



EFDI RESEARCH PAPER ON THE ASSESSMENT OF DGS' CONTINGENT LIABILITIES

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1 Abstract

Deposit Guarantee Schemes (DGSs) are subject to contingent or potential liabilities related to liquidity outflow and final losses in the case of member bank failures. The Deposit Guarantee Scheme Directive (DGSD) Article 10 (1) states that DGSs should have adequate systems in place to determine their potential liabilities, and furthermore, that the available funds should be proportional to these liabilities. No further definitions of adequate systems, potential liability or the mentioned proportionality is given in the directive.

This paper aims to examine the use of contingent liability assessments among EFDI members. Examining the applied practices and methodologies could shed light on the DGSs' individual interpretations of the terms mentioned in DGSD Article 10 (1). The DGSD Article 10 also sets minimum requirements of available funds to 0.8 percent of covered deposits of each DGS' members¹. However, a contingent liability assessment may conclude that the target level set out in DGSD is not sufficient (or too high), which makes the Article's requirement of proportionality between potential liabilities and available funds all the more relevant.

The paper starts with an outline of the legal European framework with definitions and discussion of key terms, followed by some benefits and potential pitfalls for DGSs when assessing their contingent liabilities. Section 5 provides a literature review on academic research on contingent liability methodology for DGSs, followed by practical implications derived from the theory in section 6. This could serve as a starting point for readers looking into the topic of contingent liability assessments for DGSs. Section 7 gives a description of some of the methodologies found in EFDI. To map the use of such assessments, a survey among all active EFDI members (67) was conducted. 13 responses were obtained (<20%). The population of respondents was deemed too low to conclude on the entire population of EFDI members with statistical significance. Thus, section 8 of the paper is limited to a case study containing descriptive statistical analyses of the population of respondents. The result of the survey and description of the methodologies in section 7 indicates a gap between approaches described in academic research and implemented practices among most EFDI members. Such a gap might have two interpretations: it represents either a fundamental challenge to the foundations of academic approaches or DGSs failure to incorporate such approaches in their analysis and decision making. We provide some thoughts on possible causes for this gap. The final section of the paper is a conclusion and suggestions for further research.

¹ Article 10 (6) allows for lower target level than 0.8 percent if certain criteria is met. The reduced level cannot be lower than 0.5 percent of covered deposits.

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2 Introduction and legal framework

The aim of this paper is to identify the presence and use of contingent liability assessments arising from member bank failures among EFDI members. A paramount task of Deposit Guarantee Schemes (DGS) is to maintain depositor confidence in the safety of deposits given to banks. This trust is crucial to financial stability and is rooted in the DGSs' obligation to reimburse eligible deposits in case of bank failures. To make the guarantee credible, most DGSs choose to accumulate funds through ex-ante contributions from member banks. Throughout the EU/EEA area, an ex-ante fund is required by the Deposit Guarantee Scheme Directive (DGSD).

The DGSD sets a minimum size of financial means that should be available to the DGSs². However, for a DGS to fulfil its function as contributor to financial stability, a higher level of available financial means could be necessary to maintain depositor confidence. This is further emphasized in DGSD Article 10 (1) which states that:

"Member states shall ensure that DGSs have in place adequate systems to determine their potential liabilities. The available financial means of DGSs shall be proportionate to those liabilities."

The directive does not indicate what is meant by *"adequate systems"*, *"potential liabilities"* nor the proportionality between available financial means and potential liabilities. These terms are therefore subject to member state interpretation.

One interpretation of Article 10 (1) is that the level of available financial means should be a function of the expected future outflow of liquidity and expected losses, i.e., the contingent or potential liability related to member bank failures. Another interpretation could be that expert assessments of potential liabilities are adequate. As no methodology or approach is mentioned, none can be regarded as a requirement. However, different methodologies should not be seen as competitors but rather supplements where a combination of them is likely to yield the best results. The selection of method(s) may depend on a variety of conditions such as on the structure and features of the specific banking sector. For instance, in the case of a banking sector with a large number of banks, relatively long history of bank failures, efficient markets and stable regulation; statistical regression models may find statistically significant relationships. On the other hand, if the banking sector is concentrated with few or no failures, etc., historical statistical analysis would prove inefficient and likely not yield robust and meaningful results.

An example of the interaction between statistical and expert judgement models can be seen by the International Accounting Standards Board's (IASB) statement from March 27 2020, regarding IFRS 9 and the Covid-19 pandemic³. In this document, IASB states that *"If the effects of covid-19 cannot be reflected in models, post-model overlays or adjustments will need to be considered."* The covid-19 pandemic has been referred to by the Bank of International Settlements

² DIRECTIVE 2014/49/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on deposit guarantee schemes Article 10 (2)

³ <https://www.ifrs.org/content/dam/ifrs/supporting-implementation/ifrs-9/ifrs-9-ecl-and-coronavirus.pdf>

(BIS) as the first major test of the IFRS 9 framework for estimating ECL⁴. There are several reasons why IASB would suggest post model overlays due to model prediction shortfalls. Firstly, the pandemic and its effect on the economy represented a shock that could not have been captured in the datasets of historical models, and hardly in the forward looking macro models either. Secondly, the amount of uncertainty was substantially higher than normal circumstances when it came to authorities' response, the duration of the pandemic and its effect on the real economy. Thirdly, as IFRS 9 sets requirements that ECL is measured as an unbiased and probability-weighted amount that is determined by evaluating a range of possible outcomes⁵, most banks have adapted and utilize macroeconomic models with different weighted scenarios to meet this requirement. The nature of most of these models, make them yield meaningful results only for certain intervals of their input variables; for instance, unemployment rate of [3 % , 8 %], crude oil price [60-110 USD/barrel] or GDP-growth [1 % - 3 %] etc. When the input variables are outside the ranges the model is defined for, caution must be taken when interpreting the results. The statement from IASB illustrates that economic models often supplement each other, rather than compete. Depending on their methodology and assumptions they have different weaknesses and strength. That a model or methodology fails under certain (extreme) circumstances, does not mean it does not serve its function under normal conditions. Sound model risk management (MRM) will reveal when models are at risk of shortfall and further measures need to be considered, such as model overlays or adjustments as IASB suggested March 2020. As with all models trying to simplify the real world, contingent liability models and their results need to be interpreted with caution, irrespective of chosen approach or methodology. Knowledge of the models' weaknesses and strengths is crucial, and the most accurate and robust results will often come from a combination of different methodologies and approaches.

By examining the extent of which EFDI members assess their potential liabilities, we can shed light on how member states interpret DGSD Article 10 (1), in terms of "*adequate systems*". The paper attempts to do so through a survey on how potential liabilities are assessed. The survey was distributed to 67 recipients within the EFDI community. 13 answers were received. The population of respondents is deemed too small to draw any statistically significant conclusion describing the entire member population. It does however allow for a descriptive analysis as presented in section 8 of this paper.

The paper also reviews relevant academic literature on the field and could serve as a starting point for DGSs looking into the field of contingent liability assessments. The remaining of this paper is structured as follows; definition of key terms (3), benefits and pitfalls for DGSs from assessing their contingent liabilities (4), literature review (5), practical implications derived from theoretical approaches (6), description of some of the methodologies used by EFDI members (7), findings and descriptive analysis from the survey (8), conclusions (9), suggestions for further research (10) and the survey questioner in the appendix.

⁴ https://www.bis.org/publ/qtrpdf/r_qt2103w.htm

⁵ IFRS 9, 5.5.17

3 Definitions of key terms

To ensure a common understanding of key terms of the paper, a brief discussion of the definitions is necessary.

