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METHODOLOGICAL REPORT

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

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Introduction

Insurance guarantee schemes (IGS) provide last-resort protection for policyholders and other beneficiaries when insurers are unable to fulfil their contractual commitments. IGSs offer protection against the risk that claims will not be met in the event of failure of an insurance undertaking by paying compensation or by securing continuation of the contract.

In its Communication of 4 March 2009 'Driving European recovery', the Commission stressed the need to reinforce the protection of consumers. It stressed in particular that additional measures are needed to reinforce depositor, investor and insurance policyholder protection. The Communication stated that an effective and comprehensive legal framework for retail financial services needs to be put in place and that, among other moves, the Commission would therefore review, in the beginning of 2010 the adequacy of existing guarantee schemes in the insurance sector and make appropriate legislative proposals.

To this end, the Commission intends to adopt a White Paper on IGSs by the beginning of this year. The White Paper will set out a possible European solution for IGSs and propose appropriate follow-up measures. In line with the better regulation agenda, the White Paper will be accompanied by an impact assessment (IA).

In this context, Unit H2 'Insurance and Pensions' of the Internal Market and Services Directorate-General asked the Joint Research Centre to support the impact assessment process by providing scientific expertise.

In response Unit G09 'Econometrics and Applied Statistics' of the Joint Research Centre, in cooperation with Unit MARKT-H2, developed the methodology presented in this report and used it to conduct a quantitative assessment of several of the policy options considered for inclusion in the White Paper.

In order to provide data in timely fashion to the other services of the Commission, the results presented in the report are based exclusively on publicly available data, allowing estimation of results under several high-level policy options by employing some simplifying assumptions. More precise estimates and results referring to lower-level policy options could be performed depending on the availability of additional data.

It should be noted that the methodology proposed takes into consideration the fact that introducing IGSs in the EU context means establishing a new prudential tool in a field already subject to solvency prudential requirements for insurance undertakings and in which the Solvency II measures are also going to be introduced in the near future. Consequently, the IA methodology will take into account, wherever possible, the features of current and future prudential regulation and make use of data gathered in the evaluation exercises aimed at assessing the impact of the introduction of Solvency II.

The rest of this report is organised as follows. The first section proposes the methodology for the IA exercise: estimation of loss distributions for IGSs based on a default risk model. The second section analyses the data available and the derivation of the input parameters. It also presents the current best parameter settings. The third section presents the results and compares them with: the results provided in the Oxera report, actual fund sizes and data on past failures as reported by Oxera. The fourth section compares the results obtained under different policy options. The final section contains all the annexes.

Motor insurance falls outside the scope of this report and is therefore not included in the figures on non-life and total insurance.

1 Problem definition and methodology

1.1 *Protection offered by insurance guarantee schemes and its costs*

Insurance guarantee schemes (IGS) provide last-resort protection for policyholders and other beneficiaries in case an insurance company becomes insolvent and is unable to meet its claims. IGS can offer protection in two main ways:

1. by compensating policyholders/beneficiaries or,
2. by securing continuation of the insurance portfolio.

The IGS protection can also be limited to specific subsets of policyholders and/or be subject to other limits, for example on the amounts of the protected claims, the location of the risk or insurance contract or the nationality of the underwriting insurer.

In order to provide protection, the IGS must gather funds from market players on either an ex-ante or an ex-post basis. The size of the funds collected depends on the yearly expected losses that can be caused by the default of one or more insurance undertakings and on the extent of protection provided.

The expected costs of an insurers' insolvency over a certain period (one year in this report) depend on three main factors:

1. The average **probability of default** (PD) over the period considered;
2. The **exposure at default** (EAD), which is the average maximum amount of a company's liabilities to claimants, beneficiaries and insured;
3. The **loss given default** (LGD), which is the average shortfall of assets over liabilities or the share of the exposure which it is not possible to recover from the defaulting company's assets.

Combination of these three components yields a very simple formula for determining the expected amount:

$$\text{Expected Costs of Insolvencies} = LGD \times EAD \times PD$$

Equation 1.1

This formula can also be used to calculate expected losses within an insurance market if all insurers are assumed to be identical and defaulting independently from each other. However, such an approach does not provide any information on the possible variation on the size of defaults or on the probability associated to defaults of different sizes.

Information on the distribution of losses from insurance defaults is indeed necessary in order to assess the effective level of risk to which the public is exposed and take decisions on the desired level of protection.

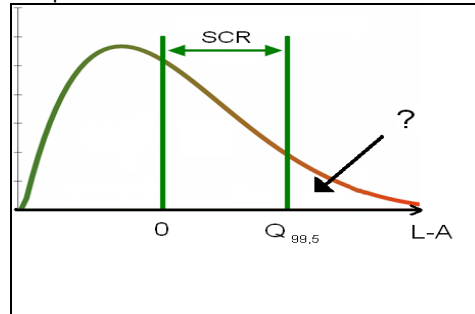
In particular, as IGS funds constitute a cost, a trade-off will be faced between cost and protection. A decision will therefore need to be taken on the maximum loss which could be covered by an IGS, based on the cost of funds and the probability of occurrence of such a loss. Therefore, in order to be able to take decisions on the desired amount of funds, it is necessary to estimate the distribution of the losses an IGS might suffer. The distribution of losses that can hit the IGS then makes it possible to calculate the amount of funds it would need to collect in order to cover all losses incurred with a chosen probability level.

1.2 *Calculating the IGS loss distribution*

In order to know the distribution of the losses generated by the default of a single undertaking, the distribution of the difference between the undertaking's liabilities and assets would need to be known.

Computing the distribution of losses in case of default in the Solvency II framework would imply knowing the distribution of the difference between liabilities and assets conditional on the fact that this value exceeds the SCR (Solvency Capital Requirements). This in turn calls for estimation of the tail of the 'liabilities – assets' distribution lying beyond the 99.5 percentile for each insurance company covered by the IGS (see Figure 1.1).

Figure 1.1: Example of distribution of 'liabilities-assets' and the role of SCR



Therefore, if we could reliably estimate the tails of these distributions and their correlation factors, we could obtain the complete distribution of IGS losses. It is, however, very difficult to estimate the tails of these distributions, as it requires highly complex actuarial models dealing with risks and losses stemming from extreme events plus precise data at individual company level.

As we are interested only in the total loss distribution of an IGS and not in the losses of the individual undertakings, it is possible to include some simplifying assumptions which allow direct estimation of the IGS loss distributions without any need to estimate the individual loss distributions.

The first simplification that can be introduced deals with the size of the losses: by considering average rather than individual increases in expected liabilities it is possible to introduce a limit on the maximum increase in the expected liabilities faced by an insurer (see Annex 2 for details). By introducing this simplification, the EAD can be estimated as a function of the capital requirements on the current date.

Focusing on an EAD calculated in this way frees the IGS loss distribution calculation problem of complications linked to estimation of the tails of the individual loss distribution. Also, the EAD of the IGS to a defaulting insurer can be obtained on the basis of information easily available at this time.

The IGS loss distribution calculation problem can then be seen as that of calculating the losses on a portfolio of exposures to a number of insurance undertakings. This, in turn, makes it possible to build on the extensive work on portfolio loss theory developed in the literature on financial risk management.

Various well-established portfolio models are available. However, for familiarity and diffusion reasons in the prudential regulation context, a natural choice is to pick the Merton-Vasicek model¹. The Merton-Vasicek model is one of the most widely applied tools for quantitative financial risk management. It is routinely used to assess default portfolio risk across a variety of business sectors, including insurance, and forms the basis for the derivation of the FIRB Basel II formula.

This methodology allows easy calculation of the IGS loss distribution on the basis of a formula² giving the maximum loss which should not be exceeded in one year under any given probability level α^3 , an amount known as the 'Value at Risk (α)':

¹ The Vasicek model is based on the Merton model of firm default, which has been used in the literature to calculate the loss distributions and funding needs of American IGSs.

² The derivation of Equation 1.2 is illustrated in Vasicek, 2002, 'The distribution of loan portfolio value', published in *Risk*. The model can also be solved computationally if the whole structure of the exposures is known.

$$VaR_{\alpha} = EAD \times LGD \times N \left(\frac{N^{-1}(1-\alpha) \sqrt{\rho + \delta(1-\rho)} + N^{-1}(PD)}{\sqrt{1-\rho - \delta(1-\rho)}} \right)$$

Equation 1.2

where:

- EAD is 'Exposure At Default' or the maximum amount for which the guarantor could be exposed towards the defaulting company;
 - LGD is 'Loss Given Default' or the percentage of the loss which will effectively be incurred on the exposure once the rate of recovery from remaining assets of the defaulting company has been taken into account;
 - α is the confidence level, or the probability of not facing a loss larger than VaR_{α} ;
 - N and N^{-1} are the normal distribution and the inverse normal distribution respectively;
 - ρ is the correlation coefficient with the 'systematic' risk factor ;
 - δ is a correction term to take into account the fact that the portfolio is made up of a discrete number of relatively large exposures and not of a very large number of identical small exposures. This correction term is called a 'granularity adjustment' and is calculated as the sum of the squares of the shares of all exposures in the portfolio; and
 - PD is the average probability of default of any insurance undertaking over the period considered.
- By letting the confidence level vary in the formula presented in Equation 1.2 the loss corresponding to each confidence level can be computed, obtaining a distribution of losses. An example of the shape of this 'Vasicek distribution' for different values of α and other parameters is given in Table 1.1.

Table 1.1: Example of the shape of the Vasicek distribution of losses under different parameters

	Input parameters ($\rho=0.2$)					
	PD=0.1%			PD=0.5%		
	$\delta=0$	$\delta=0.1$	$\delta=0.3$	$\delta=0$	$\delta=0.1$	$\delta=0.3$
	Loss not exceeded with probability α , expressed as share of total exposure					
$\alpha=70\%$	0.07%	0.05%	0.01%	0.44%	0.34%	0.15%
$\alpha=95\%$	0.42%	0.44%	0.38%	1.98%	2.22%	2.36%
$\alpha=99\%$	1.10%	1.42%	1.93%	4.30%	5.65%	8.38%
$\alpha=99.5\%$	1.51%	2.09%	3.24%	5.57%	7.65%	12.33%
$\alpha=99.9\%$	2.81%	4.32%	8.22%	9.10%	13.38%	24.11%
$\alpha=99.99\%$	5.53%	9.30%	20.24%	15.38%	23.69%	44.21%
$\alpha=99.999\%$	9.30%	16.30%	36.35%	22.74%	35.35%	63.24%

The version of the Vasicek model presented above is one of its simplest forms. Many more detailed variants of the model are presented in the literature, but this particular form was chosen to combine the advantages of limited data needs with those of scientific rigour and acceptability. In fact, it is easy to see that, when the correlation factor and the market granularity adjustment are both set to zero, Equation 1.2 reduces to the elementary formula presented in Equation 1.14:

$$VaR = EAD \times LGD \times PD$$

³ Strictly speaking, α is defined as a confidence level. This means that, for any α , the model output is the smallest value such that losses will exceed it with a probability no larger than $1-\alpha$ over the reference period.

⁴ Here the VaR has no confidence level as the distribution is degenerate and concentrated in the single point.

which is also used in the Oxera report and is based on the implicit assumptions that default events are completely uncorrelated and that the exposure is made up of an extremely large number of very small companies.

What the Vasicek model does, therefore, is to provide a probability distribution of losses by taking into consideration the fact that in the real world the exposure can be concentrated and defaults can be correlated.

A more detailed description of model assumptions and how they relate to insurance undertakings can be found in Annex A3.

1.3 Estimation of the exposure at default

As discussed in the previous section, by considering the average maximum joint exposure rather than individual exposures it is possible to derive a formula for determining the exposure at default⁵ which depends solely on known values rather than on estimation of the tail of the individual loss distributions.

The best estimate for the exposure of an insurance company to claimants and policy holders is given by the Technical Provisions (TP) including the risk margin.⁶

However, consideration must be given to the fact that, in the event of default due to a miscalculation of the risk margins, the exposure could be higher than the current level of technical provisions (see, e.g., the Mannheimer case described on page 89 of the 2007 Oxera report and Annex A3).

Moreover, in cases where 'continuation of the contracts' or 'portfolio transfer' are pursued, rather than pure compensation of outstanding claims, the prudential viability of the portfolio must be reconstructed⁷.

For these reasons, in order to estimate the average maximum exposure at default, it is necessary to include additional terms proportional to solvency capital requirements, which offer the best estimate of the additional capital required in case the technical provisions are exhausted.

Therefore, for cases in which continuation of the portfolio is desired, the formula for estimation of the exposure at default to be used is (for derivations see Annex A2):

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

Equation 1.3

where:

- TP_0 are the adjusted technical provisions at the current date⁸;

- SCR_0 is the solvency capital requirement at the current date; and

- w_M is the ratio of the solvency capital requirement for market risk to the total SCR⁹.

In cases of a pure compensation of the claimants and beneficiaries with exclusion of the unearned premiums, the EAD for non-life insurance is estimated as:

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

Equation 1.4

⁵ More precisely, the actual amount of funds needed at the end of the IGS intervention is given by the EAD x LGD where the loss given default is calculated as one minus the ratio of remaining assets over liabilities. In this report LGD is assumed to be 15%. For further details of the reasons of this choice see section 2.2.1 and Annex A3.

⁶ The technical provisions are the amounts set aside for the liabilities and to meet the insurer's commitments under the contracts.

⁷ This applies in the case that ALL existing policies will remain covered until their original contractual expiry date. In cases where some insurance policies are allowed to be discontinued at the time of default, only the viability of the 'surviving' part of the original portfolio will have to be secured.

⁸ See Annex A3.

⁹ A detailed explanation of how the SCR and its components are computed in the Solvency II framework is available in the document 'QIS4 Technical Specifications (MARKT/2505/08)'.

where

$U\pi_0$ are the unearned premiums at the current date;

$Tot\pi_0$ are the total written premiums at the current date;

and the other abbreviations have the same meaning as in Equation 1.3.

In cases of pure compensation including the unearned premiums, the EAD for non-life insurance is considered to be:

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

Equation 1.5

where:

all abbreviations have the same meaning as in Equation 1.3.

Finally, in the case of a pure compensation option in life insurance the formula for determining the EAD is given as:

$$EAD = TP_0 + (1 - w_m)SCR_0$$

Equation 1.6

2 Input analysis

Motor insurance falls outside the scope of this report and is therefore not included in the figures on non-life and total insurance.

2.1 *Input parameters*

Based on Equation 1.2, the loss distribution of the insurance sector can be estimated knowing five parameters:

- 1- the average probability of default for each undertaking in the portfolio (ρ);
- 2- the correlation between defaults (ρ);
- 3- the loss given default incurred on the exposures in case of default (LGD);
- 4- the total potential exposure at default of the covered undertakings (EAD);
- 5- the granularity (concentration) of exposures in the portfolio of covered undertakings (δ).

Moreover, as adopting a certain set of policy options over another would determine a difference in the value of some of the parameters (e.g. a different exposure or a different concentration in the portfolio of IGS exposures), loss distributions corresponding to different policy choices can be obtained.

The loss distributions can then be used to calculate funding needs associated with any desired confidence level and form a basis for guiding policy-makers in choosing the coverage level desired.

2.2 *Available data and parameter estimation*

In this report the aim is to produce approximate figures based on publicly available aggregate data. The results based on these figures, while not immediately usable for policy implementation, should none the less be precise enough to add detail to previous work on the subject (such as the Oxera report). They offer guidance the first phase of the discussion and provide cross-checks against previously proposed quantifications of potential IGS losses.

By relying on publicly available aggregate data (i.e. data from CEIOPS, CEA and the OECD¹⁰), it is possible to estimate a loss function based on the home country responsibility principle, under the additional assumption that the national market structure is a good proxy for the structure of exposures based on home country responsibility. Under some additional assumptions, the data currently available also allow estimation of the loss function for a pan-EU IGS and loss functions for the host country responsibility principle.

As data on the structure of claims are lacking, it is not possible to evaluate loss functions under limits on reimbursement amounts in this phase: it is therefore assumed that all claims will be fully repaid. By employing some restrictive proportionality assumptions, it will instead be possible to

¹⁰ CEIOPS refers to the statistical annex to the 'Report on Financial Conditions and Financial Stability in the European Insurance and Occupational Pension Fund Sector 2007-2008 (Risk Update)' by CEIOPS (<http://www.ceiops.eu/media/files/publications/reports/SA-Insurance-2007.xls>), QIS4 to the selected tables from the CEIOPS report on its Fourth Quantitative Impact Study (QIS4) for Solvency I (<http://www.ceiops.eu/media/files/consultations/QIS/CEIOPS-SEC-82-8%20QIS4%20Report%20Table%20Annex.pdf>) and CEA to 'Tables from European Insurance in Figures (2007 Data)' (http://www.cea.eu/uploads/DocumentsLibrary/documents/1225184978_eif-2006_fix.xls)

calculate loss distributions for the cases in which portfolio continuation is chosen and in which a pure compensation option is pursued (with or without consideration of unearned premiums). Finally, it is possible to obtain the joint loss function and the separate loss functions for the life and non-life business lines, again under some assumption of proportionality.

2.2.1 Calibration of the default probability, correlation and loss given default

The EAD and the 'granularity adjustment' (δ) can be recovered from aggregate data and are discussed below in subsections 2.2.2 and 2.2.3. The remaining parameters are chosen to be in line with the relevant literature and the Oxera report (see Annex A3 for details). In some cases several choices are explored:

- the default probability p is set at values of 0.5% (the maximum allowed under Solvency II) and 0.1% (the value consistent with default insurance ratings obtained by Oxera);
- the correlation parameter ρ is kept fixed at 0.2 for both business lines, in line with the literature;
- the loss given default is fixed at 15% (in line with the Oxera report).

If the asset shortfall were increased to 45% (in line with the Basel II foundation guidelines), the resulting funding needs would equal three times the funding needs under the asset shortfall of 15%.

2.2.2 Estimation of the EAD

Table 2.1 shows, step-by-step, the calculations used to obtain the EAD from the publicly available data; the results for France are given as an example. The example presented here focuses on the case where the loss distribution is calculated based on the home state principle, portfolio continuation and full coverage. This corresponds to the case where the EAD is calculated in accordance with Equation 1.3. The calculations provide results for the total insurance sector, as well as for the life and non-life business lines separately.

In the calculation three main parts can be identified:

1. the calculation relating to the gross premiums written by business line (rows A to I);
2. the calculations relating to the technical provisions (rows J to V);
3. the calculations relating to the term for the additional capital requirements as presented in Equation 1.3, including SCR (rows W to AL).

The first part of the calculation aims to quantify the share of composite companies activities' in the life and non-life business lines, as the information provided by CEIOPS divides companies into three mutually exclusive categories: companies active only in the life business, companies active only in the non-life business and composite companies, with both activities. The 'Market' column indicates the reference business line used for the calculations in each row: 'Total' means total activities in the whole insurance sector; 'Total Life' and 'Total Non-Life' refer to total activities in the life and non-life business lines, respectively; 'Pure Life Companies' and 'Pure Non-Life Companies' mean the activities of companies engage in only life or non-life business (i.e. activities of composite companies are excluded).

Next, technical provisions are calculated by using CEIOPS data (rows J to M). As the technical provisions reported in CEIOPS tables are calculated under the Solvency I settings they need to be adjusted to correspond to technical provisions under QIS4 by applying the ratio of the QIS4 provisions to Solvency I provisions. For countries where this ratio is not available a simple average by business line across all other countries is calculated, while the ratio for the total insurance business (not provided in the QIS4 report) is obtained by taking the weighted average between life and non-life business with weights proportional to the size of their premiums.

The calculations for the SCR are slightly more complicated. The only absolute number available refers to the total eligible QIS4 capital and is presented only for the total insurance sector and for companies which responded to the QIS4 questionnaire. This number is expanded to represent also non respondents by multiplying it by the rate of response in terms of total premiums. Next, by using the solvency ratio, the current SCR (SCR_0) can be obtained for the total insurance sector in each Member State. SCR_0 can then be split up between the different business lines based on their shares of total gross premiums.

SCR_0 is then used to calculate the additional capital requirement as specified in the last term of Equation 1.3, which is referred to in the table as SCR_{total} . All the information necessary for this part can be obtained from Tables 77 and 78 in the Annex of selected tables in the QIS 4 Report. Plugging them into the formula, the second term of Equation 1.3 is obtained in rows AG to AJ of the table for the different business lines. Splitting this between life and non-life and adding the technical provisions lead to the EAD for the total insurance sector, for the non-life business line and for the total life business line.

Table 2.1: Detailed Calculation of EAD for France (rows Δ and A to V)

Label	Parameters	Market	Source	France
Δ	Share of Motor in Non-Life	Total Non-Life	CEA	31.16%
A	Gross Premiums Written (m€)	Composite Companies	CEIOPS Sheet 2	112 409
B	Gross Premiums Written (m€)	Pure Life Companies	CEIOPS Sheet 2	37 667
C	Gross Premiums Written (m€)	Pure Non-Life Companies	CEIOPS Sheet 2	58 068
D	Gross Premiums Written (m€)	Total	CEIOPS Sheet 2	208 144
E	Gross Premiums Written (m€)	Total Life	CEIOPS Sheet 4	136 528
$F=(E-B)/A$	Gross Premiums Written (m€)	Total Life		87.95%
$G=1-F$	Share of Life Insurance in Composite Companies	Total Non-Life		12.05%
$H=B+F*A$	Share of Life Insurance in Composite Companies	Total Life		136 528
$I=(C+G*A)*(1-\Delta)$	Gross Premiums Written (m€)	Non-Life		49 297
J	Gross Technical Provisions (m€)	Composite Companies	CEIOPS Sheet 7	891 543
K	Gross Technical Provisions (m€)	Pure Life Companies	CEIOPS Sheet 7	311 323
L	Gross Technical Provisions (m€)	Pure Non-Life Companies	CEIOPS Sheet 7	121 027
M	Gross Technical Provisions (m€)	Total	CEIOPS Sheet 7	1 323 893
$N=K+F*J$	Gross Technical Provisions (m€)	Total Life		1 095 414
$O=(L+G*J)*(1-\Delta)$	Gross Technical Provisions (m€)	Non-Life		157 276
$P=N+O$	Gross Technical Provisions (m€)	Total		1 252 689
Q	Gross Technical Provisions (m€)	Total Life	QIS4	100.50%
R	TP_QIS4/TP_Soll	Non-Life	QIS4	81.05%
S	TP_QIS4/TP_Soll	Total	QIS4	93.81%
$T=N*Q$	TP_QIS4/TP_Soll	Total Life		1 100 891
$U=O*R$	Corrected TP (m€)	Non-Life		127 479
$V=P*S$	Corrected TP (m€)	Total		1 175 140

Table 2.1: Detailed Calculation of EAD for France (continued: rows W to AO)

W	Total Eligible Capital QIS4 (m€)	Total	QIS4-HOME	191 472
X	QIS4 Eligible Capital to SCR	Total	QIS4-HOME	2.51
Y	Market Share of Questionnaire QIS4	Total Life	QIS4-HOME	95.00%
Z	Market Share of Questionnaire QIS4	Total Non-Life	QIS4-HOME	79.40%
$AA=(Y*H+Z*I)/(H+I)$	Market Share of Questionnaire QIS4	Total		90.86%
$AB=W/AA$	Total Eligible Capital by MS (m€)	Total	QIS4-HOME	210 730
$AC=AB/X$	SCR ₀ (m€)	Total		83 822
$AD=AC*A/D$	SCR ₀ (m€)	Composite Companies		45 269
$AE=AC*B/D$	SCR ₀ (m€)	Pure Life Companies		15 169
$AF=AC*C/D$	SCR ₀ (m€)	Pure Non-Life Companies		23 385
			
AG	SCR _{total} (m€)	Composite Companies		68 827
AH	SCR _{total} (m€)	Pure Life Companies		29 444
AI	SCR _{total} (m€)	Pure Non-Life Companies		51 540
AJ	SCR _{total} (m€)	Total		170 768
$AK=AH+F*AG$	SCR _{total} (m€)	Total Life		89 976
$AL=(AI+G*AG)*(1-\Delta)$	SCR _{total} (m€)	Non-Life		41 188
$AM=T+AK$	EAD- Home State Principle (m€)	Total Life		1 190 866
$AN=U+AL$	EAD- Home State Principle (m€)	Non-Life		168 667
$AO=V+AJ$	EAD- Home State Principle (m€)	Total		1 345 909

CEA refers to 'European Insurance in Figures (2007 Data)' by CEA¹¹; CEIOPS refers to the statistical annex to the 'Report on Financial Conditions and Financial Stability in the European Insurance and Occupational Pension Fund Sector 2007-2008 (Risk Update)' by CEIOPS¹² and QIS4 to the selected tables from the CEIOPS report on its Fourth Quantitative Impact Study (QIS4) for Solvency II¹³.

2.2.3 Calculation of the market granularity

The granularity adjustment is calculated on a country basis and for each business line. It is based on the number of market players and their market shares. The granularity correction terms are estimated using data from CEA¹⁴ on the market shares for the top 5, top 10 and top 15 companies for the life and non-life business line at country level, together with data on the number of companies. Additionally, for several countries, detailed information on the first 5 companies in the life and non-life business lines is available.

A separate granularity correction coefficient is computed for the life and non-life business lines, while the coefficient for the total insurance sector is based on a weighted average of the coefficients for each business line.

As data for the top 5 companies are sometimes provided for each individual company and sometimes as an aggregate, for each country and business line the following approach has been used: in cases where the individual sizes of the top 5 companies are available, these will be used

¹¹ http://www.cea.eu/uploads/DocumentsLibrary/documents/1225184978_eif-2006_fix.xls

¹² <http://www.ceiops.eu/media/files/publications/reports/SA-Insurance-2007.xls>

¹³ <http://www.ceiops.eu/media/files/consultations/QIS/CEIOPS-SEC-82-08%20QIS4%20Report%20Table%20Annex.pdf>

¹⁴ Tables from European Insurance in Figures (2007 data):

http://www.cea.eu/uploads/DocumentsLibrary/documents/1225184978_eif-2006_fix.xls

directly to calculate their market share; in cases where individual data on market shares are not complete or absent, any available shares are subtracted from the total top 5 market share and the difference is equally split between the companies for which no data are available.

Similarly, in order to allocate a market share to all the top 10 companies, the market shares already allocated to the top 5 companies are deducted from the total market share of the top 10 and then the residual market share is split equally between the remaining five companies. The same approach is used for the other companies making up the top 15. For the remaining companies (up to the total number in the market), the market share not yet allocated to the top 15 companies is equally divided between them.

For several countries only the number of companies in the country is available but their market shares are unknown, hence the total market is equally divided between all companies¹⁵.

The granularity adjustment, δ , is then obtained by taking the sum of the squares of all market shares within each country and business line. A granularity factor of one corresponds to the case where a single company is present on the market, while the correction factor tends towards zero as the market structure tends towards the limit case where an infinite number of identical companies are operating on the market. Missing information will lead to an underestimate of granularity adjustment, especially in the cases where only the number of companies in the country is available.

2.2.4 Parameter values

The values of EAD, total premiums and δ based on the home state principle for each country and business line are summarised in Table 2.2. The values of the probability of default, ρ and LGD are constant across countries and business lines, as discussed in section 2.2.1, and set at 0.1% and 0.5%, 0.2 and 15% respectively. Total premiums are reported for comparison purposes.

¹⁵ This is the case for Hungary, Luxembourg and Romania for the life business line and for Bulgaria, the Czech Republic, Denmark, Hungary, Iceland, Ireland, Latvia, Lithuania, Luxembourg and Romania for the non-life business line.

Table 2.2: δ , EAD and total gross premiums written for the total insurance sector and by business line, all EEA countries, 2007

	Total			Life			Non-life		
	δ	EAD (m€)	Total gross premiums written (m€)	δ	EAD (m€)	Total gross premiums written (m€)	δ	EAD (m€)	Total gross premiums written (m€)
AT	0.13	67 554	12 992	0.12	58 188	7 141	0.14	10 984	5 851
BE	0.13	190 151	27 886	0.14	168 163	22 179	0.09	19 236	5 707
BG	0.07	392	354	0.12	203	120	0.05	212	234
CY	0.15	3 078	531	0.18	2 717	358	0.07	344	173
CZ	0.10	8 994	3 338	0.15	6 544	2 034	0.02	1 877	1 304
DE	0.05	1 006 801	144 749	0.05	765 180	75 170	0.05	248 637	69 579
DK	0.05	135 949	18 304	0.07	118 090	13 190	0.01	10 074	5 114
EE	0.30	569	193	0.33	509	118	0.25	101	75
ES	0.06	213 026	42 653	0.05	164 938	23 455	0.06	50 081	19 198
FI	0.21	44 020	4 704	0.21	37 099	2 784	0.20	7 888	1 920
FR	0.08	1 347 573	185 825	0.08	1 189 627	136 528	0.07	168 067	49 297
GB	0.07	2 092 219	351 427	0.06	2 034 005	305 184	0.07	103 562	46 243
GR	0.09	9 495	3 537	0.10	7 630	2 504	0.05	1 693	1 032
HU	0.04	5 887	2 728	0.05	5 282	2 017	0.03	340	712
IE	0.08	161 216	41 428	0.08	147 444	37 563	0.01	13 425	3 865
IS	0.19	795	223	0.35	147	34	0.17	650	189
IT	0.12	423 251	78 452	0.11	389 126	61 438	0.13	32 622	17 014
LI	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LT	0.10	643	326	0.12	525	204	0.06	157	122
LU	0.02	80 074	11 107	0.02	76 571	10 093	0.03	3 558	1 014
LV	0.13	269	224	0.28	83	53	0.08	191	171
MT	0.17	1 980	454	0.20	1 293	214	0.13	589	240
NL	0.10	313 024	70 162	0.11	266 317	26 437	0.09	82 629	43 725
NO	0.23	86 755	12 179	0.23	79 468	9 838	0.21	7 803	2 341
PL	0.19	20 855	8 634	0.18	17 059	6 743	0.24	3 490	1 890
PT	0.14	45 402	11 561	0.14	40 297	9 205	0.14	4 992	2 356
RO	0.04	1 468	1 044	0.05	781	415	0.03	646	629
SE	0.12	238 147	20 316	0.10	191 510	12 985	0.16	53 695	7 331
SI	0.23	3 897	1 246	0.21	2 041	443	0.24	1 455	803
SK	0.16	2 860	1 161	0.14	2 299	848	0.23	496	313
EU total ¹⁶	0.08	6 418 794	1 045 336	0.08	5 693 521	759 423	0.08	821 041	285 912

¹⁶ The EU row indicates the average δ (weighted average by total gross premiums written) and total EAD and premiums.

2.3 Data needed for improved estimation

The values of the parameters presented above, and used in this report, are based on publicly available data. The nature of this data implies that the estimation of some parameters has to rely on assumptions (e.g. some aggregated amounts are split proportionally to gross premiums written in each business line or market) and that some policy options cannot currently be evaluated as this would require additional disaggregated data.

In order to obtain more precise estimates, additional data would need to be gathered from other sources, such as supervisors or associations of insurers.

In order to try gathering such additional data, a questionnaire has been constructed in parallel with the development of the methodology: the questionnaire aims to collect specific data which would improve the precision of estimates, make available additional details for evaluation of different policy options and allow the generation of more detailed problem definition statistics.

Following consultation with the services, the questionnaire has been distributed to national associations of insurers in the second half of 2009. A report summarizing the main results of the questionnaire and the usability of the data gathered is presented together with this methodological report.

3 Model results

3.1 Selection of cases and policy options

As explained in the White Paper Impact Assessment and in the previous sections, the funding needs and the level of protection for any given IGS will depend on the policy options adopted for its operations.

Given the availability of data and the nature of the exercise, in this report the comparison will be limited to a set of high-level policy options.

In particular, throughout the rest of the analysis, the funding needs based on the loss distribution calculated on the basis of the home state principle, portfolio continuation and full coverage will be used as a baseline case.

Table 3.1 below summarises all the policy options used for the construction of the baseline case. Alternative sets of policy options and the associated funding needs will be discussed in Section 4.

3.2 IGS funding needs at selected probability levels (home state principle)

The initial results based on the proposed model and on the aggregate publicly available data are presented in this section. The model provides, for any given confidence level α , the Value at Risk (VaR_α) which is the maximum loss which should be expected with probability α . In other words, if an IGS holds this amount, it will be able to cover all losses in $\alpha\%$ for all years.

As holding capital and using funds to cover default losses is costly, the choice of α will depend on the trade-off chosen by the policymakers between additional security for consumers and higher costs for firms contributing to the fund. If the policymakers or supervisors would like to put in place a very prudent IGS, then a very high value for α (such as 99.9%) would be chosen, resulting in a very large funding needs and/or the possibility of involvement in very large interventions. However, too prudent choice of α could be costly and the policymakers might therefore decide to put in place an IGS which covers less risk and is less prudent in order to balance current costs and the possibility of facing losses which could not be covered.

Table 3.2 to Table 3.6 show, for each EEA country, the expected losses an IGS will have to face for different confidence levels and the corresponding size as a share of the total premium gathered in the national insurance sector. The estimates were obtained by considering that each country would have an individual IGS fund operating under the home state principle in place for both the life and non-life insurance businesses, for all policies and without limitations on payment¹⁷. The results can be read as follows: for the French total insurance sector with a LGD of 15% and a PD of 0.1%, the result shows that if the IGS holds a fund of €138.69m (which is equal to 0.07% of the total premium collected in 2007) it will hold enough capital to cover all losses happening in $\alpha=75\%$ of the years. Only in 25% of the years will a fund of this size not be sufficient to cover the losses suffered.

Additional tables dealing with the robustness of schemes to extremely large default incidents are available in Annex A4. A comparison of the potential costs to participants in IGS schemes funded using an ex-post and ex-ante mechanism in the case of large defaults has also been provided in Annex A4.

¹⁷ For a more detailed discussion on policy options see Annex A5.

Table 3.1: Summary of policy options applied in the calculation of the baseline case model results

	Baseline case (home state principle)
Status quo versus change	
Introduce a legally binding EU-wide approach to IGS	X
Only partially binding EU-wide approach	
No binding EU-wide approach	
Nature of intervention	
Pure compensation to claimants	
Continuation of contracts	X
Eligible claimants	
Natural persons only	
Natural persons + SMEs	
Natural and legal persons except financial institutions	
Natural and legal entities	X
Compensation limits and reductions	
Capping payouts	
Capping payouts for non-compulsory insurance (MT)	
Level of coverage in percentage terms	100
Level of coverage in percentage terms (compulsory, MT)	
Fixed deductible	
Other reduction in benefits	
Policies covered	
Only life	X
Only non-life	X
Both life and non-life	X
Funding	
Ex-ante	NC
Ex-post	NC
Capping the level of contributions over a period	NC
Other sources of funding	
Borrowing power	NC
Credit facility from members in place	NC
State guarantee on borrowing	NC
Additional guarantees as private initiative (large failures)	NC
Geographic scope	
An IGS in each MS based on the home state principle	X*
An IGS in each MS based on the host state principle	
A single EU-wide IGS	
An IGS in each MS covering only domestic activity supplemented by an additional IGS covering cross-border transactions	
Types of policies covered	
Without exclusions	X
With exclusions	

*: Home state principle results based on the assumption that exposure structure is proportional to national market structure.

NC stands for 'not considered'.

