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## Completing the Banking Union with a European Deposit Insurance Scheme: who is afraid of cross-subsidisation?

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# Abstract

On 24 November 2015, the European Commission published a proposal to establish a European Deposit Insurance Scheme (EDIS). The proposal provides for the creation of a Deposit Insurance Fund (DIF) with a target size of 0.8% of covered deposits in the euro area and the progressive mutualisation of its resources until a fully-fledged scheme is introduced by 2024. This paper investigates the potential impact and appropriateness of several features of EDIS in the steady state. The main findings are the following: first, a fully-funded DIF would be sufficient to cover payouts even in a severe banking crisis. Second, risk-based contributions can and should internalise specificities of banks and banking systems. This would tackle moral hazard and facilitate moving forward with risk sharing measures towards the completion of the Banking Union in parallel with risk reduction measures; this approach would also be preferable to lowering the target level of the DIF to take into account banking system specificities. Third, smaller and larger banks would not excessively contribute to EDIS relative to the amount of covered deposits in their balance sheet. Fourth, there would be no unwarranted systematic cross-subsidisation within EDIS in the sense of some banking systems systematically contributing less than they would benefit from the DIF. This result holds also when country-specific shocks are simulated. Fifth, under a mixed deposit insurance scheme composed of national deposit insurance funds bearing the first burden and a European deposit insurance fund intervening only afterwards, cross-subsidisation would increase relative to a fully-fledged EDIS.

The key drivers behind these results are: i) a significant risk-reduction in the banking system and increase in banks' loss-absorbing capacity in the aftermath of the global financial crisis; ii) a super priority for covered deposits, further contributing to protect EDIS; iii) an appropriate design of risk-based contributions, benchmarked at the euro area level, following a "polluter-pays" approach.

**Keywords**: European Deposit Insurance Scheme (EDIS), risk-based contributions, cross-subsidisation.

**JEL codes**: G21, G28.

# Non-technical summary

This paper provides five analytical contributions to the discussion on the establishment of a European Deposit Insurance Scheme (EDIS). First, the exposure of a fully mutualised EDIS to bank failures[1] is estimated, examining how the European Deposit Insurance Fund (DIF), with a target size of 0.8% of covered deposits of participating banking systems, would be affected under different stress and bail-in scenarios as well as under different methodological assumptions. Second, the paper provides a quantitative analysis of how the calibration of deposit insurance risk-based contributions (based on current banks' risk profiles) affects the distribution of contributions across countries and banks. Third, the paper investigates how the collection of contributions would be spread across small, medium and large banks. Fourth, the analysis aims to verify whether EDIS would produce any systematic cross-subsidisation between banking sectors in different Member States, also taking into account potential country-specific shocks. Finally, a mixed deposit insurance scheme, with national funds bearing the first burden and a European fund intervening only afterwards, is tested to investigate its potential implications for contributions and cross-subsidisation.

This paper first focuses on a fully-fledged EDIS with a target level of 0.8% of covered deposits of the participating banking systems. The analysis is based on Bankscope data as well as supervisory data for 2015:Q4 on covered deposits and balance sheet indicators to estimate EDIS exposure to bank failures and contributions to EDIS at bank level. The conclusions of the analysis are therefore based on the assumption that banks' balance sheet structures remain the same until EDIS has been fully introduced. The sample scrutinised comprises 1,675 euro area banks with total assets of €22.14 trillion, representing approximately 75% of total assets of credit institutions in the euro area, and €4,744 billion of covered deposits, corresponding to approximately 83% of covered deposits in the euro area. The sample can be considered as representative at the euro area level, both in terms of total assets and covered deposits.[2] The target size of the DIF for the sample is approximately €38 billion.

The exposure of EDIS is measured for banking crises of a different magnitude, where the riskiest 3% or 10% of banks fail simultaneously according to their estimated probabilities of default, in combination with different magnitudes of loss severity[3], ranging from 5% to 25% of total assets in resolution and between 7.5% and 37.5% in insolvency, and two variations of banks' loss-absorbing capacity. The results indicate that a fully-funded DIF would be sufficient to cover payouts even in very severe crises - even more severe than the 2007-2009 global financial crisis. It should be stressed that the loss scenarios used for the analysis are extremely

1 The term "EDIS exposure" refers to the potential need for an EDIS intervention in case of a bank failure.

2 The degree of representativeness of the sample at country level is, however, heterogeneous.

3 Losses in insolvency are assumed to be always 50% higher than losses in resolution.

conservative. First, the loss ranges considered are extremely conservative, as the lower loss rate of 5% total assets, for example, is higher than the upper bound of 4.7% reported by the FSB for G-SIBs during the last crisis, and twice the average estimates reported by the European Commission for the period 2007-2010. Second, the high loss rates tested in this study are applied simultaneously to all the banks assumed to fail.

The comparison of banks' risk-based contributions based on different indicator sets suggests that specificities of a banking system can be taken into account in the risk-based contributions to the DIF: this approach would allow to take into account country-specific features, e.g. the likelihood of a significant share of banks within a banking system to be subject to resolution instead of insolvency or the degree of bank interconnectedness. This is preferable to a lowering of the EDIS target level as is currently allowed under the Deposit Guarantee Scheme Directive (DGSD) since it maintains the Fund's level of resilience and also preserves the level playing field. In addition, adjusting the indicators in the risk-based contributions would make it possible to take into account the relative riskiness of the banking sectors while the DIF is being built up and while risk reduction measures are implemented.[4] The analysis also finds that contributions depend on the calculation method used. Most importantly, rescaling of the aggregate risk scores leads to a change in the distribution across banks and countries in favour of the most risky banks. Furthermore, a comparison of contributions that would be paid by banks of different size reveals that smaller and larger banks would not excessively contribute to EDIS relative to the amount of covered deposits in their balance sheet, suggesting that measures to reduce contributions for the smallest and/or largest banks would be unwarranted.

Banks' contributions to EDIS are estimated and compared to the EDIS exposures obtained in the previous part of the paper. This comparison aims to identify possible unwarranted cross-subsidisation across euro area countries. Given the very high loss rates necessary to produce cross-subsidisation, which would be considerably higher than those experienced in the last global financial crisis, the findings suggest no unwarranted systematic cross-subsidisation via EDIS, in the sense of some banking systems systematically contributing less than they would benefit from the DIF. This result holds also when country-specific shocks are simulated. In general, it should be noted that cross-subsidisation can be seen as a form of desirable risk-sharing in more severe crises. This is different from a systematic unwarranted cross-subsidisation and is in line with the purpose of an EDIS: pooling resources to enhance the ability of the deposit insurance system, particularly in the more severe crises, to withstand shocks better than under a system of national stand-alone DGSs.

Finally, the analysis shows that under a mixed deposit insurance scheme, composed of national funds bearing the first burden and a European fund intervening only

[4] In this context, see the 2015 European Commission Communication towards the completion of banking Union (European Commission, 2015) and the 2017 Commission Communication on completing the Banking Union (European Commission, 2017).

afterwards, each with a target level of 0.4% of covered deposits, cross-subsidisation would increase relative to a fully-fledged EDIS. The reason is that the contributions paid to the national deposit insurance fund would be fixed at 0.4% of covered deposits in a Member State and would not be risk-based relative to the euro area banking system.

In conclusion, EDIS would offer major benefits in terms of depositor protection while posing limited risks in terms of EDIS exposure, since the probability and magnitude of interventions are likely to be low. EDIS will play a key role in terms of confidence building, also avoiding risks of self-fulfilling prophecies on bank runs. Additionally, based on the results shown in this paper, there is no risk of unwarranted systematic cross-subsidisation.

The key drivers behind these results are the following: first, a significant risk-reduction in the banking system and increase in loss-absorbing capacity have taken place in the aftermath of the global financial crisis; second, a super priority for covered deposits will further contribute to protect EDIS; third, following a "polluter-pays" approach, appropriately-designed risk-based contributions, benchmarked at the euro area level, are crucial to establish the right incentives and strike the right balance between ensuring adequate and credible deposit protection and minimising cross-subsidisation across countries. Risk-based contributions can and should internalise the specificities of banks and banking systems. This would address moral hazard and facilitate moving forward with risk-sharing measures in parallel with risk-reduction measures; this approach would also be preferable to lowering the target level of the DIF to take into account banking system specificities.

# 1 Introduction

On 24 November 2015, the European Commission published a proposal for a European Deposit Insurance Scheme (EDIS). The appropriateness of the Deposit Insurance Fund's (DIF) target size – in the proposal, 0.8% of covered deposits, as already envisaged for national deposit guarantee schemes – is one crucial aspect of the design of the scheme. In addition, the distribution of risk-based contributions across different types of banks and the possibility of a reduction of contributions for specific types of banks is a subject of discussion. Some of the concerns raised upon the publication of the proposal were that the EDIS would lead to unwarranted cross-subsidisation, i.e. banking sectors in one Member State would have to pay for bank failures in other Member States.[5]

This paper investigates the validity of these concerns by first assessing the exposure[6] of a fully mutualised EDIS with a target level of 0.8% of covered deposits of the participating banking systems to bank failures under different stress and bail-in scenarios. Second, the paper provides a quantitative analysis of how the calibration of risk-based contributions (based on current banks' risk profiles) affects the distribution of contributions across countries and banks. Third, we show how the collection of contributions would be distributed across small, medium and large banks. Fourth, the analysis aims to investigate whether EDIS would produce any systematic cross-subsidisation between banking sectors in different Member States, also taking into account hypothetical country shocks. Finally, the paper compares the results on contributions and cross-subsidisation under a fully mutualised EDIS with a "mixed" deposit insurance scheme, composed of national compartments with a target level of 0.4% of domestic covered deposits - intervening first - and a European compartment with a target level of 0.4% of euro area covered deposits - intervening only after the national compartment is depleted.

The analysis is based on two steps for both the fully-fledged EDIS and the mixed deposit insurance system. In the first step, the exposure of EDIS to bank failures is calculated using covered deposits as well as banks' estimated probabilities of default (PD), loss given default (LGD) and banks' loss-absorbing capacity. Crises of different magnitudes are considered where the riskiest 3% or 10% of banks fail simultaneously according to their estimated PDs in combination with different magnitudes of loss severity (LGD)[7] and two variations of banks' loss-absorbing capacity. This first step makes it possible to assess the resilience of EDIS to potential loss scenarios of different severity and under different assumptions on loss absorption by banks' liabilities. In a second step, banks' contributions to EDIS are

5 In its June 2016 Conclusions, the Economic and Financial Affairs Council (Ecofin) agreed that political negotiations on EDIS would start as soon as sufficient further progress had been made on a set of measures to reduce risks in the banking system.

6 The term "EDIS exposure" refers to the potential need for an EDIS intervention in case of a bank failure. It is calculated, first, as losses minus loss-absorbing capacity at bank level and, second, summed up for all banks.

7 Losses in insolvency are assumed to be always 50% higher than the losses in resolution.

estimated and compared to the EDIS exposures obtained in the first step. This comparison aims to identify possible unwarranted cross-subsidisation across euro area countries. In addition, the distribution of contributions across banks of different size is studied.

The paper is organised as follows. Section 2 provides an overview of the rationale, objectives and challenges related to deposit insurance. Section 3 illustrates the key features of EDIS and sets the stage for the empirical analysis. Section 4 presents the model for the estimation of banks' default probabilities, describes the loss-absorbing mechanism and assumptions, and reports the findings on EDIS exposure. Section 5 discusses the rationale, methodology and findings of the contributions and cross-subsidisation analysis under a fully-fledged EDIS. Section 6 illustrates the results on contributions and cross-subsidisation under a mixed deposit insurance scheme. Section 7 sets out conclusions.

# 2 Deposit insurance: rationale, objectives and challenges

The guiding rationale behind a deposit insurance scheme is to enhance financial stability by increasing depositors' confidence in the safeness of their deposits (Diamond and Dybvig, 1983). By removing the depositors' incentives to withdraw their money when concerned about a bank's solvency, deposit insurance ultimately reduces liquidity risk which may in turn reduce the likelihood of financial crises and their severeness. Bernet and Walter (2009) argue that a deposit insurance scheme can also be seen as a means to strengthen the competitiveness of smaller banks, to foster growth by encouraging savings, and to have banks financing the deposit insurance thereby reducing costs otherwise borne by taxpayers or depositors in case of a resolution or insolvency.

As documented by Demirgüç-Kunt et al. (2008), the number of countries with an explicit deposit insurance system rapidly increased over the last few decades, from twenty in 1980 to eighty-seven by the end of 2003. Therefore, already before the 2008 global financial crisis, deposit insurance had become a key tool of the financial safety net. After the crisis, this trend was reinforced: Demirgüç-Kunt et al. (2014) reported that, out of 189 countries covered in their 2013 updated deposit insurance dataset, 112 countries (or 59%) had explicit deposit insurance by yearend 2013 while there were 84 (or 44%) in 2003.[8]

The widespread adoption of explicit deposit insurance schemes around the world signals a general belief that deposit insurance will bring benefits for depositor protection and financial stability. However, deposit insurance schemes can also have unintended consequences such as a shift in incentives towards risk-taking by banks (moral hazard) and a decrease in effective monitoring exercised by depositors (market discipline) (see, for example, Calomiris and Jaremski 2016a, 2016b). Indeed, theory predicts that, once insured, there is a higher incentive for bankers to enlarge the value of the deposit insurance by increasing risk (Merton, 1977). On the depositor side, there is a lower incentive to search for the best bank to entrust their savings or to demand higher interest rates in return for higher risk. For uninsured deposits and where doubts on the credibility of the insurance arise, the economic literature finds that banks' risk is in fact reflected in their interest rates (e.g., Brewer and Mondschean, 1994; Ellis and Flannery, 1992; Cook and Spellmann, 1994). However, different conclusions emerge from Allen et al. (2017), who analyse the effects of government guarantees on financial stability: the authors find that guarantees are welfare improving since they induce banks to improve liquidity

[8] Although all deposit insurance schemes share the goal of protecting depositors' confidence and financial stability, their key features differ across countries, as shown by Demirgüç-Kunt et al. (2008, 2014). Differences may relate, among other features, to the coverage level, the source of funding of deposit insurance, the institutional arrangements, the coverage of foreign currency deposits and interbank deposits, or the presence of a co-insurance mechanism (under which depositors are insured only for a fraction of their insured deposits and thus retain a portion of the possible losses).

provision although they can have (but not always) negative indirect effects on banks' risk-taking decisions.

Calomiris and Jaremski (2016b) examine the state deposit insurance experiments of the early 20th century in the US and find that deposit insurance increased both insured banks' default risk and overall systemic risk by removing market discipline that had been constraining banks that were uninsured. Anginer et al. (2014) show empirically that generous deposit insurance schemes increase systemic risk via moral-hazard mechanisms before a crisis, and reduce risk and increase stability during crisis times. Demirgüç-Kunt and Detragiache (2002) examine 61 countries from 1980 to 1997 and also find that deposit insurance increases the likelihood of a banking crisis and that this negative impact is intensified with a broader insurance. The negative aspects of a deposit insurance scheme can however be mitigated by a strong banking supervision framework correcting risk-taking incentives, e.g. a supervisory authority equipped with the power to take corrective and preventive actions (Anginer et al., 2014).

