

Małgorzata Iwanicz-Drozdowska, Marta Penczar**,
Lech Kujawski**, Monika Liszewska****

**DEPOSITS AS A STABLE SOURCE
OF BANK FUNDING.
DID THE GLOBAL FINANCE CRISIS INFLUENCE
THE BANKS' FUNDING STRUCTURE?**

The paper analyses the bank-specific and macroeconomic factors which determined the share of deposits in the funding structure of 184 EU listed banks in 2004-2016. The findings show that the global financial crisis (GFC) was one of the main factors that influenced the banks' funding models. The authors document the banks' return to funding from retail and corporate deposit markets, reducing the diversity in European banking sectors. The paper reports that the set of determinants affecting the banks' funding policies were different in the GFC in comparison to periods before and after the crisis. The authors concluded that the influence of the net loans to the total deposit ratio on the deposit to total assets ratio was higher in the crisis period. On the other hand, return on assets had a lower negative impact on the banks' funding model since they were forced to improve their profitability during the GFC.¹

Keywords: banks' business models, deposit funding, financial crisis

JEL Classification: G01, G21, G28

DOI: 10.15611/aoe.2021.2.02

1. INTRODUCTION

The funding structure is among the key areas of bank management. Its importance stems not just from the impact the funding model has on the performance of a single bank, but also from the implications of an individual bank's liability structure for the stability of the whole financial system.

Depending on the type of business, banks choose a different structure of deposits and non-deposit forms of financing. The funding model can be

* Warsaw School of Economics, Collegium of Management and Finance, Warsaw, Poland.

** University of Gdansk, Faculty of Management, Sopot, Poland.

*** The Gdansk Institute for Market Economics, Gdansk, Poland.

¹ The authors are grateful for comments from participants at the INFINITI Conference on International Finance, Glasgow 2019, specially Justine Wood from the School of Business and Economics, Loughborough University. The authors would also like to thank Sabina Nowak from the University of Gdansk, Faculty of Management for her inspirational comments.

defined in various ways. In the paper, the financing model was determined by the share of deposits in liabilities. It is worth remembering that it was deposits that proved to be the most resilient source of bank's funding in the face of the turmoil in the financial markets in 2008. Banks with a high share of deposits in total assets were considered safer and more resilient to liquidity problems during the global finance crisis (GFC) (Demirguc-Kunt and Huizinga, 2010). Moreover, in response to the financial crisis, a number of regulatory and legal changes were introduced with the purpose of increasing the importance of deposits as a source of financing banking activity.

Therefore, the authors did not analyse the entire structure of funding sources and its determinants (see e.g. Martel et al., 2012; Ayadi and de Groen, 2014; Hryckiewicz and Kozłowski, 2017; Mergaerts and Vander Vennet, 2016), but focused exclusively on the share of deposits in total liabilities.

Over the last decade, significant changes have been observed in the EU banking funding structure. The authors are positive that the GFC was the main factor that determined the funding models used by banks. The increase in risk and the introduction of the new regulatory and supervisory framework resulted in a number of changes, including the banks' return to funding from retail and corporate deposit markets, and the increased share of capital and reserves in the balance sheet structure, among the most significant, and a decline in the importance of funding obtained from financial institutions.

In this context, it is worth examining the changes in the bank funding structure in the EU. In 2007 the share of deposits from the non-financial sector in liabilities in the EU amounted to 29.5%; this increased to 37.2% in 2016. The degree of diversification of the European banks' business models also changed. In 2007, the deposits to assets ratio ranged from 13.2% in Ireland to 62.4% in the Czech Republic. This means a coefficient of variation of 48.5%. At the end of 2016, the analysed ratio ranged from 17.9% in Denmark to 70.2% in Bulgaria. Thus, the coefficient of variation decreased to 42.3%.

The aim of this paper was to point to the factors which determined the share of deposits in the EU banks' funding structure, with particular emphasis on the changes that occurred in respect to the significance of individual determinants over time. In the proposed regression model, the study applied a rarely used approach (see also Hryckiewicz and Kozłowski, 2017), which accounts for balance sheet and profit and loss account variables as well as dummy variables. Moreover, the variables represent bank-level and macroeconomic data.

The main hypothesis is that the share of deposits in banks' funding structures is determined by individual characteristics, sectoral factors and macroeconomic variables. The authors expect that the share of deposits in

bank funding structure should be negatively correlated with the capital adequacy ratio and return on assets. The last hypothesis examined in the article concerns the fact that the set of determinants shaping the banks' funding policies has changed over time.

The contribution of this paper to the literature is threefold. Firstly, to show that the banks' business models were influenced by various groups of factors and their strength and direction of influence differed significantly before, during and after the crisis. Secondly, unlike in previous studies, to take into account the varied duration of the effects of the crisis. The authors distinguished not only the actual crisis period of 2008-2011 but also the longer time intervals capturing changes which were signalled before the crisis (2004-2011) and changes that were visible also after the GFC (2008-2016). The study also expands the timeframe of the analysis up to 2016 to capture significant determinants in funding models in the post-crisis period, and introduces the 'non-crisis' dummy variable in order to identify differences in the importance of deposits in the structure of the banks' funding sources under financial crisis conditions.

The paper is organised as follows. The first section presents a review of the literature. The second section explains the data and methodology. The third section presents the empirical results, followed by the final conclusions.

The article was prepared as part of a project financed by the National Science Centre entitled "The structure of the banking sector's funding sources and the domestic banking sector stability in the context of new regulatory initiatives" (UMO-2016/23/B/HS4/03220).