Table 3.2: IGS funding needs for the total insurance sector, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; funding needs in absolute value and as a share of the total gross premiums written

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		75%	90%	99%	75%	90%	99%
AT	Funding needs (m€)	41.56	126.82	616.39	5.63	21.59	153.91
	Share of premiums	0.32%	0.98%	4.74%	0.04%	0.17%	1.18%
BE	Funding needs (m€)	118.45	357.71	1 717.44	16.17	61.22	429.37
	Share of premiums	0.42%	1.28%	6.16%	0.06%	0.22%	1.54%
BG	Funding needs (m€)	0.28	0.75	3.11	0.04	0.14	0.79
	Share of premiums	0.08%	0.21%	0.88%	0.01%	0.04%	0.22%
CY	Funding needs (m€)	1.82	5.74	28.98	0.24	0.96	7.21
	Share of premiums	0.34%	1.08%	5.46%	0.05%	0.18%	1.36%
CZ	Funding needs (m€)	6.06	17.09	75.76	0.87	3.03	19.08
	Share of premiums	0.18%	0.51%	2.27%	0.03%	0.09%	0.57%
DE	Funding needs (m€)	753.31	1 921.86	7 539.74	116.25	357.05	1 913.98
	Share of premiums	0.52%	1.33%	5.21%	0.08%	0.25%	1.32%
DK	Funding needs (m€)	102.02	259.49	1 014.21	15.78	48.27	257.50
	Share of premiums	0.56%	1.42%	5.54%	0.09%	0.26%	1.41%
EE	Funding needs (m€)	0.19	0.90	7.11	0.02	0.12	1.64
	Share of premiums	0.10%	0.47%	3.68%	0.01%	0.06%	0.85%
ES	Funding needs (m€)	157.54	406.72	1 619.01	24.11	75.16	410.70
	Share of premiums	0.37%	0.95%	3.80%	0.06%	0.18%	0.96%
FI	Funding needs (m€)	21.33	78.33	470.36	2.48	12.01	114.23
	Share of premiums	0.45%	1.67%	10.00%	0.05%	0.26%	2.43%
FR	Funding needs (m€)	941.76	2 568.60	10 928.65	138.69	462.69	2 761.11
	Share of premiums	0.51%	1.38%	5.88%	0.07%	0.25%	1.49%
GB	Funding needs (m€)	1 519.96	3 994.22	16 246.62	229.81	732.18	4 116.51
	Share of premiums	0.43%	1.14%	4.62%	0.07%	0.21%	1.17%
GR	Funding needs (m€)	6.58	18.09	77.66	0.96	3.25	19.61
	Share of premiums	0.19%	0.51%	2.20%	0.03%	0.09%	0.55%
HU	Funding needs (m€)	4.51	11.23	42.79	0.71	2.11	10.88
	Share of premiums	0.17%	0.41%	1.57%	0.03%	0.08%	0.40%
IE	Funding needs (m€)	114.25	307.53	1 287.85	16.98	55.74	325.73
	Share of premiums	0.28%	0.74%	3.11%	0.04%	0.13%	0.79%
IS	Funding needs (m€)	0.40	1.43	8.27	0.05	0.22	2.02
	Share of premiums	0.18%	0.64%	3.70%	0.02%	0.10%	0.90%
IT	Funding needs (m€)	272.42	800.06	3 717.40	37.98	138.92	932.40
	Share of premiums	0.35%	1.02%	4.74%	0.05%	0.18%	1.19%
LI	Funding needs (m€)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Share of premiums	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LT	Funding needs (m€)	0.43	1.22	5.44	0.06	0.22	1.37
	Share of premiums	0.13%	0.38%	1.67%	0.02%	0.07%	0.42%
LU	Funding needs (m€)	63.97	152.01	546.08	10.34	29.11	139.03
	Share of premiums	0.58%	1.37%	4.92%	0.09%	0.26%	1.25%
LV	Funding needs (m€)	0.17	0.51	2.42	0.02	0.09	0.61
	Share of premiums	0.07%	0.23%	1.08%	0.01%	0.04%	0.27%
MT	Funding needs (m€)	1.10	3.65	19.43	0.14	0.59	4.80
	Share of premiums	0.24%	0.80%	4.28%	0.03%	0.13%	1.06%
NL	Funding needs (m€)	209.47	594.48	2 652.50	29.96	105.03	667.70
	Share of premiums	0.30%	0.85%	3.78%	0.04%	0.15%	0.95%
NO	Funding needs (m€)	39.01	151.16	963.68	4.34	22.45	231.80
	Share of premiums	0.32%	1.24%	7.91%	0.04%	0.18%	1.90%
PL	Funding needs (m€)	10.58	37.56	217.08	1.27	5.88	53.03
	Share of premiums	0.12%	0.44%	2.51%	0.01%	0.07%	0.61%
PT	Funding needs (m€)	27.09	84.78	424.36	3.60	14.24	105.62
	Share of premiums	0.23%	0.73%	3.67%	0.03%	0.12%	0.91%
RO	Funding needs (m€)	1.13	2.80	10.58	0.18	0.53	2.69
	Share of premiums	0.11%	0.27%	1.01%	0.02%	0.05%	0.26%
SE	Funding needs (m€)	149.65	448.61	2 135.34	20.54	77.07	534.33
	Share of premiums	0.74%	2.21%	10.51%	0.10%	0.38%	2.63%
SI	Funding needs (m€)	1.76	6.80	43.21	0.20	1.01	10.40
	Share of premiums	0.14%	0.55%	3.47%	0.02%	0.08%	0.83%
SK	Funding needs (m€)	1.60	5.27	27.97	0.20	0.86	6.91
	Share of premiums	0.14%	0.45%	2.41%	0.02%	0.07%	0.60%

The 'EU average' is obtained from the weighted average (by total gross premiums written) of funding needs for the 27 Member States of the EU. The 'EU total' is the simple sum of the funding needs for all 27 Member States of the EU.

Table 3.3: IGS funding needs for EU total and EU average for the total insurance sector, based on the home state principle, for different confidence levels and default probabilities; funding needs in absolute value and as a share of the total gross premiums written

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		75%	90%	99%	75%	90%	99%
EU total	Funding needs (m€)	4 528.98	12 212.81	51 477.48	673.24	2 209.05	13 001.11
	Share of premiums	0.43%	1.17%	4.92%	0.06%	0.21%	1.24%
EU avg	Funding needs (m€)	837.77	2 222.02	9 150.66	125.89	405.44	2 316.28
	Share of premiums	0.43%	1.17%	4.92%	0.06%	0.21%	1.24%

Figure 3.1: IGS funding needs for the total insurance sector, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; the top figure indicates funding needs as a share of the total gross premiums written; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$

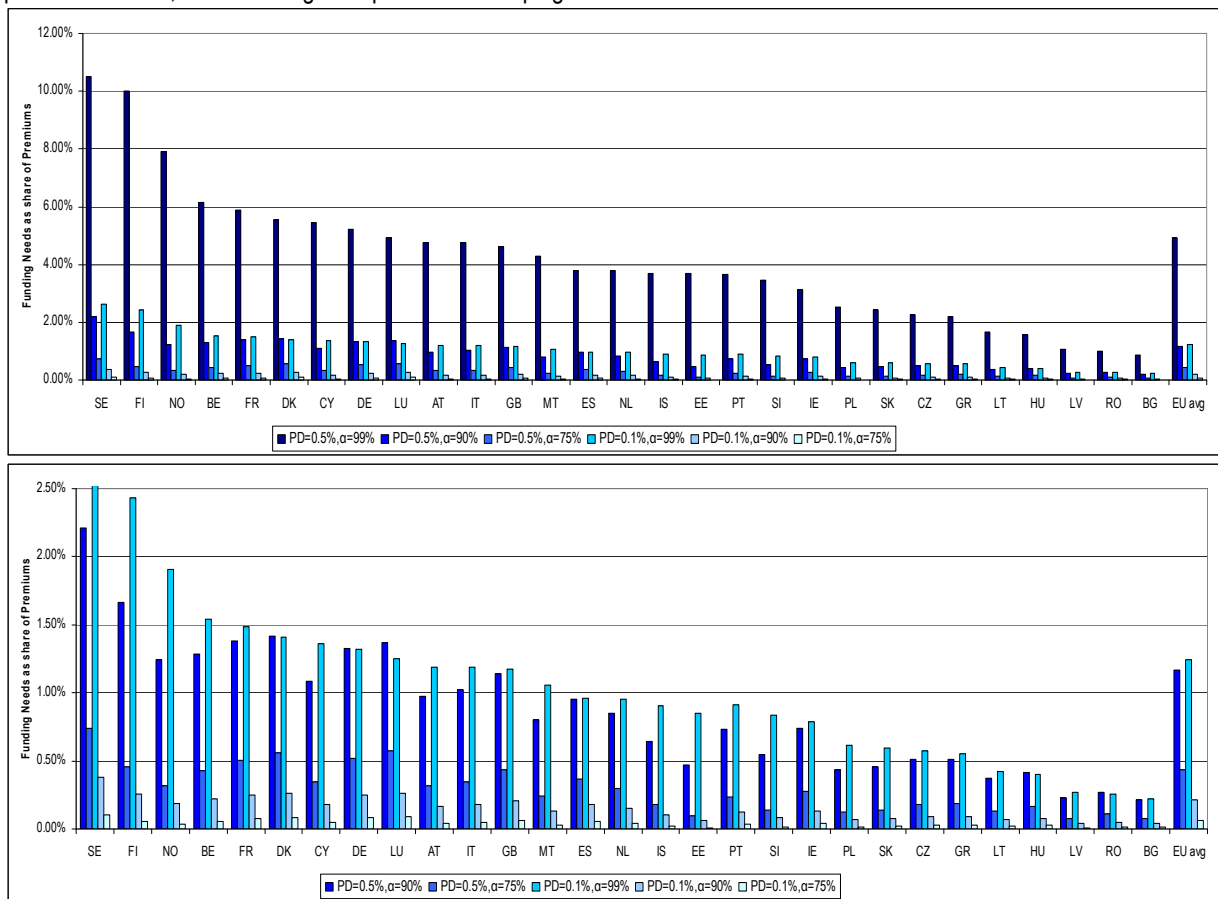


Figure 3.2: Summary of IGS funding needs for the total insurance sector, based on the home state principle, for different confidence levels and default probabilities as a share of the total gross premiums written; EU average and minimum, maximum and median values across all EEA countries

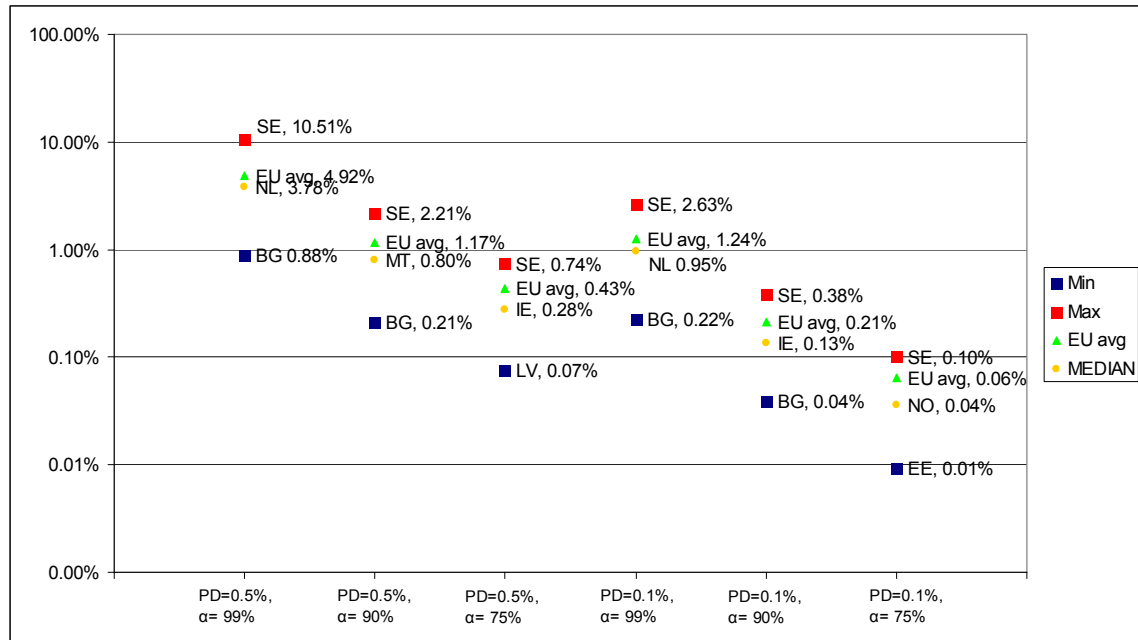


Figure 3.3: IGS funding needs for the total insurance sector, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; the top figure indicates funding needs in absolute terms; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$ case

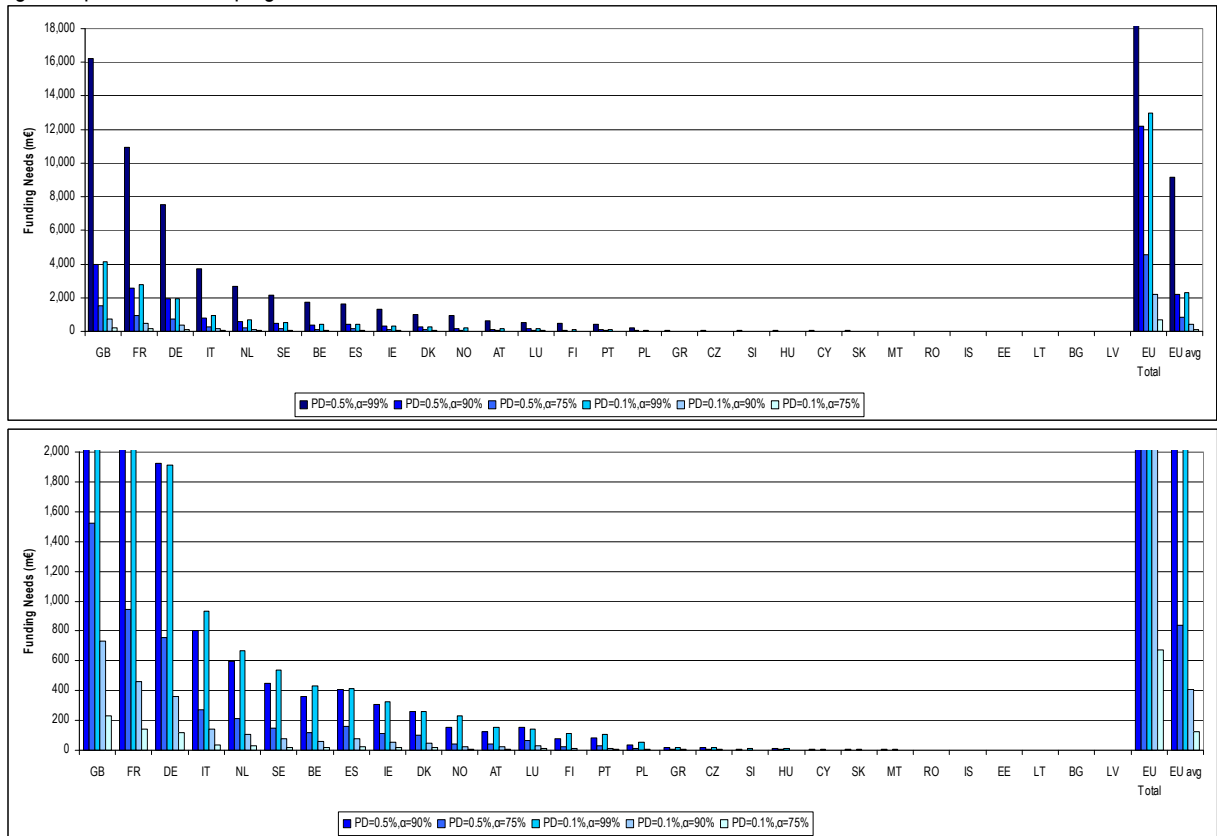


Table 3.4: IGS funding needs for the life business line, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; funding needs in absolute value and as a share of the total gross premiums written

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		75%	90%	99%	75%	90%	99%
AT	Funding needs (m€)	36.63	109.64	520.95	5.03	18.85	130.38
	Share of premiums	0.51%	1.54%	7.30%	0.07%	0.26%	1.83%
BE	Funding needs (m€)	102.17	315.03	1 549.77	13.72	53.32	386.46
	Share of premiums	0.46%	1.42%	6.99%	0.06%	0.24%	1.74%
BG	Funding needs (m€)	0.13	0.38	1.81	0.02	0.07	0.45
	Share of premiums	0.11%	0.32%	1.51%	0.01%	0.05%	0.38%
CY	Funding needs (m€)	1.43	4.94	27.62	0.18	0.79	6.78
	Share of premiums	0.40%	1.38%	7.73%	0.05%	0.22%	1.90%
CZ	Funding needs (m€)	3.87	12.20	61.60	0.51	2.04	15.32
	Share of premiums	0.19%	0.60%	3.03%	0.03%	0.10%	0.75%
DE	Funding needs (m€)	571.87	1 460.67	5 738.76	88.18	271.23	1 456.70
	Share of premiums	0.76%	1.94%	7.63%	0.12%	0.36%	1.94%
DK	Funding needs (m€)	85.61	225.44	919.33	12.92	41.28	232.90
	Share of premiums	0.65%	1.71%	6.97%	0.10%	0.31%	1.77%
EE	Funding needs (m€)	0.15	0.77	6.69	0.01	0.09	1.51
	Share of premiums	0.13%	0.65%	5.67%	0.01%	0.08%	1.28%
ES	Funding needs (m€)	122.95	314.87	1 241.05	18.92	58.40	314.98
	Share of premiums	0.52%	1.34%	5.29%	0.08%	0.25%	1.34%
FI	Funding needs (m€)	17.58	65.61	401.24	2.02	9.96	97.16
	Share of premiums	0.63%	2.36%	14.41%	0.07%	0.36%	3.49%
FR	Funding needs (m€)	825.92	2 266.56	9 715.04	121.09	407.08	2 453.20
	Share of premiums	0.60%	1.66%	7.12%	0.09%	0.30%	1.80%
GB	Funding needs (m€)	1 479.55	3 883.16	15 770.79	223.90	712.24	3 996.29
	Share of premiums	0.48%	1.27%	5.17%	0.07%	0.23%	1.31%
GR	Funding needs (m€)	5.09	14.49	64.85	0.73	2.56	16.32
	Share of premiums	0.20%	0.58%	2.59%	0.03%	0.10%	0.65%
HU	Funding needs (m€)	4.00	10.08	38.92	0.62	1.88	9.89
	Share of premiums	0.20%	0.50%	1.93%	0.03%	0.09%	0.49%
IE	Funding needs (m€)	102.75	280.99	1 199.39	15.10	50.55	302.96
	Share of premiums	0.27%	0.75%	3.19%	0.04%	0.13%	0.81%
IS	Funding needs (m€)	0.04	0.21	2.00	0.00	0.03	0.45
	Share of premiums	0.11%	0.62%	5.84%	0.01%	0.07%	1.30%
IT	Funding needs (m€)	253.42	736.69	3 381.89	35.61	128.59	849.20
	Share of premiums	0.41%	1.20%	5.50%	0.06%	0.21%	1.38%
LI	Funding needs (m€)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Share of premiums	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LT	Funding needs (m€)	0.33	0.99	4.72	0.05	0.17	1.18
	Share of premiums	0.16%	0.49%	2.31%	0.02%	0.08%	0.58%
LU	Funding needs (m€)	61.25	145.33	521.14	9.91	27.84	132.68
	Share of premiums	0.61%	1.44%	5.16%	0.10%	0.28%	1.31%
LV	Funding needs (m€)	0.03	0.13	1.01	0.00	0.02	0.24
	Share of premiums	0.06%	0.25%	1.91%	0.01%	0.03%	0.45%
MT	Funding needs (m€)	0.64	2.32	13.59	0.08	0.36	3.31
	Share of premiums	0.30%	1.08%	6.35%	0.04%	0.17%	1.55%
NL	Funding needs (m€)	171.55	503.46	2 337.43	23.93	87.45	586.32
	Share of premiums	0.65%	1.90%	8.84%	0.09%	0.33%	2.22%
NO	Funding needs (m€)	35.06	137.69	890.97	3.85	20.28	213.77
	Share of premiums	0.36%	1.40%	9.06%	0.04%	0.21%	2.17%
PL	Funding needs (m€)	9.06	31.07	172.78	1.12	4.96	42.44
	Share of premiums	0.13%	0.46%	2.56%	0.02%	0.07%	0.63%
PT	Funding needs (m€)	24.06	75.26	376.40	3.20	12.64	93.69
	Share of premiums	0.26%	0.82%	4.09%	0.03%	0.14%	1.02%
RO	Funding needs (m€)	0.59	1.49	5.79	0.09	0.28	1.47
	Share of premiums	0.14%	0.36%	1.39%	0.02%	0.07%	0.35%
SE	Funding needs (m€)	127.14	363.39	1 635.17	18.09	63.97	411.32
	Share of premiums	0.98%	2.80%	12.59%	0.14%	0.49%	3.17%
SI	Funding needs (m€)	0.97	3.61	22.09	0.11	0.55	5.35
	Share of premiums	0.22%	0.81%	4.98%	0.03%	0.12%	1.21%
SK	Funding needs (m€)	1.39	4.30	21.27	0.19	0.73	5.30
	Share of premiums	0.16%	0.51%	2.51%	0.02%	0.09%	0.63%

Table 3.5: IGS funding needs: EU total and EU average for the life business line, based on the home state principle, for different confidence levels and default probabilities; funding needs in absolute value and as a share of the total gross premiums written.

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		75%	90%	99%	75%	90%	99%
EU total	Funding needs (m€)	4 010.12	10 832.88	45 751.09	595.32	1 957.90	11 553.79
	Share of premiums	0.53%	1.43%	6.02%	0.08%	0.26%	1.52%
EU avg	Funding needs (m€)	843.30	2 237.15	9 214.04	126.69	408.17	2 332.37
	Share of premiums	0.53%	1.43%	6.02%	0.08%	0.26%	1.52%

Figure 3.4: IGS funding needs for the life business line, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; the top figure indicates funding needs as a share of the total gross premiums written, the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$

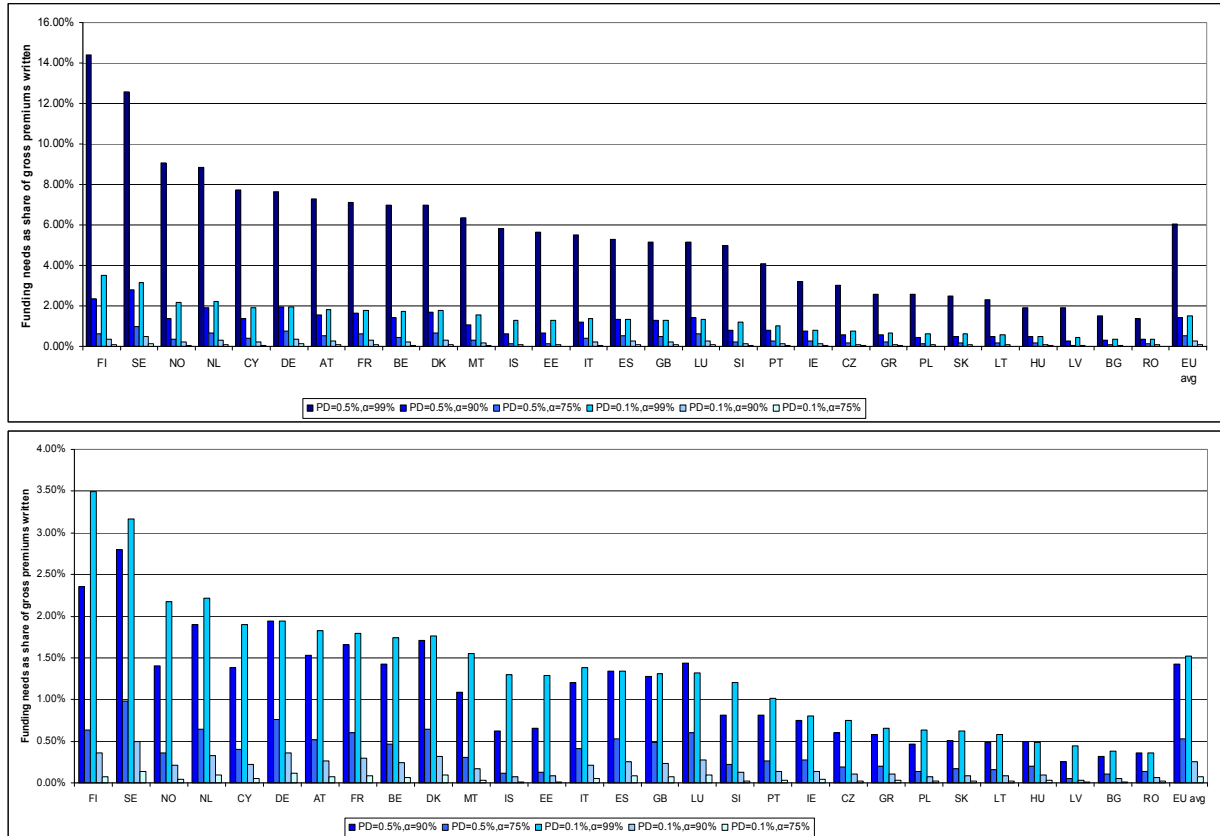


Figure 3.5: Summary of IGS funding needs for the life business line, based on the home state principle, for different confidence levels and default probabilities as a share of the total gross premiums written; EU average and minimum, maximum and median values across all EEA countries

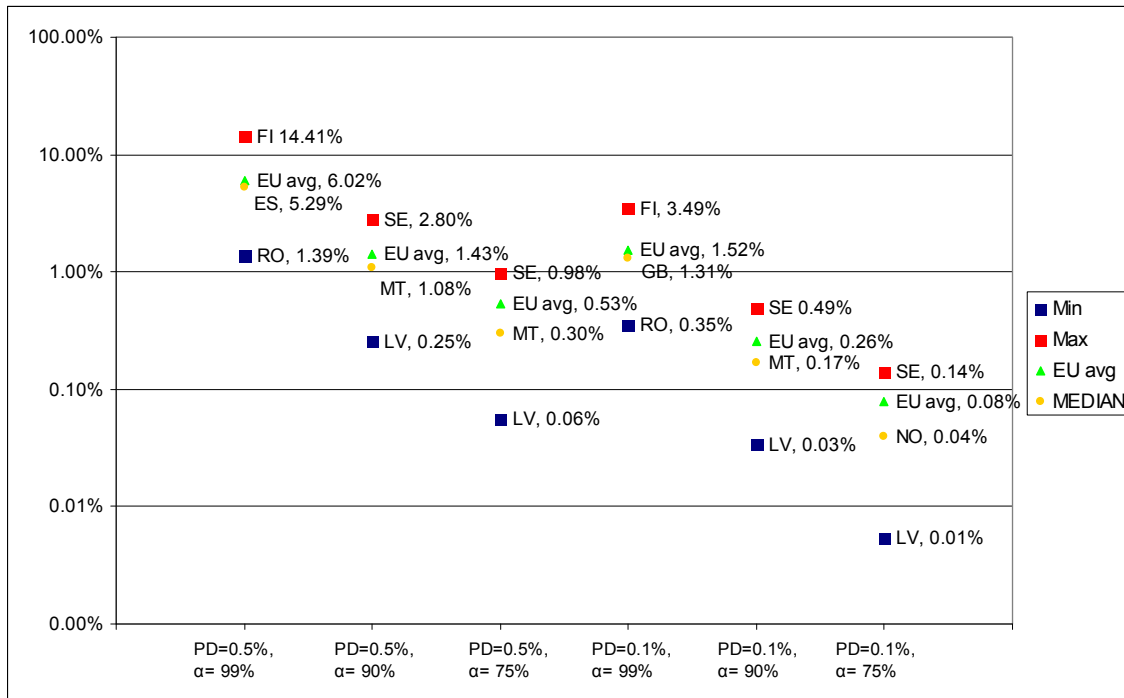


Figure 3.6: IGS funding needs for the life business line, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; the top figure indicates funding needs in absolute terms; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$

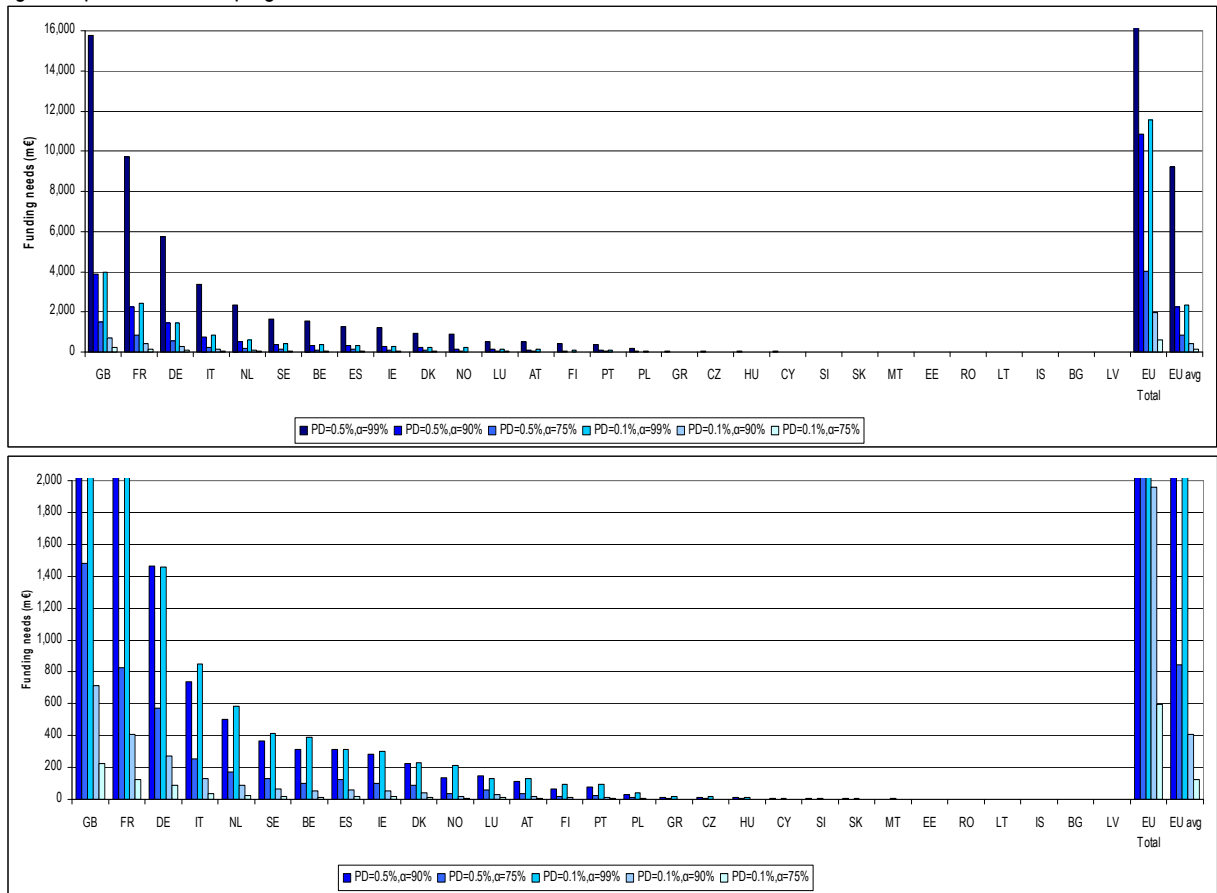


Table 3.6: IGS funding needs for the non-life business line, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; expressed in absolute value and as a share of total gross premiums written

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		75%	90%	99%	75%	90%	99%
AT	Funding needs (m€)	6.56	20.52	102.53	0.87	3.45	25.52
	Share of premiums	0.11%	0.35%	1.75%	0.01%	0.06%	0.44%
BE	Funding needs (m€)	13.12	36.60	160.02	1.90	6.52	40.35
	Share of premiums	0.23%	0.64%	2.80%	0.03%	0.11%	0.71%
BG	Funding needs (m€)	0.16	0.40	1.57	0.02	0.08	0.40
	Share of premiums	0.07%	0.17%	0.67%	0.01%	0.03%	0.17%
CY	Funding needs (m€)	0.25	0.66	2.71	0.04	0.12	0.69
	Share of premiums	0.14%	0.38%	1.57%	0.02%	0.07%	0.40%
CZ	Funding needs (m€)	1.49	3.57	12.93	0.24	0.68	3.29
	Share of premiums	0.11%	0.27%	0.99%	0.02%	0.05%	0.25%
DE	Funding needs (m€)	186.27	474.60	1 859.02	28.77	88.22	471.95
	Share of premiums	0.27%	0.68%	2.67%	0.04%	0.13%	0.68%
DK	Funding needs (m€)	8.19	19.07	66.74	1.34	3.68	17.00
	Share of premiums	0.16%	0.37%	1.31%	0.03%	0.07%	0.33%
EE	Funding needs (m€)	0.04	0.17	1.17	0.00	0.02	0.28
	Share of premiums	0.06%	0.23%	1.55%	0.01%	0.03%	0.37%
ES	Funding needs (m€)	36.67	95.62	385.25	5.57	17.59	97.66
	Share of premiums	0.19%	0.50%	2.01%	0.03%	0.09%	0.51%
FI	Funding needs (m€)	3.95	14.16	82.81	0.47	2.20	20.19
	Share of premiums	0.21%	0.74%	4.31%	0.02%	0.11%	1.05%
FR	Funding needs (m€)	119.58	320.65	1 336.68	17.82	58.23	338.18
	Share of premiums	0.24%	0.65%	2.71%	0.04%	0.12%	0.69%
GB	Funding needs (m€)	74.60	197.67	812.18	11.21	36.10	205.66
	Share of premiums	0.16%	0.43%	1.76%	0.02%	0.08%	0.44%
GR	Funding needs (m€)	1.28	3.23	12.54	0.20	0.60	3.18
	Share of premiums	0.12%	0.31%	1.21%	0.02%	0.06%	0.31%
HU	Funding needs (m€)	0.27	0.65	2.37	0.04	0.12	0.60
	Share of premiums	0.04%	0.09%	0.33%	0.01%	0.02%	0.08%
IE	Funding needs (m€)	10.96	25.38	88.25	1.80	4.91	22.48
	Share of premiums	0.28%	0.66%	2.28%	0.05%	0.13%	0.58%
IS	Funding needs (m€)	0.36	1.20	6.39	0.05	0.19	1.58
	Share of premiums	0.19%	0.63%	3.38%	0.02%	0.10%	0.83%
IT	Funding needs (m€)	20.09	61.26	297.37	2.72	10.43	74.26
	Share of premiums	0.12%	0.36%	1.75%	0.02%	0.06%	0.44%
LI	Funding needs (m€)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Share of premiums	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LT	Funding needs (m€)	0.12	0.30	1.19	0.02	0.06	0.30
	Share of premiums	0.10%	0.25%	0.98%	0.01%	0.05%	0.25%
LU	Funding needs (m€)	2.81	6.77	24.75	0.45	1.29	6.30
	Share of premiums	0.28%	0.67%	2.44%	0.04%	0.13%	0.62%
LV	Funding needs (m€)	0.14	0.36	1.53	0.02	0.07	0.39
	Share of premiums	0.08%	0.21%	0.89%	0.01%	0.04%	0.23%
MT	Funding needs (m€)	0.36	1.10	5.41	0.05	0.19	1.35
	Share of premiums	0.15%	0.46%	2.25%	0.02%	0.08%	0.56%
NL	Funding needs (m€)	56.53	157.25	685.05	8.21	28.06	172.78
	Share of premiums	0.13%	0.36%	1.57%	0.02%	0.06%	0.40%
NO	Funding needs (m€)	3.79	13.89	83.28	0.44	2.13	20.23
	Share of premiums	0.16%	0.59%	3.56%	0.02%	0.09%	0.86%
PL	Funding needs (m€)	1.48	5.98	39.83	0.16	0.87	9.51
	Share of premiums	0.08%	0.32%	2.11%	0.01%	0.05%	0.50%
PT	Funding needs (m€)	2.97	9.32	46.77	0.39	1.56	11.64
	Share of premiums	0.13%	0.40%	1.99%	0.02%	0.07%	0.49%
RO	Funding needs (m€)	0.50	1.23	4.56	0.08	0.23	1.16
	Share of premiums	0.08%	0.20%	0.73%	0.01%	0.04%	0.18%
SE	Funding needs (m€)	30.32	99.17	522.29	3.89	16.26	129.20
	Share of premiums	0.41%	1.35%	7.12%	0.05%	0.22%	1.76%
SI	Funding needs (m€)	0.64	2.52	16.35	0.07	0.37	3.92
	Share of premiums	0.08%	0.31%	2.04%	0.01%	0.05%	0.49%
SK	Funding needs (m€)	0.22	0.86	5.57	0.02	0.13	1.34
	Share of premiums	0.07%	0.27%	1.78%	0.01%	0.04%	0.43%

Table 3.7: IGS funding needs: EU total and EU average for the non-life business line, based on the home state principle, for different confidence levels and default probabilities; funding needs in absolute value and as a share of the total gross premiums

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		75%	90%	99%	75%	90%	99%
EU total	Funding needs (m€)	579.55	1 559.05	6 577.43	86.39	282.02	1 659.57
	Share of premiums	0.20%	0.55%	2.30%	0.03%	0.10%	0.58%
EU avg	Funding needs (m€)	91.87	241.52	985.11	13.89	44.24	249.44
	Share of premiums	0.20%	0.55%	2.30%	0.03%	0.10%	0.58%

Figure 3.7: IGS funding needs for the non-life business line, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; the top figure indicates funding needs as a share of the total gross premiums written; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$