3.1 Adequate systems

DGDS Article 10 (1) uses the terms *adequate systems* when describing what DGSs are expected to have in place to determine their potential liabilities. The Cambridge dictionary defines adequate as "*enough or satisfactory for a particular purpose*". A system is amongst others defined as "*a way of doing things*" or "*a particular method of counting, measuring, or weighing things*". With regards to assessing potential or contingent liabilities relating to member bank failures, these definitions give the direction of the DGS' procedures, routines and estimates regarding the uncertain future liquidity outflow and final losses, related to member bank failures.

3.2 Potential and contingent liabilities

The DGSD use the term potential rather than contingent liability, the latter being a commonly used term in accounting. These terms overlap, as they both describe liabilities that *may* occur in the future, depending on the outcome of one or more specific events. Bank failures are events that in most cases trigger liabilities in the form of liquidity outflow and financial losses for a DGS.

Even though the accounting treatment of contingent liabilities is not within the scope of this paper, the accounting definitions may help to gain a better understanding of the complexity within contingent liabilities.

Accounting standards on assessing contingent liabilities are found in different generally accepted accounting principles (GAAP), typically focus on the liabilities' likelihood to occur and whether they can be reasonably estimated to be recorded in the financial statements. The International Financial Reporting Standards (IFRS) defines contingent liabilities as⁶:

- (a) a possible obligation that arises from past events and whose existence will be confirmed only by the occurrence or non-occurrence of one or more uncertain future events not wholly within the control of the entity;*
or
- (b) a present obligation that arises from past events but is not recognized because:*
 - (i) it is not probable that an outflow of resources embodying economic benefits will be required to settle the obligation; or*
 - (ii) the amount of the obligation cannot be measured with sufficient reliability.*

For DGSs it could be argued that events regarding bank failures, triggering DGS response and outflow of funds should be regarded as a contingent liability according to the definition above (IAS 37, 10 (a)). A possible approach to this

⁶ IAS 37 Provisions, Contingent Liabilities and Contingent Assets, (10) Definitions

study could then be to examine the financial statements of those DGSs that report under IFRS to gain an understanding of how they value and assess their contingent liabilities. However, IAS 37, 10 (b) sets requirements both to the probability of the event occurring, and the ability to measure it with sufficient reliability. To measure the contingent liability to a DGS with sufficient reliability is not a straightforward task. Furthermore, a bank failure is considered an unlikely event in most jurisdictions. This could limit the opportunity for DGSs' reporting under IFRS to recognize their contingent liabilities in their financial statements.

3.3 Available financial means and proportionality to potential liabilities

A DGS needs a certain amount of available financial means to be credible and fulfil its purpose as a contributor to financial stability, as depositors' trust depends on the DGS' ability for reimbursement in the event of a bank failure. In addition, one could argue that sufficient funds are necessary to gain public confidence and avoid banks runs, which can contribute and even cause banks to enter financial distress and further destabilise the financial system as a whole. An assessment of the contingent liability due to bank failures could therefore be useful to DGSs to help determine the adequate amount of funds. In this context it is important to emphasize that the financial means of DGSs comes at a cost; the alternative return on capital in the member banks.

According to DGSD Article 10 (2), member states shall ensure that the available funds of the DGS shall at least reach a target level of 0.8 percent of the amount of the covered deposits of its members⁷. The wording "*shall at least*", points in the direction that this should be interpreted as a minimum level, and not necessarily the *adequate* amount of funds, mentioned in the preceding paragraph of the same article.

4 Potential benefits and pitfalls from assessing contingent liabilities

Assessments of a DGS' contingent liabilities can be seen as a direct response to DGSD's Article 10-1, cited above. For instance, the attention brought to the proportionality between the contingent liability and the available funds could uncover the need for additional funding sources, such as credit facilities, that go beyond the minimum level of 0.8 percent of covered deposits. Some other benefits and potential pitfalls of assessing contingent liabilities are briefly outlined in the paragraphs below.

The choice of methodology, i.e., how the potential liability is derived and estimated, will impact the benefits and pitfalls outlined below. For instance, a forward-looking statistical model utilizing current market data, could on the one hand provide useful insights and benefits, but also the risk of wrong policies due to lack of understanding/misinterpretation of the results, parameter sensitivity or

⁷ Article 10 (6) allows for lower target level than 0.8 percent if certain criteria is met. The reduced level cannot be lower than 0.5 percent of covered deposits.

errors in underlying assumptions and input data. As always when modelling risks and uncertainty, a thorough understanding of how the model works and in what intervals of input data they are defined and meant to yield meaningful results is imperatively required. Results should be supplemented and critically evaluated by subject matter experts.

4.1 Calibration and benchmarking of contribution models

DGSD Article 13 (1) states that "...[contributions] shall be based on the amount of covered deposits and the degree of risk incurred by the respective member". Furthermore, (2) states that "The calculation of contributions shall be proportional to the risk of the members and shall take due account of the risk profiles of the various business models".

The degree of risk incurred to the DGS by the respective member banks, can be seen by those using a statistical approach as a function of the probability of a default (PD), i.e. a failing member bank, and the loss incurred by the DGS given that the member enters a crisis (LGD⁸). The banks' total amount of covered deposits corresponds to the DGS' exposure⁹. The product of the PD, LGD and EAD can be interpreted as the expected credit loss (ECL), or contingent liability arising from each member. This interpretation is in line with the IRB-approach of assessing credit risk in the Basel Framework.

The above section is a description of a DGS' ECL. In cases where banks are financed with a sufficiently amount of loss absorbing capital, below covered deposits in the credit hierarchy, the DGS' LGD could be zero, resulting in no expected loss. However, to fully recognize the contingent liability, the liquidity outflow and the associated financial cost should also be assessed. With a statistical approach the expected value of the liquidity outflow can be regarded as the product of the PD and the EAD. The funding cost could then be estimated using the alternative return the DGS would expect to receive on the provided liquidity, until they are reimbursed by the bankruptcy estate.

Contagion risk is difficult to measure but should also be considered. Even if the bank at hand does not provide the DGS with direct financial loss, it could contaminate the financial market and lead to failure of other member banks that inflict direct losses to the DGS. Contagion risk is further discussed in section 8.6.

"The degree of risk incurred by the respective members" as mentioned in DGSD Article 13 (1), should include all of the above mentioned aspects; direct losses where the bankruptcy estate does not reimburse the whole amount the DGS has provided, the alternative return on the liquidity outflow in the period until the bankruptcy estate has reimbursed the DGS and contagion effects on other member banks and the financial system.

To ensure consistent application of the DGSD when it comes to contribution calculations, EBA has published guidelines to specify methods for calculating

⁸ Loss Given Default

⁹ Exposure at Default (EAD). For banks that are subject to resolution the DGS exposure would be substantially lower and limited according to the requirements set out in the BRRD Article 109 (1).

contributions to DGSs¹⁰. The aim of the guidelines is to provide a consistent way of risk-adjusting contributions among members, across jurisdictions. Most EFDI members are compliant to these guidelines¹¹. However, even fully compliant members are left with some degree of freedom for national adaptation, e.g. when it comes to the final weights assigned to each risk indicator. As the contributions shall be proportional to the level of risk incurred by each member of the DGS, a liability assessment model (on member level) can be used to benchmark and calibrate the contribution model. A DGS could for instance aim to set each member's share of the total contribution to be as equal as possible to its share of the total contingent liability, with the indicator weights as changing variables. Formally, this can be expressed by minimizing the weighted absolute mean error¹² defined as:

$$\text{Weighted Absolute Mean Error} = \frac{1 \sum_{i=1}^n w_i |y_i - \hat{y}_i|}{n \sum_{i=1}^n w_i}$$

Where;

n is the number of banks,

w_i is the inverse share of guaranteed deposits for bank i ,

y_i is the share of the total contingent liability for bank i ,

\hat{y}_i is the share of the total contribution for bank i .