2. LITERATURE REVIEW

The proper functioning of the banking sector is important for both economic activity and a country's economic development (Ayadi et al., 2011). The banks can provide support to economic policy if the banking sector develops in a stable manner, in which one of the determinants is the bank's business model (Koehler, 2015; Gonzales-Hermosillo and Oura, 2013). In this paper, the concept of a business model is defined from the perspective of the bank's funding model. A similar approach has been widely used in studies which analysed the diversity of bank business models (Martel et al., 2012; Ayadi and de Groen, 2014; Hryckiewicz and Kozłowski, 2017) and the impact of financial strategy on the banks' risk and profitability (Amidu, 2013; Demirgüç-Kunt and Huizinga, 2010; Berger et al., 2009). The financial crisis, which began in 2007, highlighted the greater importance of funding sources for the functioning of the entire sector and the risk of its destabilisation (Norden and

Weber, 2010). It also persuaded the regulators to fill the gaps in the existing legislation.

The literature on banking business models identifies four main funding strategies (Martel et al., 2012):

1. A specialised commercial bank with a funding structure dominated by customer deposits with a negligible share of other financial instruments, and the asset structure which comprises strong lending activity.

2. A universal commercial bank which has a diversified structure of funding sources with a dominant role of customer deposits, with a relatively low level of trading activities on the asset side.

3. A specialised investment bank with a funding structure dominated by short-term debt instruments, with a significant use of derivatives and reduced lending activity on the asset side of the balance sheet.

4. A diversified investment bank with a funding structure dominated by short and long-term debt issuances and meaningful exposures in the trading and derivative portfolios, with a significant level of financing through customer deposits; the asset structure shows considerable investment activity as well as lending, although the latter is less pronounced than in a universal commercial bank.

The choice of a bank's funding model is determined by multiple interrelated factors, which have been the subject of numerous studies. Gambacorta and van Rixtel (2013) point to regulations, the scale and scope of the bank's operations as well as the benefits brought by the 'too big to fail' (TBTF) status.

In turn, Gonzales-Hermosillo and Oura (2013) identify bank-specific variables as the main factors which determine the funding structure, with a smaller role assigned to macroeconomic and market variables. They stress that while bank-level factors are the most important, regulations also play a crucial role. Countries with high regulatory quality are associated with banks which hold more deposits and obtain less funding from other sources. Similarly, banks in developed economies with higher information disclosure requirements tend to have higher deposit-to-asset ratios and lower loan-to-deposit ratios. Additionally, the authors stress the role of the bank's size as an important variable. Large banks tend to exhibit higher debt levels and use less capital and deposits. The study also demonstrates that more traditional banks are less dependent on wholesale funding.

Van Rixtel and Gasperini (2013) point to three important groups of factors which determine the bank's funding model related to country specifics, the characteristics of an individual bank and the macroeconomic situation. The authors also indicate factors specific to the bank as the most important ones. They stress the impact of the bank's size, its business strategy and financial

strength on the choice of the manner of funding its activity. As a rule, smaller banks use wholesale funding less frequently than medium-sized and large ones. Similarly, the study by Carbó-Valverde et al. (2011) demonstrates that small financial institutions are less interested in the issuance of covered bonds or in asset securitisation than larger banks.

Domestic conditions differentiate between the sources of bank funding mainly through different legal regulations, but also local customs or the structure of the local banking sector. For instance, the European Central Bank notes that the Italian banks use wholesale funding to a greater extent compared to the German, Spanish or French ones (ECB, 2012).

The banks' liabilities structure also depends on macroeconomic factors. The literature indicates that the significance of individual funding sources is influenced by such factors as GDP, GDP per capita, inflation, unemployment, household consumption, exchange rate volatility and the capital market outlook. The impact of macroeconomic factors on bank funding models was pointed out by van Rixtel and Gasperini (2013) who demonstrated that the rapid rise in the prices of financial assets in capital markets in the years that preceded the crisis, contributed to a significant increase in the banks' leverage, including debt instruments as a funding instrument. When the crisis occurred, banks had to meet more restrictive capital adequacy requirements, which resulted in reducing their leverage thus mitigating the need for debt instrument issuance, and consequently the share of those instruments in the banks' balance sheets decreased.

The researchers' current interest in bank funding models is related to the analysis of the changes in funding sources that occurred after the outbreak of the 2007 crisis. Turbulence in the financial markets during the GFC turned out to be a test for the banks' financial models in terms of ensuring their stability of functioning. As Martel et al. (2012) point out, in the years preceding the crisis, global banks and investment banks caused both significant maturity and currency mismatches between their assets and liabilities. As the first symptoms of the crisis appeared in the American subprime market, short-term liquidity conditions clearly deteriorated, and this consequently turned into a crisis of confidence in the financial markets.

The Gonzales-Hermosillo and Oura study (2013) demonstrates that most banks have redesigned their funding strategies since the crisis, in order to mitigate their vulnerability to financial instability. Detailed IMF analysis resulted in the following theses:

- Banks that were not distressed (Group I) improved their funding structures, slightly increasing their capital ratios and lowering debt ratios. Their

funding sources have become slightly more diversified and reliance on short-term debt and repos (relative to total borrowings) has fallen, while the loan-to-deposit ratio has remained broadly stable.

- Banks distressed during the crisis (Group II) made some improvements to their funding models, but most indicators deteriorated. On the positive side, their use of short-term debt and repos has fallen close to the levels observed for non-distressed banks (Group I). Moreover, their funding structures became more diversified than for non-distressed banks (Group I). On the other hand, loan-to-deposit ratios rose as a result of limited access to deposits and an increase in debt financing, which pushed up their leverage and significantly lowered their equity-to-asset ratios.

