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Liquidity Risk of Banks in Light of a Dominant Share of Foreign Capital in the Polish Banking Sector

Karolina Patora

***Abstract*—**This article investigates liquidity risk management by banks, which has gained significant importance since the global financial crisis of 2008. The issue is of particular interest for countries like Poland, in which foreign capital plays a dominant role. Such an ownership structure poses certain risks to the local banking sector, which faces an increased probability of the withdrawal of funding or assets' transfers abroad in case of a crisis. Both these factors can have a detrimental influence on the liquidity position of foreign-owned banks and hence negatively affect the financial stability of the whole banking sector. The aim of this study is to evaluate the impact of a dominating share of foreign investors in the Polish banking sector on the liquidity position of commercial banks. The study hypothesizes that the ownership structure of the Polish banking sector, in which there are banks predominantly controlled by foreign investors, does not pose a threat to the liquidity position of Polish banks. A supplementary research hypothesis is that the liquidity risk profile of foreign-owned banks differs from that of domestic banks. The sample consists of 14 foreign-owned banks and 5 domestic banks owned by local investors, which together constitute approximately 87% of the banking sector's assets. The data covers the period of 2004–2014. The results of the regression models show no evidence of significant differences in terms of the dynamics of changes of the liquidity buffers between the foreign-owned and domestic banks, although the signs of the coefficients might suggest that the foreign-owned banks were decreasing the holdings of liquid assets at a slower pace over the examined period, compared to the domestic banks. However, no proof of the statistical significance of these findings has been found. The supplementary research hypothesis that the liquidity risk profile of foreign-controlled banks differs from that of domestic banks was rejected.

***Keywords*—**Financial stability, foreign-owned banks, liquidity position, liquidity risk.

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I. Introduction

AN inflow of foreign investors to the Polish banking sector started early in 1992, when the processes of privatization of the Polish banks initiated. As a consequence, foreign investors controlled almost 60% of the Polish banking assets as of the end of 2015, according to the Polish Financial Supervision Authority [1]. It is widely acknowledged that foreign investors contributed to the development of the Polish banking sector in terms of the transfer of innovation and know-how, increased financing capacity, and advanced expertise in risk assessment and risk management techniques. Despite these contributions, the dominant presence of foreign investors in the Polish banking sector has always raised questions about the safety and financial stability of the local banks. First, one risk that remains is that foreign investors may abandon the refinancing operations, especially with regard to foreign currency lending to their subsidiaries, which may hamper the liquidity position of their Polish affiliates because of a 27% share of the foreign currency denominated loans in 2015, according to the National Bank of Poland (own calculation) [2]. There is also a risk that the parent banks withdraw liquid assets from their subsidiaries in times of stress, which is potentially dangerous due to the term structure of the Polish banks' liabilities – 55% of deposits from the non-financial sector are current deposits, as of June 2016, according to the National Bank of Poland (own calculation) [2]. Furthermore, it is a common practice that the foreign-owned banks adjust their risk management practices, strategies and levels of risk appetite to the standards accepted within the multinational banking groups.

The objective of this study is to test the main research hypothesis that, regardless of the fact that foreign-owned banks play a significant role in the Polish banking sector, the way these banks adjust their liquidity holdings (or liquidity buffers) over time does not impose negative implications in terms of the liquidity position of the Polish banks. There is also a supplementary research hypothesis linked to this study that there are significant differences between the liquidity risk profiles of the foreign-owned banks and the domestic banks.

The paper is structured as follows. First, a brief overview of the related literature is provided. Second, data description and sample selection are presented, followed by an empirical specification and a description of the results of the ordinary least square regression. Lastly, main findings from the research are concluded.

II. Literature review

Worldwide scientific research concerning the impact of foreign capital presence on the host banking sectors abounds. The areas of interest can be divided into three main categories. First, there are scientific papers examining the impact of the presence of foreign capital on credit availability [3]-[7]. The second strand of the literature emphasizes the impact on banks' competitiveness and efficiency [8]-[14]. Finally, there is scientific evidence concerning the impact of foreign capital presence on financial stability and financial shock transmission channels [15], [16]. Notwithstanding the fact that thorough research covering different aspects of foreign investors' presence has already been performed, there

Karolina Patora is a Ph.D. Candidate at the University of Lodz, Faculty of Economics and Sociology, Institute of Finance, Department of Banking, 39 Rewolucji 1905 r. Street, Łódź, Poland (e-mail: karolina.patora@uni.lodz.pl).

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is a gap in the existing literature, with scarce empirical evidence of the impact of the presence of foreign capital on banks' liquidity position and liquidity risk profile.

