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Current Problems of Banking Sector Functioning in Poland and in East European Countries ISSN 1899-3192

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BANK LIQUIDITY DETERMINANTS IN CEE COUNTRIES

Summary: The aim of this paper is to identify the determinants of changes in banks' liquidity position. The research is based on a sample of 21 banks from 5 CEE countries. The data derived from annual consolidated financial statements of banks cover a period of 9 years, from 2004 to 2012. The sample is unbalanced. The results of the pooled OLS estimation deliver evidence of a statistically significant relationship between the changes in banks' liquidity and the changes in banks' profitability, opportunity cost, capitalization, market power and unemployment rate.

Keywords: bank liquidity, liquidity determinants, CEE.

1. Introduction

Bank liquidity might be perceived as an ability to fund increases in assets and fully meet both potential and contractual obligations as they come due, without incurring unacceptable losses.[1]

The recent financial crisis has changed the landscape in which banks operate. As a consequence, liquidity risk[2] had to be redefined. Banks can hedge against the liquidity risk by introducing one of the following strategies (or combining them together).[3] First, they can build up liquidity reserves in order to absorb the liquidity shocks once they occur. Second, banks may proactively manage refinancing

[1] BCBS, Principles for Sound Liquidity Risk Management and Supervision, Bank for International Settlements, Basel 2008.

[2] "Funding liquidity risk is the risk that the firm will not be able to meet efficiently both expected and unexpected current and future cash flow and collateral needs without affecting either daily operations or the financial condition of the firm" [BCBS, *op. cit.*].

[3] O. Aspachs, E. Nier, M. Tiesset, *Liquidity, Banking Regulation and the Macroeconomy. Evidence on Bank Liquidity Holdings from a Panel of UK-resident Banks*, unpublished manuscript, BIS, 2005, www.bis.org/bcbs/events/rtf05AspachsNierTiesset.pdf [accessed: 10.07.2013].

operations on the interbank market; however, this strategy refers mainly to the biggest banks. Last but not least, banks tend to rely on the support provided by a central bank, which acts as the Lender of Last Resort (LOLR).

The liquidity concerns are widely debated due to their systemic consequences in the case of a crisis. It should be noted that not only the problems of illiquidity may lead to a banking sector distress, but also the central bank's policy becomes ineffective in the event of an excessive bank liquidity. Along with the new regulatory standards on liquidity, which were initially proposed by the Basel Committee in 2008,[4] there emerged a need for identification of the determinants of the liquidity policies of banks and this is what the present paper aims at. It is structured as follows. The first part delivers a review of the related literature. The second part describes the process of data collection and the research methodology. In the third part of the paper the results are discussed. The paper ends with certain conclusions drawn from the empirical results.

2. Literature review

The empirical evidence on bank liquidity policies is relatively scarce, although the research has become more intense since 2007. There are several papers worth mentioning while making an attempt to explain the changes in banks' liquidity policies. Aspach, Nier and Tiesset[5] proposed a study of both idiosyncratic determinants and macrodeterminants of banks' liquidity buffers. They based their research on a sample of the UK-resident banks, finding that central bank LOLR policy negatively affects the liquidity buffer that banks hold. Second, they found that UK banks pursue a counter-cyclical liquidity policy. Deléchat, Henao, Muthoora, Vtyurina[6] analyzed a panel of about 100 commercial banks from Central America to find that the demand for precautionary liquidity buffers is associated with measures of bank size, profitability, capitalization, and financial development. Munteanu[7] proposed an analysis based on a panel of 27 commercial banks from Romania, finding that Z-score had an important influence on bank liquidity during the crisis period. Trenca, Petria, Mutu, Corovei[8] used a panel of 30 banks from Central and Eastern European countries to discover several factors that determine liquidity, such as the

[4] BCBS, *op. cit.*

[5] O. Aspachs, E. Nier, M. Tiesset, *op. cit.*

[6] C. Deléchat, C. Henao, P. Muthoora, S. Vtyurina, *The Determinants of Banks' Liquidity Buffers in Central America*, IMF Working Paper, WP/12/301, International Monetary Fund, December 2012.

[7] I. Munteanu, Bank liquidity and its determinants in Romania, *Procedia Economics and Finance* 2012, No. 3, 2012, pp. 993–998.