Given that the DGS would like to be compliant with the EBA guidelines, these can be computed as constraints in the optimization problem above, e.g. min() and max() constraints on the core indicators weights.

In the revised guidelines on methods for calculating contributions to deposit guarantee schemes (81)¹⁰, EBA states that DGSs should calibrate the calculation method based on expert judgement, as part of the regular review. Article 82 further emphasises that contributions should reflect the liability incurred by members considering the likelihood of a DGS intervention (PD), and the potential losses for the DGS, on a net basis after the potential recoveries from the bankruptcy estate of the failed institution (LGD). The expert judgement could in many cases be supplemented by a contingent liability assessment, as outlined above.

4.2 Contingency planning and fund size assessment

Reimbursing depositors in failing banks is not the only measure for a DGS to fulfil its mandate. DGSD Article 11.6 states that:

¹⁰ EBA/GL/2015/10 (22.09.2015) and the revised guidelines in EBA/GL/2023/02 (21/2/2023)

¹¹ Of a total of 31 respondents, 25 answered that they are compliant or intend to be, whereas 3 answered "Does not comply/does not intend to comply" and another 3 answered blank. The used "Guidelines compliance table" was updated 5 October 2023, available here: <https://www.eba.europa.eu/legacy/regulation-and-policy/regulatory-activities/recovery-resolution-and-dgs/guidelines-methods>

¹² One could also define the optimization problem as minimizing the weighted mean squared error or preferably use both methods.

"Member States may decide that the available financial means may also be used to finance measures to preserve the access of depositors to covered deposits, including transfer of assets and liabilities and deposit book transfer, in the context of national insolvency proceedings, provided that the costs borne by the DGS do not exceed the net amount of compensating covered depositors at the credit institution concerned."

DGSD Article 11 (3) also opens for alternative use of DGS funds, other than reimbursement, if certain criteria are met. Alternative measures as mentioned in Article 11 (6) and 11 (3) can not only reduce a DGS' losses, but also severely reduce its liquidity outflow and corresponding loss of the alternative return on the liquidity outflow. When a member bank fails, the DGS must decide a course of action. In times of economic distress, the remaining liability and available funds of the DGS after the failed bank has been resolved should also be considered. The assessment of the remaining liability could affect the chosen course of action. If the remaining liability is found to be high (i.e. the risk of more member banks failure is high), liquidity preservation through alternative measures could become all the more relevant.

4.3 Adequate available financial means

Monitoring the contingent liability can also indicate whether the DGS' financial means are proportional to its liabilities. If the financial position of the DGS is found to be sound compared to its liability, it could be used as an argument to reduce the contribution and the financial burden on the member banks. Vice versa, if the liability is found to increase beyond the available financial means of the DGS, this could indicate the need for additional funding sources, such as credit facilities, or justify continued collection of contributions beyond the 0,8 percent minimum requirement.

4.4 Investment strategy

A DGS' contingent liability is likely to follow the business cycle and increase in times of economic turmoil. Keeping track of the liability over time could provide input to the investment strategy of the fund. If bank failures become more likely and the probability that the DGS must reimburse depositors, provide alternative measures or contribute with funds to crisis resolution according to DGSD Article 11 (2), liquidity becomes crucial in managing the fund. In times of strong economic growth more emphasis could be given to returns of the fund, possibly easing the financial burden on member banks' contributions. It could be argued that DGSD Article 8 and the seven working days deadline for making deposits available, limits the investment strategy of the fund to high quality liquid assets only. However, close monitoring of the contingent liability could provide a source of input to the investment strategy where e.g. a portion of the fund is allocated towards slightly higher returns at the cost of liquidity in times where the probability of liquidity outflow is deemed low.

4.4. Potential pitfalls

As with all models trying to describe the real world, caution must be taken when interpreting the results. It is crucial to know how the model works. Some points to consider are, but not limited to:

- i) What assumptions and simplifications are made in the model, and what are their implications.
- ii) For which intervals the input variables yield meaningful results.
- iii) Quality of the input data.
- iv) Are there decisive circumstances not captured by the model.

Having a clear understanding of these matters, DGSs can mitigate the risk by applying expert judgement overlays, sensitivity analysis on key assumptions, parameters and variables and benchmark the output to other sources of information, such as market development, other economic analysis or results from renowned rating agencies.

5 Literature review

There are two basic approaches to determining the optimal size of a deposit insurance reserve to cover DGS liabilities, according to IADI (2009). The first is to levy steady premiums over an extended period. The second is a premium system to maintain a target reserve level or range. The target level should be adequate to cover the potential losses of the insurer under normal circumstances. On the other hand, an excessive burden on the banking sector will have a negative impact on its development¹³.

To determine the losses of the DGS, systems in different countries use either the historical method, the credit portfolio approach (CPA) or an expert judgement approach. According to IADI (2009), the most common approach is to refer to the historical experience with bank failures and associated losses. The historical approach is characterized as easily understandable, but not a good guide to the future, as it does not consider the current risk profile of member banks¹⁴. The credit portfolio approach requires more analytical sophistication and is used in selected countries. This approach uses the concept of bank loan portfolio counterparty risks but applies it to the portfolio of DGS liabilities with individual banks being the counterparties. Adopting this approach requires developing specific estimations of risk and size of expected losses for each member bank. The use of the method also should distinguish between expected losses and determining reserves for unexpected losses¹⁵. The difficulty of using this approach lies in estimating its key input parameters: probability of default (PD), loss given default (LGD) and a correlation parameter which distinguish between idiosyncratic and systemic risk. For the calculation of unexpected losses IADI (2009) notes that Monte Carlo estimation techniques are increasingly being used¹⁶.

¹³ IADI (2009), pp.17-18

¹⁴ IADI (2009), p.18.

¹⁵ IADI (2009), Annex I Credit Portfolio Approach to Determining a Reserve Target

¹⁶ IADI (2009), p.32

Academic work on the proper setting of fair deposit insurance premiums has been done since the 1970s. Merton (1977) used the theory of option pricing (Black & Scholes model) to derive a formula to evaluate the liability or cost on the deposit guarantee for issuing of a guarantee. The goal was to demonstrate an isomorphic correspondence between loan guarantees and common stock put options. Here the premium for deposit insurance is equivalent to a put option on the bank's asset value. Marcus, Shaked (1984) applied this concept and calculated bank-specific estimates of the proper premium for deposit insurance. Ronn, Verma (1986) further showed a methodology for arriving at empirical estimates of deposit insurance premiums from market data by using isomorphic relationships between equity and a call option, and insurance and a put option. They utilized the market value of equity to solve for the asset value and its volatility.

Leaven (2002) estimated the cost of deposit insurance for a large sample of banks in 14 economies to assess the relationship between the risk-taking behaviour of banks and their corporate governance structure.

Kuritzkes et al. (2002, 2005) estimated the loss distribution faced by the FDIC using a Monte Carlo simulation. They estimated the probabilities of default implied by the S&P credit ratings for banks that were rated. For the remaining banks they used the average historical default probability of 0.26%, corresponding to a BBB rating.

