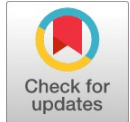


Changes in Financial Performance of Traditional Intermediaries for Financial Innovation



Rajnish kler

Abstract: *The purpose of this thesis is to examine the impact of digital bank deposit, asset and loan growth on selected traditional bank performance measures. In order to estimate whether a causal relationship between digital bank measures and traditional bank performance exists, Granger causality method is selected as the main empirical model. In addition, to determine the direction and strength of said relationship, OLS regressions are performed. Research results lead to the conclusion that digital bank deposit and loan growth have a causal relationship to traditional bank performance ratios. Deposit growth has a negative impact on traditional bank performance ratios and loan growth shows both positive and negative impact on different ratios. This research demonstrates some of the challenges that traditional banks are facing in the age of innovation.*

Keywords: *Financial innovation, digital banks, traditional financial intermediaries, granger causality*

I. INTRODUCTION

We are living in times of innovation and development and witnessing constant change marked by the emergence of new business models in various industries. Innovation is changing the face of business and improving its conditions by creating value for the shareholders. There's no arguing that innovation is one of the most important variables in economic growth. The economic development, in the long run, is impossible without innovation and innovation is the only variable which impacts growth [1]. Even though Solow discusses technological innovation, rather than financial, Without financial innovation technological and economic development would be much slower and as a consequence, wealth of nations would be lower [2]. Thus, financial innovation is critical, both, for the business sector to spur development and growth, which increases shareholder value, and for the public sector to increase the economic growth and thus, the standard of living. The banking sector has always been one of the most vital organs of the economy. Both, the private business sector and the public sector relies on banks for loans and investment opportunities. However, banks not only take deposits and create credits but are also a key element to keeping a stable economy in the region. While banks are one of the most traditional businesses, they are also clearly in the center of the financial world. This makes them more exposed to changes in the industry and the whole economy. According to [3], innovation in the financial industry has been an ongoing process for centuries – beginning with first stock exchanges and continuing with

more recent innovations such as bank teller replacement by ATM's and plastic cards, which are becoming increasingly more important than cash. The banking sector has always adapted and even benefited from innovation. However, nowadays new challenges are posed in front of traditional financial intermediaries as the changes in the industry are as rapid as never before with new competitors rising from the FinTech industry ("companies that use technology for banking, payments, financial data analytics, capital markets and personal financial management" [4], which has been growing as fast as 201% in 2014 [5].

However, even though financial innovation is clearly an important field, there is lack of research made in this area. Most research made in the innovation field is focused on innovation in manufacturing industries. Another tendency seen in more recent research is considering financial innovation as technological innovation in the financial sector (FinTech). This direction is an improvement in the current situation of financial innovation research, however, it still makes up a small part of innovation research and rarely separates different types of FinTech (such as digital banks, electronic money, cryptocurrencies) but handles it as one bundle. Thus, distinguishing digital banks as one of the types of financial innovation and performing an empirical analysis of its impact on traditional bank performance is a great improvement in the current situation of financial innovation research.

II. LITERATURE REVIEW

The aim of literature review is to familiarize the reader with the theoretical background on the concept of innovation, its impact on economic performance, the concept of financial innovation, its various categories and its impact on traditional banking as well as the critique by various authors on the topic and to form a strong base for designing a suitable methodological approach for further empirical research.

Financial innovation field does not have a long history of research and literature behind it - the field of financial innovation is quite recent in scientific terms as the beginning of research on it commences around 1970s. However, despite its novelty due to the rapid rate of innovation in the financial sector and the growing importance of the financial sector itself to the economy, there is a high interest in this field. An unexpected attribute of the field, however, is that although there are some studies conducted, few of them are empirical. Which is even more surprising given the quantity of such research in other fields associated with innovations such as manufacturing. Therefore, there is a gap for empirical research in the financial innovations field. Schumpeter [6] is considered to be the first one to define innovation in scientific research.