At the same time, the literature review indicates that the impact of the crisis on individual banks varied and was dependent on the funding model adopted. An analysis by Vazquez and Federico (2015) demonstrates that banks which used the model based on retail funding sources were more resilient to the global financial crisis of 2007-2009 compared to those which relied on wholesale funding (including investment banks). This was related to the lower exposure of the trading and derivatives market. Another important factor was those banks' greater reliance on stable sources of funding, owing to their customer deposits and a greater variety of business lines, which allowed them to offset losses in some business segments with alternative sources of revenue. Similarly, an analysis by Ratnovski and Huang (2009) demonstrated that the use of the deposit-based funding model was a key factor in the relative resilience of Canadian banks during the 2007 financial crisis. In the same vein, Adrian and Shin (2010) showed that those U.S. investment banks that were reliant on short-term wholesale funding suffered severe financial losses.

The negative effects of the financial crisis stimulated a discussion on the directions of development of the banks' business models, above all those of systemically important banks (G-SIBs), in the context of financial sector stability. Blundell-Wigal and Atkinson (2012) point to the need to separate traditional banking from investment banking. Investment banks have strong connections with the global financial market, which may have an adverse impact on the banks' balance sheets and, despite attempts by banks to manage risk, result in the need to post losses which absorb excessive amounts of bank capital.

Hence, the literature clearly indicates the stabilising nature of deposits in mitigating liquidity shocks in conditions of turmoil in financial markets. Martel et al. (2012) stress that the banks' liquidity was an issue of particular concern during the global financial crisis. The fact that in the run-up to the crisis, banking expansion was financed with short-term wholesale funding,

combined with the use of excessive leverage, was a key factor that contributed to increased imbalances and heightened systemic risk as well as the subsequent spreading of crisis mechanism. Hahm et al. (2013) stated that the degree of reliance on sources of funding other than deposits and equity has a significant predictive power for various types of financial crises.

3. DATA AND METHODOLOGY

The authors selected 184 banks from the Thomson Reuters database. The selection criteria were as follows. Firstly, the authors selected publicly listed banks in the European Union, secondly, banks with assets of more than EUR 100 million. This resulted in 33,448 bank-year observations from the period 2004-2016.

Based on a literature review the study analysed the factors which determined the share of deposits in the bank funding model, following Amidu (2013). The authors proposed three different types (groups) of indicators: macroeconomic, bank-specific and binary (dummy) variables (see Table 1).

Inflation was chosen as a macroeconomic factor, because studies document that inflation negatively impacts bank deposits – in periods of inflation, economic agents, both households and firms, are forced to supplement their expenditure by drawing on their bank accounts, hence a reduction in bank deposits.

The main group of determinants are the bank-specific factors. The authors selected total deposits to total assets lagged by one year because their share of deposits in the funding structure largely depends on their importance in the preceding period. As the funding model cannot be changed in a short period of time, the model must necessarily include an endogenous lagged variable.

The decision on the structure of funding sources must account for both risk and profitability. For this reason, the capital adequacy ratio (car) and return on assets (ROA) were selected for the study. Banks with low capital adequacy levels, and therefore considered riskier, will exhibit a lower level of deposits and vice versa. Regarding profitability, studies indicate (Finger and Hesse, 2013) that banks with a high level of ROA have funding models with a lower share of deposits. In the pre-crisis period, many banks pursued the strategy of shifting from deposit market funding towards cheaper wholesale funding in order to improve their profitability.

Moreover, lending market activity, measured by the net loans to total assets ratio, has also an impact on the funding model adopted by the bank. Banks with a high share of loans in their assets usually rely on funding obtained from the deposit market to a greater extent. Therefore, they will have a positive impact on the deposits to total assets ratio. Conversely, banks

Table 1. Selected variables

Label	Definition	Example applications	Expected sign	Source of data
Macroeconomic factors				
inf	Inflation (CPI)	Studies document that inflation measured by the consumer price index (CPI) negatively impacts bank deposits – in periods of inflation, economic agents, both households and firms, are forced to supplement their expenditure by drawing on their bank accounts, hence a reduction in bank deposits. Demirgüç-Kunt and Huizinga (2010) analysed the annual inflation rate because inflation could affect bank performance and influence bank decisions to diversify into fee income-generating activities.	–	AMECO
Bank-specific factors				
td2ta(-1)	total deposits to total assets lagged by one year	A change in the bank's funding model requires time and no significant fluctuations are observed in this respect, unless in periods of several years. The authors selected a response variable which is lagged by one period because their share of deposits in the funding structure largely depends on their importance in the preceding period.	+	Thomson Reuters
car	capital adequacy ratio	The existing literature shows that the level of capital is an important determinant of financial distress during a crisis (Demirgüç-Kunt and Huizinga, 2010). Banks with low capital adequacy levels, and therefore considered riskier, exhibit a lower level of deposits and vice versa. On the other hand, the increase in the share of equity causes a decrease in the share of deposits in the liabilities structure.	– +	Thomson Reuters
roa	return on assets (profit after tax to total assets)	Demirgüç-Kunt and Huizinga (2010) demonstrated that more profitable banks are also riskier. At low levels of non-deposit funding, there could be some risk diversification benefits in increasing these shares, although at higher levels of non-deposit funding shares, further increases result in higher bank risk.	–	Thomson Reuters
nl2ta	net loans to total assets	Beltratti and Stulz (2013) use several variables to characterise the banks' asset side. Banks with higher loans level are those with a smaller portfolio of securities, and therefore with a potentially higher share of deposits.	+	Thomson Reuters
nl2td	net loans to total deposits	The increase in this ratio indicates financing of credits from sources other than deposits, which negatively affect the explained variable (td2ta). In banks where the level of net loans to total deposits increases, liquidity deteriorates and there is greater dependence on non-deposits funding sources (European Commission, 2017).	–	Thomson Reuters
Dummy variable				
ncr	ncr=1 if GDP growth>0; 1 otherwise	It was decided not to include GDP growth in the model and use the 'non-crisis' dummy variable instead, which is defined as 1 if GDP growth>0 and 0 otherwise;	+	Own

Source: own elaboration.

with a high share of securities in their asset structure will rely to a greater degree on funding obtained from the wholesale market rather than the deposit market.

