs when moving from the home state to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches, for the total insurance sector and the life and non-life business lines, for all EEA countries (relative differences are equal across model parameterisations due to use of the same loss distribution function)



1.2 Using a single pan-EU IGS

This section considers the case where a single mandatory IGS for the whole European Union is introduced. In order to test this scenario, the total EAD at EU/EEA level[2] is obtained as the sum of EADs over all countries. The loss distribution function is then calculated by setting parameter δ to zero to reflect the lower granularity of the market at European level. The contributions that each country would need to make to this pan-EU/EEA IGS can be obtained by considering its share of the total EAD.

Setting δ to zero changes each country's loss distribution function compared with the baseline case. Therefore, in this case relative changes in funding needs will be different for each choice of α and PD when moving from the baseline case to introduction of a single pan-EU/EEA scheme.

[2] As explained in section **Error! Reference source not found.**, CEIOPS does not provide separate data for cross-border activity within the EU and within the larger EEA. Calculations for a single EU/EEA-wide scheme are therefore based on EEA data for coherency reasons.

1.2.1 Total insurance

Figure 0.11: IGS funding needs at country level for the total insurance sector under a single pan-European scheme, for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average and cross-border IGS, countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%

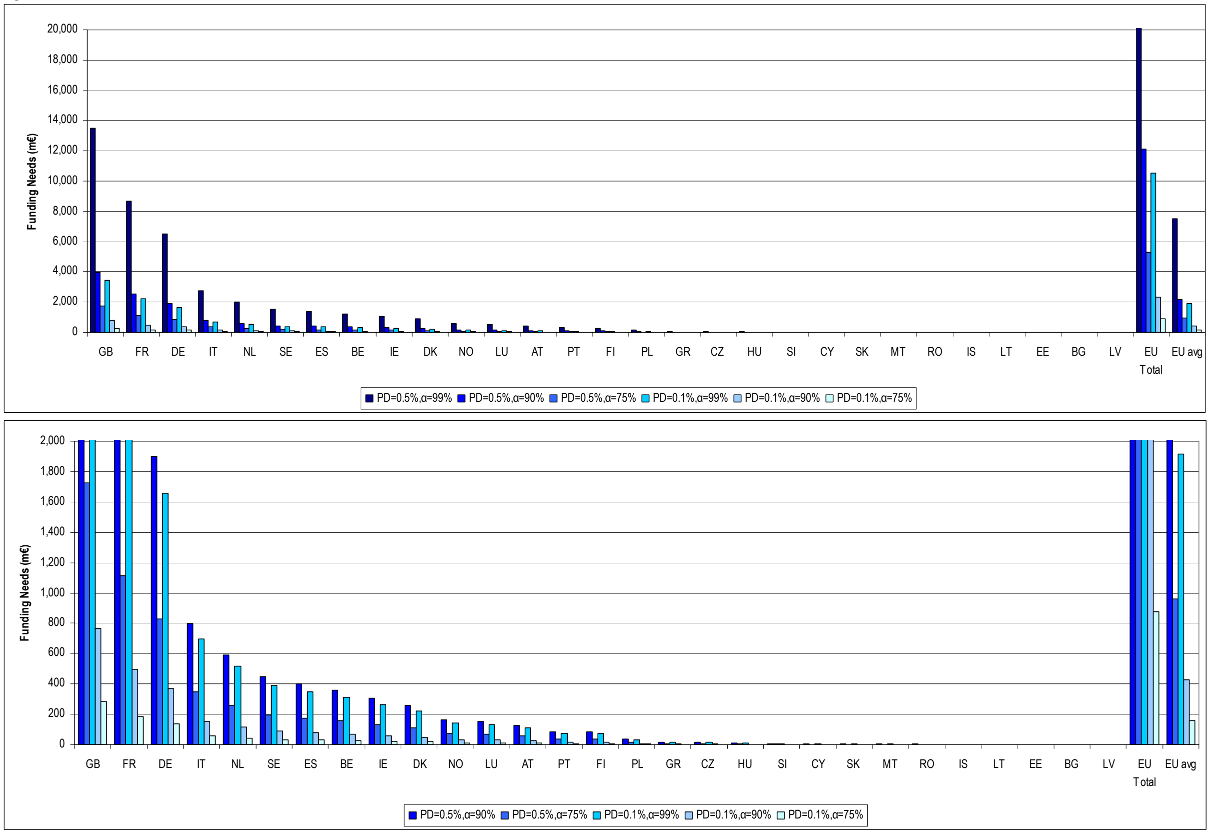


Figure 0.12: Absolute variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; total insurance sector; all EEA countries; countries in order of gross premiums written

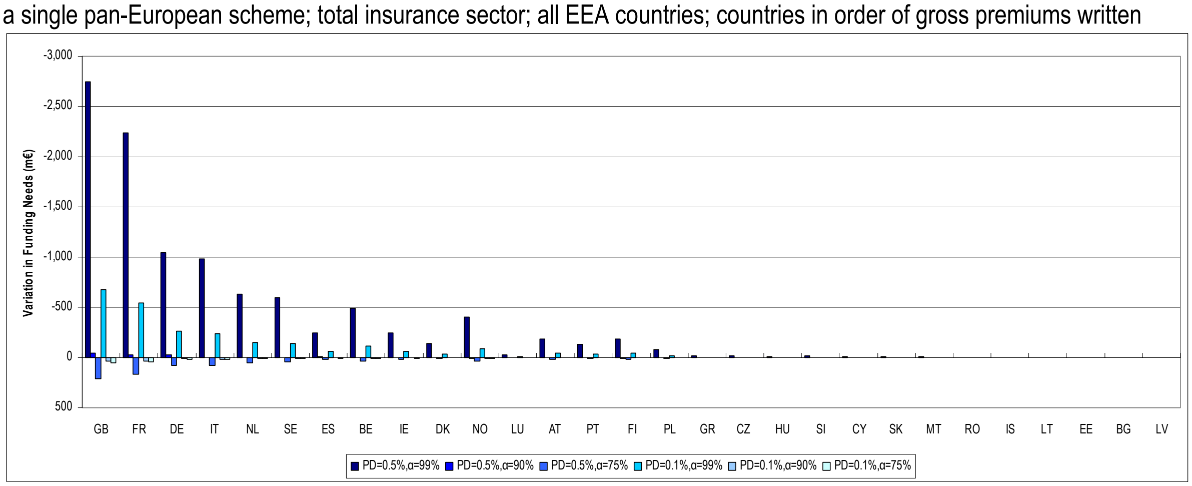


Figure 0.13: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; total insurance sector, PD=0.1% and α=90%; countries in order of gross premiums written

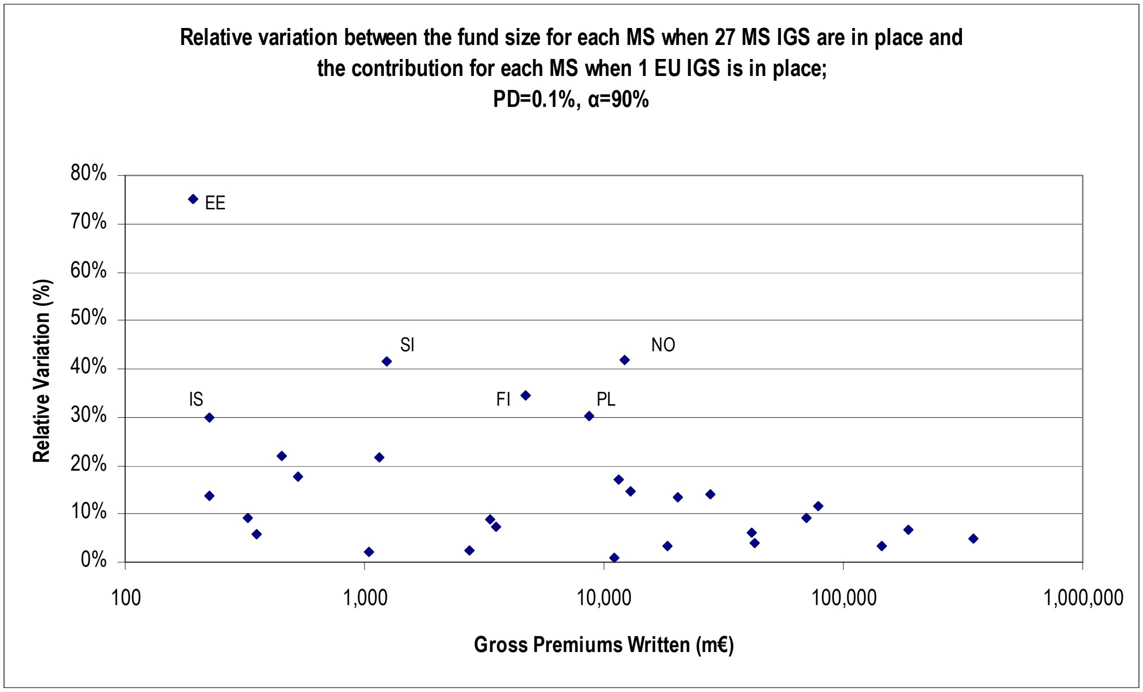


Figure 0.14: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; total insurance sector, PD=0.5% and α=90%; countries in order of gross premiums written

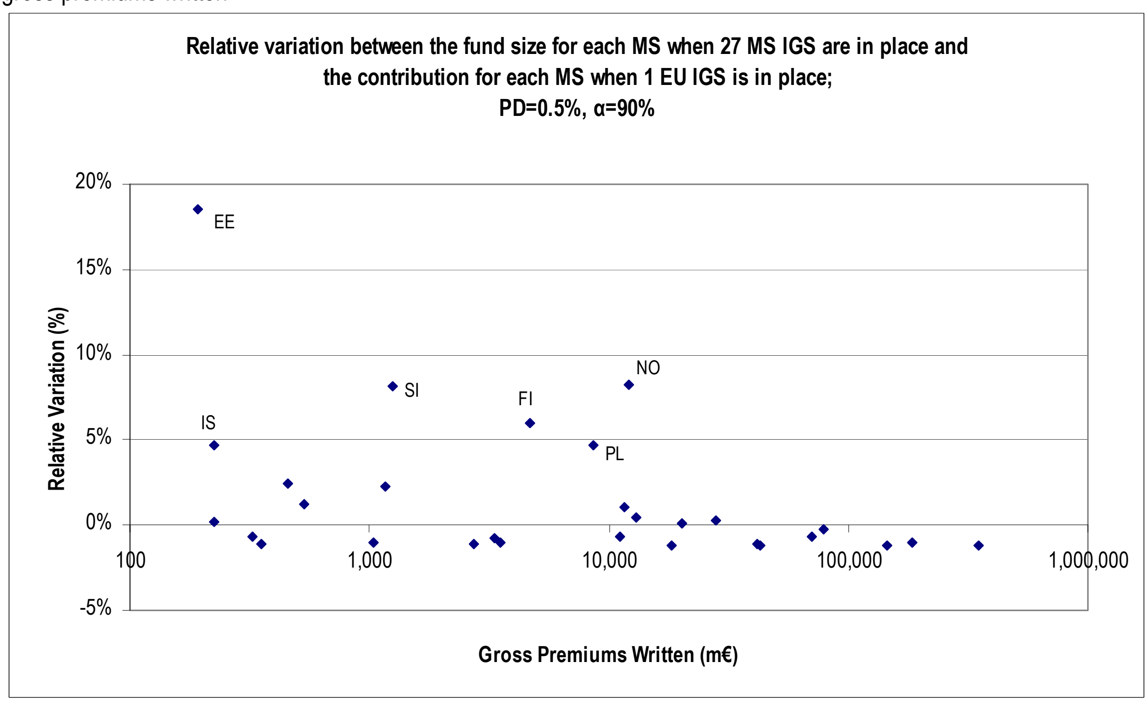


Table 0.6: Summary of relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; EU average and minimum, median and maximum across all EEA countries; total insurance sector

	MIN		MEDIAN		MAX		EU avg
PD=0.1%,α=90%	0.89%	LU	11.73%	IT	75.22%	EE	5.65%
PD=0.5%,α=90%	-1.20%	ES	-0.21%	IT	18.54%	EE	-1.37%

1.2.2 Life insurance

Figure 0.15: IGS funding needs at country level for the life business line under a single pan-European scheme, for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average; countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%

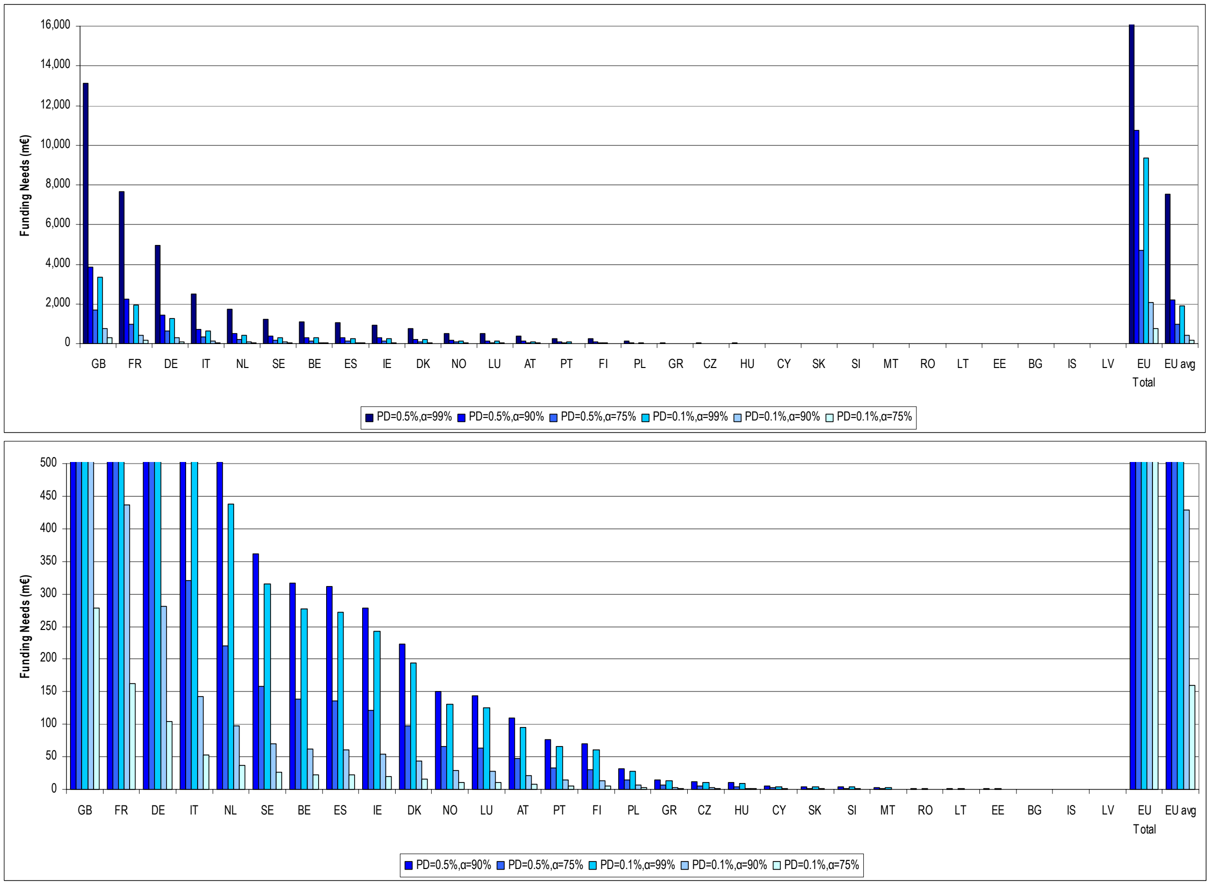


Figure 0.16: Absolute differences between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; life business line; countries in order of gross premiums written

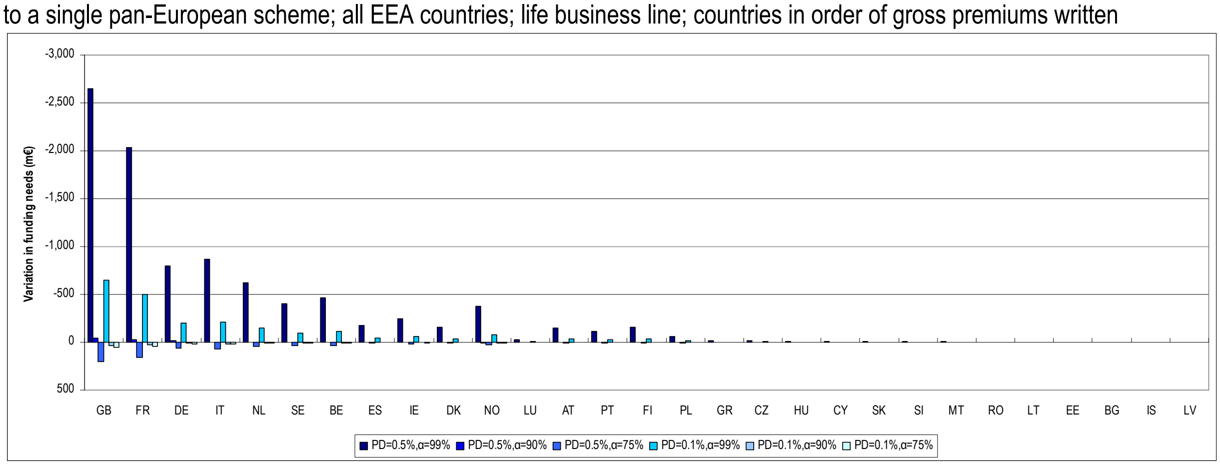


Figure 0.17: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; life business line, PD=0.1% and α=90%; countries in order of gross premiums written