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He defined innovation as a change in production system in order to increase profit and decrease costs. Acs & Audretsch [7] defines innovation as “<...> a process that begins with an invention, proceeds with the development of the inventions, and results in the introduction of a new product, process or service to the market-place.”. [8] states that innovation is simply an adoption of an idea or a behavior. [9] agrees with Damanpour by defining innovation as “the adoption of an idea of behavior that is new to the organization” which can be a new product, service, technology or process. [10] have the same idea of innovation being a new idea, practice, behavior or object that is new to the perceiver of it. [11] narrow the definition down by stating that innovation is simply creation of a new product. [12] is even more specific by defining innovation as “a technologically new or significantly enhanced product compared to the firm’s previous product”. Although [13] state that innovation cannot be restricted as it can vary in its complexity and scope from minor changes to existing products, processes or services to completely new products, processes or services. To summarize, to one extent or another, all the definitions above state that innovation is a new invention or an improvement for an older invention that brings better value to the company, consumer and/or economy. Innovation can either complement old services, if used together, or replace them by meeting the same needs of the consumer better [14]. Consumer theory combined with the research conducted by [15] leads to believe that the impact of financial innovation on traditional financial intermediaries is as well headed the same direction. If the innovation can better serve future customers, it will raise a threat for traditional bank existence, however, if the innovation is jointly utilized with traditional financial intermediaries, it can serve as complementary to them. Mishkin [16] discusses that financial innovation is no different than innovation in any other field as it is driven by the same factors as other types of innovation, precisely – changes in technology and market conditions. Although as the financial sector is highly regulated, financial innovation has one additional factor to it – regulation. However, financial innovation regulation is not discussed in this thesis as the topic of regulation itself is very wide and thus is out of scope for this particular research. Other sources, such as [17], choose a very abstract definition – financial innovation is defined simply as the creation of new assets and reduction in transaction costs. In this thesis, a broader approach to financial innovation than the one by Simsek is exploited and financial innovation is perceived as the new creation of a product, process or organizational form (or a significant improvement of an already existing), which brings value to the company using it. According to [18], the main functions of financial intermediaries are pooling savings (e.g. accepting resources through savings accounts from savers and lending to borrowers), safekeeping and accounting (e.g. keeping the savings accounts safe, giving access to savers to payments systems), providing liquidity (e.g. allowing depositors to transfer their financial assets into cash quickly), diversifying risk (e.g. creating different investment opportunities in order to diversify risk), collecting and processing information (e.g. providing financial information to customers). Providing these functions involve various costs incurred by financial intermediaries and financial facilitators. Uncertainties about future due to numerous time periods involved also raise the risk which transfers to costs for financial system participants. As there are costs and risks involved, the demand for better

designed products and processes that are likely to reduce costs and risks is always growing. Thus, financial innovation can be explained as new product or process that reduces costs, risks and/or better satisfies the demands of financial sector participants [19].

III. RESEARCH QUESTIONS

Therefore, the research question is: what is the impact of digital banks on the performance of the traditional banks? In order to answer the research question, the research goal of this study is set: analyze the impact of financial innovation, such as digital banks, on the performance of traditional financial intermediaries, such as traditional banks by concentrating on financial digitalization. This goal is achieved through the following objectives:

1. By analyzing the existing literature on financial innovation, define the concept of financial innovation and create a theoretical background on the subject in order to identify the gap in the current situation;
2. Based on previous research, identify the performance measures of traditional financial intermediaries, which can be impacted by certain factors in digital banks;
3. Identify an appropriate econometrical model to test digital bank impact on traditional financial intermediaries, collect relevant data and determine the possible limitations of the selected model and dataset;
4. Based on the defined research methodology, perform an empirical research to verify whether digital banks challenge the performance of traditional financial intermediaries’;

IV. RESEARCH METHODOLOGY

To answer the research question and reach the research goal, which is to analyze the impact of financial innovation, such as digital banks, on the performance of traditional financial intermediaries, such as traditional banks, several steps are followed:

- Factors which are used to evaluate traditional bank performance and digital bank measures, which might impact them, are determined;
- Economic hypotheses are constructed in accordance to the identified measures to clearly define the purpose and direction of the research;
- An appropriate econometric model which would assist in examining the constructed hypotheses is justified and econometric hypotheses are raised;
- The scope and scale of the traditional and digital bank data set used in the research is described;
- Methods for data testing and modification in the selected model are clarified.