The authors believe that an important indicator that should be included in the model is the indicator illustrating the bank's liquidity needs, and used the net loans to total deposits ratio to check the stability of funding sources in banks. As stated by the European Commission (2017), this ratio indicates the percentage of loans portfolio covered by deposits that are considered a stable source of funding.

The authors also selected the 'non-crisis' dummy variable whose value is equal to 1 when no crisis is present, i.e. GDP growth for the country is positive, and 0 otherwise. Thus, it was decided not to include GDP growth in the model because of the correlation risk.

The study supplemented the values missing from the Thomson Reuters dataset with annual data collected from the banks' annual statements and websites. The authors used macroeconomic data from the AMECO macroeconomic database (the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs).

The tool used to empirically test the factors which determine the share of deposits in funding sources is a dynamic econometric panel model formulated as follows:

$$y_{it} = f(y_{t-1,i}, x_{it}, \xi_{it}) \quad (1)$$

where y_{it} denotes the dependent variable, x_{it} is a set of independent variables and ξ_{it} is an error term. The double index it indicates variation over time (t) and with respect to individual objects, i.e. the banks (i) subjected to analysis.

One of the goals of this article was to point to factors and changes (in time) in the factors which determined the share of deposits in EU banks' funding structure, thus among the set of independent variables x_{it} dummy variables are included (d=1 period with crisis and d=0 in periods without crisis), as well as products of dummies and pure explanatory variables reflecting the interaction terms between the crisis and the variables. In this respect it is to be noted that three different 'crisis period' definitions were explored in three different models:

- model 1.2: d=1 for 2008-2011,
- model 1.3: d=1 for 2004-2011,
- model 1.4: d=1 for 2008-2016.

The main descriptive statistics are presented in Table 2.

Table 2
Descriptive statistics

Variable	Mean	Std. dev.	Median	5 th perc.	25 th perc.	75 th perc.	95 th perc.
td2ta	0.68	0.20	0.73	0.31	0.57	0.82	0.89
car	17.96	36.86	14.20	9.38	11.80	17.10	26.23
roa	0.51	3.23	0.60	-1.70	0.20	1.10	2.70
inf	0.02	0.02	0.02	0.00	0.01	0.03	0.04
nl2ta	0.60	0.20	0.63	0.21	0.52	0.71	0.82
nl2td	6.46	191.71	0.88	0.37	0.73	1.06	1.79
ncr	ncr = 1 – 1930 (80.7%); ncr=0 – 462 (19.3%)						

Source: based on Thomson Reuters, AMECO, and manually collected data.

Except for the dummy variables, the data panel used in the study is a multidimensional table of numbers with the following dimensions: $184 \times 14 \times 13 = 33,488$ (number of banks \times number of variables \times number of years, eventually in the models the authors applied 6 from 14 variables available in the collected database).

Initially the database was 92.7% complete, i.e. 31,043 observations were included in the database, so the data panel available was unbalanced. Some data gaps had the form of single missing observations (at the beginning, at the end or in the middle of a time series), in which case the missing observations were either extrapolated or interpolated. The procedure for filling the gaps was as follows: the missing data were obtained as forecasts (for missing last or first observations) or theoretical values (for missing internal observations) from unconstrained VAR models. The pre-selection of variables for the VAR models was based on correlation matrix analysis for which the three most correlated variables were selected. The optimal order of the VAR process was determined on the basis of information capacity criteria (AIC – Akaike Information Criterion). The application of this procedure enabled 784 missing observations to be filled in, which resulted in a database which was 95.0% complete, obviously still yielding an unbalanced panel. The descriptive statistics presented in Table 2 refer to the variables with the gaps filled in.

Given that the model presented is a dynamic one, and also due to the fact that it contains an endogenous variable as the explanatory variable included in the x_{it} matrix, the empirical models were estimated with the generalised method of moments (GMM) using the Arellano-Bond estimator (Arellano and Bond, 1991), and the variable considered endogenous was lagged.

The model was constructed in accordance with the general-to-specific modelling approach, with the use of variable addition and deletion tests (Baltagi, 2013). The plm package: Linear Models for Panel Data operating in the R environment, was used for modelling and testing purposes.¹ The ready-made tests and estimators available in this package were employed.