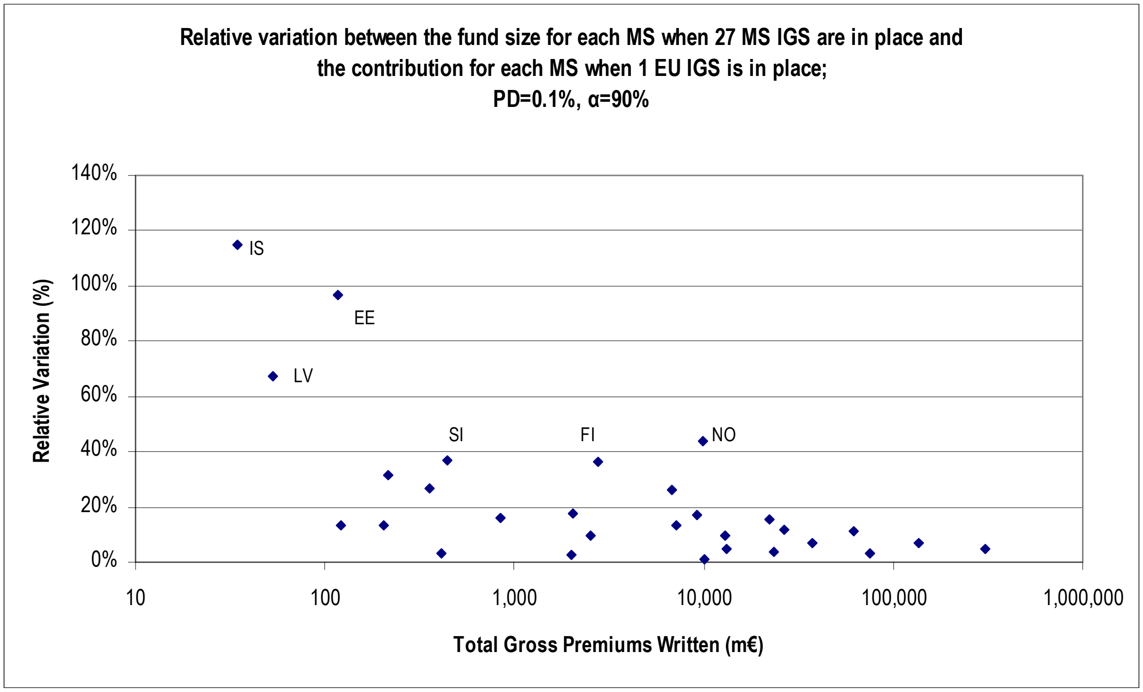


Figure 0.18: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; life business line, PD=0.5% and α=90%; countries in order of gross premiums written

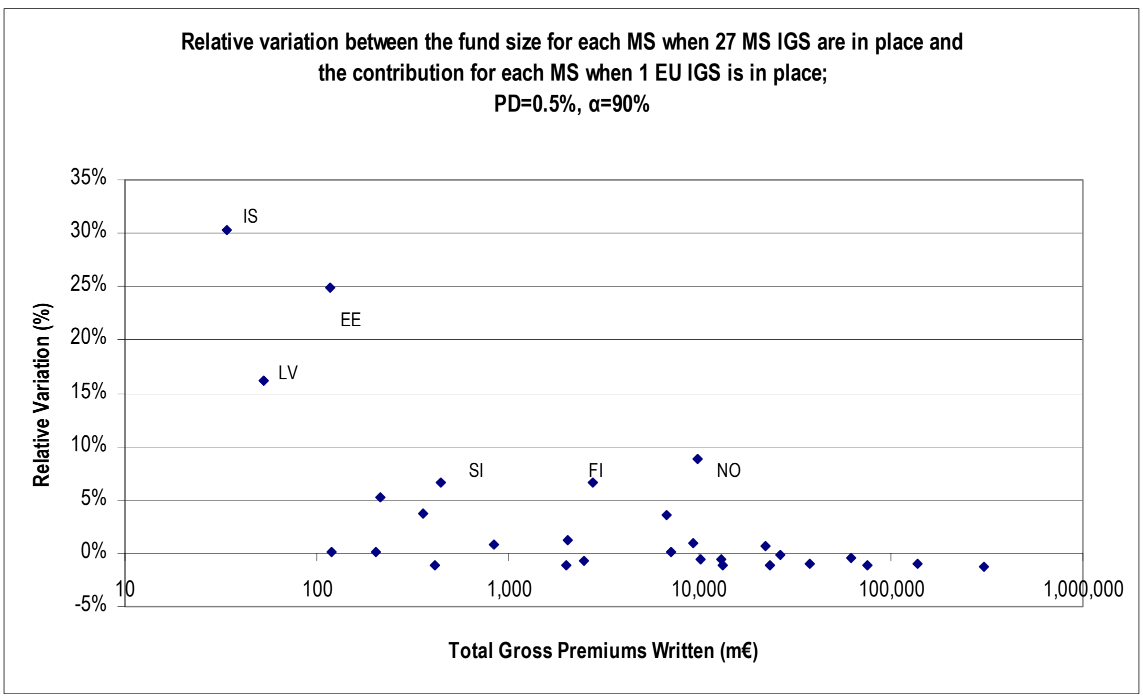


Table 0.7: Summary of relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; EU average and minimum, median and maximum across all EEA countries; life business line, PD=0.1% and 0.5% and α=90%

	MIN		MEDIAN		MAX		EU avg
PD=0.1%,α=90%	0.85%	LU	13.20%	AT	115.00%	IS	5.37%
PD=0.5%,α=90%	-1.20%	GB	0.11%	AT	30.23%	IS	-1.12%

1.2.3 Non-life insurance

Figure 0.19: IGS funding needs at country level for the non-life business line under a single pan-European scheme, for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average; countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%

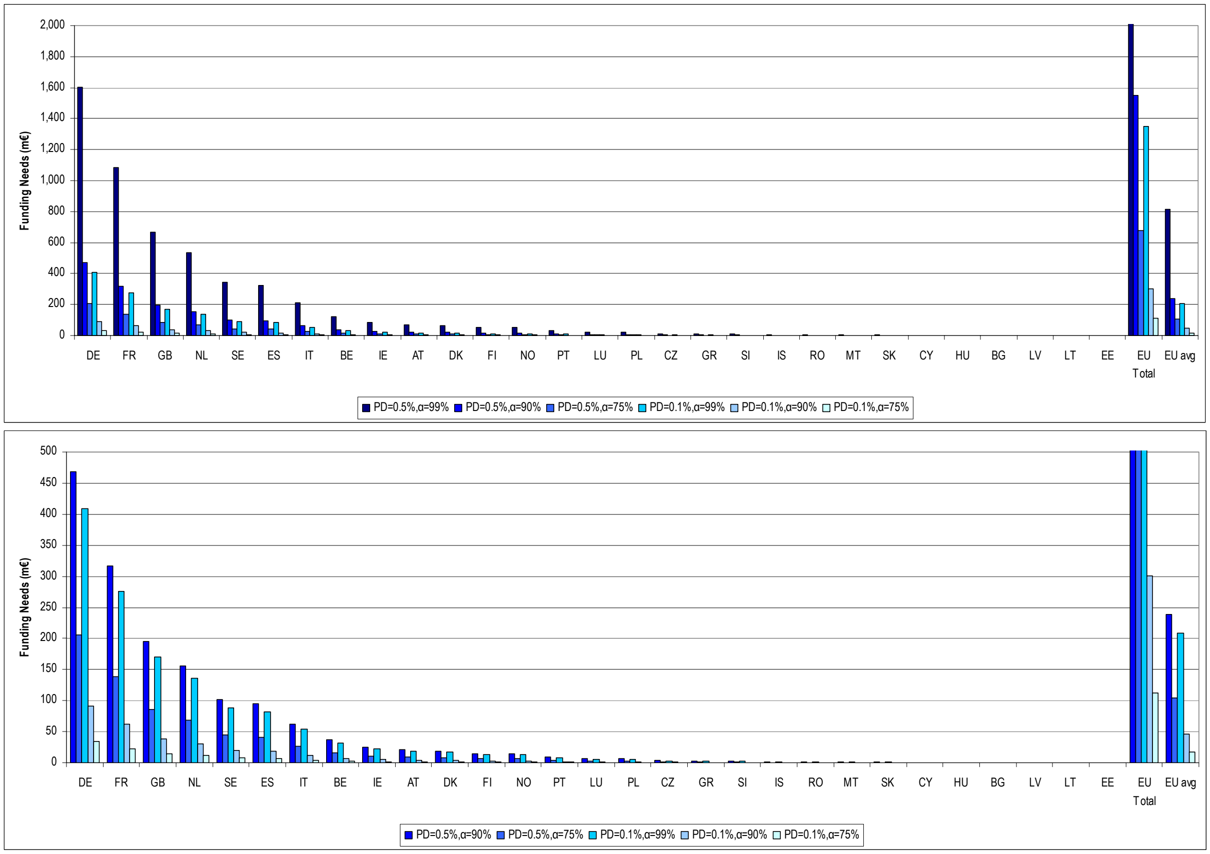


Figure 0.20: Absolute differences between funding needs at country level when moving from the home state principle to a single pan-European scheme; non-life business line; all EEA countries; countries in order of funding needs

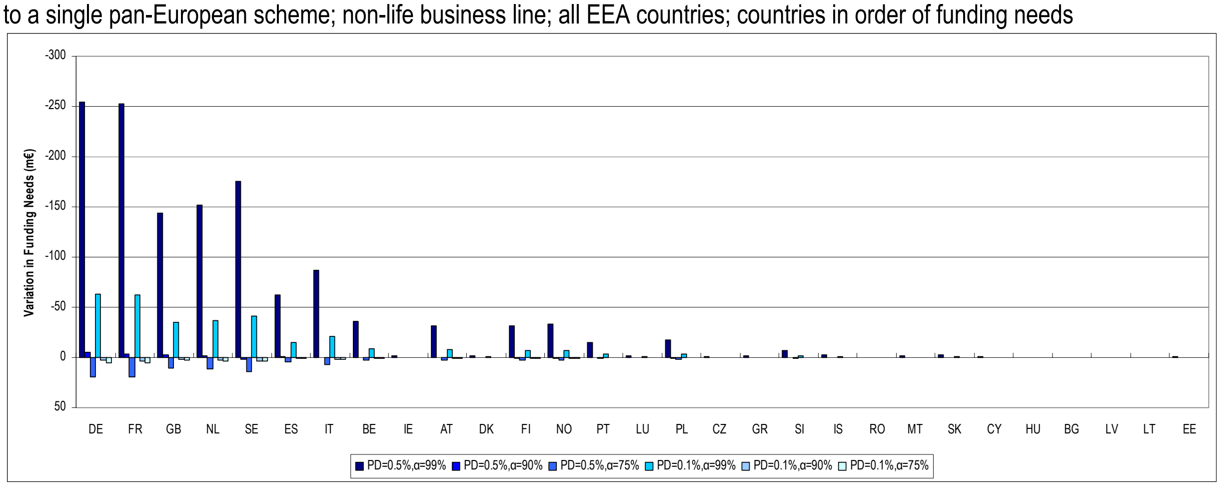


Figure 0.21: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; non-life business line, PD=0.1% and α=90%; countries in order of gross premiums written

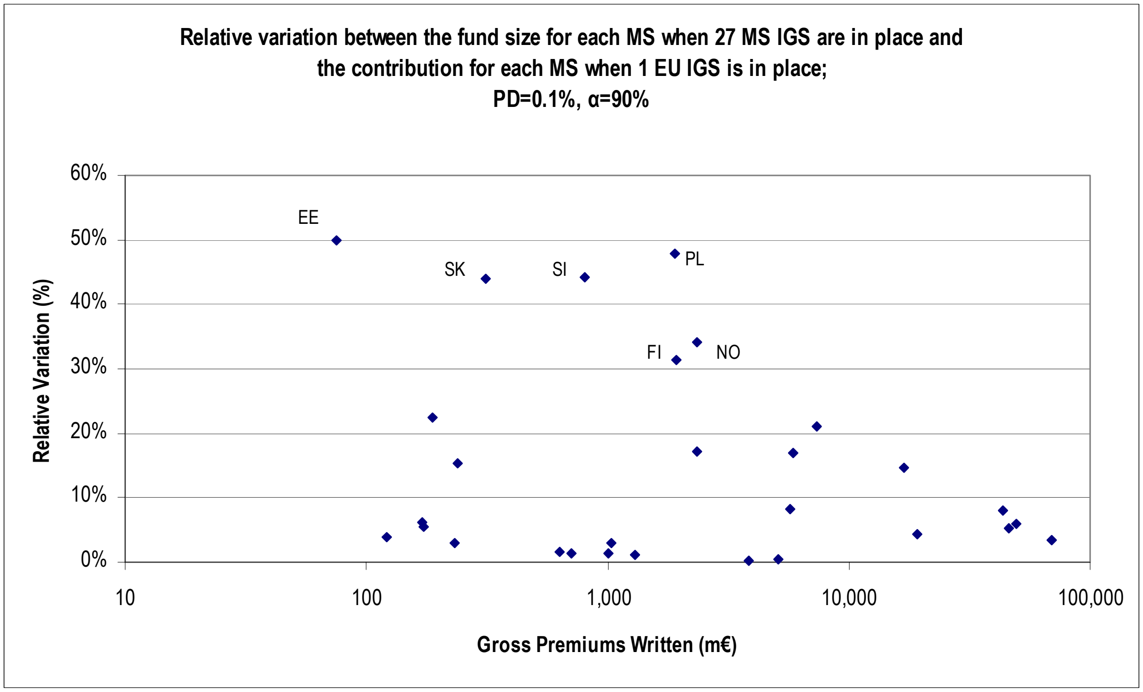


Figure 0.22: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; non-life business line, PD=0.5% and α=90%; countries in order of gross premiums written

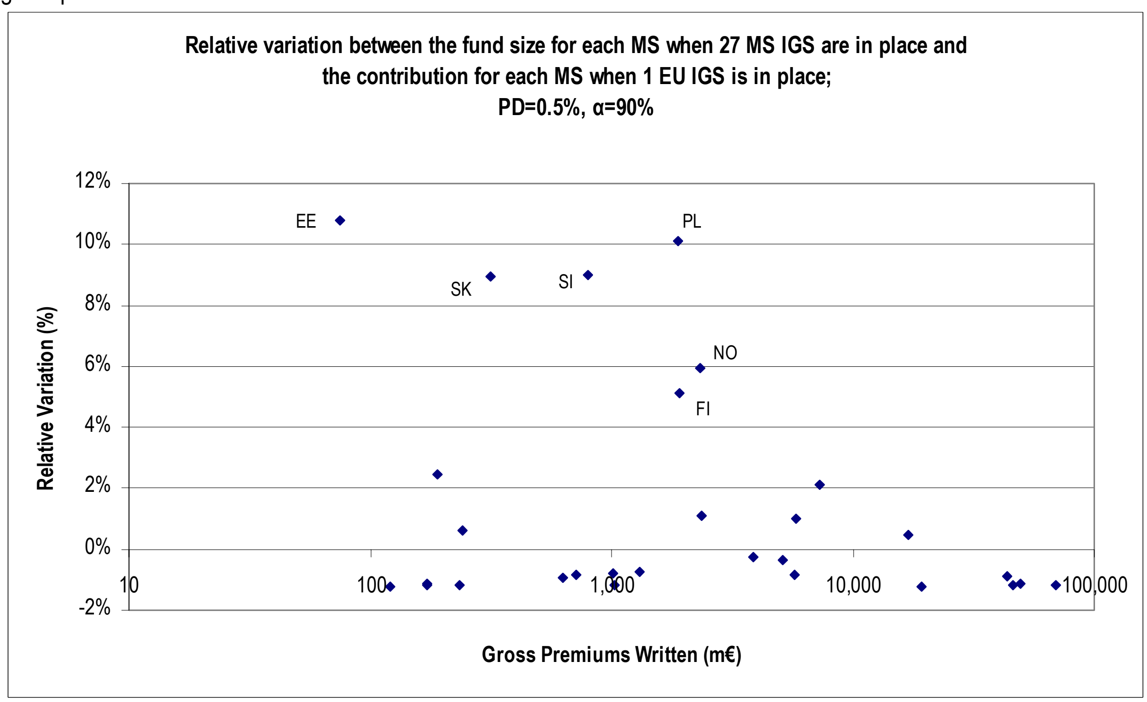


Table 0.8: Summary of relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; EU average and minimum, median and maximum across all EEA countries; non-life business line, PD=0.1% and 0.5% and α=90%

	MIN		MEDIAN		MAX		EU avg
PD=0.1%,α=90%	0.25%	IE	6.17%	LV	49.98%	EE	5.02%
PD=0.5%,α=90%	-1.20%	ES	-0.73%	CZ	10.80%	EE	-1.07%

1.2.4 Summary of statistics at EU level

Table 0.9: Average funding needs at country level for EU Member States under a single pan-European scheme for different probabilities of default and confidence levels; weighted averages by gross premiums written, for the total insurance sector and the life and non-life business lines (in m€)

	PD = 0.5%			PD=0.1%		
α →	75%	90%	99%	75%	90%	99%
Total insurance (EU)	959	2 191	7 497	159	427	1 915
Life (EU)	964	2 204	7 540	160	429	1 921
Non-life (EU)	105	239	817	17	46	208

Table 0.10: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle to a single pan-European scheme under different probabilities of default and confidence levels for the total insurance sector and the life and non-life business lines (in m€)

		PD = 0.5%			PD=0.1%		
	α →	75%	90%	99%	75%	90%	99%
Total insurance (EU)	Funding needs under home	4 529	12 213	51 477	673	2 209	13 001
	Funding needs under a single EU IGS	5 297	12 108	41 418	877	2 354	10 551
	Relative difference	16.95%	-0.86%	-19.54%	30.32%	6.56%	-18.85%
Life (EU)	Funding needs under home	4 010	10 833	45 751	595	1 958	11 554
	Funding needs under a single EU IGS	4 698	10 739	36 738	778	2 088	9 359
	Relative difference	17.16%	-0.86%	-19.70%	30.72%	6.64%	-19.00%
Non-life (EU)	Funding needs under home	580	1 559	6 577	86	282	1 660
	Funding needs under a single EU IGS	678	1 549	5 298	112	301	1 350
	Relative difference	16.90%	-0.66%	-19.45%	29.90%	6.76%	-18.68%