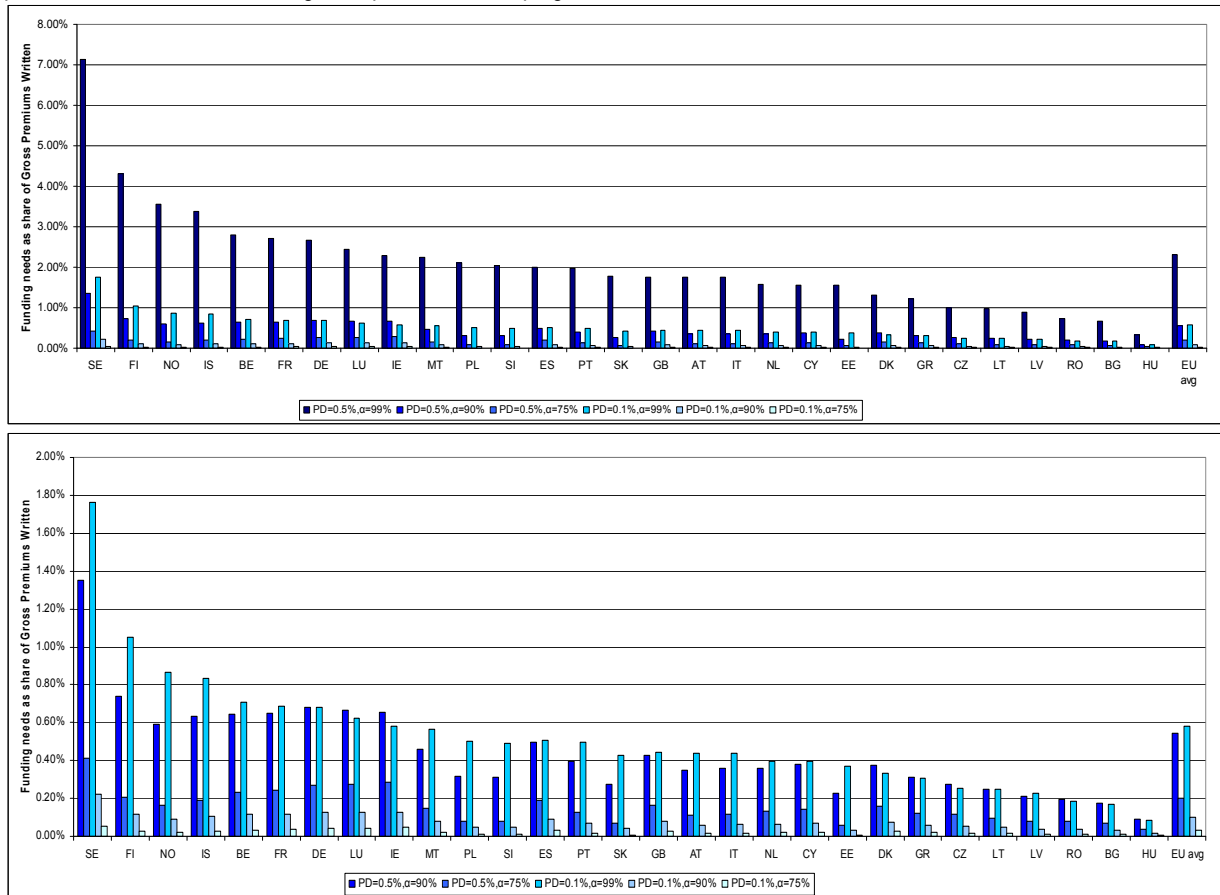


Figure 3.8: Summary of IGS funding needs for the non-life business line sector, based on the home state principle, for different confidence levels and default probabilities as a share of the total gross premiums written; EU average and minimum, maximum and median values across all EEA countries

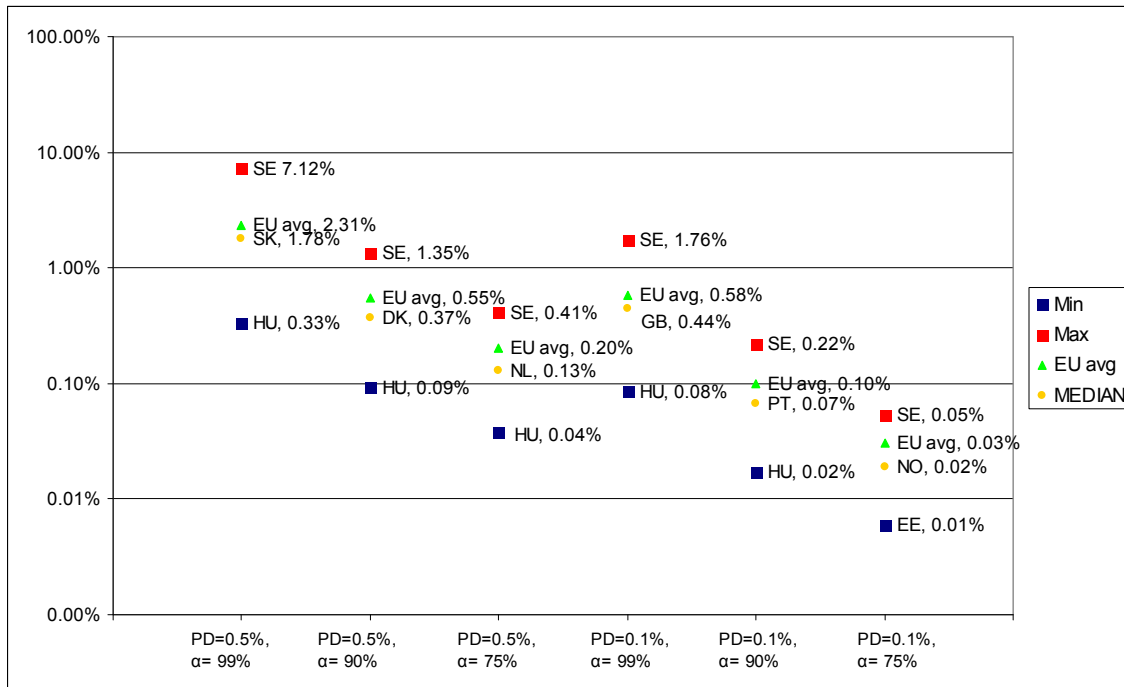


Figure 3.9: IGS funding needs for the non-life business line, based on the home state principle, for different confidence levels and default probabilities; all EEA countries; the top figure indicates funding needs in absolute terms; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$

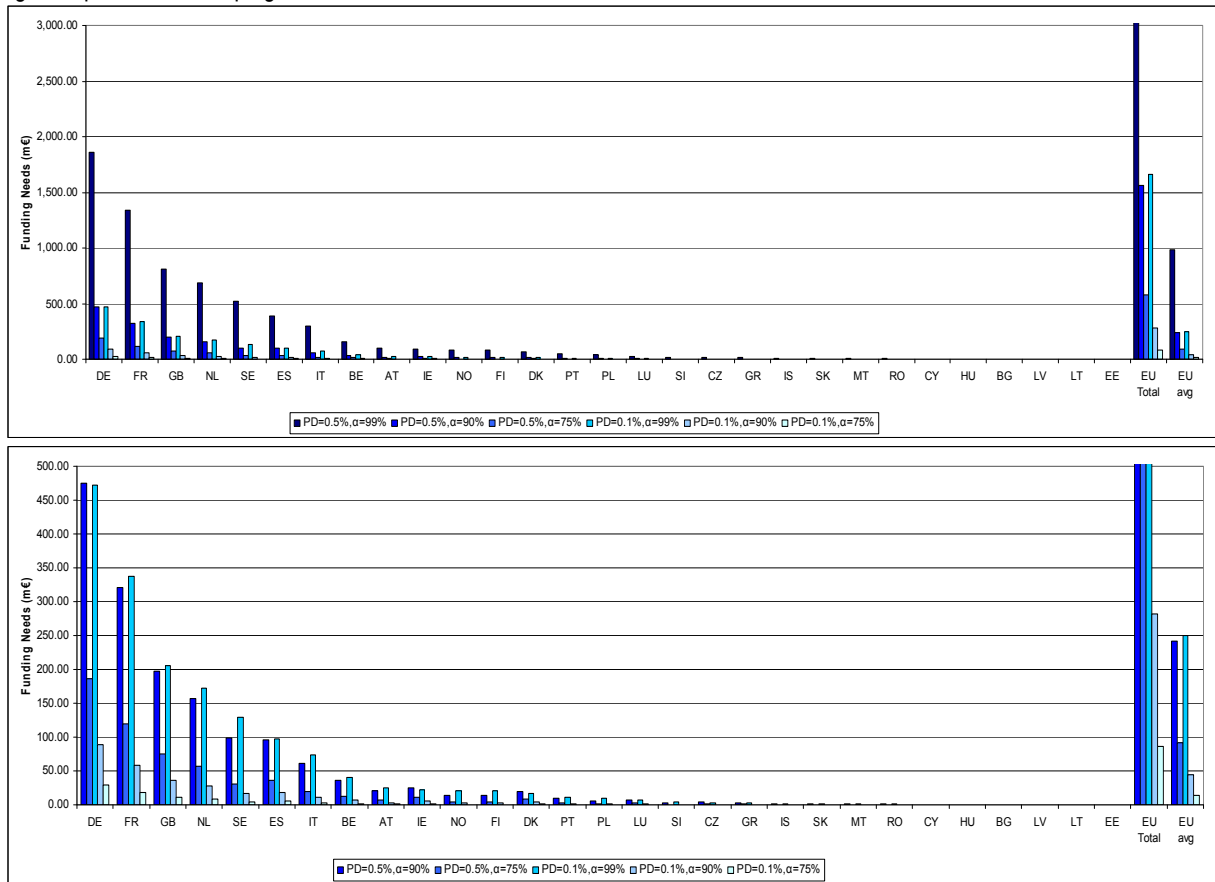


Table 3.8: IGS funding needs: EU total in absolute value and as a share of total premiums, based on the home state principle, for total insurance sector, life and non-life business lines

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	75%	90%	99%	75%	90%	99%
Absolute values (in m€)						
Total insurance (EU)	4 529	12 213	51 477	673	2 209	13 001
Life (EU)	4 010	10 833	45 751	595	1 958	11 554
Non-life (EU)	580	1 559	6 577	86	282	1 660
As share of total premiums						
Total insurance (EU)	0.43%	1.17%	4.92%	0.06%	0.21%	1.24%
Life (EU)	0.53%	1.43%	6.02%	0.08%	0.26%	1.52%
Non-life (EU)	0.20%	0.55%	2.30%	0.03%	0.10%	0.58%

3.2.1 Analysis of probability levels associated with funding needs presented in the Oxera report

This section compares the results from the previous section with the results presented in the Oxera report (2007). Note that the current data availability limitations make it impossible to reproduce detailed results reflecting the policy options activated at country level. Moreover, it should be kept in mind that the results given in this report were obtained using 2006 and 2007 data, whereas the Oxera report is based on 2004-2006 data.

Oxera's IGS report (Oxera 2007; and updated figures in CEIOPS 2009) not only provides figures on actual fund sizes, but also aims to estimate the expected future insurance guarantee costs (for which the results are presented on pages 102 and 103 in Tables 5.4 and 5.5). The same results can be obtained with the model presented in Equation 1.2 when setting ρ and δ at zero, highlighting how this result reflects the situation on a market with infinite granularity populated by insurers with completely independent default risks. The full model of Equation 1.2, however, makes it possible to obtain, besides the funding needs, the probability of exceeding any given loss threshold for the various EU countries.

The first comparison therefore aims to calculate the confidence level associated with the IGS sizes proposed in the Oxera report, in other words the probability that losses in any given year will not be higher than the proposed funding needs.

In order to favour comparability with the Oxera report, the EAD estimate in this section will be limited to technical provisions for calculations with the full model as well, but the adjustment for technical provisions will be taken into account¹⁸. The other input parameters of the model are: PD is set at 0.1%; ρ is taken as equal to 0.2 and an asset shortfall of 15% is assumed. These parameters are completed by adding the business line and country-specific δ presented in Table 2.2. Results reproducing Table 5.4 from the Oxera report are presented in Table 3.9 and Table 3.10. The first column of each table indicates the funding needs obtained using the Oxera formula based on the updated EAD data, the second the confidence level and the last two the input parameters used in the calculations.

Table 3.9: Comparison of loss distributions calculated in accordance with the model expressed by Equation 1.2 with the results of the formula employed in the Oxera report (2007, updated figures in CEIOPS, 2009) to obtain Tables 5.4 and 5.5; the yellow column indicates the probability that losses over a certain period will not exceed the amounts in the first column, when the loss distributions are calculated using the parameters in the last two columns (data for the life business line)

	Expected costs of insolvencies using OXERA formula (m€)	Probability of NOT exceeding this value, according to model	Input parameters ($\rho=0.2$ $PD=0.1\%$ $LGD=15\%$)	
			EAD used for this calculation (adjusted TPs) (m€)	δ
Germany	104.59	79.15%	697 273	0.05
Spain	23.23	79.21%	154 875	0.05
United Kingdom	265.95	79.70%	1 772 996	0.06
Poland	2.75	84.21%	18 349	0.18
Italy	56.25	81.61%	374 968	0.11
France	164.31	80.56%	1 095 414	0.08
Malta	0.17	84.85%	1 147	0.20

¹⁸ See section 2.2.2 'Estimation of the EAD and Annex A3.11 for further details on this procedure.

Table 3.10: Comparison of loss distributions calculated in accordance with the model expressed by Equation 1.2 with the results of the formula employed in the Oxera report (2007, updated figures in CEIOPS, 2009) to obtain Tables 5.4 and 5.5; the yellow column indicates the probability that losses over a certain period will not exceed the amounts in the first column, when the loss distributions are calculated using the parameters in the last two columns (non-life business line)

	Expected costs of insolvencies using OXERA formula (m€)	Probability of NOT exceeding this value, according to model	Input parameters ($\rho=0.2$ PD=0.1% LGD=15%)	
			EAD used for this calculation (adjusted TPs) (m€)	δ
Germany	29.46	79.10%	196 403	0.05
Spain	6.46	79.57%	43 090	0.05
United Kingdom	13.53	20.49%	90 215	0.05
Poland	0.40	86.27%	2 647	0.05
Italy	4.28	82.41%	28 547	0.05
France	23.59	80.12%	157 276	0.05
Malta	0.04	82.53%	272	0.05

The same approach could be applied for all the expected shares of losses indicated in Table 5.5 of the Oxera report to calculate, for each of the resulting losses, the probability of not exceeding such a loss.

Besides calculating the probability of not exceeding a certain loss, it might also be interesting to know the effect of the different inputs on the resulting IGS funding needs. For this reason Table 3.11 shows the effect of changing the different inputs one by one when moving from the Oxera formula to the full model used to obtain the results in Table 3.2 to Table 3.6. The first six rows in Table 3.11 indicate the input parameters for the life insurance business in Germany. In every row, the green cells indicate the difference from the first column where the Oxera input has been used¹⁹. The row 'Expected costs using Oxera formula' indicates the cost proposed by Oxera ($EAD \cdot PD \cdot LGD$) for each combination of input parameters. Below this row the corresponding probability that the IGS will have to bear a loss which does not exceed these funding needs is added. To emphasise the effect of changing the input parameters, the last rows indicate for various α values, the corresponding cost to set up an IGS with such a confidence level and the corresponding size as a share of the total premium.

¹⁹ As outlined in section 1.2, Oxera's equation for funding needs ($EAD \times LGD \times p$) can be seen as a particular case for this model where both p and δ are set to zero and the distribution collapses to a single point.

Table 3.11: The effects of changes in the model parameters on results. Example using data for the life insurance business line in Germany. The first column is obtained by applying the formula presented in the Oxera report (2007), which is equivalent to the model expressed in Equation 1.2 with ρ and δ set to zero, the second and third column introduce positive correlation and granularity parameters, the next three columns show the effects of changes in PD, EAD and LGD, the last column resets δ to zero.

	Data from OXERA report	Include ρ	Include δ	Set PD=0.5 %	Update EAD data	Set LGD=45 % with updated EAD data	Set $\delta =0$ with updated EAD data
δ	0.00	0.00	0.05	0.05	0.05	0.05	0.00
PD	0.10%	0.10%	0.10%	0.50%	0.10%	0.10%	0.10%
ρ	0	0.2	0.2	0.2	0.2	0.2	0.2
EAD (in m€)	641 078	641 078	641 078	641 078	765 639	765 639	765 639
LGD	15%	15%	15%	15%	15%	45%	45%
Gross premiums written(in m€)	73 969	73 969	73 969	73 969	75 170	75 170	75 170
Expected costs using Oxera formula (in m€)							
	96.16	96.16	96.16	480.81	114.85	344.54	344.54
Probability of not exceeding value							
	N.A.	76.72%	79.15%	75.07%	79.15%	79.15%	76.72%
Funding needs (in m€)							
α							
75.00%	96	88	74	479	88	265	314
90.00%	96	235	227	1 224	271	814	842
95.00%	96	407	423	2 039	505	1 514	1 460
99.00%	96	1 054	1 220	4 808	1 458	4 373	3 776
99.50%	96	1 453	1 740	6 374	2 078	6 235	5 208
99.90%	96	2 700	3 422	10 810	4 086	12 259	9 673
Funding needs as a share of gross premiums written							
α							
75.00%	0.13%	0.12%	0.10%	0.65%	0.12%	0.35%	0.42%
90.00%	0.13%	0.32%	0.31%	1.65%	0.36%	1.08%	1.12%
95.00%	0.13%	0.55%	0.57%	2.76%	0.67%	2.01%	1.94%
99.00%	0.13%	1.42%	1.65%	6.50%	1.94%	5.82%	5.02%
99.50%	0.13%	1.96%	2.35%	8.62%	2.76%	8.29%	6.93%
99.90%	0.13%	3.65%	4.63%	14.61%	5.44%	16.31%	12.87%

3.3 Analysis of probability levels associated with existing IGS fund sizes

Another comparison which can be performed is between funding needs according to the model expressed by Equation 1.2 and the actual fund sizes in place or target fund sizes across European states. This comparison is shown in Table 3.12, which also indicates the probability of not exceeding the actual or target funds according to the model, assuming a given set of policy options.

The first two rows of the table compare the funding needs calculated by the model with the actual fund sizes — or in some cases the target fund sizes — of existing IGSs in Member States, as reported by Oxera. Note that the data presented concern only IGSs of countries which have an ex-ante funding system in place and for which the actual or the target level fund has been provided.

This comparison assumed the correlation coefficient ρ to be 0.2, the confidence level $\alpha = 90\%$, the loss given default 15% and the probability of default 0.1% and 0.5%. The results show that there are several countries with an actual fund that exceeds the maximum loss results given the parameter values assumed.

It is also interesting to see which combinations of parameters in this model would produce maximum losses that correspond to the actual or target funds. This is shown in the lower section of the table. The first row in the lower section shows what confidence level²⁰ has to be chosen, leaving everything else unchanged, to obtain maximum losses identical to the actual funds. In the case of Germany, for instance, the result is an α of around 77.1%, which means a probability of 77.1% that the losses will not exceed the target fund of €640bn.

The next three rows show how the level α changes as different sets of parameters are applied. The fifth and sixth rows show what probability of default would have to be assumed to obtain a maximum loss equal to the actual funds with an α of 90% and an asset shortfall of 15% and 45% respectively.

The last two rows show what level of asset shortfall would reproduce, in this model, the actual funding needs given a probability of default of 0.5% and 0.1% respectively.

The last row of the table, in particular, shows how using a PD of 0.1% the actual fund sizes of certain countries could be obtained only by assuming assets shortfalls in excess of 100%.

Note that countries can choose several different policy options which can have a major impact on the expected payout. Table 3.13 provides a summary of the differences among policy options adopted in the Member States cited in Table 3.12 and in the model used in obtaining the results. Options marked in parentheses refer to alternative options analyzed in Section 4.

²⁰ The probability that the actual fund size is the maximum loss that will not be exceeded with that probability during the reference period.

Table 3.12: Comparison of estimated IGS funding needs indicated in section 3.2 with actual funding reported by Oxera (2007)

	Life					Non-life				Total Spain	
	Latvia	Malta(#)	France	Germany	Romania	Latvia	Malta(#)	Romania	Denmark		
Estimated IGS funding needs ($\rho=0.2$, $\alpha=90\%$, PD=0.5%,LGD 15%) (in m€)	0.13	2.35	2 266.56	1 460.67	1.49	0.36	1.16	1.23	19.07	406.72	
Estimated IGS funding needs ($\rho=0.2$, $\alpha=90\%$, PD=0.1%,LGD 15%)(in m€)	0.02	0.36	407.08	271.23	0.28	0.07	0.20	0.23	3.68	75.16	
Actual fund size (OXERA, latest available figures) (in m€)	0.8 (1)	2.33 (2)	569 (4)	640 (2)	136 (3)	17.1 (3)	2.8 (1)	2.33 (2)	84.5 (3)	40.3 (2)	1331 (3)

The model used in this study would produce results identical to the actual fund size with the following parameters:

$\rho=0.2$, LGD=15%, PD=0.5% then	$\alpha =$	98.55%	89.93%	67.99%	77.15%	44.24%	99.97%	99.79%	95.62%	100.00%	97.00%	98.47%
$\rho=0.2$, LGD=45%, PD= 0.5% then	$\alpha =$	94.49%	77.39%	45.94%	53.99%	24.00%	98.96%	97.36%	85.48%	100.00%	84.67%	91.00%
$\rho=0.2$, LGD=15%, PD= 0.1% then	$\alpha =$	99.85%	98.36%	92.80%	96.33%	81.64%	100.00%	99.99%	99.58%	100.00%	99.87%	99.93%
$\rho=0.2$, LGD=45%, PD= 0.1% then	$\alpha =$	99.15%	94.62%	81.38%	63.32%	63.32%	99.96%	99.84%	97.64%	100.00%	98.44%	99.13%
$\rho=0.2$, $\alpha =90\%$, LGD=15% then	PD =	2.35%	0.50%	0.14%	0.05%	0.05%	6.11%	3.85%	0.97%	65.26%	1.06%	1.62%
$\rho=0.2$, $\alpha =90\%$, LGD=45%then	PD =	0.89%	0.19%	0.05%	0.02%	0.02%	1.91%	1.25%	0.35%	13.72%	0.35%	0.54%
$\rho=0.2$, $\alpha =90\%$, PD=0.5% then	LGD =	89.32%	14.88%	3.77%	1.40%	1.40%	172.03%	115.07%	30.24%	1030.23%	31.71%	49.09%
$\rho=0.2$, $\alpha =90\%$, PD=0.1% then	LGD =	662.41%	95.84%	20.97%	7.52%	7.52%	922.67%	635.40%	178.30%	5437.75%	164.23%	265.63%

Notes: (#)IGS funding needs for Malta are estimated based on the host state principle, as explained in section 4.
 (1) 2006 data; (2) target fund size as given for 2008; (3) 2008 data; (4) 2007 data.

Table 3.13: Summary of policy options currently applied in selected EU Member States and used for the model employed in this report

	Used in this report	Life					Non-life				Total ES
		LV	MT	FR	DE	RO	LV	MT	RO	DK	
Status quo versus change											
Introduce a legally binding EU-wide approach to IGS	X										
Only partially binding EU-wide approach											
No binding EU-wide approach		X	X	X	X	X	X	X	X	X	X
Nature of intervention											
Pure compensation to claimants	X	X	X	X		X	X	X	X	X	X
Continuation of contracts	(X)			X	X						X
Eligible claimants											
Natural persons only		X					X	X			
Natural persons + SMEs										X	
Natural and legal persons except financial institutions				X							
Natural and legal entities	X		X		X	X			X		X
Compensation limits and reductions											
Capping payouts		X		X			X				n/a
Capping payouts for non-compulsory insurance (MT)			X					X			
Level of coverage in percentage terms	100	100	75	100		100	50	75	100	100	n/a
Level of coverage in percentage terms (compulsory)			100					100			
Fixed deductible										X	
Other reduction in benefits					X						X
Policies covered											
Only life	X	X	X	X	X	X					
Only non-life	X						X	X	X	X	
Both life and non-life	X										X
Funding											
Ex-ante	NC•	X	X	X	X	X	X	X	X	X	X
Ex-post	NC•			X							
Capping the level of contributions over a period	NC	X		X	X		X				
Other sources of funding											
Borrowing power	NC		X	X	X			X		X	
Credit facility from members in place	NC			X							
State guarantee on borrowing	NC									X	
Additional guarantees as private initiative (large failures)	NC				X						
Geographic scope											
An IGS in each MS based on the home state principle	X*			X	X	X			X	X	X
An IGS in each MS based on the host state principle	(X)	X	X				X	X			
A single EU-wide IGS	(X)										
An IGS in each MS covering only domestic activity supplemented by an additional IGS covering cross-border transactions	(X)										
Other											X
Types of policies covered											
Without exclusions	X			X	X	X			X		
With exclusions		X	X				X	X		X	X

*: Home state principle results based on the assumption that exposure structure is proportional to national market structure.

•: This topic is shortly discussed in Annex A4

NC stands for not considered; Options marked (X) are analysed in Section 4

Source: CEIOPS 2009

3.4 Analysis of historical losses stemming from selected defaults of insurance undertakings

An initial comparison has been performed between historical observed costs for IGS funds and the loss distribution of IGS funds obtained under the settings applied in this study. There are several cases where IGSs have provided protection to claimants in relation to both life and non-life business. Three failures in relation to non-life business and one in relation to life business are considered here. Their historical data are taken from the Oxera report (p. 89 et seq.) and are summarised in Table 3.14.

Table 3.14: Historical losses stemming from defaults of selected insurance undertakings

Country	Failure	Sector	Total cost (m€)	As share of country total premium	Fund size in country (year) (m€)	Target fund size in country (m€)
Germany	Mannheimer	Life	100	0.13%	136 (2008)	640
Denmark	Plus Forsiking A/S	Non life	13.1	0.18%		40.3
United Kingdom	Independent Insurance	Non life	738	0.84%		
United Kingdom	Chester Street	Non life	146.5	0.17%		

The graphs set out below present the cumulative loss distribution functions implied by Equation 1.2 under two different PD values. For each country and line of business the fund sizes as a share of premium are plotted on the x-axis on a logarithmic scale²¹ while confidence levels are indicated on the y-axis. The curves indicate the maximum losses which should not be exceeded with a certain probability and the pink and blue curves correspond to different choices for the PD parameter (0.1% and 0.5%). The vertical green line starts from the point on the x-axis corresponding to the size of a historic failure and the confidence level of not exceeding this loss with a given choice of PD can be read where the vertical green line crosses the curves.

For calculation of the fund needs, the following parameters have been set: PD has been taken as 0.1% and 0.5%; ρ as 0.2 and the asset shortfall as 15%.

²¹ I.e. doubling the distance along the axis equals a tenfold increase in the loss.

Figure 3.10: Position of the losses generated by the Mannheimer default on the estimated loss distribution function for the life business line in Germany, based on home state principle and two different probabilities of default

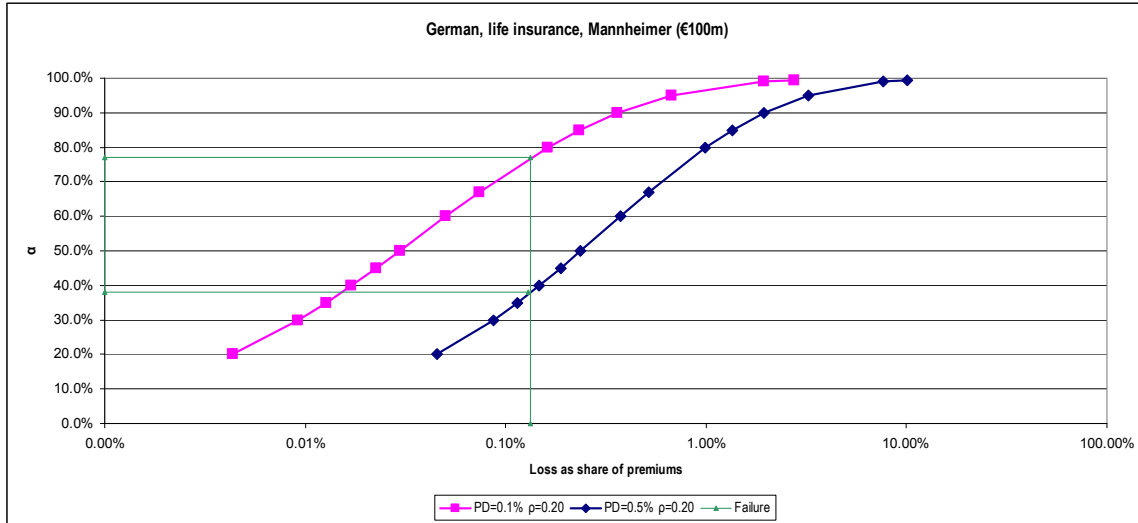


Figure 3.11: Position of the losses generated by the Plus Forsikring default on the estimated loss distribution function for the non-life business line in Denmark, based on home state principle and two different probabilities of default

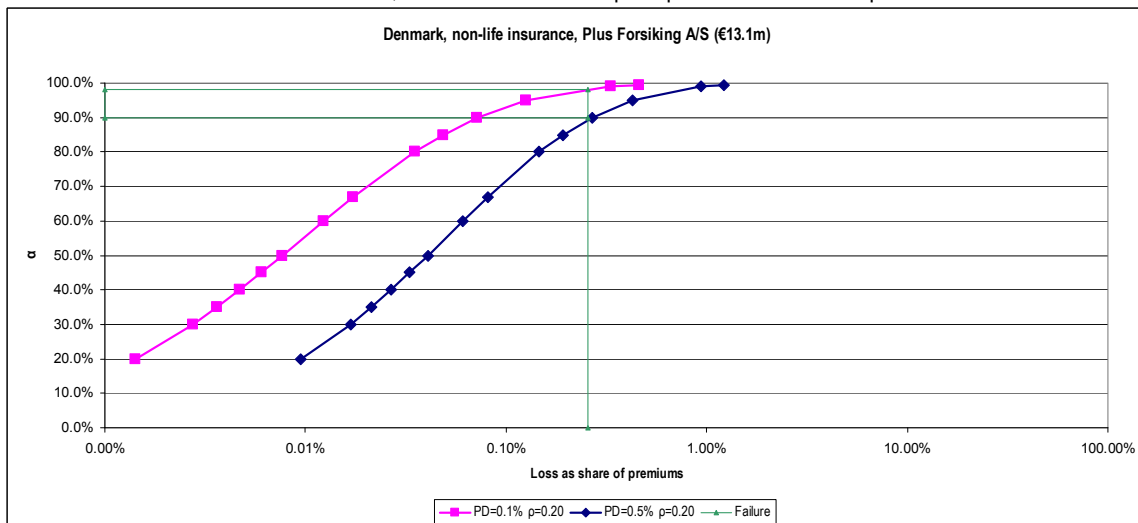


Figure 3.12: Position of the losses generated by the Independent Insurance default on the estimated loss distribution function for the non-life business line in the United Kingdom, based on home state principle and two different probabilities of default

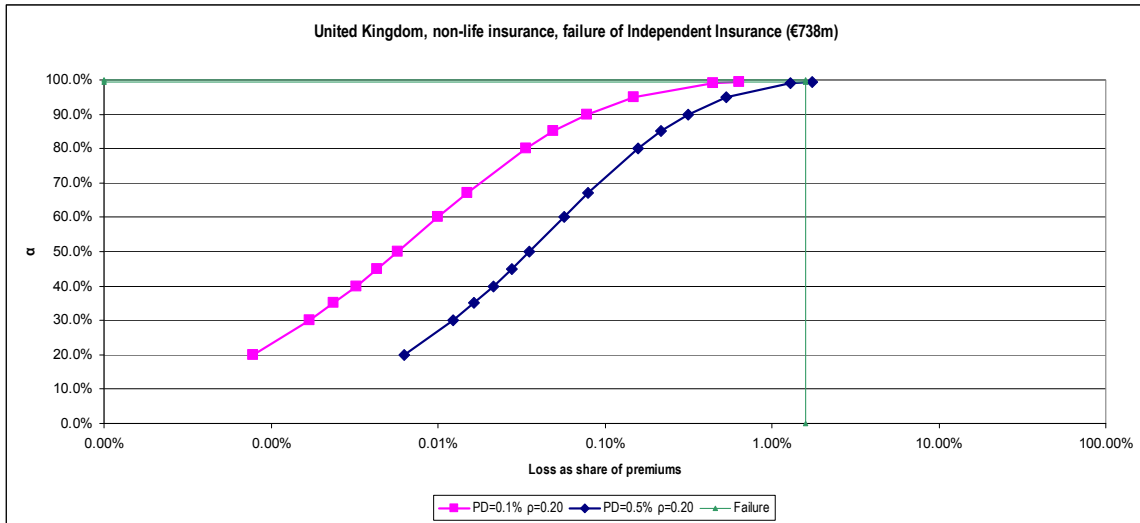
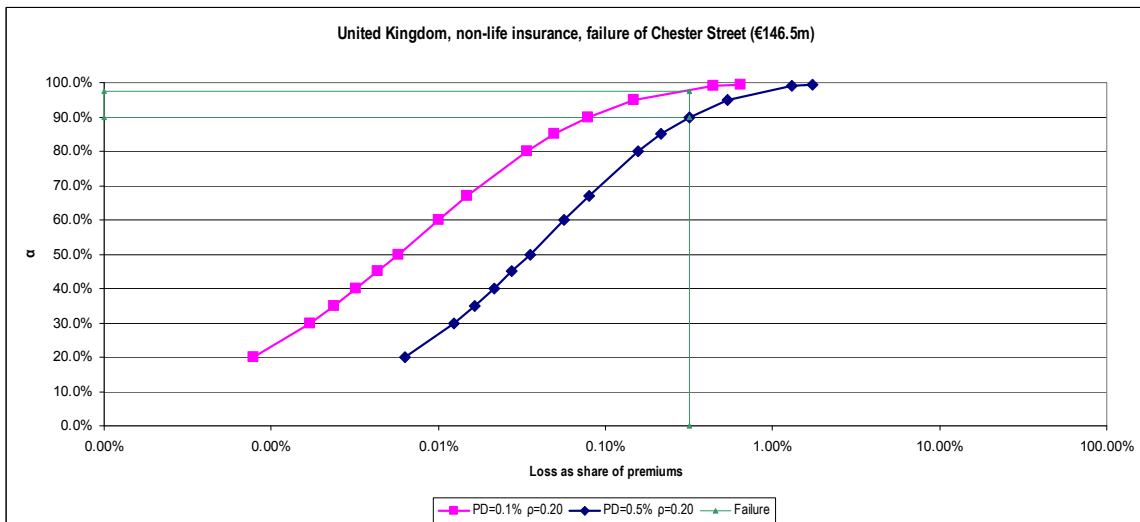


Figure 3.13: Position of the losses generated by the Chester Street default on the estimated loss distribution function for the non-life business line in the United Kingdom, based on home state principle and two different probabilities of default



4 Analysis of alternative policy options

4.1 Introduction

The previous chapter presented one specific policy option and calculated the corresponding funding needs. That option corresponded to the case where each Member State puts in place an IGS working on the basis of the home state principle, portfolio continuation and full coverage.

This chapter compares the funding needs if different policy options are introduced, such as changing the geographical scope and the nature of interventions, with that baseline case.

Policy options used in this analysis include:

- using the host state rather than the home state principle;
- using a national IGS covering domestic activities supplemented by an additional EU-wide IGS for cross-border insurance transactions:
 - a. including cross-border activities conducted under the freedom to provide services (FPS);
 - b. excluding cross-border activities conducted under the freedom to provide services;
- using a single pan-European scheme rather than national schemes;
- using a pure compensation mechanism rather than portfolio continuation/transfer.

The definition of home, host and domestic activities are presented in Table 4.3.

An overview of all the selected scenarios is given in Table 4.1.

Table 4.1: Summary of the structure of the different policy options

	Home state	Host state	Domestic w/o cross-border (FPS and branches)	Domestic w/o cross-border (branches only)	Pan-EU IGS	Home state with compensation
Status quo versus change						
Introduce a legally binding EU-wide approach to IGS	X	X	X	X	X	X
Only partially binding EU-wide approach						
No binding EU-wide approach						
Nature of intervention						
Pure compensation to claimants						X
Continuation of contracts	X	X	X	X	X	
Eligible claimants						
Natural persons only						
Natural persons + SMEs						
Natural and legal persons except financial institutions						
Natural and legal entities	X	X	X	X	X	X
Compensation limits and reductions						
Capping payouts						
Capping payouts for non-compulsory insurance						
Level of coverage in percentage terms	100	100	100	100	100	100
Level of coverage in percentage terms (compulsory)						
Fixed deductible						
Other reduction in benefits						
Policies covered						
Only life						
Only non-life						
Both life and non-life	X	X	X	X	X	X
Funding						
<i>Not covered</i>						
Ex-ante						
Ex-post						
Capping the level of contributions over a period						
Other sources of funding						
<i>Not covered</i>						
Borrowing power						
Credit facility from members in place						
State guarantee on borrowing						
Additional guarantees as private initiative (large failures)						
Geographic scope						
An IGS in each MS based on the home state principle	X					X
An IGS in each MS based on the host state principle		X				
A single EU-wide IGS					X	
An IGS in each MS covering only domestic activity and an additional IGS covering cross-border transactions			X	X		
Types of policies covered						
Without exclusions	X	X	X	X	X	X
With exclusions						

To obtain the data necessary for calculation of the funding needs under the different policy options, CEIOPS data on premiums for 2007 are used. Table 4.2 presents the data given by CEIOPS, while Table 4.3 shows how these data were used to obtain the premiums covered for different policy options.

Due to the limitations of the data currently available, δ was kept constant for each country over the different policy options. As a consequence, the probability distribution of losses remains invariant across policy options.

Moreover, in each country, due to lack of detailed data, the change of the EAD when moving from one policy option to another was adjusted proportionally to the change in the total premiums covered under each policy option with respect to the baseline case.

The combined result of these two simplifications is that at this stage the loss as a share of covered premiums will remain constant across all policy options. For this reason this result is not reported.

A further limitation of the data currently available is that the data on cross-border transactions available from CEIOPS are based on an EEA aggregation. As a consequence, figures for common schemes such as single schemes for cross-border transactions and pan-EU schemes will refer to an EEA basis.

Table 4.4 to Table 4.9 present the whole set of input parameters used for all the policy options for all three business lines considered.