The testing procedure was as follows:

(1) testing the ‘poolability’ of data in order to answer the question of whether the models’ structural parameters should be considered identical for each of the units tested; the standard F test was used, which is based on a comparison of two models: constrained (pooled) and unconstrained;

(2) testing the significance of individual and time effects in order to determine whether one or two-way models should be estimated; for this purpose the procedure proposed by Honda (1985) was used;

(3) testing the type of effects: fixed versus random; the Hausman test was used (Hausman, 1978); when selecting the type of effects, attention should be paid to the fact that the bank population data were used instead of the sample data, therefore according to the principles of econometrics, the preference should be to use fixed effects rather than random ones;

(4) the estimation of models using the Arellano-Bond estimator; general-to-specific modelling procedure (Croissant and Millo, 2008);

(5) testing the overall validity of the instruments (the Sargan test);

(6) testing the autocorrelation of the error term (the inclusion of a lagged dependent variable in a panel framework might yield biased and inconsistent estimates, thus to address this issue the Arellano-Bond estimator with properly selected instruments was applied; note that it is crucial for the consistency of the Arellano-Bond estimator test whether the second-order autocorrelation is insignificant);

(7) making inferences from the model, in particular inferences about the significance of model parameters.

4. EMPIRICAL RESULTS

The results of the GMM estimation for the full sample are presented in Table 3. Model 1.1 is treated as the baseline model. Model 1.2 shows the structural breaks that occurred under the influence of the GFC (2008-2011). In that model, the reference period is 2004-2007 and 2012-2016.

¹ The plm package: Linear Models for Panel Data operating in the R environment, is available at <https://cran.r-project.org/package=plm>

It was assumed that some of the changes that became apparent during the global financial crisis were signalled earlier than just in 2008-2011. Similarly, some of the changes that were caused by the crisis could have affected banks' funding models also in the post-crisis period. Hence to better understand structural breaks the authors estimated two additional models:

- model 1.3 to analyse the changes before and during the crisis – in 2004-2011 in comparison with the reference period 2012-2016;
- model 1.4 to analyse the changes during and after the crisis – in 2008-2016 in comparison with the reference period 2004-2007.

In the discussion, wherever the concept of the significance of a variable was used, a 10% level of significance was assumed, in the case of diagnostics tests a 5% level of significance was applied.

Table 3

Models 1.1-1.4 of total deposits to total assets – the results of estimations

	Model 1.1 (z-value)		Model 1.2 (z-value)		Model 1.3 (z-value)		Model 1.4 (z-value)
lag(td2ta)	0.36292 (2.6948)**		0.32891 (3.9867)***		0.35666 (5.3509)***		0.45063 (6.1174)***
car	-0.00097886 (-6.9650)***	2004-2007; 2012-2016 2008-2011	-0.0010621 (-17.8833)*** -0.00011907 (-1.2726)	2012-2016 2004-2011	-0.00074069 (-4.6760)*** -0.00029847 (-2.3991)*	2004-2007 2008-2016	-0.0011642 (-27.1698)*** 0.00026357 (2.2505)*
roa	-0.0059123 (-2.7591)**	2004-2007; 2012-2016 2008-2011	-0.0093173 (-4.6073)*** 0.0039893 (2.0045)*	2012-2016 2004-2011	-0.0076488 (-3.2858)** 0.0031605 (1.4669)	2004-2007 2008-2016	-0.0033238 (-3.0673)** -0.0041726 (-2.4859)*
inf	-0.32627 (-2.8534)**	2004-2007; 2012-2016 2008-2011	-0.44622 (-2.6885)** 0.26667 (1.4021)	2012-2016 2004-2011	-0.24567 (-1.4323) 0.16391 (0.8287)	2004-2007 2008-2016	-0.3993 (-1.0691) 0.024741 (0.0622)
nl2ta	0.15606 (2.0026)*	2004-2007; 2012-2016 2008-2011	0.24878 (3.3913)*** -0.010597 (-1.0945)	2012-2016 2004-2011	0.23184 (3.5479)*** -0.025882 (-2.7536)**	2004-2007 2008-2016	0.212 (2.9457)** 0.002465 (0.1510)
nl2td	-0.00002734 (-1.9684)*	2004-2007; 2012-2016 2008-2011	-0.000020618 (-3.9055)*** -0.010505 (-2.4138)*	2012-2016 2004-2011	-0.0000091429 (-1.4888) -0.00047141 (-8.7676)***	2004-2007 2008-2016	-0.00034799 (-13.3469)*** 0.00033068 (12.1997)***
ncr	0.0083035 (0.017354)*						

Source: based on Thomson Reuters, AMECO, bank annual statements and manually collected data.

Table 4
Model 1.1 diagnostic test results (stat [prob])

'Poolability' test:	5.4529 [0.000]
Individual effects:	3.1283 [0.001]
Time effects:	4.5833 [0.000]
Hausman test:	450.98 [0.000]
Autocorrelation test (1):	-2.1902 [0.028]
Autocorrelation test (2):	-0.6613 [0.508]
Sargan test:	48.5822 [0.096]
Total sum of squares:	15.62; R ² =0.5661
Wald test for coefficients:	82.0854 [0.000]

Source: own elaboration.

The results of the GMM estimation for the full sample are presented in Table 3.

In Model 1.1 the explanatory variables show cumulative statistical significance (the Wald test). Explanatory variables are also individually significant (the Student t-test, cf. z-value). Additionally, the relevant tests indicate the significance of individual effects and the insignificance of time effects, which were probably taken into account by including in the model a non-crisis variable (ncr). The Hausman test result indicates the need to estimate the model with fixed effects (Table 4).

The Sargan test result suggests (at 1% and 5% statistical significance level) the validity of the instruments used in the Arellano-Bond estimation procedure.

The model error terms do not exhibit second order autocorrelation (and reveal first order autocorrelation as expected in the Arellano-Bond first difference type estimator), additionally the fit of the model as measured by the determination factor was 56.61%. The above model can be considered a 'good model' and in light of the results obtained, it can be treated as a tool for making inferences about the relation to be tested.

The research results indicate that among the variables included in the model, three factors have a positive effect on the share of deposits in the balance sheet structure.