Demirgüç-Kunt and Huizinga (2004) shed light on the relationship between market discipline, on the one hand, and deposit insurances and their design, on the other hand. When looking at 30 developed and developing countries in the period from 1990 to 1997, they find that deposit insurance decreases market discipline and causes lower interest rates. Regarding the design of deposit insurance, they examine over 50 countries and show that co-insurance, in the sense of a deductible for depositors, strengthens market discipline and increases deposit rates. On the contrary, a higher explicit coverage reduces market discipline and lowers deposit rates. With regard to the timing of the funding of a deposit insurance fund, there is evidence that an ex-ante funded scheme deteriorates market discipline the most as opposed to an ex-post funding mechanism, i.e. unfunded or an unfunded but callable mechanism.

Funding of the deposit insurance fund may come from banks only, banks and governments or just governments. The source of funding also affects market discipline and interest rates: the more involved the government, the lower the interest rates and market discipline. Hovakimian et al. (2003) focus their analysis on 56 countries and uncover that the introduction of explicit deposit insurance encourages banks to shift risk onto the deposit insurer by increasing either their leverage or the volatility of the return on assets. However, this effect can be moderated by including risk-based premiums, coverage limits and co-insurance in the insurance design. A similar alleviating effect can be attributed to a sound legal system. In fact, Laeven (2002) finds that a strong legal system largely corrects for the adverse consequences of an explicit deposit insurance.

# 3 A European Deposit Insurance Scheme: key features and the way forward

In November 2015 the European Commission presented a proposal to establish an EDIS as the third pillar of the banking union.[9] EDIS would be set up in three stages: first, for three initial years from July 2017 to July 2020[10], a reinsurance scheme would cover up to 20% of the liquidity shortfall[11] and up to 20% of the excess loss[12] of a participating DGS whenever payouts and losses exceed the DGS's available financial means. The liquidity would be provided by means of a loan which the DGS has to pay back, while the reinsured part of the excess loss, i.e. 20%, would not have to be paid back. Furthermore, in order to limit moral hazard, the reinsurance funding would be capped at 20% of the DIF's initial target level or ten times the target level of the insured DGS, whichever is lower. In addition, the benchmark for calculating whether and to what extent a DGS can access the EDIS during the re-insurance phase is the hypothetical level of liquidity the DGS should have if it had complied with all its obligations (e.g. collecting ex ante contributions to reach the target level), and not the actual level of liquidity in a DGS. Finally, other sources available to the DGS (e.g. raising short-term ex post contributions) have to be tapped before resorting to EDIS and the SRB is mandated to monitor the way the DGSs pursue their claims during insolvency proceedings. During the reinsurance stage, banks' risk-based contributions to the DIF would be calculated with reference to the national banking system, i.e. relative to the riskiness of banks in the same country and not of all banks in the banking union.

In the second stage, for four years after the end of the reinsurance stage and until July 2024, a co-insurance scheme would be set up where the DIF would cover a gradually increasing share (20% in year 1, 40% in year 2, 60% in year 3, 80% in year 4) of the liquidity needs and losses of participating DGSs. Co-insurance would kick-in "as of the first euro", so independently of the national DGSs' resources being exhausted. As it is the DGS which has the claim against the DIF (as opposed to depositors or banks), any payout would be channelled through the national DGS. While the liquidity provided to the DGS would have to be repaid, this is not the case for the covered loss, which would be shared pro rata between the national DGSs and DIF in line with the gradually increasing coverage ratio. No cap would be provided for the amount due by the DIF. During the co-insurance stage, and differently from the

9 Proposal for a Regulation of the European Parliament and Council amending Regulation (EU) 806/2014 in order to establish a European Deposit Insurance Scheme.

10 To note, due to delays in the on-going negotiations, the timeline foreseen by the Commission is not expected to be met.

11 According to the Commission proposal, the liquidity shortfall is the amount of covered deposits in the failing bank which exceeds the total available financial means in the DGS (i.e. under the DGSD, available funding plus extraordinary contributions that the DGS can raise within 3 days of the payout event).

12 The excess loss is the loss remaining once the insolvency procedure is over (after recovery) and long-term ex-post contributions have been called.

reinsurance stage, banks' risk-based contributions would be calculated with reference to the riskiness of all banks in the banking union.

In the third and final stage, starting in July 2024 (after the seven years of re- and co-insurance), a full insurance scheme would be in place: the EDIS would cover all liquidity needs and losses of participating DGSs. In other words, the final stage consists of a 100% mutualisation with national DGSs being fully insured by the DIF. Also in this case there is no cap provided for the amount due by the DIF. Finally, to limit the potential moral hazard linked to a full EDIS, the Commission proposal also foresees that DGSs can be disqualified from EDIS coverage if they do not comply with their obligations under the framework.[13] As in the coinsurance stage, banks' risk-based contributions would be calculated taking into account the riskiness of all banks in the banking union.

In October 2017 the European Commission published a Communication on the completion of Banking Union (European Commission, 2017), including a proposed new approach on EDIS aimed to address diverging views in the European Parliament and the Council. The Commission proposed to introduce EDIS more gradually relative to its original proposal. During re-insurance, differently from the November 2015 proposal, there would be no coverage of losses, although the coverage of the liquidity shortfall would be higher, increasing progressively up to 90% in the third year. The move to the second phase, i.e. co-insurance, would not be automatic but contingent on a set of conditions to be assessed by the Commission, for example related reduction of banks' portfolios of Non-Performing Loans and Level 3 assets (illiquid assets which cannot be evaluated on the basis of market prices or models). If these conditions are met and co-insurance starts, EDIS would also provide coverage for losses, starting with a 30% coverage which should progressively increase. However, the Communication does not provide any information on how such an increase would take place and therefore the path of mutualisation is unclear. Depending on the end point of the progressive increase in losses coverage, the final stage could be closer or distant from a fully-fledged EDIS with full insurance. As the Communication indicated that the original proposal "remains on the table unchanged", full-insurance in the steady state remains a possibility to be discussed by co-legislators.

The main focus of this paper is on a fully-fledged EDIS with full insurance at the European level, as in the steady state of the November 2015 Commission proposal - that the European Central Bank supported in its public opinion in April 2016.[14] This choice is made also taking into account that the October 2017 Communication is not formally a new proposal and that full-insurance in the steady state is still possible.

However, recent policy discussions have also considered different approaches to EDIS, notably referring to a possible design under which national DGSs would

13 Article 41 (i) of the Commission proposal envisages that a DGS shall not be covered in the reinsurance, co-insurance or full insurance phase if disqualifying conditions are met.

14 Opinion of the European Central Bank of 20 April 2016 on a proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 806/2014 in order to establish a European Deposit Insurance Scheme (CON/2016/26).

intervene first, and the European deposit insurance fund would only step in as a second line of defence. Despite some technical differences, the idea of national DGSs or national compartments of EDIS bearing the first burden is common across several proposals, e.g. respectively the November 2016 draft report of the Committee on Economic and Monetary Affairs, drafted by Member of the European Parliament Esther de Lange,[15] and the proposal by a group of French and German economists in January 2018 (Bénassy-Quéré et al., 2018). For this reason, this study also includes an additional analysis based on a mixed deposit insurance scheme, composed of national compartments with a target level of 0.4% of domestic covered deposits - intervening first - and a European compartment with a target level of 0.4% of covered deposits - intervening only after depletion of the national compartment - which is substantially in line with the De Lange's report.

Creating an EDIS is a logical step in completing the European Banking Union: while the supervision and resolution pillar have already started to operate, respectively with the Single Supervisory Mechanism (SSM) and the Single Resolution Mechanism (SRM), the deposit insurance pillar is still missing. Ensuring a uniform protection of depositors across the entire banking union, regardless of geographic location, is a crucial element to preserve depositors' trust and thus avoid bank runs and protect financial stability. Establishing a fully-fledged EDIS would therefore strengthen the banking union and reinforce the single currency.

Not all deposits should be afforded protection. Retail deposits of small, less sophisticated investors should be insured, but wholesale deposits of large sophisticated investors should not, in order to strike an appropriate balance between protecting depositors' trust and financial stability, on the one hand, and preserving market discipline and limiting moral hazard, on the other hand. The European legislation has achieved such a balance by restricting deposit insurance only to "eligible deposits" and by setting a maximum level of coverage at €100,000 per depositor per bank, which is harmonised throughout Europe.

Directive 2014/49/EU defines as "covered deposits" the deposits which are eligible[16] for the deposit guarantee and up to the €100,000 coverage level. It should be noted that deposits from other banks and financial institutions are not eligible for coverage. Therefore, the combination of a coverage cap and the exclusion of deposits from certain types of investors aims to narrow the deposit insurance protection only to

15 Draft report on the Proposal for a regulation of the European Parliament and of the Council amending Regulation (EU) 806/2014 in order to establish European Deposit Insurance Scheme (COM(2015)0586 – C8-0371/2015 – 2015/0270(COD)) Committee on Economic and Monetary Affairs, European Parliament, rapporteur: Esther de Lange, 4 November 2016.

16 "Eligible" deposits are defined by exclusion under Article 5 of Directive 2014/49/EU, which excludes from the protection the following items: a) interbank deposits; b) own funds; c) deposits arising out of transactions in connection with which there has been a criminal conviction for money laundering as defined in Article 1(2) of Directive 2005/60/EC; (d) deposits by financial institutions as defined in point (26) of Article 4(1) of Regulation (EU) No 575/2013; (e) deposits by investment firms as defined in point (1) of Article 4(1) of Directive 2004/39/EC; (f) deposits the holder of which has never been identified pursuant to Article 9(1) of Directive 2005/60/EC, when they have become unavailable; (g) deposits by insurance undertakings and by reinsurance undertakings as referred to in Article 13(1) to (6) of Directive 2009/138/EC of the European Parliament and of the Council; (h) deposits by collective investment undertakings; (i) deposits by pension and retirement funds; (j) deposits by public authorities; (k) debt securities issued by a credit institution and liabilities arising out of own acceptances and promissory notes.

those deposits and investors deemed in need of protection, i.e. assumed to be small and non-sophisticated. The lack of protection for wholesale investors and for amounts exceeding the coverage level should tackle moral hazard and enhance market discipline, for investors which are considered non-retail and more sophisticated. In the empirical analysis on EDIS developed in this paper, the focus will thus be on covered deposits only, i.e. deposits which are eligible for deposit insurance protection and up to the coverage level of €100,000.

A second crucial issue for the functioning of EDIS is the interaction with the new requirement for Total Loss-Absorbing Capacity (TLAC) introduced by the Financial Stability Board for Global Systemically Important Banks (G-SIBs) and the new Minimum Requirement for own funds and Eligible Liabilities (MREL) introduced for all European and banking union banks by the BRRD (Bank Recovery and Resolution Directive[17]) and the Single Resolution Mechanism Regulation (SRMR)[18], respectively. Both TLAC and MREL will in fact play a loss-absorbing function which, in principle, could shield the EDIS from losses related to resolution and enhance the resilience of the banking system in general. The amount of TLAC and MREL liabilities, in proportion to the overall bank balance sheet, as well as the amount of covered deposits in a bank will play a crucial role in determining whether the deposit insurance fund would be effectively protected or should step in to bear part of the losses – in lieu of covered deposits – in a bank resolution context. While the involvement of the deposit insurance fund for loss coverage is less likely in a resolution, it might still be possible, especially if a bank does not have sufficient loss-absorbing capacity and/or if the resolution authority decides to exercise its power to exclude on a discretionary basis some liabilities from the scope of bail-in, e.g. for financial stability purposes. This could narrow the cushion of loss-absorbing capacity which protects covered deposits/deposit insurance fund.

However, the possible intervention of the resolution fund, which is subject to certain preconditions and caps, would lower the probability of exposures of the deposit insurance fund to losses. Finally, the choice by the resolution authorities between resolving or liquidating a bank under an ordinary insolvency procedure will also play a crucial role: losses are likely to be higher under an insolvency procedure than in resolution, meaning that the deposit insurance fund could be potentially more exposed to losses in insolvency than in resolution (although this depends on the loss-absorbing capacity of liabilities in resolution and liquidation; in any case, the reverse cannot happen because losses for the deposit insurance fund in resolution cannot be higher than under insolvency; see Article 109.1 BRRD and Article 79.5 SRMR).

All these elements have fundamental implications for the exposure of the DIF which would be established under the EDIS. A key objective of this paper will be to assess the EDIS exposure under different scenarios, obtained by combining different assumptions on the features discussed above.

17 Directive 2014/59/EU.

18 Regulation (EU) No. 806/2014.

A crucial, related issue concerns the appropriate size of the deposit insurance fund. In the European Commission proposal, the target size for the DIF in the steady state is set at 0.8% of covered deposits. This is in line with the European Directive on Deposit Guarantee Scheme (DGSD), which harmonised the target level for national DGSs.[19] At the time of the proposed review of the DGSD in 2010, the Commission had prepared an impact assessment looking among other things at the potential target for national DGS. The impact assessment of the Commission concluded that the target level should be sufficiently high to ensure that schemes are credible and capable of dealing with medium-sized bank failures, while maintaining banks' profitability.[20] The Commission proposed a target of 1.5% of eligible deposits to be reached with ex-ante contributions. The target was subsequently reduced to 0.8% of covered deposits during the co-legislative process between the European Parliament and the Council of the European Union. Additionally, a possibility was introduced for Member States to authorise a lower minimum target level of 0.5% of covered deposits, where the banking system in the Member State is highly concentrated with a large quantity of assets held by a small number of credit institutions or banking groups, which are more likely to go into resolution than insolvency. Finally, the DGSD contains the possibility for Member States to agree to a mechanism of voluntary lending between national DGSs, but it has never been used so far.

In the context of the EDIS proposal, the Commission also published an effect analysis on EDIS which concludes that pooling risk at the European level delivers a significantly stronger deposit guarantee system than a system of purely national schemes, or a scheme with voluntary lending between DGSs.[21]

However, the study of the Commission did not take into account several aspects related to MREL and bail-in as well as scenarios including combinations of probability of default and loss given default for banks. Therefore, this paper conducts further empirical analysis to test whether and under what scenarios and conditions a 0.8% target would be appropriate and sufficient. In addition, the paper analyses how different calibrations of risk-based deposit insurance affect the distribution of contributions across countries, investigates how the collection of contributions would be distributed across small, medium and large banks and assesses whether an EDIS would produce any systematic cross-subsidisation between banking sectors in different Member States.

19 Directive 2014/49/EU.

20 Commission staff working document - Impact Assessment - Accompanying document to the Proposal for a Directive …/…/EU of the European Parliament and of the Council on Deposit Guarantee Schemes [recast] and to the Report from the Commission to the European Parliament AND to the Council Review of Directive 94/19/EC on Deposit Guarantee Schemes, published 12 July 2010.

21 See Effects analysis on the European deposit insurance scheme, published 11 October 2016.

**Box 1**

Comparison between EDIS and the US FDIC

The deposit insurance scheme set up by the Federal Deposit Insurance Corporation (FDIC) in the US has performed a crucial role in ensuring financial stability since it was created in the 1930s. In addition to deposit protection, the FDIC also has a key role in bank supervision and resolution (Beck and Laeven, 2006). In fact, following the financial crisis of 2007-2009, the Dodd-Frank Act gave the FDIC even more responsibility in this regard, notably on resolution.

First, regarding the degree of protection of deposits, while the EDIS aims to continue covering deposits up to €100,000 in case of a bank failure, the FDIC insurance amount is currently USD250,000 per depositor per insured bank.