Table 4.2: Gross premiums written as reported by CEIOPS: total insurance sector (including motor), all EEA countries, 2007 (m€)

	National enterprises				by branches of non-EU/EEA countries in the MS (5)	by branches of other EU/EEA countries in the MS (6)
	Total (1)	of which: under FPS in other EU/EEA countries (2)	of which: by branches in other EU/EEA countries (3)	of which: by branches in non-EU/EEA countries (4)		
AT	16 019	0	59	0	27	0
BE	30 738	428	1 437	44	0	856
BG	770	0	0	0	0	0
CY	622	48	18	55	53	27
CZ	4 647	2	10	0	9	323
DE	165 171	498	1 351	34	2 001	2 490
DK	20 302	157	1 042	225	0	0
EE	356	0	63	0	0	16
ES	55 699	0	0	0	0	0
FI	5 888	15	196	0	0	0
FR	207 231	499	3 379	1 105	913	0
GB	349 166	0	0	0	18 590	3 163
GR	4 798	0	0	0	343	75
HU	3 674	0	0	0	0	0
IE	44 234	20 014	6 123	306	73	1 842
IS	429	4	0	0	0	0
IT	100 594	840	449	194	1 562	4 798
LI	2 798*	2 776	1	3	0	0
LT	556	2	3	0	0	45
LU	11 410*	10 300	854	36	0	111
LV	437	0	17	0	0	25
MT	689	385	3	0	5	28
NL	73 392	0	0	0	1 560	0
NO	13 698	353	10	0	0	2 909
PL	11 560	0	1	0	18	0
PT	13 497	3	120	1	68	0
RO	2 105	0	0	0	0	0
SE	23 796	0	0	0	0	0
SI	1 799	1	0	0	0	0
SK	1 707	2	7	0	0	0
Total	1 167 782	36 327	15 143	2 003	25 222	16 708

Source: 'Report on Financial Conditions and Financial Stability in the European Insurance and Occupational Pension Fund Sector 2007-2008 (Risk Update)', Statistical Annex 2007, sheet 2.1: <http://www.ceiops.eu/content/view/20/24/>

* For Liechtenstein and Luxembourg the FPS activity has been included in 'National enterprises'.

Table 4.3: Calculations to obtain gross premiums written covered under different policy options. Example with data referring to the total insurance sector (life, non-life and motor), all EEA countries, 2007 (m€), assuming no exclusions or limitations are applied; numbers in column headings refer to columns in Table 4.2

	Home state principle (=1+5)	Host state principle (=1+5+6-3-4)	Cross-border (branches + FPS) (=2+3+4)	Domestic w/o cross-border (branches + FPS) (=1+5-2-3-4)	Cross-border (branches only) (=3+4)	Domestic w/o cross-border (branches only) (=1+5-3-4)	Total activity (=1+5+6)
AT	16 046	15 987	59	15 987	59	15 987	16 046
BE	30 738	30 113	1 909	28 829	1 481	29 257	31 594
BG	770	770	0	770	0	770	770
CY	675	629	121	554	73	602	702
CZ	4 656	4 969	12	4 644	10	4 646	4 979
DE	167 172	168 277	1 884	165 289	1 385	165 787	169 662
DK	20 302	19 035	1 424	18 878	1 267	19 035	20 302
EE	356	309	63	293	63	293	372
ES	55 699	55 699	0	55 699	0	55 699	55 699
FI	5 888	5 692	211	5 677	196	5 692	5 888
FR	208 144	203 660	4 983	203 161	4 484	203 660	208 144
GB	367 756	370 919	0	367 756	0	367 756	370 919
GR	5 141	5 216	0	5 141	0	5 141	5 216
HU	3 674	3 674	0	3 674	0	3 674	3 674
IE	44 307	39 720	26 443	17 864	6 429	37 878	46 149
IS	429	429	4	425	0	429	429
IT	102 156	106 311	1 483	100 673	643	101 513	106 954
LI	2 798	2 794	2 780	18	4	2 794	2 798
LT	556	598	4	551	3	553	601
LU	11 410	10 631	11 190	220	890	10 520	11 521
LV	437	445	17	420	17	420	462
MT	694	719	388	306	3	691	722
NL	74 952	74 952	0	74 952	0	74 952	74 952
NO	13 698	16 597	364	13 335	10	13 688	16 607
PL	11 578	11 577	1	11 577	1	11 577	11 578
PT	13 565	13 444	123	13 441	121	13 444	13 565
RO	2 105	2 105	0	2 105	0	2 105	2 105
SE	23 796	23 796	0	23 796	0	23 796	23 796
SI	1 799	1 799	1	1 798	0	1 799	1 799
SK	1 707	1 700	10	1 698	7	1 700	1 707
Total	1 193 004	1 192 566	53 473	1 139 531	17 146	1 175 858	1 209 712

Table 4.4: Premiums covered under different policy options, in terms of gross premiums written, for the total insurance sector (life and non-life only; excluding motor), all EEA countries, 2007 data (m€)

	Gross premiums written						
	Home	Host	Domestic + single cross-border (branches and FPS)	Domestic + single cross-border (branches only)	Pan-EU/EEA	Home state principle; pure compensation	Home state principle; compensation (including unearned premiums)
Austria	12 992	12 946	12 946	12 946		12 992	12 992
Belgium	27 886	27 413	26 447	26 804		27 886	27 886
Bulgaria	354	354	354	354		354	354
Cyprus	531	485	416	464		531	531
Czech Republic	3 338	3 630	3 330	3 331		3 338	3 338
Germany	144 749	145 772	143 227	143 663		144 749	144 749
Denmark	18 304	17 371	17 253	17 371		18 304	18 304
Estonia	193	135	130	130		193	193
Spain	42 653	42 653	42 653	42 653		42 653	42 653
Finland	4 704	4 508	4 499	4 508		4 704	4 704
France	185 825	182 441	182 057	182 441		185 825	185 825
United Kingdom	351 427	353 767	351 427	351 427		351 427	351 427
Greece	3 537	3 569	3 537	3 537		3 537	3 537
Hungary	2 728	2 728	2 728	2 728		2 728	2 728
Ireland	41 428	37 864	17 538	36 371		41 428	41 428
Iceland	223	223	222	223		223	223
Italy	78 452	81 778	77 519	78 046		78 452	78 452
Liechtenstein	2 798	2 794	18	2 794		2 798	2 798
Lithuania	326	359	324	325		326	326
Luxembourg	11 107	10 320	417	10 228		11 107	11 107
Latvia	224	241	217	217		224	224
Malta	454	468	257	452		454	454
The Netherlands	70 162	70 162	70 162	70 162		70 162	70 162
Norway	12 179	13 979	11 958	12 173		12 179	12 179
Poland	8 634	8 633	8 633	8 633		8 634	8 634
Portugal	11 561	11 453	11 451	11 453		11 561	11 561
Romania	1 044	1 044	1 044	1 044		1 044	1 044
Sweden	20 316	20 316	20 316	20 316		20 316	20 316
Slovenia	1 246	1 246	1 246	1 246		1 246	1 246
Slovakia	1 161	1 158	1 157	1 158		1 161	1 161
Cross-border scheme			44 254	10 539			
Pan-EEA scheme					1 057 738		

Table 4.5: Input parameters (EAD and δ) under different policy options, total insurance sector (life and non-life only; excluding motor), all EEA countries, 2007 (EAD in m€)

Name	δ	EAD						Home state principle; compensation (including unearned premiums)
		Home	Host	Domestic + single cross-border (branches and FPS)	Domestic + single cross-border (branches only)	Pan-EU/EEA	Home state principle; pure compensation	
Austria	0.13	67 554	67 317	67 317	67 317		59 911	60 583
Belgium	0.13	190 151	186 928	180 338	182 773		167 926	167 926
Bulgaria	0.07	392	392	392	392		338	358
Cyprus	0.15	3 078	2 811	2 413	2 691		2 814	2 814
Czech Republic	0.10	8 994	9 780	8 971	8 974		6 632	6 632
Germany	0.05	1 006 801	1 013 915	996 216	999 247		945 831	948 962
Denmark	0.05	135 949	129 020	128 145	129 020		118 926	118 975
Estonia	0.30	569	398	383	383		522	526
Spain	0.06	213 026	213 026	213 026	213 026		190 826	192 003
Finland	0.21	44 020	42 186	42 099	42 186		40 358	40 481
France	0.08	1 347 573	1 323 032	1 320 242	1 323 032		1 233 672	1 241 835
United Kingdom	0.07	2 092 219	2 106 151	2 092 219	2 092 219		1 976 408	1 978 512
Greece	0.09	9 495	9 582	9 495	9 495		8 249	8 256
Hungary	0.04	5 887	5 887	5 887	5 887		4 737	4 737
Ireland	0.08	161 216	147 348	68 250	141 537		148 896	148 896
Iceland	0.19	795	795	788	795		440	479
Italy	0.12	423 251	441 195	418 216	421 060		387 111	388 629
Liechtenstein	N.A.	N.A.	N.A.	N.A.	N.A.		0	0
Lithuania	0.10	643	708	640	641		542	554
Luxembourg	0.02	80 074	74 404	3 009	73 738		71 814	71 911
Latvia	0.13	269	288	260	260		218	218
Malta	0.17	1 980	2 042	1 123	1 973		1 489	1 502
The Netherlands	0.10	313 024	313 024	313 024	313 024		300 900	300 900
Norway	0.23	86 755	99 576	85 184	86 711		78 965	79 007
Poland	0.19	20 855	20 852	20 852	20 852		17 129	17 320
Portugal	0.14	45 402	44 978	44 971	44 978		41 409	41 531
Romania	0.04	1 468	1 468	1 468	1 468		1 053	1 173
Sweden	0.12	238 147	238 147	238 147	238 147		188 189	189 240
Slovenia	0.23	3 897	3 897	3 895	3 897		2 171	2 473
Slovakia	0.16	2 860	2 853	2 851	2 853		2 367	2 372
Cross-border scheme				236 521	77 766			
Pan-EEA scheme						6 506 344		

Table 4.6: Premiums covered under different policy options, in terms of gross premiums written, life business line, all EEA countries, 2007 data (m€)

	Gross premiums written					Home state principle; pure compensation
	Home	Host	Domestic + single cross-border (branches and FPS)	Domestic + single cross-border (branches only)	Pan-EU/EEA	
Austria	7 141	7 121	7 121	7 121		7 141
Belgium	22 179	22 011	21 680	21 895		22 179
Bulgaria	120	120	120	120		120
Cyprus	358	312	251	299		358
Czech Republic	2 034	2 305	2 029	2 030		2 034
Germany	75 170	75 937	74 771	75 012		75 170
Denmark	13 190	13 112	13 095	13 112		13 190
Estonia	118	55	55	55		118
Spain	23 455	23 455	23 455	23 455		23 455
Finland	2 784	2 588	2 588	2 588		2 784
France	136 528	135 578	135 445	135 578		136 528
United Kingdom	305 184	305 194	305 184	305 184		305 184
Greece	2 504	2 509	2 504	2 504		2 504
Hungary	2 017	2 017	2 017	2 017		2 017
Ireland	37 563	35 373	17 101	34 348		37 563
Iceland	34	34	34	34		34
Italy	61 438	64 169	60 899	61 202		61 438
Liechtenstein	2 756	2 756	21	2 756		2 756
Lithuania	204	232	204	204		204
Luxembourg	10 093	9 281	0	9 252		10 093
Latvia	53	76	53	53		53
Malta	214	217	209	214		214
The Netherlands	26 437	26 437	26 437	26 437		26 437
Norway	9 838	9 944	9 838	9 838		9 838
Poland	6 743	6 742	6 742	6 742		6 743
Portugal	9 205	9 112	9 111	9 112		9 205
Romania	415	415	415	415		415
Sweden	12 985	12 985	12 985	12 985		12 985
Slovenia	443	443	443	443		443
Slovakia	848	848	848	848		848
Cross-border scheme			33 639	3 442		
Pan-EEA scheme					769 296	

Table 4.7: Input parameters (EAD and δ) under different policy options, life business line, all EEA countries, 2007 data (EAD in m€)

Name	δ	EAD					
		Home	Host	Domestic + single cross-border (branches and FPS)	Domestic + single cross-border (branches only)	Pan-EU/EEA	Home state principle; pure compensation
Austria	0.12	58 188	58 028	58 028	58 028		53 452
Belgium	0.14	168 163	166 891	164 380	166 012		152 592
Bulgaria	0.12	203	203	203	203		183
Cyprus	0.18	2 717	2 367	1 904	2 268		2 564
Czech Republic	0.15	6 544	7 415	6 528	6 530		5 448
Germany	0.05	765 180	772 985	761 114	763 568		736 269
Denmark	0.07	118 090	117 390	117 243	117 390		112 060
Estonia	0.33	509	237	237	237		464
Spain	0.05	164 938	164 938	164 938	164 938		153 808
Finland	0.21	37 099	34 487	34 487	34 487		34 770
France	0.08	1 189 627	1 181 346	1 180 195	1 181 346		1 114 114
United Kingdom	0.06	2 034 005	2 034 070	2 034 005	2 034 005		1 898 896
Greece	0.10	7 630	7 645	7 630	7 630		6 897
Hungary	0.05	5 282	5 282	5 282	5 282		4 651
Ireland	0.08	147 444	138 848	67 126	134 825		136 608
Iceland	0.35	147	147	147	147		111
Italy	0.11	389 126	406 424	385 715	387 632		364 670
Liechtenstein	0.03	0	0	0	0		0
Lithuania	0.12	525	598	525	525		449
Luxembourg	0.02	76 571	70 414	0	70 189		69 366
Latvia	0.28	83	119	83	83		70
Malta	0.20	1 293	1 310	1 260	1 291		1 148
The Netherlands	0.11	266 317	266 317	266 317	266 317		252 736
Norway	0.23	79 468	80 324	79 468	79 468		73 074
Poland	0.18	17 059	17 056	17 056	17 056		14 664
Portugal	0.14	40 297	39 891	39 886	39 891		37 423
Romania	0.05	781	781	781	781		678
Sweden	0.10	191 510	191 510	191 510	191 510		161 984
Slovenia	0.21	2 041	2 041	2 039	2 041		1 677
Slovakia	0.14	2 299	2 299	2 299	2 299		2 007
Cross-border scheme				182 750	37 157		
Pan-EEA scheme						5 773 137	

Table 4.8: Premiums covered under different policy options, in terms of gross premiums written, non-life business line, all EEA countries, 2007 data (m€)

	Gross premiums written						
	Home	Host	Domestic + single cross-border (branches and FPS)	Domestic + single cross-border (branches only)	Pan-EU/EEA	Home state principle; pure compensation	Home state principle; compensation (including unearned premiums)
Austria	5 851	5 825	5 825	5 825		5 851	5 851
Belgium	5 707	5 402	4 766	4 908		5 707	5 707
Bulgaria	234	234	234	234		234	234
Cyprus	173	173	166	166		173	173
Czech Republic	1 304	1 325	1 301	1 301		1 304	1 304
Germany	69 579	69 835	68 456	68 651		69 579	69 579
Denmark	5 114	4 259	4 158	4 259		5 114	5 114
Estonia	75	80	75	75		75	75
Spain	19 198	19 198	19 198	19 198		19 198	19 198
Finland	1 920	1 920	1 911	1 920		1 920	1 920
France	49 297	46 864	46 611	46 864		49 297	49 297
United Kingdom	46 243	48 573	46 243	46 243		46 243	46 243
Greece	1 032	1 060	1 032	1 032		1 032	1 032
Hungary	712	712	712	712		712	712
Ireland	3 865	2 491	437	2 023		3 865	3 865
Iceland	189	189	187	189		189	189
Italy	17 014	17 609	16 620	16 844		17 014	17 014
Liechtenstein	43	38	-2	38		43	43
Lithuania	122	127	120	121		122	122
Luxembourg	1 014	1 039	417	976		1 014	1 014
Latvia	171	165	164	164		171	171
Malta	240	251	49	238		240	240
The Netherlands	43 725	43 725	43 725	43 725		43 725	43 725
Norway	2 341	4 035	2 120	2 335		2 341	2 341
Poland	1 890	1 890	1 890	1 890		1 890	1 890
Portugal	2 356	2 341	2 340	2 341		2 356	2 356
Romania	629	629	629	629		629	629
Sweden	7 331	7 331	7 331	7 331		7 331	7 331
Slovenia	803	803	803	803		803	803
Slovakia	313	310	310	310		313	313
Cross-border scheme			10 615	7 135			
Pan-EEA scheme					288 442		

Table 4.9: Input parameters (EAD and δ) under different policy options, non-life business line, all EEA countries, 2007 data (EAD in m€)

Name	δ	EAD						
		Home	Host	Domestic + single cross-border (branches and FPS)	Domestic + single cross-border (branches only)	Pan-EU/EEA	Home state principle; pure compensation	Home state principle; compensation (including unearned premiums)
Austria	0.14	10 984	10 936	10 936	10 936		6 459	7 131
Belgium	0.09	19 236	18 209	16 067	16 545		15 334	15 334
Bulgaria	0.05	212	212	212	212		155	175
Cyprus	0.07	344	344	329	329		250	250
Czech Republic	0.02	1 877	1 907	1 872	1 873		1 184	1 184
Germany	0.05	248 637	249 552	244 626	245 321		209 563	212 693
Denmark	0.01	10 074	8 390	8 191	8 390		6 865	6 915
Estonia	0.25	101	108	101	101		58	61
Spain	0.06	50 081	50 081	50 081	50 081		37 017	38 195
Finland	0.20	7 888	7 888	7 850	7 888		5 588	5 711
France	0.07	168 067	159 770	158 909	159 770		119 558	127 721
United Kingdom	0.07	103 562	108 780	103 562	103 562		77 512	79 616
Greece	0.05	1 693	1 738	1 693	1 693		1 352	1 360
Hungary	0.03	340	340	340	340		86	86
Ireland	0.01	13 425	8 653	1 519	7 027		12 288	12 288
Iceland	0.17	650	650	644	650		329	368
Italy	0.13	32 622	33 763	31 866	32 296		22 441	23 959
Liechtenstein	0.04	0	0	0	0		0	0
Lithuania	0.06	157	164	155	156		93	105
Luxembourg	0.03	3 558	3 645	1 464	3 425		2 449	2 545
Latvia	0.08	191	184	183	183		147	147
Malta	0.13	589	616	120	585		340	354
The Netherlands	0.09	82 629	82 629	82 629	82 629		48 165	48 165
Norway	0.21	7 803	13 450	7 068	7 782		5 890	5 933
Poland	0.24	3 490	3 490	3 490	3 490		2 465	2 657
Portugal	0.14	4 992	4 960	4 958	4 960		3 986	4 109
Romania	0.03	646	646	646	646		375	495
Sweden	0.16	53 695	53 695	53 695	53 695		26 205	27 256
Slovenia	0.24	1 455	1 455	1 455	1 455		495	797
Slovakia	0.23	496	492	490	492		361	366
Cross-border scheme				34 345	22 982			
Pan-EEA scheme						829 493		

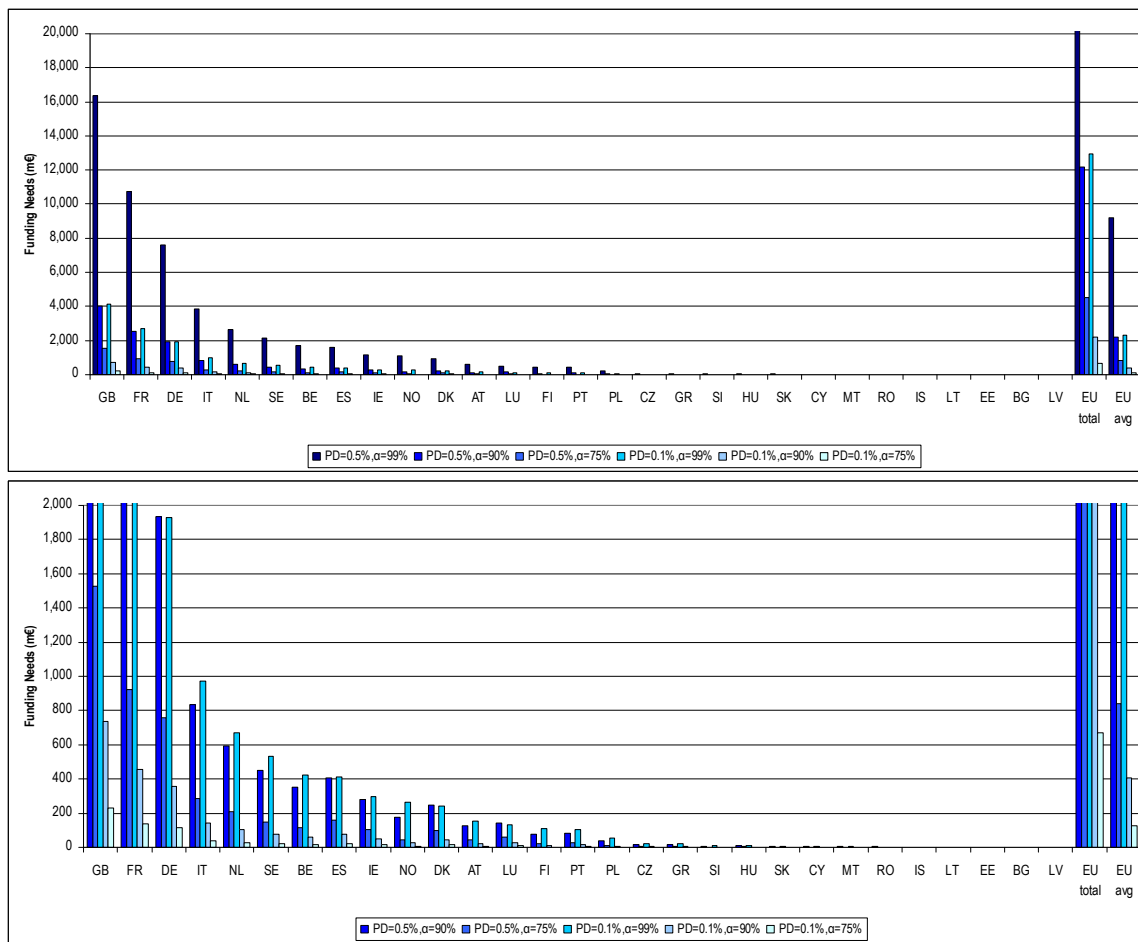
4.2 Using the host state rather than the home state principle

Under this option an IGS should be put in place in each Member State using the host state principle to determinate the policies covered. In this case the total premiums covered can be calculated using totals under national supervision plus the branches of EU/EEA countries operating in the country minus branches from the country operating in other EU/EEA or in non-EU/EEA countries.

As no data is available for the calculation of a different δ under different policy options, δ is kept constant in these estimates, while total premiums and EAD are adjusted.

4.2.1 Total insurance

Figure 4.1: IGS funding needs for the total insurance sector based on the host state principle for different confidence levels and default probabilities, all EEA countries, EU total and 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 $\alpha=99\%$



The funding needs obtained for this policy option are then compared with those obtained under the home state principle. As δ has been kept constant across policy options, the probability distribution of losses remains unchanged in the two cases. This leads to a constant relative impact for each country and each choice of PD and α when moving from the home state to the host state principle. Relative differences in funding needs at country level are shown in Figure 4.2 and Table 4.10. Differences in the EU totals are presented in Table 4.14.

Figure 4.2: Relative difference between funding needs when moving from the home state principle to the host state principle, total insurance sector, all EEA countries, countries in order of gross premiums written.

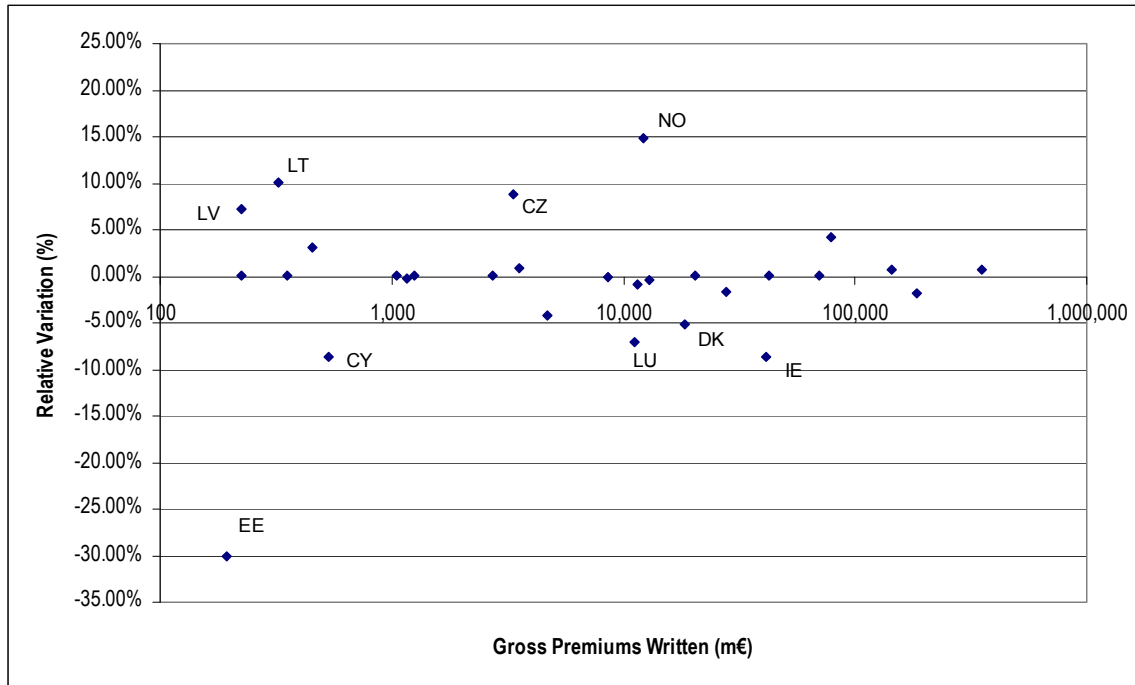


Table 4.10: Summary of relative differences between funding needs when moving from the home state principle to the host state principle, EU average and minimum, median and maximum across all EEA countries; total insurance sector

MIN		MEDIAN		MAX		EU avg
-30.00%	EE	0.00%	NL	14.78%	NO	0.29%

4.2.2 Life insurance

Figure 4.3: IGS funding needs for the life business line based on the host state principle for different confidence levels and default probabilities, all EEA countries, EU total and 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 $\alpha=99\%$

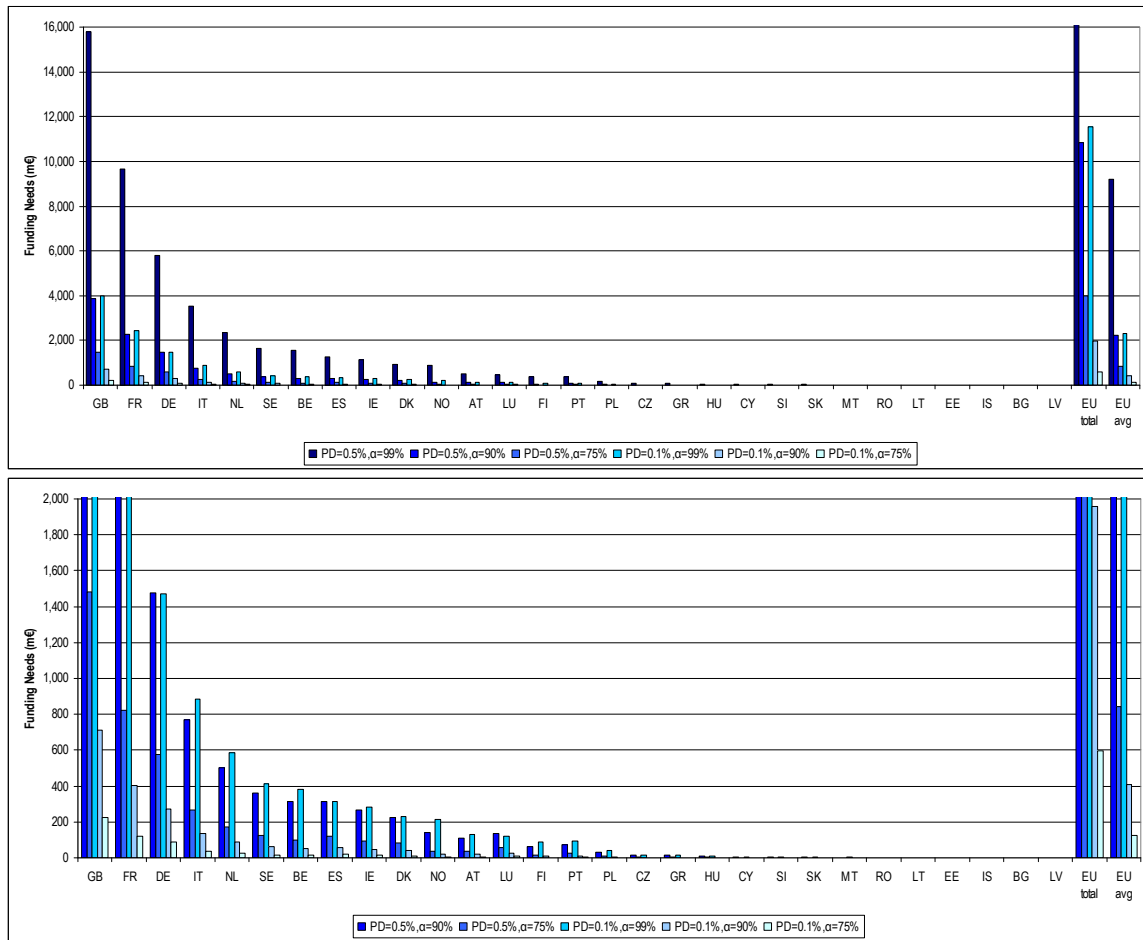


Figure 4.4: Relative difference between funding needs when moving from the home state principle to the host state principle, life business line; all EEA countries; countries in order of gross premiums written in the life business line

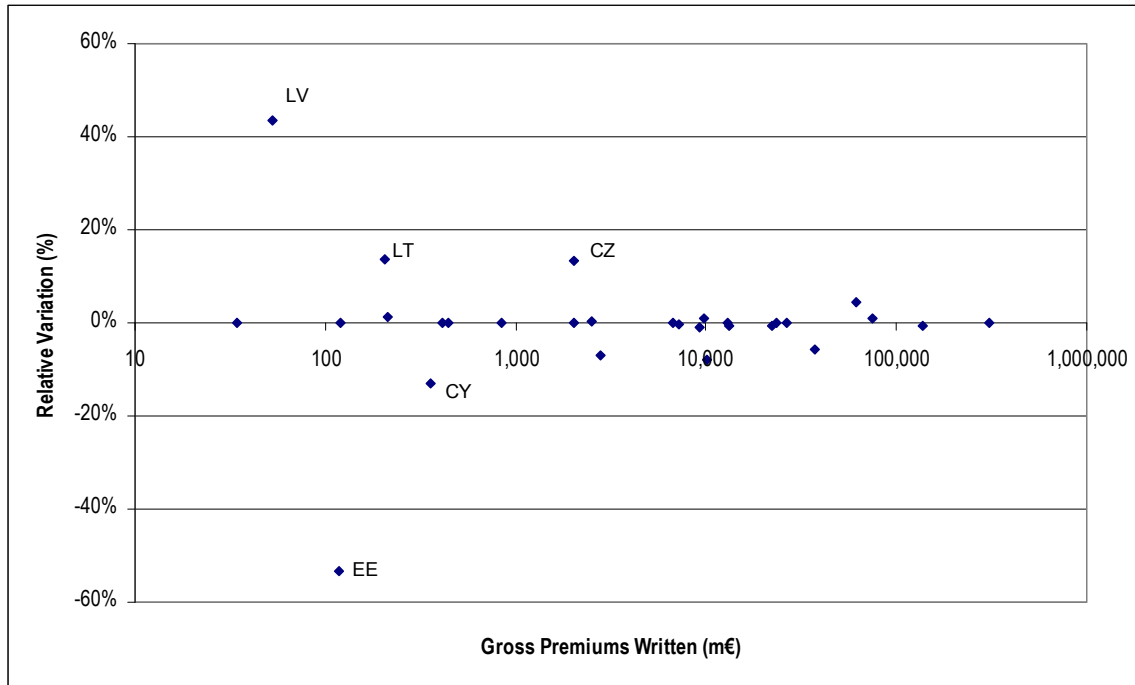


Table 4.11: Summary of relative differences between funding needs when moving from the home state principle to the host state principle; EU average and minimum, median and maximum across all EEA countries; life business line

MIN		MEDIAN		MAX		EU avg
-53.39%	EE	0.00%	NL	43.40%	LV	0.14%

4.2.3 Non-life insurance

Figure 4.5: IGS funding needs for the non-life business line based on the host state principle for different confidence levels and default probabilities, all EEA countries, EU total and 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 $\alpha=99\%$

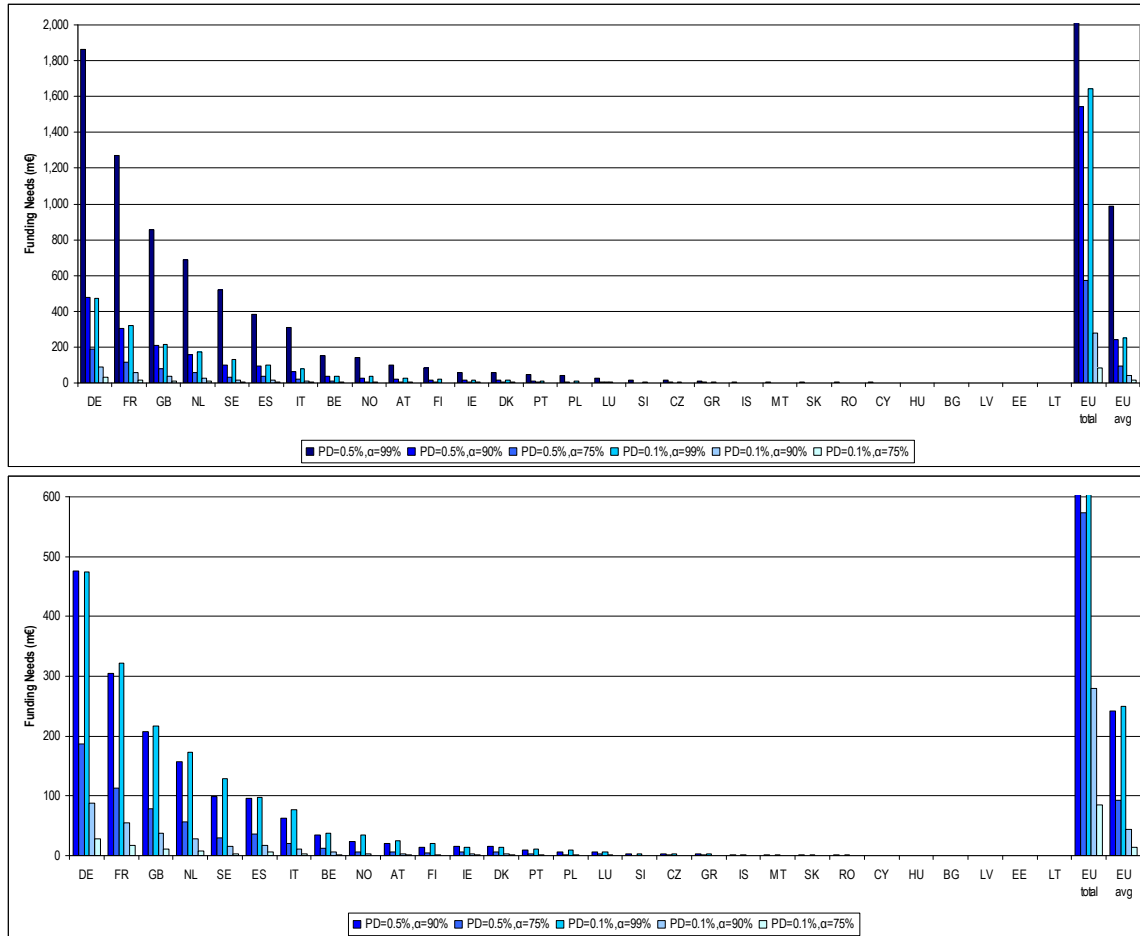


Figure 4.6: Relative difference between funding needs when moving from the home state principle to the host state principle, non-life business line, all EEA countries, countries in order of gross premiums written in the non-life business line

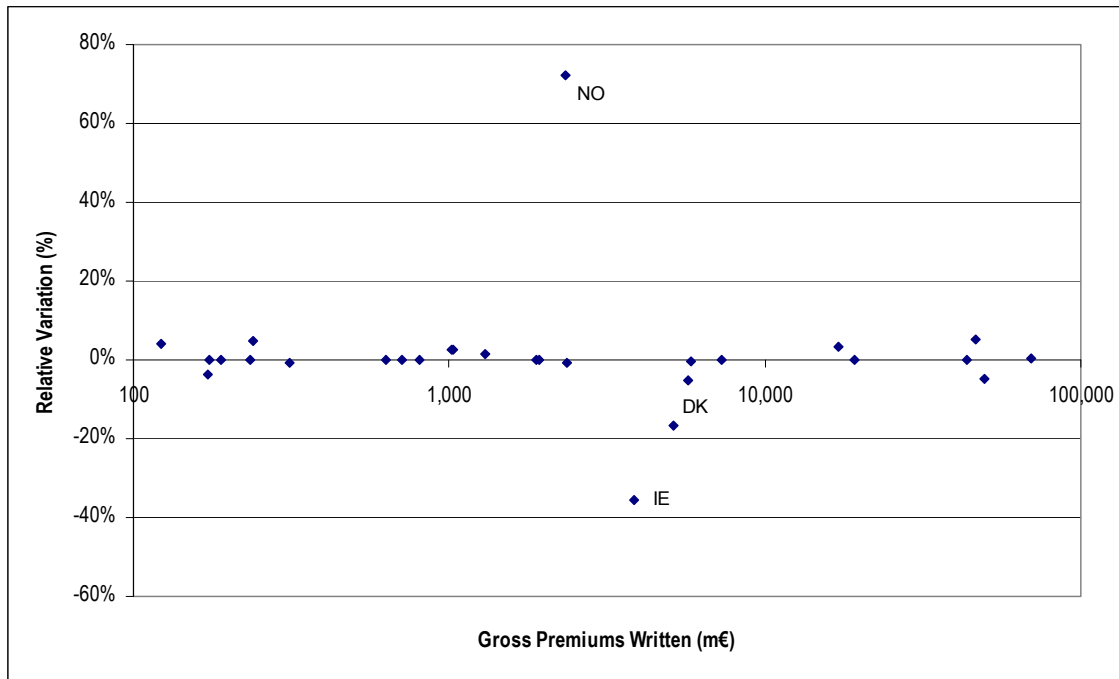


Table 4.12: Summary of relative differences between funding needs when moving from the home state principle to the host state principle; EU average and minimum, median and maximum across all EEA countries; non-life business line

MIN		MEDIAN		MAX		EU avg
-35.54%	IE	0.00%	NL	72.36%	NO	0.04%

4.2.4 Summary of statistics at EU level

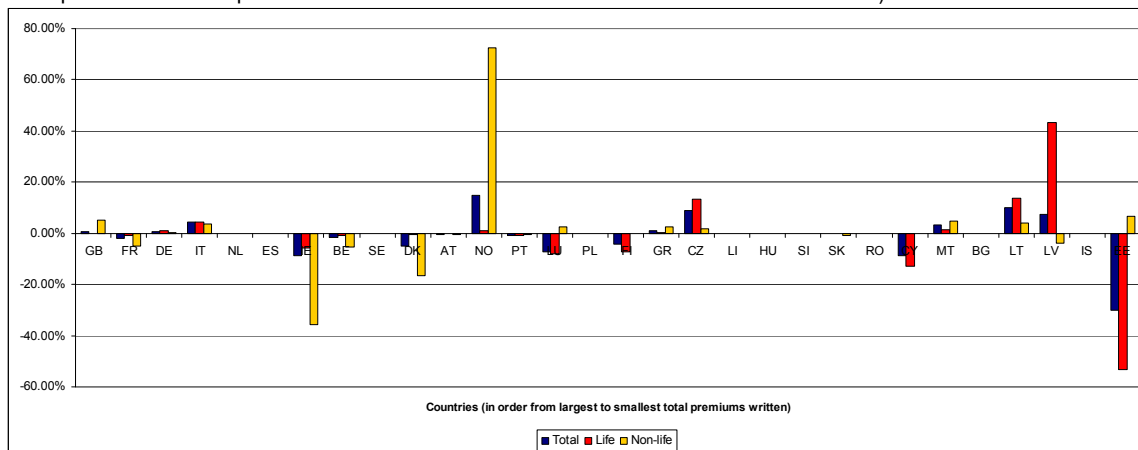
Table 4.13: Average funding needs at EU level based on the host state principle under different probabilities of default and confidence levels; weighted averages by gross premiums written for the total insurance sector and the life and non-life business lines (in m€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	75%	90%	99%	75%	90%	99%
Total insurance (EU)	840	2 229	9 177	126	407	2 323
Life (EU)	841	2 232	9 194	126	407	2 327
Non-life (EU)	92	242	986	14	44	250

Table 4.14: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle to the host state principle under different probabilities of default and confidence levels for the total insurance sector and the life and non-life business lines (in m€)

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		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 host	4 516	12 180	51 345	671	2 203	12 968
	Relative variation	-0.28%	-0.27%	-0.26%	-0.29%	-0.27%	-0.26%
Life (EU)	Funding needs under home	4 010	10 833	45 751	595	1 958	11 554
	Funding needs under host	4 008	10 828	45 733	595	1 957	11 549
	Relative variation	-0.05%	-0.04%	-0.04%	-0.06%	-0.05%	-0.04%
Non-life (EU)	Funding needs under home	580	1 559	6 577	86	282	1 660
	Funding needs under host	573	1 543	6 519	85	279	1 645
	Relative variation	-1.14%	-1.02%	-0.89%	-1.23%	-1.08%	-0.89%

Figure 4.7: Relative difference between funding needs when moving from the home state principle to the host state principle for the total insurance sector and the life and non-life business lines, for all EEA countries (relative differences are equal across model parameterizations due to use of the same loss distribution function)



4.3 Setting up an EU-wide IGS covering cross-border activity (branches and FPS)

This section analyses the possibility of introducing an IGS in each Member State, covering all domestic activity²², supplemented by an additional pan-EU scheme covering all cross-border activities, including those conducted under the freedom to provide services (FPS). Under this option the premiums covered by the national schemes covering domestic activity are obtained by starting from the total premiums under national supervision and subtracting premiums from branches, in both EU/EEA and non-EU/EEA countries and from activities conducted under the FPS²³.