Dinger [17] was the first to accentuate a lack of empirical evidence of the different liquidity risk management practices of foreign-controlled banks. He conducted a study in which he proved that foreign-controlled banks, compared to domestic banks, held relatively lower liquidity buffers during the times of stable economic development, whereas the situation seemed to be the opposite in turbulent times. In other words, the foreign investors contributed to a higher resiliency of banks and positively influenced aggregate liquidity of the examined banking sectors. The study conducted by Dinger [17] was based on a sample of ten Central and Eastern European economies and hence does not allow for a country-specific assessment. This need is met by the current study.

Konovalova et al. [18] assessed liquidity imbalances in Latvian banks, which were divided into several groups: foreign-owned, private, government-owned, and of a mixed capital structure. They revealed, inter alia, that the liquidity position of foreign-owned banks was satisfactory, apart from the imbalances occurring in the time horizon above 5 years.

Aspachs et al. [19] conducted a study aiming to answer the following questions – what is the level of liquidity buffer that banks hold to safeguard themselves from liquidity shocks?, what are the idiosyncratic and macroeconomic factors affecting the banks' liquidity buffers?, how does the lender of last resort policy interplay with banks' liquidity management? and how does the ownership structure affect banks' liquidity buffers? The study was performed on a sample of 57 UK-based banks in 1985–2003. The authors revealed that the foreign-owned banks reacted differently than the domestic banks, as the size of their liquidity buffers was not affected by the central bank's lender of last resort policy; it was less affected by the short-term changes in interest rates, and it was less affected by changes in GDP.

Deléchat et al. [20] conducted a study on a sample of 100 banks from Central America in 2006-2010. The authors proved that the foreign-owned banks held fewer liquid assets relative to deposits, although the relationship was not significant. They also proved that the foreign-owned banks with riskier credit portfolios tended to hold relatively more liquid assets, which indicates a prudent approach.

Another study [21] contributing to the area of this study was conducted on a sample of Polish banks in the years 2008–2010 and 2010–2012. The authors showed that the negative funding shocks transmitted from the parent banks more affected those subsidiaries that relied to a greater extent on the credit lines and maintained higher amounts of illiquid assets. The authors, however, came to the conclusion that foreign investors play a stabilizing role in the Polish banking sector.

The study presented herein contributes to the existing literature in such a way that it allows for the assessment of the role of foreign investors in the banking sector from the perspective of a single host country, in which the banks are predominantly controlled by foreign investors.

III. Data and Sample Description

The sample consists of 14 foreign-owned banks and 5 domestic banks owned by local investors, as presented in Table I, which altogether constituted approximately 87% of the banking sector assets as of December 2014.

TABLE I
SAMPLE

Bank name	*Size (% of the banking sector assets as of Dec 2014)*	*Foreign-owned vs. domestic*
1. Bank BPH SA	2%	foreign-owned
2. Bank Gospodarki Zywnosciowej SA	3%	foreign-owned
3. Bank Handlowy w Warszawie SA	4%	foreign-owned
4. Bank Millennium SA	4%	foreign-owned
5. Bank Ochrony Srodowiska SA	1%	domestic
6. Bank Polska Kasa Opieki SA	12%	foreign-owned
7. Bank Zachodni WBK SA	10%	foreign-owned
8. BNP Paribas Bank Polska SA	2%	foreign-owned
9. Deutsche Bank Polska S.A	3%	foreign-owned
10. Getin Holding SA	6%	domestic
11. ING Bank Śląski SA	7%	foreign-owned
12. Kredyt Bank SA*	n/a	foreign-owned
13. mBank SA	9%	foreign-owned
14. Nordea Bank Polska SA*	n/a	foreign-owned
15. Powszechna Kasa Oszczędności Bank Polski SA	18%	domestic
16. Raiffeisen Bank Polska SA	4%	foreign-owned
17. Bank Pocztowy	1%	domestic
18. LUKAS Bank/Crédit Agricole Bank Polska SA	1%	foreign-owned
19. PLUS Bank SA	0,2%	domestic
Sum	**87%**	

* The relative share in the banking sector assets cannot be estimated because Kredyt Bank SA and Nordea Bank Polska SA were no longer operating as standalone banks in 2014, as they were overtaken by other banks – Bank Zachhodni WBK SA and Powszechna Kasa Oszczędności Bank Polski SA, respectively.

The data covers the period of 2004–2014. Data on individual bank characteristics were taken from the banks' financial statements, whereas data on macroeconomic and market characteristics were derived from publicly available resources. The data panel is unbalanced. The list of variables is given in Table II.

The basic summary statistics are given in Table III.

To ensure assumptions for the linear model and stationarity, log differences of variables have been applied. From the results of the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test [22], the stationarity of the variables can be assured (the results can be obtained on request).

Distribution of the dependent variable, as presented in Fig. 1, points rather to a low heterogeneity among the examined banks.