Second, similarly to Europe where the target level for ex-ante funds was set at 0.8% of covered deposits after the initial proposal to set it at 1.5% of eligible deposits, there has been a substantial debate in the US about the optimal size of the deposit insurance fund. From its creation until 1989 there was no target size for the FDIC fund. However, to address concerns about the viability of the fund after 2,900 bank and thrift failures from 1980 through 1994 (Ellis, 2013), a target size in the form of a Designated Reserve Ratio (DRR) equal to at least 1.25% of insured deposits was introduced in 1989. However, the FDIC deposit insurance fund went negative again following the 2007-2009 financial crisis and, as a result, the Dodd-Frank Act of 2010 increased the minimum reserve ratio to 1.35%, to be reached by 2020. Since 2011, the FDIC has set the DDR at 2%. Following the greater authority that was given to the FDIC in 2010, the Corporation moved from portfolio management techniques and loss distribution simulation models to determine the size of its fund to a much simpler approach determining the size of the fund on the basis of two severe banking crises to prevent it from going negative. This framework underpins the current fund-management strategy of the FDIC and corresponds to a long-term target of 2% of insured deposits. The US FDIC deposit insurance fund had a balance of USD 83 billion at the end of 2016, corresponding to 1.20% of the total amount of insured deposits (USD 6.9 trillion). Based on the volume of insured deposits at year-end 2016, a 2% DRR would translate into a USD 138 billion fund.

When assessing the appropriateness of the European target level, it has to be noted that the DIF will coexist with the SRF, which itself has a target level of 1% of covered deposits. Thus, a total amount of 1.8% of covered deposits will be dedicated to resolution and deposit insurance purposes, corresponding to about €100 billion. In the US, the deposit insurance fund is also used to perform resolution functions. As a result, its target size could be compared with the target size in the steady state of both the SRF and the DIF.

Third, the DGSD specifies that contributions to the EDIS should be made ex ante and be based not only on the amount of covered deposits but also on banks' individual degree of risk. Similarly, the FDIC fund has always been financed ex ante by the banks since alternative arrangements such as ex-post assessments and contributions could arguably increase the risk of costly delays and undermine the confidence in the financial system (Ellis, 2013). Nevertheless, the FDIC evolved from simple rules into a more sophisticated system to determine what premium banks have to pay. In fact, from its inception to 1991 all banks paid the same rate set by the US Congress and, as a result, less risky banks were effectively subsidising banks with a higher risk profile. However, in 1991 the US Congress required the FDIC to adopt a risk-based premium framework which started being implemented in 1993 (Ellis, 2013).

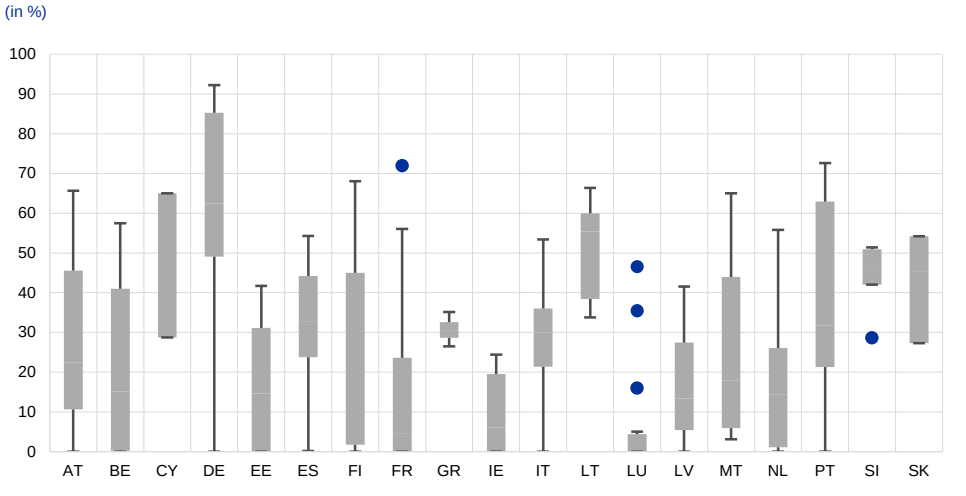
# 4 EDIS exposure

## 4.1 Data on covered deposits

The analysis uses Bankscope data and supervisory data from COREP (Common Reporting) and FINREP (Financial Reporting) for 2015:Q4 on covered deposits and balance sheet indicators to estimate EDIS exposure to bank failures and contributions to EDIS at bank level. The conclusions of the analysis are therefore based on the assumption that the banks' balance sheet structure remains the same until EDIS has been fully introduced. The sample scrutinised comprises 1,675 euro area banks with total assets of €22.14 trillion, which amounts to about 75% of total assets of credit institutions in the euro area, and €4,744 billion of covered deposits, corresponding to about 83% of covered deposits in the euro area. The sample can be considered as representative, both in terms of total assets and covered deposits.[22] The target size of the DIF for the sample is approximately €38 billion. The box plot in Chart 1 shows the distribution of covered deposits per total assets within each country in the euro area as of year-end 2015. There is generally heterogeneity across countries both in terms of median and in terms of dispersion. German banks have the highest median of covered deposits per total assets in the euro area, but also considerable variation in the amount of covered deposits relative to their balance sheet size.

**Chart 1**

Distribution of covered deposits to total assets by country




Sources: ECB calculations based on COREP for 1,675 banks, reporting date 2015:Q4.
Notes: The bottom and top of the box represent the first and third quartiles of the within-country distribution, while the band inside the box is the second quartile (median). The ends of the whiskers are the maximum and minimum values excluding outliers. Outliers are represented by diamonds.

[22] The degree of representativeness of the sample at country level is, however, heterogeneous. For example, the coverage ratio in terms of total assets is 77% for Germany and France, 62% for Italy, 83% for the Netherlands, 88% for Greece, 65% for Belgium, 43% for Austria, 34% for Ireland and 24% for Cyprus.

## 4.2 Methodology

### 4.2.1 Probability of default estimation

The analysis of the exposure of EDIS is based on various crisis simulations which follow the methodology for calculating the Probability of Default (PD) for banks provided in Betz et al. (2014) as well as Lang et al. (2018). The PD of around 5,000 euro area banks is estimated via an early warning model that accounts for different bank-specific, aggregate banking sector and macro-financial variables, using panel data from 1999 to 2013.

To estimate the coefficients used to calculate bank-specific PDs, banks in the sample were classified as either in distress/default or not in distress/default. The identification of distress events can be challenging given that actual bank failures have not been frequent in the euro area. As a result, following Betz et al. (2014), a bank is defined as in distress/default if: (i) the status of the bank in the Bankscope database is either “bankruptcy”, “dissolved” or “in liquidation”; (ii) the bank has negative capital; (iii) the bank was involved in a distressed merger, i.e. the merged entity has a negative coverage ratio (capital equity and loan loss reserves minus non-performing loans to total assets) one year before the merger; or (iv) the bank received state aid based on the data from the European Commission.[23] A forecast horizon of two years prior to bank distress/default events is used to identify the build-up of vulnerabilities with a sufficient lead time.

Table 1 shows the estimated coefficients from the logit regressions using either five or eight bank specific controls and five or eight country-level characteristics – specifications (A) and (B), respectively. All coefficients are statistically significant in both models. In detail, less profitable banks, banks with lower tangible equity as a percentage of assets, higher share of trading income, lower share of deposits and higher provisions for NPLs have a higher probability of default. In terms of country-level characteristics, in line with Jordà et al. (2017), who analyse 17 advanced economies from 1870 to 2013 and find that credit growth on the asset-side of banks’ balance sheet and liquidity indicators such as the loan-to-deposit ratio are key crises predictors, the reported coefficients show that banks’ probability of default is higher in countries with higher 1-year change in the loan-to-deposit ratios. Also in line with economic theory and previous empirical evidence (e.g. Lang et al., 2018), the estimates indicate that banks’ probability of default is higher in countries with higher financial assets as a percentage of GDP, lower 1-year change in the ratio of issued debt securities to total liabilities, as well as higher unemployment and inflation.

[23] This information is publicly available at: state aid. In this analysis, resort to central bank Emergency Liquidity Assistance is not considered as an indicator of distress/default, because it concerns banks which are facing temporary liquidity problems but are solvent.

Finally, the relatively high area under the receiving operating curve (AUROC) indicates that the models can explain and predict the data well.[24] This finding is also confirmed by the in-sample test (see Appendix). Given the very high correlation between the two sets of predicted PDs (above 90% both in terms of estimated PDs and rankings) specification (A) below is used throughout the study to maximise the number of banks in the analysis.

**Table 1**

Estimated coefficients for the early warning models (1999 - 2013)

| | A | B |
|---|---|---|
| **Tangible equity / Total assets** | -0,009** (0,004) | -0,011** (0,005) |
| **Return on Equity** | -0,045*** (0,004) | -0,022*** (0,007) |
| **Interest expenses / Total liabilities** | 0,139*** (0,033) | 0,195*** (0,039) |
| **Share of trading income** | 0,042*** (0,008) | 0,043*** (0,009) |
| **Deposits to Assets** | -0,022*** (0,002) | -0,024*** (0,002) |
| **Provisions for NPLs / Total assets** | | 0,345*** (0,081) |
| **Cost to Income** | | 0,012*** (0,003) |
| **Loans to Deposits** | | -0,000* (0,000) |
| **Financial assets / GDP** | 0,000*** (0,000) | 0,000* (0,000) |
| **Loans / Deposits (1-year change)** | 0,010*** (0,003) | 0,014*** (0,004) |
| **Issued debt / Total liabilities (1-year change)** | -0,052*** (0,008) | -0,036*** (0,011) |
| **Unemployment** | 0,077*** (0,011) | 0,065*** (0,014) |
| **Inflation** | 0,018*** (0,006) | 0,030*** (0,008) |
| **House price index** | | -0,037** (0,015) |
| **10-year yield (1-year change)** | | 0,126*** (0,046) |
| **Bank concentration (HHI)** | | 3,382*** (0,882) |
| **No. Observations** | 47 775 | 45 167 |
| **No. Banks** | 5 082 | 4 881 |
| **No. Distressed Banks** | 293 | 241 |
| **Pseudo R2** | 0,128 | 0,153 |
| **AUROC** | 0,795 | 0,818 |

Source: ECB staff calculations based on Bankscope, ECB Statistical Data Warehouse and European Commission dataset on state aid measures, 1999:Q1 – 2013:Q4.
Note: Standard errors robust to heteroskedasticity in parentheses. Statistical significance at the 10%, 5% and 1% levels is denoted by *, ** and ***, respectively.

The bank-specific PDs for the year 2015 are calculated on the basis of the coefficients estimated above. Given the distribution of the estimated 2015 PDs for 1,675 banks (93 of which are Significant Institutions - SIs), the 3% (using the 97th percentile as a threshold) and 10% (corresponding to the 90th percentile) of banks with the highest PDs are singled out as banks most likely to fail on the basis of the described PD methodology. The analysis assumes that, for each crisis simulation, all banks belonging to the riskiest 3% or 10% fail simultaneously. The 97th and 90th percentiles correspond to a PD of 5.32% and 3.04%, respectively.

[24] The AUROC (Area Under the Receiver Operating Characteristics Curve) is used to measure the performance of the early-warning model. The greater the predictive power, the more bowed the curve, and hence the area beneath the curve is often used as a measure of the predictive power. A perfect indicator has an AUROC of 1, while an uninformative indicator has an AUROC of 0.5.

As a result of the empirical set-up for the estimation of PDs, crisis simulations in this analysis strongly depend on observed banking failures and crises. Additionally, while the data on independent variables used to calculate banks' probabilities of failing are point in time (year-end 2015), the coefficients for the regressions to obtain PDs are calculated taking the economic and financial cycle into account. The inclusion of the recent financial crisis may influence this paper's results leading to potential discrepancies between simulated failures and those possibly materialising in the steady state.

### 4.2.2 Loss given default

To define a range for the Loss Given Default (LGD), i.e. the amount of losses for each bank when it fails, we have considered the historical bank losses observed in the past, particularly during the recent financial crisis. The European Commission[25] estimated average losses for 23 banks over the period of 2007-2010 to be 2.5% of total liabilities (maximum of 46.4%; minimum of 0.2%) while losses plus recapitalisation needs were on average 6% of total liabilities (maximum of 50.7%; minimum of 2.6%). The Financial Stability Board found that for G-SIBs losses as a fraction of total assets ranged from less than 1% to 4.7%, with most banks in a 2-4% range. The maximum ratio of losses and recapitalisation amounts relative to total assets was 8.8%, with most banks between 3.9% and 6.1% (Financial Stability Board, 2015).

Given the evidence above and the significant variation in the estimates of LGDs, a wide range for average LGD for banks in distress is considered. Since one of the objectives of the simulations in this paper is to also test an extremely stressful scenario, the analysis considers losses in resolution (with bail-in) from 5% to 25% of total assets. This is an extremely conservative range if compared to the values observed in the last crisis. The lower threshold of 5% total assets, for example, is higher than the upper bound reported by the FSB for G-SIBs during the last crisis, and twice the average estimates reported by the Commission for the period 2007-2010. In addition, the analysis presented in this paper not only simulates extremely severe shocks, but also considers the same amount of losses simultaneously affecting a wide sample of banks, e.g. the 3% and the 10% of the euro area riskiest banks. This is a very conservative assumption, also when compared to events in the last financial crisis.

Insolvency proceedings can be particularly complex, costly and time-consuming, thus often resulting in higher average losses than when a bank is resolved. This is true even if one ignores externalities such as spillovers into the rest of the financial system and the losses that could ultimately be borne by the bank's depositors (Hardy, 2014). Therefore, to consider the complexity, cost and length of insolvency proceedings, losses in insolvency are assumed to be always 50% higher than the losses in resolution, and therefore range from 7.5% to 37.5%.

25 Commission staff working document impact assessment.

### 4.2.3 Methodology to model resolution and loss-absorption capacity

The need for an EDIS contribution in case of a bank failure depends on whether the bank goes into resolution or insolvency, and on its level of loss-absorption capacity. For the purpose of the analysis, it is assumed that a bank would be resolved if it has (i) a balance sheet size of more than €20 billion, or (ii) more than 40,000 transactional accounts, and that it would otherwise be liquidated.[26] Since there is no available data on the number of transactional accounts for the banks in the sample, the assumption is that any bank with more than €4 billion in covered deposits is above the 40,000 threshold, i.e. that each account has €100,000 (corresponding to the maximum amount covered by deposit insurance per depositor per bank). This assumption is conservative, since on average each account has less than €100,000. Therefore, the analysis may overestimate the number of banks going into insolvency rather than resolution, which is overall conservative in terms of losses since insolvency may cause more destruction of value than resolution. In resolution, a contribution from the Single Resolution Fund (SRF) is considered in each scenario, respecting the conditions set out in the legislation. This means that SRF contributions are capped at a maximum of 5% of bank's total assets after shareholders and creditors have absorbed losses and recapitalisation costs corresponding to at least 8% of total assets.[27] In addition, cumulative SRF contributions cannot exceed the overall size of the SRF (i.e. 1% of total covered deposits in the sample which equals €47.4 billion[28]). Furthermore, the DIF contribution in resolution cannot be higher than the contribution it would have paid in insolvency.[29]

Regarding banks' loss-absorption capacity in resolution, two scenarios are used in the analysis:

A. All liabilities except for secured liabilities and covered deposits absorb losses;

B. Only regulatory capital, subordinated debt and senior unsecured bonds with a remaining maturity of at least 12 months absorb losses.

