Economic Research-Ekonomska Istraživanja

ISSN: 1331-677X (Print) 1848-9664 (Online) Journal homepage: http://www.tandfonline.com/loi/rero20

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To cite this article: Ausrine Lakstutiene, Aida Barkauskaite & Justyna Witkowska (2018) The importance of systemic risk assessment in a risk-based common European Union deposit insurance system: case of Lithuania, Economic Research-Ekonomska Istraživanja, 31:1, 73-86, DOI: 10.1080/1331677X.2017.1421997

To link to this article: https://doi.org/10.1080/1331677X.2017.1421997

Published online: 18 Jan 2018.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA, 2018
VOL. 31, NO. 1, 73–86
https://doi.org/10.1080/1331677X.2017.1421997

The importance of systemic risk assessment in a risk-based common European Union deposit insurance system: case of Lithuania

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ABSTRACT
The financial crisis has shown that the deposit insurance system did not help to maintain depositors' confidence and financial stability for the whole banking sector. In order to ensure equal protection to depositors in all European Union countries, the European Commission presented the common European Union risk-based deposit insurance system model in 2015. In this model, the individual risk of each bank should be measured. However, there are discussions in scientific literature that the amount of systemic risk of the banks should be measured. In the current economy it is very important to measure the arising amount of systemic risk in the banking sector, but even the new E.U. common deposit insurance system model of 2015 does not take systemic risk assessment into account. The aim of the research is to evaluate the risk-based common European deposit insurance system impact on deposit insurance premiums to Lithuanian banks: not only individual banks' risks, but the systemic risk as well. The most appropriate systemic risk assessment method was selected according to different scientific researchers and strong Lithuanian banking sector concentration. The results showed that inclusion of the systemic risk assessment in risk-based deposit insurance system helps to have more accurate bank risk assessment.

ARTICLE HISTORY
Received 2 December 2016
Accepted 16 August 2017

KEYWORDS
Deposit insurance; risk-based; systemic risk

JEL CLASSIFICATIONS
G21; G31; G32

1. Introduction

The global financial crisis of 2008 revealed the instability of the banking system and caused a negative impact on the entire financial system. The main problems associated with banks are too high amounts of assumed risks and too low deposit insurance. Basic functions and objectives of deposit insurance systems are to protect consumers and to increase the stability of financial markets (Gerhardt & Lannoo, 2011). The efficiency of a deposit insurance system depends on the macro-economic environment financial structure, prudential regulation, supervision of the legal and judicial systems as well as accounting disclosure systems. Even identically designed deposit insurance systems can have very different effects on financial

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stability and depositors' protection due to environmental differences in which it operates. In most Member States of the European Union and countries of European Economic Area deposit insurance rates are the same, but, during the banking crisis, countries often issue guarantees which exceed the pre-announced limits (Cannas, Cariboni, Veisari, & Pagano, 2014). The European Union tried to create a common deposit insurance system based on banks' risk assessment in the European Union countries several times. In order to equalise the deposit insurance systems since 2008 , the European Commission has started to present a common deposit insurance scheme, which could be applicable in all European Union countries. Since 2008, the European Commission has presented three different deposit insurance schemes, with the latest one being introduced only in the middle of 2015.

Scientific research (Andries & Billon, 2010; Angkinand & Wihlborg, 2010; Bijlsma & Van Der Wiel, 2015; Forssbæck, 2011; Gómez-Fernández-Aguado, Partal-Ureña, & Trujillo-Ponce, 2014; Imai & Takarabe, 2011; Lin, 2015; Prean & Stix, 2011) emphasised that the deposit insurance system not only contributes to the protection of depositors, but also affects their own bank decisions and the entire banking system, which is especially important in the case of the common European Union financial system. The common risk-based E.U. deposit insurance system would help to unify the differences of the deposit insurance system in all E.U. countries, it will contribute to the moral hazard risk decrease, banks' assumed risks limitation and growth of all financial system stability. The importance and necessity of the common risk-based E.U. deposit insurance system have become a definite aspect in the recent period. However, there are no final decisions and approvals which banks' risks should be assessed in the calculation of deposit insurance premiums yet. Scientific studies (Acharya, Engle, & Richardson, 2011; Brownlees & Engle, 2011; Huang, Zhou, & Zhu, 2011; Londono & Tian, 2014; Oordt & Zhou, 2015; Varotto & Zhao, 2014) highlight that, in many countries, existing systems do not evaluate bank risks when calculating deposit insurance premiums and do not provide sufficient stability of the banking system and also do not assess the amount of systemic risk. Banks can no longer focus on individual bank risks only, because the amount of systemic risk, integration among banks and the interconnectedness are increasing. A deposit insurance system not only affects depositors but also the bank and its level of risk taking, because the additional risks from the financial system contribute to the growth of individual bank risk. In the scientific literature various studies with risk-based deposit insurance systems can be found, which show that assessment of systemic risk is inevitable in order to create a more effective deposit insurance scheme. Researchers (Acharya, Santos, & Yorulmazer, 2010; Anginer, Demirguc-Kunt, & Zhu, 2014) emphasise that systemic risk has an impact on the stability of the entire banking system. Increasing interconnectedness among banks and growing integration contribute to faster systemic risk growth in banks. Various scientific studies (Gómez-Fernández-Aguado et al., 2014; Lee, Lin, & Tsai, 2015; Staum, 2012) confirmed that systemic risk assessment should be included in the deposit insurance system, in order to increase stability of the entire financial system. Therefore, creation of a common risk-based deposit insurance system in an aspect of the European Union countries is particularly important, not only as a scientific, but also as a practical problem. Therefore, the aim of this research is to evaluate the impact of the risk-based common European Union deposit insurance system on deposit insurance premiums to Lithuanian banks, including the assessment of systemic risk.

