Negative Nominal Interest Rates: Effect on Bank Profitability

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Abstract

This paper examines the effect of negative interest rates on commercial bank profitability in Denmark, Sweden, Switzerland, and the euro area for the years 2004-2016, observed in quarterly periods. Using a two-way fixed effect model on an unbalanced panel of 29 international banks, this study investigates two measures of bank performance: return on assets (ROA) and return on equity (ROE), as regressands, and finds an adverse effect on both measures with ROE having the greater impact. While this study finds a positive relationship between the nominal interest rate on central banks' deposit facilities and commercial bank profitability, evidence suggests that negative interest rates have not had a significant effect.

JEL classification: C01, C12, C33, C87, E43, E58, F33, G21, O57, Y1

Keywords: International banks, negative interest rates, monetary policy, bank profitability, reserves, panel data

1. Introduction

The central bank of Japan reduced its deposit facility interest rate to -0.10% on February 16th, 2016. Japan's stated reasons are: to counter "persistent deflationary pressure and economic stagnation" (Ilgmann and Menner, 2011, p.385). In Hungary, the Magyar Nemzeti Bank's (MNB) deposit facility rate is -0.05% and has been in negative territory since March 23rd, 2014. The MNB implemented negative interest rate policy to "mitigate spillover effects from unconventional monetary policy measures", with the intention of "[promoting] new lending and [reducing] vulnerabilities" (Jobst and Lin, 2016, p.5). In Norway, the Norges Bank's (NB) current rate is -0.50%. This deposit facility interest rate first went negative on September 24th, 2015 to encourage lending between banks and discourage deposits with the NB. Rates in Denmark fell below zero from July 2012 through April 2014 and again in September 2014, remaining negative all the way to the present. Denmark's deposit facility rate, today at -0.65%, was deemed necessary by the Danmarks Nationalbank (DN) to discourage capital inflows and address currency appreciation. Sweden's central bank Sveriges Riksbank (SR) has introduced negative interest rates February 12th, 2015 in effort to counter deflation and create higher demand. The SR current deposit facility rate is by far the most negative of all central banks at -1.25% (Turk, 2016). Similar to Denmark, the Swiss National Bank (SNB) has their deposit facility rate at -0.75%. The SNB introduced negative rates on January 15th, 2016 with the intention to decrease capital inflows and address appreciation pressure on the Swiss franc (McAndrews, 2015). In the euro area, the European Central Bank's (ECB) policy objective was in an effort to increase inflation to just below 2% as well as maintain price stability (ECB, 2016). Negative interest rates, first implemented June 11th, 2014 with the current rate at -0.40%, were adopted to provide the stimulus needed to achieve this goal (Arteta, Kose, Stocker, & Taskin, 2016). This study focuses on Denmark, Sweden, Switzerland, and the euro area where negative rates have been effective for over a year. Please see Table I for a summary of central banks implementing negative rates on their deposit facility.

The negative interest rate policy (NIRP) adopted by these central banks is intended to heighten inflation, counter currency appreciation, maintain price stability and create an incentive for banks to lend (ECB, 2016). Central banks in Japan, Hungary, Norway, Switzerland, Sweden, Denmark, and the euro area have all departed from paying interest on balances held at the central bank to actively charging commercial banks for deposits above the required reserve. This paper examines the relationship between those negative interest rates and commercial bank profitability.

The goal of this study is to quantify the impact of nominal interest rates on bank performance measures as short term rates fall below zero. I analyze twenty-nine large and small international banks with the periodicity of data in quarter years. I find there is an adverse effect on profitability measures (ROA)[1] and (ROE)[2] with ROE being the most impacted. The magnitude of estimated effect is reported along with the other explanatory variables in Table VII.

[1] Return on assets = $\frac{Net\ income}{Total\ assets}$

[2] Return on equity = $\frac{Net\ income}{Total\ equity\ capital}$

The methodological approach in this study estimates the model using nonlinear two-way fixed effects transformation, with time demeaned data on both regressands. I use robust data sets from years 2004-2016, spanning 48 periods of quarterly observations. I chose 12 years to prevent the anomalies associated with the Global Financial Crisis of 2007-2008 from skewing the results found here. I control for macroeconomic factors growth, population and domestic credit.