Scenario A is always used to model banks' loss-absorption capacity in liquidation.

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26 These assumptions broadly follow the Bank of England's proposed approach to direct institutions to maintain a minimum requirement for own funds and eligible liabilities, in their December 2015 consultation paper (Bank of England, 2015). Following feedback to the consultation, the Bank of England made two changes regarding the transactional accounts threshold: first, it clarified that accounts are defined as "transactional" on the basis of the frequency of their use (at least nine withdrawals over the previous three months); second, a range of between 40,000 and 80,000 accounts replaced a fixed threshold of 40,000; see Bank of England (2016).

27 The BRRD (art. 44.5 and 49.3) requires that the 8% threshold to allow SRF intervention and the 5% cap on the SRF intervention are calculated on total liabilities and own funds (TLOF), taking into account netting agreements for derivatives. However, this analysis uses total assets as a proxy for TLOF due to data availability issues.

28 For the purpose of the calculation of this cap, only ex-ante contributions are taken into account. Ex-post contributions to the SRF could raise the cap.

29 See Article 79 of the Single Resolution Mechanism Regulation. To ensure that this condition is met, the EDIS exposure for a bank subject to resolution is compared to that bank's hypothetic loss posed to EDIS if it had been liquidated. The EDIS exposure is then set to be the lower of the two.

The analysis follows the existing creditor hierarchy, where covered deposits have a super-priority, both in resolution and liquidation. Indeed, the BRRD and the SRMR make it possible to subject a wide range of unsecured liabilities to losses, e.g. via a bail-in, and give a super-priority to covered deposits in the ranking of creditors. However, in practice, it is unlikely that all liabilities within the scope of bail-in will be fully loss-absorbing at the point of resolution. Therefore, scenario B considers a bail-in scenario in which only MREL-eligible liabilities are considered to be fully loss-absorbing (but deposits of large corporates above €100,000 are not included, despite being MREL-eligible, to make the scenario more conservative). It should be noted, however, that senior unsecured liabilities currently rank alongside other liabilities classes, e.g. derivatives. Thus, it is unlikely that they would be fully loss-absorbing given the "no-creditor-worse-off" principle.

## 4.3 Main results

Table 2 presents the simulation results showing the estimated exposure of EDIS under loss absorbency scenarios A and B in resolution, respectively. These scenarios are estimated for different levels of LGD and different PD thresholds, i.e. the 90th and 97th percentiles. Additionally, for all scenarios the simulations show the estimated EDIS exposure with and without SRF contribution assuming the requirements mentioned in the previous section are satisfied.[30]

[30] The analysis takes into account the following caps: (1) a ceiling for the SRF contribution in order not to deplete the SRF (SRF contribution is capped at 1% of covered deposits of participating banks); (2) EDIS exposure for each bank cannot exceed the amount of covered deposits held by that bank; (3) a resolution cap not allowing EDIS exposure in resolution to exceed the theoretical exposure if the bank had been subject to insolvency; and 4) SRF contribution cannot exceed 5% of a bank's total assets. Note that, in this exercise, the fact that DGS contribution in resolution cannot exceed 50% of its target level as per Article 109 BRRD and Article 79 SRMR is not considered. As a result of the different caps which limit EDIS exposure, the exposure numbers are similar with and without SRF contribution calculations. Furthermore, it should also be noted that only bank losses are considered for the calculations on the EDIS exposure, while bank recapitalisation needs (which would not be borne by EDIS) are not included.

**Table 2**

EDIS exposure in EUR billion for scenario A and B, with and without SRF contribution

(EDIS target size amounts to €38 billion)

| | | Scenario A in resolution | | | | Scenario B in resolution | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Without SRF | | With SRF | | Without SRF | | With SRF | |
| 1) | 2) | 3) | 4) | 5) | 6) | 7) | 8) | 9) | 10) |
| Loss in Resolution (as % of total assets) | Loss in Insolvency (as % of total assets) | 3 Percent riskiest banks fail | 10 Percent riskiest banks fail | 3 Percent riskiest banks fail | 10 Percent riskiest banks fail | 3 Percent riskiest banks fail | 10 Percent riskiest banks fail | 3 Percent riskiest banks fail | 10 Percent riskiest banks fail |
| 5% | 7,50% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10% | 15% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15% | 22,50% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20% | 30% | 0,003 | 0,003 | 0,003 | 0,003 | 3 | 3,6 | 3 | 3,6 |
| 25% | 37,50% | 0,04 | 0,04 | 0,04 | 0,04 | 23,9 | 30,4 | 23,8 | 30,4 |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: Resolution scenario A: all liabilities except for secured liabilities and covered deposits absorb losses. Resolution scenario B: only capital, subordinated debt and senior unsecured bonds with a remaining maturity of at least 12 months absorb losses.

The table depicts different levels of losses for scenario A (B) in columns 3 to 6 (columns 7 to 10) as a percentage of total assets, both in resolution and insolvency (columns 1 and 2). Columns 3(7) and 5(9) represent the DIF exposure when the riskiest 3% of euro area banks in the sample fail, without and with SRF contribution, respectively. For the sample of 1,675 banks, this implies the failure of 51 banks which hold 12.66% of the total assets in the sample. 18 of those failing banks enter into resolution and 33 into insolvency, corresponding to 12.42% and 0.24% of total assets, respectively. Columns 4(8) and 6(10) show the equivalent numbers for an extremely severe crisis where the riskiest 10% of euro area banks in the sample fail, respectively, both without and with SRF contribution: this implies the failure of 167 banks which hold approximately 40% of the total assets in the sample [31]

The table shows that EDIS exposure never exceeds the DIF target size in the sample, equal to € 38bn: this means that despite the severity of the simulated losses (up to 25% of the total assets in resolution, simultaneously applied to all the 3% and 10% riskiest banks in the sample), and the conservative assumptions on the loss-absorbing capacity in resolution (Scenario B), the fund is never depleted.

The results also suggest that a fully-funded DIF with ex-ante contributions of 0.8% of covered deposits would have no exposure in cases of loss rates up to 20% in resolution and 30% in insolvency, in both scenarios A and B. This finding reflects the strengthening of banks' loss-absorbing capacity and the effects of the risk-reducing measures that have been implemented so far.

Under scenario A, EDIS exposure remains very limited in all the crisis-loss combinations, with and without SRF contribution in resolution: even with a loss rate equal to 25% of total assets in resolution, for instance, the EDIS exposure is capped at € 40mln.

[31] As a term of comparison, according to the definition of default/distress used in this analysis, in 2007-2009 the share of failed/distressed banks was 0.8% in terms of number of banks and 39.1% in terms of total assets.

Under scenario B, EDIS exposure would become material only in case of losses at least equal to 25% of total assets in resolution. It should be emphasised that, according to the FSB estimates (see Section 4.2.2), during the last crisis only one bank reported losses higher than 8% of total assets: in order to trigger high EDIS exposures, in this study it is necessary to assume that the entire 3% (or 10%) of the banks in the sample is affected by the 25% loss rate - a scenario considerably harsher than the historical cases occurred both in Europe and the US. It should be noted, in fact, that the analysis in this paper assumes a simultaneous failure of the riskiest banks and a fixed level of losses relative to total assets rather than a distribution, which is extremely more conservative than what was observed in past crises, notably for high loss levels.

Finally, it should be emphasised that the main benefit of an EDIS derives from reducing the sovereign-bank nexus as well as from pooling resources across Member States. A European Deposit Insurance Scheme would enhance depositor confidence and reduce the risk of wider deposit withdrawals which may also spill over to other banks: this effect would be even more beneficial considering that the banking system would be exposed to EDIS only in case of extremely severe crises. Spillovers are not modelled in the analysis given the confidence enhancing role of an EDIS.

# 5 Risk-based contributions to EDIS

## 5.1 Rationale

One concern which is frequently voiced regarding EDIS relates to the possibility that the pooling of resources could lead to cross-border subsidies, i.e. the eventuality of one or several banking systems structurally contributing more and benefitting less from the scheme than other, potentially riskier, systems. The pooling of resources could also lead to increased moral hazard and incentivise risk-taking behaviour by banks given the existence of a larger deposit guarantee scheme and fund. There might also be the risk that certain banking systems would be more likely to tap into the EDIS funds than others, even though all banking systems would benefit from the enhanced capacity of the deposit scheme to withstand larger crises.

The post-crisis review of the European Deposit Guarantee Scheme Directive (DGSD) applied the concept of risk-based contributions to national DGSs.[32] The Commission proposal on EDIS also foresees the use of risk-based contributions to the DIF, the methodology of which would be determined in a Commission Delegated Act. The use of a "Banking Union methodology", i.e. a methodology comparing banks across the banking union rather than within each national banking system, would have the potential to reduce the risk of cross-border subsidies compared to a system where banks' contributions would be calculated only relative to their national peers. This is because, following a "polluter-pays" principle, a national banking system would contribute more to the DIF overall if it is riskier relative to other banking systems in the banking union. This approach would have the benefit of aligning incentives and tackling moral hazard, since banking systems which include riskier banks would contribute more to the DIF overall than they would if contributions were solely based on the amount of deposits or calculated only taking into account the riskiness of banks within the national banking system.

## 5.2 Methodology

Given that the exact methodology for the calculation of banks' contributions to the DIF is yet to be developed, the analysis below is based on a modified version of the methodology developed by the EBA for national DGSs in which banks' contributions are risk-based.[33] It must be stressed that, while the EBA methodology for national DGSs applies the risk adjustment at a national level, the risk adjustment in this analysis is carried out at the banking union level.

According to the EBA Guidelines, the calculation of an institution's contribution is based on five risk categories: (1) capital, (2) liquidity and funding, (3) asset quality,

32 Directive 2014/49/EU.

33 See EBA Guidelines on methods for calculating contributions to deposit guarantee schemes to be found here : Guidelines.

(4) business model and management, and (5) potential losses for the DGS (this factor is not considered in this analysis due to limited data on unencumbered assets). For the purpose of this study, the leverage ratio and the total risk-based capital ratio are included for category (1), liquid assets per total assets[34] are included for category (2), and the Return On Equity (ROE) and Risk Weighted Assets (RWA) per total assets are used for the category representing an institution's business model and management (4). Furthermore, the analysis includes a measure of (part of) MREL-eligible liabilities.[35] The higher the MREL, the higher the likelihood of a bank going into resolution rather than liquidation, the higher the bank's expected capacity to absorb losses and, all else being equal, the lower the potential exposure for EDIS.[36] The combination of these indicators shall hereinafter be referred to as "DGS-baseline indicators" and is comparable to the list of indicators proposed for EDIS. As these indicators are still under discussion, the set used here does not prejudge the final calculation method that will be decided by the Council of the EU and the European Parliament. In a first modification of the baseline list of indicators, the indicator for MREL-eligible liabilities is excluded to test the impact of this indicator on the contributions. In a second modification, the established baseline set of indicators is extended by additionally including an indicator for interconnectedness measured as the sum of loans and advances from and to banks relative to the total amount of these items in the sample. The non-performing loans ratio (category (3)) is not included in the baseline analysis because of data limitations. However, it is reported separately in column 7 in Table 3, where it is added to the baseline indicators to indicate its potential relevance for the purpose of future analyses. Finally, the established baseline indicator set is extended by including the World Bank index for the strength of insolvency frameworks, since the proper functioning of the insolvency framework will have an impact on the deposit insurance's capacity to recover money in insolvency after a payout.[37]

The EBA Guidelines suggest two alternative approaches to constructing aggregate risk weights (ARW) that are used in the contribution calculation: a bucket approach and a sliding scale approach. The results presented are those for the sliding scale approach, since this approach requires fewer assumptions and uses a normalisation method that is better suited to preserving the level of information of the indicators.[38] The 25th and 75th percentiles are used as lower and upper boundaries,

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34 Defined as: (Cash & balances with central banks + Net loans and advances to banks + Level 1 assets (fair value hierarchy)) / Total Assets.

35 Senior unsecured bonds only: regulatory capital is not included to avoid double consideration, given that it is already used for category (1) on capital.

36 The EDIS exposure could be lower for several reasons: for example, MREL-eligible liabilities cannot be suddenly withdrawn, e.g. in a run, because they must have residual maturity of at least one year; losses in insolvency tend to be higher than in resolution; the losses for the deposit guarantee scheme in resolution cannot be higher than in insolvency (see Article 109 of the BRRD and Article 79 of the SRMR).

37 See Resolving Insolvency

38 See OECD and JRC (2008). The construction of the composite risk indicator is a crucial topic in the calculation of risk-based contributions as contributions strongly depend on the choice and design of the various steps taken to calculate the ARW. The aforementioned work of the OECD and JRC gives an insightful overview of indicator construction in general.

respectively.[39] The normalisation transforms each individual indicator value into an individual risk score (IRS) such that a lower score corresponds to a better performing bank in the respective field. In a second step, the IRSs are aggregated using a weighted arithmetic average to obtain a single aggregate risk score (ARS) for each bank.[40] The relative size of the weights used in the analysis follows the EBA Guidelines. In this paper's analysis the ARS is not rescaled before it is used as an ARW in the contribution calculation.[41]

In a last step, banks' contributions are calculated as the product of the contribution rate, the ARW, the total covered deposits held by a bank and an adjustment factor that ensures that contributions add up to the target size, which is set to 0.8% of the total covered deposits in the sample.

To gain some insight into the importance of the calculation method used, the results are also compared with the risk-based contributions calculated under the SRF approach[42].

## 5.3 Contributions

Table 3 gives an overview of the amounts (in billions of euro) and the share contributed by each banking system based on the different indicator sets described above. All columns are obtained using the DGS sliding scale methodology according to the EBA Guidelines. Column 3 shows the amount and the non-risk based share contributed only on the basis of covered deposits amounts. Column 4 reports contributions and the share for each banking system on the basis of the DGS-baseline indicators. The comparison between columns 3 and 4 provides an indication of the impact of the risk factor in the calculation of contributions. A reduction in contributions following the "polluter-pays" principle is visible for banks in Austria, Belgium, Finland, France, Lithuania, Latvia and the Netherlands; on the contrary, banks in Germany, Spain, Greece, Italy, Portugal and Slovakia would see an increase in contributions due to their higher risk with respect to the European benchmark. Columns 5 to 8 show the modifications of the baseline indicators as described in the previous section and column 9 presents the results based on the SRF approach. The impact of the MREL indicator on the contributions becomes apparent when comparing column 4 to column 5. This indicator can be perceived as a proxy for a bank's likeliness to go into resolution instead of insolvency. The

39 Except for the NPL ratio, where missing values are set to zero in order to keep the sample size large, the first and third quartile thresholds are both zero. To avoid division by zero and to produce a more differentiated IRS, the upper bound is set to the highest value observed.

40 An alternative to this aggregation method would be a geometric average which, in contrast to the arithmetic average, does not allow for the compensation of a poor performance in one field by a very good performance in another field (OECD and JRC, 2008).

41 Rescaling has a distorting effect on aggregate risk scores by, in this case, reducing risk scores for riskier banks more than for safer banks. See Box 2.