2. Aggregate risk weight and systemic risk methods

In 2015, according to the newly adopted Directive of the European Parliament on the new deposit guarantee system, the European Banking Authority (E.B.A.) provided guidance on the calculation methodologies (European Parliament & Council Directive, 2014) of the new deposit guarantee scheme premiums. E.B.A. is an independent institution, with the objective to ensure an effective and consistent level of prudential regulation and supervision across the European banking sector. The main task of the E.B.A. institution is to maintain financial stability in the E.U. and ensure the banking sector integrity, efficiency and fluent functioning (EBA guidelines, 2015).

According to a new resolution, contributions to the deposit guarantee system will be based on the amount of insured deposits and the risk level assumed by each bank. It is argued that such a contributions calculation reduces the appearance of moral hazard risk in banking activities. According to the deposit guarantee scheme, Member States may provide lower contributions in lower-risk sectors which are governed by national law (European Parliament & Council Directive, 2014).

By the guidelines of the European Banking Authority, annual contributions to the Deposit Guarantee Scheme (D.G.S.) may be calculated according to the following formula (EBA guidelines, 2015):

$$Ci = CR \times ARWi \times CDi \times \mu \tag{1}$$

where Ci = Annual contribution from member institution; CR = Contribution rate (identical for all member institutions in a analysed year); ARWi = Aggregate risk weight for member institution; CDi = Covered deposits for member institution; and μ = Adjustment coefficient (identical for all institutions in an analysed year).

Aggregate risk weight (A.R.W.) calculation of each participating institution should be assessed individually and based on the assessment of various risk indicators from each risk category (see Table 1). Each additional indicator weight or the main risk indicator weight could be enlarged to 15%, with the exception of additional qualitative indicators related to the results of a comprehensive assessment of a Member State risk profile and management.

Table 1. Main risk indicators assessment of the 1 risk group, 2 risk group and 3 risk group.

Risk indicators groups	Indicator	1 risk group	2 risk group	3 risk group
Capital indicators individual risk weight groups	Leverage ratio (L.E.V.)	> 0.11	≤ 0.11 < 0.09	≤ 0.09
	Common equity tier 1 ratio (C.E.T.)	> 0.17	≤ 0.17 < 0.12	≤ 0.12
	I.R.S.	0	50	100
Liquidity indicator individual risk weight groups	Liquidity ratio	> 0.45	≤ 0.45 < 0.39	≤ 0.39
	I.R.S.	0	50	100
Non-performing loans ratio indicator individual risk weight groups	Non-performing loans ratio	> 0.04	≤ 0.04 < 0.01	≤ 0.01
	I.R.S.	100	50	0
Business model and management indicators individual risk weight groups	Risk-weighted assets/Total assets ratio (R.W.A.)	> 0.75	≤ 0.75 < 0.60	≤ 0.60
	Return on assets (R.O.A.)	< 0.28 or ≥ 1.85	≤ 0.28 < 0.75	≤ 0.75
	I.R.S.	100	50	0
Potential losses for the DGS indicator individual risk weight groups	Unencumbered assets/covered deposits	> 1.45	≤ 1.45 < 1.3	≤ 1.3
	I.R.S.	0	50	100

Source: Own elaboration, based on E.B.A. guidelines (2015).