Apart from the endogenous variable, the ratio of net loans to total assets has a positive effect on the deposit-to-asset ratio. It should be expected that an increase in lending entails the need to seek additional sources of funding, and thus also increasing the value of deposits as the basic source of funding for lending activities. This may indicate that banks strive to achieve a balanced structure of funding for their lending activities, rather than relying on funding from the interbank market, which is considered unstable.

In addition, the dummy (non-crisis) variable also has a positive effect. The positive correlation between periods of economic growth ($GDP\ Growth > 0$) and the share of deposits in the structure of funding sources can be explained by the fact that financial surpluses are larger during economic booms, and those who have them try to invest them, e.g. in the deposit market.

On the other hand, the remaining factors included in the study result in the decrease in the dependent variable studied. The first statistically significant variable with a negative impact on the deposit-to-asset ratio is inflation (inf). The negative correlation between the inflation rate and the share of deposits in the balance sheet structure results *ceteris paribus* from the reduced attractiveness of deposits against other forms of investing financial surpluses during periods of inflation growth.

The next three variables with a negative impact are bank-specific factors.

The capital adequacy ratio (car) is calculated as the value of the bank's capital in relation to risk-weighted assets. Therefore an increase in the car ratio may reflect an increase in the level of capital or a reduction in risk exposure. In the period when tensions prevailed in the financial markets, the banks strengthened their capital position. This was because they were faced with the need to improve their capital ratios and at the same time it was difficult to reduce lending rapidly. A natural consequence of the increase in the share of equity in liabilities was therefore a decrease in the share of deposits in the balance sheet structure, unless the bank was engaged in the issuance of debt instruments.

The second factor that turned out to have a negative impact on the deposit-to-asset ratio is the return on assets (roa). The negative relation may follow from the direct relation between the ROA ratio as a profitability indicator and the level of risk to which a given institution is exposed (Demirgüç-Kunt and Huizinga, 2010). A bank's higher risk level may translate into the depositors' reduced willingness to invest their financial surpluses in this type of institution. Moreover, the increase in the bank's profitability results from greater involvement in non-deposit activities, derived from fees and commissions.

The last variable with a negative impact is the ratio of net loans to total deposits. As expected, the increase in this ratio indicates the financing of credits from sources other than deposits, which negatively affects the explained variable (td2ta). The authors believe that in banks where the level of net loans to total deposits increases, liquidity deteriorates and there is greater dependence on non-deposits funding sources.

The financial crisis resulted in a significant change in the banks' approach to designing their funding structures.

The results of Model 1.2 indicate that in 2004-2007 and 2012-2016 which are treated as reference period, the influence of all variables was in line with the baseline model. Moreover, the crisis effects were not revealed for all variables. During the crisis, statistically significant weakening of the negative impact of the return on assets indicator (roa) on the dependent variable was observed. On the other hand, during the crisis the negative impact of net loans to total deposits (nl2td) was higher than in the reference period. The financial crisis did not have a statistically significant impact on changing the importance of other variables.

As indicated earlier, in order to better understand the impact of the GFC on the banks' funding models, the study analysed the changes that took place in 2004-2011 (i.e. the period before and during the crisis) in relation to the post-crisis period (2012-2016). The results of Model 1.3. indicate that in 2012-2016 the dependent variable (total deposits to total assets) was determined by total deposits to total assets lagged by one year (lag(td2ta)), capital adequacy ratio (car), return on assets (roa) and net loans to total assets (nl2ta). The direction of the impact of statistically significant variables was consistent with the base model. Our estimates also indicate that in the period before and during the crisis, the negative impact of capital adequacy ratio (car) on the dependent variable was significantly higher. Moreover, in the analysed period, a smaller impact of the net loans to total assets (nl2ta) variable on the explained variable was observed. It is worth noting that while in 2012-2016 the net loans to total deposits (nl2td) variable proved not be statistically significant, the effect of the crisis (to be precise, the effect of the period 2004-2011) was statistically significant. Additional estimates indicate that net loans to total deposits (nl2td) was statistically significant for the dependent variable in 2004-2011.

Model 1.4. allows to identify changes in the variables determining the bank funding models during the crisis and in the years immediately following the period of the greatest tensions in the financial markets (i.e. 2008-2016). The reference period here are the years before the GFC, i.e. 2004-2007. During this period the dependent variable was significantly determined by all the variables included in the model, except inflation (inf). As in previous models, the direction of the individual variables on the dependent variable was consistent with the base model. During the crisis and in the post-crisis period, the negative impact of capital adequacy ratio (car) and net loans to total deposits (nl2td) on the dependent variable decreased. On the other hand, in 2008-2016 the negative impact of return on assets (roa) on the dependent variable increased. The period of crisis extended by the post-crisis years also had a significant impact on changing the importance of net loans to total assets (nl2ta) for the dependent variable. The results of the estimates indicate that during this period there was a statistically significant increase in the positive impact of the net loans to total assets (nl2ta) on the deposit to assets ratio.

5. ROBUSTNESS CHECK

To avoid drawing misleading conclusions, the authors performed a robustness check to confirm the stability of the results. As already mentioned in the section containing the description of the research methodology, owing to the dynamic nature of the models estimated and tested, and also due to the endogenous nature of some explanatory variables, the model estimation was based on the Arellano-Bond estimator, which is in fact a generalised method of the moments (GMM) estimator.