Once the funding needs under the domestic activity principle are calculated, the funding needs for the additional cross-border IGS are obtained by adding up the differences between the funding needs based on the home state principle across all countries and the funding needs based on the domestic activity principle²⁴.

Note that the data available for Luxembourg on the life business line indicate domestic activity equal to zero. Again, due to lack of data for recalculation of δ under this policy option, the values of this parameter have been kept constant at to the values presented in section 2.

Under the assumption that there will be no appreciable diversification effects obtained by pooling the cross-border fraction at EU level the total amount of funds payable to the two funds (the domestic and the EU-wide) at country level will stay the same. As a consequence, the EU-level variation in funding needs due to introduction of this additional IGS can be obtained by adding up the individual differences across Member States.

²² The definition of home, host and domestic activities are presented in Table 4.3.

²³ As explained in section 4.1, 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 referring to this option.

²⁴ The implicit assumptions are that the single correlation factor in the model operates at country level only (decreasing the estimated funding needs for the additional scheme) and that no appreciable diversification effects are obtained by pooling the cross-border fraction at EU level (increasing the estimated funding needs for the additional scheme).

4.3.1 Total insurance

Figure 4.8: IGS funding needs for the total insurance sector under a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, for different confidence levels and default probabilities, all EEA countries, EU total and 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 $\alpha=99\%$

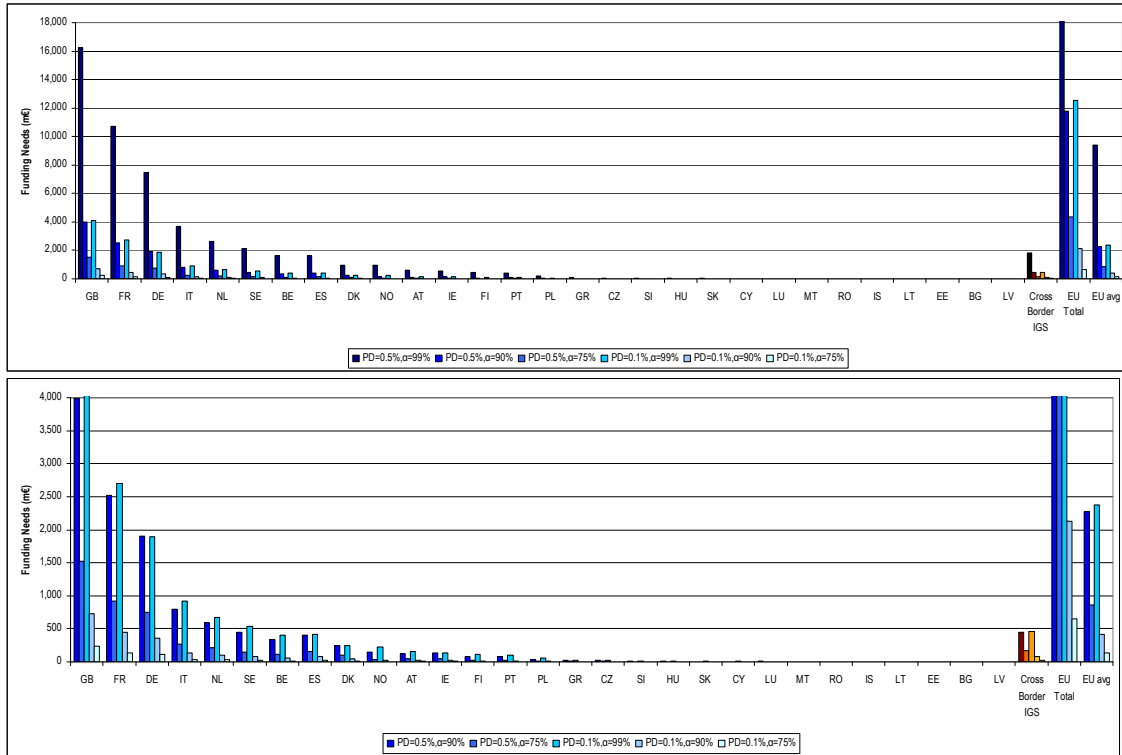


Figure 4.9: Absolute difference between funding needs when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, total insurance sector; all EEA countries; countries in order of funding needs (the sum of all the differences at country level gives the funding needs for the additional cross-border scheme)

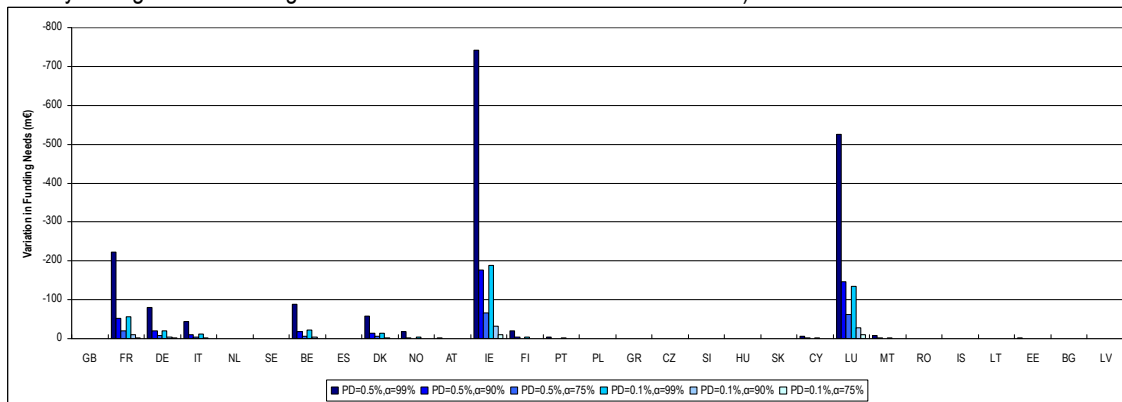


Figure 4.10: Relative difference between funding needs at country level when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, total insurance sector; all EEA countries; countries in order of gross premiums written

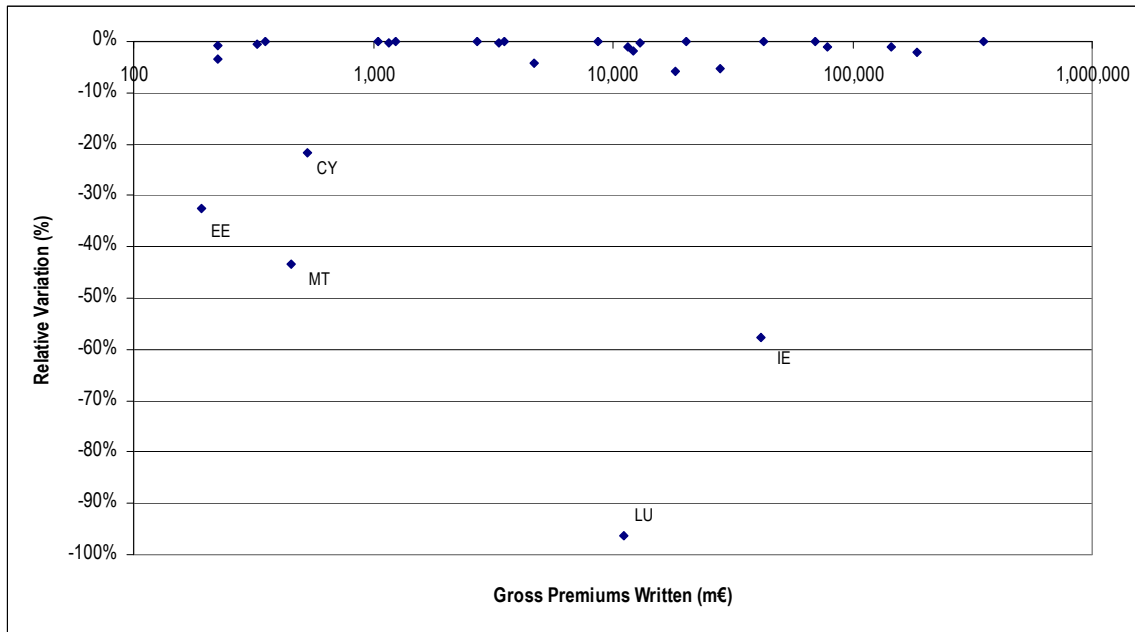


Table 4.15: Summary of relative difference between funding needs at country level when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS; EU average and minimum, median and maximum across all EEA countries; total insurance sector

MIN		MEDIAN		MAX		EU avg
-96.24%	LU	-0.78%	IS	0.00%	GB	2.84%

4.3.2 Life insurance

Figure 4.11: IGS funding needs for the life business line under a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, for different confidence levels and default probabilities, all EEA countries, EU total and 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 $\alpha=99\%$

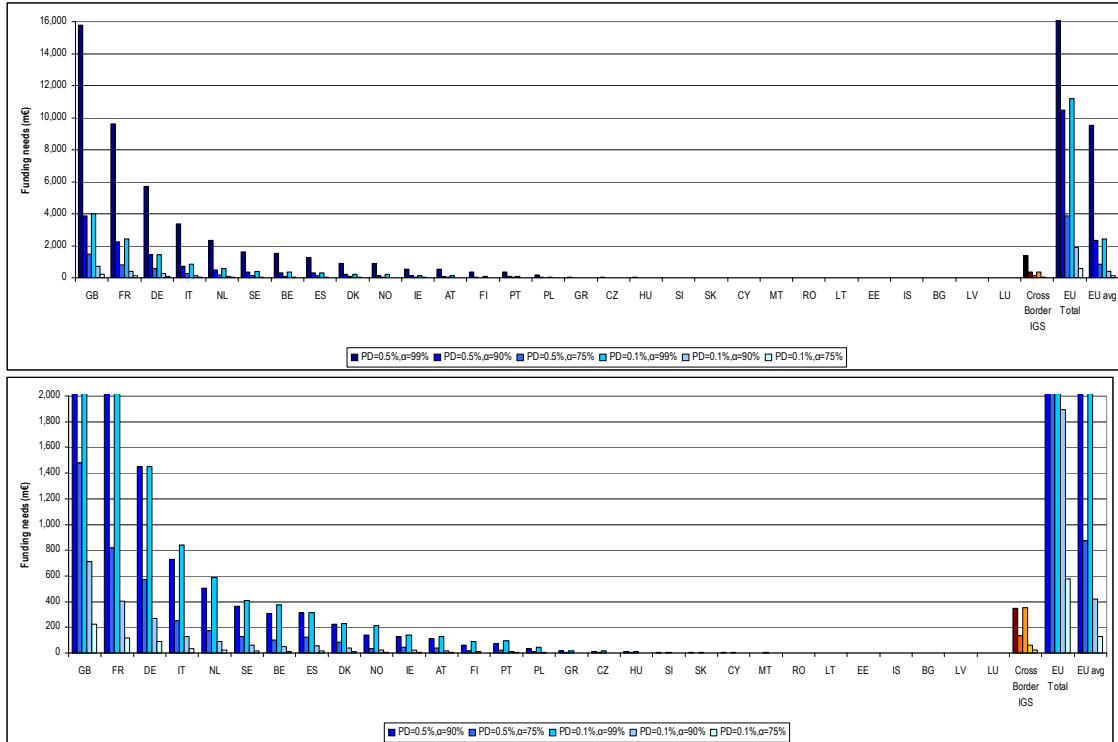


Figure 4.12: Absolute difference between funding needs when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, life business line; all EEA countries; countries in order of funding needs (the sum of all the differences at country level gives the funding needs for the additional cross-border scheme)

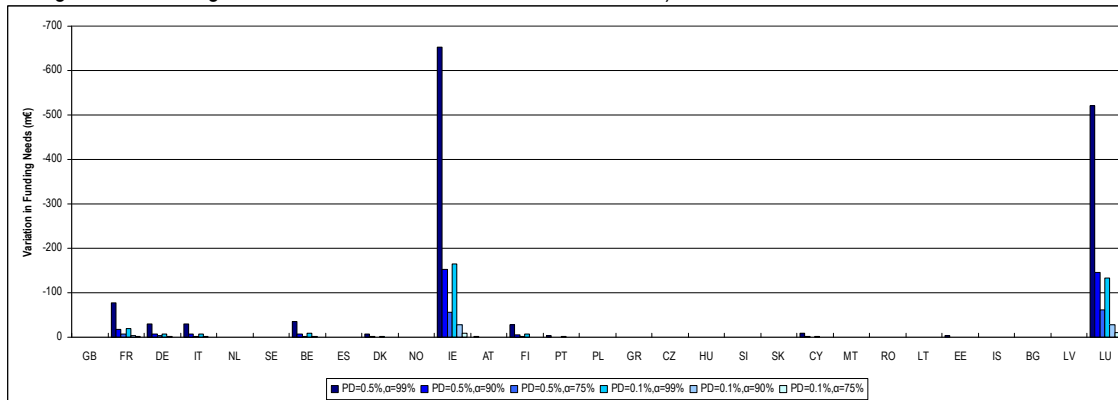


Figure 4.13: Relative difference between funding needs at country level when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, life business line; all EEA countries; countries in order of gross premiums written

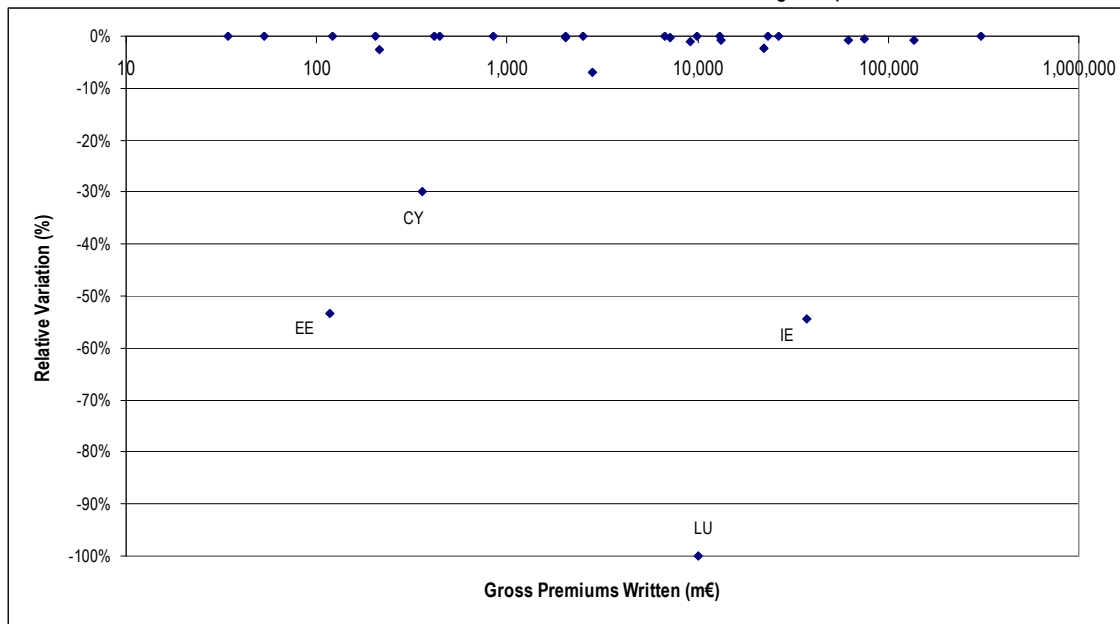


Table 4.16: Relative difference between funding needs at country level when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS; EU average and minimum, median and maximum across all EEA countries; life business line

MIN		MEDIAN		MAX		EU avg
-100.00%	LU	-0.09%	SI	0.00%	GR	3.93%

4.3.3 Non-life insurance

Figure 4.14: IGS funding needs for the non-life insurance business line under a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, 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 $\alpha=99\%$

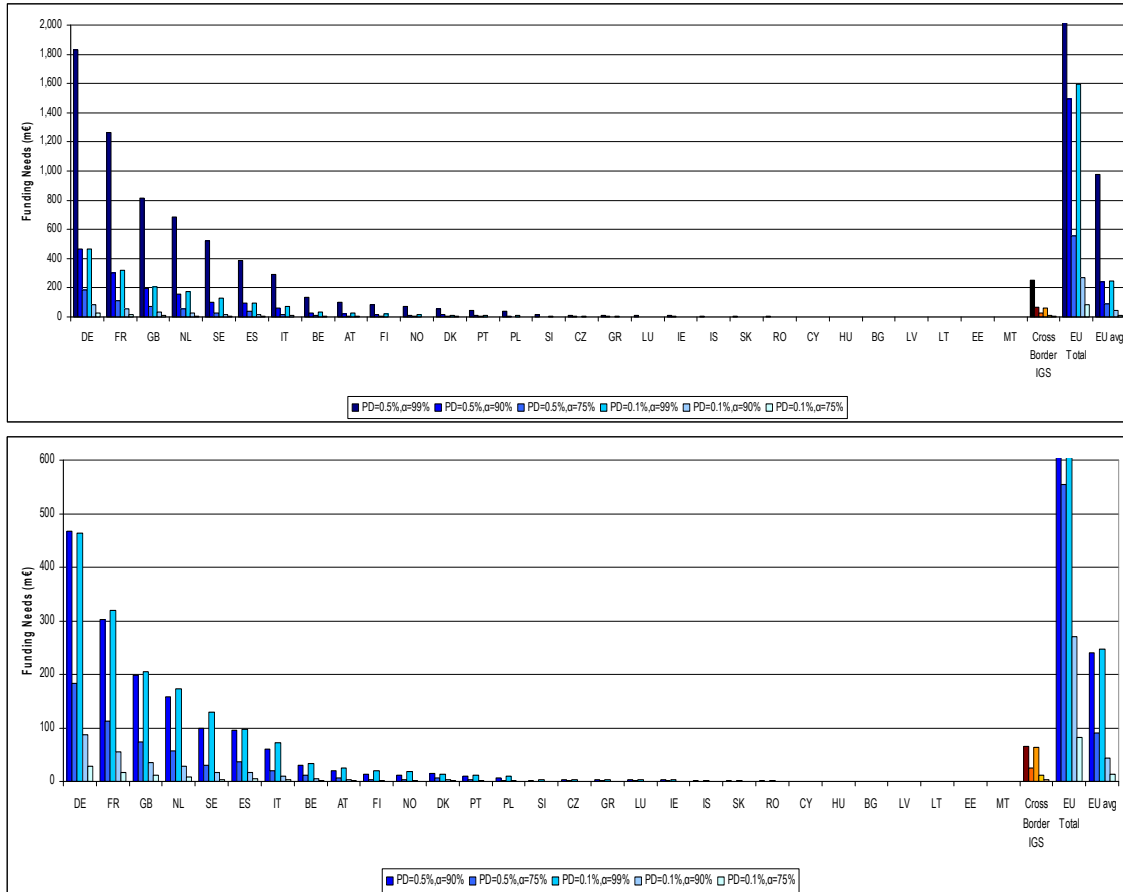


Figure 4.15: Relative difference between funding needs when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, non-life business line; all EEA countries; countries in order of funding needs (the sum of all the differences at country level gives the funding needs for the additional cross-border scheme)

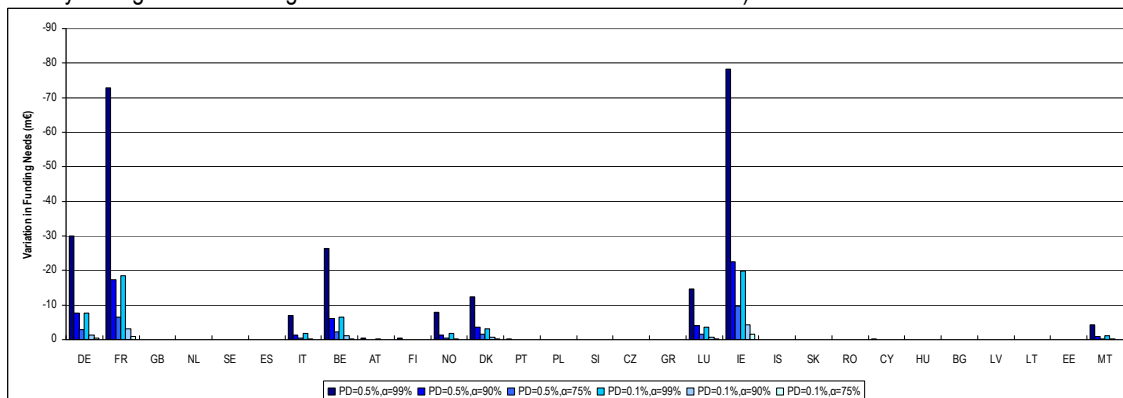


Figure 4.16: Relative difference between funding needs at country level when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, non-life business line; all EEA countries; countries in order of gross premiums written

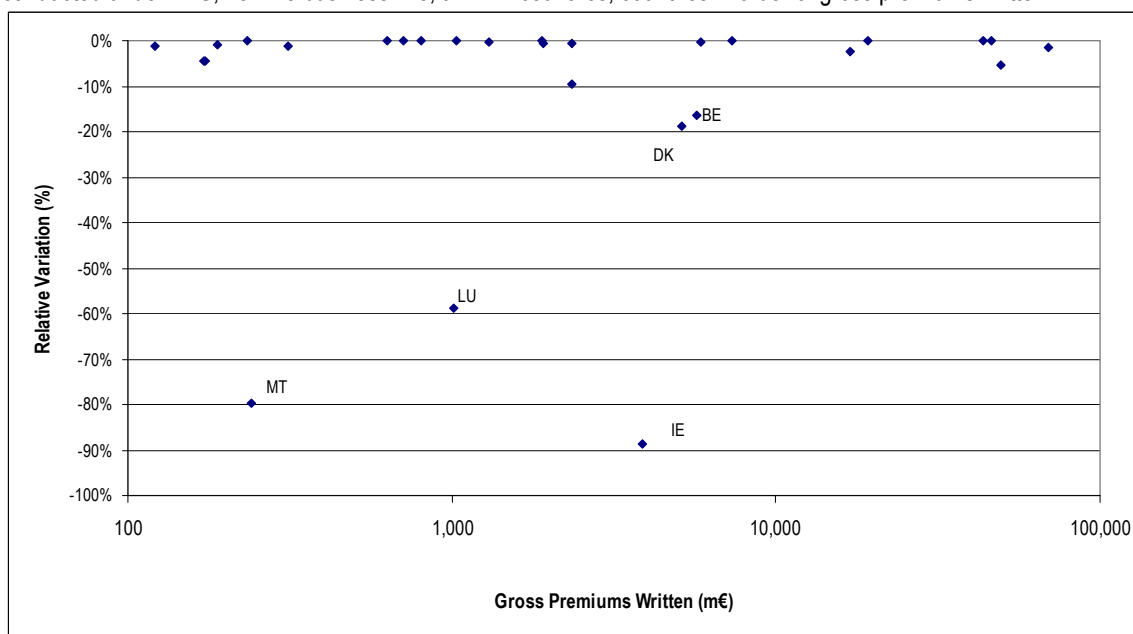


Table 4.17: Summary of relative differences between funding needs at country level when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS; EU average and minimum, median and maximum across all EEA countries; non-life business line

MIN		MEDIAN		MAX		EU avg
-88.69%	IE	-0.68%	PT	0.00%	GB	-0.69%

4.3.4 Summary of statistics at EU level

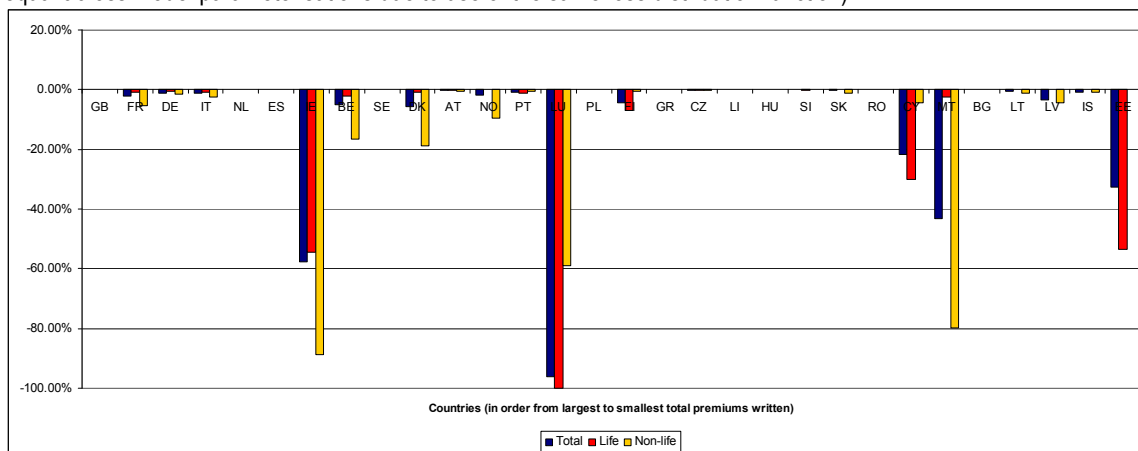
Table 4.18: Average funding needs at EU level under a domestic activity regime excluding all cross-border activities; under different probabilities of default and confidence levels; weighted averages by gross premiums written, for the total insurance sector and the life and non-life business lines (in m€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	75%	90%	99%	75%	90%	99%
Total insurance (EU)	860	2 280	9 385	129	416	2 376
Life (EU)	874	2 317	9 542	131	423	2 415
Non-life (EU)	91	240	978	14	44	248

Table 4.19: Total funding needs at EU level and relative variations in funding needs when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS; under different probabilities of default and confidence levels for the total insurance sector and the life and non-life business lines (in m€)

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		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	4 357	11 766	49 673	647	2 127	12 545
	Relative difference	-3.80%	-3.66%	-3.51%	-3.90%	-3.72%	-3.51%
	Funding needs for cross-border IGS	172	447	1 804	26	82	457
Life (EU)	Funding needs under home	4 010	10 833	45 751	595	1 958	11 554
	Funding needs under domestic	3 876	10 486	44 352	575	1 894	11 200
	Relative difference	-3.34%	-3.20%	-3.06%	-3.45%	-3.26%	-3.06%
	Funding needs for cross-border IGS	134	347	1 399	21	64	354
Non-life (EU)	Funding needs under home	580	1 559	6 577	86	282	1 660
	Funding needs under domestic	554	1 495	6 330	82	270	1 597
	Relative difference	-4.39%	-4.09%	-3.76%	-4.60%	-4.22%	-3.78%
	Funding needs for cross-border IGS	25	64	247	4	12	63

Figure 4.17: Relative difference between funding needs when moving from the home state principle to a domestic activity regime supplemented by an additional IGS covering all cross-border activities, including those conducted under FPS, 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)



4.4 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/EEA²⁵ 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).

²⁵ As explained in section 4.1, 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.

4.4.1 Total insurance

Figure 4.18: 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 $\alpha=99\%$

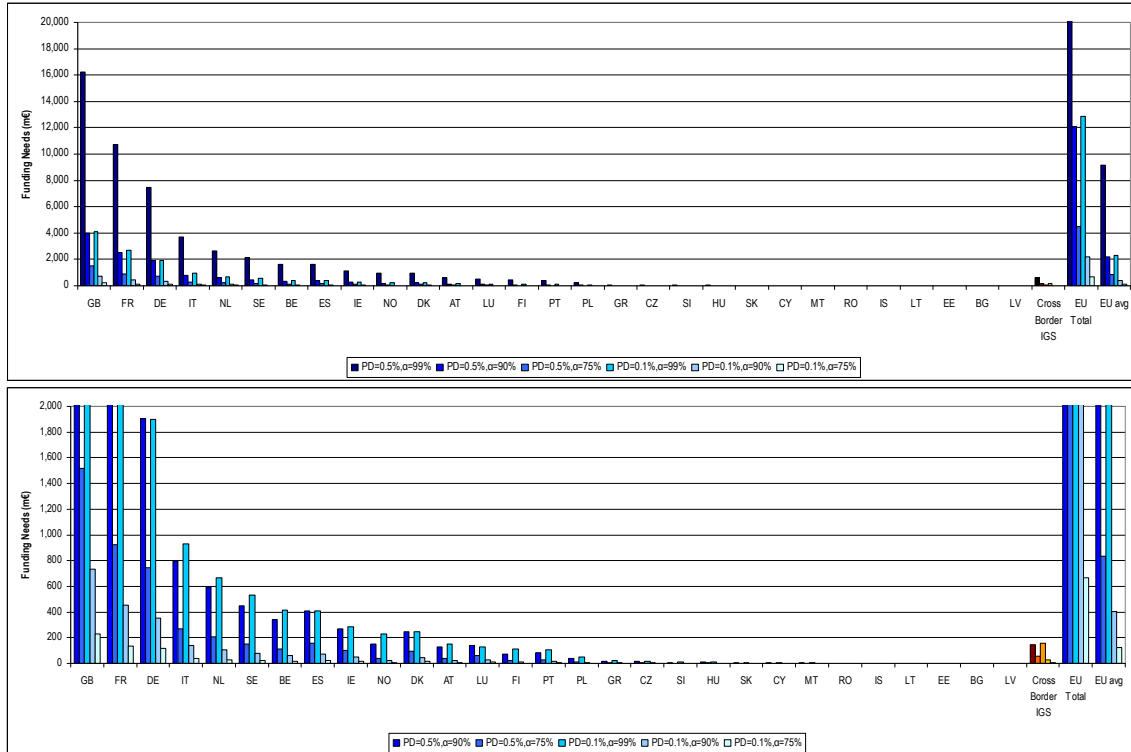


Figure 4.19: Absolute differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; total insurance sector; all EEA countries, countries in order of gross premiums written (the sum of all the differences at country level gives the funding need for the additional cross-border scheme)

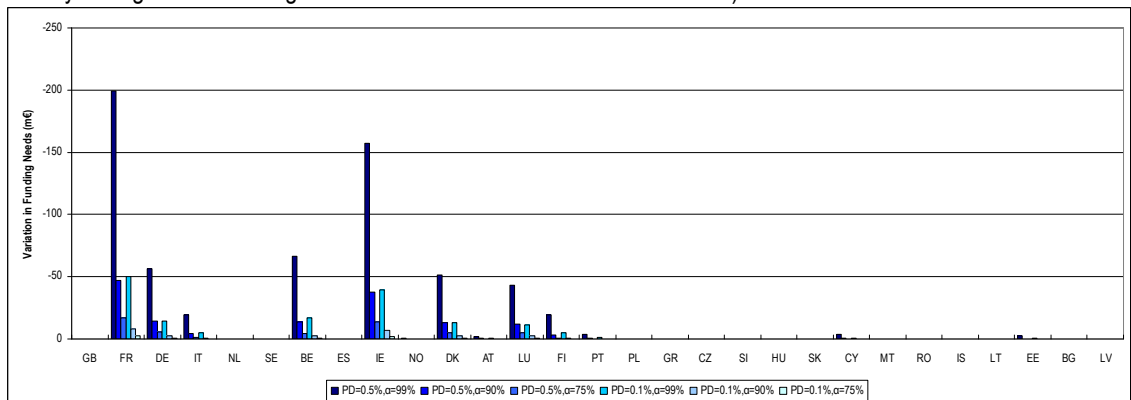


Figure 4.20: Relative differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; total insurance sector; all EEA countries, countries in order of gross premiums written