1.1 Brief literature review

The research applied in this analysis empirically shows that there is a negative effect on profitability when interest rates decline past zero. C.W. (2015) determines policy rates below the zero bound have an adverse effect on commercial banking profitability. This study supports his findings in that negative interest rates adversely impact both ROA and ROE. Borio, Gambacorta and Hofman (2015), find higher interest rates lead to higher profitability overall. They discovered a concave relationship exists between ROA and interest rates as well as the slope of the yield curve and interest rate structure. It is noteworthy that their data set was limited to positive interest rates. Concavity is not an issue in a negative rate environment. Rognlie (2015) believes the effect of negative rates will be of mild consequence. His opinion supports the conclusion of this study. Jobst and Lin (2016) describe how banks have reacted to the lowered deposit rate by replacing excess reserves with riskier assets. A move, both authors conclude, will influence quantitative easing measures through the portfolio rebalancing channel. Jobst and Lin's findings are supported in the present study.

Several researchers have contrary inferences than those found in this study. Scheiber, Silgoner and Stern (2016) warn that bank profitability will decline at an increasing rate if interest rates remain negative for much longer. Concluding bank profitability has been stable and that adverse effects from negative interest rates have yet to surface. I reject the null hypothesis that there has been no effect in contrast with their study. Arteta, Kose, Stocker and Taskin (2016) find that with the limited data available since rates have gone negative, that there are inconclusive results as to the impact on bank profitability. I will show empirical evidence to the contrary. Please see Table VII, Appendix (A.3) and (A.4) for conclusive results.

2. Theoretical model

Model (a): $$ROA_{i,t} = \alpha_{it} + \beta_1 DEP_{i,t} + \beta_2 SYLD_{i,t} + \beta_3 \ln(SIZE_{i,t}) + \beta_4 GRW_{i,t} + \beta_5 CRD_{i,t} + \beta_6 \ln(POP_{i,t}) + u_{i,t}$$

Model (b): $$ROE_{i,t} = \alpha_{it} + \beta_1 DEP_{i,t} + \beta_2 SYLD_{i,t} + \beta_3 \ln(SIZE_{it}) + \beta_4 GRW_{i,t} + \beta_5 CRD_{i,t} + \beta_6 \ln(POP_{i,t}) + u_{i,t}$$

I have run two separate models in order to verify findings and corroborate any trends. Model (a) is run using return on assets (ROA) per individual bank, as the dependent variable, and Model (b) uses return on equity (ROE) as the dependent variable. ROA and ROE are recognized measures of bank performance and were chosen for this purpose. Of primary interest is the deposit facility rate (DEP) which has been negative for a year or more and is projected to directly

affect profitability. The slope of the yield curve (SYLD) is the spread between long term maturities and short term maturities' yield. This spread is driving bank profitability and derived here from the difference between the areas' 10-year government bond yield and the three-month London inter-bank lending rate (LIBOR). Size (SIZE) is measured by total assets for each bank and converted into US dollars using the exchange rate on the balance sheet date for each observation. Size influences profitability by the proportional nature of the relationship between excess reserves deposited and resulting quantity subject to negative rates. The natural logarithm of size ln (SIZE) is used in model to normalize the disparity in these data points. Growth (GRW) as a percentage of the gross domestic product (GDP), will indicate the likelihood of spending by households making deposits and those securing loans, both potential sources of revenue for commercial banks. Growth affects profitability by countering the consequences of negative rates. Domestic credit (CRD) measures the amount of credit extended to the local economies by the finance sector as a percentage of real GDP. This value will indicate the volume of lending and its impact on bank portfolios. Population (POP) is a measure of the likelihood that: (1) interest bearing accounts will be issued; and (2) loans will be secured by the public. The larger the population the higher the probability of such events. Both loans and interest bearing accounts are critical sources of profitability for banks and help to mitigate the effect of negative interest rates. The logarithm of population ln (POP) is chosen to transform these data to similar scale of models' other coefficients while preserving the integrity of these data. Please see Table III for a review of all variables in both models, including data sources.