[8] I. Trenca, N. Petria, S. Mutu, E. Corovei, Evaluating the liquidity determinants in the Central and Eastern European banking system, *Finance – Challanges of the Future* 2012, No. 14/2012, Year XII, pp. 85–90.

lending interest rate, the spread between the lending interest rate and deposit interest rate, the credit flow to the private sector, the ratio between equity and total assets, the private debt, and the current account balance. Tseganesh[9] used a sample of 8 commercial banks from Ethiopia during 2000–2011. The results of fixed effects regression showed that the capital adequacy, the bank size, the share of non-performing loans in the total volume of loans, the interest rate margin, the inflation rate and the short term interest rate had a positive and statistically significant impact on banks' liquidity. He also found that the impact of bank liquidity on financial performance was non-linear (positive and negative). Vodová[10] proposed an interesting analysis of banks' liquidity determinants, based on a sample of about 30 commercial banks from Poland during 2001–2010. Vodová[11] performed fixed effects regression to determine the factors that influence liquidity of Polish banks, such as the overall economic conditions, the financial crisis, the unemployment rate, the profitability measures, the interest rate margins, the size of banks, the capital adequacy, the inflation rate, the share of non-performing loans, the interest rates on loans and the interbank transactions.

Distinguin, Roulet and Tarazi[12] investigated the relationship between bank regulatory capital buffer and liquidity for European and US publicly traded commercial banks by using the simultaneous equations framework. They found that banks do not strengthen their regulatory capital buffer when they face higher illiquidity as defined in the Basel III accords or when they create more liquidity. They also proved that smaller banks do not behave similarly to the bigger ones, which imposes a need to regulate them differently. What is more, the results of their research highlighted a need to further develop the definition and measurement of illiquidity. Finally, Berrospide[13] found that unrealized securities losses and loan loss reserves provide supporting evidence for the precautionary motives of liquidity hoarding. He conducted the research by using a panel data of US commercial banks between 2005 and 2009 on a quarterly basis.

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[9] T. Tseganesh, *Determinants of Banks Liquidity and their Impact on Financial Performance: Empirical Study on Commercial Banks in Ethiopia*, A thesis submitted to the Department of Accounting and Finance, College of Business and Economics, Addis Ababa University, Ethiopia, June 2012.

[10] P. Vodová, Determinants of commercial banks' liquidity in Poland, [in:] *Proceedings of 30th International Conference Mathematical Methods in Economics 2012*, Karviná: Silesian University, School of Business Administration, 2012, pp. 962–967.

[11] *Ibidem*.

[12] I. Distinguin, C. Roulet, A. Tarazi, Bank Regulatory Capital Buffer and Liquidity: Evidence from U.S. and European publicly traded banks, *Journal of Banking & Finance* 2013, Vol. 37, Issue 9, September, pp. 3295–3317.

[13] J. Berrospide, *Bank Liquidity Hoarding and the Financial Crisis: An Empirical Evaluation*, Finance and Economics Discussion Series, No. 2013-03, Divisions of Research & Statistics and Monetary Affairs. Federal Reserve Board, Washington, D.C., 2013.

The results of the research described herein are somewhat ambiguous. The concerns of banks' liquidity policies seem not to be explored sufficiently. Therefore, the need to conduct further analysis is justifiable.

3. Data and methodology

The research was based on the data collected manually from the annual consolidated financial statements of banks over the nine-year time span, ranging from 2004 to 2012. Only the largest banks were taken into consideration. The data allows for an average coverage of 50% of the banking sector assets in each examined country. The panel data sample, which is unbalanced, consists of 21 banks operating in 5 Central and Eastern European countries (CEE), namely: Poland, the Czech Republic, Slovakia, Slovenia and Hungary (see Table 1).

Table 1. The sample

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012
Poland, an average coverage of 51% of the banking sector assets									
Number of banks	5	5	6	6	6	6	6	6	6
Banking sector assets coverage (%)	48	47	49	54	51	54	52	49	52
The Czech Republic, an average coverage of 50% of the banking sector assets									
Number of banks	5	5	5	5	4	5	5	5	4
Banking sector assets coverage (%)	52	54	57	56	48	50	49	50	42
Slovakia, an average coverage of 49% of the banking sector assets									
Number of banks	3	3	3	3	3	3	3	3	2
Banking sector assets coverage (%)	52	47	52	50	54	56	54	40	35
Slovenia, an average coverage of 54% of the banking sector assets									
Number of banks	3	3	3	3	3	3	3	3	3
Banking sector assets coverage (%)	57	59	61	55	53	54	52	48	44
Hungary, an average coverage of 52% of the banking sector assets									
Number of banks	4	4	4	4	4	4	4	4	3
Banking sector assets coverage (%)	51	52	55	56	55	55	52	48	44

Source: own computation.