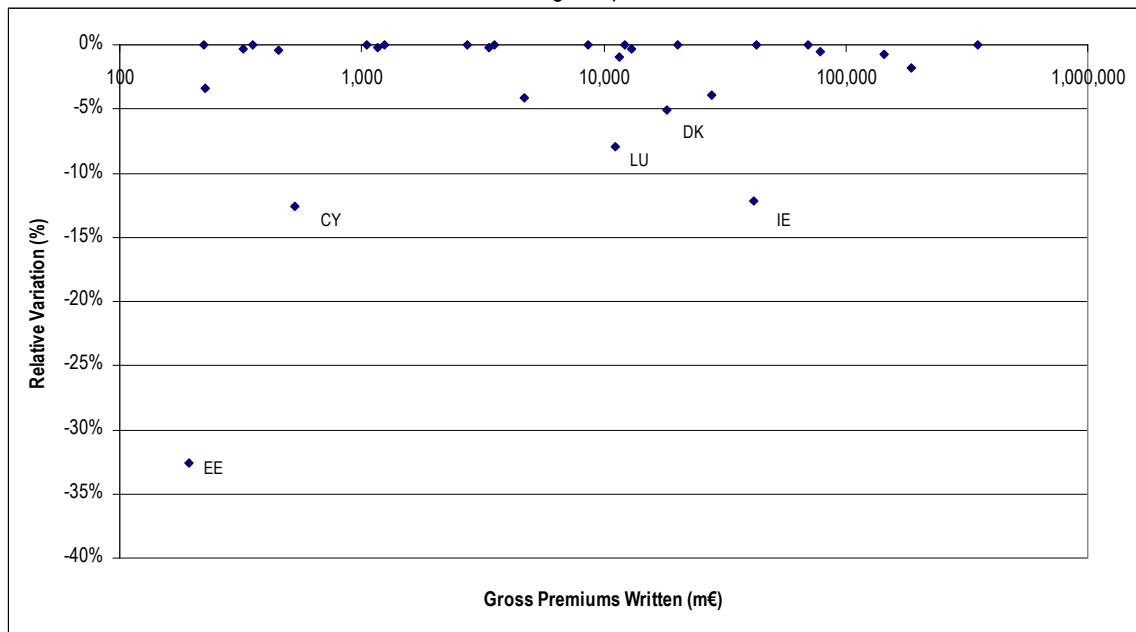


Table 4.20: Summary of relative difference between funding needs at country level when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; EU average and minimum, median and maximum across all EEA countries; total insurance sector

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

4.4.2 Life insurance

Figure 4.21: 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 $\alpha=99\%$

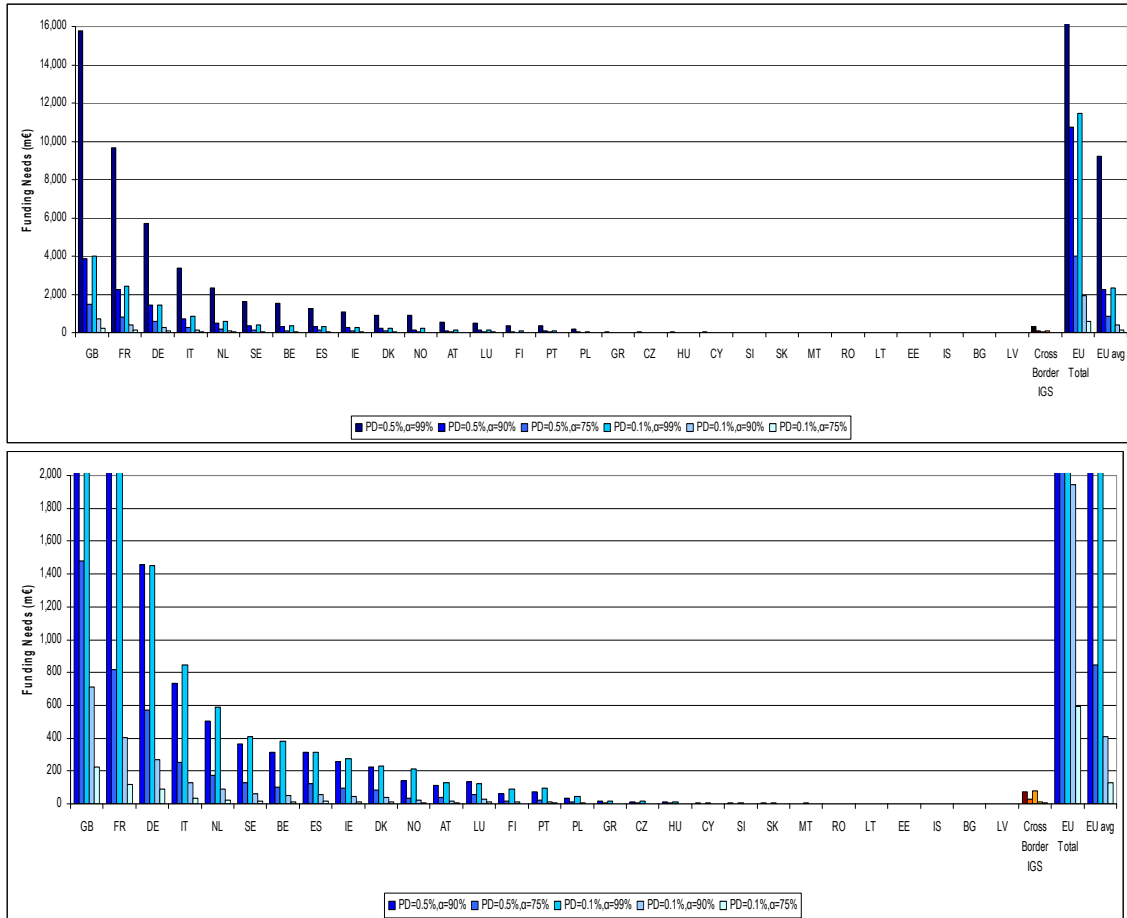


Figure 4.22: Absolute differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; life business line; all EEA countries, countries in order of funding needs (the sum of all the differences at country level gives the funding needs for the additional cross-border scheme)

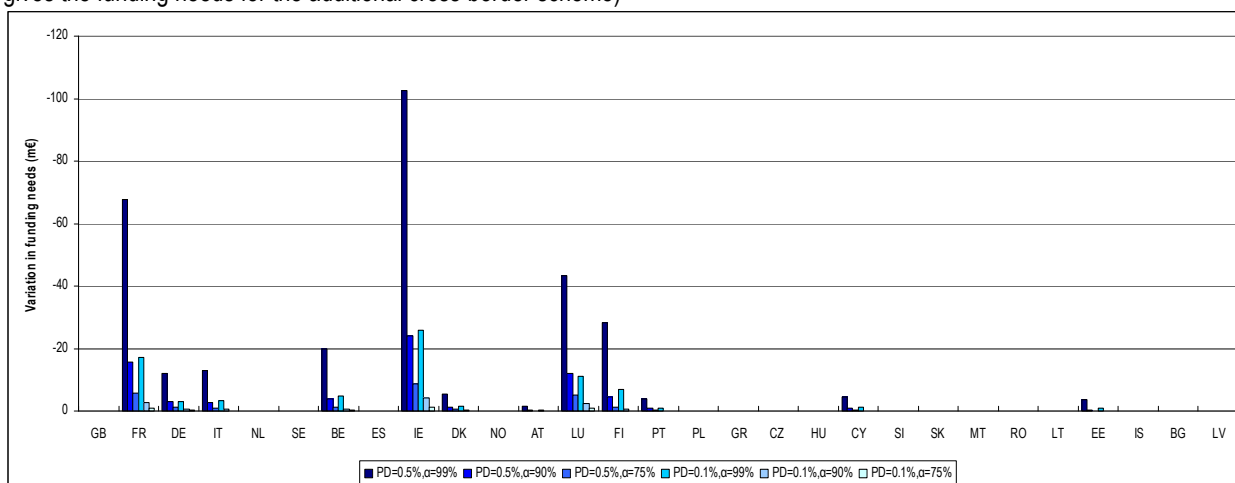


Figure 4.23: Relative differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; life business line; all EEA countries; countries in order of gross premiums written

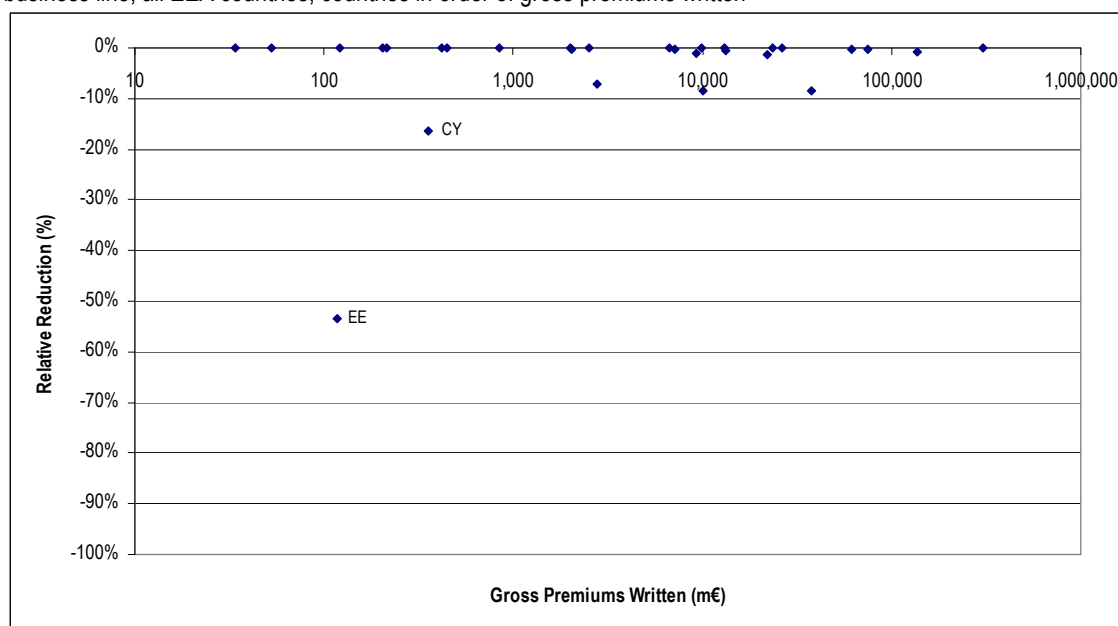


Table 4.21: Summary of relative differences between funding needs for national IGS when moving from the home state principle to a domestic activity regime supplemented by an additional cross-border IGS covering branches only; EU average and minimum, median and maximum across all EEA countries; life business line

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

4.4.3 Non-life insurance

Figure 4.24: 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 $\alpha=99\%$

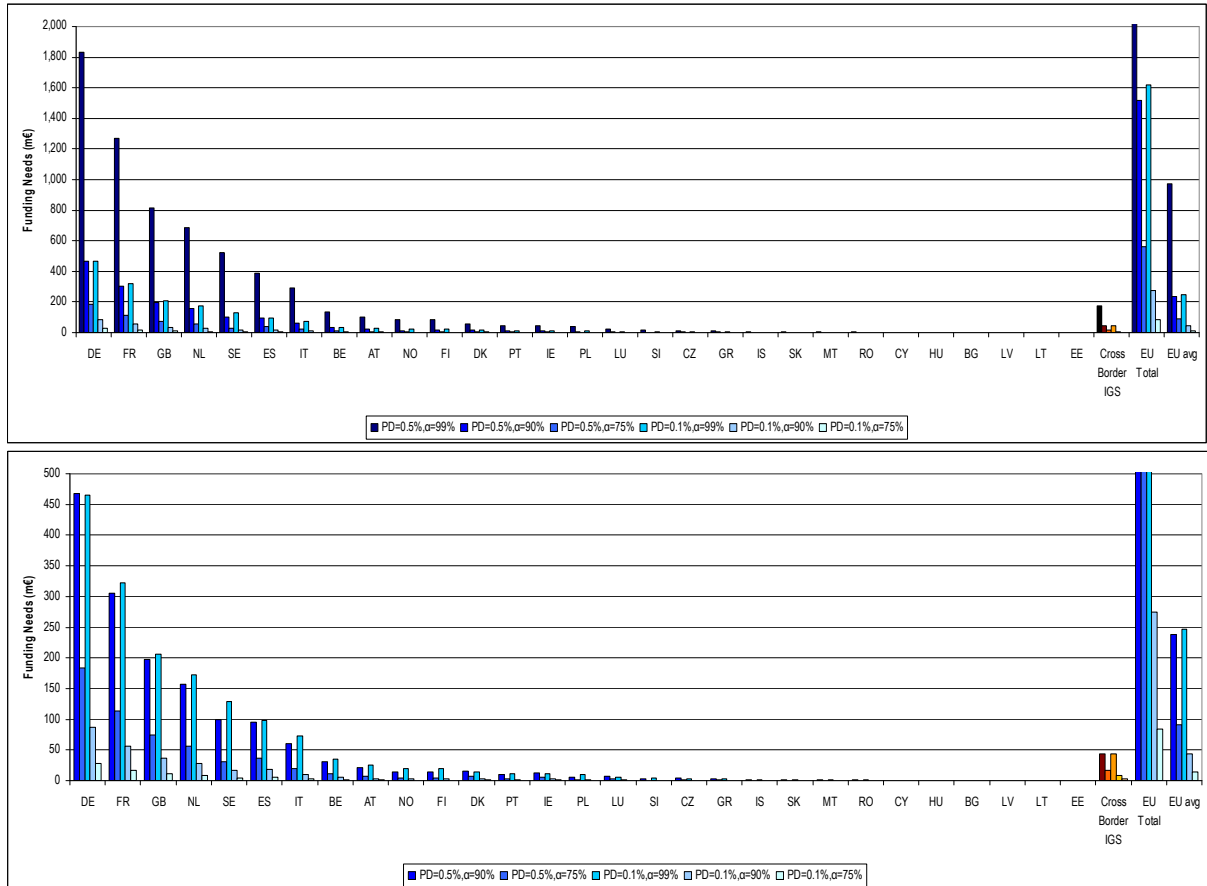


Figure 4.25: Absolute differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; non-life business line; all EEA countries; countries in order of gross premiums written (the sum of all the differences at country level gives the funding need for the additional cross-border scheme)

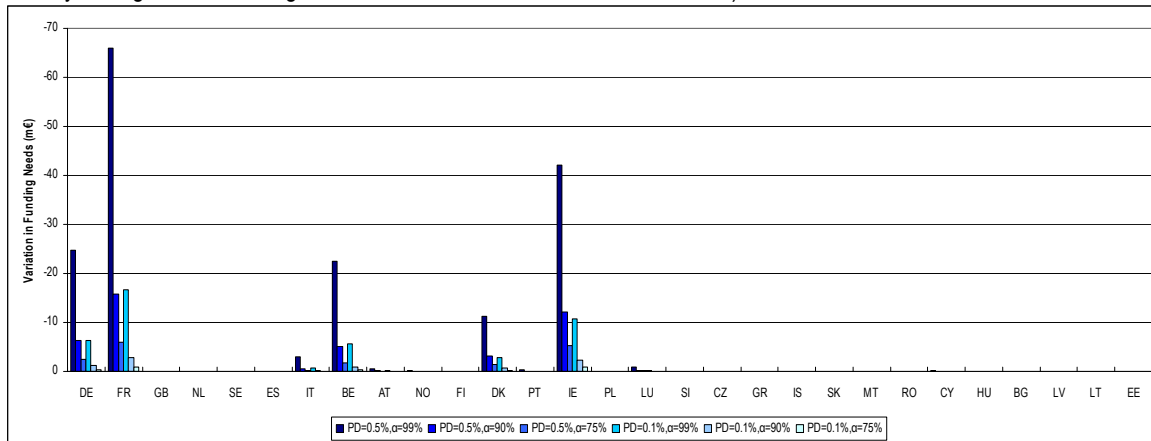


Figure 4.26: Relative differences between funding needs when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; non-life business line; all EEA countries; countries in order of gross premiums written

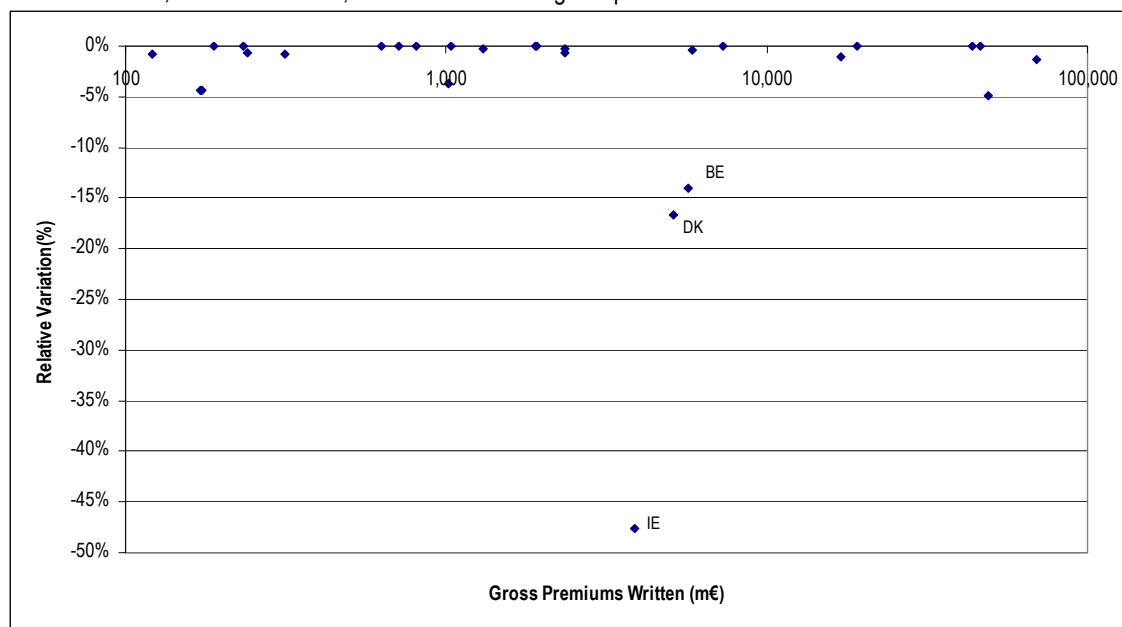


Table 4.22: Summary of relative difference between funding needs at country level when moving from the home state principle to a domestic plus FPS activity regime supplemented by an additional IGS covering cross-border activities conducted via branches; EU average and minimum, median and maximum across all EEA countries; non-life business line

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

4.4.4 Summary of statistics at EU level

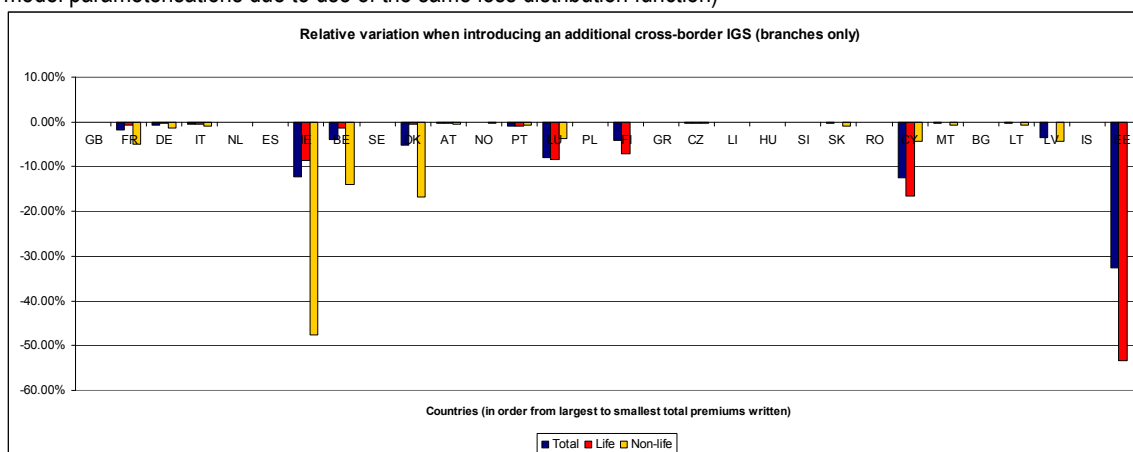
Table 4.23: Average funding needs at EU level under a domestic plus FPS activity regime, excluding cross-border activity conducted via branches; under different probabilities of default and confidence levels; weighted averages by gross premiums written, for the total insurance sector and the life and non-life business lines (in m€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	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 4.24: 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€)

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		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 4.27: 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)



4.5 *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 level²⁶ 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.

²⁶ As explained in section 4.1, 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.

4.5.1 Total insurance

Figure 4.28: 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 $\alpha=99\%$

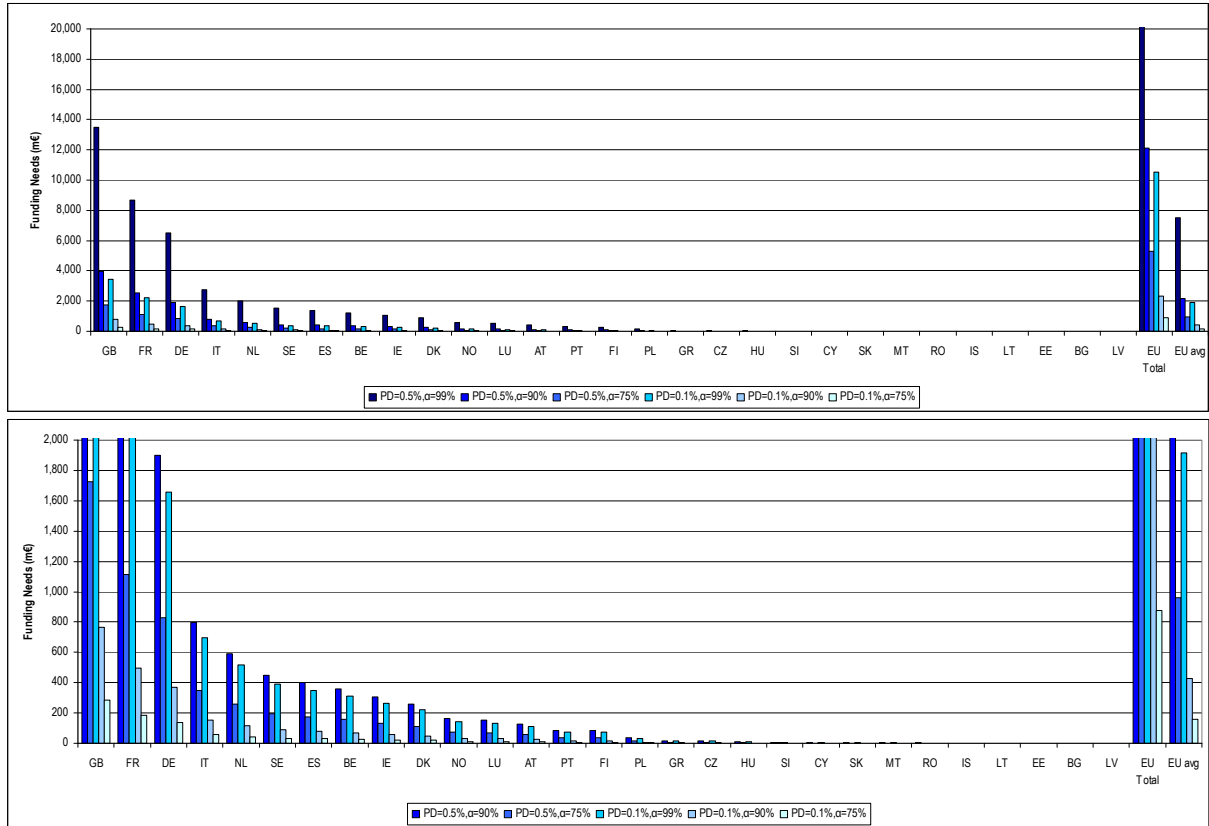


Figure 4.29: Absolute variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; total insurance sector; all EEA countries; countries in order of gross premiums written

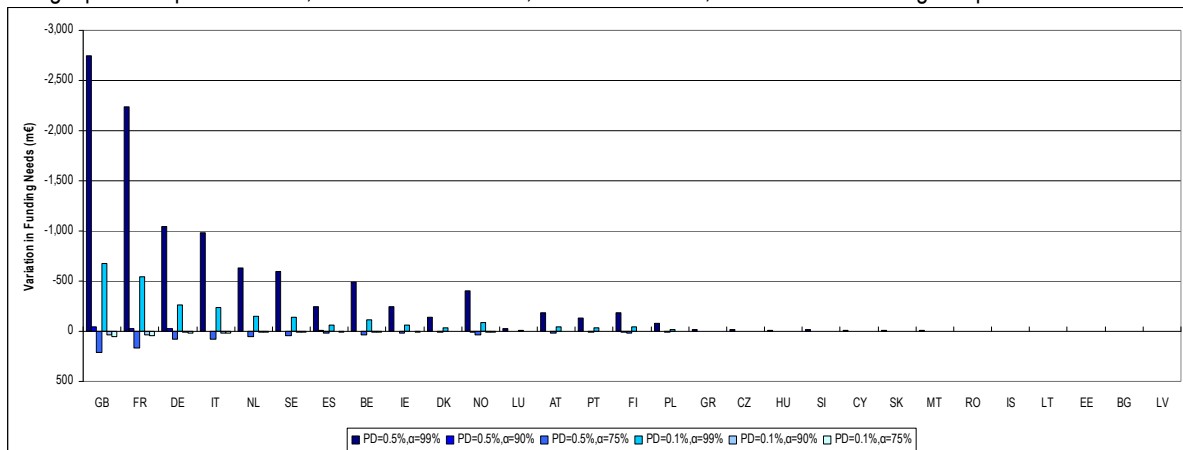


Figure 4.30: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; total insurance sector, PD=0.1% and $\alpha=90\%$; countries in order of gross premiums written

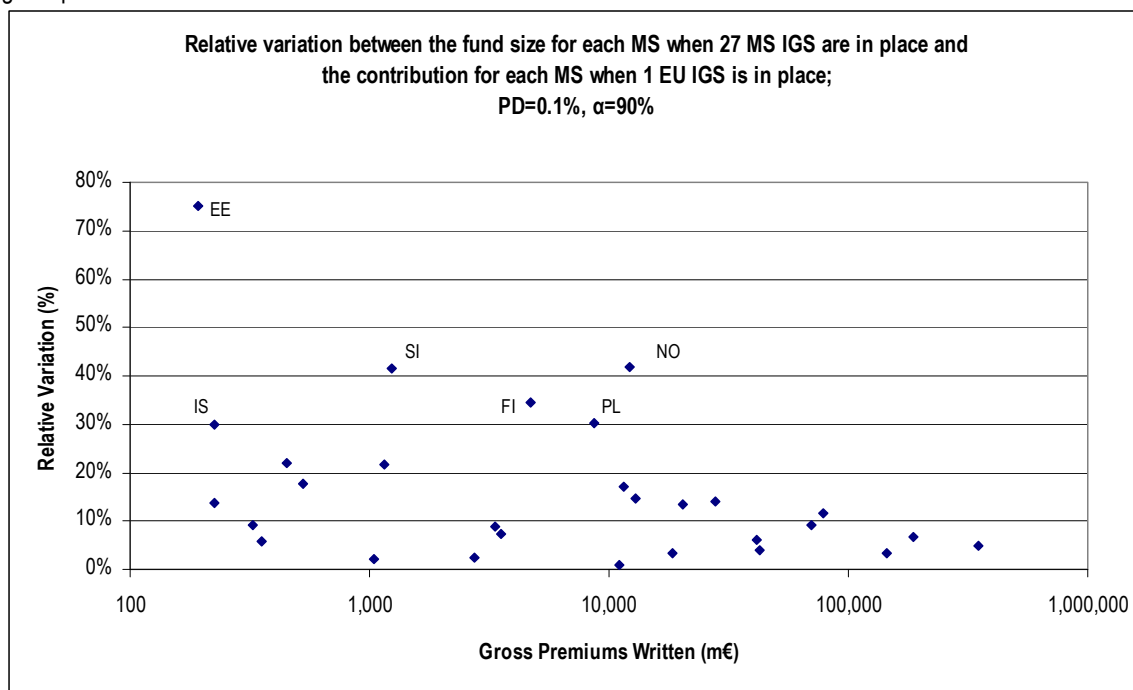


Figure 4.31: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; total insurance sector, PD=0.5% and $\alpha=90\%$; countries in order of gross premiums written

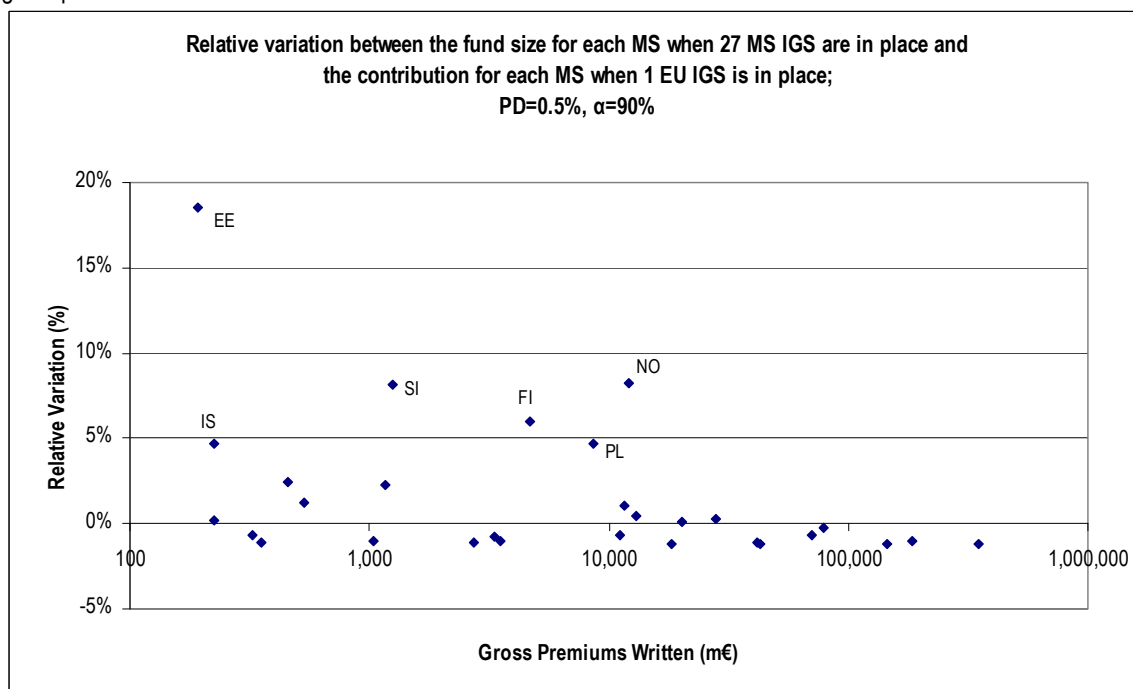


Table 4.25: Summary of relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; EU average and minimum, median and maximum across all EEA countries; total insurance sector

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

4.5.2 Life insurance

Figure 4.32: 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 $\alpha=99\%$

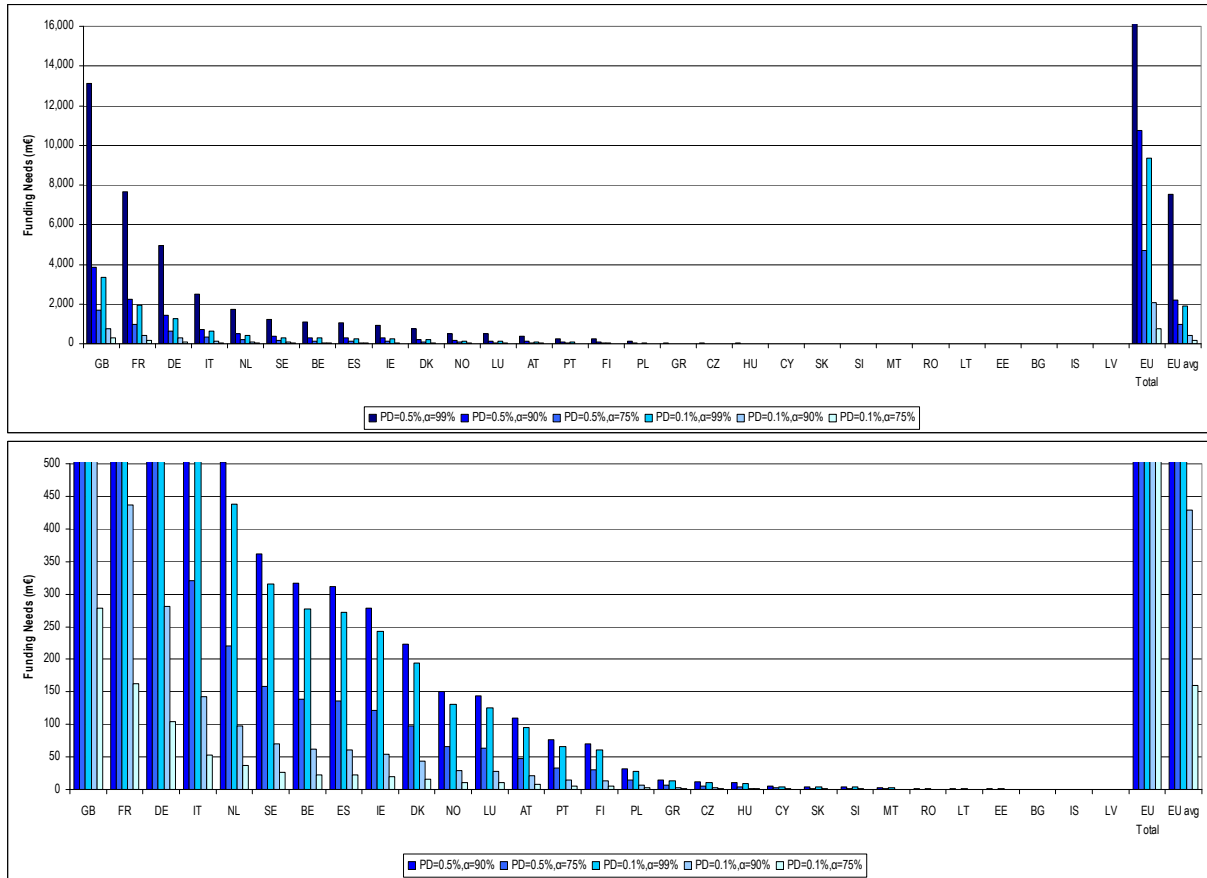


Figure 4.33: Absolute differences between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; life business line; countries in order of gross premiums written

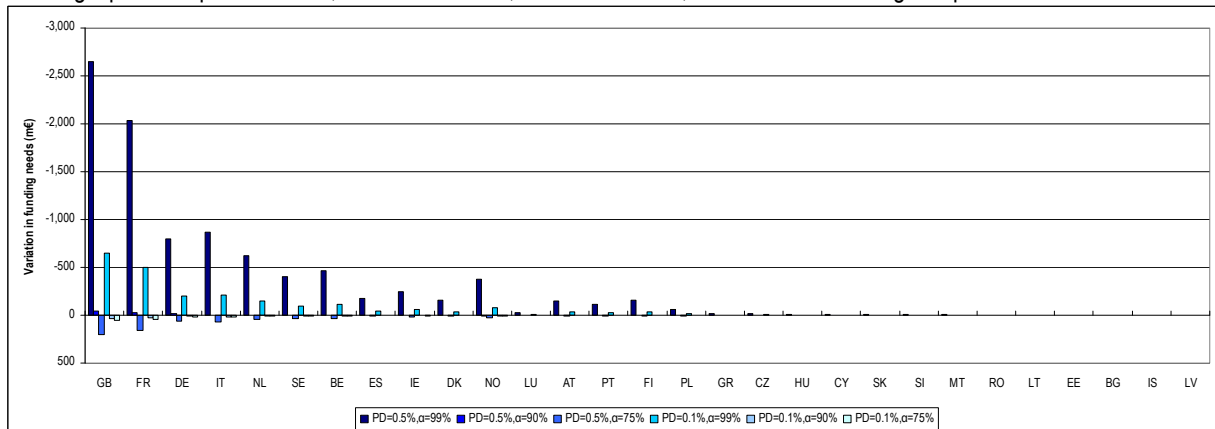


Figure 4.34: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; life business line, PD=0.1% and $\alpha=90\%$; countries in order of gross premiums written

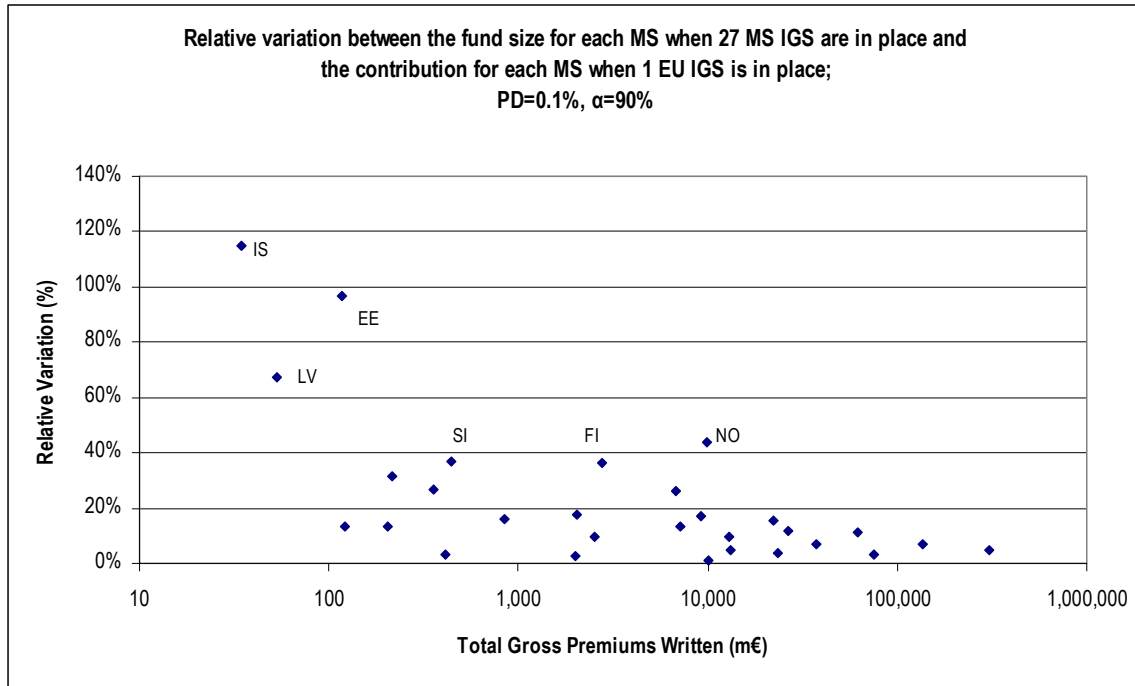


Figure 4.35: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; life business line, PD=0.5% and $\alpha=90\%$; countries in order of gross premiums written