Also, if a deposit insurance system is using only the main risk indicators, the minimum weights, which are specified in the risk category, shall be maintained by moving the weights to other indicators in the same risk group. However, in the 2014 European Parliament Directive on the new deposit guarantee system and the E.B.A. guidance of payments calculation, Member States may decide that credit institutions should pay a minimum contribution, irrespective of the amount of covered deposits (European Parliament & Council Directive, 2014; EBA guidelines, 2015). If a Member State decides to take the opportunity to pay minimum contributions (M.C.), regardless of the amount of covered deposits, then, in order to calculate individual contributions, the calculation formula should be adjusted. In cases where the minimum contributions are paid by every Member State institution, in addition to the risk-based contributions, the calculation would be as follows:

$$C_i = MC + (CR \times ARWi \times CDi \times \mu) \tag{2}$$

where MC = the minimum size of contributions.

Minimum deposit insurance premiums could be paid only to those Member States where an annual risk-based assessment contribution, calculated in accordance with the standard formula, would be less than a minimum contribution:

$$C_i = Max\,\{MC\,;(CR \times ARWi \times CDi \times \mu)\} \tag{3}$$

It should be emphasised that, in setting a minimum contribution, competent authorities and designated authorities should take care, due to the moral hazard risk inherent in setting fixed contributions and the risk of creating barriers to entering the market for banking services.

It should be emphasised that this deposit guarantee system calculation model is only one possible means. Each Member State may develop and submit its own-created premium calculation model for approval. Deposit guarantee schemes may use its risk-based models, which would be used for risk-based deposit insurance premiums contribution calculation. Contributions should be proportionally calculated according to each member's risk, properly assessing the various business models risk profiles. This once again proves that common E.U. deposit insurance system development began from creation of one simplest indicator model, later continued to several risk indicators and finally to the foundation of risk-based deposit insurance premiums calculation.

In 2015, risk assessment included one more additional risk indicator and replaced some of the risk indicators, these changes contributed to creation of an aggregate risk weight deposit insurance model, which provided flexibility to deal with systemic risk assessment in calculating deposit insurance premiums. Although the latest E.U. deposit insurance premium calculation model assesses the assumed risks by banks more accurately and includes a variety of risk indicators assessments, it still does not take into account one of the most important risks – an assessment of systemic risk amount in banks.

Scientific studies (Acharya et al., 2011; Brownlees & Engle, 2011; Gómez-Fernández-Aguado et al., 2014; Huang et al., 2011; Lee et al., 2015; Londono & Tian, 2014; Oordt & Zhou, 2015; Staum, 2012; Varotto & Zhao, 2014) have confirmed that assessment of systemic risk is indispensable in the modern financial system. Even in 2009, Bernet and Walter examined deposit insurance schemes of all 27 E.U. countries, in order to create a modern common deposit insurance system for the entire E.U. The research showed that the deposit insurance system should assess four different risk classes, where each class corresponds to a specific contribution factor and the calculated contribution must be multiplied by the systemic risk premium factor (Bernet & Walter, 2009). According to Acharya et al. (2010), the most effective deposit insurance model would be the one including the assessment of systemic risk, which would justify the need for a risk-based deposit insurance system. Researchers' studies showed that one of the main determinants of a bank systemic risk is the relationship between bank returns and the size of a bank and other banks' interconnectedness, so these factors should be clearly and continuously evaluated, calculating deposit insurance premiums (Acharya et al., 2010). Staum's (2012) studies showed that participants of a deposit insurance system should be encouraged to reduce their systemic risk components. He also established a number of deposit insurance schemes that may be appropriate to establish deposit insurance premiums which would determine the amount of banks assumed systemic risk. Anginer et al. (2014), examining deposit insurance system impact on banks risk and systemic stability in critical and the pre-crisis periods, also calculated and emphasised the importance of systemic risk assessment. According to Lee et al. (2015), deposit insurance tends to be under-estimated in the view of a systemic risk. The researchers found that a deposit insurance model with assessment of a systemic risk can mitigate distortions in the financial system (Lee et al., 2015). Gómez-Fernández-Aguado et al. (2014) argue that risk measurement, according to the deposit insurance system funding, would favourably regulate market discipline in the E.U. and also would help to better manage credit institutions and finally would contribute to banking system stability growth.