Figure 0.23: Relative difference between funding needs at country level when moving from the home state principle to a single pan-European scheme, for the total insurance sector and the life and non-life business lines; PD=0.1% and α=90%; all EEA countries; countries in order of gross premium written in the total insurance sector

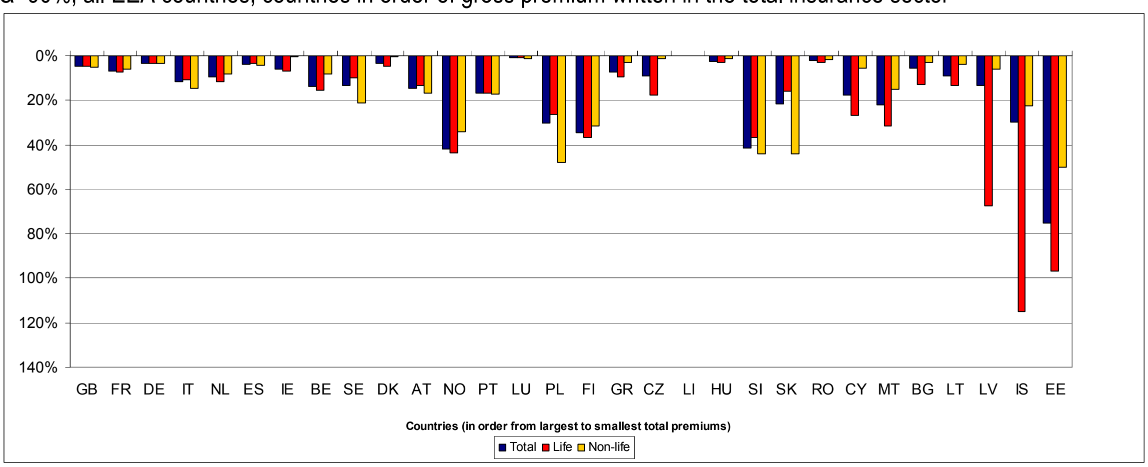
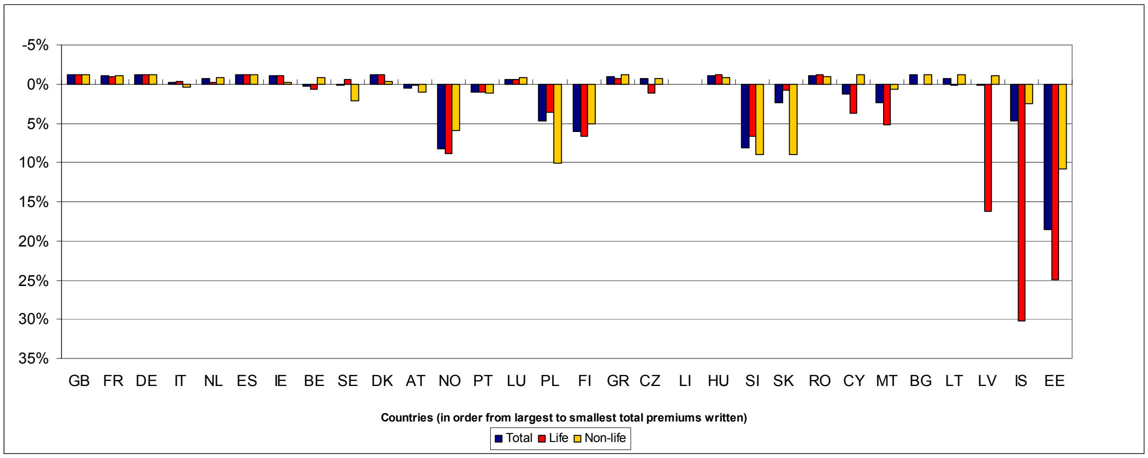


Figure 0.24: Relative difference between funding needs at country level when moving from the home state principle to a single pan-European scheme, for the total insurance sector and the life and non-life business lines; PD=0.5% and α=90%; all EEA countries; countries in order of gross premium written in the total insurance sector



1.3 Using a pure compensation mechanism rather than portfolio continuation/transfer

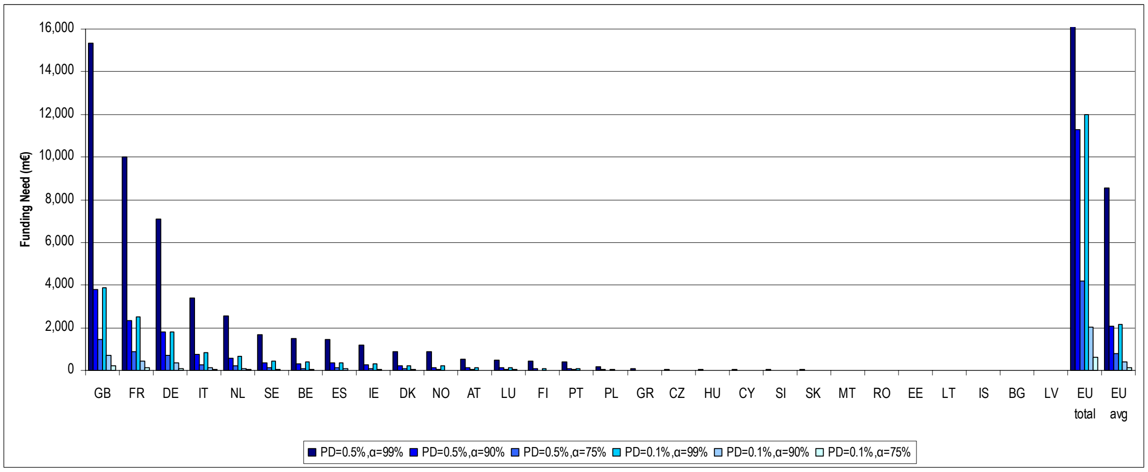
Under this policy option the portfolio of the failed insurance company is not continued/transferred but the IGS only provides compensation for claims incurred up to the date of default. Additional, coverage for unearned premiums could be provided to policy-holders.

As discussed in Section **Error! Reference source not found.**, this implies that the EAD is lower than in the baseline case to reflect the fact that the regulatory viability of the portfolio might not need to be re-established. In this case the EAD is therefore calculated in accordance with **Error! Reference source not found.** for the life business line and **Error! Reference source not found.** or **Error! Reference source not found.** for the non-life business line.

1.3.1 Total insurance

1.3.1.1 Compensation of claims only

Figure 0.25: IGS funding needs for the total insurance sector under the home state principle and a pure compensation mechanism covering only claims for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average; countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



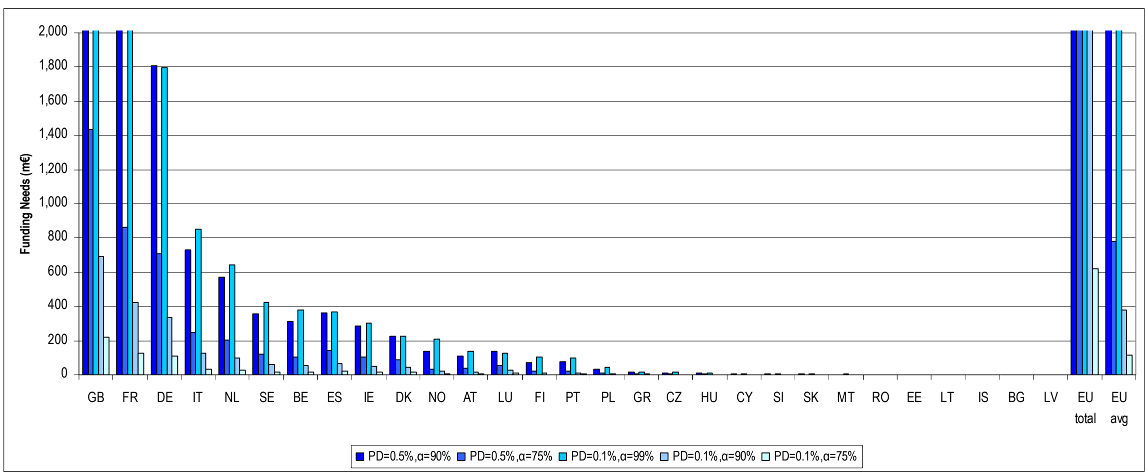


Figure 0.26: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; total insurance sector; all EEA countries, plus EU total and EU average ;countries in order of funding needs

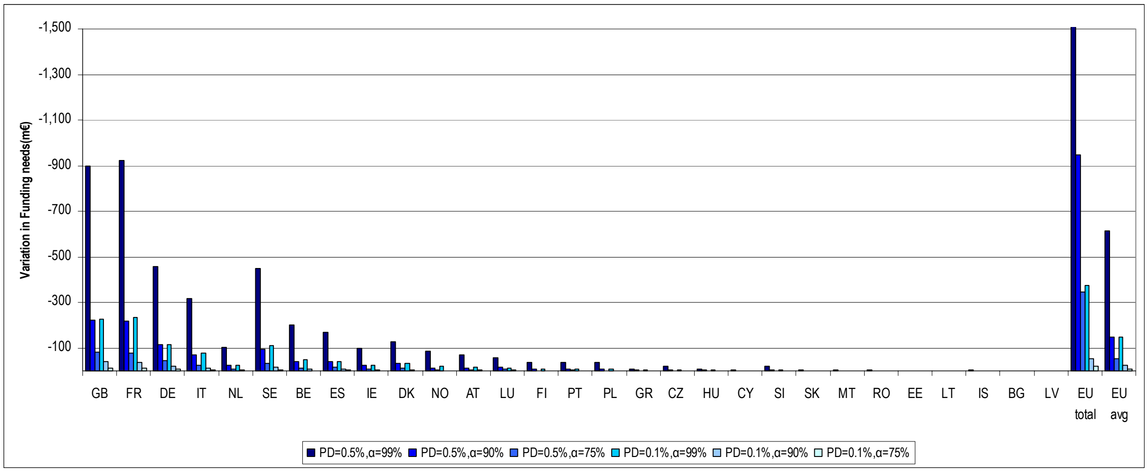


Figure 0.27: Relative variations between funding needs at country level when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; total insurance sector; all EEA countries; countries in order of gross premiums written

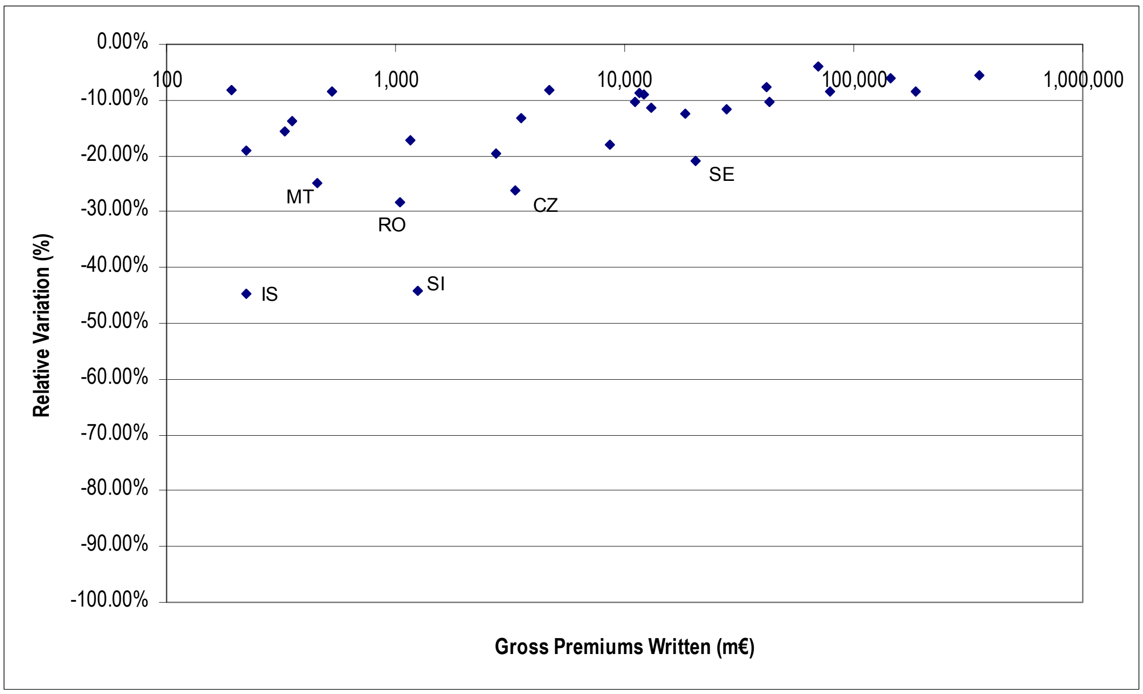


Table 0.11: Summary of relative variations between funding needs at country level when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; EU average and minimum, median and maximum across all EEA countries; total insurance sector

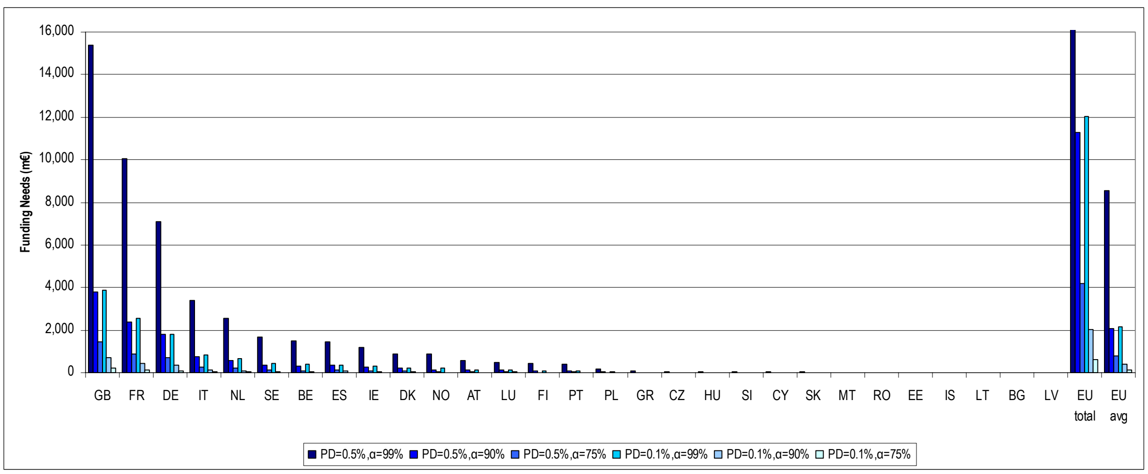
MIN		MEDIAN		MAX		EU avg
-44.65%	IS	-11.69%	BE	-3.87%	NL	-6.70%

Table 0.12: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; under different probabilities of default and confidence levels for the total insurance sector (in m€)

	PD = 0.5%			PD=0.1%		
α →	75%	90%	99%	75%	90%	99%
EU, funding needs under home with portfolio transfer	4 529	12 213	51 477	673	2 209	13 001
EU, funding needs under home; compensation only	4 182	11 266	47 419	622	2 039	11 978
Relative difference	-7.65%	-7.75%	-7.88%	-7.59%	-7.70%	-7.87%

1.3.1.2 Pure compensation for life insurance and pure compensation including unearned premiums for non-life insurance

Figure 0.28: IGS funding needs for the total insurance sector under the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; for different confidence levels and default probabilities, all EEA countries, plus EU total and EU average; countries in order of funding needs; the top figure indicates funding need; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



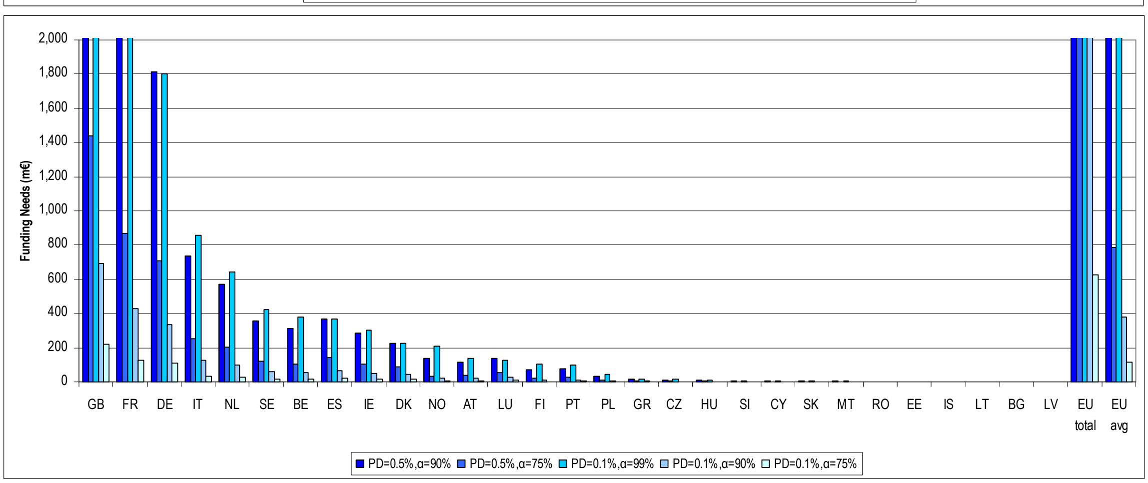


Figure 0.29: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; total insurance sector; all EEA countries, plus EU total and EU average; countries in order of funding needs