42 The construction of the aggregate risk weight for contributions to the SRF differs in several aspects from the EBA Guidelines. For instance, for the normalisation method the relevant Commission delegated regulation prescribes a bucketing approach, applies several rescalings and makes use of geometric and linear aggregation methods. For a full description of the methodology see Commission Delegated Regulation (EU) 2015/63.

inclusion of this variable means that banks which are likely to go into resolution experience a reduction in contributions; the rationale being that these banks are expected to cause less exposure for EDIS. A reduction in contributions following the inclusion of the MREL indicator can be observed, for instance, for French, Spanish and Dutch banks, and could potentially constitute an alternative to a target level reduction in favour of countries in which a significant portion of banks is likely to go into resolution rather than insolvency. This approach would have the advantage of not reducing the overall target level of EDIS, thereby maintaining its level of resilience. It should be noted that, as our analysis is based on banks' current risk profiles, and given this composition of indicators, contributions from larger banks are likely to decrease further in the future when MREL buffers are built up.

Column 6 shows the results under the same DGS methodology, but also including an indicator for interconnectedness. This would allow the risks posed by the failure of interconnected banks to the rest of the banking system, and hence to EDIS, to be taken into account. Column 7 shows the results with the inclusion, on top of the baseline, of an indicator for NPLs, the NPL ratio (non-performing loans and advances over total gross loans and advances as reported in FINREP). The ratio is only included for 134 banks, including 89 SIs and 45 LSIs, and for the other banks in the sample it is set to zero. While the inclusion of this indicator does not allow us to draw definitive conclusions regarding the banks' contributions due to data limitations, NPLs are likely to be an important indicator affecting the possibility of cross-subsidisation within EDIS.

In addition, column 8 reports risk-based contributions when the World Bank index for the strength of insolvency frameworks is included. This is relevant given the impact of insolvency regimes in allowing DGSs to effectively recoup resources in insolvency proceedings. The inclusion of the index modifies the contributions of banking systems in most Member States.

A comparison of contributions based on the SRF method in column 9 with non-risk adjusted contributions (based on covered deposits only) in column 3 and with contributions calculated using the EBA Guidelines (column 4) suggests that contributions based on the SRF methodology could be less risk sensitive than those based on the DGS method. SRF-based contributions always fall in the range between risk-unadjusted and DGS-method-based contributions. The former are closer or equally close to the risk-unadjusted contributions as DGS-method-based contributions for all countries. This points towards a lower risk sensitivity of the SRF methodology. The reason for this finding is the effect of the rescaling of the aggregate risk scores. While it is used to calculate contributions with the SRF methodology, in this analysis a final rescaling to the risk scores under the DGS approach is not applied.[43] Indeed, when rescaling risk scores, prior to the contribution calculation, to the same range which is used in the SRF methodology [0.8, 1.5], the contributions converge towards non-risk adjusted contributions.

[43] The EBA Guidelines do not explicitly require risk scores to be rescaled. Furthermore, the boundaries can be chosen freely. Choosing a range of [0,100] would leave the risk scores unchanged.

Furthermore, they are even closer to non-risk adjusted contributions than those based on the SRF methodology. Box 2 provides further insights into this topic.

**Table 3**

Contributions by country based on DGS sliding scale methodology

| 1) | 2) | 3) | | 4) | | 5) | | 6) | | 7) | | 8) | | 9) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Country | Number of banks | 0.8% of covered deposits | | DGS - Baseline | | DGS without MREL indicator | | DGS plus Interconnectedness | | DGS plus NPL ratio | | DGS plus insolvency indicator | | SRF methodology with baseline indicator set | |
| | | In EUR billion | In percent of fund | In EUR billion | In percent of fund | In EUR billion | In percent of fund | In EUR billion | In percent of fund | In EUR billion | In percent of fund | In EUR billion | In percent of fund | In EUR billion | In percent of fund |
| AT | 33 | 0,6 | 1,56% | 0,5 | 1,38% | 0,6 | 1,46% | 0,6 | 1,45% | 0,5 | 1,38% | 0,6 | 1,57% | 0,6 | 1,50% |
| BE | 11 | 0,7 | 1,87% | 0,5 | 1,28% | 0,5 | 1,33% | 0,6 | 1,47% | 0,5 | 1,28% | 0,6 | 1,59% | 0,6 | 1,69% |
| CY | 3 | 0,1 | 0,24% | 0,1 | 0,34% | 0,1 | 0,25% | 0,1 | 0,27% | 0,2 | 0,42% | 0,1 | 0,34% | 0,1 | 0,31% |
| DE | 1180 | 9,8 | 25,72% | 12,5 | 32,92% | 11,1 | 29,17% | 11,3 | 29,65% | 11,8 | 31,19% | 9,5 | 24,99% | 10,5 | 27,71% |
| EE | 6 | 0,002 | 0,01% | 0,002 | 0,01% | 0,001 | 0,00% | 0,001 | 0,00% | 0,002 | 0,01% | 0,002 | 0,01% | 0,002 | 0,01% |
| ES | 20 | 7,2 | 19,00% | 7,9 | 20,85% | 8,3 | 21,93% | 7,9 | 20,72% | 7,9 | 20,80% | 8,4 | 22,13% | 7,4 | 19,55% |
| FI | 8 | 0,2 | 0,48% | 0,1 | 0,34% | 0,1 | 0,35% | 0,1 | 0,36% | 0,1 | 0,33% | 0,1 | 0,31% | 0,2 | 0,43% |
| FR | 23 | 9,6 | 25,38% | 6,6 | 17,52% | 7,1 | 18,80% | 7,7 | 20,33% | 6,6 | 17,47% | 8,2 | 21,71% | 8,6 | 22,67% |
| GR | 6 | 0,8 | 2,12% | 1,4 | 3,68% | 1,5 | 3,94% | 1,2 | 3,27% | 1,7 | 4,38% | 1,3 | 3,49% | 1 | 2,76% |
| IE | 5 | 0,3 | 0,70% | 0,3 | 0,70% | 0,3 | 0,69% | 0,3 | 0,71% | 0,3 | 0,79% | 0,3 | 0,76% | 0,3 | 0,69% |
| IT | 297 | 4 | 10,50% | 4,2 | 11,13% | 4,5 | 11,85% | 4,2 | 10,99% | 4,5 | 11,98% | 4,5 | 11,93% | 4,1 | 10,90% |
| LT | 5 | 0,1 | 0,19% | 0,04 | 0,11% | 0,01 | 0,05% | 0,03 | 0,10% | 0,04 | 0,11% | 0,1 | 0,14% | 0,1 | 0,16% |
| LU | 17 | 0,1 | 0,23% | 0,1 | 0,19% | 0,1 | 0,16% | 0,1 | 0,20% | 0,1 | 0,18% | 0,1 | 0,22% | 0,1 | 0,22% |
| LV | 16 | 0,05 | 0,13% | 0,03 | 0,10% | 0,01 | 0,05% | 0,03 | 0,09% | 0,03 | 0,10% | 0,04 | 0,12% | 0,04 | 0,12% |
| MT | 6 | 0,01 | 0,03% | 0,01 | 0,03% | 0,01 | 0,03% | 0,01 | 0,03% | 0,01 | 0,03% | 0,01 | 0,04% | 0,01 | 0,03% |
| NL | 18 | 3,7 | 9,67% | 2,3 | 6,02% | 2,4 | 6,39% | 2,8 | 7,27% | 2,3 | 5,94% | 3 | 7,78% | 3,3 | 8,64% |
| PT | 12 | 0,7 | 1,93% | 1,2 | 3,18% | 1,3 | 3,33% | 1,1 | 2,86% | 1,3 | 3,34% | 1 | 2,63% | 0,9 | 2,37% |
| SI | 6 | 0,1 | 0,22% | 0,1 | 0,16% | 0,1 | 0,16% | 0,1 | 0,16% | 0,1 | 0,19% | 0,1 | 0,20% | 0,1 | 0,20% |
| SK | 3 | 0,01 | 0,04% | 0,02 | 0,06% | 0,02 | 0,05% | 0,01 | 0,05% | 0,02 | 0,06% | 0,02 | 0,06% | 0,01 | 0,04% |
| Total | 1675 | 38 | 100% | 38 | 100% | 38 | 100% | 38 | 100% | 38 | 100% | 38 | 100% | 38 | 100% |

Source: ECB staff calculations based on COREP, FINREP and Bankscope data, 2015:Q4.
Note: The DGS-baseline calculation includes the following indicators: total risk-based capital ratio, leverage ratio, highly liquid assets per total assets, RWA per total assets, MREL-eligible liabilities (only senior unsecured bonds), and ROE.

## Box 2

### Aggregate risk weight construction – DGS vs. SRF methodology

The method used for the construction of the aggregate risk weight (ARW) is a decisive part of the determination of banks' contributions to the Fund as was shown by comparing contributions based on the EBA method to those determined using the SRF methodology in Table 3. This box aims to investigate the impact of several steps taken under the two methodologies to obtain the ARW, which is a composite indicator.

The two methodologies differ, first, in the normalisation method used. The normalisation method is applied to all individual indicators before aggregation into one composite indicator. While the DGS sliding scale method uses the distance from some benchmark value (here: the 75th and 25th percentile), the SRF makes use of a bucketing method, where banks are assigned to different bins based on their relative performance regarding the various individual indicators. The two approaches

differ in that the former one preserves information on the relative difference in observations of the raw indicators, whereas the latter one only preserves some. The bucketing method can be thought of as discretising the observations by clustering them on different levels; in contrast, the DGS approach preserves continuity of the indicators (see OECD and JRC (2008) for further normalisation methods).

As regards the choice of weights, both approaches rely on expert opinion and prescribe weights to indicators. As noted by OECD and JRC (2008), weights are a crucial part of aggregation. In general weights express the individual indicator's importance for the relevant object of measurement. Statistical methods can be used to determine weights from the data in order to correct for correlation between individual variables. This might be desirable to avoid double counting of the correlated part of the variables.

Another difference in the two methodologies lies in the choice of the aggregation method. In contrast to the SRF methodology, which uses a linear aggregation method for the within pillar aggregation and a geometric one for the across pillar aggregation[44], the EBA Guidelines prescribe a linear aggregation method only. Linear aggregation allows for making up for bad performance in one pillar by a better performance in another pillar. The compensability indeed depends on the pillar-specific weights, but it is independent of the indicator value of the pillar.[45] When using a geometric average the marginal impact of a change in an indicator on the composite indicator value depends on the size of the indicator. An increase in a low indicator has a higher impact on the composite indicator than an increase in a high indicator value.[46] Since under the SRF methodology the geometric average is used to aggregate indicators where higher values signify a better performance in the respective category, bad performance in one field cannot easily be offset by an even better performance in a pillar where the bank already performs well. This gives incentives to improve the weaknesses in a bank's risk profile. The use of a geometric average for the DGS method would be counterintuitive since the indicators to be aggregated are such that a higher value identifies a riskier bank. Thus, an improvement in a risky field would have a relatively small decreasing impact on the composite indicator.

Both guidelines consider a rescaling of the composite indicator (which was not applied under the DGS methodology in this paper). While rescaling to a fixed range of [0.8, 1.5] constitutes a mandatory step in the SRF methodology, the EBA Guidelines leave it to the discretion of the responsible authority to decide on the range of rescaling and whether rescaling is applied in the first place. One option presented in the EBA Guidelines for a rescaling of the aggregate risk score (ARS) to obtain the ARW is a linear transformation of the form $\mathrm{ARW} = (\mathrm{a} - \mathrm{b}) * \mathrm{ARS}/100 + \mathrm{b}$, where $\mathrm{b}$ is the lower and $\mathrm{a}$ the upper bound.

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44 The linear aggregation looks as follows: $\mathrm{PI}_j = \sum_{i=1}^{P} w_{ij} * I_{ij}$ where $PI_j$ determines the aggregated indicator for pillar $j$, and $w_{ij}$ is the weight for the $i$-th indicator $I_{ij}$ in pillar $j$. The geometric aggregation method means application of the following formula: $CI = \prod_{j=1}^{P} PI_j^{w_j}$ with $CI$ denoting the composite risk indicator for a given bank, and $w_j$ is the weight assigned to pillar $j$.

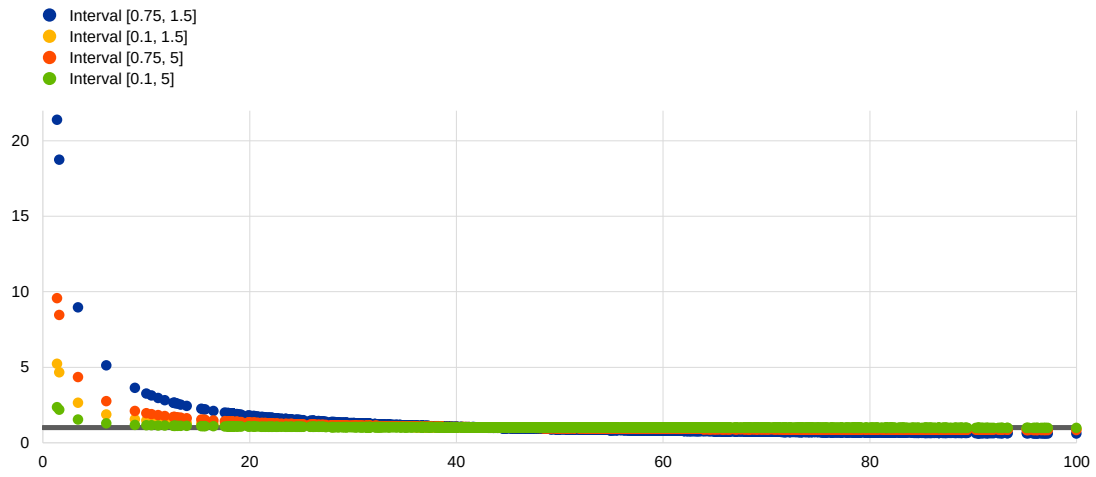
45 This can be seen when looking at the derivatives of the linear aggregation formula. We have: $\frac{\partial CI}{\partial PI_i} = w_i$ so that an increase in a pillar value has a marginal impact on the composite indicator equal to its weight independent of the initial size of the pillar.

46 Compare the 2nd derivative: $\frac{\partial^2 CI}{\partial PI_i^2} = \left(PI_l^{w_l} * PI_m^{w_m} * \ldots * PI_p^{w_p}\right) * w_i * \underbrace{(w_i - 1)}_{<0} * PI_i^{w_i - 2} < 0$. Thus, the higher the initial pillar value, the lower its marginal impact on the composite indicator.

When rescaling the ARSs a change in contributions can be observed. Chart A shows the change in contributions due to rescaling as a function of ARS. The change in contribution is defined as the fraction of contributions based on rescaled risk scores [$C_{rescaled}$] with respect to contributions based on non-rescaled risk scores [$C_{non-rescaled}$]: $C_{rescaled}/C_{non-rescaled}$. The chart shows the effect of rescaling for four different rescaling ranges: [0.75, 1.5] (used as an example in the EBA Guidelines), [0.1, 1.5], [0.75, 5], and [0.1, 5]. The black line indicates no change in contributions due to rescaling.

Chart A
Change in contributions ($C_{rescaled}/C_{non-rescaled}$) due to rescaling

(y-axis: C_rescaled/C_nonrescaled; x-axis: ARS)




Source: ECB staff calculations based on COREP, FINREP and Bankscope data, 2015:Q4.