However, according to the European directives, the evaluation and analysis of potential systemic risk sources which could lead to systemic risk growth of credit institutions and could cause negative changes in all systems is not provided. Therefore, according to the authors, the E.U. institutions should consider possible changes and include the assessment of systemic risk to the deposit insurance schemes (Gómez-Fernández-Aguado et al., 2014). However, many systemic risk assessment methods are based on the data of financial markets and their results and reliability are highly dependent on the financial markets participants' awareness and ability to assess financial risks. It is noted that the methods which rely on borrowing between banks assessment (Huang et al., 2011) are not available to adapt, since this information is not presented in the financial statements of banks and the information is only available in the internal environment of banks. Therefore, researchers (Huang et al., 2011) offer a systemic risk indicator, which evaluates two main insolvency factors: individual bank default risk and return on asset between banks strength. It must be emphasised that the systemic risk level often depends on the size of a bank. Laeven, Ratnovski, and Tong (2014) argue that the biggest banks are more risky; they create more systemic risk because they usually have less capital and less stable funding; in addition, it was found that large banks create more systemic risk, but, when they are considered separately, they are not more risky. Therefore, the traditional banking regulation, which mainly evaluates individual bank risks only, may not be sufficient for large banks and Laeven et al. (2014) state that further regulation should be made and suggest using the S.R.I.S.K. indicator for systemic risk. Brownlees and Engle's (2011) method involves creation of a simulation environment, which helps to determine when the whole system faces the problem of capital shortfalls. Brownlees and Engle (2011), calculating the S.R.I.S.K. indicator, also evaluate a systemic risk indicator which shows capital size, which a bank would need in case of the start of a financial crisis. Acharya et al. (2011) said that systemic risk must be assessed as a separate bank systemic expected capital shortage size (lack of capital), when the whole system is faced with the problem of capital deficit. Varotto and Zhao (2014) evaluated the joint systemic risk indicator, which indicates when the bank is unable to meet its obligations and when the assets of the bank are less than the bank's debt in the future period. Varotto and Zhao's (2014) systemic risk assessment method is very similar to the Brownlees and Engle (2011) method, which carries out a Monte Carlo simulation and also evaluates when the bank asset is less than the bank debt in the future period. Acharya et al.'s (2011) method is also based on the Brownlees and Engle (2011) method mainly and only corrects its assumptions and evaluation of crisis. Londono and Tian's (2014) systemic risk assessment method, in order to investigate the relationship between downside correlation risk premium (D.C.P.R.) rate and economic disasters, used the Brownlees and Engle (2011) vector auto regression model (V.a.R.). Londono and Tian (2014) proposed to measure systemic risk as a negative correlation between the risk premium (D.C.P.R.), when index variance is expressed as the average variance, and its components' function and combined evaluating pair-wise correlations.

Oordt and Zhou's (2015) method is one of the latest systemic risk assessment methods, which is based on stock price returns and market capitalizations analysis. This method is applicable to all banks, where shares are publicly traded on the stock exchange market. Oordt and Zhou's (2015) systemic risk assessment method is based on market analysis and researchers offers to measure systemic risk as a bank stock price sensitivity of return to very large adverse shocks in the financial system. It is interesting to note that the Brownlees and Engle (2011) systemic risk assessment method is one of the most widely used systemic risk assessment methods and most authors base their studies on adjusting this method for calculating systemic risk, but the Oordt and Zhou (2015) method is very suitable when the market is concentrated and is dominated by a small number of banks.

In scientific literature various studies with risk-based deposit insurance systems can be found which showed that systemic risk assessment is inevitable for effective deposit insurance system creation. Systemic risk is particularly important in the current financial system, where banks' inter-dependences are very strong. Scientists point out that it is important to determine whether systemic risk must be assessed in the whole banking sector or in an individual bank level, but, since the deposit insurance premium is calculated and determined for each bank individually, systemic risk assessment must also be carried out in the case of each bank.

3. Data and methodology

The research included all six operating banks in Lithuania: J.S.C. 'SEB bank', J.S.C. 'Swedbank', J.S.C. 'DNB bank', J.S.C. 'Siaulių bank', J.S.C. 'Citadele bank' and P.L.L.C. 'Medicinos bank'. To calculate all the risks' indicators, the data is collected from banks' balance sheets, profit (loss) statements and explanatory notes (JSC "Citadele bank", 2016; JSC "DNB bank", 2016; JSC "SEB bank", 2016; JSC "Siauliu bank", 2016; JSC "Swedbank", 2016; PLLC "Medicinos bank", 2016). The risk indicators assessment covers the period from 2010 to 2014. In order to obtain more accurate assessment of systemic risk, the systemic risk analysing period is 2008–2014, which covers the period of the financial crisis.

Deposit insurance premiums calculation is based on a basic guidelines formula (see equation 1), according to which annual contributions to the deposit insurance system are calculated separately for each bank. Calculating each bank's aggregate risk weight coefficient, first of all, each bank risk indicator's individual risk score is determined, which is based on various risk indicators' calculation from five risk categories defined by E.B.A. (see Table 1). When determining aggregate risk weight, a systemic risk indicator is also involved.