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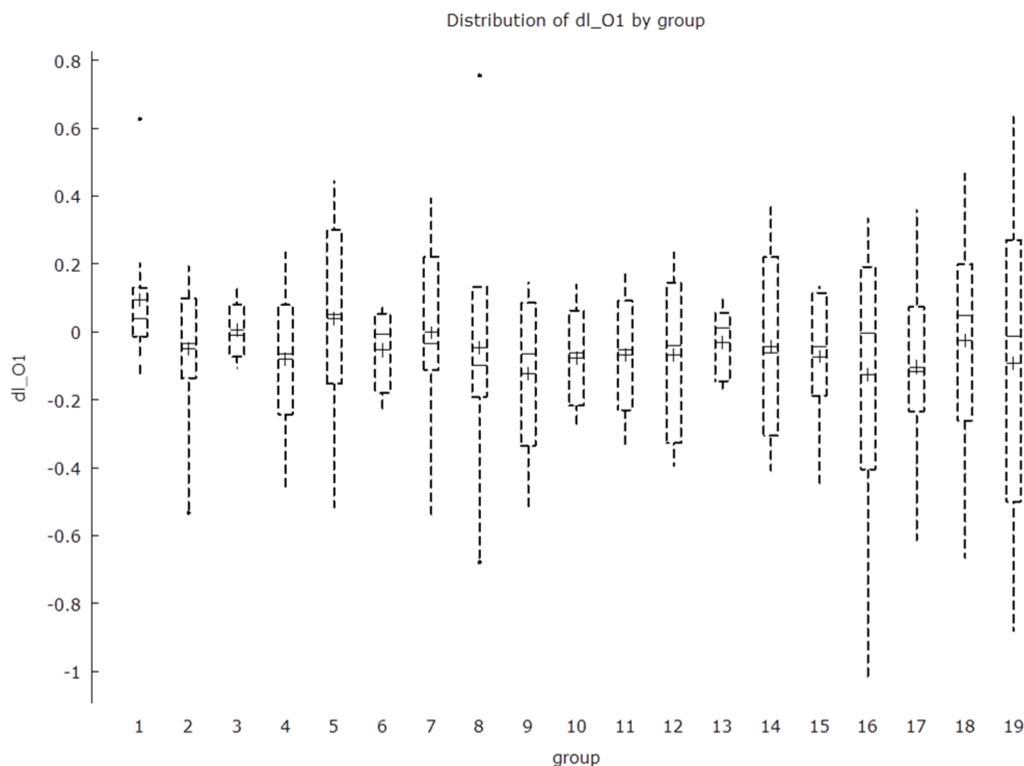

Fig. 1 Distribution of dependent variable by groups

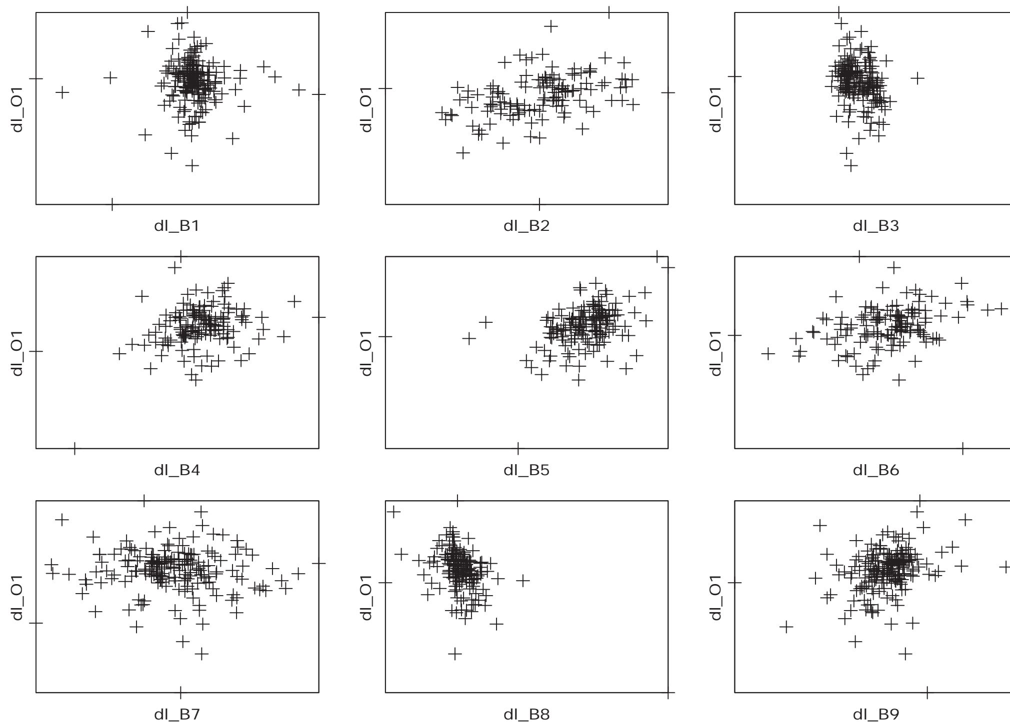

Fig. 2 Multiple scatter plot

The multiple scatter plot in Fig. 2 exhibits a linear correlation between the dependent variable and explanatory variables.