All graphs reveal a negative relationship between the change in contributions due to rescaling, and riskiness (measured by the ARS). Focusing on the interval given as an example in the EBA Guidelines [0.75, 1.5], for instance, the safest banks are confronted with a contribution after rescaling which is up to 21 times as high as without rescaling, while the riskiest bank sees a contribution after rescaling that is 0.59 times its non-rescaled contribution. In other words, the higher the ARS (meaning the riskier a bank is), the higher is the reduction in the aggregate risk score. The reason is that the change in the composite indicators due to rescaling differs across banks $\text{ARW\_i}/\text{ARS\_i} \neq \text{ARW\_j} / \text{ARS\_j}$ . This difference then feeds through to the contributions.

The degree of distortion differs with the rescaling range. There is no change in contributions when the lower bound is set to zero, irrespective of the value chosen for the upper bound. The reason is that a zero lower bound only causes the change in contributions to be non-bank-specific such that $\text{ARW\_i}/\text{ARS\_i} = \text{ARW\_j} / \text{ARS\_j}$ for all banks. A negative lower bound leads to a reversed effect: the safest banks profit while the riskiest banks pay more. However, this transformation leads to negative contributions, a payout from the Fund, for the safest banks.

For intervals with a lower bound above zero the broader the interval, the less pronounced the negative effect on safer banks and also the more muted the positive effect on riskier banks. For example, the orange dots, which refer to the broadest range depicted, [0.1, 5], can be shown to be always closer to the red line than the blue ones, representing the narrowest interval in the sample [0.75, 1.5]. This can be interpreted as a lower degree of distortion for the broader interval as contributions based on rescaled risk scores are closer to contributions based on non-rescaled risk scores for all ARS. A decrease in the degree of distortion can also be seen when only broadening

one side of the interval at a time. The green and red dots display a broadening of the interval on one side of the narrowest interval each and show both a decrease in distortion as compared to the narrowest interval.

All in all, rescaling diminishes risk sensitivity of the risk weights and contributions. It would, however, be desirable to design risk weights that are able to precisely distinguish between risky and safe banks in order to give the right incentives. In their article on deposit insurance pricing options for the FDIC, Bloecher et al. (2003) define risk sensitivity to be the "*primary* objective of deposit insurance pricing reform" as it would reduce subsidies paid by low-risk institutions to riskier ones and moderate incentives for increased risk taking and it "would achieve the goal of making the deposit insurance system more equitable and economically efficient".

## 5.4 Distribution of contributions to the DIF across banks

Another key issue relates to the distribution of EDIS contributions across banks and to the question of whether the risk-based contributions should be further lowered for smaller banks (to ensure the proportionality principle) or whether the target level should be lowered for larger banks (as these are less likely to benefit from EDIS). Table 4 sheds light on these issues showing, for each decile of banks' total assets in our sample of 1,675 banks, the sum of contributions, the average contribution per euro of covered deposits and the smallest and largest value of contributions per covered deposits. Column 3 provides the aggregate amount of contributions paid by banks in each decile. The numbers suggest that the smallest 10 percent of banks in our sample would pay €0.11 billion or 0.28% of the €38 billion target size of EDIS. In contrast, the largest 10% of banks would pay €28.5 billion or 75.09% of the overall EDIS target. These numbers need to be put in relation to the actual covered deposits of the banks in each decile to check whether the largest banks bear the brunt of the cost of EDIS. In fact, column 4 suggests that the smallest and the largest banks' contribution per covered deposits on their balance sheet is relatively low on average with 1 cent (approximately) and 0.83 cent per euro, respectively.[47] It is rather the banks in the intermediate decile range that pay slightly more ranging from 1 to 1.14 cents per euro of covered deposits. This finding is further underpinned by the range of the largest and the smallest contributions per euro of covered deposits in column 5 which demonstrates that the range for each decile is by and large comparable. In sum, the evidence in Table 4 indicates that smaller and larger banks would not excessively contribute to EDIS, relative to their amount of covered deposits.

[47] To note, this contribution is not a "one-off" but is rather built-up over the years as EDIS is being filled.

**Table 4**

Contribution distribution across different bank sizes

| 1) | 2) | | 3) | 4) | 5) | |
|---|---|---|---|---|---|---|
| Decile group by total assets | Interval total assets | | Total contribution per decile group | Contribution per covered deposits, average | Contribution per covered deposits, interval | |
| | Smallest in EUR billion | Largest in EUR billion | In EUR billion (in % of EDIS target size) | | Lower bound | Upper bound |
| 10 | 0,02 | 0,15 | 0,11 (0,28%) | 0,0097 | 0,0024 | 0,0183 |
| 20 | 0,15 | 0,26 | 0,25 (0,65%) | 0,0107 | 0,0035 | 0,0176 |
| 30 | 0,26 | 0,38 | 0,34 (0,90%) | 0,0104 | 0 | 0,0181 |
| 40 | 0,38 | 0,56 | 0,48 (1,25%) | 0,011 | 0,003 | 0,0184 |
| 50 | 0,56 | 0,76 | 0,61 (1,62%) | 0,01 | 0,0003 | 0,0182 |
| 60 | 0,76 | 1,08 | 0,96 (2,52%) | 0,0109 | 0 | 0,019 |
| 70 | 1,09 | 1,66 | 1,39 (3,66%) | 0,0114 | 0,0024 | 0,0185 |
| 80 | 1,66 | 2,77 | 2,03 (5,34%) | 0,0109 | 0,0024 | 0,0178 |
| 90 | 2,77 | 6,49 | 3,3 (8,69%) | 0,0104 | 0,0007 | 0,0183 |
| 100 | 6,6 | 1807,57 | 28,5 (75,09%) | 0,0083 | 0,0003 | 0,0165 |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: Each decile corresponds to 167 or 168 banks; Contribution based on DGS baseline indicator set. The value in column 1 indicates the upper bound of the interval the observation belongs to. For example, "20" refers to all banks with total assets being above the 10th and below or equal to the 20th percentile.

## 5.5 Cross-subsidisation

Tables 5, 6 and 7 provide information about the magnitude of cross-subsidisation across banking systems under simulated crises of different magnitude. First, the 3% riskiest banks (51 banks, representing the 12.66%of the total assets of the entire euro area sample) are assumed to fail and to be hit by losses from 5% (7.5%) to 25% (37.5%) of total assets in resolution (insolvency). Such loss rates, simultaneously applied to a set of banks, are significantly higher than the averages observed in the last crisis (see Section 4.2.2). The same loss levels are then applied to the 10% riskiest banks failing (167 banks, representing approximately the 40% of the total assets of the entire euro area sample), thus simulating an extremely severe crisis.

Table 5 reports the results referred to the 3% riskiest banks failing, with contributions based on the DGS-baseline indicators and resolution scenario B with SRF contribution. The first two columns refer to a given LGD value under resolution and insolvency. Rows 1, 3, 5, 7 and 9 show the EDIS exposure per euro contributed for banking systems in each country: this is equal to the sum of the EDIS exposure posed by all banks located in a country divided by the sum of the contributions paid by the same banks. A value exceeding one (red cells in the Tables below) indicates that the banks in a country would contribute less than what they would receive from

EDIS in the simulated crisis when 3% of the riskiest banks fail.[48] Rows 2, 4, 6, 8 and 10 show EDIS exposure in euro billion for given LGD values. For a crisis in which 3% of the banks in the sample fail simultaneously, the analysis shows that there is never an EDIS exposure and, consequently, no cross-subsidisation for loss rates in resolution up to 15% of total assets. Some EDIS exposure only starts to materialise in Spain and Greece for loss rates in resolution of 20% of total assets, but without cross-subsidisation. The only evidence of cross-subsidisation is found, in Spain and Greece, for loss rates of 25% in resolution (37.5% in insolvency), which reproduce a scenario much harsher than the 2007-2009 global financial crisis.

Table 6 reports the results referred to the 10% riskiest banks failing and loss rates in resolution (insolvency) equal to 5% (7.5%) and 10% (15%): even though the number of banks affected by losses is now approximately three times bigger than in Table 5, with these loss rates the EDIS exposure continues to be equal to zero and there is no evidence of cross-subsidisation in any country. It must be stressed that the 167 banks which are assumed to fail under this scenario have assets corresponding to about 40% of the total assets of euro area banks in the sample: hitting all these 167 banks simultaneously with losses in resolution (insolvency) of 5% (7.5%) and 10% (15%) of total assets creates a scenario much more severe than the last crisis. Therefore, the 10% scenario can be described as a black swan event.[49]

Table 7 reports the results referred to a "big black swan" scenario: in particular, it shows the EDIS exposure in case the 10% riskiest banks simultaneously fail and are simultaneously affected by losses in resolution (insolvency) from 15% (22.5%) to 25% (37.5%) of total assets. The red cells indicate exposures per euro contributed above 1, meaning that banks in a country, for a certain loss rate, would contribute less than what they would receive from EDIS in case of a crisis, thus indicating cross-subsidisation.

The first evidence of EDIS exposure is only found for loss rates of 20% in resolution (30% in insolvency); but only one country, Belgium, would receive more funds from EDIS than it would contribute, thus showing very limited cross-subsidisation despite the severity of the simulated crisis. Losses equal to 25% of total assets in resolution (37.5% in insolvency) are necessary to observe cross-subsidisation in more countries, precisely in Belgium, Cyprus, Spain and Greece. Given the high loss rates[50] necessary to produce cross-subsidisation (and given that such rates are set equally high for all banks, making the crisis more severe than in actual crises where

48 This methodology is used as a proxy for cross-subsidisation and is based on several assumptions, including those for the estimation of PDs and the calculation of risk-based contributions. Among the various caveats, as explained in Section 4.2.1, is the fact that the coefficients to calculate PDs are estimated using through-the-cycle data while PDs are obtained using point-in-time data for the independent variables. Risk-based contributions are also based on point-in-time data. The effectiveness of the risk-based contributions as a tool to mitigate cross-subsidisation is therefore subject to the aforementioned limitations.

49 The black swan theory has been introduced by Nassim Nicholas Taleb in its 2007 book "The Black Swan: The Impact of the Highly Improbable". According to Taleb, a black swan event is characterised by the following three features: rarity, extreme impact, and retrospective (though not prospective) predictability.

50 As a term of comparison, see the loss rates referred to the last crisis in Section 4.2.2.

loss rates vary across banks), these findings suggest that there is no unwarranted systematic cross-subsidisation via EDIS in the steady state.[51]

[51] An assessment of the possible cross-subsidisation in the transition to the steady state would require a different quantitative analysis and is not the object of this paper. Furthermore, due to the lack of granular information on the nationality of deposit holders, no specific consideration and treatment have been given to cross-border deposits, i.e. deposits at one bank headquartered in a Member State which are held by counterparts from other Member States. This implies that the results could in principle overestimate the extent of cross-subsidisation.

## Table 5

Cross-subsidisation: Fund exposure per euro contributed and in EUR billion - 3% riskiest banks failing

Loss-absorbency scenario B in resolution with 97th-percentile crisis simulation with SRF contribution; banks' contributions to EDIS based on DGS sliding scale method and DGS-baseline indicators

| Loss resolution (%TA) | Loss Insolvency (%TA) | Country | AT | BE | CY | DE | EE | ES | FI | FR | GR | IE | IT | LT | LU | LV | MT | NL | PT | SI | SK | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contributions in EUR bn | 0,52 | 0,48 | 0,13 | 12,49 | 0,002 | 7,92 | 0,13 | 6,65 | 1,39 | 0,27 | 4,23 | 0,04 | 0,07 | 0,04 | 0,01 | 2,29 | 1,21 | 0,06 | 0,02 | 38 |
| | | EDIS exposure | | | | | | | | | | | | | | | | | | | | |
| 5% | 7,50% | (1) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (2) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10% | 15% | (3) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (4) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15% | 22,50% | (5) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (6) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20% | 30% | (7) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0,26 | 0 | 0 | 0,63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (8) in EUR bn | 0 | 0 | 0 | 0 | 0 | 2,1 | 0 | 0 | 0,9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 25% | 37,50% | (9) per EUR contributed | 0 | 0 | 0 | 0 | 0 | **1,04** | 0 | 0 | **11,2** | 0 | 0,01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (10) in EUR bn | 0 | 0 | 0 | 0 | 0 | **8,2** | 0 | 0 | **15,5** | 0 | 0,04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23,8 |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: EDIS exposure per euro contributed for each country is calculated as the sum of EDIS exposures to all banks within a country divided by the sum of contributions of all banks' of that country.

## Table 6

Cross-subsidisation: Fund exposure per euro contributed and in EUR billion - 10% riskiest banks failing

Loss-absorbency scenario B in resolution with 90th-percentile crisis simulation with SRF contribution; banks' contributions to EDIS based on DGS sliding scale method and DGS-baseline indicators

| Loss resolution (%TA) | Loss Insolvency (%TA) | Country | AT | BE | CY | DE | EE | ES | FI | FR | GR | IE | IT | LT | LU | LV | MT | NL | PT | SI | SK | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contributions in EUR bn | 0,52 | 0,48 | 0,13 | 12,49 | 0,002 | 7,92 | 0,13 | 6,65 | 1,39 | 0,27 | 4,23 | 0,04 | 0,07 | 0,04 | 0,01 | 2,29 | 1,21 | 0,06 | 0,02 | 38 |
| | | EDIS exposure | | | | | | | | | | | | | | | | | | | | |
| 5% | 7,50% | (1) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (2) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10% | 15% | (3) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (4) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: EDIS exposure per euro contributed for each country is calculated as the sum of EDIS exposures to all banks within a country divided by the sum of contributions of all banks' of that country.

## Table 7

Cross-subsidisation: Fund exposure per euro contributed and in EUR billion - 10% riskiest banks failing

Loss-absorbency scenario B in resolution with 90th-percentile crisis simulation with SRF contribution; banks' contributions to EDIS based on DGS sliding scale method and DGS-baseline indicators

| Loss resolution (%TA) | Loss Insolvency (%TA) | Country | AT | BE | CY | DE | EE | ES | FI | FR | GR | IE | IT | LT | LU | LV | MT | NL | PT | SI | SK | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contributions in EUR bn | 0,52 | 0,48 | 0,13 | 12,49 | 0,002 | 7,92 | 0,13 | 6,65 | 1,39 | 0,27 | 4,23 | 0,04 | 0,07 | 0,04 | 0,01 | 2,29 | 1,21 | 0,06 | 0,02 | 38 |
| | | EDIS exposure | | | | | | | | | | | | | | | | | | | | |
| 15% | 22,50% | (1) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (2) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20% | 30% | (3) per EUR contributed | 0 | 1,37 | 0 | 0 | 0 | 0,26 | 0 | 0 | 0,63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (4) in EUR bn | 0 | 0,7 | 0 | 0 | 0 | 2,1 | 0 | 0 | 0,9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,7 |
| 25% | 37,50% | (5) per EUR contributed | 0 | 6,15 | 2,03 | 0 | 0 | 1,45 | 0 | 0 | 11,2 | 0 | 0,01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (6) in EUR bn | 0 | 3 | 0,3 | 0 | 0 | 11,5 | 0 | 0 | 15,6 | 0 | 0,04 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30,4 |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: EDIS exposure per euro contributed for each country is calculated as the sum of EDIS exposures to all banks within a country divided by the sum of contributions of all banks' of that country.