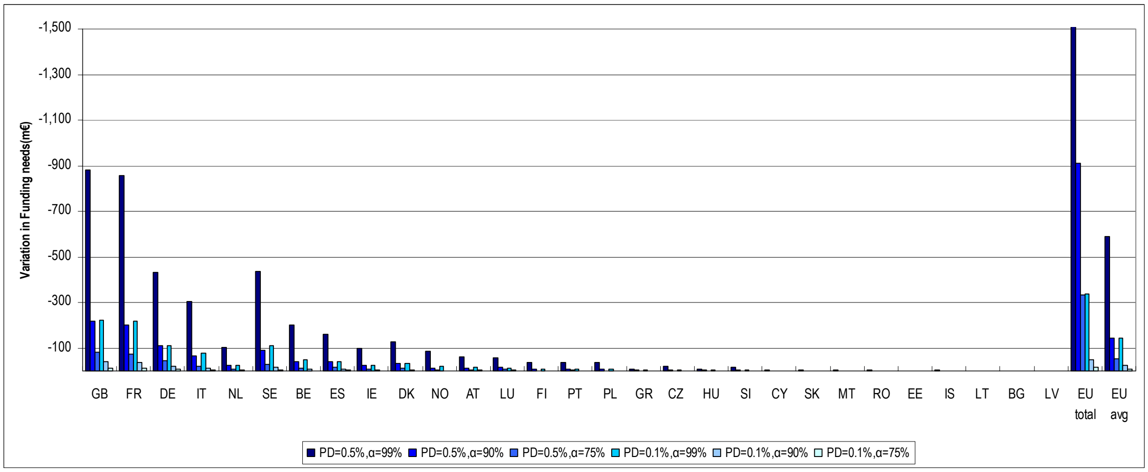


Figure 0.30: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; total insurance sector; all EEA countries; countries in order of gross premiums written

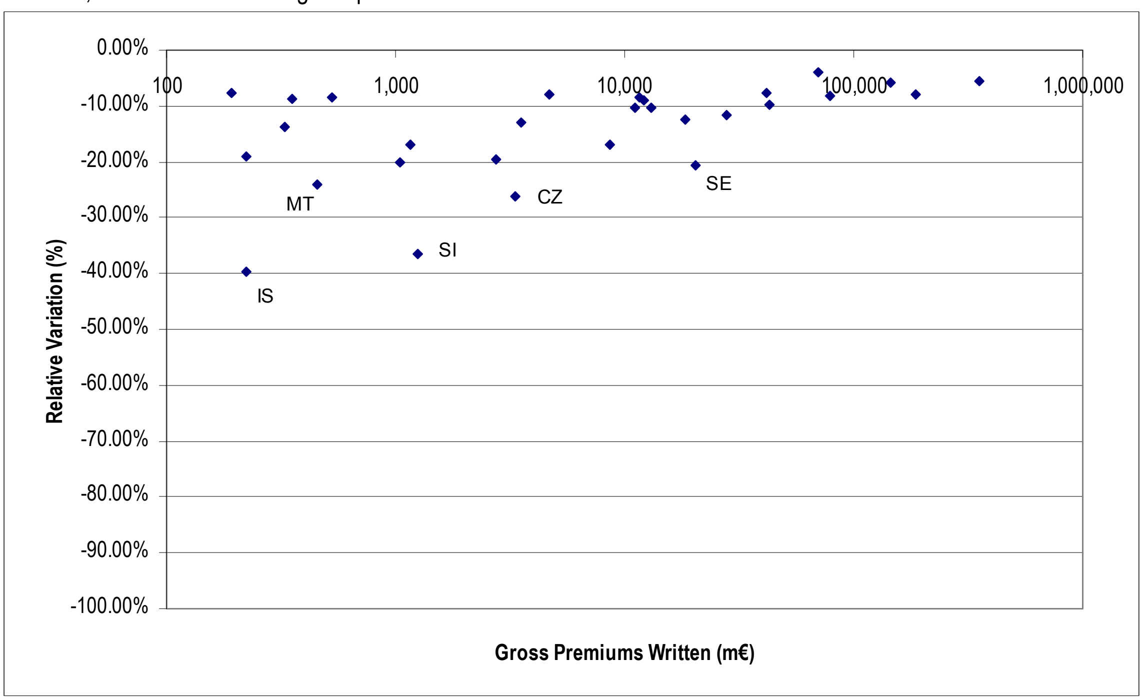


Table 0.13: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; EU average and minimum, median and maximum across all EEA countries; total insurance sector

MIN		**MEDIAN**		**MAX**		**EU avg**
-39.77%	IS	-10.32%	AT	-3.87%	NL	-6.46%

Table 0.14: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; under different probabilities of default and confidence levels for the total insurance sector (in m€)

	PD = 0.5%			**PD=0.1%**		
α →	**75%**	**90%**	**99%**	**75%**	**90%**	**99%**
EU, funding needs under home with portfolio transfer	4 529	12 213	51 477	673	2 209	13 001
EU, funding needs under home; compensation only	4 196	11 302	47 573	624	2 045	12 016
Relative difference	-7.36%	-7.46%	-7.59%	-7.30%	-7.41%	-7.57%

1.3.2 Compensation for life insurance

In the life insurance business line the EAD for the pure compensation case is determined in accordance with **Error! Reference source not found.**.

Figure 0.31: IGS funding needs for the life business line under the home state principle and a pure compensation mechanism covering only claims; for different confidence levels and default probabilities, all EEA countries, plus EU total, EU average; countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%

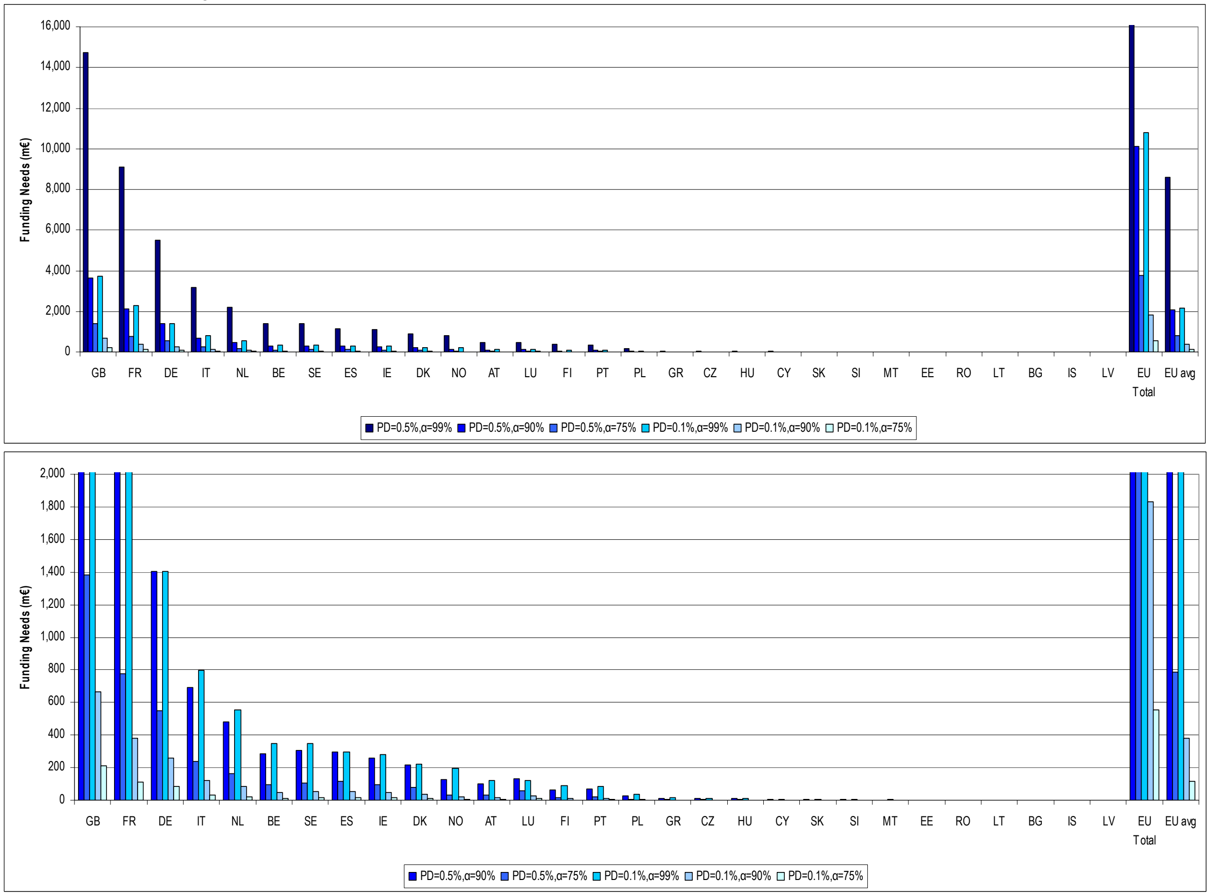


Figure 0.32: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; life business line; all EEA countries; countries in order of funding needs

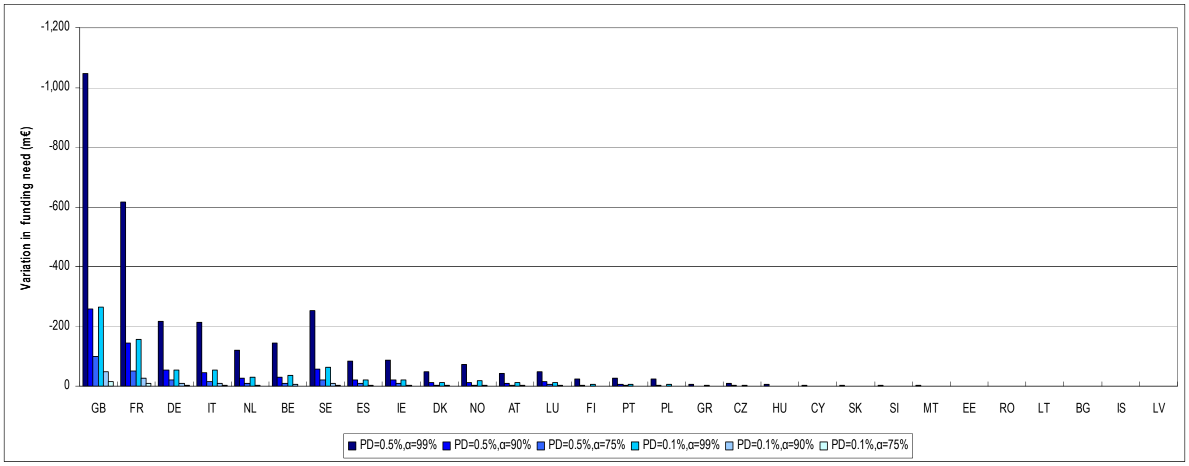


Figure 0.33: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; life business line; all EEA countries; countries in order of gross premiums written

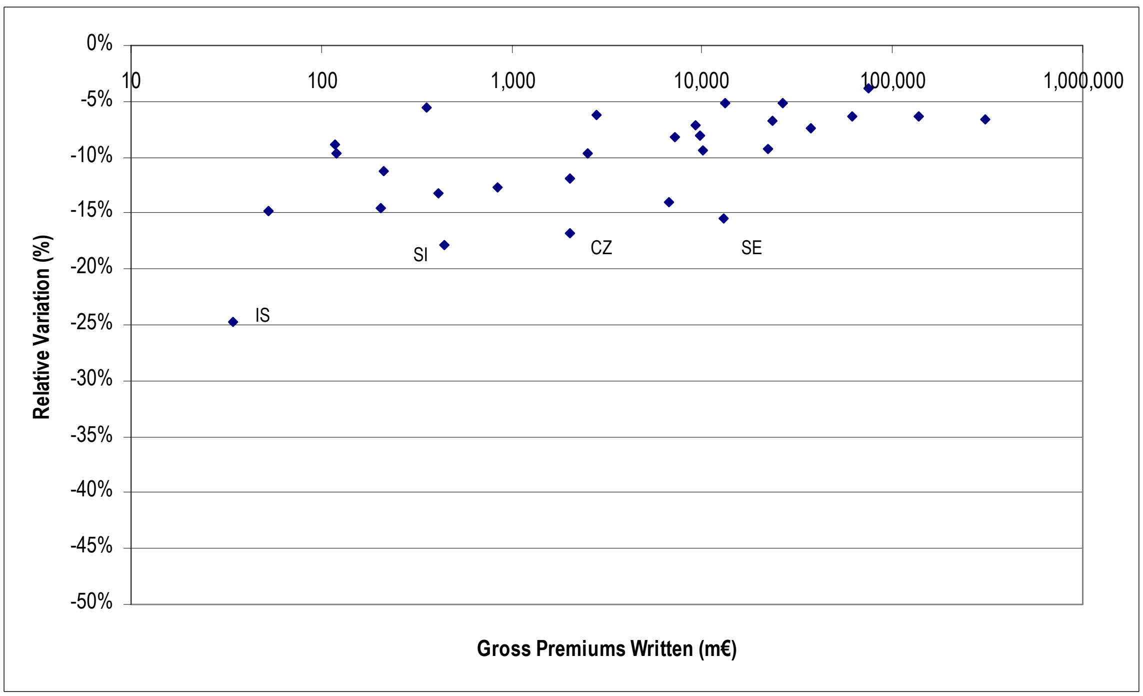


Table 0.15: Summary of relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; EU average and minimum, median and maximum across all EEA countries; life business line

MIN		MEDIAN		MAX		EU avg
-24.78%	IS	-9.26%	BE	-3.78%	DE	-6.43%

Table 0.16: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; under different probabilities of default and confidence levels for the life business line (in m€)

	PD = 0.5%			**PD=0.1%**		
α →	**75%**	**90%**	**99%**	**75%**	**90%**	**99%**
EU, funding needs under home, with portfolio transfer	4,010	10,833	45,751	595	1,958	11,554
EU, funding needs under home, compensation only	3,749	10,122	42,723	557	1,830	10,790
Relative difference	-6.52%	-6.56%	-6.62%	-6.49%	-6.54%	-6.61%

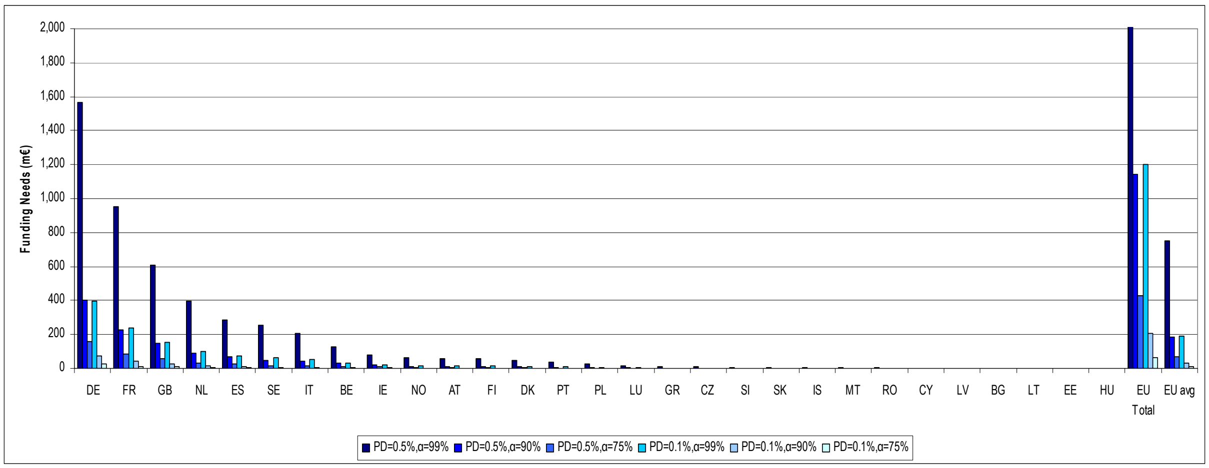
1.3.3 Compensation for non-life insurance

When a compensation option is applied to non-life insurance policies there are two possible options for the part premium which is unearned: ignore it or reimburse it.

1.3.3.1 Compensation of claims only

If the unearned premium is not covered, the EAD will be given by **Error! Reference source not found.**, reflecting the fact that the regulatory viability of the portfolio will not need to be reconstructed.

Figure 0.34: IGS funding needs for the non-life business line under the home state principle and a pure compensation mechanism covering only claims; for different confidence levels and default probabilities all EEA countries, countries in order of funding needs the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



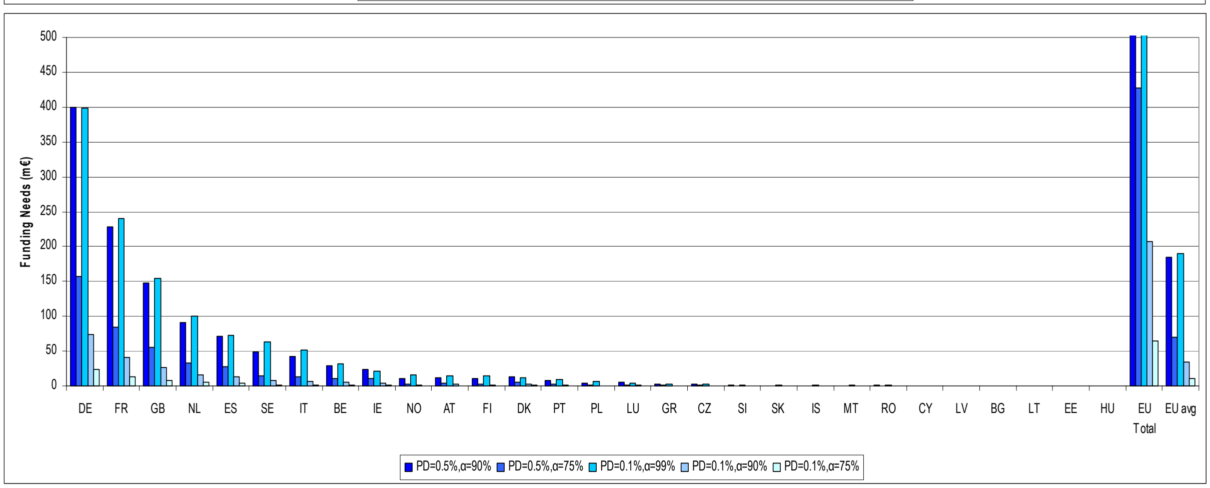


Figure 0.35: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; non-life business line; all EEA countries; countries in order of funding needs

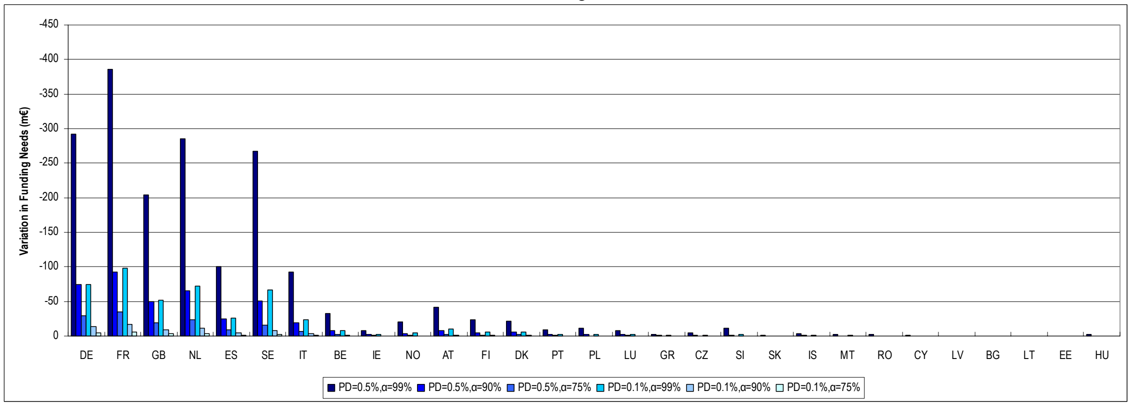


Figure 0.36: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; non-life business line; all EEA countries; countries in order of gross premiums written.