In order to determine aggregate risk weight, each bank risk indicator is assigned to an appropriate individual risk score (I.R.S.). Individual risk scores groups are determined by using a bucketing method. By this method, each risk indicator is set to a risk group, with upper and lower boundaries of each group. Boundaries of groups reflect the riskiness of a particular indicator and, in this case, banks can get to the same group, when they have a similar level of a particular indicator's riskiness. Determining the boundaries of groups, it is important to ensure an adequate and meaningful differentiation between member institutions. IRS scores must be from 0 to 100, depending on a relevant indicator risk, where the value 0 represents the lowest risk and the value of 100 indicates the highest risk.

During a research each risk indicator is distinguished into three risk groups, an indicator's value shows in which group each of the indicators fall, as well as its individual risk score values. Indicators are divided into three risk groups by quintiles (minimum risk, medium risk and high risk), because the division into smaller risk groups would not be appropriate. The distribution of risk indicators by quintiles is carried out based on the E.B.A. guidelines (2015) instructions and previous European Commission research (European Commission, 2009). The first quintile is from 0–33, the second is from 34–66 and the third quintile is from 67–100.

Setting individual risk scores to each of the indicators, each I.R.S. value of an indicator should be multiplied by each indicator's individual risk weight. Received values are summed using the arithmetic mean and then the aggregate risk score value is determined. The same set of indicators' weights should be used by all member institutions. Each obtained overall risk score value is needed to be used for the calculation of aggregate risk weights. Aggregate risk weights groups can also be determined by using the bucketing method, where A.R.S. indicators intervals show a corresponding risk class and relevant aggregate risk weights value. The number of A.R.W. risk groups must be proportionate to a member institution number and their variety. However, the minimum possible number of risk groups is four. There must be at least one risk group, which shows the average bank's risk, at least one group showing low risk and at least two risk groups showing high risk institutions.

According to the E.B.A. guidelines (2015) instructions, there are individual risk indicators weights determined for main risk categories and each indicator. Based on E.B.A. instructions, each risk indicator has its minimum risk weights, while the remaining 25% are attributed to systemic risk, because many research studies have proved that this risk assessment and amount have a major impact on the stability of the whole financial system (see Table 2).

The most appropriate systemic risk assessment method was selected according to different scientific researchers and a strong Lithuanian banking sector concentration. A systemic risk is assessed using one of the newest Oordt and Zhou (2015) systemic risk assessment methods. The method is selected because of the possibility to more accurately assess a small number of analysed banks. This method has an advantage that, in order to avoid relatively large evaluation errors due to a small number of analysed banks, a new index for each bank is formed. This is one of the newest systemic risk assessment methods which uses stock returns and market capitalizations data.

In Oordt and Zhou's (2015) systemic risk assessment method, a systemic bank risk is calculated as the beta coefficient value according to equation (4):

Table 2. Minimum and applied risk categories and key risk indicators weights in model.

Risk categories and core risk indicators	Minimal weights	Applied weights in model
1. Capital	18%	18%
1.1. Leverage ratio	9%	9%
1.2. Common equity tier 1 ratio	9%	9%
2. Liquidity and funding	18%	18%
2.1. Liquidity ratio	18%	18%
3. Asset quality	13%	13%
3.1. Non-performing loans ratio	13%	13%
4. Business model and management	13%	13%
4.1. Risk-weighted assets/Total assets ratio	6.5%	6.5%
4.2. Return on assets (R.O.A.)	6.5%	6.5%
5. Potential losses for the D.G.S.	13%	13%
5.1. Unencumbered assets/covered deposits	13%	13%
6. Systemic risk assessment	—	25%
6.1. Systemic risk level in institution	—	25%
Sum	75%	100%

Source: Own elaboration, based on E.B.A. guidelines (2015).

$$\widehat{\beta}_i^T := \widehat{\tau}_i(k/n)^{1/\widehat{\varsigma}_{S-i}} \frac{\widehat{\mathrm{VAR}}_i(k/n)}{\widehat{\mathrm{VAR}}_{S^{-i}}(k/n)} \tag{4}$$

where: $\widehat{\varsigma}_{S-i}$ is the tail index and $\widehat{\mathrm{VAR}}_i(k/n)$ ir $\widehat{\mathrm{VAR}}_{S^{-i}}(k/n)$ are estimated by the (k+1)th worst return on the bank's stock and the Lithuanian banking index; $\widehat{\tau}_i(k/n)$, which is the non-parametric estimator of tail dependence between $R_{i,t}$ and $R_{S-i,t}$ established in multivariate E.V.T. (Extreme Value Theory).