5.1 EU Joint Research Centre (JRC) models - De Lisa (2010) and the SYMBOL approach

An influential branch of literature was started with the De Lisa et al. (2010) paper. Their innovation was to estimate the default probability of the bank's obligors through a novel approach that uses publicly available regulatory capital information. They also extended the existing literature on deposit insurance by taking into account the correlation between banks' assets and the risk stemming from the interbank lending (interbank contagion). They applied their approach to 2007 data for a sample of Italian banks to assess the adequacy of the Italian DGS. Their approach used the Basel 2 Regulatory Framework to estimate the Implied Obligor Probability of Default. These probabilities are internally known to banks and are not public. They showed that they can compute a proxy of the quality of a bank obligor portfolio by inverting the Basel 2 FIRB capital requirement formula. The capital requirement is a known value and other variables in the formula can be set to regulatory values. They use the estimated PD again as a parameter in the Basel 2 formula to simulate a sample of correlated bank asset losses, introducing common random shocks through the systemic factor in the equation. The losses are checked against the bank's capital, to determine failures. The sum of failures leads to the simulated loss of the DGS. Repeating this procedure over 500 000 Monte Carlo simulations creates a loss distribution for the DGS. They use the loss distribution to assess the funds of the Italian DIS for adequacy. Generally, loss distributions can also be used to determine the target fund, at the chosen confidence level. Their approach was continued for the next decade in a series of impactful papers from the JRC and for EU banking legislation.

In a follow-up paper for the EU JRC Campolongo, De Lisa et al. (2010) extended the model to include 3 other EU countries: UK, Germany and Spain. They show that their approach is flexible and can provide answers to policy questions. Existing literature estimated the DGS loss distribution based on structural models, that had to assume the Loss Given Default (LGD). They show that that their model can deliver a more nuanced loss distribution: (1) the worst case needed to cover all depositors but also (2) the exact excess loss, which takes into account only the excess losses obtained in the simulations. The per simulation sum of these losses will be lower as it takes into account the individual capital buffers that the banks do have. Therefore, the flexibility of the model can deliver more precise estimation of the DIS fund target, at the assumed confidence level (at the chosen loss distribution percentile).

Benczur et al. (2017) model the impact of major EU reforms dealing with the banking sector: CRR/CRD IV, BRRD and SRMR. They quantify the cumulative effects of the adopted pieces of legislation on government contingent liabilities, that is on public finance costs conditional on a severe financial crisis.

Fernández-Aguado (2022) used the SYMBOL model to simulate the European Deposit Insurance Scheme (EDIS) loss distribution. They analyse the sensitivity of the EDIS to the risk of the bank portfolio considering different scenarios. They tested 3 correlation matrices to assess how an integrating European banking system might impact the loss distribution. Their methodology allows them to analyse the fairness of the EDIS contributions scheme.

Cariboni and Maccaferri (2011) investigated a possible technique to design an effective DGS, focusing on the empirical loss distribution of the fund. They simulated the loss distribution relying on the classical credit risk techniques, under the assumption that defaults occur if the bank's asset value falls below a threshold. Asset values followed a Gaussian model. Their methodology allowed defining a target level for the funds to be collected by the scheme to promptly and effectively respond to financial crisis.

For some DGSs the problem of estimating default probabilities is complicated by the availability of data with a significant number of default events. Systems with a large number of banks and decades of data can estimate PDs with high credibility. For instance, FDIC (2023) lists 567 entries since 2000 on its online Failed Banks List. Systems in small countries will often be limited by too few default events.

Vasicek (1987, 2002) developed a model for the amount of capital necessary to support a portfolio of debt securities dependent on the probability distribution of the portfolio loss. Based on his work and Merton (1974), the Basel Committee on Banking Supervision decided to adopt the assumptions of a normal distribution for the systematic and idiosyncratic risk factors into the internal ratings-based approach for capital requirements (BCBS 2005). The IRB capital requirements approach was later adopted in literature for the estimation DIS fund liabilities.

This model was recently referenced by O'Keefe, Ufier (2017), who demonstrated a framework to help deposit insurers determine a Target Fund Ratio. The framework takes into consideration the role that credit and liquidity risks play in a

bank failure, overcoming data limitations some DIS face when attempting to determine deposit insurance losses. It was applied in Nigeria, Zimbabwe, Columbia, Canada, Singapore and the United States.

5.2 Limits and pitfalls when employing statistical models

Statistical models also have some limitations that is important to be aware of. Historical models refer to the past, and it is therefore crucial that the historical data in the model is representative for the future events the model is meant to predict or estimate. This represents model uncertainty. In many jurisdictions, bank failures are rare, and without a significant number of default events, historical regression models would not yield meaningful results.

Bank failures can also often be linked to rare extreme events, e.g. the closing of Sberbank in European countries due to the sanctions against the Russian invasion of Ukraine. Such extreme events are often referred to as "black swan events" and cannot easily be included in economic models.

Another important aspect when using historical time series data, is to correctly adjust for changes in regulation and legal framework, as it changes over time. Statisticians needs to carefully consider this and the impact on the data and make necessary adjustments if possible. When new legislation and regulation is introduced, there will be a period of uncertainty with regards to how this will be reflected in the real economy, i.e. how market participants will adjust and adapt. Regulators' intention is not necessarily the actual end result.

Statistical models can also be said to only refer to a limited number of factors. It is for example difficult to include the consequence of good or bad management of a banking or financial crisis from the authorities. Poor management could potentially lead to contagion, bank runs in other banks which can impact DGSs contingent liabilities substantially.

Some of the theory and techniques also rely on the law of large numbers. This may not be applicable for a DGS with a limited portfolio of member banks. Ultimately, it is important to understand that models that try to describe rare and complicated events are not able to capture all elements and possibilities or describe a future state with 100% accuracy. This should, however, not be an argument against the use of such models, as they often will contribute to and improve decision making in normal circumstances.

5.3 The expert-judgement oriented approach

The expert-judgement oriented approach is essentially a quantitative approach based on judgment. In this respect a DGS may determine its contingent liabilities, for example, in terms of the covered deposits of the biggest banks not subject to resolution or the aggregate amount of covered deposits in all small and medium-sized banks in financial weakness.

The expert-judgement oriented approach may or may not integrate into the analysis facts and data on past bank failures and subsequent losses. In fact, DGSs

with limited experience on bank failures may inevitably employ this method and rely solely on experts' viewpoints on the Fund's potential exposures.

The aspects considered in determining the contingent liabilities could include (but not limited to):

- i) Banking system structure and features involving its concentration, the number and financial status of participating institutions, the past failures, the probability of future failures and interbank interrelations.
- ii) DGS's mandates.
- iii) Resolution regime.
- iv) Macroeconomic conditions which exert an impact on the stability of certain banks and the banking system as a whole.
- v) Accessibility to external backup capital.

6 Practical implications derived from theoretical approaches

The literature review could provide useful insights and practical guidance for DGSs' experts in assessing contingent liabilities. The Credit Portfolio Approach (CPA) provides a forward-looking perspective while its data prerequisites could be fulfilled even when DGSs confront some data problems. In this respect, it can be implemented and adjusted for a variety of country contexts.

Under the CPA, the optimal level of funds of a DGS is determined by the expected losses in different states of the economy. Expected losses are commonly defined by the product of (a) the probability of default – PD, (b) the Loss Given Default – LGD and (c) the Exposure at Default – EAD.

$$\text{Expected Losses} = PD \times LGD \times EAD$$

The recognition of the different states of the economy could be the first stage of the process. The economic indicators that best explain variation in the economic data should be identified in order to distinguish between crisis and non-crisis periods. The framework could take into consideration conditions over a full business cycle, as well as current economic conditions, by exploring, for example, a through the cycle period (from previous trough to peak).