It can be ensured that multicollinearity is not an issue, as the specification has been tested for the variance inflation factor. The results are shown in Table IV.

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TABLE II
LIST OF VARIABLES

Symbol	*Description*	*Proxy*	*Type*
dl_O1	Liquid assets/total assets	Liquidity buffer	Dependent variable, bank characteristic
dl_S1	bank non-performing loans/total gross loans	Assets quality	Explanatory variable, market characteristic
dl_B1	liabilities to banks/total assets	Stability of funding	Explanatory variable, bank characteristic
dl_B2	Tier I/(capital requirements*12.5)	Capital adequacy	Explanatory variable, bank characteristic
dl_B3	interest expense/average liabilities to clients	Cost of funding	Explanatory variable, bank characteristic
dl_B4	contractual outflows from clients' deposits within 1 month/total time deposits	Cash flows	Explanatory variable, bank characteristic
dl_B5	(time deposits + bank debt obligations)/gross loans to clients	Stability of funding	Explanatory variable, bank characteristic
dl_B6	cumulated assets contractually maturing within 3 months/ cumulated liabilities contractually due within 3 months	Cash flows	Explanatory variable, bank characteristic
dl_B7	total liabilities/own funds	Financial leverage	Explanatory variable, bank characteristic
dl_B8	total gross loans/total deposits	Liquidity	Explanatory variable, bank characteristic
dl_B9	gross loans to banks/liabilities to banks	Interbank market	Explanatory variable, bank characteristic
foreign	0 – if domestic bank, 1 – if foreign-owned bank		Explanatory dummy variable
crisis	1 – for the years 2008 and 2009, 0 – for the remaining years		Explanatory dummy variable

TABLE III
SUMMARY STATISTICS, USING THE OBSERVATIONS 1:01 - 19:11
(MISSING VALUES WERE SKIPPED)

Variable	*Mean*	*Median*	*Minimum*	*Maximum*	*Std. Dev.*
dl_O1	-0.0558473	-0.0338727	-1.47571	0.755628	0.275913
dl_S1	-0.110411	-0.0469845	-0.611184	0.418281	0.292149
dl_B1	-0.0365835	-0.0445655	-5.05358	3.98172	0.865612
dl_B2	-0.00204350	0.0105791	-0.544184	0.452031	0.170534
dl_B3	-0.0586523	-0.0842357	-2.31456	2.81828	0.383276
dl_B4	0.0370006	0.0320611	-1.42562	1.10371	0.307844
dl_B5	-0.0906197	-0.0619313	-1.41841	0.465281	0.213732
dl_B6	-0.0471141	-0.0174108	-1.02703	0.781692	0.268683
dl_B7	-4.89934e-005	0.00233424	-0.481123	0.509834	0.163215
dl_B8	0.00728257	-0.00318039	-0.432302	1.21442	0.136171
dl_B9	-0.203328	-0.110681	-6.53801	5.21058	1.25537

IV. EMPIRICAL SPECIFICATION

In a panel regression analysis, a dependent variable has been defined as the ratio of liquid assets to total assets. The buffer of liquid assets consists of cash, loans to other banks, and available assets held for trading – excluding derivatives, assuming that these portfolios consist mainly of Polish sovereign bonds, which are deemed liquid, according to the Commission Delegated Regulation (EU) 2015/61 of 10 October 2014 to supplement Regulation (EU) No 575/2013 of the European Parliament and the Council with regard to liquidity coverage requirement for credit institutions [23]. It has to be noted, though, that the approach undertaken in this study does not allow for approximation of the liquid assets as understood under relevant provisions of the Commission Delegated Regulation (EU) 2015/61, as it would require more information, which is not publicly available.

TABLE IV
VARIANCE INFLATION FACTORS

dl_S1	2.200
dl_B1	2.511
dl_B2	2.546
dl_B3	1.723
dl_B4	1.600
dl_B5	1.894
dl_B6	1.234
dl_B7	2.330
dl_B8	1.621
dl_B9	2.687
foreign	1.113
crisis	1.554

Minimum possible value = 1.0.
Values > 10.0 may indicate a collinearity problem.
VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient between variable j and the other independent variables.

The set of explanatory variables has been defined to allow for approximation of the different bank characteristics, such as asset quality, capital adequacy, stability of funding, cost of funding, financial leverage, cash flow structure or reliance on the interbank market, which can altogether affect banks' liquidity management in terms of the amount of liquidity buffer maintained over time in response to the changes of these factors. These variables serve as control variables. Taking first differences of the variables' logarithms leads to the interpretation of the coefficients in terms of elasticities.