Calculating banks' market capitalizations and using bank shares data in all cases, an actual number of shares for a particular day are used. In order to obtain the most accurate results for the systemic risk assessment, the data of 2008–2014 is used in calculations, because, in this method, share prices must have large fluctuations of returns. The largest fluctuations were recorded during crisis in the year 2008, so the analysed period was extended with the data of 2008–2009. In order to avoid relatively large errors in assessment, due to a small number of analysed banks, S^{-i} was calculated for each bank index from the Lithuanian banking system. Thus, S^{-i} returns are determined from equation (5):

$$R_{S^{-i},t} = \frac{\sum_{j \neq i} e_{j,t-1} R_{j,t}}{\sum_{j \neq i} e_{j,t-1}} \tag{5}$$

where: $R_{j,t}$ = market capitalization of bank j at the end of the previous trading day and $e_{j,t-1}$ = return of bank j on day t.

The systemic risk is measured by assessing the bank's sensitivity to large shocks in the Lithuanian banking system. In V.a.R. (Value at Risk) calculations a 10% percentile was used, which indicates the threshold at which bank's returns are considered as risky.

Setting risk indicators for each operating bank in Lithuania and setting them to appropriate individual risk scores, each bank's aggregate risk score was determined. A.R.W. target groups distribution is carried out based on the E.B.A. guidelines (2015) (see Table 3).

Table 3. Aggregate risk weight groups and their values.

Risk group/risk value	A.R.S. value	A.R.W. value
group 1/low	< 40	75%
group 2/medium	≤ 40 < 50	100%
group 3/high	≤ 50 < 60	125%
group 4/very high	≥ 60	150%

Source: Own elaboration, based on E.B.A. guidelines (2015).

The aggregate risk score (A.R.S.) was calculated based on each bank's risk indicators weights and assigned risk scores (I.R.S.) to each risk indicator. After calculating A.R.S. values, each bank was assigned a respective A.R.W. coefficient value.

After setting each bank's A.R.W. coefficients and knowing covered deposit amounts, annual deposit insurance premiums were calculated. Each bank's contribution to a common E.U. deposit insurance fund was calculated by the main formula (EBA guidelines, 2015).

In order to determine the impact of a risk-based common E.U. deposit insurance system with a systemic risk assessment, the calculated annual deposit insurance premiums were compared with the current Lithuanian deposit insurance system's premiums. By the current deposit insurance system in Lithuania, all commercial banks need to pay 0.45% from their covered deposit amount to the deposit insurance company. This percentage is the same for all of the operating banks in Lithuania, regardless of their assumed risk level. Comparing current deposit insurance premiums with risk-based premiums, relative change with risk-based deposit insurance contributions and current deposit insurance contributions in Lithuania were analysed.

4. Numerical analysis of deposit insurance premiums in Lithuanian banks

Analysing specific characteristics, which have an impact on systemic risk calculations, out of six banks operating in Lithuania, shares of four of them are publicly traded on stock exchanges, but the data for the remaining two banks is not available. 'Citadele bank's' shares are not publicly traded on any exchange market; 75% and one share of J.S.C. 'Citadele bank' is owned by an international group of investors, which is represented by 'Ripplewood advisers L.L.C.' and 12 solid reputation different investors and the remaining 25% without one share are controlled by European Bank for Reconstruction and Development ('Citadele Bank' Information, Citadele Bank Information, 2015). 'Medicinos bank's shares are not traded on any stock exchange market, because of its bank type. Therefore, the calculation of 'Citadele bank' and 'Medicinos Bank' systemic risk is not possible.

Studies of other authors (Laeven et al., 2014) show that small banks have lower systemic risk and their negative consequences do not seriously affect other market participants. Thus, according to the analysis and low covered deposits amounts, 'Medicinos bank' and 'Citadele bank' are attributed to low systemic risk groups (attributed the I.R.S. value 0).

First of all, in systemic risk assessment, Lithuanian Banks' index R_S was calculated, where k parameter value was determined by using a bootstrapping method. In further calculations, 1000 random k values are used to obtain k values averages, the values of which are provided in Table 4. The relatively very low k coefficients values received showed that Lithuanian banks do not have large stock return volatility and high risk. All banks' k coefficients values where from 0.1083 to 0.1264. As mentioned earlier, each bank's V.a.R. values and the whole

Table 4. Systemic risk assessment in Lithuanian banks.

	Swedbank, J.S.C.	SEB bank, J.S.C.	DNB bank, J.S.C.	Siaulių bank, J.S.C.
k	0.1087	0.1264	0.1083	0.1201
$\hat{\tau}_i(k/n)$	0.65462	0.64898	0.52483	0.18059
$\hat{\beta}_i^T$	0.025	0.030	0.002	0.000

Source: Own calculations.

system's V.a.R.$_S$ values were calculated using the 10% percentile. After setting V.a.R. and V.a.R.$_S$ values, each bank's $\hat{\tau}_i(k/n)$ parameter values were calculated (see Table 4). After all mentioned calculations and indicators determination, each bank systemic risk was calculated (beta coefficient). All the four Lithuanian banks systemic risk results are presented in Table 4. Each indicator and beta coefficient calculations were implemented using the M.A.T.L.A.B. programme and its functions.