### 5.5.1 Cross-subsidisation with country shocks

The results presented in the previous Section refer to simulated losses applied to the 3% and 10% riskiest banks at the banking union level. The selection of the 3% and 10% riskiest banks in the sample of euro area banks is not based on any country-specific shocks and is carried out only on the basis of the riskiness of banks relative to all the other euro area banks in the sample. This Section provides additional and complementary information, showing the results on cross-subsidisation in a scenario where country-specific shocks are simulated.

The country-specific shocks are designed to mimic the European shock simulated above, on the basis of the share of total assets of the banks assumed to fail. Therefore, the first set of results has been obtained by assuming that the riskiest banks in each country, representing up to the 13% of the domestic banking system total assets, simultaneously fail. The choice of the 13% total assets threshold is based on the fact that the 3% riskiest banks assumed to fail in the euro area scenario (results reported in Table 5) represent 13% of the total assets of the euro area banks in the sample. The second set of results is obtained under the assumption that the riskiest banks in each country, representing up to the 40% of the domestic banking system total assets, simultaneously fail. This choice is in line with the scenario with the 10% riskiest banks failing at the euro area level (results reported in Table 6 and 7), whose assets represent approximately 40% of total assets of euro area banks in the sample.

Table 8 presents the results, expressed in terms of EDIS exposure and cross-subsidisation, referred to the assumption that the riskiest banks in each country, representing the 13% of the domestic bank total assets, simultaneously fail. First, regardless of the severity of the loss rates imposed to the failing banks, the DIF would be sufficient to cover all financial needs, even in case the country-specific shocks occur all at the same time. Second, cross-subsidisation becomes material in Cyprus and Spain only for loss rates equal to 25%; on the other hand, cross-subsidisation in Luxembourg appears to be higher, and already visible with losses equal to the 15% of total assets in resolution (22.5% in insolvency).

Table 9 reports the results referred to the assumption that the riskiest banks in each country, representing the 40% of the domestic bank total assets, simultaneously fail. Even if the crisis simulated in this scenario is extremely severe - the 40% of the total assets of each country simultaneously stressed with losses from 5% to 25% (in resolution) of the banks' balance sheet - the overall exposure of the deposit insurance fund remains well below its target size (equal to € 38bn for the sample). In terms of cross-subsidisation, only for very high loss rates five countries would receive payouts from EDIS of more than what they would pay into EDIS: Cyprus, Spain and Luxembourg (consistent with Table 8) and Belgium and Malta (starting with loss rates equal to 20% in resolution).

Even though the 13% and 40% thresholds calibrated on total assets are consistent with the crisis simulated, respectively, with the 3% and 10% riskiest banks failing at

the euro area level (Section 5.5, Tables 5, 6 and 7), the results differ in some countries: in particular, and differently from the results in Tables 5 and 7, Tables 8 and 9 reveal no evidence of cross-subsidisation in Greece. This can be explained by the fact that when a sample of riskiest banks is selected at the euro area level, such banks may be concentrated in some countries, thus representing a very high portion of the domestic bank total assets; when the same share of riskiest banks is instead selected at the national level, it may happen that some banks, even if risky at the euro area level, are not included among the riskiest ones at the domestic level.

Finally, the comparison of the results reported in Tables 8 and 9 reveals that, even though the total assets of the failing banks in the second scenario (Table 9) is much higher than the total assets of the failing banks in the first scenario (Table 8), the overall (aggregate across the euro area) increase in the EDIS exposure is not substantial (in the most severe crisis - loss rate equal to 25% in resolution - the EDIS exposure increases from € 8.9 bn to € 11.9 bn): this can be explained by the fact that EDIS exposure is mainly due to the 3% riskiest banks in each country. For extremely high loss rates (20% and 25% in resolution), cross-subsidisation would materialise also for Belgium and Malta in Table 9, but there would be no change for Cyprus, Spain and Luxembourg relative to Table 8.

Overall, the key results of the analysis are consistent across both a banking union shock and country-specific shocks: first, an EDIS exposure would only materialise for very high loss rates - much higher than experienced in the 2007-2009 global financial crisis; second, cross-subsidisation would generally materialise only for extremely high loss rates, and only few countries would be affected[52]. Therefore, this analysis confirms that there would be no unwarranted systematic cross-subsidisation via EDIS in the steady state.

[52] This conclusion is confirmed by an additional analysis that defines the country shock as the 10% riskiest banks failing in each country, consistently with the scenario simulated at the euro area level (see Tables 6 and 7). Even in this adverse situation (on average, the 10% riskiest banks failing correspond to the 30% of domestic bank total assets), cross-subsidisation materialises only in Belgium for loss rates in resolution (insolvency) of at least 20% (30%).

## Table 8

Cross-subsidisation: Fund exposure in EUR billion and per euro contributed - riskiest banks in each country, representing up to the 13% of the domestic total assets, failing

Loss-absorbency scenario B in resolution with SRF contribution; banks' contributions to EDIS based on DGS sliding scale method and DGS-baseline indicators

| Loss resolution (%TA) | Loss Insolvency (%TA) | Country | AT | BE | CY | DE | EE | ES | FI | FR | GR | IE | IT | LT | LU | LV | MT | NL | PT | SI | SK | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contributions in EUR bn | 0,52 | 0,48 | 0,13 | 12,49 | 0,002 | 7,92 | 0,13 | 6,65 | 1,39 | 0,27 | 4,23 | 0,04 | 0,07 | 0,04 | 0,01 | 2,29 | 1,21 | 0,06 | 0,02 | 38 |
| | | EDIS exposure | | | | | | | | | | | | | | | | | | | | |
| 5% | 7,50% | (1) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (2) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| 10% | 15% | (3) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,76 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (4) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,05 | 0 | 0 | 0 | 0 | 0 | 0 | **0,05** |
| 15% | 22,50% | (5) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2,22** | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (6) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0,16** | 0 | 0 | 0 | 0 | 0 | 0 | **0,16** |
| 20% | 30% | (7) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0,26 | 0 | 0 | 0 | 0 | 0 | 0 | **3,68** | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (8) in EUR bn | 0 | 0 | 0 | 0 | 0 | 2,07 | 0 | 0 | 0 | 0 | 0 | 0 | **0,26** | 0 | 0 | 0 | 0 | 0 | 0 | **2,33** |
| 25% | 37,50% | (9) per EUR contributed | 0 | 0 | **2** | 0 | 0 | **1,04** | 0 | 0 | 0 | 0 | 0,01 | 0 | **5,14** | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (10) in EUR bn | 0 | 0 | **0,26** | 0 | 0 | **8,25** | 0 | 0 | 0 | 0 | 0,04 | 0 | **0,36** | 0 | 0 | 0 | 0 | 0 | 0 | **8,91** |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: EDIS exposure per euro contributed for each country is calculated as the sum of EDIS exposures to all banks within a country divided by the sum of contributions of all banks' of that country.

## Table 9

Cross-subsidisation: Fund exposure in EUR billion and per euro contributed - riskiest banks in each country, representing up to the 40% of the domestic total assets, failing

Loss-absorbency scenario B in resolution with SRF contribution; banks' contributions to EDIS based on DGS sliding scale method and DGS-baseline indicators

| Loss resolution (%TA) | Loss Insolvency (%TA) | Country | AT | BE | CY | DE | EE | ES | FI | FR | GR | IE | IT | LT | LU | LV | MT | NL | PT | SI | SK | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contributions in EUR bn | 0,52 | 0,48 | 0,13 | 12,49 | 0,002 | 7,92 | 0,13 | 6,65 | 1,39 | 0,27 | 4,23 | 0,04 | 0,07 | 0,04 | 0,01 | 2,29 | 1,21 | 0,06 | 0,02 | 38 |
| | | EDIS exposure | | | | | | | | | | | | | | | | | | | | |
| 5% | 7,50% | (1) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (2) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10% | 15% | (3) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,76 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | | (4) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,05 | 0 | 0 | 0 | 0 | 0 | 0 | 0,05 |
| 15% | 22,50% | (5) per EUR contributed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,22 | 0 | 0,66 | 0 | 0 | 0 | 0 | - |
| | | (6) in EUR bn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,16 | 0 | 0,01 | 0 | 0 | 0 | 0 | 0,16 |
| 20% | 30% | (7) per EUR contributed | 0 | 1,38 | 0 | 0 | 0 | 0,26 | 0 | 0 | 0 | 0 | 0 | 0 | 3,68 | 0 | 1,99 | 0 | 0,01 | 0 | 0 | - |
| | | (8) in EUR bn | 0 | 0,66 | 0 | 0 | 0 | 2,07 | 0 | 0 | 0 | 0 | 0 | 0 | 0,26 | 0 | 0,02 | 0 | 0,01 | 0 | 0 | 3,02 |
| 25% | 37,50% | (9) per EUR contributed | 0 | 6,21 | 2 | 0 | 0 | 1,04 | 0 | 0 | 0 | 0 | 0,01 | 0 | 5,14 | 0 | 3,32 | 0 | 0,02 | 0 | 0 | - |
| | | (10) in EUR bn | 0 | 2,98 | 0,26 | 0 | 0 | 8,25 | 0 | 0 | 0 | 0 | 0,04 | 0 | 0,36 | 0 | 0,03 | 0 | 0,02 | 0 | 0 | 11,94 |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: EDIS exposure per euro contributed for each country is calculated as the sum of EDIS exposures to all banks within a country divided by the sum of contributions of all banks' of that country.

# 6 A mixed deposit insurance system

As discussed in Section 3, several proposals on EDIS have introduced the principle of national DGSs bearing the first burden before the European deposit insurance fund steps in. This Section provides quantitative information on how the risk-based contributions would change under such a "mixed" deposit insurance scheme, and how EDIS exposure and cross-subsidisation would be affected.

## 6.1 Contributions

First, the mixed deposit insurance scheme is assumed to be funded, with an equal share of 0.4% of covered deposits, at the national level and at the European level (the overall target level remains 0.8% of covered deposits). The key change relative to a fully-fledged EDIS is that the contributions paid by banks to reach the national 0.4% target would be risk-based relative to their national benchmark, and not to the riskiness of the entire euro area banking system. Therefore, for the purpose of the national 0.4% target, contributions would still be risk-based, but this would only affect the distribution of contributions among domestic banks, while the overall national target would be risk-insensitive and would be fixed at 0.4% of covered deposits in the domestic banking system. This implies that some banking systems would end up paying overall less than they would under a fully-fledged EDIS; on the other hand, some banking systems would pay overall more than they would under a fully-fledged EDIS. This is illustrated in Table 10, which shows the contributions paid by banking systems under both a fully-fledged EDIS and under a mixed deposit insurance scheme: the latter is divided into contributions to the national funds (equal to 0.4% of domestic covered deposits) and to the European compartment (equal to the remaining 0.4% of euro area covered deposits). The last two columns report the overall contributions banking systems would pay under the mixed scheme: the red cells, in particular, identify the banking systems that would pay more under the mixed scheme.

The results indicate that under a mixed deposit insurance scheme Cyprus, Germany, Spain, Greece, Ireland, Italy and Portugal would pay less than under a fully-fledged EDIS, while Austria, Belgium, Finland, France, Lithuania, Luxembourg, Malta, the Netherlands and Slovenia would pay more.

**Table 10**

Contributions by country based on DGS sliding scale methodology and DGS baseline indicators: fully-fledged EDIS and mixed deposit insurance scheme

| 1) | 2) | 3) | | 4) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Fully-fledged EDIS | | Mixed deposit insurance system | | | | | |
| | | | | National target level | | European target level | | National + European target level | |
| Country | Number of banks | In EUR billion | In percent of fully-fledged EDIS fund (DIF) | In EUR billion | In percent of national compartments | In EUR billion | In percent of European compartment | In EUR billion | In percent of mixed fund |
| AT | 33 | 0,52 | 1,37% | 0,3 | 1,58% | 0,26 | 1,37% | **0,56** | **1,48%** |
| BE | 11 | 0,48 | 1,26% | 0,36 | 1,90% | 0,24 | 1,26% | **0,6** | **1,58%** |
| CY | 3 | 0,13 | 0,34% | 0,05 | 0,26% | 0,06 | 0,32% | 0,11 | 0,29% |
| DE | 1180 | 12,49 | 32,90% | 4,88 | 25,71% | 6,25 | 32,93% | 11,13 | 29,32% |
| EE | 6 | 0,002 | 0,01% | 0,001 | 0,01% | 0,001 | 0,01% | 0,002 | 0,01% |
| ES | 20 | 7,92 | 20,86% | 3,61 | 19,02% | 3,96 | 20,86% | 7,57 | 19,94% |
| FI | 8 | 0,13 | 0,34% | 0,09 | 0,47% | 0,06 | 0,32% | **0,15** | **0,40%** |
| FR | 23 | 6,65 | 17,52% | 4,82 | 25,40% | 3,32 | 17,49% | **8,14** | **21,44%** |
| GR | 6 | 1,39 | 3,66% | 0,4 | 2,11% | 0,7 | 3,69% | 1,1 | 2,90% |
| IE | 5 | 0,27 | 0,71% | 0,13 | 0,68% | 0,13 | 0,68% | 0,26 | 0,68% |
| IT | 297 | 4,23 | 11,14% | 1,99 | 10,48% | 2,11 | 11,12% | 4,1 | 10,80% |
| LT | 5 | 0,04 | 0,11% | 0,04 | 0,21% | 0,02 | 0,11% | **0,06** | **0,16%** |
| LU | 17 | 0,07 | 0,18% | 0,04 | 0,21% | 0,04 | 0,21% | **0,08** | **0,21%** |
| LV | 16 | 0,04 | 0,11% | 0,02 | 0,11% | 0,02 | 0,11% | 0,04 | 0,11% |
| MT | 6 | 0,01 | 0,03% | 0,01 | 0,05% | 0,01 | 0,05% | **0,02** | **0,05%** |
| NL | 18 | 2,29 | 6,03% | 1,83 | 9,64% | 1,14 | 6,01% | **2,97** | **7,82%** |
| PT | 12 | 1,21 | 3,19% | 0,37 | 1,95% | 0,6 | 3,16% | 0,97 | 2,56% |
| SI | 6 | 0,06 | 0,16% | 0,04 | 0,21% | 0,03 | 0,16% | **0,07** | **0,18%** |
| SK | 3 | 0,02 | 0,05% | 0,01 | 0,05% | 0,01 | 0,05% | 0,02 | 0,05% |
| Total | **1675** | **38** | **100%** | **19** | **100%** | **19** | **100%** | **38** | **100%** |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: The contributions calculation includes the following indicators: total risk-based capital ratio, leverage ratio, highly liquid assets per total assets, RWA per total assets, MREL-eligible liabilities (only senior unsecured bonds), and ROE

## 6.2 Cross-subsidisation

The change in the overall contributions paid by banking systems produces implications for cross-subsidisation. Given the same simulated shocks (3% or 10% riskiest banks failing) and, consequently, given the same exposures of a deposit insurance scheme, cross-subsidisation under a mixed system would increase in those countries that would pay more contributions under a fully-fledged EDIS than under the mixed system. This is illustrated in Table 11, which shows a comparison between cross-subsidisation under a fully-fledged EDIS and under a mixed system in the scenario with the 3% riskiest banks failing. Under the mixed system, cross-subsidisation is measured as the ratio between the exposure of the European fund and the contributions paid to the European fund only. The red cells indicate an increase in cross-subsidisation under the mixed system, and this can be observed in Spain and Greece for losses in resolution (insolvency) equal to 25% (37.5%) of total assets.