The different components of *Expected Losses* could be determined as follows:

The Probability of Default (PD) is affected by credit failures, liquidity failures and systemic failures. Asset returns data and data management could provide the input for the aforementioned metrics, each coming from asset return simulations.

- *Credit failures* occur when the total asset value falls below that of their outstanding liabilities. Since credit failures comprise of systemic and idiosyncratic (specific) risk, credit failure probabilities can be inferred, for example, from asset return data by means of a Monte Carlo simulation.
- On *liquidity failures*, data on banks that their asset returns place them "near" credit failure status could be used, since banks will lose a significant portion of uncovered deposits and other short-term funding if their asset

returns place them “near” credit failure status and no further government guarantees are forthcoming, at which point fire sale of assets may lead the bank to failure.

- *Systemic failures* can be interpreted as the loss of confidence in short- and long-term interbank lending for all banks. Taking into consideration the importance of interbank borrowing to each bank, if the decrease in interbank lending exceeds an assumed threshold, banks that rely significantly on interbank funds might fail.

Loss Given Default (LGD) could be determined by the hierarchy of claims, i.e. the priority that the DGS has over other claimants of the failed bank and the structure of the bank’s assets and liquidation expenses, which make up for the DGS loss rate. Information on net loss rates as a percentage of failed-bank assets can be used to extract the necessary data. Needless to say, that the loss rate could be adjusted to take account of certain policy measures such as a bank coverage by SRF.

Exposure at Default (EAD) can be calculated from data on deposits and bank liabilities which are commonly available from bank financial statements.

The process could be fine-tuned by incorporating a correlation of defaults through the correlation in asset returns. For this, two approaches can be used: a *Stock Return Data* approach, where correlations from pricing data for publicly traded banks are used, and a *Book Equity* approach, where book equity is used instead, since not all banks are publicly traded.

It should be stressed that the proper application of these models requires the use of market values for equity capital and assets. In cases of efficient markets, the stock market values reflect the actual fair value, which means that all relevant and existing information is reflected in the stock market capitalizations. Nevertheless, the application of these models could be compromised in countries with illiquid stock markets where market values might deviate from fair values. Further, market values could only be available for a limited number of banks since not all of them are listed. Finally, there is also evidence that indicates that market values could often be distorted by insufficient information or speculation.

This, however, does not imply that the statistical approaches are irrelevant, but rather that the analysis should incorporate the above deliberations. In this respect a combination of the statistical and expert-judgement methods might provide a way forward with the balance between the two determined by the idiosyncrasies of the particular banking sector.

7 Description of some EFDI-methodologies

The following model descriptions were received on request by the initial members of the Liability Research group, in September 2022. It is not meant to cover all models within EFDI, but merely give an insight to a selection of the different methodologies employed. It is not the scope of this paper to give a complete description of all methodologies within EFDI.

7.1 Poland – Monte Carlo

In 2015-2016, the Polish DGS used a simplified Monte Carlo simulation in order to estimate financial liabilities of the Banks' Guarantee Fund. This was done in preparation for the legislative act that set target fund size¹⁷. The Fund used a two-method hybrid approach to determine the sufficient target level: historical expert method and statistical method. For the first method, the upper historical levels of the coverage ratio was taken into account, the capacity of the current coverage ratio and expert analysis of the ability to cover the nth largest bank (ranked by covered deposits).

For the statistical Monte Carlo method, the following key assumptions were made:

- i) 1 year horizon,
- ii) 100% loss given default of covered deposits per bank,
- iii) probability of default was assumed to be linked to an internally calculated risk score,
- iv) confidence level percentile 98,75%.

First, it was assumed that a DGS fund has to cover liabilities that can happen in the time horizon of 1 year, until further solutions can be introduced through central bank borrowing or further legislative action. Second, the Fund has to take a liquidity perspective, which leads to the assumption of 100% loss given default in the 1-year time horizon. Recovery of losses through judiciary action takes several years and cannot be relied on in this time horizon. Third, probabilities of default (PD) were attributed to banks on the basis of international experience (rating agencies' research). Risk scores from the internal Early Warning System (EWS) ratings were mapped by risk class to average historical default frequencies established by Standard & Poor's. Every bank received a PD depending on its EWS rating falling into a determined range that matched the S&P rating.

The simplified Monte Carlo simulation was conducted with 1 million trials for approximately 600 banks. No correlations between banks were assumed. From the simulation it was possible to estimate a distribution of potential DGS liabilities, stemming from multiple bank default events in one year. This was repeated for different data sets (CDs, EWS scores) for the years 2009-2014.

The result of the analysis was to estimate the Fund's liabilities, which will have to be provided in the perspective of one year. The aim of the analysis was to determine the level of guarantee resources that will allow to cover the expected liabilities with a sufficiently high level of confidence (98,75th percentile of the simulated one-year distribution).

7.2 Norway – Forward-looking simulation model

The Norwegian DGS' methodology for contingent liability estimation uses a credit portfolio approach, where all the member banks are regarded as a portfolio of

¹⁷The full justification of the act (with simulation details) is available at:
<https://www.sejm.gov.pl/Sejm8.nsf/druk.xsp?nr=215>

counterparty credit risk¹⁸. The methodology has clear resemblance to the IRB approach of the Basel II framework. The portfolio consists of individual exposures (set to each member banks' guaranteed deposits), each having a small, but non-zero, probability of default. The procedure used to simulate the loss distribution relies on classical credit risk techniques, where default occurs if a bank's asset values fall below a threshold and asset values follow a Gaussian one-factor model. The model uses the member banks' capital structure, bond spread data on their capital instruments and stock price returns (on listed banks) to estimate PDs, correlation/contagion and LGDs for each bank. This is done under the assumption that all capital instruments from the same bank have the same PD. Under this assumption, the difference in spreads between the instruments can then be interpreted as the LGD. As the risk premium on the bonds consist of more than just credit risk (e.g., liquidity risk), the model uses only a user-set fraction of the spread to account for the credit risk premium.

For listed banks, the contamination effect is estimated by using the correlation between historical stock returns and the returns of the total Norwegian stock index (OSEBX). The approach for unlisted banks uses total assets (size) as a proxy for the contamination effect, where size is positively correlated with contamination.

The methodology estimates both the liquidity outflow (PD*EAD) and the expected loss (PD*EAD*LGD). The model population is all Norwegian banks, and only omits branches of foreign banks that operate in Norway¹⁹. The user specifies which banks that are presumed to be a candidate for resolution, and in the simulations where such a bank defaults, the model caps the liquidity outflow and loss according to BRRD (50 per cent of the minimum target level of 0.8 per cent of total guaranteed deposits)²⁰.

Simulations are done quarterly under different key assumptions, scenarios for resolution candidates and for a range of confidence intervals. Due to the high amount of uncertainty, the horizon for the liability estimation is limited to 1 year. The most prominent use of the results has been calibration of the contribution model²¹, identification of funding gap (leading to access to credit facilities) and contingency planning in exercises where alternative measures are considered. As the model is sensitive to key assumptions, and the simulations are done under different key assumptions, the results are interpreted in intervals, and both input data and results/output are subject to expert judgement. One example is the spike

¹⁸ The full model description with references to relevant academic literature can be found here:

[https://www.bankenessikringsfond.no/getfile.php/135470-](https://www.bankenessikringsfond.no/getfile.php/135470-1705058466/Nettsted%20Norsk/Om%20oss/Publikasjoner/03_Om%20innskuddsgarantiordningen/Teknisk%20rapport%20garantiansvaret%20%28engelsk%29.pdf)

[1705058466/Nettsted%20Norsk/Om%20oss/Publikasjoner/03_Om%20innskuddsgarantiordningen/Teknisk%20rapport%20garantiansvaret%20%28engelsk%29.pdf](https://www.bankenessikringsfond.no/getfile.php/135470-1705058466/Nettsted%20Norsk/Om%20oss/Publikasjoner/03_Om%20innskuddsgarantiordningen/Teknisk%20rapport%20garantiansvaret%20%28engelsk%29.pdf)

¹⁹ As the Norwegian coverage limit is 2 million NOK per depositor per bank > 100 000 €, branches of foreign banks operating in Norway can voluntarily become member of the Norwegian DGS to cover the difference in the two coverage limits.