V. EMPIRICAL RESEARCH RESULTS AND DISCUSSION

The empirical research in this thesis is conducted using averaged data from 12 traditional banks and 10 digital banks for the time frame of 2004: Q3-2017: Q4. The summary statistics of the data are reviewed before any transformations or adjustments are made.



The summary statistics of the variables are provided in the table 1.

Table 1: Summary statistics of the un-adjusted data

	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Ex. kurtosis
ROE	0.021316	0.022259	-0.04927	0.041921	0.013607	-2.8599	12.208
ROA	0.002652	0.002807	-0.00563	0.005059	0.001614	-2.8532	11.732
NIM	0.012306	0.011525	0.009634	0.020955	0.001947	2.0955	5.9103
NNIM	-0.00375	-0.00386	-0.01148	0.001804	0.001969	-0.54413	4.4294

From the summary statistics it can be seen that the skewness of all the variables is high ranging from -2.8 to 1.2 and excess kurtosis ranges from -0.14 to 12.2. Both, skewness and excess kurtosis indicate the normality of data distribution. Skewness and kurtosis values that are between -1 and 1 indicate normal distribution, while very high negative or positive values indicate that the data might not be normally distributed and requires transformation. The overview of summary statistics implies that all variables, except deposit growth and Federal Funds rate might need transformation. Normality tests are applied in the following sections and the needed transformations and adjustments are performed.

5.1 Granger causality

First, to perform Granger causality test with VAR, an appropriate number of lags has to be selected. Akaike information criterion (AIC), Schwarz-Bayesian information criterion (BIC) and Hannan-Quinn information criterion (HQC) are used to identify the appropriate number of lags. As the data used is quarterly, max 4 lags are selected to perform the mentioned tests.

From the results it is seen that the recommended number of lags differ between variable pairs and AIC, BIC and HQC tests. Democracy of criterion is followed and models with all recommended lags are built in order to select the model which has less trouble in residuals with autocorrelation and normality. After comparing the autocorrelation and normality of residuals test results, the selected VAR models for the Granger pairs are provided. If the differences of autocorrelation and normality test results are not significantly better for a model with less lags, a model with more lags is selected instead. After the appropriate lag selection, Granger causality tests for variable pairs are run. Summary of test results are provided in table 2; full test results are provided.

Granger causality test reveals that deposit growth in digital banks Granger causes ROA and ROE in traditional banks with 99% confidence level; liabilities to equity in traditional banks with 95% confidence level. Loan growth in digital banks Granger causes loans-to-assets and liabilities-to-equity in traditional banks with 95% confidence level. None of the other variables show causal relationships. As significant Granger causality is confirmed for the previously mentioned variables, hypotheses H1.1., H1.2., H1.6., H3.5. and H2.2.6. (table 2) are failed to reject; other hypotheses (H1.3. through H1.5.; H2.1. through H2.6.; H2.2.1. through H2.2.4.) are rejected.

Further analysis demonstrates the direction of the relationship between digital bank variables and traditional bank performance.

Impulse response analysis is performed next on the models that indicate the existence of a causal relationship. Shock in deposit growth affects ROA after 1 quarter to some extent and then the most drastic impact is seen after 2.5 quarters. ROA returns to normal at quarter 10. Between the initial

shock and the return to normal, ROA seems to fluctuate, but has an increasing trend.