The results showed that none of the four operating banks in Lithuania has a large systemic risk. Low beta coefficient values were mainly determined by low k coefficients, which were affected by a small amount of negative equity returns, because k coefficient changes have a significant affect to beta coefficients values. Even in 2008, when stock prices fell the most, there were only several significant negative equity return values. However, from the obtained beta coefficients, values of J.S.C. 'Swedbank' and J.S.C. 'SEB bank' can be distinguished from other banks. Although the systemic risk of the above-mentioned banks was not very high, assessing by average systemic risk value it was significantly higher than J.S.C. 'DNB bank' and J.S.C. 'Siauliu bank'. The results were partly determined by J.S.C. 'Swedbank' and J.S.C. 'SEB bank' market capitalizations, because these banks have the largest parts in the Lithuanian market. J.S.C. 'SEB bank' stock returns had greater volatility, which inferred that J.S.C. 'SEB bank' systemic risk was slightly higher than J.S.C. 'Swedbank'. According to the obtained results, J.S.C. 'Swedbank' and J.S.C. 'SEB bank' were attributed to medium systemic risk groups (respectively assigned I.R.S. value 50) and J.S.C. 'DNB bank' and J.S.C. 'Siauliu bank' were attributed to the lowest systemic risk groups (respectively assigned I.R.S. value 0).

Individual banks' risk indicators were calculated using banks financial reports' information and showed different risk indicators amounts of each bank analysed. Individual banks risk indicators only show the assumed risk of each bank (capital, liquidity and funding, etc.), but do not take into account the inter-connectedness of the banks and the systemic risk generated by them. Summarising the results of the research showed that all operating banks in Lithuania do not fall into the largest systemic risk groups, but J.S.C. 'Swedbank' and J.S.C. 'SEB bank' have a greater systemic risk than other operating banks in Lithuania and the above-mentioned banks were assigned to the medium systemic risk group. The systemic risk, assessing deposit insurance premium determination, not only includes systemic risk analysis, but also the main EBA submitted risk groups and its indicators evaluation (see Table 5).

Examination of the results shows that 'Citadele bank' can be considered as one of the least risky banks, because its aggregate risk weight values throughout the analysed period were one of the smallest. 'SEB bank' can also be attributed to the less risky banks. During all the analysed period, 'Medicinos bank' can be considered as the most risky, as its aggregate risk weight values through the analysed period were relatively the highest. 'Siauliu bank' was in a similar risk level, which had a lower risk in 2010 only. In the period 2013–2014, in comparison to 2012, the 'Siauliu bank' risk profile increased, which was mainly affected by

Table 5. Deposit insurance premiums determination when assessing systemic risk.

Year	J.S.C. Swedbank	J.S.C. SEB bank	J.S.C. DNB bank	J.S.C. Siauliu bank	J.S.C. Citadele bank	P.L.L.C. Medicinos bank
Aggregate risk score values						
2010	52	71.25	62	28.5	31	52.5
2011	52	46.75	31	49.75	38.75	44
2012	47.5	57	27.75	34.25	18.75	47.25
2013	63	49.25	31	53.75	25.25	53
2014	47.5	41.5	27.75	40.75	25.25	40.75
Aggregate risk weight values						
2010	1.25	1.5	1.5	0.75	0.75	1.25
2011	1.25	1	0.75	1	0.75	1
2012	1	1.25	0.75	0.75	0.75	1
2013	1.5	1	0.75	1.25	0.75	1.25
2014	1	1	0.75	1	0.75	1
Annual deposit insurance premiums size (LTL)						
2010	70,899	65,102	52,603	5,944	2,064	3,663
2011	73,734	54,715	19,211	8,960	2,361	2,722
2012	66,670	69,713	20,357	7,454	2,466	3,208
2013	100,830	59,606	21,648	25,940	2,316	3,980
2014	77,627	69,533	24,979	22,267	3,422	3,359

Source: Own calculations.

capital indicators increase (leverage and common equity tier 1 ratio) and unencumbered assets and guaranteed deposit ratio reduction. 'Swedbank' and 'DNB bank' had medium risk, but their aggregate risk weight values vary greatly during the analysed period.

Examining total annual premium sizes in all operating banks in Lithuania, the highest paid contributions for the analysed period were in 2013 (see Table 6). In 2014, the total volume of guaranteed deposits in all Lithuanian banks were higher than in 2013, but, due to the higher assumed risks, banks had to pay higher contributions to the common E.U. deposit insurance system in 2013. The smallest deposit insurance premiums through the analysed period, with the exception of in 2014, would have been paid by 'Citadele bank'. The largest contributions would have been paid by 'Swedbank' and, only in 2012, the contribution of 'SEB bank' would have been higher than 'Swedbank'.