²⁰ Bank Recovery and Resolution Directive (BRRD) Article 109.

²¹ The contribution model was calibrated against the liability model so that the sum of the absolute value of the residuals of the difference in each bank's share of the total contribution and their share of the total liability was minimized, setting the weight of each risk indicator in the contribution model as changing variables, within the constraints of the current EBA guidelines. The same procedure was also used to determine inclusion of additional risk indicators, in line with EBA Guidelines on methods for calculating contributions to DGS (EBA/GL/2015/10) (58).

in bond spreads seen under the outbreak of the covid-19 pandemic in March 2020, where uncertainty with regards to government intervention, the duration and effects of the pandemic on the real economy was extremely high. The input data was deemed to be outside what the model was defined for, and the results more or less discarded.

In addition to the above-mentioned methodology the Norwegian DGS also analyse the banks that are assumed not to be subject to resolution in a simplified model. The method is a computation of the liquidity requirements for cases where 1-5 non-resolution banks fail simultaneously. Different thresholds for available liquidity are set as x, y and z, representing different levels of available financial means (e.g. fund size, guarantees and extraordinary contributions and credit facilities). The short-term liquidity requirement is set as the covered deposits in the respective banks. For each level of financial means, the share of instances/combinations of defaulting banks where the required liquidity is above the available financial means is computed. The computation is fairly easy and does not consider the likeliness or probability of a bank defaulting, nor does it take into account the final loss to the DGS or contagion between banks. It does, however, shed light to the DGS' ability to handle combinations of non-resolution banks under different assumptions of available financial means. Depending on the composition of the DGS members, computation of more than 5 banks failing simultaneously could require substantial processing power, as the number of possible combinations increase exponentially. An illustration of the output table is given below:

Number of banks that simultaneously fails*	Minimum liquidity requirement	Median liquidity requirement	Maximum liquidity requirement	% of combination with liquidity requirement > than x**	% of combination with liquidity requirement > than y**	% of combinations with liquidity requirement >z**
1						
2						
3						
4						
5						

**not subject to resolution*

*** Where x = fund size, y=fund size + available credit facilities and z=fund size + available credit facilities + extraordinary contributions and guarantees*

7.3 France - implicit expert judgement

The French Deposit Guarantee Scheme (FGDR) does not use any statistic or probabilistic model. It assesses its liabilities by considering the amount of covered deposits in banks who are not eligible to a resolution procedure from the Single Resolution Fund (SRF).

The banks that we consider when assessing the risk are the ones that are not part of a banking group covered by the Single Resoluton Fund. There are approximately

113 banks in this category²². The amount of covered deposits of these banks equals 40 bn€. The largest bank has 13 bn covered deposits in 2021. The FGDR has calibrated its ex ante resources (6,1 bn) + alternative funding (1,5 bn credit facility + ex-post funding 7 bn) in order to be able to cover the failure of this bank bearing in mind that the second largest bank in the list has only 3bn€ covered deposits.

In other words, the FGDR adds the covered deposits amounts of its members who are not covered by SRF to assess its liability. The FGDR does not apply any default probability on these members but compares the calculated liability with its available financial means + alternatives financial means.

7.4 Bulgaria - implicit expert judgement

The Bulgarian Deposit Insurance Fund's (BDIF) contingent liabilities are estimated as an amount of all covered deposits in the whole banking system in Bulgaria.

BDIF has also considered the possibility of contingent liabilities to be assessed as covered deposits in banks which are non-systemic credit institutions / are not foreseen for resolution measures. In order to be highly conservative and taking into account that BDIF participates in resolution measures up to a certain limit of covered deposits, BDIF use all covered deposits in the whole banking system as basis for their estimate.

7.5 Greece - implicit expert judgement

The estimation of The Greek Deposit and Investment Guarantee Fund's (TEKE) contingent liabilities is essential in determining the optimal level of available financial means. TEKE uses the following implicit approach, based on expert judgement, to estimate contingent liabilities. The approach focuses on banks' business model and geographical contagion risk. In this estimation, two parameters are essentially taken into account:

The DGS available funds are primarily intended for non-systemic credit institutions. Although the DGS might be called upon to contribute to the cost of resolution of systemic credit institutions, the DGS participation cannot be safely estimated.

The credit institutions' business model and geographical location significantly affect contagion risk. It is expected that problems in credit institutions with strong ties with local communities, e.g., cooperative banks, will have increased risk of contagion to other credit institutions with similar business models.

On the basis of the above, TEKE's contingent liabilities are estimated with the assumption that default risk will spread to all non-systemic credit institutions with similar business models in a given geographical location. The DGS's jurisdiction is divided in appropriate geographical clusters and all credit institutions within that cluster that share similarities in their business model are treated as defaulting together.

²² At det time of reporting, the French DGS had 341 members in total.

As a result, DGS contingent liabilities are estimated in a way that the DGS will be able to cover the cost of pay-outs in all such institutions in the same geographical cluster simultaneously.

8 Descriptive analysis of the survey results

8.1 About the survey and its limitations

Leading up to this paper, an initial survey was sent out to all EFDI members. The goal of the survey was to map the use of contingent liability assessments and the interest for an EFDI paper, brief or technical note on the topic. Most of the 19 respondents saw merit in an EFDI publication examining this topic further. Based on the result of the initial survey, a working group was formed to address the topic.

The research group decided to conduct another more comprehensive survey with more focus on methodology and DGS attributes, to examine if there are differences between the DGSs that do and do not assess their contingent liabilities. The survey has a somewhat low number of respondents, especially the population that does not assess their liability. Caution needs to be used when interpreting the results, as they may not be representative due to the limited dataset. Of the 67 recipients of the survey we received 13 respondents. The dataset has been deemed insufficient to make any meaningful and significant regression analysis of the results. Given the dataset at hand, this study is limited to a descriptive statistical analysis of the results. Emphasis is made to the population that assesses their contingent liability in some form, with focus on how this is done across jurisdictions.

The questions in the survey were divided into different categories covering

- 1) General questions regarding DGS attributes
- 2) Methodology questions
- 3) Input data
- 4) Utilization of the results of the assessments

The main goal is to gain a better understanding of how DGSs assess their contingent liabilities, map the DGS properties and gain some insight into challenges when developing and implementing the methodology. The full survey can be found in the Appendix 12.1.

8.2 General questions regarding DGS attributes

We do not find any clear relationships between DGS' attributes that explain whether they assess their contingent liability or not. As table 1 below shows, the average coverage ratio is the same in both sub-populations as the total population. The exposure concentration in the banking market, measured by the market share of covered deposits in the 10 largest banks, is also quite similar in all three populations. The data indicates that there might be some relationship where DGSs with higher number of member banks, full time employees and exposure in terms

of covered deposits tend to assess their liabilities. Again, caution needs to be taken when interpreting the limited dataset. For example, the second largest DGS in terms of exposure does not assess their contingent liabilities. The same DGS is also ranked third when it comes to the number of member banks.