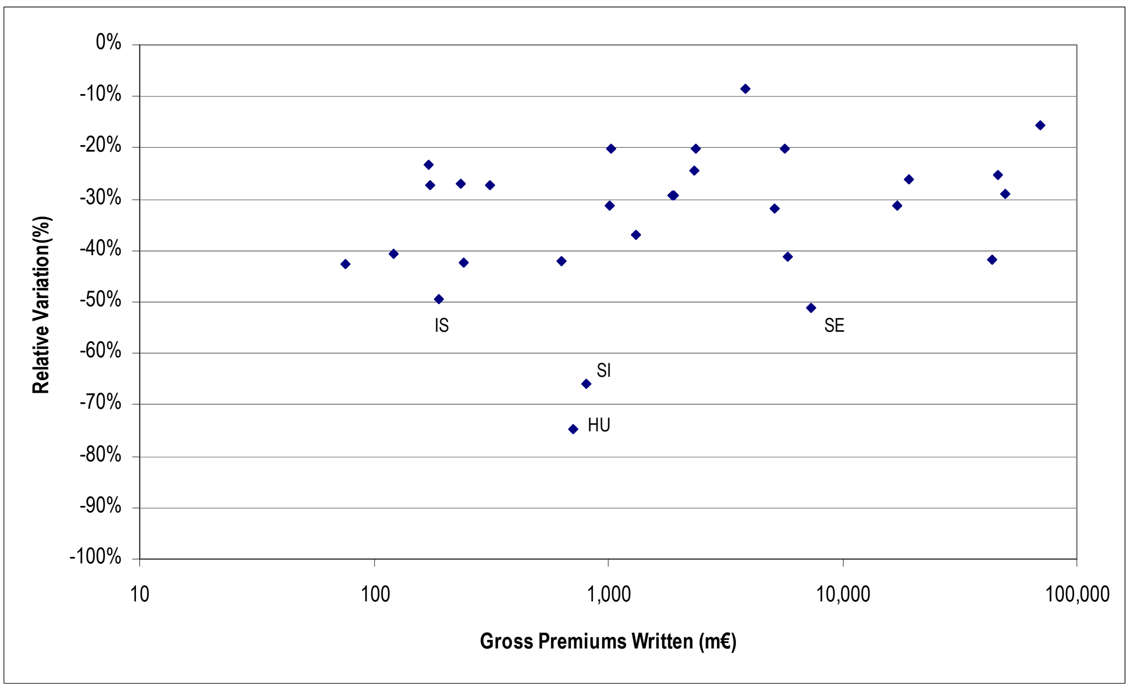


Table 0.17: Summary of relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; EU average and minimum, median and maximum across all EEA countries; non-life business line

MIN		MEDIAN		MAX		EU avg
-74.62%	HU	-29.35%	PL	-8.47%	IE	-23.93%

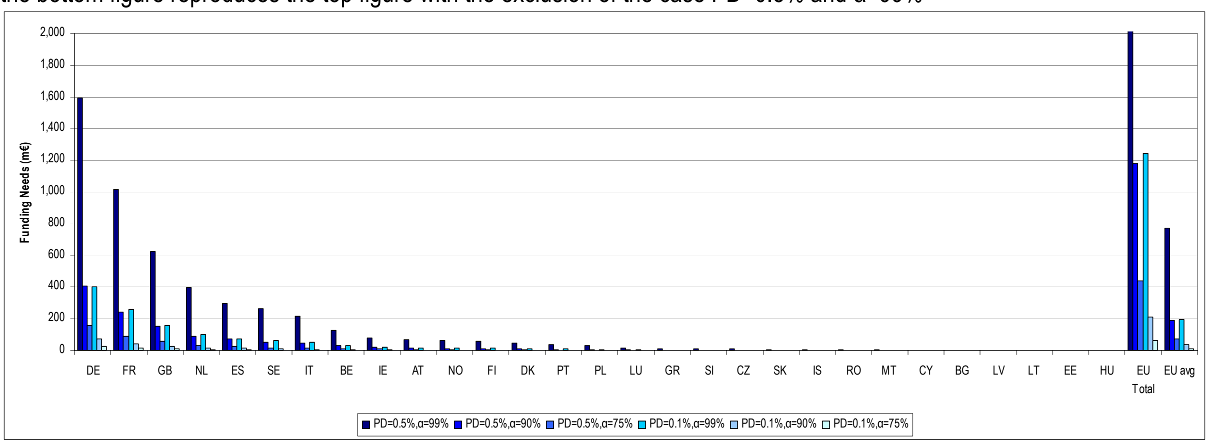
Table 0.18: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; under different probabilities of default and confidence levels for the non-life business line (in m€)

	PD = 0.5%			PD=0.1%		
α →	75%	90%	99%	75%	90%	99%
EU, funding needs under home, with portfolio transfer	580	1 559	6 577	86	282	1 660
EU, funding needs under home, compensation only	428	1 142	4 764	64	207	1 203
Relative difference	-26.14%	-26.76%	-27.57%	-25.73%	-26.45%	-27.50%

1.3.3.2 Pure compensation including unearned premiums

If unearned premiums are covered by the IGS, the EAD will also include a term corresponding to unearned premiums, as illustrated in **Error! Reference source not found.**.

Figure 0.37: IGS funding needs for the non-life business line under the home state principle and a pure compensation mechanism covering claims and unearned premiums for different confidence levels and default probabilities, all EEA countries, plus EU total and EU average; countries in order of funding needs; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



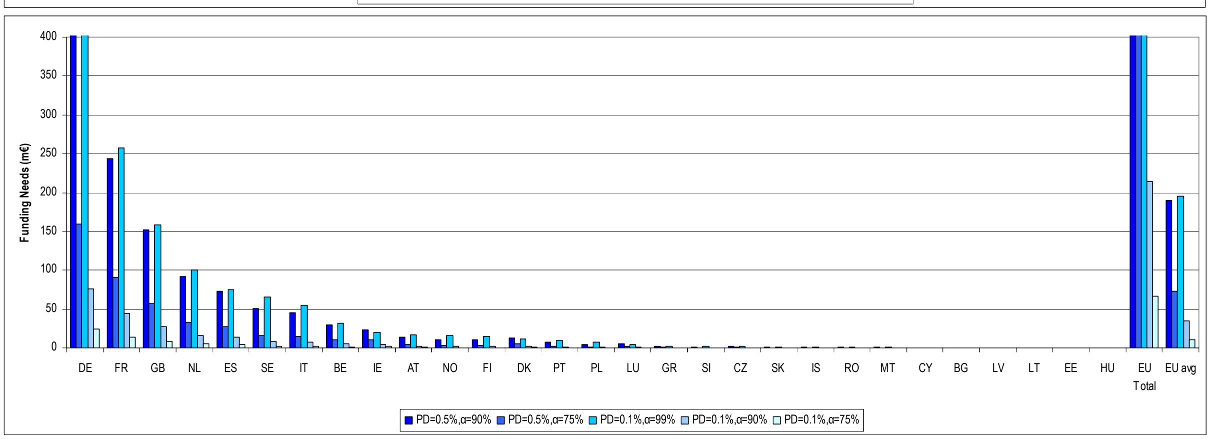


Figure 0.38: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims and unearned premiums; non-life business line; all EEA countries; countries in order of funding needs

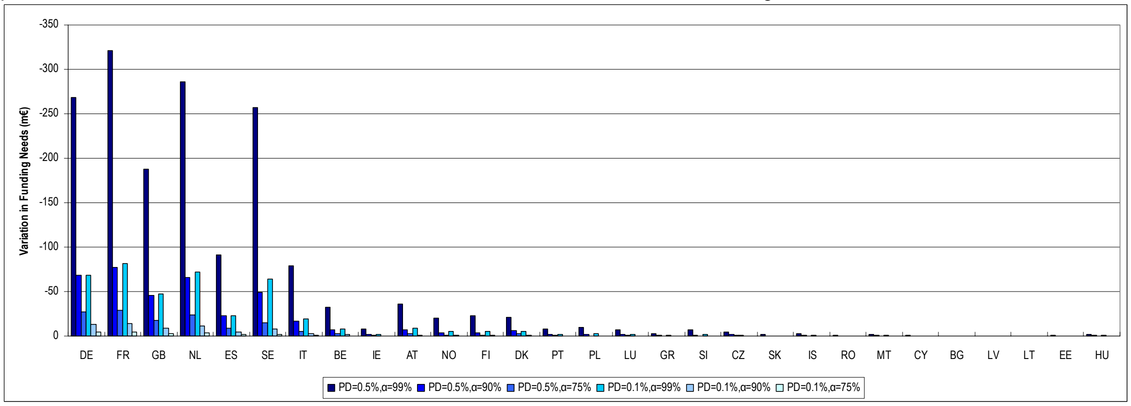


Figure 0.39: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims and unearned premiums; non-life business line; all EEA countries; countries in order of gross premiums written

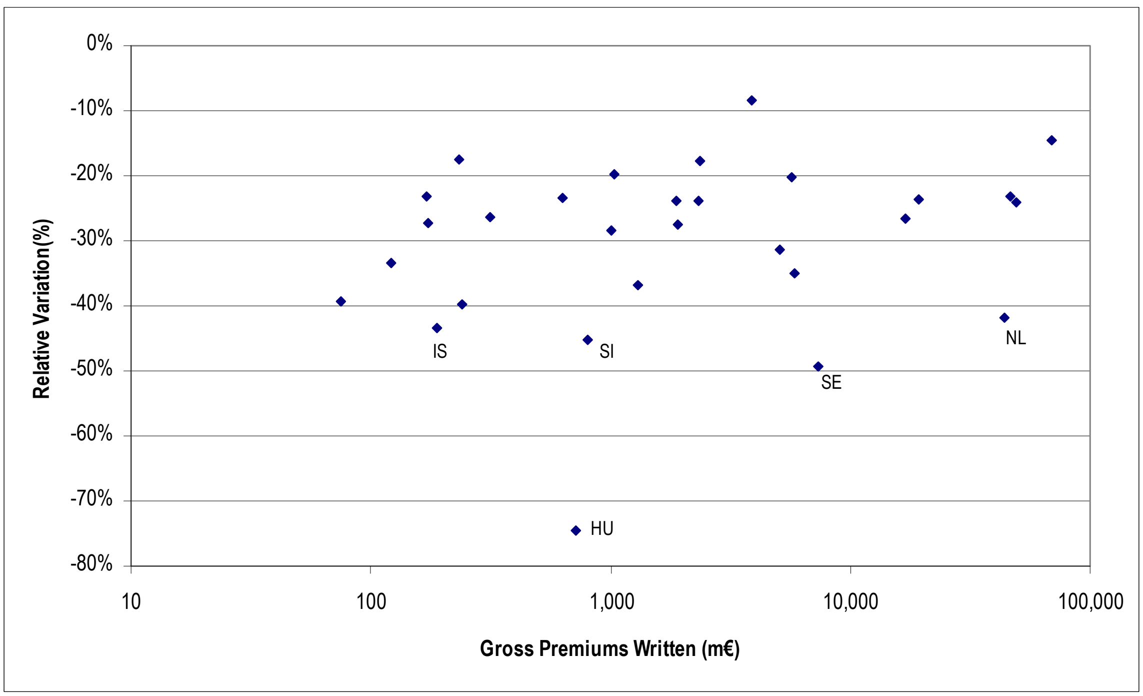


Table 0.19: Summary of relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims and unearned premiums; EU average and minimum, median and maximum across all EEA countries; non-life business line

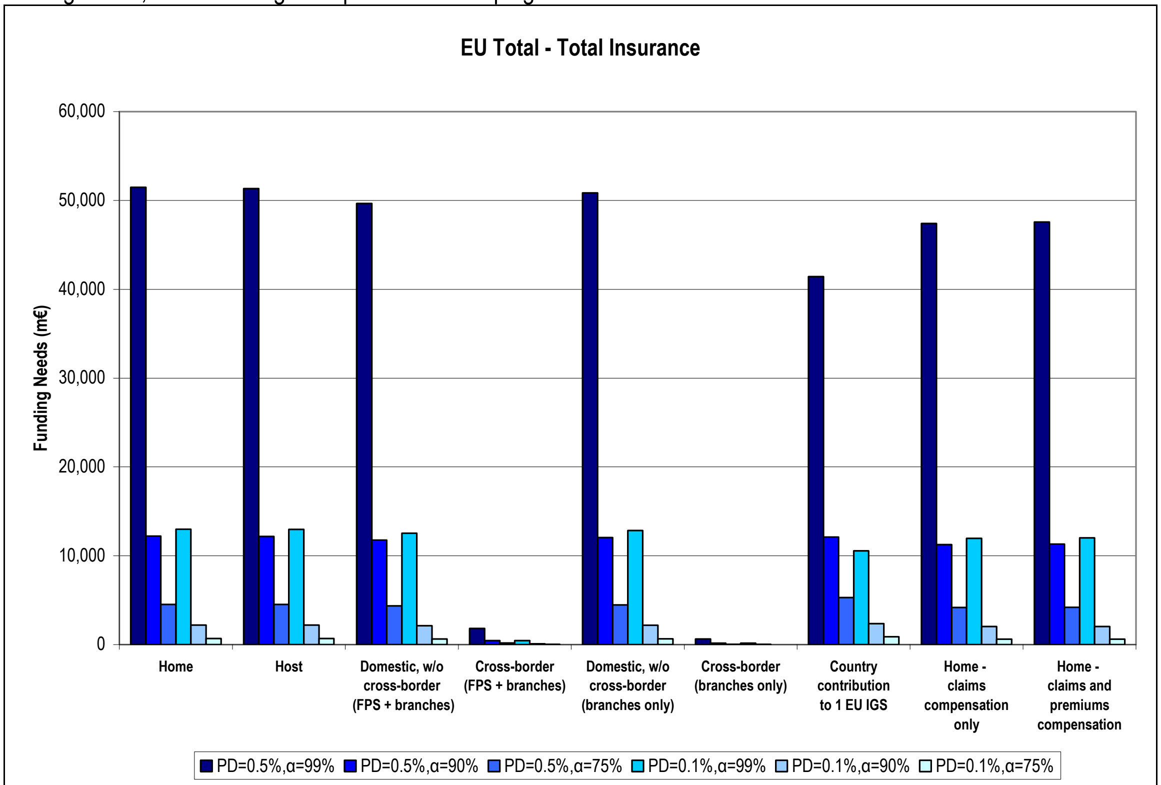
MIN		MEDIAN		MAX		EU avg
-74.62%	HU	-26.56%	IT	-8.47%	IE	-21.75%

Table 0.20: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims and unearned premiums; under different probabilities of default and confidence levels for the non-life business line (in m€)

	PD = 0.5%			**PD=0.1%**		
α →	**75%**	**90%**	**99%**	**75%**	**90%**	**99%**
EU, funding needs under home, with portfolio transfer	580	1 559	6 577	86	282	1 660
EU, funding needs under home, compensation only (including unearned premiums)	441	1 178	4 919	66	214	1 242
Relative difference	-23.89%	-24.46%	-25.22%	-23.50%	-24.17%	-25.15%

1.4 Comparison of policy options for the EU

Figure 0.40: Total insurance sector, comparison of different policy options for the EU total; the top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