In order to identify the determinants of banks' liquidity position, an econometric model was proposed. The Pooled Ordinary Least Squares (pooled OLS) method was deployed for the estimation of banks' liquidity variance. An introduction of 4 dummy variables allowed for country identification, hence the Czech Republic = 1 if the Czech Republic and 0 otherwise, Slovakia = 1 if Slovakia and 0 otherwise, Slovenia = 1 if Slovenia and 0 otherwise, Hungary = 1 if Hungary and 0 otherwise. Poland served as a control group. Observation of the residuals (see Appendix) allowed for further introduction of 3 dummy variables reflecting the crisis period:

dt_5 = 1 if 2008 and 0 otherwise, dt_6 = 1 if 2009 and 0 otherwise, dt_7 = 1 if 2010 and 0 otherwise.

Both dependent and independent variables are listed in Tables 2 and 3. The variables were transformed to log differences in order to ensure that they are normally distributed. The coefficients can be then interpreted in terms of percentage changes.

Table 2. Dependent variable

Dependent variable	
ld_Liq_I	log difference of liquid assets/total assets as a proxy for liquidity shock absorption capacity

Source: own work.

Table 3. Independent variables

Independent variables	Name	Proxy (log differences)	Expected impact on liquidity	Data source
Bank specific factors				
Assets Risk	ld_AR	loan loss provisions/gross loans to the non-financial sector	positive (+)	Banks FS
Capitalization	ld_CAP	equity/total assets	positive (+)	Banks FS
Size	ld_ln_A	natural logarithm of assets	negative (−)	Banks FS
Profitability	ld_ROA	net profit/total assets	negative (−)	Banks FS
Opportunity cost	ld_OC	gross interest income/net loans to the non-financial sector net of gross interest expense/total deposits	negative (−)	Banks FS
Business model	ld_BM	gross interest income/total gross income	negative (−)	Banks FS
Market power	ld_MP	bank assets/banking sector assets	negative (−)	Banks FS
Funding cost	ld_FC	gross interest expense/total deposits	negative(−)	Banks FS
Macroeconomic factors				
Business cycle	ld_GDP_growth	annual growth rate of GDP	negative (−)	Eurostat
Monetary policy	ld_IB_r	average 3 month interbank rate	positive (+)	OECD
Monetary policy	ld_CB_r	central bank reference rate	positive (+)	Eurostat
Liquidity pressures	ld_IB_CB_ spread	interbank rate and central bank rate spread in bps	positive (+)	OECD/ Eurostat
Opportunity cost	ld_Loan_Dep_r	loan rate and deposit rate spread in bps	negative (−)	ECB
Cost of funding	ld_Dep_r	households and non-profit institutions' deposits of original maturity of over 1 and up to 2 years, annualized agreed rate	negative (−)	ECB
Profitability	ld_Loan_r	households and non-profit institutions' loans due from 1 to 5 years, annualized agreed rate	negative (−)	ECB
Unemployment	ld_Unemp_r	unemployment rate	positive (+)	Eurostat
Financial depth	ld_PSD_GDP	private debt to GDP	negative (−)	Eurostat

Source: own work.

4. Results

It is clear from Figure 1 that there is a significant heterogeneity across banks from different countries in terms of liquidity changes, whereas the problem is the most apparent in the Czech Republic.