Of the three respondents answering that they do not assess their liability, two state that they plan to do so in the future. One within 1-2 years, and the second has yet to determine a timeline.

DGS attributes	DGSs assess liabilities	DGSs that do not assess their liabilities	Total population
Respondents	10	3	13
Respondents (%)	77 %	23 %	100 %
DGS average coverage ratio	1,43 %	1,43 %	1,43 %
Average number of member banks	124	83	112
Average number of full-time employees	37	6	28
Average exposure in terms of covered deposits (billion Euro)	265	142	227
Market share of the 10 largest member banks in terms of covered deposits	89,43 %	88,27 %	89,04 %

Table 1: DGS attributes divided between DGSs that do and do not assess their liabilities, and the total population of respondents.

In the remaining sections of this chapter, the population will be the 10 respondents that have answered that they assess their contingent liabilities and will focus on their methodology, input data and utilization of the results.

8.3 Methodology for assessing contingent liabilities

Half of the DGSs report that they assess their contingent liability covering all covered deposits while the other half only cover a portion. The most common frequency for liability assessments is yearly (60 percent) followed by quarterly (30 percent). One DGS reports that assessments are done ad-hoc.

When asked to describe their methodology, half of the DGSs describe it as an “*opinion oriented approach*”, while the other half describe it as a “*mathematical/statistical method*”, or a combination of both. Four of the five DGSs that use a mathematical/statistical method also takes an opinion oriented approach into account, i.e. a combination of the two. This implies that even though there are mathematical and statistical methodologies employed, these are subject to expert opinions and adjustments.

All the five DGSs using a mathematical/statistical method calculate expected losses. Only one of them also makes an estimate of the unexpected losses. Two DGSs estimate the probability of default (PD) on a bank level as part of their assessment, whereas one of them only for a portion of the banks. The methodology

of this DGS is based on credit ratings in a financial market where only a few of the member banks receive an external rating. Two of the DGSs also take into account the contagion risk between banks. The most common time horizon to make the contingent liability assessment is one year (50 percent), followed by 1-3 years (20 percent). One DGS makes the assessment for over 5 years ahead in time, and two answered "Not applicable". 40 percent of the respondents highlights "access to relevant quality data" as the main challenge when developing and/or implementing their methodology. 20 percent also highlights "internal resources (e.g. time, available resources, budget, prioritization)".

8.4 Input data

70 percent of the DGSs collect input data directly from member banks. The Central Bank is the most common source of data, where 70 percent of the DGSs respond that they receive data from their respective central banks, followed by the FSA (30 percent). 20 Percent report that they do not collect data from other institutions or public authorities. 40 percent use commercial market providers of data. When asked whether the methodology was based on historical or forward-looking data, 40 percent answered historical data only and 40 percent is based on both forward and historical data. Three of the four DGSs using forward looking data use macro-economic conditions/predictions in their estimates.

8.5 Utilization of the liability assessment

The utilization of the results is widespread, ref table 2 below. The most common use is to assess the funding and/or target level, followed by input to the investment strategy. It could be seen as somewhat surprising that 60 percent of the respondents report that they use the results as input for their investment strategy, given the restriction on making deposits available within seven working days according to DGSD Article 8 (1). One could argue that this constraint limits DGSs' room of opportunity to invest their funds in other than high quality liquid assets (HQLA). However, the same article further states a transitional period until 31 December 2023:

- (a) 20 working days until 31 December 2018;
- (b) 15 working days from January 2019 until 31 December 2020;
- (c) 10 working days from 1 January 2021 until 31 December 2023.

As the survey was conducted while DGSs were still in the transitional period, it will be interesting to follow if investment strategy continues to be one of the seemingly main purposes for contingent liability assessments beyond the transition period. To continue to use the output for investment decisions will require highly accurate and reliable methodology under the seven working days regime starting in 2024.

Purpose / Utilization of results	Number of observations	Percentage of respondents assessing their liability
Target level / funding assessment	7	70 %
Investment strategy	6	60 %
Contribution calculation ²³	3	30 %
Accounting purposes/requirements	3	30 %
Indicator of operational readiness	2	20 %
Early warning	2	20 %

Table 2: Utilization of the results from contingent liability assessments. The total population is the DGSs responding that they regularly assess their contingent liability.

80 percent of the respondents state that the results from their liability assessments may trigger internal responses.

8.6 EFDI member approaches and academic literature

The five methodology descriptions in section 7 can be categorized into statistical simulation models (Norway and Poland) and implicit expert judgement models (Bulgaria, France and Greece). Even though the description is not included in this paper, research and publications indicate that the Italian DGS has utilized simulation models to assess their contingent liability, De Lisa et al. (2010).

The challenges to use simulation models could be in deriving accurate probabilities of bank failures. As noted, Kuritzkes et al. (2002, 2005) used S&P ratings to derive the PDs on US banks. This approach will require that a majority of the guaranteed deposits within a jurisdiction are concentrated in rated banks. The lack of rated banks and therefore applicable data could be a restriction in many jurisdictions. The same issue can be said to apply to the use of regression analysis to estimate potential liabilities; it will require a historical dataset with a sufficient number of bank failures to yield statistically significant results. Hence, the lack of representative data could also be the explanation to why we do not observe extensive use of regression models.

None of the described methodologies in section 7, or respondents in the survey, use information in option prices of banks as an approach to estimating their liabilities, ref. section 5 Literature Review. The lack of publicly listed banks and therefore no efficient market for corresponding options in some jurisdictions could be a part of the explanation.

Of all the respondents from the survey, only two DGSs takes contagion risk into account when assessing their contingent liabilities. Contagion risk could be estimated through stress testing, assets or returns' correlation or interbank exposures – all data that should be available to DGSs. Such estimates would omit other factors that may prove more difficult to quantify, such as signal effects implying broader systemic distress, loss of confidence in the banking sector or payment system disruptions. As one of the main purposes of DGSs is to contribute

²³ Hereunder calibration and validation of contribution models

to financial stability and limit contagion of financial distress, and the fact that contagion effects can significantly affect the DGSs' liquidity outflow and losses, it is somewhat surprising that not more DGSs consider this in their estimates.

As contagion risk could be difficult to accurately quantify and measure, due to its inherent complexity, a desire to keep models understandable and transparent could be an explanation for the seemingly lack of its inclusion. Furthermore, the assumptions made in modelling contagion risk could significantly influence the final estimated contingent liability, introducing more uncertainty to the overall model. As the financial system and its vulnerability to contagion are constantly evolving due to changes in regulation, market practices, and innovation, models based on historical data may not fully capture future risks, requiring continuous updates and adjustments.

While including contagion risk in the estimation of contingent liabilities for DGSs can enhance the understanding and management of systemic risks, it also introduces significant challenges related to measurement, data quality, and model complexity. Balancing the benefits of a more comprehensive risk assessment against the costs and uncertainties involved is crucial for effective policymaking in this area.

In summary, we find a gap between academic research on the field and EFDI member practices for most members, without exploring the potential causes further. The reasons could be as general as the challenges and complexity involved in translating theoretical academic models into practical applications and the access to relevant quality data. However, De Lisa et al. (2010) demonstrates an approach based on publicly available data on regulatory capital for Italian banks, and later also expanded their model use to three other European countries, ref section 5. However, replication and implementation of academic models still requires expertise in mathematics and statistical methods to understand, develop and maintain. Due to the different mandates, setup and resources available to DGSs across jurisdictions, some may lack the resources and/or technical staff needed to apply academic models effectively. For DGSs with limited mandate and resources, the estimation of contingent liabilities may merely be a response to regulatory framework, rather than adaptation of sophisticated risk assessment models. The prioritization of simplicity and transparency over sophistication and potential precision can also be a valid argument, irrespective of a DGSs available resources.