Table 2: Summary of Granger test results

Dependent variable	Independent variable	F-statistic value	p-value	adj. r-squared
	Deposit growth	7.3138	0.0002 ***	0.572148
	Loan growth	0.41246	0.5238	0.358111
	Asset growth	0.5667	0.4552	0.323531
Return on equity	Deposit growth	7.0999	0.0002 ***	0.552352
	Loan growth	0.24662	0.91	0.245463
	Asset growth	1.3512	0.2509	0.103693
Net interest margin	Deposit growth	1.334	0.2739	0.094886
	Loan growth	0.47178	0.627	0.060156
	Asset growth	0.14007	0.7099	0.242436
Net non-interest margin	Deposit growth	2.4223	0.1002	0.272183
	Loan growth	0.13258	0.7174	0.242318
	Asset growth	0.61712	0.608	0.591985
Loans to assets	Deposit growth	0.45417	0.7158	0.587162
	Loan growth	2.6892	0.0592 **	0.64475
	Asset growth	0.63296	0.4302	0.815455
Liabilities to equity	Deposit growth	4.8094	0.0128 **	0.835347
	Loan growth	3.1823	0.0235 **	0.827627

Note: compiled by the author; * - 90% confidence level, ** - 95% confidence level, ***

ROE experiences a very similar effect of a shock in deposit growth, however, the extent to which it is affected is bigger (-0.0008 in ROA vs. -0.007 in ROE). Loan- to-asset ratio experiences a positive effect after 1 quarter of a shock in loan growth in digital banks and then a sharp negative effect after 2 quarters. It does not seem to return to normal and fluctuates between positive and negative values. After a shock in deposit growth, liabilities-to- equities in traditional banks incur a sharp positive effect after 2 quarters and then gradually returns to normal at quarter 7. However, after a shock in loan growth in digital banks, the same variable incurs a small positive effect after 1 quarter, then a sharp negative effect after quarter 2 and again, a positive effect after 4 quarters. It returns to somewhat normal at quarter 6. However, to indicate the significant direction and size of the relationship between traditional bank performance ratios and digital bank variables, an OLS analysis is performed on the variables that show causal relationships.

5.2 Ordinary least squares regression analysis

In this part, 5 OLS regressions are run. For OLS model to be robust, heteroscedasticity should not exist in the model. Thus, the formed OLS regressions are first tested for heteroscedasticity by using White’s test (Appendix 16) and as heteroscedasticity is in fact found in all the models, the models are run using GRETL function of “Heteroscedasticity corrected” model. Summarized results of the OLS analysis can be found in table 3.



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Table 3: Summarized results of OLS analysis

Model	Dependent variable	Independent variable	Coefficient	p-value	adj. r-squared
OLS_1	ROA	Deposit growth t-1	0.0000791	0.985	0.500804
		Deposit growth t-2	-0.00437310	0.0884*	
		Deposit growth t-3	-0.00953934	0.0207**	
		Deposit growth t-4	0.00158599	0.6411	
		FedFunds rate	0.119117	0.0682*	
		Crisis dummy	-0.000967887	0.0444**	
OLS_2	ROE	Deposit growth t-1	0.0150767	0.6575	0.275277
		Deposit growth t-2	-0.0127538	0.6535	
		Deposit growth t-3	-0.0568608	0.0997*	
		Deposit growth t-4	0.0116093	0.684	
		FedFunds rate	0.951963	0.1349	
		Crisis dummy	-0.00800081	0.0245**	
OLS_3	Loans to assets	Loan growth t-1	0.054926	0.0698*	0.225766
		Loan growth t-2	-0.0357887	0.0095***	
		Loan growth t-3	0.0188642	0.2525	
		FedFunds rate	0.0415059	0.9355	
		Crisis dummy	-0.00134319	0.7643	
OLS_4	Liabilities-to-equity	Deposit growth t-1	2.34557	0.001***	0.647909
		Deposit growth t-2	2.69851	0.0003***	
		FedFunds rate	-9.25084	0.5281	
		Crisis dummy	0.172915	0.0173**	
OLS_5	Liabilities to equity	Loan growth t-1	1.86799	0.0017***	0.767764
		Loan growth t-2	-0.0385897	0.9386	
		Loan growth t-3	0.767854	0.2912	
		Loan growth t-4	2.14455	0.0009***	
		FedFunds rate	-14.8570	0.0568*	
		Crisis dummy	0.289808	0.0002***	