Since the aim of the study was to identify the factors which determine the role of deposits in the structure of the funding sources used by banking institutions, it is of particular importance that the results of individual significance tests obtained from model 1 are confirmed using a model estimated with a parameter estimator other than the GMM one, which automatically entails the use of a different estimation error estimator and, as a result, generates different individual significance test statistics. If the results of the significance tests are confirmed, this can be treated as confirmation of the results previously obtained, that is independent of the estimation method used. It was proposed that a one-factor within-group OLS estimator be applied to a model constructed on the basis of model 1. In order for an OLS estimator to be used, endogenous variables must be removed from the set of explanatory variables used in model 1.1. For this purpose, the autoregressive variable $td2ta_{t-1,i}$ which reflected the long memory of the process was directly removed, while the variables $nl2ta_{t,i}$ and $nl2td_{t,i}$ were replaced by the lagged terms $nl2ta_{t-1,i}$, and $nl2td_{t-1,i}$, respectively, which were treated as instruments to the original variable. Those three changes made it possible to estimate the model based on model 1 with the use of OLS.

Model 1.1 was expressed as follows:

$$y_{ii} = f(x_{ii}, \xi_{ii}) \quad (2)$$

where y_{ii} is the dependent variable, x_{ii} is a set of independent variables together with the instruments described above, ξ_{ii} is an error term; y_{ii} and x_{ii} are defined in the same manner as in model 1.1 (it should be noted that in model 2.1, the autoregressive component was left out and the model ceased to be dynamic in the strict sense). Models 1.1 and 2.1 differ in the assumptions made with respect to the error term; in model (1), which was estimated using the GMM, no specific ξ_{ii} distribution is assumed; additionally, ξ_{ii} sphericity assumptions may or may not be met, while in model 2 sphericity is a necessary condition for the effectiveness of the OLS estimator.

Table 5
Model 2.1 estimation results

Variable	Estimate	Std. Error	z-value	Pr(> z)
car	-0.00072	0.00009	-7.84430	0.00000
roa	-0.00687	0.00129	-5.34450	0.00000
inf	-1.30720	0.14409	-9.07230	0.00000
lag(nl2ta)	0.05049	0.01817	2.77790	0.00553
lag(nl2td)	-0.00001	0.00001	-0.83360	0.40464
ncr	0.00948	0.00594	1.59740	0.11037
			(stat[prob])	
'Poolability' test:			51.817[0.000]	
Individual effects:			73.593[0.000]	
Time effects:			-0.3134[0.623]	
Total sum of squares:			15.66; R2=0.1020	
Wald test for coefficients:			31.3513[0.000]	

Source: based on Thomson Reuters, AMECO, bank annual statements and manually-collected data.

It should be noted that the estimated static version of model 1.1, namely the estimated model 2.1 (see Table 5), confirms the results previously obtained (cf. model 1):

- the parameter estimate signs are consistent for both models;
- excluding ncr and lagged nl2ta, the significance test results are consistent;
- obviously, model 2 fits the empirical data less well due to the removal of the autoregressive variable which accounts for the long memory (and time effects) of the process modelled.

Regarding the comparison between the results of both estimates, it should be stated that the results obtained (parameter signs, significance of variables) do not depend on the estimation methods used and are to some extent resilient to changes in model specifications (since removing the autoregressive variable from model 1 may be equated with imposing zero constraints on the parameter of this variable).

DISCUSSION AND CONCLUSIONS

This paper analysed the factors which determined the share of deposits in the EU banks' funding structure, with particular emphasis on the changes that occurred with respect to the significance of individual determinants over time.

Deposits are an important source of bank funding in most EU countries, but their importance in individual markets varies. At the end of 2016, deposit-to-asset ratio ranged from 17.9% in Denmark to 70.2% in Bulgaria. Moreover, the analysis of deposits as a share of liabilities indicates the considerable changes which took place in this respect in 2004-2016. In the period preceding the outbreak of the global financial crisis (2004-2007), the deposit-to-asset ratio averaged 29.7%. For comparison, during the crisis (2008-2011), the share of assets in total liabilities averaged 31.3% in the EU, and in the post-crisis period (2012-2016) amounted to 35.4%.

This research indicates that the share of deposits in the liabilities structure was shaped both by macroeconomic variables (inflation, non-crisis dummy variable = $GDP > 0$) and by bank-specific factors, including bank's capital adequacy ratio, return on assets, the net loans to total assets ratio and net loans to total deposits ratio. It is worth pointing out that among the factors examined, apart from the explanatory variable lagged by one year, total loans to total assets and the positive rate of economic growth (dummy variable) had a positive influence on the total deposits to total assets ratio. Other factors had a negative impact on the studied variable.

The division of the studied period into three sub-periods allowed to observe the following changes in the factors determining the total deposits to total assets ratio:

- during the crisis (2008-2011), the negative impact of return on assets was smaller than in 2004-2007 and 2012-2016, which was dictated by a greater concern to maintain profitability during the financial market's turmoil;
- during the crisis (2008-2011), the negative impact of net loans to total deposits was higher than in 2004-2007 and 2012-2016, which could be related to the liquidity crisis in the banks;
- in 2004-2011, the negative impact of the capital adequacy ratio on the examined variable was greater than in the post-crisis period;
- in 2004-2011, the positive impact of net loans to total assets was smaller than in the post-crisis period;
- in the pre-crisis period (2004-2007), the negative impact of capital adequacy ratio on the examined variable was greater than in 2008-2016;
- the negative impact of returns on assets on the explained variable was stronger in 2008-2016;
- in the years 2008-2016 the negative impact of net loans to total assets on the total deposit to total assets ratio was weaker than in the period 2004-2007.