To empirically test the main research hypothesis, a dummy variable (foreign) has been included that takes the value of "0" for domestic banks and "1" for foreign-owned banks. If this dummy variable proves to be statistically significant, the sign of the coefficient permits the assessment of the behaviour of the foreign-owned banks in terms of the rate of changes of their liquidity buffers over the examined years, while controlling for the behaviour of domestic banks.

The statistical significance of the *foreign* dummy variable would also allow the preliminary acceptance or rejection of the supplementary research hypothesis of the differences between the liquidity risk profiles of the foreign-owned banks and domestic banks. This research hypothesis can be further confirmed based on the results of the Chow test, which examines whether the parameters of one group (foreign-owned banks) are equal to those of the other group (domestic banks) in two linear regressions [24].

The basic empirical model (1) has been specified as:

$$dl_O1_{it} = \alpha_0 + \beta_1 dl_S1_{it} + \beta_2 dl_B1_{it} + \beta_3 dl_B2_{it} + \beta_4 dl_B3_{it} + \beta_5 dl_B4_{it} + \beta_6 dl_B5_{it} + \beta_7 dl_B6_{it} + \beta_8 dl_B7_{it} + \beta_9 dl_B8_{it} + \beta_{10} dl_B9_{it} + foreign_i + \varepsilon_{it} \quad (1)$$

where i = 1, 2, 3, …, 19; t = 1, 2, 3, …, 11. The subscript i stands for the respective bank, and the subscript t stands for the respective year. Here, *dl_O1* is a dependent variable that varies over banks and time, *dl_S1, dl_B1, dl_B2, dl_B3, dl_B4, dl_B5, dl_b6, dl_B7, dl_B8, dl_B9* are independent variables that vary among banks and over time; *foreign* is a time invariant independent variable, whereas ε denotes an error term.

The second regression model (2), which is used to test for differences in the banks' behaviour in times of crisis, has been specified as:

$$dl_O1_{it} = \alpha_0 + \beta_1 dl_S1_{it} + \beta_2 dl_B1_{it} + \beta_3 dl_B2_{it} + \beta_4 dl_B3_{it} + \beta_5 dl_B4_{it} + \beta_6 dl_B5_{it} + \beta_7 dl_B6_{it} + \beta_8 dl_B7_{it} + \beta_9 dl_B8_{it} + \beta_{10} dl_B9_{it} + foreign_i + crisis_i + \varepsilon_{it} \quad (2)$$

Here, *crisis* is an independent variable that takes the value of 1 for the years 2008 and 2009.

The third regression model (3), which is used to test whether the foreign-owned banks themselves behaved differently in times of crisis, has been specified as:

$$dl_O1_{it} = \alpha_0 + \beta_1 dl_S1_{it} + \beta_2 dl_B1_{it} + \beta_3 dl_B2_{it} + \beta_4 dl_B3_{it} + \beta_5 dl_B4_{it} + \beta_6 dl_B5_{it} + \beta_7 dl_B6_{it} + \beta_8 dl_B7_{it} + \beta_9 dl_B8_{it} + \beta_{10} dl_B9_{it} + foreign\ x\ crisis_i + \varepsilon_{it} \quad (3)$$

Here, *crisis x foreign* is an independent variable representing an interaction term between two dummy variables – *foreign* and *crisis*.

V. Results

The results of the three pooled ordinary least square regression analyses are presented in Table V, whereas the results of the three estimated equations (1)-(3) are summarized in Tables VI–VIII.

TABLE V
POOLED OLS, USING 93 OBSERVATIONS INCLUDED 15 CROSS-SECTIONAL UNITS TIME-SERIES LENGTH: MINIMUM 2, MAXIMUM 9 DEPENDENT VARIABLE: DL_O1

Variable	*(1)*		*(2)*		*(3)*	
	Coefficient	*p-value*	*Coefficient*	*p-value*	*Coefficient*	*p-value*
const	0.03255	0.3102	0.04164	0.1997	0.03728	0.0430**
dl_S1	0.17314	0.0107**	0.19350	0.0050***	0.19407	0.0046***
dl_B1	0.05317	0.0307**	0.05192	0.0956*	0.05243	0.0889*
dl_B2	0.33376	0.0074***	0.38663	0.0028***	0.38705	0.0026***
dl_B3	−0.1311	0.0743*	−0.1162	0.1138	−0.1163	0.1111
dl_B4	0.13385	0.0375**	0.11387	0.0799*	0.11378	0.0783*
dl_B5	0.37630	0.0009***	0.34558	0.0025***	0.34781	0.0020***
dl_B6	0.15003	0.0135**	0.14750	0.0145**	0.14900	0.0119**
dl_B7	0.32628	0.0135**	0.42990	0.0041***	0.43327	0.0034***
dl_B8	−0.9173	<0.0001***	−0.9011	<0.0001***	−0.8933	<0.0001***
dl_B9	0.07527	0.0005***	0.06631	0.0026***	0.06627	0.0025***
foreign	−0.0126	0.7239	−0.0058	0.8699		
crisis			−0.0576	0.1371		
foreign x crisis					−0.0584	0.1265