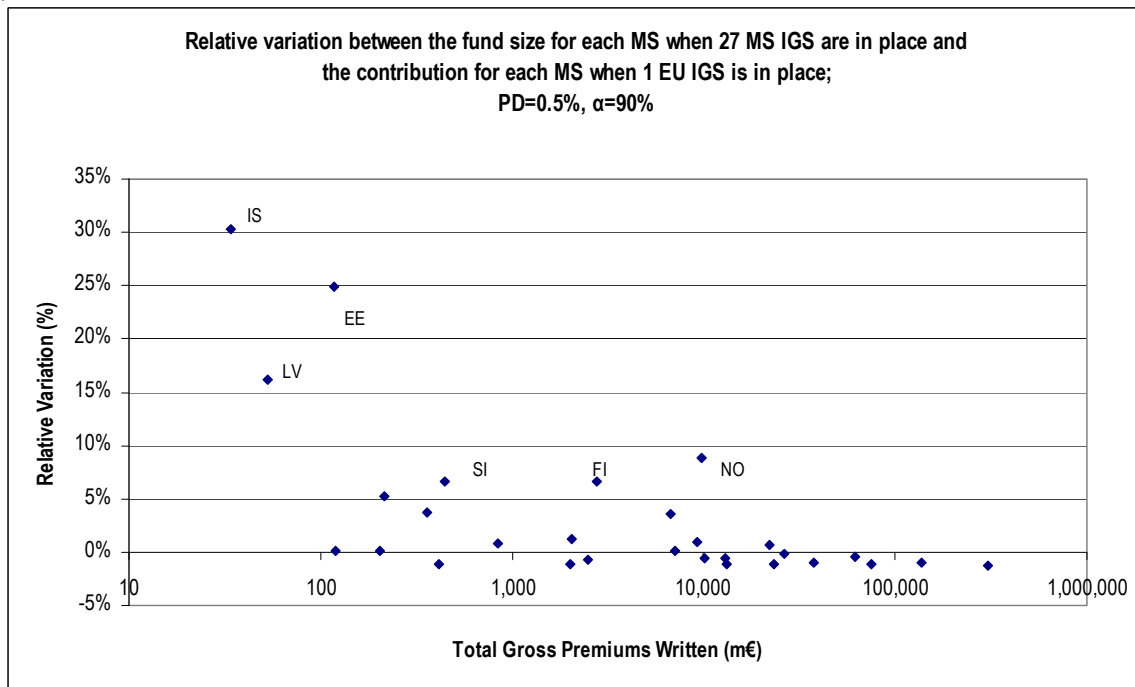


Table 4.26: Summary of relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; EU average and minimum, median and maximum across all EEA countries; life business line, PD=0.1% and 0.5% and $\alpha=90\%$

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

4.5.3 Non-life insurance

Figure 4.36: 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 $\alpha=99\%$

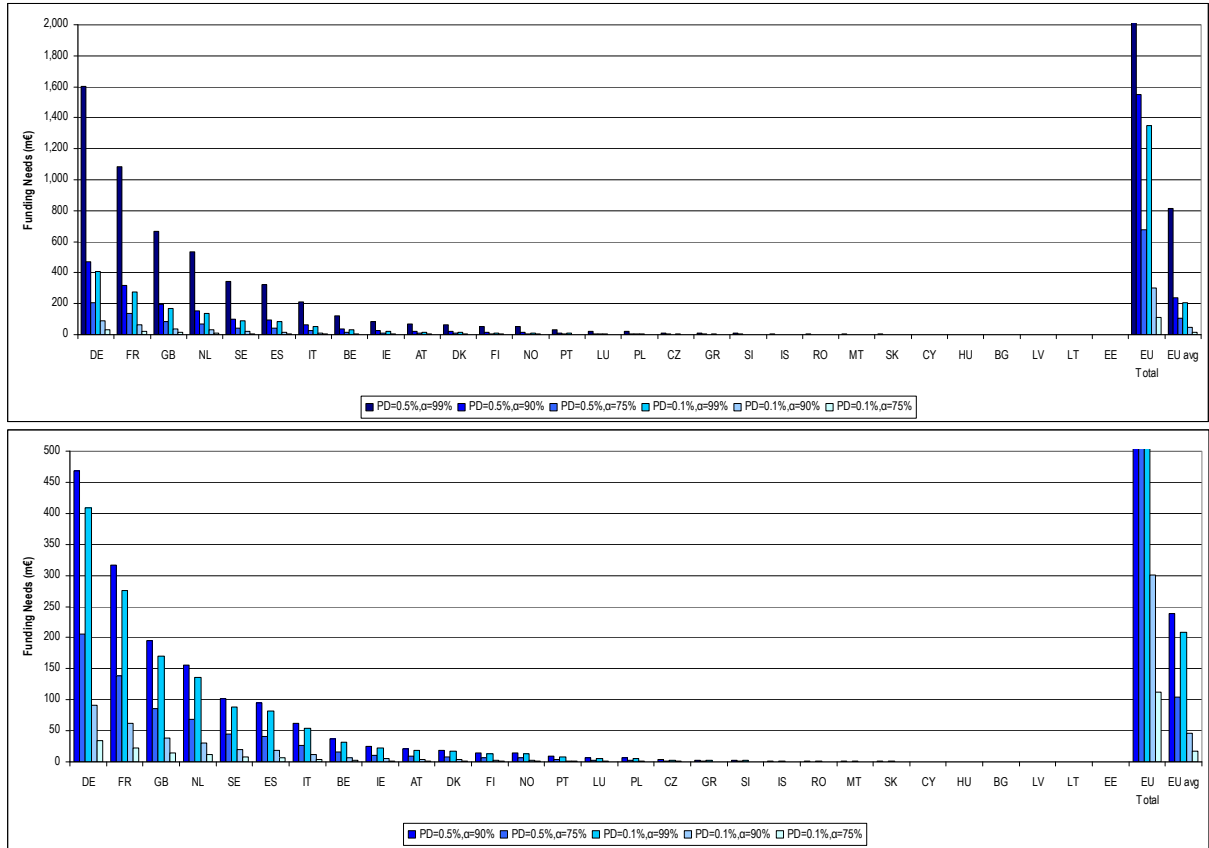


Figure 4.37: Absolute differences between funding needs at country level when moving from the home state principle to a single pan-European scheme; non-life business line; all EEA countries; countries in order of funding needs

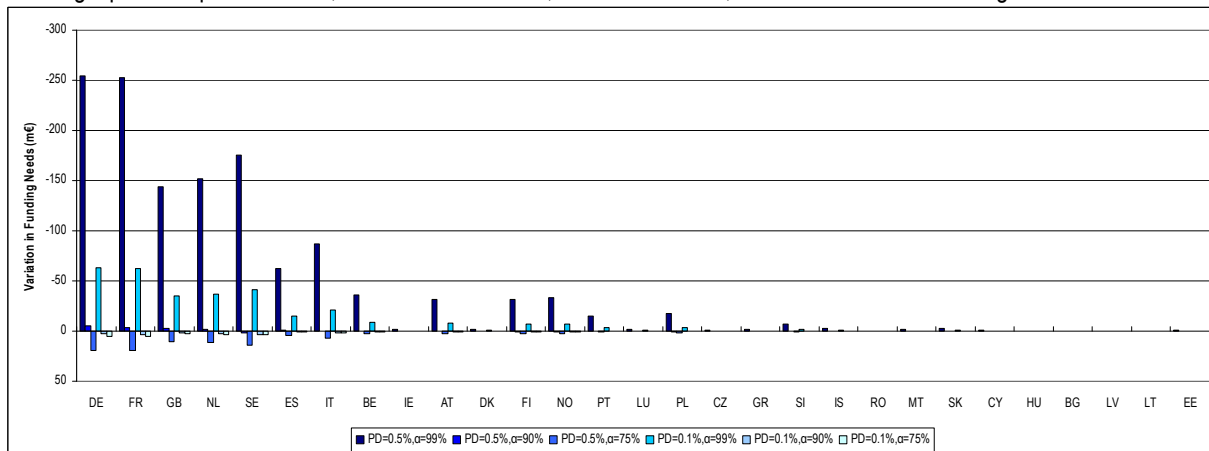


Figure 4.38: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; non-life business line, PD=0.1% and $\alpha=90\%$; countries in order of gross premiums written

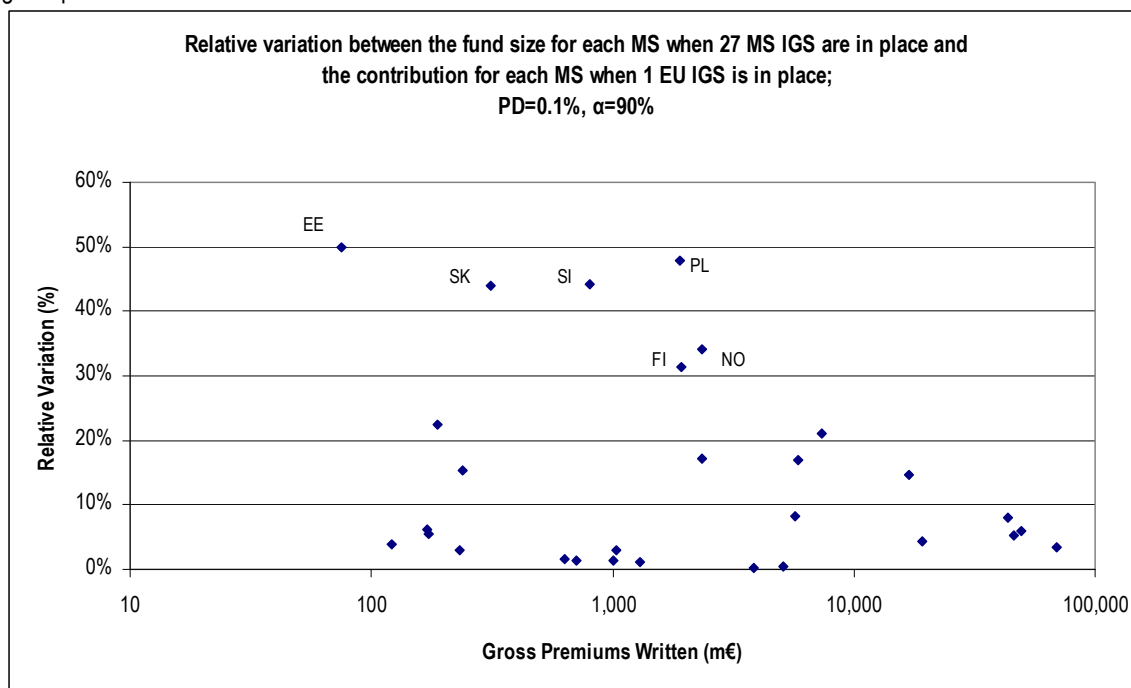


Figure 4.39: Relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; all EEA countries; non-life business line, PD=0.5% and $\alpha=90\%$; countries in order of gross premiums written

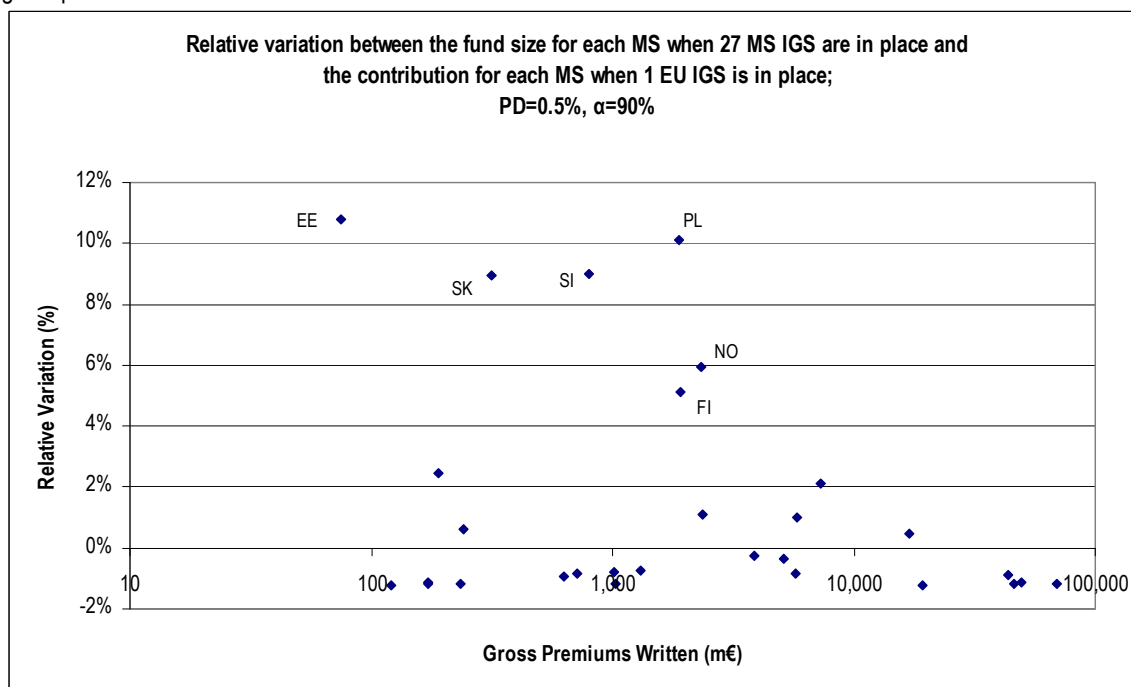


Table 4.27: Summary of relative variations between funding needs at country level when moving from the home state principle to a single pan-European scheme; EU average and minimum, median and maximum across all EEA countries; non-life business line, PD=0.1% and 0.5% and $\alpha=90\%$

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

4.5.4 Summary of statistics at EU level

Table 4.28: 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€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	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 4.29: 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€)

$\alpha \rightarrow$		PD = 0.5%			PD=0.1%		
		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 4.40: 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 $\alpha=90\%$; all EEA countries; countries in order of gross premium written in the total insurance sector

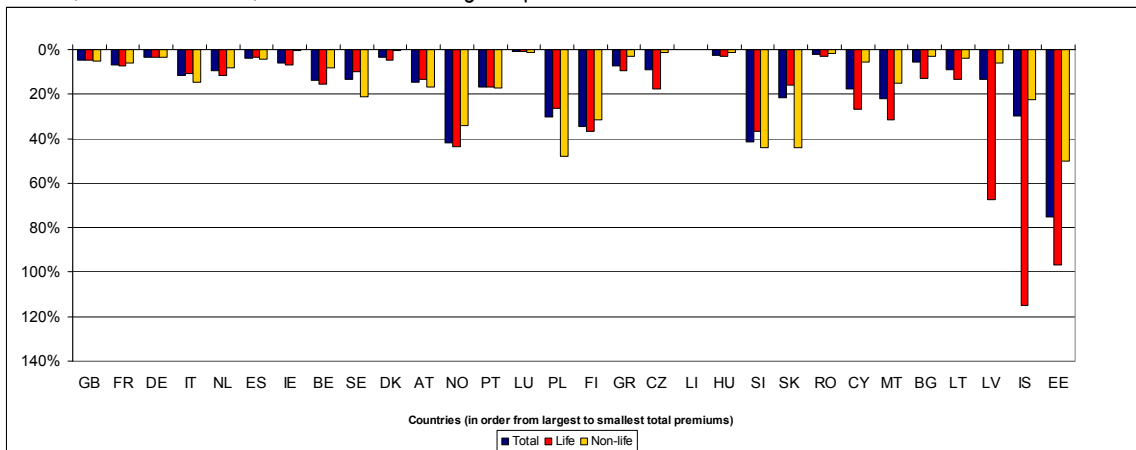
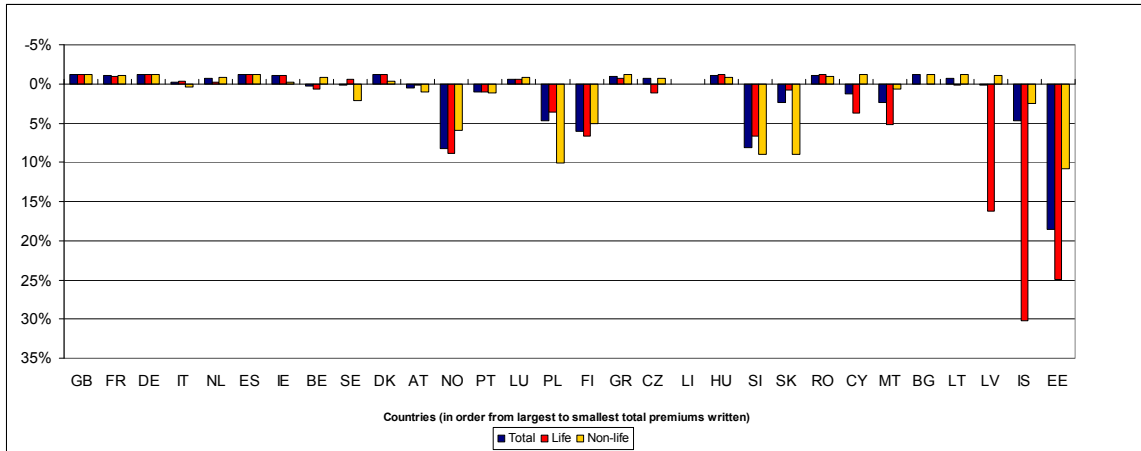


Figure 4.41: Relative difference between funding needs at country level when moving from the home state principle to a single pan-European scheme, for the total insurance sector and the life and non-life business lines; PD=0.5% and $\alpha=90\%$; all EEA countries; countries in order of gross premium written in the total insurance sector



4.6 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 1.3, 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 Equation 1.6 for the life business line and Equation 1.4 or Equation 1.5 for the non-life business line.

4.6.1 Total insurance

4.6.1.1 Compensation of claims only

Figure 4.42: 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 $\alpha=99\%$

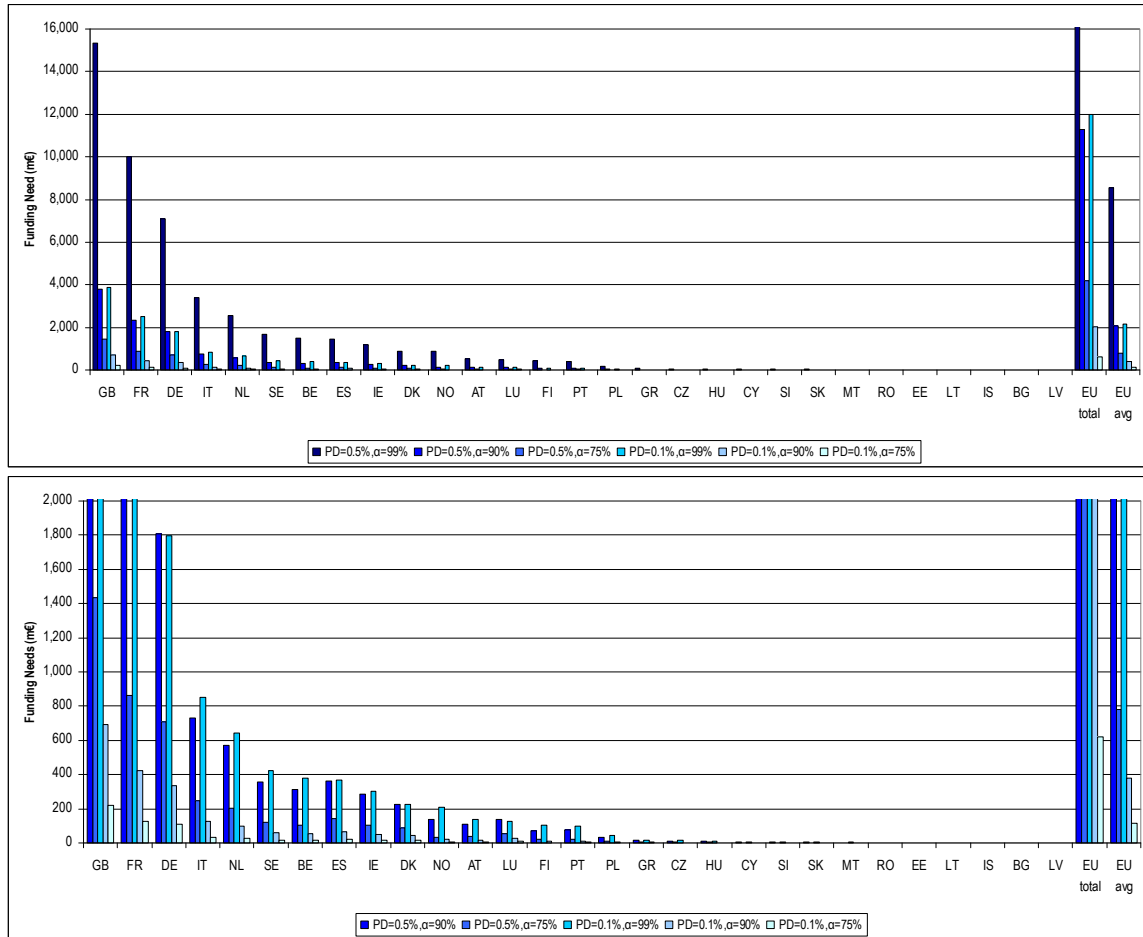


Figure 4.43: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; total insurance sector; all EEA countries, plus EU total and EU average ;countries in order of funding needs

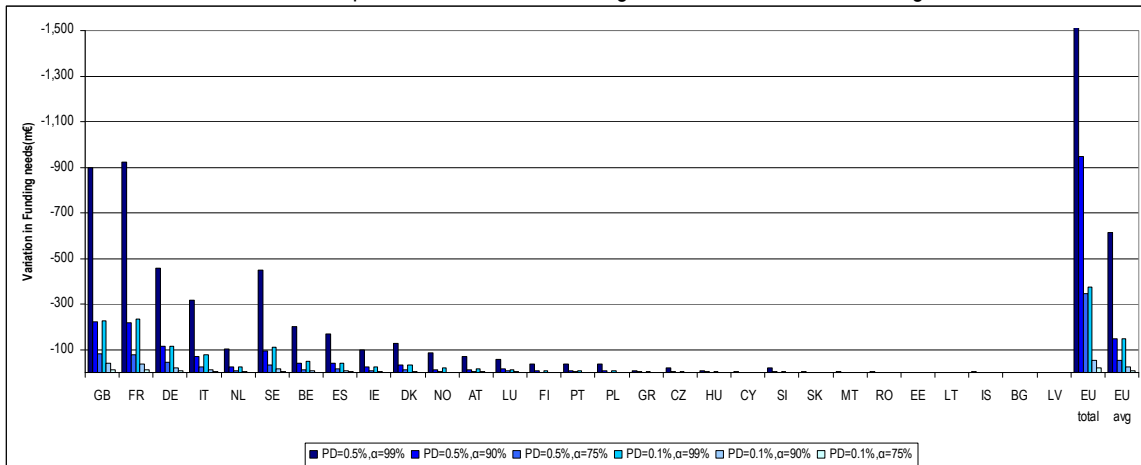


Figure 4.44: Relative variations between funding needs at country level when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; total insurance sector; all EEA countries; countries in order of gross premiums written

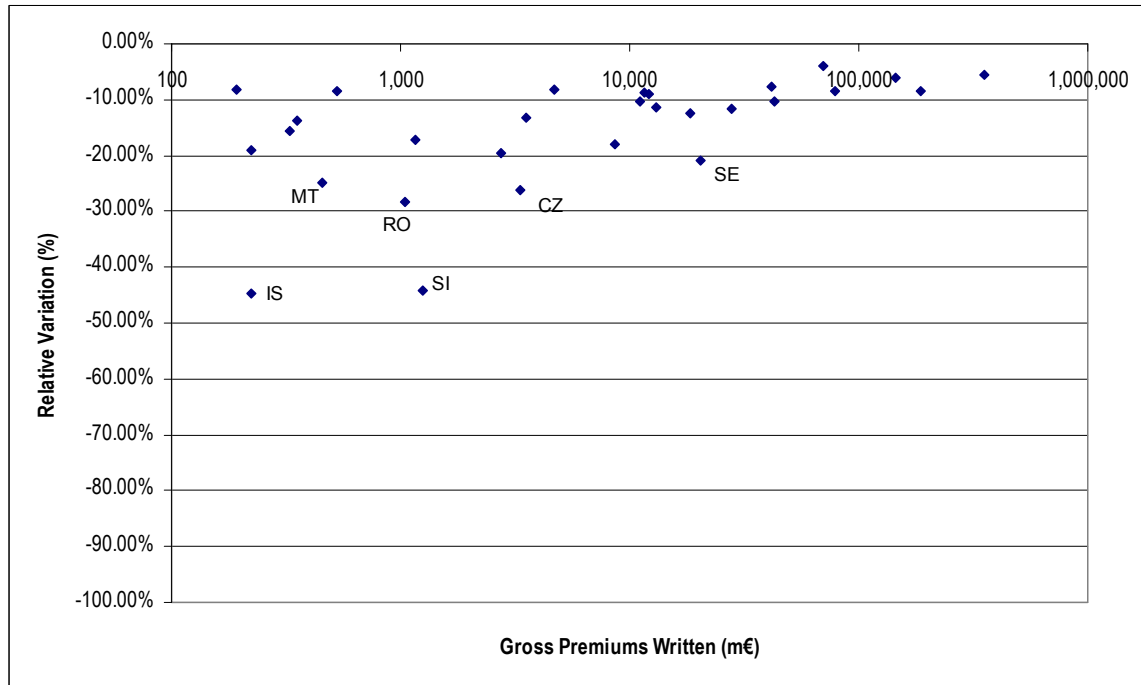


Table 4.30: Summary of relative variations between funding needs at country level when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; EU average and minimum, median and maximum across all EEA countries; total insurance sector

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

Table 4.31: 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€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	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%

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

Figure 4.45: 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 $\alpha=99\%$

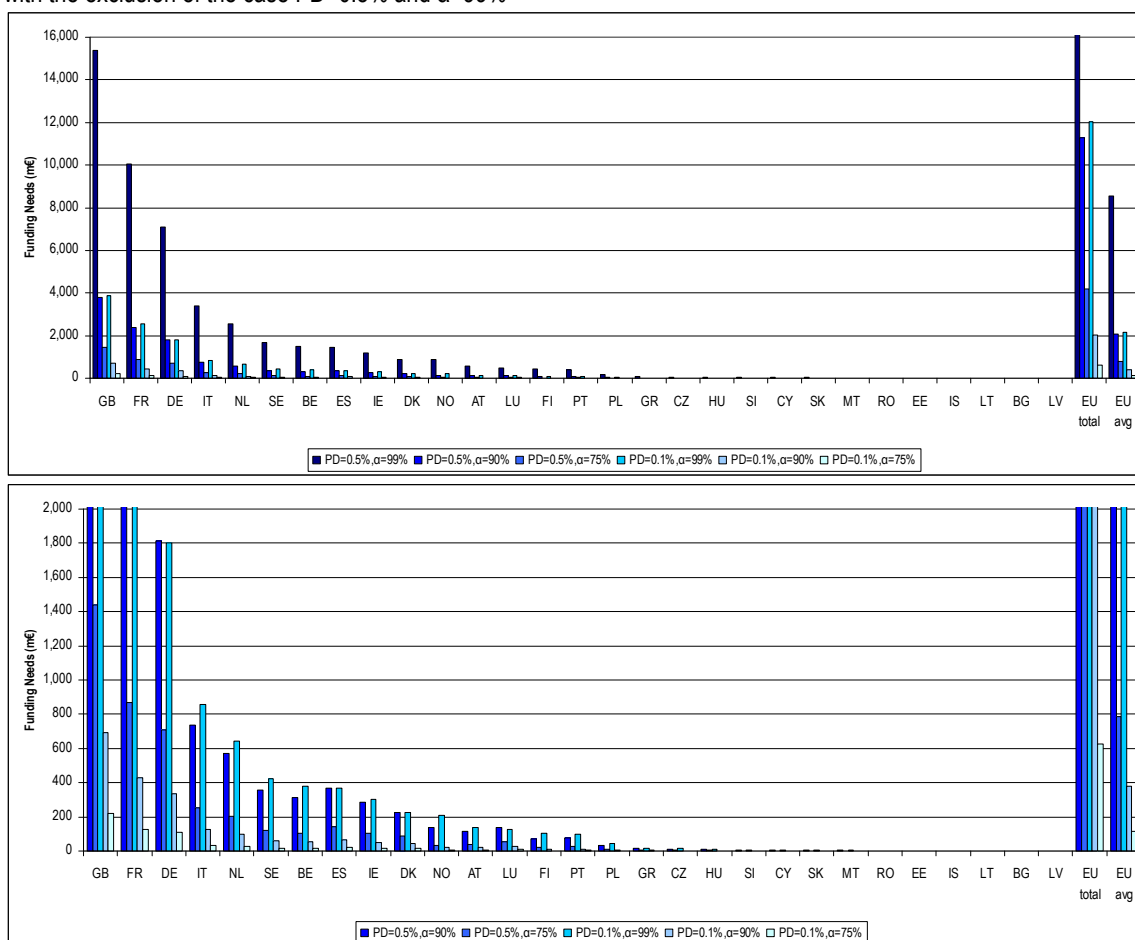


Figure 4.46: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; total insurance sector; all EEA countries, plus EU total and EU average; countries in order of funding needs

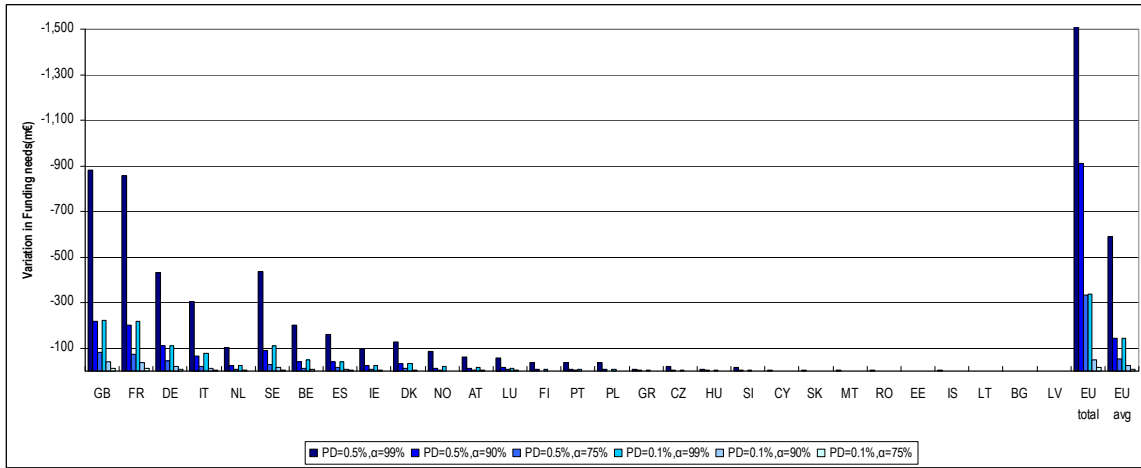


Figure 4.47: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; total insurance sector; all EEA countries; countries in order of gross premiums written

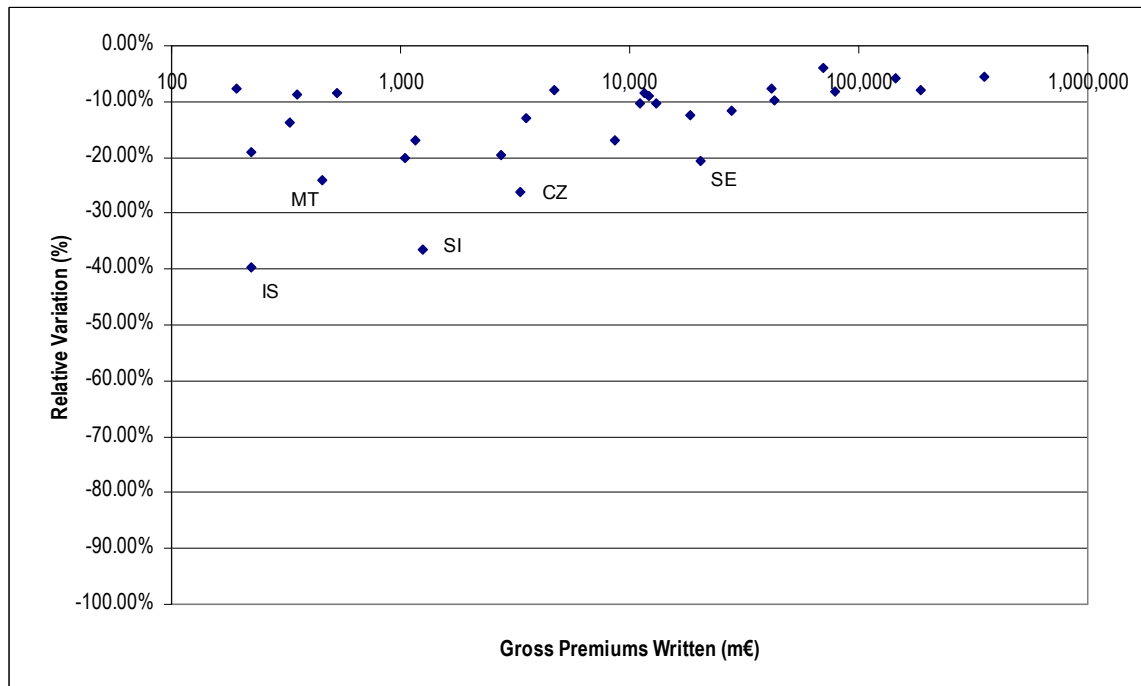


Table 4.32: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering only claims in the life business and covering claims and unearned premiums in the non-life business; 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 4.33: 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€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	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%

4.6.2 Compensation for life insurance

In the life insurance business line the EAD for the pure compensation case is determined in accordance with Equation 1.6.