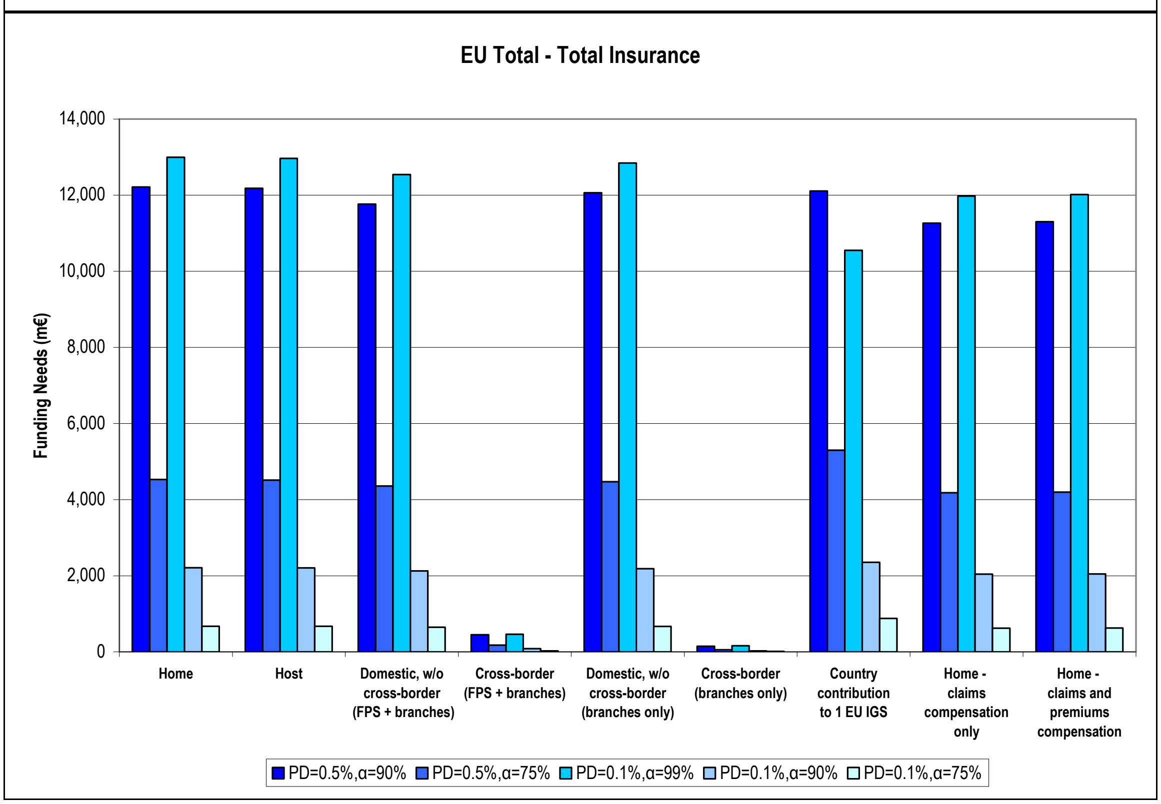
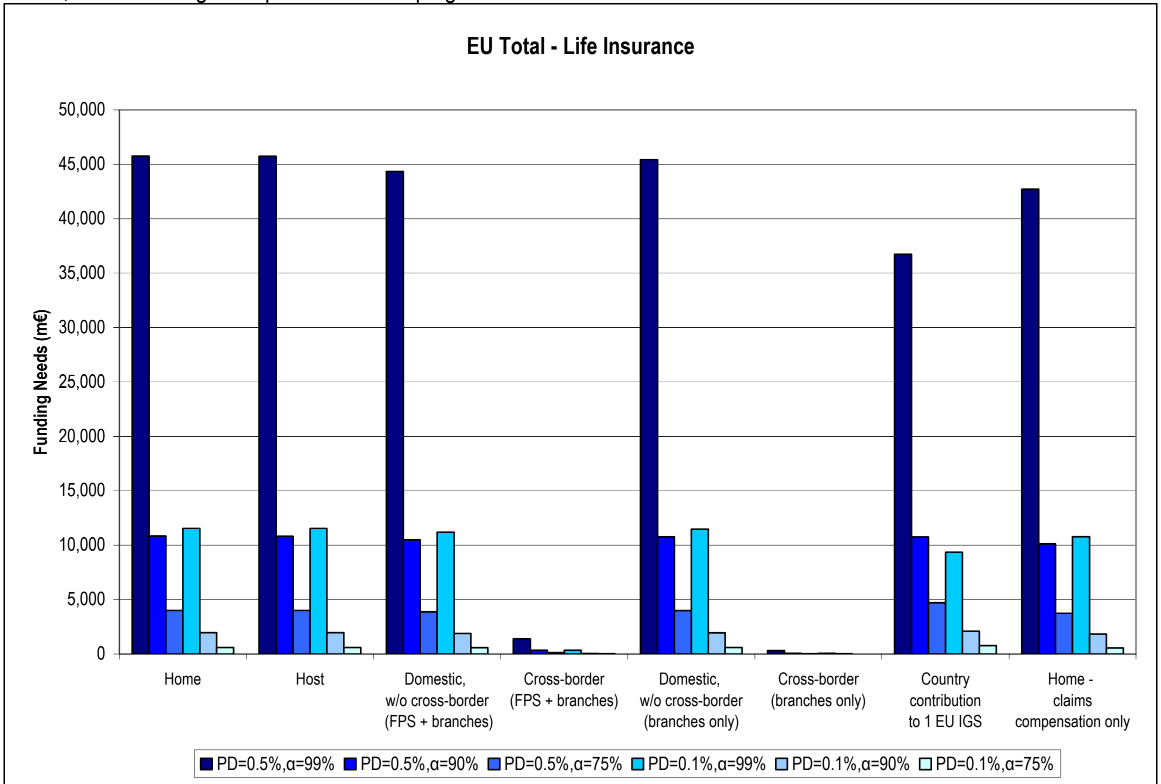


Figure 0.41: Life insurance, comparison of different policy options for the EU total. The top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%



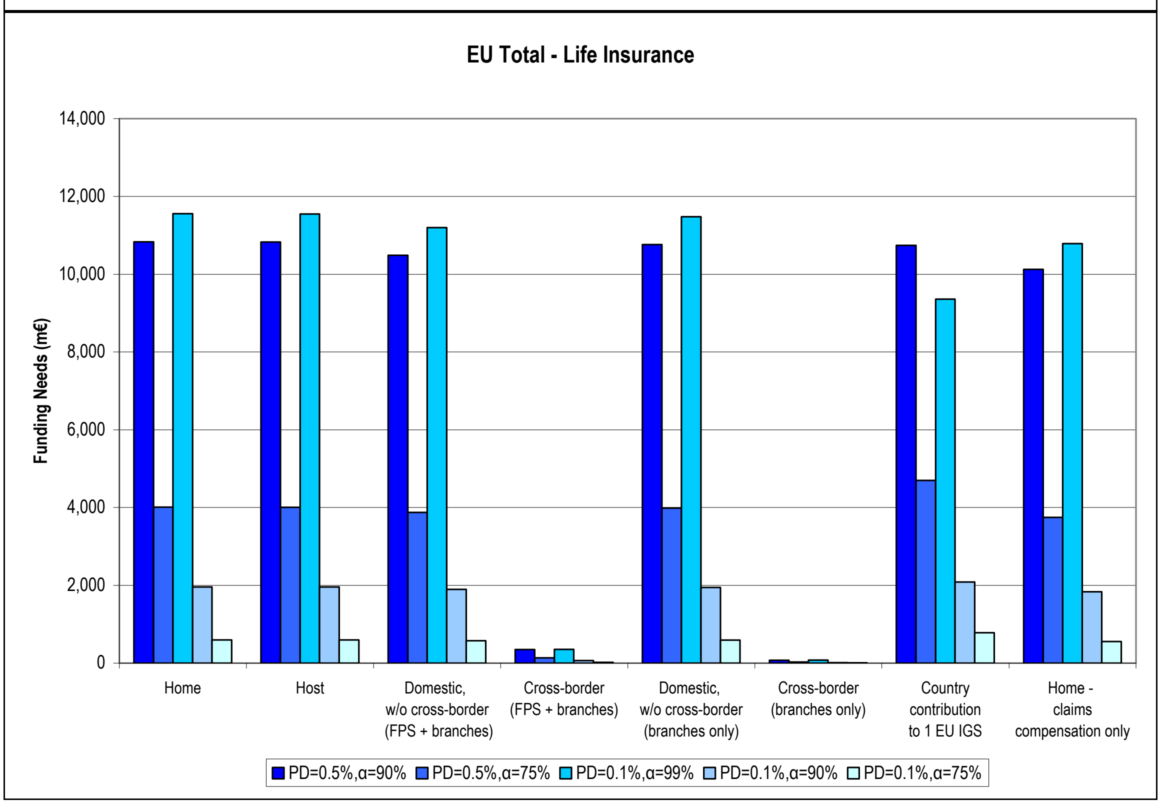
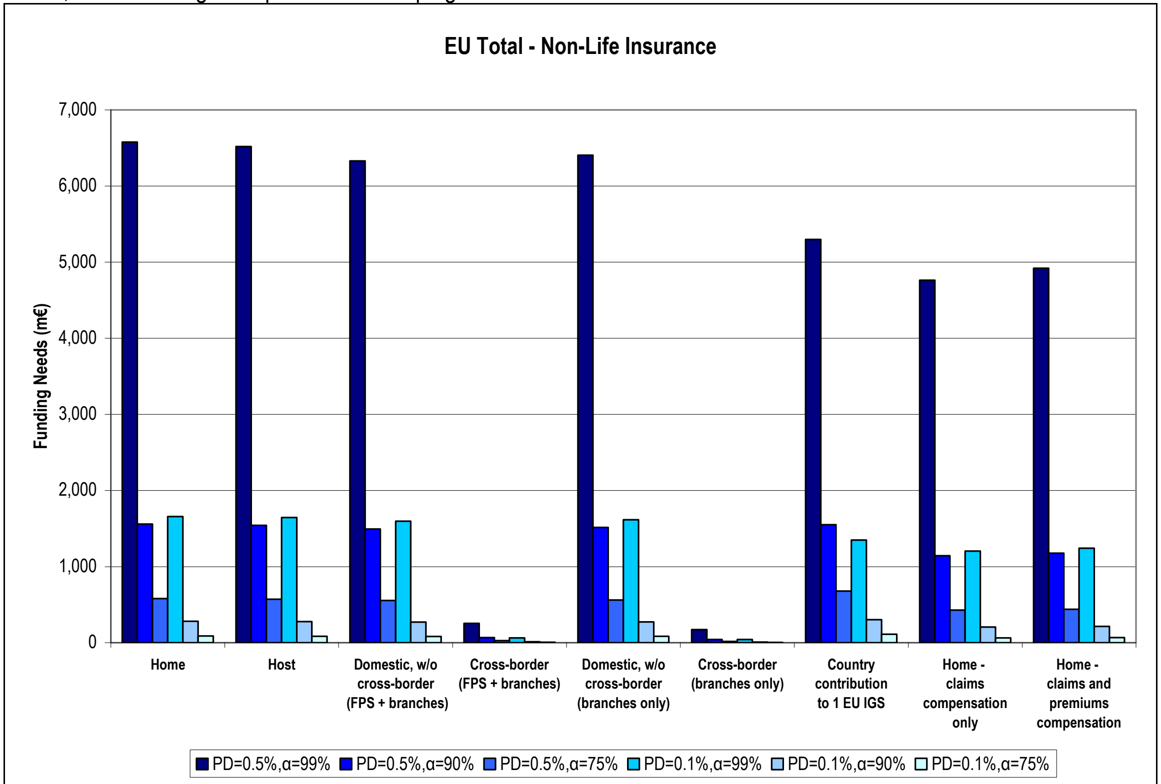
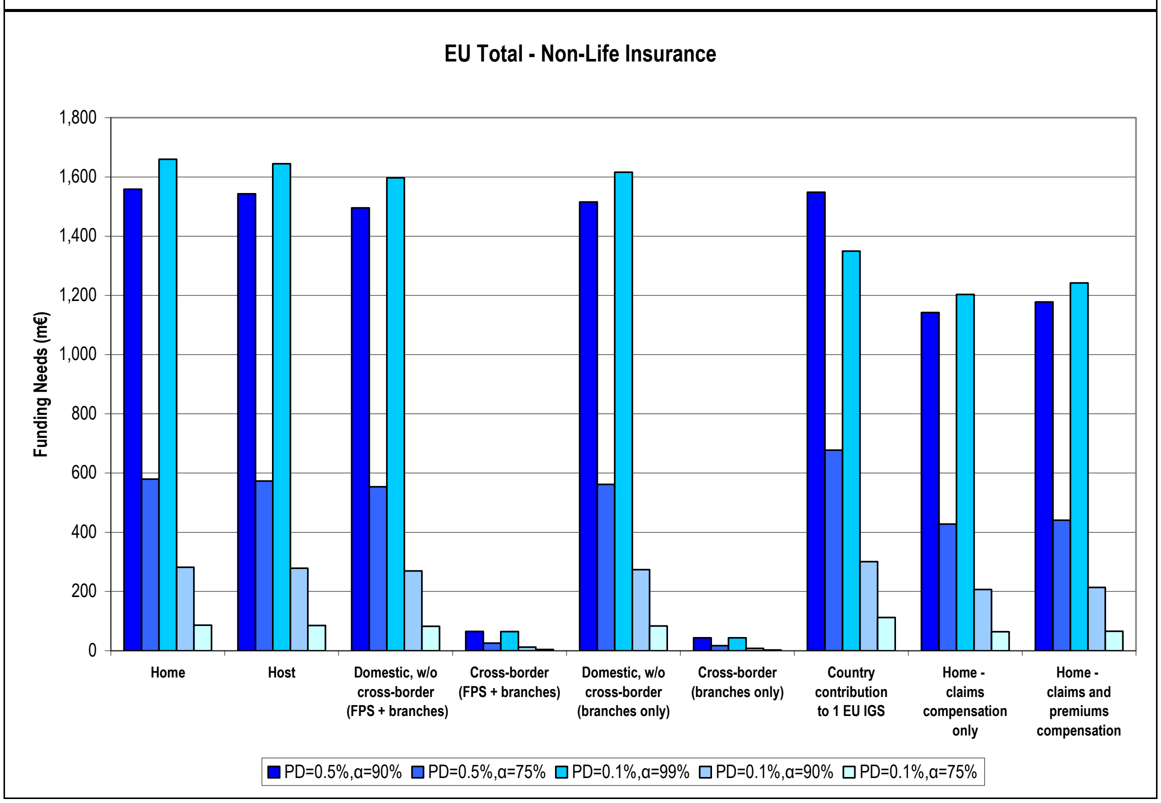


Figure 0.42: Non-life insurance, comparison of different policy options for the EU total. The top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and α=99%





Annexes

A1 Derivation of the Vasicek portfolio default model (Error! Reference source not found.)

A Merton-type one-factor model of credit risk was employed. The Merton model assumes that a company defaults if the value V_i of its assets is below the value of its liabilities at a predefined horizon[3]. Within this framework, the owner of the firm can then be seen as holding a ‘put’ option on the assets of the firm with a selling price equal to the total of its non-equity liabilities[4]. The distribution of the value of non-equity liabilities at the end of the period can therefore be calculated using the option-pricing theory developed by Black, Scholes, and Merton.
As in the standard Black-Scholes-Merton model a geometric Brownian motion is assumed to drive the dynamics of the firm’s value. Consequently, the logarithmic difference of the asset returns between time 0 and horizon *H*, formally written as $\ln(V_{iH}/V_{i0}) = Z_i$, follows a normal distribution.
Under these assumptions, the firm defaults when this logarithm (or, more conveniently, its standardised value V) falls below threshold L. As the value of the firm in the Black-Scholes-Merton model is normally distributed, this implies that default occurs when

$$Z_i \leq L_i = N^{-1}(p),$$

where:
p is the probability of default (PD in the main text)
N(.) is the cumulative normal distribution function[5] and N^{-1} is the inverse of *N*, such that if $N(x)=a$, then $x = N^{-1}(a)$.

The main feature of the Vasicek version of the Merton model is the introduction of dependence on a common factor in the driving process of value when considering a portfolio of companies. The simplest set-up for this model is obtained by considering a single normally distributed common factor and a single correlation coefficient ρ for all companies in the portfolio. Under this assumption the value of the assets of any company can be seen as being driven by a combination of a common factor *Y* and an idiosyncratic factor X_i with the result that the default condition is given by

$$Z_i = Y\sqrt{\rho} + X_i\sqrt{1-\rho} \leq L_i = N^{-1}(p).$$

This representation makes it possible to calculate a stressed default probability by considering the distribution of Z_i when the systemic factor *Y* is not average, or $Y \neq 0$. This stressed default probability, designated *PD**, can thus be written as follows:

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3 An alternative interpretation is that the firm defaults if the value of the firm falls below zero. In the current framework the development of the model is identical in both cases. The only difference is that in the second case X has to be interpreted as the net value of assets and the default threshold L is set at zero.
4 In other words, if the value of assets falls below the value of liabilities, the owner of the firm can ‘exercise the option’ by defaulting and ‘selling’ the firm’s assets to the creditors. The ‘price’ paid by the creditors for acquiring the assets is the value of their outstanding credits.
5 $N(x)=P(\mathbf{X}<x)$ where x is a specific value of the random variable $\mathbf{X}$ and $P(.)$ stands for probability.

$$PD^* = P(Z_i < L \mid Y) = P(\sqrt{\rho}Y + \sqrt{1-\rho}X_i < L \mid Y).$$

If L is replaced by $N^{-1}(p)$ in the equation above, the following is obtained:

$$PD^* = P(\sqrt{\rho}Y + \sqrt{1-\rho}X_i < N^{-1}(p)).$$

Isolating the firm-specific factor (X_i) on the left-hand side, PD^* can be written as:

$$PD^* = P\left(X_i < \frac{N^{-1}(p) - \sqrt{\rho}Y}{\sqrt{1-\rho}} \right).$$

Given that $P(X_i < a) = N(a)$, the equation can be rewritten as:

$$PD^*(Y) = N\left(\frac{N^{-1}(p) - \sqrt{\rho}Y}{\sqrt{1-\rho}} \right).$$

This $PD^*(Y)$ indicates, for any company, the probability that default could occur under the given scenario of $Y = N^{-1}(1-\alpha)$, where $(1-\alpha)$ is the probability that the common factor will take a value lower than Y.
To obtain the loss distribution function for the portfolio, start by considering that:

$$PD^* = P(F_i = 1 \mid Y).$$

where F_i is a random variable equal to 1 if the insurer defaults and 0 otherwise.
The total loss on the portfolio, expressed as a share between 0 and 1 (i.e. 0% to 100%), can be obtained as:

$$F = \sum_{i=1}^{n} F_i / n.$$

Conditional on the value of Y, the variables F_i are independent equally distributed variables with finite variance. Applying the law of large numbers, the loss of the whole insurance market conditional on Y converges to its expectation $PD^*(Y)$ as n goes to infinity. Or:

$$P(F \le x) = P\left(\sum_{i=1}^{n} F_i / n \le x \right) = P\left(PD^*(Y) \le x\right).$$

The probability that a loss smaller than x% will be incurred in a large portfolio can be written as[6]:

$$P(F \le x) = N\left(\frac{\sqrt{1-\rho}N^{-1}(x) - N^{-1}(p)}{\sqrt{\rho}} \right).$$

[6] This result is obtained relying on the fact that the common factor is normally distributed.