TABLE VI
OUTPUT FROM THE REGRESSION ANALYSIS (1)

Mean dependent var	−0.021155	S.D. dependent var	0.217535
Sum squared resid	1.351894	S.E. of regression	0.129190
R-squared	0.689474	Adjusted R-squared	0.647304
F(11, 81)	16.34982	P-value(F)	2.33e-16
Log-likelihood	64.78453	Akaike criterion	−105.5691
Schwarz criterion	−75.17786	Hannan-Quinn	−93.29796
rho	−0.110549	Durbin-Watson	1.910840

TABLE VII
OUTPUT FROM THE REGRESSION ANALYSIS (2)

Mean dependent var	−0.021155	S.D. dependent var	0.217535
Sum squared resid	1.314834	S.E. of regression	0.128201
R-squared	0.697987	Adjusted R-squared	0.652685
F(12, 80)	15.40744	P-value(F)	3.39e-16
Log-likelihood	66.07707	Akaike criterion	−106.1541
Schwarz criterion	−73.23035	Hannan-Quinn	−92.86046
rho	−0.111178	Durbin-Watson	1.891876

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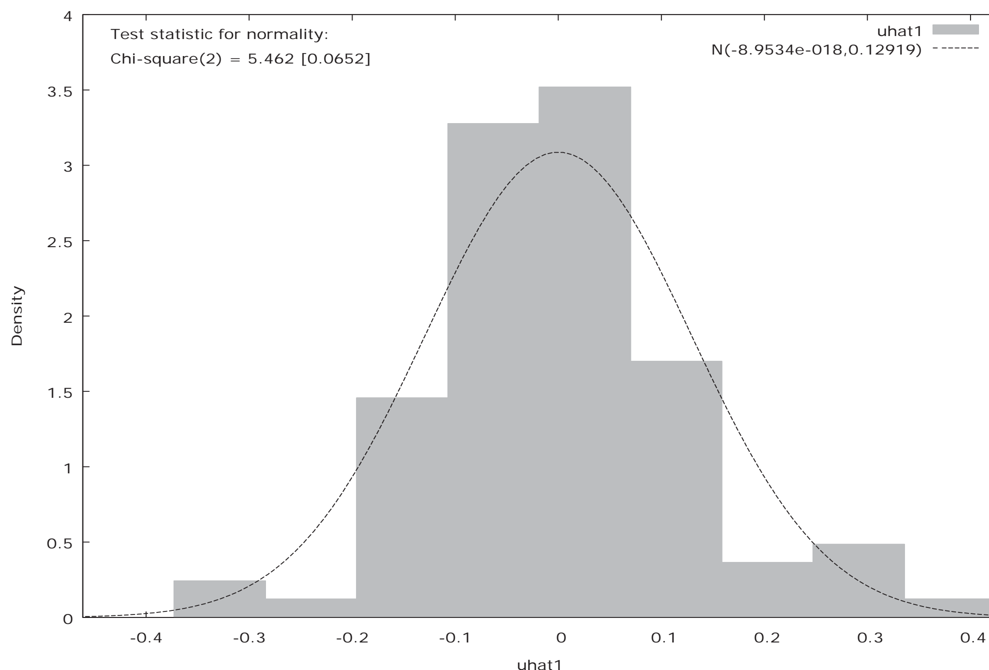