To conclude, the introduction of dummy variables in models 1.2 to 1.4 revealed statistically significant effects. This means that there is a structural

change in the baseline model, that causes a statistically significant change in the structural parameters. As a result, the predictive property of the baseline model was reduced. This confirms the validity of distinguishing not only the actual crisis period of 2008-2011 but also the longer time intervals capturing the changes signalled before the crisis (2004-2011) and the changes visible also in the years after the GFC (2008-2016). This shows that it is important to take a differentiated view on the factors determining the share of deposits in assets over different periods.

Although there are several existing studies on the banking funding model, they do not completely cover the post-crisis period. Monitoring and analysing the share of deposits in the structure of funding sources over such a long time-frame will help to better understand the changes in the banking sector. Moreover, the analysis of the factors which determined the banking funding model may contribute in the future to improving the safety of the financial sector.

The authors consider this study as a starting point for further work on determining the impact of the funding structure on the stability of individual banks and the entire financial system.

REFERENCES

- Adrian, T. P., Shin, H. S., *The changing nature of financial intermediation and the financial crisis of 2007–2009*, Annual Review of Economics, Vol. 2, pp. 603-618, 2010.
- Amidu, M., *The effect of the structure of banking market and funding strategy on risk and return*, International Review of Financial Analysis, No. 28(2013), pp. 143-155, 2013.
- Arellano, M., Bond S., *Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations*. Review of Economic Studies, Vol. 58(2), pp. 277-297, 1991.
- Ayadi, R., Arbak, E., de Groen, W., *Business Models in European Banking: A Pre- and Post-Crisis Screening*, Centre for European Policy Studies, 2011.
- Ayadi, R., de Groen, W., *Banking business models monitor 2014 – Europe*, Centre for European Policy Studies and International Observatory on Financial Services Cooperatives, 2014.
- Baltagi, B., *Econometric Analysis of Panel Data*. 5th edition. John Wiley and Sons Ltd., 2013.
- Banking Sector and Financial Stability, European Semester Thematic Factsheet*, European Commission, https://ec.europa.eu/info/sites/default/files/file_import/european-semester_thematic-factsheet_banking-sector-financial-stability_en_0.pdf, 2017.
- Beltratti, A., Stulz, R. M., *The credit crisis around the globe: why did some banks perform better?*, Journal of Financial Economics, No. 105(2012), pp. 1-17, 2012.
- Berger, A., Klapper, L., Turk-Ariss, R., *Bank competition and financial stability*, Journal of Financial Services Research, No. 35, pp. 99-118, 2009.
- Blundell-Wignall, A., Atkinson, P. E., *Deleveraging, traditional versus capital markets banking and the urgent need to separate and recapitalise G-SIFI Banks*, Financial Market Trends, No. 2012/1, OECD, 2012.

- Carbó-Valverde, S., Rosen R., Rodríguez-Fernández, F., *Are covered bonds a substitute for mortgage-backed securities?*, Federal Reserve Bank of Chicago, Working Paper Series, No. 2011-2014, 2011.
- Changes in bank financing patterns*, European Central Bank, 2012.
- Croissant. Y., Millo, G., *Panel Data Econometrics in R: The plm Package*, Vol. 27, Issue 2, <http://www.jstatsoft.org/>, 2008.
- Demirguc-Kunt, A., Huizinga, H. P., *Bank activity, and funding strategies: the impact on risk and return*, Journal of Financial Economics, No. 98(3), pp. 626-650, 2010.
- Gambacorta, L., van Rixtel A., *Structural bank regulation initiatives: approaches and implications*, BIS Working Papers, No. 412, 2013.
- Gonzales-Hermosillo, B., Oura H., *Changes in bank funding patterns and financial stability risks, in the Global Financial Stability report: transition challenges to stability*, IMF, 2013.
- Hahn, J-H., Shin H., Shin K., *Non-core bank liabilities and financial vulnerability*, Journal of Money, Credit and Banking, Vol. 45, Issue 1. The Ohio State University, 2013.
- Hausman, J., *Specification Tests in Econometrics*, Econometrica, No. 46(6), pp. 1251-1271, 1978.
- Honda, Y., *Testing the Error Components Model With Non-Normal Disturbances*, Review of Economic Studies, No. 52(4), pp. 681-690, 1985.
- Hryckiewicz, A., Kozłowski, Ł., *Banking business models and the nature of financial crisis*, Journal of International Money and Finance, No. 71(2017), pp. 1-24, 2017.
- Köhler, M., *Which banks are more risky? The impact of business models on bank stability*, Journal of Financial Stability, No. 16(2015), pp. 195-212, 2015.
- Martel, M. M., van Rixtel, A., Gonzalez, Mota E., *Business models of international banks in the wake of the 2007-2009 global financial crisis*, Banco de Espana Estabilidad Financiera, No. 22, 2012.
- Mergaerts, F, Vennet, R., *Business models and bank performance: a long-term perspective*, Journal of Financial Stability, No. 22(2016), pp. 57-75, 2016.
- Norden, L., Weber M., *Funding modes of German banks: structural changes and their implications*, Journal of Financial Services Research, No. 38, pp. 69-93, 2010.
- Ratnovski, L., Huang, R., *Why are Canadian banks more resilient?*, IMF Working Paper, WP/09/, 2009.
- Van Rixtel, A., Gasperini, G., *Financial crises and bank funding: Recent experience in the euro area*, BIS Working Papers, No. 406, 2013.
- Vazquez F., Federico P., *Bank funding structures and risk: Evidence from the global financial crisis*, Journal of Banking & Finance, 61, pp. 1-14, 2015.

Received: February 2020