Note: compiled by the author

OLS regression results confirm Granger causality test results. Both tests show that deposit growth in digital banks has an impact on traditional bank ROA, ROE and liabilities-to-equities; loan growth in digital banks has an impact on traditional bank loan-to-assets and liabilities-to-equity. In addition, it is worth mentioning that the adjusted r-squared ratios for all the OLS models are considerably high, which indicates that the models fit the data.

Deposit growth in digital banks has a negative impact on both, traditional bank ROA and ROE, which is also seen from impulse response analysis. If deposit growth in digital banks increase by 1%, the ROA of a traditional bank is expected to fall by 0.004% in 2nd quarter and 0.01% in 3rd quarter and the ROE of a traditional bank is expected to fall by 0.06% in 3rd quarter.

On the other hand, deposit growth in digital banks has a positive effect on traditional bank liabilities-to-equity, a solvency measure, as well as predicted by the impulse response analysis. If deposit growth in digital banks increases by 1%, liabilities-to-equity ratio in traditional banks is expected to increase by 2.35% in 1st quarter and 2.7% in 2nd quarter. Similarly, loan growth in digital banks has a positive impact on traditional bank liabilities-to-equity. The same

effect was seen in impulse response analysis, however, a negative effect was noticed in Q2, which even though is seen in OLS analysis, but is not significant. The OLS analysis shows that if loan growth in digital banks increases by 1%, liabilities-to-equity in traditional banks are expected to rise by 1.87% in 1st quarter and 2.14% in 2nd quarter. However, loan growth has a negative impact on loans-to-assets in traditional banks at lag 2. Similarly, in impulse response analysis, the negative effect of a shock in loan growth is observed at Q2, while positive effects are seen at other quarters. In OLS analysis, positive relationship of loan growth in digital banks to loan-to-asset ratio in traditional banks is also seen at lags 1, 3 & 4, however, only the effect in 1st quarter is significant. The significant relationships show that a 1% increase in digital bank loan growth should increase loan-to-asset ratio of traditional banks by 0.05% in 1st quarter and decrease it by 0.03% in the 2nd quarter. The implications of these results are discussed in the next section.

VI. DISCUSSION

The main purpose of this part of the thesis is to summarize the results of the research, review them in the light of previous literature and discuss practical implications of the results as well as consider the implications of the limitations discussed in the research methodology part and provide suggestions for further research in the field.

In the table 4 a summary of research results in the light of previously stated economic hypothesis are presented.

Granger causality test results have shown that changes in deposits in digital banks indeed have an impact on traditional bank performance, thus, H1 is failed to reject. Deposits showed to have a Granger cause relationship with traditional bank ROA, ROE and the selected measure for traditional bank solvency, liabilities to equity. As expected, OLS analysis showed that deposit growth in traditional banks negatively impacts traditional bank ROA and ROE. Because growth levels rather than level data are taken, these results indicate that if digital banks acquire deposits faster, previously mentioned performance ratios in traditional banks decrease. As stated in research methodology part, growth in digital bank deposits is considered to be a proxy for digital bank customer growth. Thus, the pace of digital bank deposit growth is assumed to be a proxy for how fast they attract new customers. The assumption discussed in research methodology part was that customers chose to deposit their funds in digital, rather than traditional banks, due to their ability to offer better conditions and this leads to customer loss in traditional banks. As deposit growth in fact was confirmed to have an impact on traditional bank performance ratios, one of the reasons for this could be the conditions they offer for the customer. Another reason for these results could be the simplicity of managing their finances solely through digital means that digital banks offer their customers. However, in order to verify these assumption, additional analysis should be performed, including a comparison of depositing conditions offered by digital and traditional banks and/or testing customer preferences of ways to manage personal finance.