Fig. 3 Normality of residuals

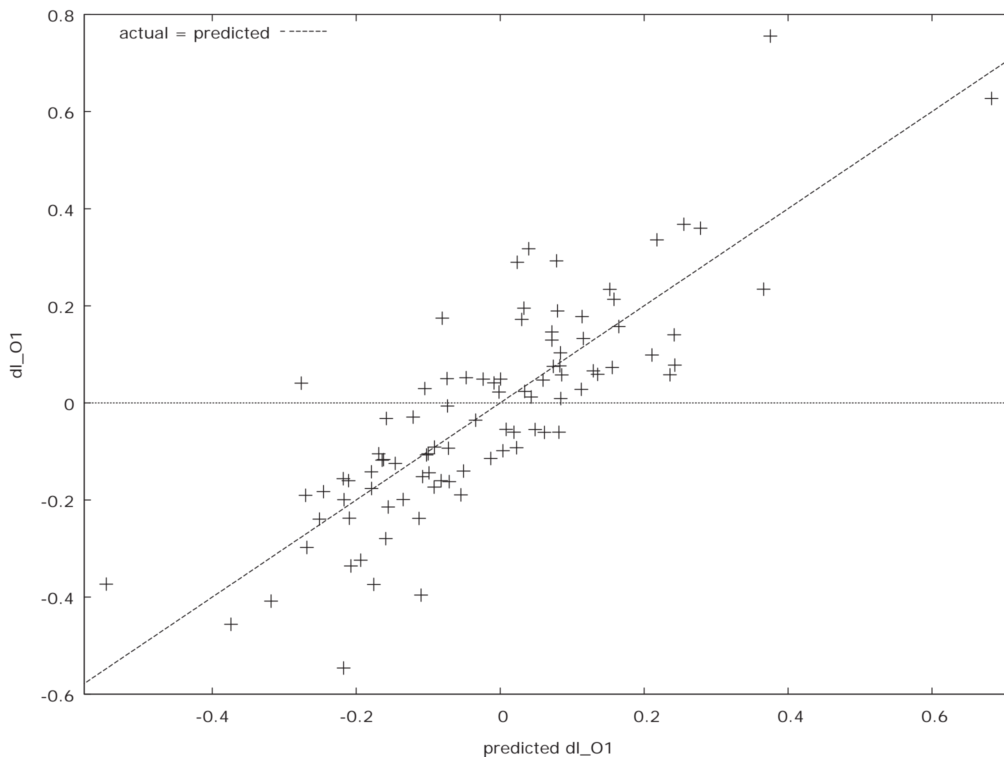

Fig. 4 Fitted, actual plot

The diagnostic tests point to a proper specification. The residuals are normally distributed, as shown in Fig. 3.

The assumption of homoscedasticity can be assured from White's test, where the null hypothesis is that heteroscedasticity is not present, with p-values significantly greater than 0.3 for all the regressions performed (1), (2), (3). It can also be assured from the D-W statistic that there is no autocorrelation present.

The models' fitting is satisfactory, with an R-squared of approximately 69%. The goodness of fit is presented in Fig. 4.

TABLE VIII
OUTPUT FROM THE REGRESSION ANALYSIS (3)

Mean dependent var	−0.021155	S.D. dependent var	0.217535
Sum squared resid	1.315277	S.E. of regression	0.127428
R-squared	0.697885	Adjusted R-squared	0.656857
F(11, 81)	17.01000	P-value(F)	8.07e-17
Log-likelihood	66.06138	Akaike criterion	−108.1228
Schwarz criterion	−77.73156	Hannan-Quinn	−95.85166
rho	−0.110644	Durbin-Watson	1.889555

The panel diagnostic tests do not allow rejection of the hypothesis that the pooled OLS model is adequate, compared with the fixed effects (a) or random effects (b) alternatives. For explanatory reasons, the results of these tests for regression model (1) are presented below:

(a) Joint significance of differing group means: F(14, 68) = 0.392684 with a p-value of 0.972589. A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favour of the fixed effects alternative.

(b) Breusch-Pagan test statistic: LM = 3.00515 with p-value = prob(chi-square(1) > 3.00515) = 0.0830004. A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favour of the random effects alternative.

It has been found from the regression (1) that the dynamics of change of the liquidity buffers was slightly lower for the foreign-owned banks than for the domestic banks, holding all other independent variables constant, although the relationship was not statistically significant. If the relationship was significant, it could suggest more prudent behaviour and a stabilizing role of the foreign-owned banks, possibly stemming from the fact that the foreign-owned banks can obtain funding from their parents operating abroad in case of increased liquidity needs. From the regression (2), it can be assumed that during the financial crisis, the rate of growth of the liquidity buffers was slightly lower for all banks, possibly indicating liquidity constraints, although this relationship is also statistically insignificant. Finally, taking into account the results of the regression (3), it can be concluded that the rate of growth of the liquidity buffers in times of crisis was somewhat lower in case of the foreign-owned banks compared to the domestic banks; however, this relationship also remains statistically insignificant.

The results of the three regression analyses performed in this study do not allow unambiguous confirmation of the main research hypothesis that foreign-owned banks do not pose a threat to the liquidity position of the Polish banks. The main research hypothesis cannot be rejected either because no statistically significant differences have been found in terms of the dynamics of changes of the liquidity buffers between the foreign-owned banks and the domestic banks, which indicates a similar behaviour of these two groups of banks in terms of the management of their liquidity buffers.

To test the supplementary research hypothesis that there are significant differences regarding the liquidity risk profiles of foreign-owned banks and domestic banks, the Chow test for structural difference has been performed (Tables IX and X).