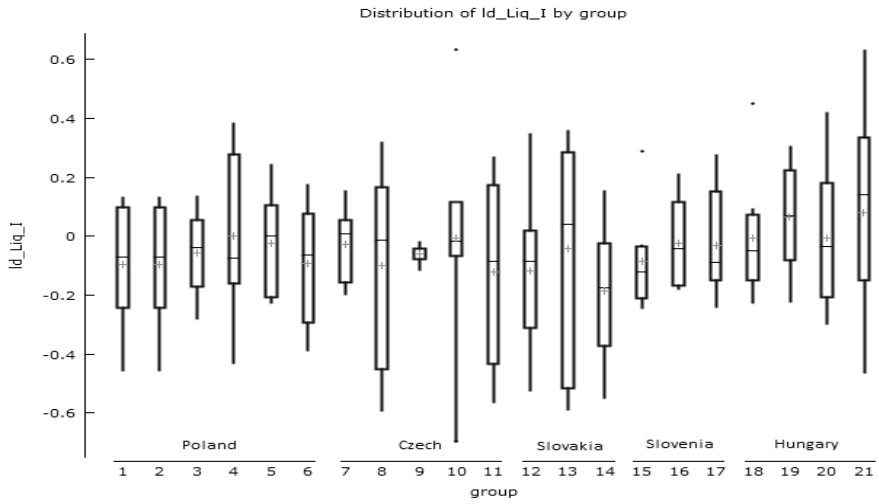

Figure 1. Heterogeneity across banks

Source: own computation.

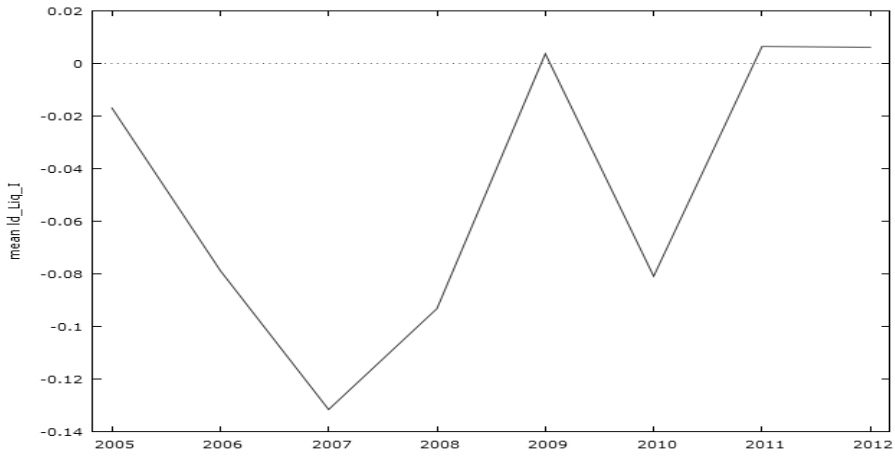

Figure 2. Group means for ld_Liq_I

Source: own computation.

It is interesting to note that, as seen in Figure 2, banks' liquidity levels were declining in the examined CEE countries from 2005 to 2010. The magnitude of the decline decreased only in 2008 and 2009 as a result of the financial crisis. This seems to be the opposite to the theory of a bank liquidity hoarding.[14] On the contrary, banks on average increased their liquidity buffers in 2011 and 2012, probably in anticipation of the new regulatory standards.

The regression results are presented below.

Pooled OLS, using 142 observations
Included 21 cross-sectional units
Time-series length: minimum 3, maximum 8
Dependent variable: ld_Liq_I

	Coefficient	Std. Error	t-ratio	p-value	
const	0.051965	0.0432186	1.2024	0.23142	
ld_CAP	−0.478101	0.169045	−2.8282	0.00543	***
ld_ROA	0.0459936	0.0221008	2.0811	0.03940	**
ld_MP	0.346904	0.20908	1.6592	0.09951	*
ld_OC	0.597921	0.107801	5.5465	<0.00001	***
ld_Unemp_r	0.401065	0.16004	2.5060	0.01345	**
The Czech Rep.	−0.0285611	0.0463827	−0.6158	0.53913	
Slovakia	−0.0507431	0.0525378	−0.9658	0.33593	
Slovenia	0.00544728	0.0608024	0.0896	0.92875	
Hungary	−0.0347659	0.0598493	−0.5809	0.56233	
dt_5	−0.0429306	0.0524395	−0.8187	0.41448	
dt_6	−0.0836864	0.0763851	−1.0956	0.27530	
dt_7	−0.121965	0.0656095	−1.8590	0.06531	*

Mean dependent var	−0.062393	S.D. dependent var	0.229818
Sum squared resid	5.154041	S.E. of regression	0.199884
R-squared	0.307916	Adjusted R-squared	0.243536
F(12, 129)	4.782791	p-value(F)	1.89e-06
Log-likelihood	33.95000	Akaike criterion	−41.90000
Schwarz criterion	−3.474247	Hannan-Quinn	−26.28533
rho	−0.123340	Durbin-Watson	1.999097

The results of the estimation show that there are five variables statistically significant in explaining the variance of liquidity log differences. These are the log

[14] D. Gale, T. Yorulmazer, Liquidity hoarding, *Theoretical Economics* 2013, No. 8, pp. 291–324.

differences of the capitalization, the profitability (ROA), the market power, the opportunity cost (interest margin) and the unemployment rate.