Inverting this formula provides, for each possible probability α, the corresponding 'Value at Risk' *x* of the loss which is not going to be exceeded with probability α:

$$\alpha = P(F \le VaR_\alpha) \Leftrightarrow VaR_\alpha = N\left(\frac{\sqrt{\rho}N^{-1}(\alpha) + N^{-1}(p)}{\sqrt{1-\rho}}\right).$$

This gives only the percentage loss; the real loss can then be obtained by multiplying this share by the EAD and the asset shortfall (LGD).
The result above is obtained under the assumptions that the insurance market is equally distributed and that the law of large numbers can be applied. Vasicek (2002) proposes an adjustment to take into consideration the market granularity of insurance companies. He proposes replacing ρ by ρ+δ(1-ρ) which leads to **Error! Reference source not found.** where δ is the quadratic sum of the weights and the weights are defined as the ratio of the size of each insurance company to the total market size.

A2 Estimation of the EAD of a defaulting insurance company

An insurance undertaking facing expected estimated liabilities TP_0 and solvency capital requirement SCR_0 at time t_0 will be taken as an example, starting by considering the case of continuation of the portfolio.

The insurance undertaking can be hit by one of several kinds of shocks at t_1 that could trigger its default.

1. A shock due to incurring a 'market' risk, resulting in a fall in the value of its assets to below the technical provisions;
2. A shock due to incurring an 'underwriting' risk for a particular business line (e.g. life, non-life, health, etc.), resulting in an increase in the amount of technical provisions to above the value of its assets;
3. A shock due to incurring an 'operational risk', where, due to errors or malpractice, the technical provisions turn out to be undervalued or assets turn out to be overvalued in such a way that the real value of assets is lower than the real value of the technical provisions;
4. A shock due to incurring a 'counterparty risk', where, due to the default of a counterparty (e.g. a reinsurer), the value of the technical provisions needs to be updated and will then exceed the value of the undertaking's assets.

In the case of a shock due to incurring a market risk, liabilities remain constant and the exposure at default can therefore be estimated as equal to liabilities before the shock:

$$EAD = TP_0 + SCR_0.$$

Equation A2.1

In the case of a shock due to incurring an underwriting risk, the value of liabilities increases. The exposure at default is therefore estimated by considering the value of liabilities after the shock[7] $TP_1 = TP_0+SCR_0$ and adding an extra term equal to the SCR that the insurer would need in order to operate when facing this new level of liabilities. The estimated value of the EAD in this case is:

$$EAD = TP_1 + SCR_1 = \left(TP_0 + SCR_0\right) + SCR_1.$$

Equation A2.2

By considering SCR_1 as directly proportional to TP_1[8], equation A2.2 can be rewritten as:

$$EAD = \left(TP_0 + SCR_0\right) + SCR_0 \frac{TP_1}{TP_0} = \left(TP_0 + SCR_0\right)\left(1 + \frac{SCR_0}{TP_0}\right).$$

Equation A2.3

This procedure can be used to estimate the EAD in the case of shocks due to incurring any kind of underwriting risk and also in the cases of shocks due to incurring

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7 The increase can not be easily estimated. As the SCR is the best current estimate of unexpected losses, it is assumed that the increase will stay below this value.

8 $SCR_1 \approx TP_1 \times SCR_0 / TP_0$.

counterparty or operational risk, as they all basically imply a revision of the value of liabilities[9].
As the value of the EAD would depend on which kind of shock is incurred, the expected EAD can be calculated as the weighted average of the EADs that would result from all types of shocks, the weights reflecting the relative importance of the operational, counterparty, market and underwriting risks, as measured by the relative sizes of the corresponding components of the SCR:

$$w_M = \frac{SCR_M}{\sum_{i=OP,CP,M,NL,L,H} SCR_i} \quad ; \quad w_j = \frac{SCR_j}{\sum_{i=OP,CP,M,NL,L,H} SCR_i} \qquad for \quad j = OP, CP, L, NL, H.$$

Consequently, the expected EAD is given as:

$$EAD = w_M \left(TP_0 + SCR_0\right) + \left(\sum_{j=OP,CP,NL,L,H} w_j\right)\left(TP_0 + SCR_0\right)\left(1 + \frac{SCR_0}{TP_0}\right),$$

which can be written as:

$$EAD = TP_0 + SCR_0\left(2 - w_M + \left(1 - w_M\right)\frac{SCR_0}{TP_0}\right).$$

Equation A2.5

In cases where continuation of the portfolio is not contemplated (i.e. the scheme follows a pure compensation logic), the terms relating to replenishment of the SCR can be ignored. In addition, as all policies will be considered to terminate at the time of default, in the non-life line the exposure will need to be rescaled in proportion to the share of premiums which have been earned. This leads to the following formula for the EAD:

$$EAD = \left(w_M \left(TP_0\right) + \sum_{j=OP,CP,NL,L,H} w_j \left(TP_0 + SCR_0\right)\right)\frac{Tot\pi_0 - U\pi_0}{Tot\pi_0},$$

which can be simplified to:

$$EAD = \left(TP_0 + (1 - w_M)SCR_0\right)\frac{Tot\pi_0 - U\pi_0}{Tot\pi_0},$$

Equation A2.6

where
$Tot\pi_0$ is the total premium written at $t_{0;\ \text{and}}$
$U\pi_0$ is the unearned premium at t_0.

In cases where reimbursement of unearned premiums is contemplated, the EAD becomes:

[9] A different procedure for estimation of the EAD in these two cases was considered to lead to a very small increase in precision, while introducing considerable additional complexity.

$$EAD = \left(TP_0 + (1 - w_M)SCR_0\right)\frac{Tot\pi_0 - U\pi_0}{Tot\pi_0} + U\pi_0.$$

Equation A2.7

The case of life insurance rescaling the exposure by the share of earned premiums would be appropriate only for the term life insurance, but as this normally makes up only a very small share of premiums the EAD for Life insurance in the pure compensation case is calculated using the formula:

$$EAD = \left(TP_0 + (1 - w_M)SCR_0\right).$$

Equation A2.8

A3 Questions and answers on the Vasicek portfolio model used for estimation of IGS loss distribution

A3.1 Is using a geometric Brownian motion for the assets process appropriate?

Yes. Use of the diffusion process is an ‘industry standard’ for portfolio default risk modelling. In the literature on insurance, a generalised geometric Brownian motion process, like the one characterising the Merton model (Merton 1974) and the Vasicek portfolio credit risk model (Vasicek 1991; Vasicek 2002), has been employed to calculate the value of IGS guarantees in the USA (Chang, Dong, and Yu 1998; Lindset and Persson 2008; Duan and Yu 2005). This method is also used to represent the process driving the value of a bank’s assets in the literature on the valuation of DGS guarantees (Merton 1977; Kuritzkes, Schuermann, and Weiner 2005).

A3.2 Could a stochastic liabilities process be introduced?

Not at this stage. Although liabilities could be modelled as a stochastic process, and this would make to the model more generally applicable, it would, however, add to the complexity and require additional data (Chang, Dong, and Yu 1998; Cummins 1998; Lindset and Persson 2008; Alvarez 2009). Given that, provided the correct parameters are chosen, the same default intensity can be obtained from models with and without stochastic liabilities and considering the current operational and time constraints, modelling stochastic liabilities was not considered a priority.

A3.3 Why not use a compound Poisson process driving liabilities for the IGS?

In order to limit the complexity of the model and to be able to estimate parameters with the limited data available. A standard representation in actuarial literature of the process driving the liabilities of an individual insurance undertaking to policyholders is based on a compound Poisson distribution (see e.g. Dickson 2005 and references therein). For large numbers of relatively frequent homogeneous claims this distribution can be approximated by a normal distribution (Dickson 2005). Introducing this approximation allows use of geometric Brownian motion for the liabilities process and, consequently, use of Merton-type models, which admit closed formula solutions and limited data for estimation of their parameters. This kind of approach therefore seems desirable in cases where a rapid assessment based on limited data is required, whereas a full model could be preferred in cases where greater precision is needed and data to estimate the model are available.

A3.4 Should the model allow for the fact that the duration of insurance undertakings’ assets and liabilities can be very different from one business line to another?

No, what matters is the duration of the exposures of the IGS to the insurers, which are all identical. In the Vasicek portfolio credit risk model it is assumed that companies make a decision to default or to stay in business at the end of each period of model time. As the default event is the trigger for intervention by an IGS, the maturity of all exposures off the IGS to the companies is therefore identical and equal to the length of this decision or review period. This kind of framework is adopted in the literature both for valuation of IGS guarantees (Chang, Dong, and Yu 1998; Lindset and Persson 2008) and for valuation of DGS guarantees (Merton 1977; Kuritzkes, Schuermann, and Weiner 2005).

A3.5 Is the Vasicek portfolio model appropriate to represent the default process of a portfolio of insurance companies?

Yes. The Vasicek portfolio model is used in one form or another to represent portfolio default processes in a wide range of settings in different industries and enterprise class sizes. From QIS4 of the Solvency II method of calculation of the under-writing solvency capital margin (CEIOPS 2008b, para. TS.X.A.13-20) requires insurers to include a module for risk of default by their reinsurers, using the Vasicek model for quantification.

A3.6 Why a granularity adjustment?

Granularity adjustment avoids underestimation of loss variability. In fact, as the standard form of the Vasicek model relies on an asymptotic approximation to obtain its analytical solution, the main consequence of ignoring granularity in the portfolio is that part of the residual 'idiosyncratic risk' which is not diversified in a small portfolio is ignored and that, in the case of portfolios dominated by a few large exposures, the variance of the losses could be under-estimated.

Vasicek (Vasicek 2002) tackles this problem by introducing a 'correction term' based on the squared sum of the shares of exposures in the portfolio. This is also applied in the estimations in this report. This approach has sometimes been criticised as not fully precise (Huang, Oosterlee, and Mesters 2007) for determining prudential capital requirements. The literature proposes a variety of solutions (Emmer and Tasche 2005; Wilde 2001; Federov 2009; Gordy and Lütkebohmert 2007) and the gain in precision as a result off introducing these additional terms has been measured by several authors (Huang, Oosterlee, and Mesters 2007; Gurtler, Heithecker, and Hibbeln 2006). Their results seem to imply that for portfolios of a few dozen exposures the error incurred by ignoring any granularity correction terms, while large (relative errors of between 2% and 30% compared with the Vasicek asymptotic version), could still be tolerable in a first rapid assessment of the magnitudes involved.

A3.7 Would it not be better to use Monte Carlo simulations, instead?

No, given the extremely high data and computational requirements of a Monte Carlo approach in proportion to the current needs and operational constraints.

While it is true that a full computational solution for the portfolio VaR can be made by Monte Carlo simulations (See e.g. Huang, Oosterlee, and Mesters 2007; Laurent 2008), this approach is computationally demanding and its precision depends directly on the quality of the inputs (i.e. the structure of exposures and estimated parameters of the model). Consequently, it can offer a significant improvement only when large and precise amounts of data are available and ease and speed of computation are considered to be less important than the resulting gain in precision.

A3.8 How is the loss given default parameter chosen? Should it be stochastic?

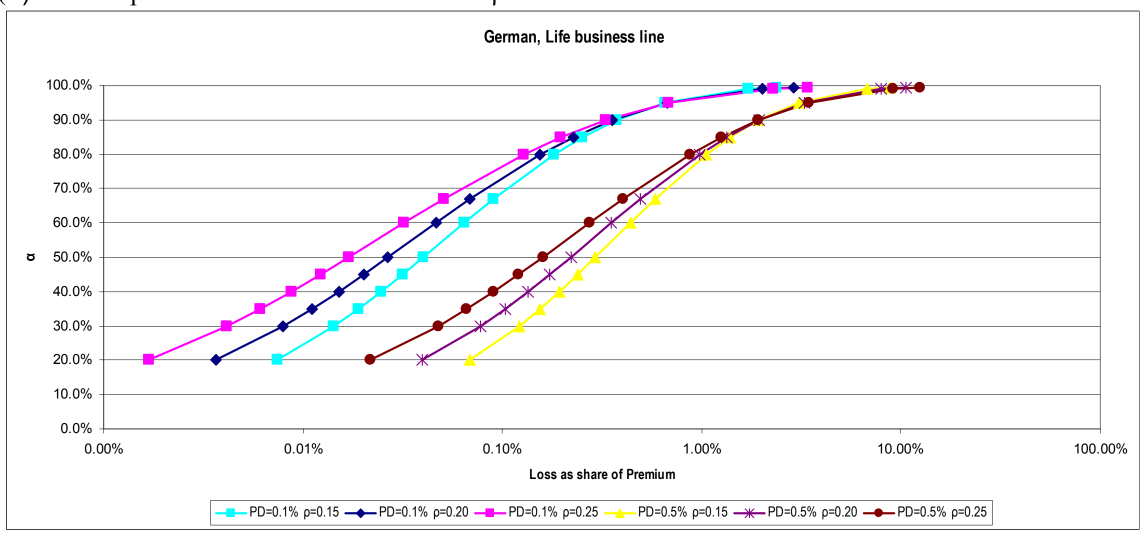
Loss given default is currently set at 15% in order to make the results from this model comparable with the results presented in Oxera's IGS report (Oxera 2007, 102). A comparison with a value of 45%, as suggested in the Basel II foundation IRB credit risk module, was made but is not included in the tables as these figures can be obtained simply by multiplying the current results by 3.

The possibility of using different or even random LGD terms is discussed in the literature, which presents solutions tying the LGD to systemic risk factors (see e.g. Kupiec 2007 and references therein). This additional precision could be obtained only at the cost of a relatively heavy additional burden in terms of data needs and model complexity, which does not seem justified given the needs and operational constraints of the White Paper Impact Assessment.

A3.9 How is the correlation coefficient chosen?

The value of ρ, the correlation coefficient has been set at 20% in line with the Basel II IRB foundations credit risk model recommendations. This estimate also lies at the upper bound of the sectoral default correlation coefficients provided by Demey et al. (2004, fig. E), which range from 0.136 to 0.178 for the one-factor model. Moody's KMV surveys this literature and presents some methods for estimating of this parameter (Zhang, Zhu, and Lee 2008 and references therein) but an independent estimation is not compatible with the current needs and operational constraints.
For completeness, Figure A3.1 presents a comparison of the effect of ρ in the German life insurance business. Along the x-axis, the loss as a share of the total Life premium is presented on a logarithmic scale. The y-axis shows the probability of not exceeding a given level of loss. The curves indicate loss functions obtained under different combinations of ρ and PD.

Figure A3.1: Effect of the correlation coefficient in the case off the German life insurance business. Horizontal axis: loss as a share of premiums. Vertical axis: probability of not exceeding any level of loss (α). Lines represent different combinations of ρ and PD



A3.10 How is the probability of default decided and is it realistic to employ a single average probability of default across EU markets?

The model is currently evaluated using two different probabilities of default: 0.1% and 0.5% per annum. The first is extracted from implied default probabilities recovered from the insurance companies' bonds' credit ratings as indicated in the Oxera report (Oxera 2007, 102). The second is the maximum probability of default which should be attained in the Solvency II framework and therefore marks an upper boundary to the probability distribution of defaults.
Different average probabilities of default could be used for different insurance markets or even within the same market. However, both these options would require substantial additional data, which might not even be available for some companies and markets, and, eventually, the introduction of additional complexity to the model.

A3.11 Why are the technical provisions adjusted?

The technical provisions are currently calculated under Solvency I which leaves Member States considerable freedom to impose an obligation on companies to include country-specific safety loadings. This way some countries will have higher technical provisions than others, as they include components calculated on the basis of different actuarial tables and levels of prudence. Differences between Member States in the calculations of the safety margins should diminish once capital requirements are calculated in the Solvency II framework.

In order to reduce any bias due to these differences in current practices the technical provisions have been adjusted by multiplying them by the ratio of current technical provisions to QIS4 capital requirements reported in the QIS4 results document.

A3.12 Is the model able to evaluate all possible proposed policy options?

Mostly yes. The Merton-Vasicek model can be used to evaluate all options which result in a variation of the model parameters. Currently, the biggest limits to estimation of the loss function associated with most policy options are the quantity and quality of the data available. Given the current data limitations, this means that at this time the model can be used to evaluate all options for which reliable quantification of the exposure at default is possible.

A3.13 Is it possible to evaluate all policy options based on the currently available data?

No, the publicly available data allows the estimation of a limited number of policy options, and even then only by employing some assumptions on the structure of markets and the allocation of technical provisions. Additional data would be necessary for a more precise estimation of high level policy options and for the evaluation of lower-level policy options.

A3.14 If the model cannot evaluate all policy options under currently available data would it not be simpler to use a scenario analysis and problem definition technique based on descriptive statistics?

Not really, as the data needs for the two approaches are basically identical. The Merton-Vasicek model used in the version adopted is very parsimonious and can produce estimates of the loss function from the same kind of data which would be needed for a detailed problem definition and scenario analysis. Descriptive statistics relating to most currently available data can be found in the Oxera report (Oxera, 2007).

A4 Robustness indicators and comparison of ex-ante and ex-post contributions in the case of very large defaults

For some countries the only available information on the market concentration was the number of active business players. No precise data on the size of the largest market players were found. In those cases all players were considered identical and default of the 'largest player' means default of one of the identical market participants. Those countries have been marked with an asterisk (*).

A4.1 Robustness indicators in the case of very large defaults

These tables present indicators showing how an IGS based on the obtained funding needs (column G) would cope with default of the largest market player in each country.