## Table 11

Cross-subsidisation: Fund exposure per euro contributed under a "mixed" deposit insurance scheme and fully-fledged EDIS - 3% riskiest banks failing

Loss-absorbency scenario B in resolution with SRF contribution; banks' contributions based on DGS sliding scale method and DGS-baseline indicators, calibrated at the European level for the fully-fledged EDIS and for the European compartment in the "mixed" scheme, calibrated at the national level for the national compartments in the "mixed" scheme

| Loss resolution (%TA) | Loss Insolvency (%TA) | Country | AT | BE | CY | DE | EE | ES | FI | FR | GR | IE | IT | LT | LU | LV | MT | NL | PT | SI | SK | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contributions to "mixed" scheme (EUR bn) | 0,56 | 0,6 | 0,11 | 11,13 | 0,002 | 7,56 | 0,16 | 8,14 | 1,1 | 0,26 | 4,11 | 0,06 | 0,08 | 0,04 | 0,01 | 2,98 | 0,97 | 0,07 | 0,02 | 38 |
| | | Contributions to fully-fledged EDIS (EUR bn) | 0,52 | 0,48 | 0,13 | 12,49 | 0,002 | 7,92 | 0,13 | 6,65 | 1,39 | 0,27 | 4,23 | 0,04 | 0,07 | 0,04 | 0,01 | 2,29 | 1,21 | 0,06 | 0,02 | 38 |
| | | EDIS exposure per EUR contributed | | | | | | | | | | | | | | | | | | | | |
| 5% | 7,50% | (1) Mixed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (2) Full EDIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 10% | 15% | (3) Mixed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (4) Full EDIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 15% | 22,50% | (5) Mixed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (6) Full EDIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 20% | 30% | (7) Mixed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0,68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (8) Full EDIS | 0 | 0 | 0 | 0 | 0 | 0,26 | 0 | 0 | 0,63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 25% | 37,50% | (9) Mixed | 0 | 0 | 0 | 0 | 0 | **1,17** | 0 | 0 | **21,81** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (10) Full EDIS | 0 | 0 | 0 | 0 | 0 | **1,04** | 0 | 0 | **11,2** | 0 | 0,01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: EDIS exposure per euro contributed for each country is calculated as the sum of EDIS exposures to all banks within a country divided by the sum of contributions of all banks' of that country. Under the mixed system, cross-subsidisation is measured as the ratio between the exposure of the European fund and the contributions paid to the European fund only.

Table 12 shows a comparison between cross-subsidisation under a fully-fledged EDIS and under a mixed system in the scenario with the 10% riskiest banks failing. Cross-subsidisation under a mixed scheme would increase in Belgium, Cyprus, Spain and Greece in case of losses in resolution (insolvency) equal to 25% (37.5%) of total assets. On the other hand, cross-subsidisation would decrease in Belgium for losses in resolution equal to 20% of total assets: this can be explained by the fact that there is a certain level of exposure below which the national compartment is enough, or almost enough, to cover all the financial needs, thus reducing cross-subsidisation.

## Table 12

Cross-subsidisation: Fund exposure per euro contributed under a "mixed" deposit insurance scheme and fully-fledged EDIS - 10% riskiest banks failing

Loss-absorbency scenario B in resolution with SRF contribution; banks' contributions based on DGS sliding scale method and DGS-baseline indicators, calibrated at the European level for the fully-fledged EDIS and for the European compartment in the "mixed" scheme, calibrated at the national level for the national compartments in the "mixed" scheme

| Loss resolution (%TA) | Loss Insolvency (%TA) | Country | AT | BE | CY | DE | EE | ES | FI | FR | GR | IE | IT | LT | LU | LV | MT | NL | PT | SI | SK | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Contributions to "mixed" scheme (EUR bn) | 0,56 | 0,6 | 0,11 | 11,13 | 0,002 | 7,56 | 0,16 | 8,14 | 1,1 | 0,26 | 4,11 | 0,06 | 0,08 | 0,04 | 0,01 | 2,98 | 0,97 | 0,07 | 0,02 | 38 |
| | | Contributions to fully-fledged EDIS (EUR bn) | 0,52 | 0,48 | 0,13 | 12,49 | 0,002 | 7,92 | 0,13 | 6,65 | 1,39 | 0,27 | 4,23 | 0,04 | 0,07 | 0,04 | 0,01 | 2,29 | 1,21 | 0,06 | 0,02 | 38 |
| | | EDIS exposure per EUR contributed | | | | | | | | | | | | | | | | | | | | |
| 5% | 7,50% | (1) Mixed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (2) Full EDIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 10% | 15% | (3) Mixed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (4) Full EDIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 15% | 22,50% | (5) Mixed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (6) Full EDIS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 20% | 30% | (7) Mixed | 0 | 1,27 | 0 | 0 | 0 | 0 | 0 | 0 | 0,68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (8) Full EDIS | 0 | 1,37 | 0 | 0 | 0 | 0,26 | 0 | 0 | 0,63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 25% | 37,50% | (9) Mixed | 0 | **10,84** | **3,33** | 0 | 0 | **1,99** | 0 | 0 | **21,81** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | (10) Full EDIS | 0 | **6,15** | **2,03** | 0 | 0 | **1,45** | 0 | 0 | **11,2** | 0 | 0,01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

Source: ECB staff calculations based on COREP and Bankscope data, 2015:Q4.
Note: EDIS exposure per euro contributed for each country is calculated as the sum of EDIS exposures to all banks within a country divided by the sum of contributions of all banks' of that country. Under the mixed system, cross-subsidisation is measured as the ratio between the exposure of the European fund and the contributions paid to the European fund only.

# 7 Conclusions

The analysis in this paper provides five main insights which support the policy discussion on the introduction of a European Deposit Insurance Scheme.

First, a fully-funded deposit insurance fund with ex-ante contributions of 0.8% of covered deposits (€38 billion in the sample analysed) would be sufficient to cover payouts even in case of hypothetical losses much higher than the losses experienced during the last crisis (2007-2009). Considering a scenario where the riskiest 3% of euro area banks fail simultaneously and only MREL-eligible liabilities are bailed-in (with the exception of large corporate deposits above €100,000), losses in resolution and insolvency up to, respectively, 15% and 22.5% of banks' total assets are not enough to create exposures of the DIF in any country. The same conclusion is reached when considering a scenario where the 10% riskiest banks in the euro area simultaneously fail and are all affected by losses in resolution equal to 5%, 10% and 15% of total assets (corresponding to 7.5%,15% and 22.5% losses in insolvency). These loss scenarios are considerably more severe than historical losses both in Europe and in the United States, including the recent global financial crisis. Exposures of the DIF are triggered only in case of an extremely severe crisis, where the 3% or 10% riskiest banks simultaneously fail and are all affected by losses in resolution at least equal to 20% of total assets, (corresponding to losses in insolvency of 30%). Even in this extreme case, however, the DIF is never depleted.

Second, the specificities of banks and, as a result, also of banking systems can be taken into account in the risk-based contributions to the deposit insurance fund, which is preferable to the lowering of the EDIS target level. The methodology used in this paper follows the EBA Guidelines for national DGS contributions but is applied to all participating banks within the scope of EDIS to ensure that a bank's risk profile is compared to its peers across the entire banking union rather than only within each national banking system. The features of banks and banking systems can be appropriately reflected in the risk-based contributions using a "polluter pays" approach. This would have the benefit of keeping the credible target level of EDIS, which has been shown in Section 4 to be appropriate in dealing also with severe banking crises. Furthermore, risk-based contributions would allow a wide range of factors which are likely to have an impact on EDIS to be taken into account. For example, including an indicator for MREL-eligible liabilities provides an indication of banks' loss-absorbing capacity and could also be a proxy for the likelihood of a bank going into resolution rather than insolvency. Therefore, including this variable means that banks that are likely to go into resolution may have their contributions reduced because of their higher loss-absorbing capacities and the resulting potentially lower exposure for EDIS. This could cater for the fact that a banking system composed of larger institutions would be less likely to benefit from EDIS as these are more likely to be resolved, thus limiting the possible contribution needed from the deposit insurance fund. Also, the inclusion of an interconnectedness indicator would permit the impact of a bank's failure on the banking system as a whole, and therefore on

EDIS, to be taken into account. This would be particularly relevant for a banking system composed mainly of interconnected institutions.

In addition, contributions are impacted by the choice of the calculation method. Contributions based on the SRF methodology appear less risk sensitive than those based on the EBA Guidelines without rescaling. However, when rescaling the latter to the same range as under the SRF, contributions are even closer to non-risk-adjusted contributions. This paper shows that rescaling has a diminishing effect on risk sensitivity of the contributions: for intervals with positive lower bound the riskiest banks profit at the expense of the safest banks.

Third, the analysis indicates that smaller and larger banks would not excessively contribute to EDIS relative to the amount of covered deposits in their balance sheet, suggesting that measures to reduce contributions for the smallest and/or largest banks, as had been proposed by some Member States, would be unwarranted. As regards the distribution of contributions across different banks, the 10% smallest banks in the sample would pay €0.11 billion or 0.28% of the €38 billion target size of EDIS. In contrast, the 10% largest banks would pay €28.5 billion or 75.09% of the overall EDIS target. However, when comparing the contributions to the level of covered deposits, the smallest and the largest banks' contribution per covered deposits on their balance sheet is relatively low with approximately 1 cent and 0.83 cent per euro of covered deposit respectively, while the banks in the intermediate deciles range pay slightly more ranging from 1 to 1.14 cents per euro of covered deposits.

Fourth, there is no unwarranted systematic cross-subsidisation within EDIS, in the sense of some banking systems systematically contributing less than they would benefit from the deposit insurance fund. A comparison of banks' risk-based contributions to the DIF exposure shows that, while there are some cases in which the contributions of a banking system are lower than the amounts which would be received from EDIS, this is only the case for very high loss rates that have a low probability of occurring and for crises which would be much more severe than the 2007-2009 global financial crisis. This result holds also when considering country-specific shocks, i.e. when the same share of banks in terms of total assets is assumed to fail in each country, rather than at the euro area level. It should also be noted that cross-subsidisation can be seen as a form of desirable risk-sharing in more severe crises. This is different from a systematic unwarranted cross-subsidisation and is in line with the purpose of an EDIS: pooling resources to enhance the ability of the deposit insurance system, particularly in the more severe crises, to withstand shocks better than under a system of national stand-alone deposit guarantee schemes.

Fifth, the comparison between a fully-fledged EDIS and a mixed deposit insurance scheme (where the national funds intervene before the European insurance fund) reveals that the latter would increase cross-subsidisation. This result is the consequence of some banking systems paying less under a mixed scheme, thus building up a smaller pool of resources: the reason is that national target levels depend only on the amount of covered deposits and are thus risk-insensitive.

In conclusion, EDIS would offer major benefits in terms of depositor protection while posing limited risks in terms of EDIS exposure since the probability and magnitude of interventions are likely to be low. It should be emphasised that EDIS will play a key role in terms of confidence building, also avoiding risks of self-fulfilling prophecies on bank runs. Additionally, based on the results shown in this paper, there is no risk of unwarranted systematic cross-subsidisation.

The key elements driving these results are the following: first, a significant risk-reduction and increase in loss-absorbing capacity have taken place in the aftermath of the global financial crisis, including higher levels of capital, the build-up of other loss-absorbing liabilities (which can absorb losses e.g. via bail-in) and the new resolution framework. As the data in the analysis refer to year-end 2015, the banks' loss-absorbing capacity is expected to further increase over time. Second, a super priority for covered deposits will further contribute to protect EDIS. Finally, following a "polluter-pays" approach, appropriately-designed risk-based contributions, benchmarked at the euro area level, are crucial to establish the right incentives and strike the right balance between ensuring adequate and credible deposit protection and minimising cross-subsidisation across countries. Risk-based contributions can and should internalise the specificities of banks and banking systems. This would facilitate moving forward with risk-sharing measures in parallel with risk-reduction measures, address moral hazard and avoid lowering EDIS capacity.

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# Appendix

## PD estimation and in-sample test

Starting from the specification A of the model implemented to estimate the default probability of banks, an in-sample test has been performed to compare the predicted results with the real, observed ones. According to the estimated regressors (see Table 1), the default probability has been calculated for the entire sample of banks, and for the period ranging from 2000 to 2013 (same period used to estimate the model). Given that the outcome of the model is a probability (continuous variable, between 0 and 1) while the observed defaults are classified as a dummy variable (0 in case of non-default, 1 in case of default), two different thresholds have been used to transform the estimated PDs into dichotomic values:

(i) When the estimated PD is higher than the PD corresponding to the 97th percentile of the distribution, the bank is classified as in default. This choice is consistent with the 3% riskiest banks failing scenario;

(ii) When the estimated PD is higher than the PD corresponding to the 90th percentile of the distribution, the bank is classified as in default. This choice is consistent with the 10% riskiest banks failing scenario.

Table A1 summarises the performance of the model specification A under options (i) and (ii).

**Table A1**

Performance of the model used to estimate default probabilities

| Diagnostic | (i) 97th percentile as threshold | (ii) 90th percentile as threshold |
|---|---|---|
| TP | 99 | 155 |
| TN | 46 496 | 45 384 |
| FP | 767 | 1 879 |
| FN | 413 | 357 |
| Accuracy | 98% | 95% |
| Sensitivity | 19% | 30% |
| Specificity | 98% | 96% |

Source: ECB staff calculations based on Bankscope, ECB Statistical Data Warehouse and European Commission dataset on state aid measures, 1999:Q1 – 2013:Q4.
Note: TP abbreviates True Positive (default events correctly estimated as defaults); TN abbreviates True Negative (non-default events correctly estimated as non-defaults); FP abbreviates False Positive (or false alarms, non-default events estimated as defaults); FN abbreviates False Negative (or II type errors, default events estimated as non-defaults). Accuracy is calculated as the ratio between TP+TN and the overall population; Sensitivity is calculated as the ratio between TP and TP+FN; Specificity is calculated as the ratio between FP and FP+TN.

On the one hand, the overall accuracy of the model is extremely high under both options (i) and (ii); on the other hand, the discrimination between failing and non-failing banks based on the 90th percentile (option (ii)) seems to substantially increase the sensitivity of the model.

# Abbreviations

ARS Aggregate Risk Score

ARW Aggregate Risk Weight

AUROC Area Under the Receiver Operating Characteristics Curve

BRRD Bank Recovery and Resolution Directive

COREP Common Reporting

DGS Deposit Guarantee Scheme

DGSD Deposit Guarantee Scheme Directive

DIF Deposit Insurance Fund

EBA European Banking Authority

EDIS European Deposit Insurance Scheme

FDIC Federal Deposit Insurance Corporation

FINREP Financial Reporting

G-SIB Global Systemically Important Bank

IRS Individual Risk Score

LGD Loss Given Default

MREL Minimum Requirement for own funds and Eligible Liabilities

NPL Non-Performing Loans

OECD Organisation for Economic Cooperation and Development

JRC Joint Research Centre

PD Probability of Default

ROE Return on Equity

RWA Risk Weighted Assets

SRF Single Resolution Fund

TLAC Total Loss-Absorbing Capacity

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