The explanatory power of the model is not very high as an adjusted R-squared is 24%. However, the joint significance of the variables can be ensured as *p*-value (F) is low. It ought to be noted that the coefficient of variation equal to 3.2 is rather high; therefore, the coefficients should be interpreted with caution. What is more, the Durbin-Watson statistic allows for an assumption that there is a lack of autocorrelation. It can also be confirmed[15] that the residuals are normally distributed (with *p*-value = 0.929383). Moreover, the relationship is linear, as proved by the non-linearity test (squared) with *p*-value = 0.136494 and the RESET test for specification with *p*-value = 0.212946. The White's test indicates that the heteroskedasticity is not present with *p*-value = 0.241986. It is worth mentioning that the F test supports the evidence of the pooled OLS model being adequate, in contrast to the fixed effects alternative. In spite of the fact that the Breusch-Pagan test supports the hypothesis that the random effects alternative might be adequate instead of the pooled OLS model, the random effects model does not seem to influence the estimation results, hence the pooled OLS is considered acceptable.

5. Conclusions

As clearly seen in Table 3, the signs of coefficients prove to be somewhat surprising, taking into consideration the former expectations.

Table 4. Comparison between the expectations and empirical results

Independent variables	Name	Proxy (log differences)	Expected impact on liquidity	Empirical results
Bank specific factors				
Capitalization	ld_CAP	equity/total assets	positive (+)	negative (-)
Profitability	ld_ROA	net profit/total assets	negative (−)	positive (+)
Market power	ld_MP	bank assets/banking sector assets	negative (−)	positive (+)
Opportunity cost	ld_OC	gross interest income/net loans to the non-financial sector net of gross interest expense/total deposits	negative (−)	positive (+)
Macroeconomic factors				
Unemployment	ld_Unemp_r	unemployment rate	positive (+)	positive (+)

Source: own work.

[15] See the appendix for the results of robustness tests.

The changes in liquidity holdings are negatively affected by the changes in the capitalization of banks. In other words, the increasing level of capitalization leads to a poorer liquidity position of banks. Therefore, the introduction of the regulatory liquidity standards in line with the capital requirements seems reasonable.

The changes in bank liquidity buffers are positively affected by the changes in profitability measured with ROA. Contrary to a traditional belief, it appears that banks do not have to distinguish between profitability and liquidity. This finding might be reinforced, taking into account that an increase in banks' interest margins boosts the liquidity of banks. The reason for such an exceptional behavior of banks might be that they build up liquidity reserves when they envisage their lending prospects as favorable, as a consequence of experiencing the enhanced profitability.

The changes in bank liquidity were expected to be negatively affected by the changes in market share – the higher the market share, the easier it should be for a bank to access the interbank market. Surprisingly, it occurred that banks tend to increase their liquidity buffers in response to a rise in the market share. This might stem from the fact that banks accumulate liquid assets as a result of undertaking expansionary strategies.

Finally, the changes in bank liquidity holdings are positively affected by the changes in the unemployment rate. This finding corresponds with the initial assumption of a decreasing lending activity of banks connected with a growing unemployment rate, and hence rising liquidity reserves.

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DETERMINANTY PŁYNNOŚCI FINANSOWEJ BANKÓW Z KRAJÓW EUROPY ŚRODKOWO-WSCHODNIEJ

Streszczenie: Celem artykułu jest identyfikacja czynników determinujących zmiany płynności finansowej banków. Badanie przeprowadzono na próbie 21 banków, na przestrzeni 9 lat, w przekroju 5 krajów EŚW. Wykonano estymację panelową MNK, na podstawie której stwierdzono, że istnieje istotna statystycznie zależność pomiędzy zmianami rentowności, kosztu alternatywnego, kapitalizacji, siły rynkowej i stopy bezrobocia a zmianami płynności finansowej banków.