Table 4: Summary of research results

Economic hypothesis	Econometric model	Result
H1: Deposit growth in digital banks has a negative impact on traditional bank performance	Granger causality	Deposit growth in digital banks causes traditional bank ROA, ROE and SOLVENCY measures; other traditional bank performance ratios do not show Granger cause relationship.
	OLS analysis	Deposit growth in digital banks has a negative relationship with ROA and ROE in traditional banks; positive relationship with SOLVENCY in traditional banks.
H2.1: Asset growth in digital banks has a negative impact on traditional bank performance	Granger causality	Asset growth in digital banks has no Granger cause relationship with traditional bank performance measures
	OLS analysis	N/a
H2.2: Loan growth in digital banks has a negative impact on traditional bank performance	Granger causality	Loan growth in digital banks causes traditional bank RISK and SOLVENCY measures
	OLS analysis	Loan growth in digital banks has a positive relationship with traditional bank RISK at lag 1 and a negative relationship at lag 2; a positive relationship with traditional bank SOLVENCY.

Note: compiled by the author

Non-interest income is a significant part of bank profitability [20]. Net income, which is the numerator in both, ROA and ROE, is constituted of interest income and non-interest income. As the results show that deposit growth impacts ROA and ROE, in the light of the research of DeYoung &

Rice, it can be assumed that this impact is caused through impact on non-interest income. However, deposits in digital banks do not show any causal relationship with net non-interest margin of traditional banks. On the other hand, as was predicted in the limitations of this thesis, the lack of the relationship can be explained through an overview of net non-interest margin formula. The numerator of this ratio is net non-interest income, which should be decreased by growth in digital bank deposits, however, the denominator is traditional bank deposits, which also should be decreased for the same reason. Thus, the decrease in both, numerator and denominator could offset each other and causes the lack of impact on this particular variable. A more detailed analysis on the relationships between digital bank deposits and traditional bank measures might improve and expand the results of this finding. As discussed in the limitations parts of this thesis, to verify the assumption that deposit growth causes impact on ROA and ROE through non-interest income and that there is no causal relationship with net non-interest margin due to counterbalance effect, impact on non-combined measures rather than ratios should be analyzed. To summarize, the performed research has failed to reject two out of three stated economic hypotheses, as deposit and loan growth indeed show impact on some performance measures in traditional banks. Thus, it can be concluded that digital banks in fact have at least partial impact on traditional bank performance. These results significantly contribute to the scarce research on financial innovation impact. In further research, several different approaches to data type, performance measures, methodology or direction of the research can be adapted to broaden the current literature even further.

VII. CONCLUSION

Financial innovation, that could have the biggest impact on traditional financial intermediaries has been identified as digital banks, as they are direct competitors of traditional financial intermediaries, although, they have risen from a synergy of various other financial innovations such as ACH, pre-paid cards and internet banking. Finally, the paper builds a base for further research that might be conducted by eliminating some of the limitations. Analyzing digital bank impact on non-combined financial measures in traditional banks rather than ratios would shine a light on the exact traditional bank factors that are impacted by digital banks. Performing an analysis of level data in addition to growth data and comparing the results might improve the accuracy of the research outcome. Incorporation of discussion of regulatory requirements might bring some interesting implications to light as well as would testing the impact of non-bank financial innovations, such as electronic money institutions impact on traditional financial intermediaries. As usual, a different geographical region or time frame might lead to different results. A comparison of the impact of financial innovation on traditional financial intermediaries in US market and in European market would shine a light on the subject in the global perspective, however, it could only be conducted in later stages as for now, digital banking is still in the start-up phase in Europe, thus, there is no sufficient data to obtain valid results.



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