The results showed that, via evaluation of the risk-based assessment model, involving systemic risk, in the period 2010–2013, the total amount of deposit insurance fund would have been higher compared to current existing deposit insurance system premiums in Lithuania. The largest increase in total contributions would be in 2010 (34.60%). The 2014 situation would have been the opposite, the total amount of premiums would have been lower compared to current banks paid contributions and would be 4.49% lower.

The obtained results showed that introduction of a risk-based deposit insurance system, compared with the current system existing in Lithuania, would modify deposit insurance premiums and the bank's largest individual contribution increase would be +50%, while the largest decrease would be −25%. Results showed that, during the analysed period, only J.S.C. 'Swedbank' and J.S.C. 'SEB bank' fell to the medium systemic risk group, while all other operating banks in Lithuania were assigned to the low systemic risk group. It should be emphasised that, in systemic risk, assigned in the research, the individual risk weight was 25%, which is why the impact of systemic risk to aggregate risk weight was significant. Therefore, in further research, it is recommended to give a lower individual risk score for systemic risk in Lithuanian banks, in order not to reduce the other risk indicators' affect to

Table 6. Comparison of deposit insurance premiums in Lithuanian banks.

Year	Premiums	J.S.C. Swedbank	J.S.C. SEB bank	J.S.C. DNB bank	J.S.C. Siauliu bank	J.S.C. Citadele bank	P.L.L.C. Medicinos bank	Total
2010	Current contribution, thousand LTL	56,719	43,401	35,069	7,925	2,752	2,931	148,796
	Risk-based contribution, thousand LTL	70,899	65,102	52,603	5,944	2,064	3,663	200,275
	Contributions change, proc.	25.00%	50.00%	50.00%	−25.00%	−25.00%	25.00%	34.60%
2011	Current contribution, thousand LTL	58,987	54,715	25,615	8,960	3,149	2,722	154,149
	Risk-based contribution, thousand LTL	73,734	54,715	19,211	8,960	2,361	2,722	161,705
	Contributions change, proc.	25.00%	0.00%	−25.00%	0.00%	−25.00%	0.00%	4.90%
2012	Current contribution, thousand LTL	66,670	55,770	27,143	9,939	3,289	3,208	166,019
	Risk-based contribution, thousand LTL	66,670	69,713	20,357	7,454	2,466	3,208	169,869
	Contributions change, proc.	0.00%	25.00%	−25.00%	−25.00%	−25.00%	0.00%	2.32%
2013	Current contribution, thousand LTL	67,220	59,606	28,864	20,752	3,088	3,184	182,713
	Risk-based contribution, thousand LTL	100,830	59,606	21,648	25,940	2,316	3,980	214,319
	Contributions change, proc.	50.00%	0.00%	−25.00%	25.00%	−25.00%	25.00%	17.30%
2014	Current contribution, thousand LTL	77,627	69,533	33,305	22,267	4,562	3,359	210,653
	Risk-based contribution, thousand LTL	77,627	69,533	24,979	22,267	3,422	3,359	201,186
	Contributions change, proc.	0.00%	0.00%	−25.00%	0.00%	−25.00%	0.00%	−4.49%

Source: Own calculations.

aggregate risk weight, because Lithuanian operating banks have low or moderate systemic risk level.

5. Conclusion

In summary, it can be said that the deposit insurance system should limit the scope of assumed risk by banks and to not cause negative impact on the entire financial system and that is why the deposit insurance system should be based on banks' risk assessment. Creation of the risk assessment based deposit insurance system would redistribute contributions among the banks operating in Lithuania and, thus, contribute to the negative effects of deposit insurance systems mitigation and growth of stability in all the financial system.

A variety of performed scientific studies showed that the deposit insurance system should be based not only on individual banks risk indicators analysis, but also on banks' systemic risk assessment. Inclusion of systemic risk in risk-based deposit insurance system would help to more accurately assess banks' risk. Thus, it is recommended to include the systemic risk assessment into the risk-based common E.U. deposit insurance system model.

Inclusion of systemic risk into the risk-based common E.U. deposit insurance system would contribute to the overall E.U. banking sector financial stability growth; therefore, the benefits of this system are undeniable, which is demonstrated by the analysis in the Lithuanian banking system. In further research it would be purposeful to analyse the results and the impact of the risk-based deposit insurance system in other E.U. countries.

Disclosure statement

No potential conflict of interest was reported by the authors.

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