9 Conclusion

Numerous academic research has been conducted on target fund estimation using various models and simulations. Deposit insurers can determine the target deposit insurance fund using multiple methodologies and rely on several sources of information. As far as the latter is concerned forward -looking data appears superior given the pace of change in the economic environment the over the past years. DGSs that use backward -looking data might make policy errors that have to be corrected afterwards. However, this does not imply that even forward -looking data should not be treated with caution. In an environment of strong

volatility, when market sentiments are not neutral, significant challenges for policymaking emerge.

Given certain limitations, a combination of statistical and expert-judgment methodologies may give an apt path forward, with the balance between the two, defined by the unique characteristics of the respective banking sector.

Last but not least, the assessment of DGS' contingent liabilities could be undertaken in the context of banks stress tests. European banking supervision employs stress tests to assess banks' ability to withstand financial shocks with the respective results used to assist supervisors in identifying vulnerabilities and addressing them early in their supervisory process. The several types of stress tests conducted by the ECB as well as national supervisors included, but not limited to (a) EU-wide stress tests coordinated by the European Banking Authority (EBA) as part of the Supervisory Review and Evaluation Process (SREP); (b) Thematic stress tests; (c) Forward-looking vulnerability analyses; (d) Stress tests for macroprudential purposes. The respective results could provide important input for assessing the DGSs contingent liabilities especially in the context of expert judgement assessment and forward-looking perspective.

10 Suggestion for further research

As the dataset (number of respondents) in this study was rather limited, we suggest increasing the target response group. As we are aware that liability assessments are conducted in countries such as Canada, the US and Korea, it could prove fruitful with a similar study on global level.

In-depth studies of the methodologies applied and comparison to relevant literature on the field would also be interesting to explore. We suggest further identifying differences in practice and theory. To close the gap between academic research and practical DGS application, collaboration between academia, DGSs and regulatory bodies could provide fruitful. Such collaboration could facilitate the development of more practical and scalable models, improve data and experience sharing and align regulatory risk assessment capabilities across jurisdictions. Additionally, collaboration across DGSs through education and training of DGS staff on the latest developments in risk assessment methodologies can help bring academic insights into practice.

In-depth studies could also shed light on best practices and may even give indications on what types of methodology is best suited for different purposes and for different banking structures and available data. Our survey shows that the utilization of results of liability assessments is widespread, covering a variety of topics. It is not unlikely that different methodologies are better suited for different areas of application. Finally, the input of banks stress test results in assessing the DGSs contingent liabilities could be a field of future research.

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12 Appendix

12.1 Survey questions

All questions listing "Other" as an alternative, included a free text box to specify the answer.

EFDI Liability Calculations Survey

1. In which country are you responsible for administrating the deposit guarantee?
2. What is the deposit guarantee scheme fund's cover ration as per 31.12.22?
3. How many banks are member of your DGS?
4. How many full time employees does your DGS have?
5. What is your DGS' exposure in terms of covered deposits (in billion Euros)
6. What is the market share of the largest 10 banks in terms of covered deposits?
7. Does your DGS assess its potential liability covering all covered deposits?
 - Not applicable
 - Yes
 - No
 - Only a portion of the covered deposits
 - Other
8. If your DGS does not calculate potential liabilities, do you plan to do so in the future?
 - Not applicable
 - No
 - Yes, within the next year
 - Yes, within the next 2 years
 - Yes, with in next > 2 years
 - Other
9. Does your DGS assess its potential liability regularly or ad-hoc?
 - Not applicable
 - Regular
 - Ad-hoc
 - Other
10. How often does your DGS assess its potential liability?
 - Not applicable
 - Monthly
 - Quarterly
 - Yearly
 - Ad-hoc
 - Other

11. Do you use an opinion oriented approach (expert judgement) or a quantitative method or a combination of both?

- Not applicable
- Opinion oriented approach
- Quantitative method
- Combination
- Other

12. Which methodology do you use to calculate potential liabilities?

- Not applicable
- Similar methodology and indicators as the contribution calculation
- Other methodology and indicators than the contribution calculations
- Expert opinion (judgement) / stress testing
- Mathematical/statistical method
- Other

13. If you use an opinion oriented approach, do you take into account (you may select multiple answers)

- Historical data on bank failure and corresponding losses
- Covered deposits of small banks
- Covered deposits of medium sized banks
- Covered deposits of all banks, except the systemic banks
- Market conditions (favourable/unfavourable)
- Scenario analysis
- Not applicable
- Other

14. If you use a quantitative method, do you calculate expected losses and/or unexpected losses?

- Not applicable
- Expected losses
- Unexpected losses
- Both
- Other

15. In case you estimate the expected losses, do you calculate the probability of default (PD) on a bank level?

- Not applicable
- Yes
- No
- Other

16. In case you calculate the PD on bank level, what methodology do you use? (you may select multiple answers)

- Not applicable
- Credit rating
- Econometric model
- Market analysis
- Other

17. Does your methodology capture contagion risk between member bank failures?

- Not applicable

Yes
No

18. If yes to question 17, which methodology is used to capture contagion risk?

Not applicable
Correlation between PD of banks
Correlation of banks returns on the share price development
Correlation in accounting data
Other

19. For what time horizon do you estimate your potential liability?

Not applicable
> 1 year
1 year
1-3 years
> 5 years
Other

20. How often is the methodology validated and/or revised?

Not applicable
More often than yearly
Yearly
Every 2 years
> 2 years
Other

21. Which main challenges did you face when developing and/or implementing your methodology? (You may select multiple answers)

Not applicable
Access to relevant quality data
Internal resources (e.g. time, available resources, budget, prioritization)
Motivation / value of results or output
Other

22. Has your institution ever included expected liquidity outflow or losses in its budget plan and/or financial reporting?

Not applicable
Yes
No

23. Has your institution ever assumed expected liquidity outflow or losses in its plans to reach the Target Level?

Not applicable
Yes
No

24. Do you collect input data directly from member banks?

Not applicable
Yes
No

25. Do you collect data from other institutions or public authorities to assess your potential liability? (You may select multiple answers)

- Not applicable
- No
- FSA
- Ministry of Finance
- Central Bank
- National Statistics Institute
- Other

26. Do you use commercial market providers of data as input in your calculation of your potential liability?

- Not applicable
- Yes
- No

27. Is your methodology mainly based on:

- Not applicable
- Historical data
- Forward looking data
- Both
- Other

28. If the methodology is based on forward looking data, which factors are used? (You may select multiple answers)

- Not applicable
- Macroeconomic conditions/predictions
- Financial conditions/predictions
- Institution specific data
- Market data
- Other

29. How is the input data quality assessed? (you may select multiple answers)

- Not applicable
- No quality controls
- Plausibility controls with reference data
- Statistical controls, e.g. identification of outliers etc.
- Back testing
- Sample testing
- Other

30. What are the results from your liability estimates used for? (You may select multiple answers)

- Not applicable
- Investment strategy
- Contribution calculation (hereunder calibration and validation of contribution models)
- Target level / funding assessment
- Early warning
- Indicator of operational readiness
- Accounting purposes/requirements
- Other

31. Do the results of your liability calculations trigger policy responses? (You may select multiple answers)

Not applicable

DGS internal

Institutional (law)

None

Other