Table A4.1 Life insurance, ratios of calculated funding needs to the expected loss and to potential losses of the largest player

Input data	Total EAD	Total premium	δ	% of largest company	Total premium excluding the largest company	EAD of the largest company	Funding needs under δ, PD=0.1%,α=90%	Expected loss =EAD*LGD*PD	Ratio= funding needs (δ, PD=0.1%, α=90%)/expected loss	Loss for largest failure under LGD=15%	Max LGD in order to cover largest failure	Percentage of largest loss covered with funding needs (δ, PD=0.1%, α=90%)	Funding needs under δ=0,PD=0.1%,α=90%	Ratio= funding needs (δ=0, PD=0.1%, α=90%)/ expected loss	Percentage of largest loss covered by funding needs (δ=0, PD=0.1%, α=90%)
	A	B	C	D	E	F	G	H=A*15%*0.1%	I=G/H	J=F*15%	K=G/F	L=G/J	M	N=M/H	O=M/J
AT	58 188	7 141	0.12	24.27%	5 408	14 120	18.85	8.73	2.16	2 118	0.13%	0.89%	21.34	2.44	1.01%
BE	168 163	22 179	0.14	21.77%	17 351	36 610	53.32	25.22	2.11	5 491	0.15%	0.97%	61.67	2.44	1.12%
BG	203	120	0.12	24.45%	91	50	0.07	0.03	2.16	7	0.13%	0.88%	0.07	2.44	1.00%
CY	2 717	358	0.18	26.37%	263	717	0.79	0.41	1.93	107	0.11%	0.73%	1.00	2.44	0.93%
CZ	6 544	2 034	0.15	31.79%	1 387	2 080	2.04	0.98	2.08	312	0.10%	0.65%	2.40	2.44	0.77%

DE	765 180	75 170	0.05	9.29%	68 187	71 085	271.23	114.78	2.36	10 663	0.38%	2.54%	280.62	2.44	2.63%
DK	118 090	13 190	0.07	15.29%	11 174	18 051	41.28	17.71	2.33	2 708	0.23%	1.52%	43.31	2.44	1.60%
EE	509	118	0.33	48.41%	61	247	0.09	0.08	1.24	37	0.04%	0.26%	0.19	2.44	0.51%
ES	164 938	23 455	0.05	9.78%	21 162	16 125	58.40	24.74	2.36	2 419	0.36%	2.41%	60.49	2.44	2.50%
FI	37 099	2 784	0.21	30.65%	1 931	11 372	9.96	5.56	1.79	1 706	0.09%	0.58%	13.61	2.44	0.80%
FR	1 189 627	136 528	0.08	16.58%	113 893	197 230	407.08	178.44	2.28	29 584	0.21%	1.38%	436.27	2.44	1.47%
GB	2 034 005	305 184	0.06	9.13%	277 312	185 763	712.24	305.10	2.33	27 864	0.38%	2.56%	745.93	2.44	2.68%
GR	7 630	2 504	0.10	18.16%	2 049	1 385	2.56	1.14	2.23	208	0.18%	1.23%	2.80	2.44	1.35%
HU*	5 282	2 017	0.05	4.55%	1 925	240	1.88	0.79	2.38	36	0.78%	5.23%	1.94	2.44	5.38%
IE	147 444	37 563	0.08	18.54%	30 600	27 331	50.55	22.12	2.29	4 100	0.18%	1.23%	54.07	2.44	1.32%
IS	147	34	0.35	44.61%	19	66	0.03	0.02	1.14	10	0.04%	0.25%	0.05	2.44	0.55%
IT	389 126	61 438	0.11	25.97%	45 483	101 050	128.59	58.37	2.20	15 158	0.13%	0.85%	142.70	2.44	0.94%
LT	525	204	0.12	24.03%	155	126	0.17	0.08	2.16	19	0.13%	0.90%	0.19	2.44	1.02%
LU*	76 571	10 093	0.02	1.75%	9 916	1 343	27.84	11.49	2.42	202	2.07%	13.82%	28.08	2.44	13.94%
LV	83	53	0.28	40.69%	31	34	0.02	0.01	1.46	5	0.05%	0.36%	0.03	2.44	0.60%
MT	1 293	214	0.20	20.00%	171	259	0.36	0.19	1.86	39	0.14%	0.93%	0.47	2.44	1.22%
NL	266 317	26 437	0.11	22.23%	20 560	59 205	87.45	39.95	2.19	8 881	0.15%	0.98%	97.67	2.44	1.10%
NO	79 468	9 838	0.23	33.12%	6 580	26 318	20.28	11.92	1.70	3 948	0.08%	0.51%	29.14	2.44	0.74%
PL	17 059	6 743	0.18	38.35%	4 157	6 542	4.96	2.56	1.94	981	0.08%	0.51%	6.26	2.44	0.64%
PT	40 297	9 205	0.14	21.56%	7 220	8 689	12.64	6.04	2.09	1 303	0.15%	0.97%	14.78	2.44	1.13%
RO*	781	415	0.05	4.76%	396	37	0.28	0.12	2.37	6	0.75%	4.98%	0.29	2.44	5.13%
SE	191 510	12 985	0.10	16.48%	10 844	31 569	63.97	28.73	2.23	4 735	0.20%	1.35%	70.23	2.44	1.48%
SI	2 041	443	0.21	37.72%	276	770	0.55	0.31	1.79	115	0.07%	0.47%	0.75	2.44	0.65%
SK	2 299	848	0.14	26.18%	626	602	0.73	0.34	2.11	90	0.12%	0.80%	0.84	2.44	0.93%

Table. A4.2: Non-life insurance, ratios of calculated funding needs to the expected loss and to potential losses of the largest player

Input data	Total EAD	Total premium	δ	% of largest company	Total premium excluding the largest company	EAD of the largest company	Funding needs under δ, PD=0.1%,α=90%	Expected loss =EAD*LGD*PD	Ratio= funding needs (δ, PD=0.1%, α=90%)/expected loss	Loss for largest failure under LGD=15%	Max LGD in order to cover largest failure	Percentage of largest loss covered with funding needs (δ, PD=0.1%, α=90%)	Funding needs under δ=0,PD=0.1%,α=90%	Ratio= funding needs (δ=0, PD=0.1%, α=90%)/ expected loss	Percentage of largest loss covered by funding needs (δ=0, PD=0.1%, α=90%)
	A	B	C	D	E	F	G	H=A*15%*0.1 %	I=G/H	J=F*15%	K=G/F	L=G/J	M	N=M/H	O=M/J
AT	10 984	5 851	0.14	23.05%	4 502	2 532	3.45	1.65	2.09	380	0.14%	0.91%	4.03	2.44	1.06%
BE	19 236	5 707	0.09	16.60%	4 759	3 194	6.52	2.89	2.26	479	0.20%	1.36%	7.05	2.44	1.47%
BG*	212	234	0.05	4.76%	223	10	0.08	0.03	2.37	2	0.75%	4.98%	0.08	2.44	5.13%
CY	344	173	0.07	15.90%	146	55	0.12	0.05	2.32	8	0.22%	1.46%	0.13	2.44	1.54%
CZ*	1 877	1 304	0.02	2.17%	1 276	41	0.68	0.28	2.42	6	1.67%	11.12%	0.69	2.44	11.25%
DE	248 637	69 579	0.05	8.94%	63 356	22 238	88.22	37.30	2.37	3 336	0.40%	2.64%	91.18	2.44	2.73%
DK*	10 074	5 114	0.01	0.85%	5 070	86	3.68	1.51	2.44	13	4.27%	28.50%	3.69	2.44	28.60%
EE	101	75	0.25	36.11%	48	37	0.02	0.02	1.63	5	0.07%	0.45%	0.04	2.44	0.68%
ES	50 081	19 198	0.06	18.26%	15 692	9 147	17.59	7.51	2.34	1 372	0.19%	1.28%	18.37	2.44	1.34%

FI	7 888	1 920	0.20	27.57%	1 391	2 175	2.20	1.18	1.86	326	0.10%	0.67%	2.89	2.44	0.89%
FR	168 067	49 297	0.07	13.90%	42 443	23 370	58.23	25.21	2.31	3 505	0.25%	1.66%	61.64	2.44	1.76%
GB	103 562	46 243	0.07	16.31%	38 701	16 891	36.10	15.53	2.32	2 534	0.21%	1.42%	37.98	2.44	1.50%
GR	1 693	1 032	0.05	14.62%	882	247	0.60	0.25	2.37	37	0.24%	1.62%	0.62	2.44	1.67%
HU*	340	712	0.03	2.63%	693	9	0.12	0.05	2.41	1	1.37%	9.16%	0.12	2.44	9.29%
IE*	13 425	3 865	0.01	0.60%	3 842	80	4.91	2.01	2.44	12	6.11%	40.73%	4.92	2.44	40.83%
IS*	650	189	0.17	16.67%	158	108	0.19	0.10	2.00	16	0.18%	1.20%	0.24	2.44	1.47%
IT	32 622	17 014	0.13	22.21%	13 236	7 244	10.43	4.89	2.13	1 087	0.14%	0.96%	11.96	2.44	1.10%
LT*	157	122	0.06	5.56%	115	9	0.06	0.02	2.36	1	0.64%	4.24%	0.06	2.44	4.40%
LU*	3 558	1 014	0.03	2.50%	989	89	1.29	0.53	2.41	13	1.45%	9.65%	1.30	2.44	9.78%
LV*	191	171	0.08	7.69%	158	15	0.07	0.03	2.30	2	0.45%	2.99%	0.07	2.44	3.18%
MT	589	240	0.13	16.14%	201	95	0.19	0.09	2.12	14	0.20%	1.31%	0.22	2.44	1.51%
NL	82 629	43 725	0.09	20.17%	34 906	16 665	28.06	12.39	2.26	2 500	0.17%	1.12%	30.30	2.44	1.21%
NO	7 803	2 341	0.21	38.00%	1 451	2 965	2.13	1.17	1.82	445	0.07%	0.48%	2.86	2.44	0.64%
PL	3 490	1 890	0.24	46.60%	1 009	1 626	0.87	0.52	1.65	244	0.05%	0.36%	1.28	2.44	0.52%
PT	4 992	2 356	0.14	32.62%	1 587	1 628	1.56	0.75	2.09	244	0.10%	0.64%	1.83	2.44	0.75%
RO*	646	629	0.03	3.03%	610	20	0.23	0.10	2.40	3	1.19%	7.94%	0.24	2.44	8.07%
SE	53 695	7 331	0.16	25.06%	5 494	13 454	16.26	8.05	2.02	2 018	0.12%	0.81%	19.69	2.44	0.98%

SI	1 455	803	0.2 4	38.49%	494	560	0.37	0.22	1.70	84	0.07%	0.44%	0.53	2.44	0.64%
SK	496	313	0.2 3	39.29%	190	195	0.13	0.07	1.70	29	0.06%	0.43%	0.18	2.44	0.62%

A4.2 Comparison of contributions necessary to cover large defaults in ex-ante and ex-post systems

These tables show the magnitude of the ex-ante or ex-post contributions that would be needed in order to obtain sufficient funds to cover the default of the largest market player in each country.

Table A4.3 Comparison of contributions in ex-ante and ex-post systems for the life insurance business line

Input data	Total premium	EAD	Market share of largest company	Funding needs (δ, PD=0.1% and α=90%)	Largest single loss	Contribution in an ex-ante system after failure of the largest company	Contribution in an ex-post system after failure of the largest company	Ratio between ex-post and ex-ante in case of the largest failure
	A	B	C	D	E=B*C*15 %	F=D/A	G=min(D E)/[A*(1-B)]	H=G/F
AT	7 141.00	58 187.84	24.27%	18.85	2 117.93	0.26%	0.35%	132.04%
BE	22 179.00	168 162.62	21.77%	53.32	5 491.50	0.24%	0.31%	127.83%
BG	120.42	202.87	24.45%	0.07	7.44	0.05%	0.07%	132.35%
CY	357.50	2 716.86	26.37%	0.79	107.48	0.22%	0.30%	135.82%
CZ	2 034.00	6 544.28	31.79%	2.04	312.04	0.10%	0.15%	146.60%
DE	75 170.13	765 180.21	9.29%	271.23	10 662.79	0.36%	0.40%	110.24%
DK	13 189.98	118 090.18	15.29%	41.28	2 707.70	0.31%	0.37%	118.04%
EE	118.00	509.34	48.41%	0.09	36.98	0.08%	0.16%	193.82%
ES	23 455.00	164 938.20	9.78%	58.40	2 418.82	0.25%	0.28%	110.84%
FI	2 784.00	37 099.21	30.65%	9.96	1 705.75	0.36%	0.52%	144.20%
FR	136 528.00	1 189 627.49	16.58%	407.08	29 584.48	0.30%	0.36%	119.87%
GB	305 184.22	2 034 004.57	9.13%	712.24	27 864.42	0.23%	0.26%	110.05%
GR	2 504.06	7 629.83	18.16%	2.56	207.78	0.10%	0.12%	122.18%
HU*	2 016.65	5 281.69	4.55%	1.88	36.01	0.09%	0.10%	104.76%
IE	37 563.00	147 444.31	18.54%	50.55	4 099.66	0.13%	0.17%	122.75%
IS	34.23	147.34	44.61%	0.03	9.86	0.07%	0.13%	180.54%
IT	61 438.00	389 126.42	25.97%	128.59	15 157.57	0.21%	0.28%	135.08%
LT	203.99	525.43	24.03%	0.17	18.94	0.08%	0.11%	131.63%
LU*	10 092.82	76 570.61	1.75%	27.84	201.50	0.28%	0.28%	101.79%
LV	53.00	82.78	40.69%	0.02	5.05	0.03%	0.06%	168.61%
MT	214.00	1 292.66	20.00%	0.36	38.78	0.17%	0.21%	125.00%
NL	26 437.00	266 316.57	22.23%	87.45	8 880.76	0.33%	0.43%	128.59%
NO	9 838.00	79 467.87	33.12%	20.28	3 947.70	0.21%	0.31%	149.52%
PL	6 743.20	17 058.98	38.35%	4.96	981.34	0.07%	0.12%	162.21%
PT	9 205.00	40 297.22	21.56%	12.64	1 303.30	0.14%	0.18%	127.49%
RO*	415.45	781.27	4.76%	0.28	5.58	0.07%	0.07%	105.00%
SE	12 985.00	191 510.40	16.48%	63.97	4 735.41	0.49%	0.59%	119.74%
SI	443.28	2 041.27	37.72%	0.55	115.49	0.12%	0.20%	160.56%

SK	847.59	2 299.01	26.18%	0.73	90.30	0.09%	0.12%	135.47%

Table.A4.4 Comparison of contributions in ex-ante and -ex-post systems for the non-life insurance business line

Input data	Total premium	EAD	Market share of largest company	Funding needs (δ, PD=0.1% and α=90%)	Largest single loss	Contribution in an ex-ante system after failure of the largest company	Contribution in an ex-post system after failure of the largest company	Ratio between ex-post and ex-ante in case of the largest failure
	A	B	C	D	E=B*C*15 %	F=D/A	G=min(D E)/[A*(1-B)]	H=G/F
AT	5 850.86	10 984.27	23.05%	3.45	379.80	0.06%	0.08%	129.96%
BE	5 706.63	19 236.29	16.60%	6.52	479.11	0.11%	0.14%	119.91%
BG*	233.70	211.73	4.76%	0.08	1.51	0.03%	0.03%	105.00%
CY	173.18	343.98	15.90%	0.12	8.21	0.07%	0.08%	118.91%
CZ*	1 304.03	1 876.67	2.17%	0.68	6.12	0.05%	0.05%	102.22%
DE	69 578.72	248 636.54	8.94%	88.22	3 335.71	0.13%	0.14%	109.82%
DK*	5 113.56	10 074.03	0.85%	3.68	12.92	0.07%	0.07%	100.86%
EE	75.15	101.31	36.11%	0.02	5.49	0.03%	0.05%	156.51%
ES	19 198.32	50 080.78	18.26%	17.59	1 372.05	0.09%	0.11%	122.35%
FI	1 920.20	7 888.49	27.57%	2.20	326.19	0.11%	0.16%	138.06%
FR	49 297.45	168 067.18	13.90%	58.23	3 505.44	0.12%	0.14%	116.15%
GB	46 242.77	103 561.51	16.31%	36.10	2 533.59	0.08%	0.09%	119.49%
GR	1 032.46	1 692.82	14.62%	0.60	37.12	0.06%	0.07%	117.12%
HU*	711.62	340.02	2.63%	0.12	1.34	0.02%	0.02%	102.70%
IE*	3 865.05	13 424.93	0.60%	4.91	12.06	0.13%	0.13%	100.60%
IS*	189.05	649.57	16.67%	0.19	16.24	0.10%	0.12%	120.00%
IT	17 014.37	32 622.31	22.21%	10.43	1 086.66	0.06%	0.08%	128.55%
LT*	121.78	157.33	5.56%	0.06	1.31	0.05%	0.05%	105.88%
LU*	1 014.04	3 557.75	2.50%	1.29	13.34	0.13%	0.13%	102.56%
LV*	171.45	191.35	7.69%	0.07	2.21	0.04%	0.04%	108.33%
MT	239.97	588.97	16.14%	0.19	14.26	0.08%	0.09%	119.25%
NL	43 724.84	82 628.50	20.17%	28.06	2 499.79	0.06%	0.08%	125.26%
NO	2 340.88	7 803.20	38.00%	2.13	444.78	0.09%	0.15%	161.29%
PL	1 890.35	3 489.57	46.60%	0.87	243.93	0.05%	0.09%	187.27%
PT	2 355.95	4 991.67	32.62%	1.56	244.26	0.07%	0.10%	148.42%
RO*	629.05	646.22	3.03%	0.23	2.94	0.04%	0.04%	103.13%
SE	7 330.79	53 694.52	25.06%	16.26	2 018.13	0.22%	0.30%	133.43%
SI	803.13	1 455.39	38.49%	0.37	84.02	0.05%	0.07%	162.56%
SK	313.04	495.97	39.29%	0.13	29.23	0.04%	0.07%	164.71%

A5 Tables relativing to all policy options tested

See additional document.

A6 Comparison of policy options by country

See additional document.

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