Słowa kluczowe: płynność banku, determinanty płynności, EŚW.

Appendix

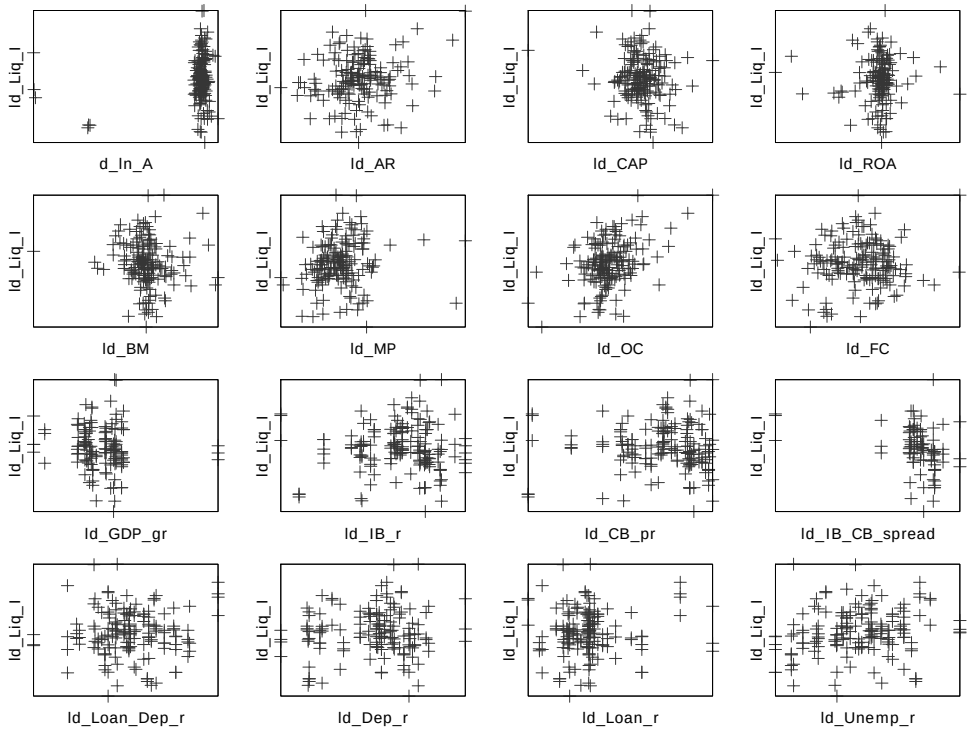

Figure A. Multiple scatter plot

Source: own computation.

Table A. Descriptive statistics

Summary statistics, using the observations 1:1 - 21:9 for the variable "ld_Liq_I" (163 valid observations)	
Mean	−0.049163
Median	−0.049222
Minimum	−0.69463
Maximum	0.63458
Standard deviation	0.23041
C.V.	4.6866
Skewness	−0.016947
Ex. kurtos	0.56411
5% percentile	−0.45942
95% percentile	0.33274
Missing obs.	26

Source: own computation.

Robustness check:

1. Test for normality of residual –

Null hypothesis: error is normally distributed

Test statistic: Chi-square(2) = 0.146469 with *p*-value = 0.929383

2. White's test for heteroskedasticity –

Null hypothesis: heteroskedasticity not present

Test statistic: LM = 78.9588 with *p*-value = P(Chi-square(71) > 78.9588) = 0.241986

3. Non-linearity test (squares) –

Null hypothesis: relationship is linear

Test statistic: LM = 8.38011 with *p*-value = P(Chi-square(5) > 8.38011) = 0.136494

4. RESET test for specification –

Null hypothesis: specification is adequate

Test statistic: F(2, 127) = 1.56571 with *p*-value = P(F(2, 127) > 1.56571) = 0.212946

5. Joint significance of differing group means:

F(20, 113) = 0.349644 with *p*-value 0.995518

A low *p*-value counts against the null hypothesis that the pooled OLS model is adequate, in favor of the fixed effects alternative.

6. Breusch-Pagan test statistic:

LM = 4.31838 with *p*-value = prob(chi-square(1) > 4.31838) = 0.0377028

A low *p*-value counts against the null hypothesis that the pooled OLS model is adequate, in favor of the random effects alternative.