Figure 4.48: 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 $\alpha=99\%$

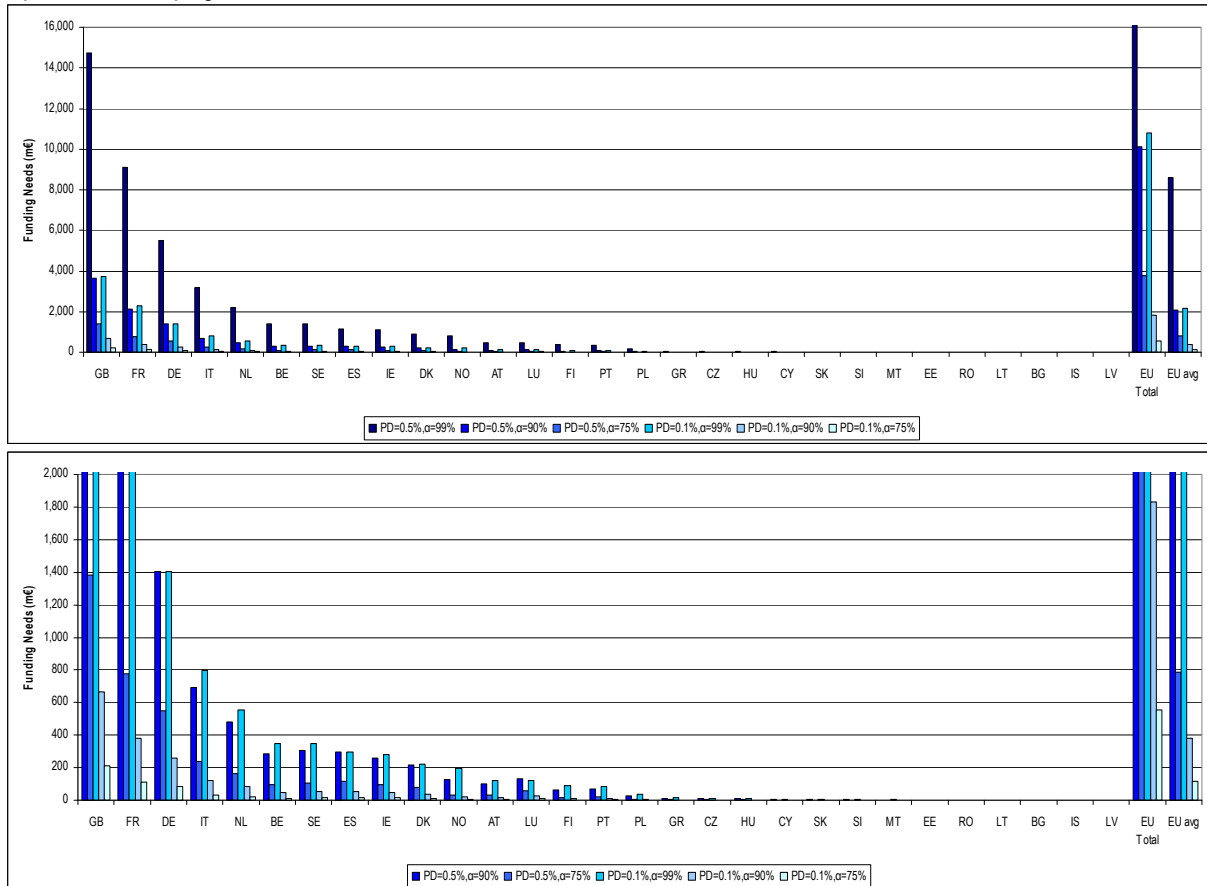


Figure 4.49: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; life business line; all EEA countries; countries in order of funding needs

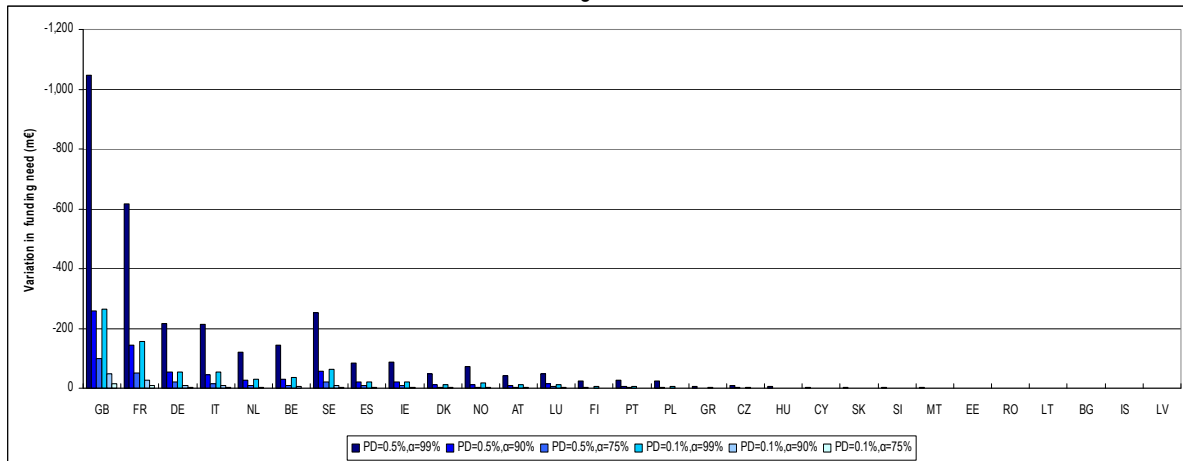


Figure 4.50: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; life business line; all EEA countries; countries in order of gross premiums written

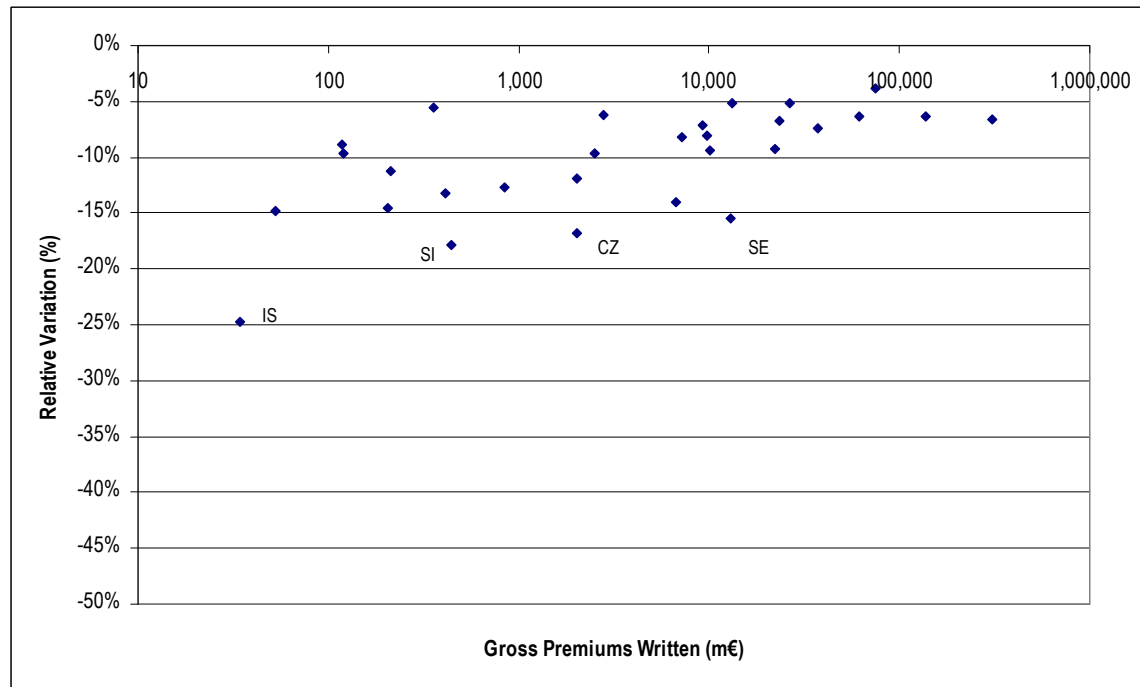


Table 4.34: Summary of relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; EU average and minimum, median and maximum across all EEA countries; life business line

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

Table 4.35: 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€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	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%

4.6.3 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.

4.6.3.1 Compensation of claims only

If the unearned premium is not covered, the EAD will be given by Equation 1.4, reflecting the fact that the regulatory viability of the portfolio will not need to be reconstructed.

Figure 4.51: 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 $\alpha=99\%$

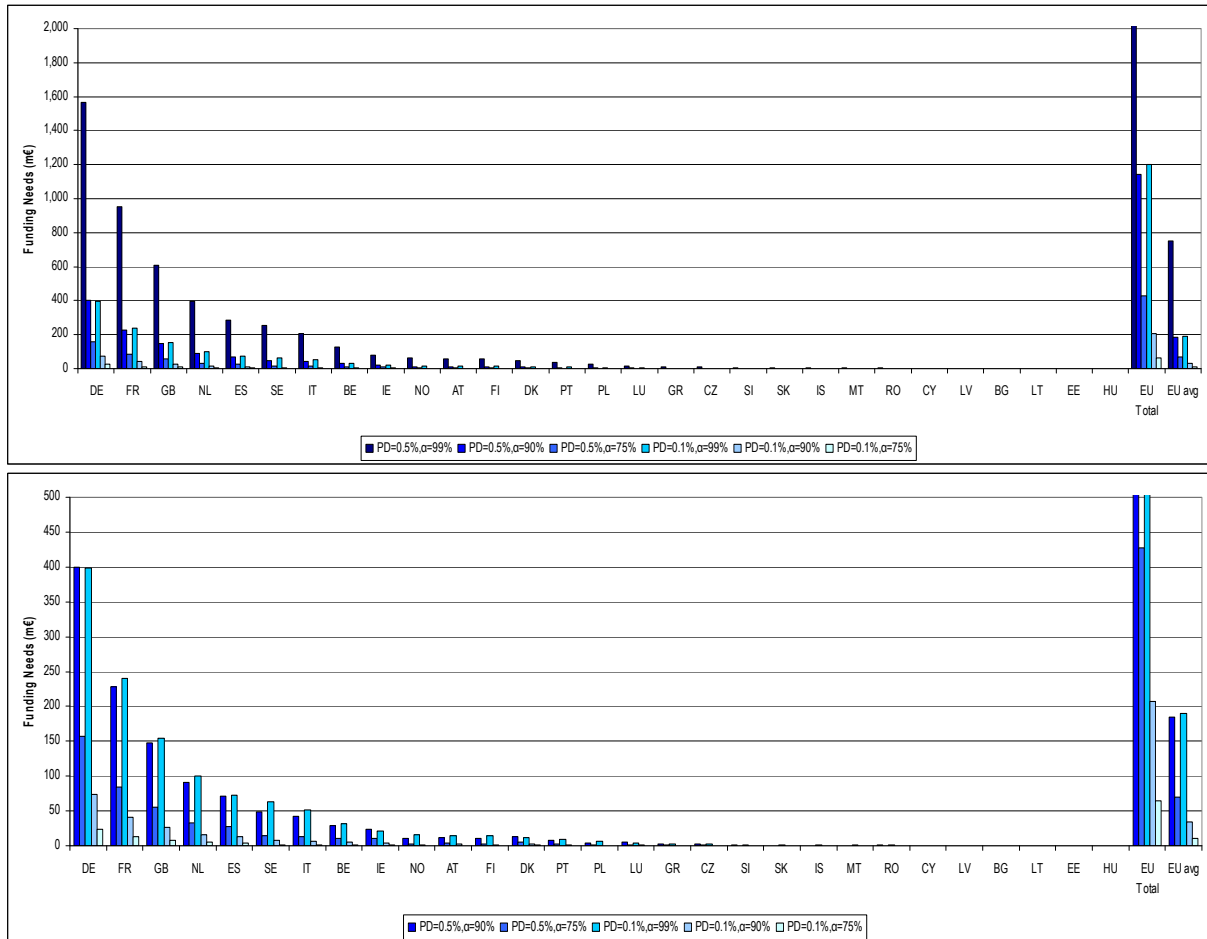


Figure 4.52: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; non-life business line; all EEA countries; countries in order of funding needs

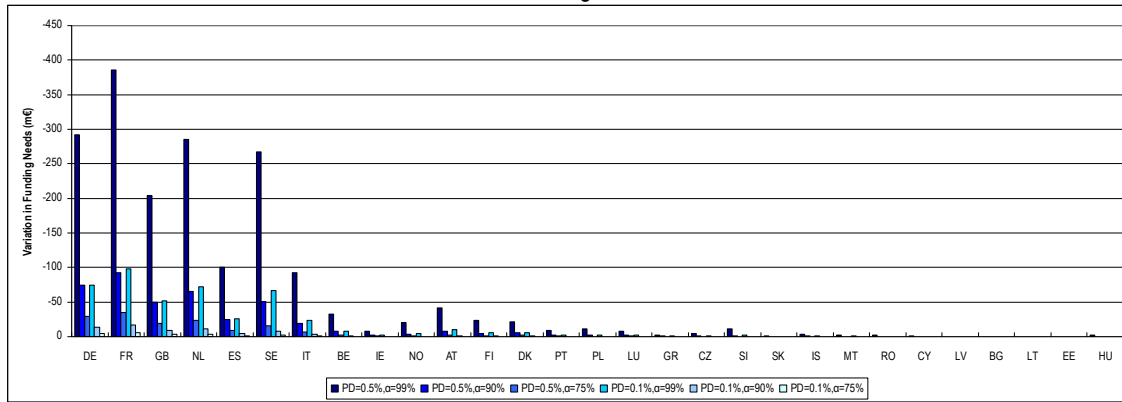


Figure 4.53: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; non-life business line; all EEA countries; countries in order of gross premiums written.

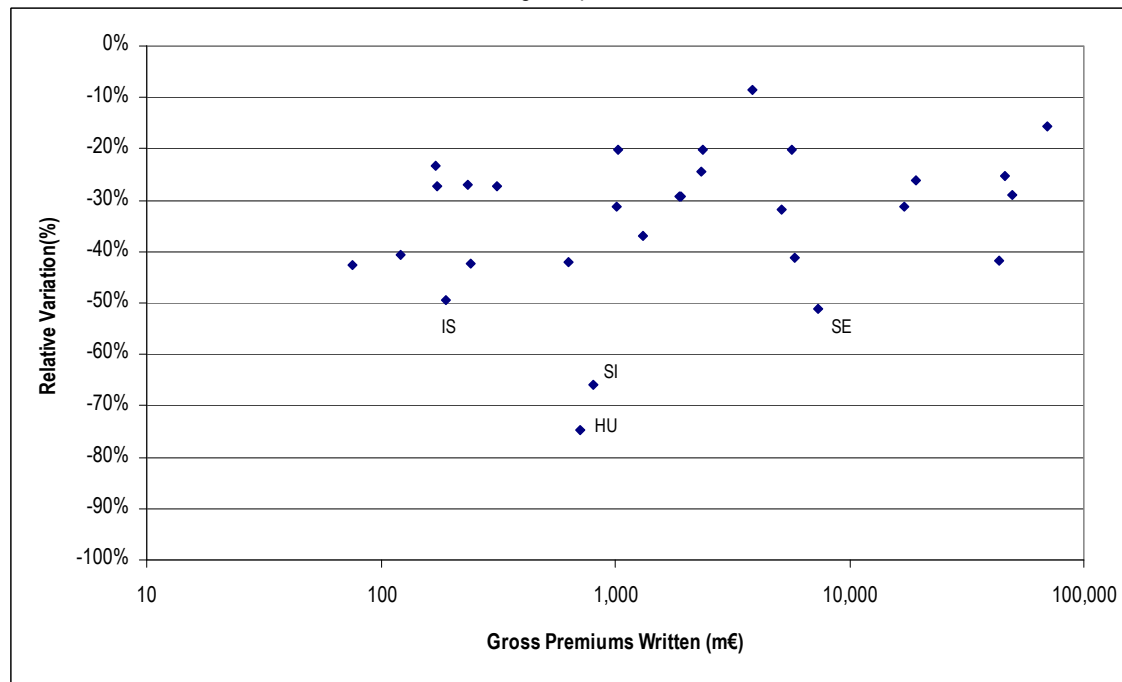


Table 4.36: Summary of relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims only; EU average and minimum, median and maximum across all EEA countries; non-life business line

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

Table 4.37: 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€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	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%

4.6.3.2 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 Equation 1.5.

Figure 4.54: 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 $\alpha=99\%$

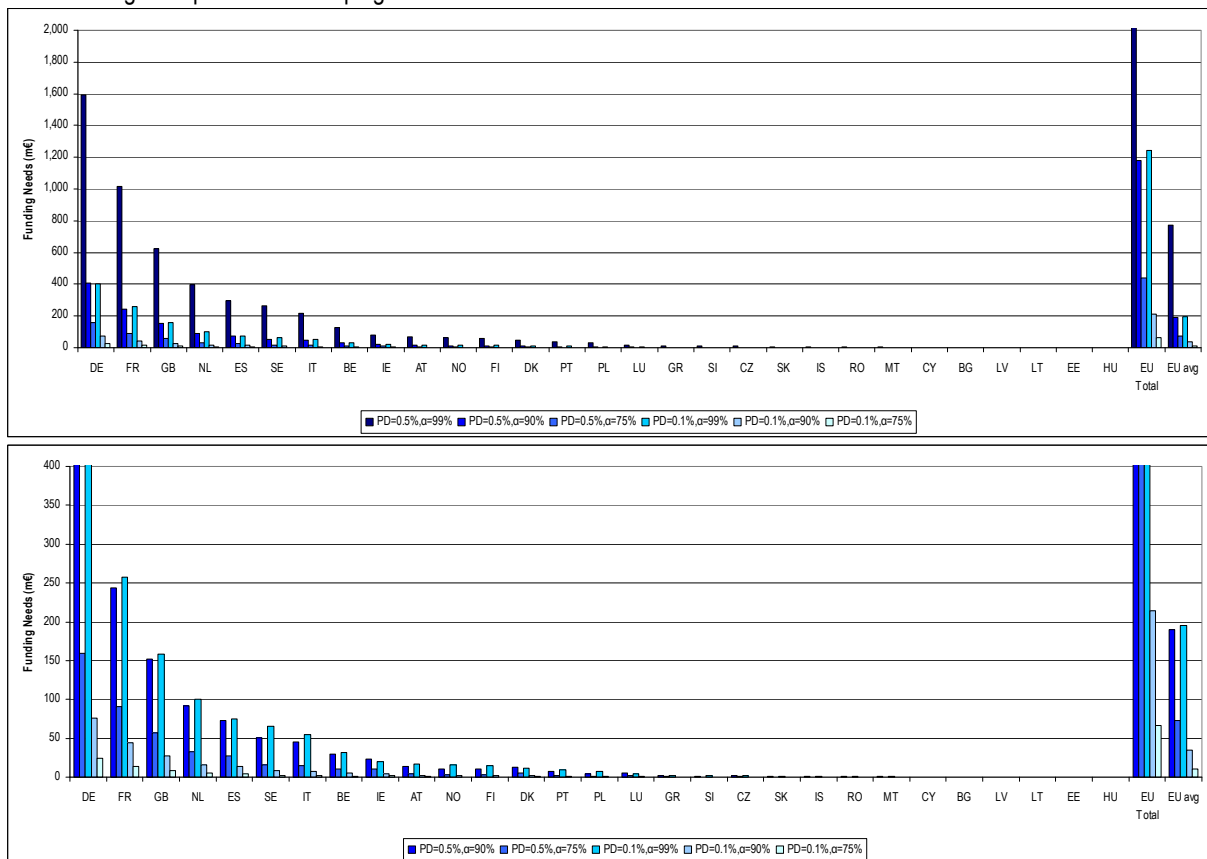


Figure 4.55: Absolute variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims and unearned premiums; non-life business line; all EEA countries; countries in order of funding needs

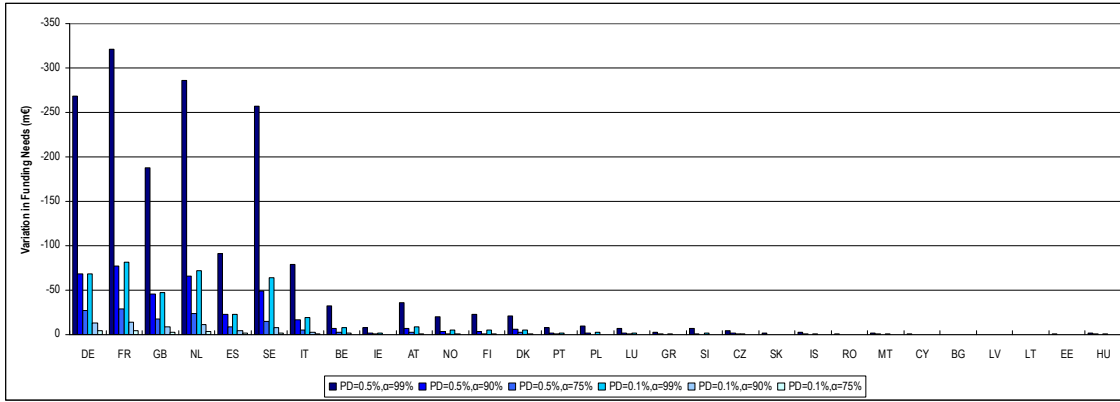


Figure 4.56: Relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims and unearned premiums; non-life business line; all EEA countries; countries in order of gross premiums written

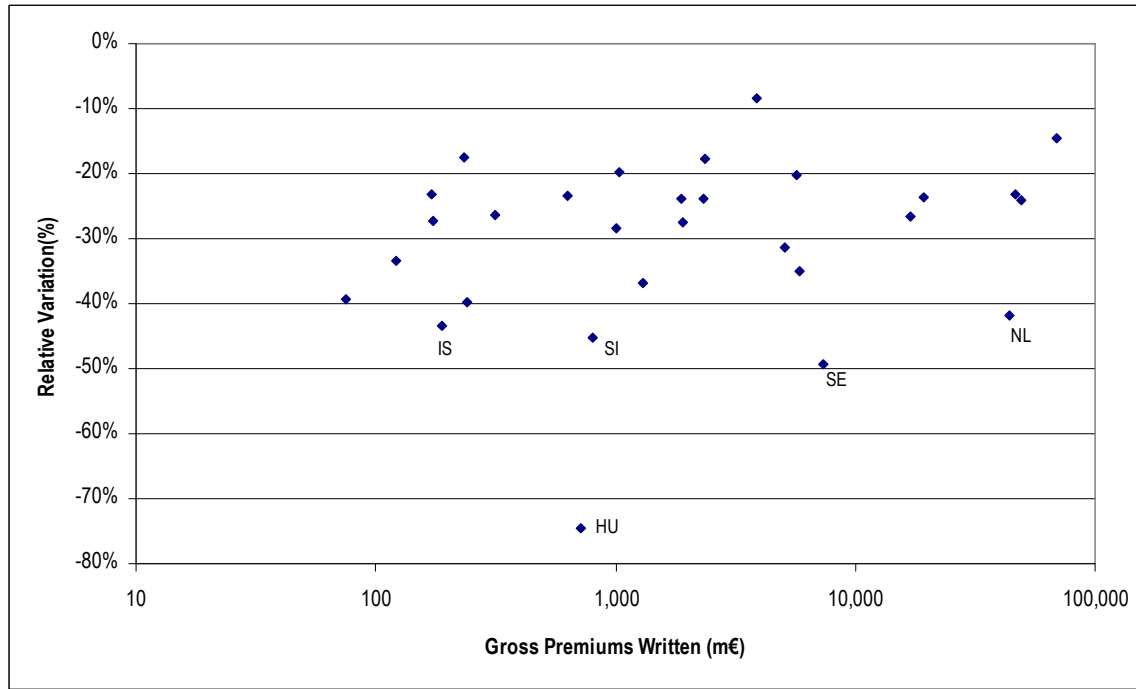


Table 4.38: Summary of relative variations between funding needs when moving from the home state principle and a portfolio transfer mechanism to the home state principle and a pure compensation mechanism covering claims and unearned premiums; EU average and minimum, median and maximum across all EEA countries; non-life business line

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

Table 4.39: 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€)

$\alpha \rightarrow$	PD = 0.5%			PD=0.1%		
	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%

4.7 Comparison of policy options for the EU

Figure 4.57: 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 $\alpha=99\%$

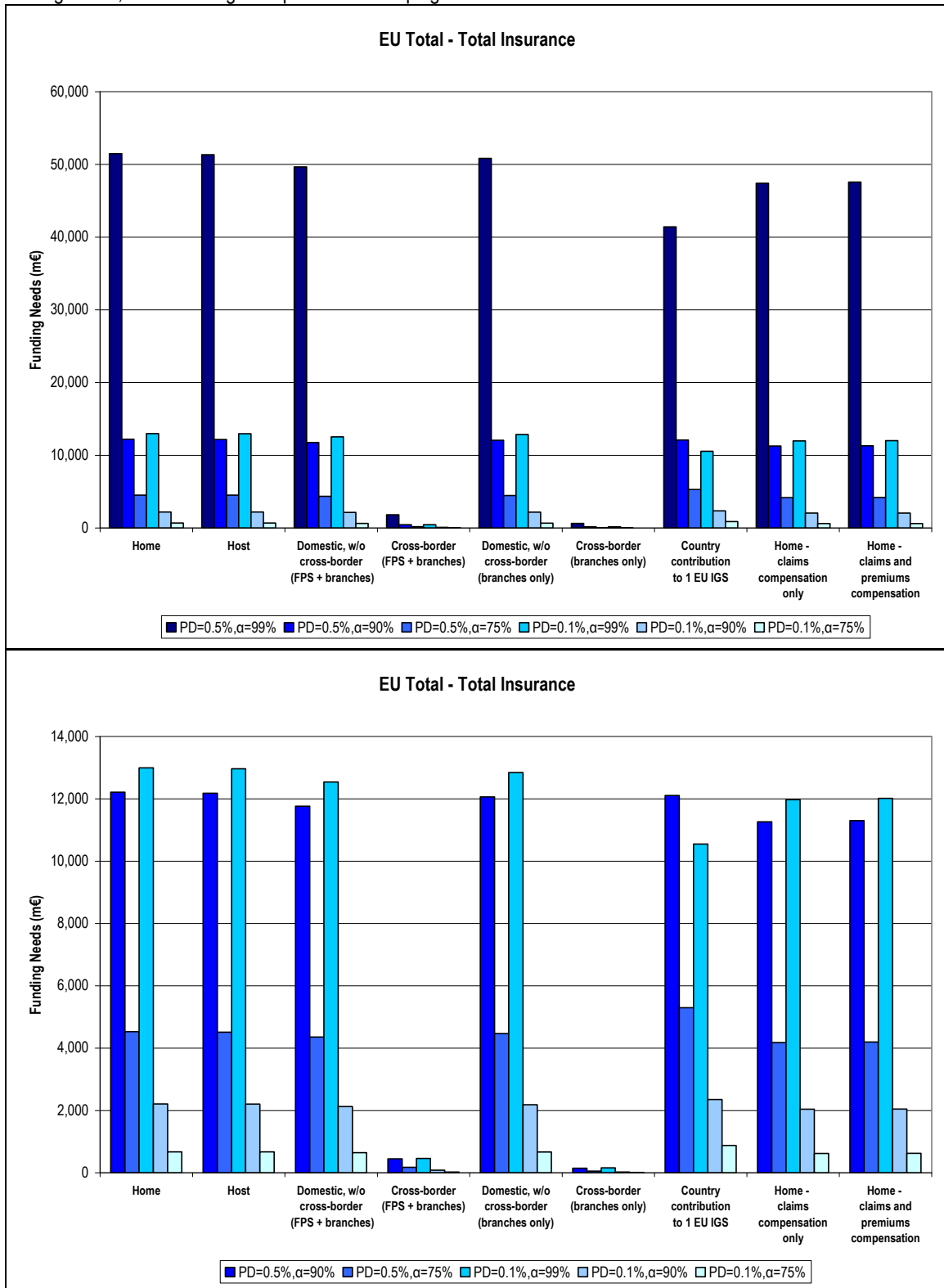


Figure 4.58: Life insurance, comparison of different policy options for the EU total. The top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$

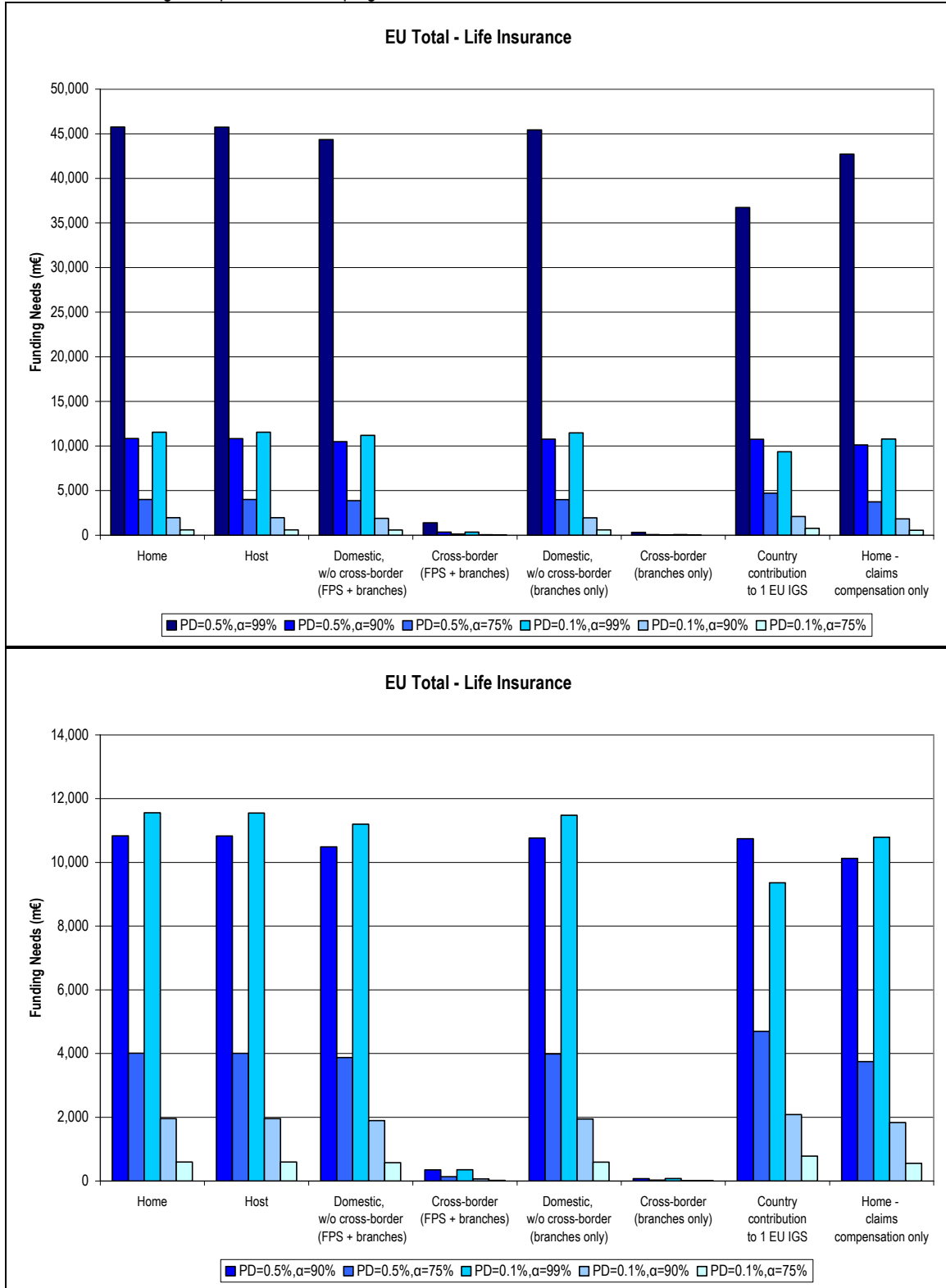
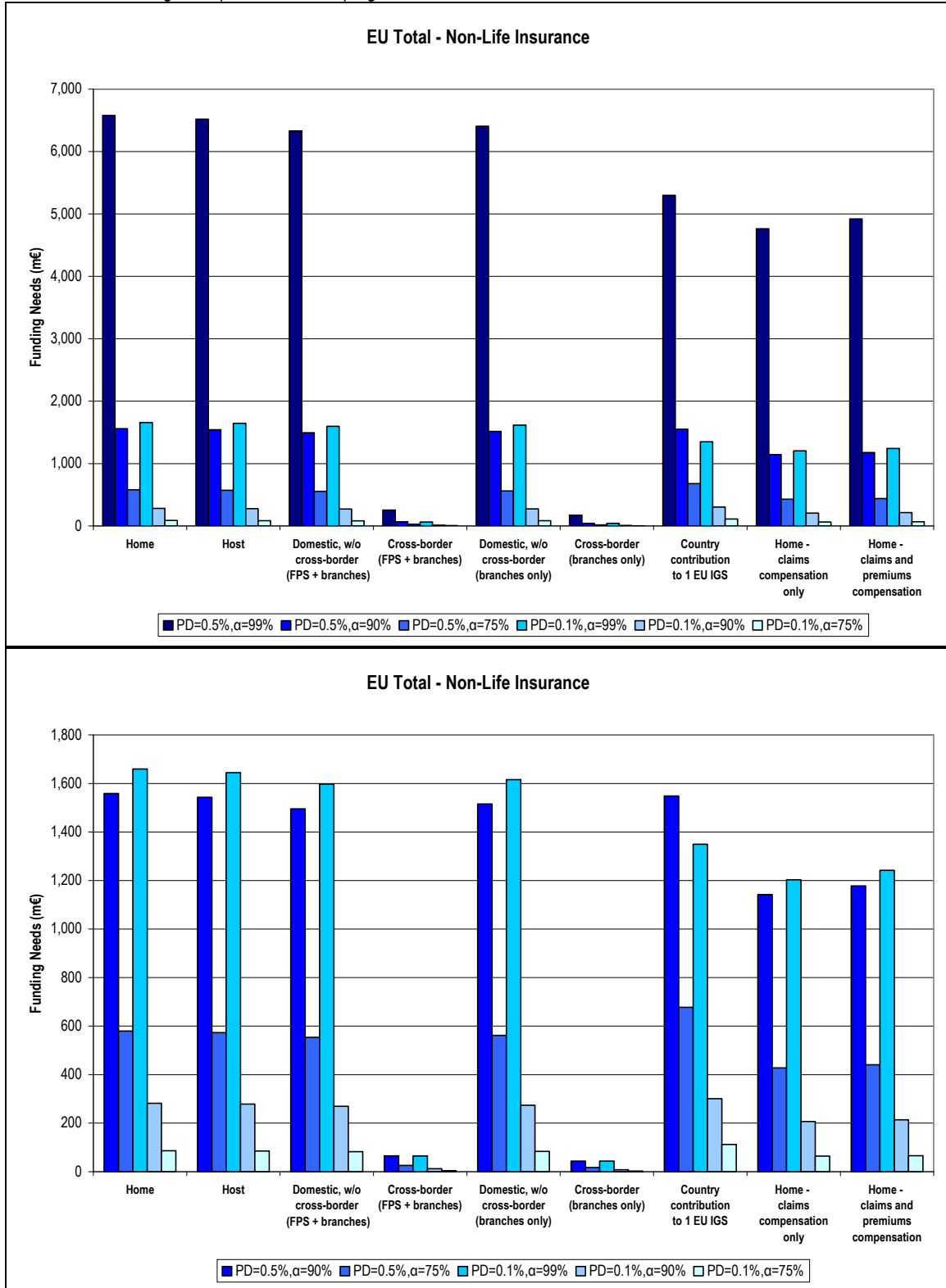


Figure 4.59: Non-life insurance, comparison of different policy options for the EU total. The top figure indicates funding needs; the bottom figure reproduces the top figure with the exclusion of the case PD=0.5% and $\alpha=99\%$



Annexes

A1 Derivation of the Vasicek portfolio default model (Equation 1.2)

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 horizon²⁷. 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 liabilities²⁸. 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)

$N(\cdot)$ is the cumulative normal distribution function²⁹ 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:

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

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

²⁷ 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.

²⁸ 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.

²⁹ $N(x)=P(\mathbf{X}<x)$ where x is a specific value of the random variable \mathbf{X} and $P(\cdot)$ stands for probability.

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

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:

$$PD^* = P(F_i = 1 | Y)$$

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:

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

The probability that a loss smaller than $x\%$ will be incurred in a large portfolio can be written as³⁰:

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

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 :

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

³⁰ This result is obtained relying on the fact that the common factor is normally distributed.

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 $\rho + \delta(1 - \rho)$ which leads to Equation 1.2 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 shock³¹ $TP_1 = TP_0 + SCR_0$ 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:

$$EAD = TP_1 + SCR_1 = (TP_0 + SCR_0) + SCR_1.$$

Equation A2.2

By considering SCR_1 as directly proportional to TP_1 ³², equation A2.2 can be rewritten as:

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

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 counterparty or operational risk, as they all basically imply a revision of the value of liabilities³³.

³¹ 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.

³² $SCR_1 \approx TP_1 \times SCR_0 / TP_0$.

³³ 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.

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:

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

Consequently, the expected EAD is given as:

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

which can be written as:

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

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:

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

which can be simplified to:

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

Equation A2.6

where

$Tot\pi_0$ is the total premium written at t_0 ; and

$U\pi_0$ is the unearned premium at t_0 .

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

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

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:

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

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 of 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?

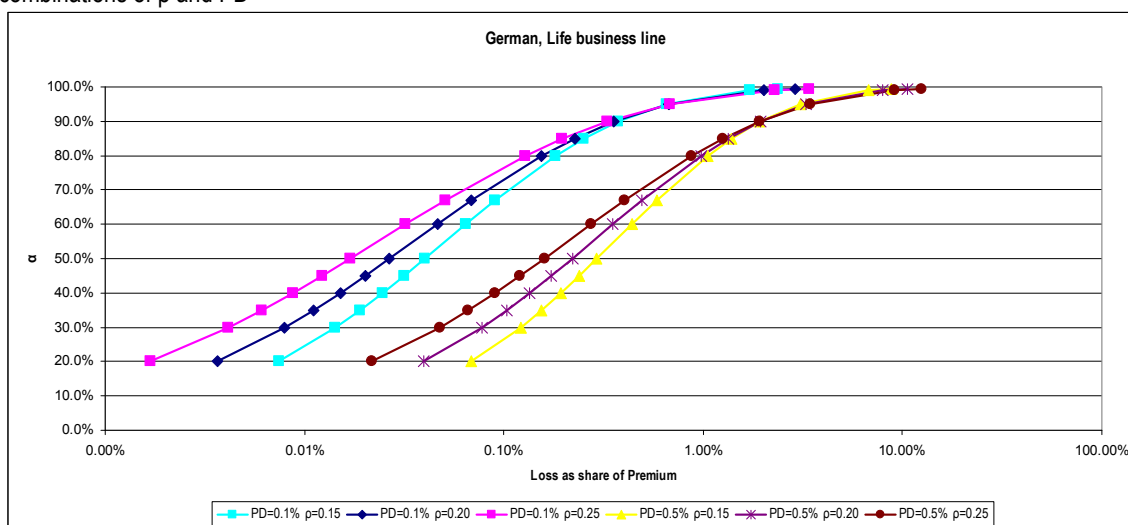
Loss given default is currently set at 15% in order to make the results from this model comparable with the results presented in Oxera's IGS report (Oxera 2007, 102). A comparison with a value of 45%, as suggested in the Basel II foundation IRB credit risk module, was made but is not included in the 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 $\delta, PD=0.1\%, \alpha=90\%$	Expected loss $= EAD * LGD * PD$	Ratio= funding needs ($\delta, PD=0.1\%, \alpha=90\%$)/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 ($\delta, PD=0.1\%, \alpha=90\%$)	Funding needs under $\delta=0, PD=0.1\%, \alpha=90\%$	Ratio= funding needs ($\delta=0, PD=0.1\%, \alpha=90\%$)/ expected loss	Percentage of largest loss covered by funding needs ($\delta=0, PD=0.1\%, \alpha=90\%$)
	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	0.24	38.49%	494	560	0.37	0.22	1.70	84	0.07%	0.44%	0.53	2.44	0.64%
SK	496	313	0.23	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 $\alpha=90\%$)	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 $\alpha=90\%$)	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 relating to all policy options tested

See additional document.

A6 Comparison of policy options by country

See additional document.

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