TABLE IX
AUGMENTED REGRESSION FOR CHOW TEST OLS, USING 93 OBSERVATIONS
DEPENDENT VARIABLE: DL_O1

Variable	*Coefficient*	*Std. error*	*t-ratio*	*p-value*
const	0.0486902	0.0400846	1.215	0.2285
d_l_S1	0.0915050	0.194842	0.4696	0.6401
dl_B1	0.0950699	0.0980334	0.9698	0.3355
dl_B2	0.262288	0.327883	0.7999	0.4264
dl_B3	0.106912	0.331388	0.3226	0.7479
dl_B4	0.434326	0.213805	2.031	0.0460 **
dl_B5	0.720511	0.370628	1.944	0.0559 *
dl_B6	0.0925447	0.216434	0.4276	0.6702
dl_B7	0.125674	0.415317	0.3026	0.7631
dl_B8	−0.888622	0.604058	−1.471	0.1457
dl_B9	0.107576	0.0787160	1.367	0.1761
foreign	−0.0293601	0.0439263	−0.6684	0.5060
fo_d_l_S1	0.163358	0.209693	0.7790	0.4385
fo_dl_B1	−0.0340588	0.108606	−0.3136	0.7547
fo_dl_B2	0.0348779	0.353974	0.09853	0.9218
fo_dl_B3	−0.311068	0.341310	−0.9114	0.3652
fo_dl_B4	−0.378870	0.224723	−1.686	0.0962*
fo_dl_B5	−0.449475	0.390811	−1.150	0.2540
fo_dl_B6	0.0604590	0.225778	0.2678	0.7896
fo_dl_B7	0.373446	0.443531	0.8420	0.4026
fo_dl_B8	0.223045	0.655775	0.3401	0.7348
fo_dl_B9	−0.0334904	0.0817992	−0.4094	0.6835

TABLE X
OUTPUT FROM THE CHOW TEST OLS

Mean dependent var	−0.021155	S.D. dependent var	0.217535
Sum squared resid	1.161265	S.E. of regression	0.127890
R-squared	0.733261	Adjusted R-squared	0.654367
F(21, 71)	9.294192	P-value(F)	4.18e-13
Log-likelihood	71.85237	Akaike criterion	−99.70474
Schwarz criterion	−43.98755	Hannan-Quinn	−77.20773

In the Chow test with respect to foreign, the null hypothesis is that there is no structural difference.

Test statistic: F(11, 71) = 1.07121 with p-value = P(F(11, 71) > 1.07121) = 0.396502

From the results of the Chow test, it can be assumed that the independent variables have similar impacts on both the foreign-owned and domestic banks. Therefore, at a confidence level of 5%, the supplementary research hypothesis should be rejected. The model should be perceived as stable.

VI. ROBUSTNESS CHECK

It can be argued that loans to other banks should not be included in the liquidity buffer because of their weak performance during the recent financial crisis (it is widely acknowledged that banks were imposing tighter limits and shortening the maturities of the interbank exposures). An additional regression model has been proposed and presented in Tables XI and XII as a robustness check, where the interbank loans are excluded from the banks' liquidity buffers.

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TABLE XI
POOLED OLS, USING 93 OBSERVATIONS INCLUDED 15 CROSS-SECTIONAL UNITS TIME-SERIES LENGTH: MINIMUM 2, MAXIMUM 9 DEPENDENT VARIABLE: DL_O1_2

Variable	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
const	0.0741334	0.0399208	1.8570	0.0669*
dl_B1	−0.114502	0.0371306	−3.0838	0.0028***
dl_B2	0.50711	0.143429	3.5356	0.0007***
dl_B3	−0.1693	0.0824382	−2.0537	0.0432**
dl_B4	0.142676	0.0791434	1.8028	0.0751*
dl_B5	0.175451	0.134347	1.3059	0.1952
dl_B6	0.154609	0.0715939	2.1595	0.0337**
dl_B7	0.33892	0.162996	2.0793	0.0407**
dl_B8	−1.46816	0.270045	−5.4367	<0.0001***
dl_B9	−0.056005	0.0259923	−2.1547	0.0341**
foreign	−0.0480353	0.0451075	−1.0649	0.2900

TABLE XII
OUTPUT FROM THE REGRESSION ANALYSIS (4)

Mean dependent var	0.033962	S.D. dependent var	0.235907
Sum squared resid	2.177160	S.E. of regression	0.162944
R-squared	0.574772	Adjusted R-squared	0.522915
F(10, 82)	11.08378	P-value(F)	1.04e-11
Log-likelihood	42.62660	Akaike criterion	−63.25319
Schwarz criterion	−35.39460	Hannan-Quinn	−52.00469
rho	−0.195242	Durbin-Watson	2.021426

The results of the regression model (4) also indicate that the relationship between the dummy variable *foreign* and the dependent variable was not significant over the examined period. The coefficient of the dummy variable is negative, which suggests lower dynamics of changes of the liquidity buffers in the case of foreign-owned banks, controlling for the domestic banks.

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