2.1 Model Construction

Indexing individual banks with *i* and quarter years with *t,* over an unbalanced panel of twenty-nine banks. Financial institutions are sampled across four regions: Switzerland, Sweden, Denmark and the euro area. I regress predictor variables DEP, SYLD, ln(SIZE), GRW, CRD and ln(POP) on dependent variables ROA and ROE. I use a nonlinear functional form with two-way fixed effect model transformation allowing the intercept to differ both with time and entity. In both models $\alpha_{it} = \beta_0 +$ BNK; the bank (BNK) variable includes bank specific and time fixed factors. Bank fixed includes elements such as strategy, culture, inherent advantage and human capital which will vary across banks but not over time. Whereas time fixed effects such as location and central bank governance will vary across time but not across banks. Sources of endogeneity, such as simultaneity and measurement error, are not present because of the usage of time-fixed and bank-fixed variables. The natural logarithm of population, ln(POP), is included in both models to transform the large values into logarithmic scale to better relate to the size neighboring variables. Conversely, the natural logarithm is taken of SIZE to normalize the disparities in these data sample. The unobserved term u contains those factors that cannot be quantified but do have an effect on profitability such as ability and motivation of bank personnel.

Steps taken to arrive at final model.

1. Using stepwise regression to check whether the model specification is correct.
2. Correlation analysis showed a high correlation 0.85 or more between FDI and POP. Please see appendix (A.1) for the resulting matrices.

The slope coefficient is expected to be positive, indicating a relationship where bank profitability decreases as nominal interest rates decline even beyond the zero bound.

Theoretically, increased expense will decrease profitability. Please view Table IV for the expected sign of coefficients.

2.2 Testable hypothesis

H_0: *Negative nominal interest rates have no effect on bank profitability.*

H_A: $Not\ H_0$

The null hypothesis purports interest rates below zero will not depress bank profitability.

The alternative hypothesis states that the null hypothesis is false.

Regressing complete model on both ROA and ROE I find the p-values on the slope coefficient DEP, to be 0.0078 and 0.0521 respectively. I reject the null based on both values being < 0.10.

3. Empirical section

3.1 Data

The banks in this sample were chosen under the assumption that larger banks would have greater excess reserves and be most sensitive to negative interest rates. Small banks are included for a representative sample. Size is determined by total assets converted to USD. Please see Table II for a complete list of banks examined in this study.

I have adjusted the sample by omitting incomplete periods of observation. Three quarters in 2016 were excluded due to the unavailability of growth, population and domestic credit quarterly data for that year. Several banks failed to report the ROA for 2016's third quarter. Thus, third quarter observations for these banks have been excluded.

The slope of the yield curve was derived by calculating the difference in the 10-year government bond yield and the three-month LIBOR. The Intercontinental Exchange (ICE), formerly British Bankers Association (BBA), discontinued LIBOR fixing after 2013 in several currencies including the Danish krone and Swedish krona these observations were also omitted as the slope of the yield curve could not calculated.

There are 1,034 complete observations for the model with regressand ROA and 1,041 for the model regressed against ROE. I control for macroeconomic variance by including indicators such as growth, domestic credit issued by financial sector and population. Please see Table III for comprehensive variable descriptions including their source.

3.2 Results

The econometric model defined in this paper demonstrates that central bank deposit facility interest rates have had a positive relationship with both ROE and ROA. Negative rates adversely affect both profitability measures: ROA and ROE. As interest rates decline into negative territory, commercial bank profitability also decreases.

I test for multicollinearity using correlation analysis. Variables with value 0.85 indicate high collinearity with other explanatory variables. I find foreign direct investment (FDI) and population squared (POP^2) were highly correlated with other regressors and were subsequently dropped from original model. Please view appendix (A.1) for resulting correlation matrices. In order to test for the correct model specification, I use a stepwise estimation method. Each variable in present model I verify is necessary for multiple regression. Additionally, I use a stepwise method to test for whether I have the wrong functional form or if interaction terms are needed

I apply the White Period covariance method to solve for autocorrelation and remedy heteroskedasticity. Clustered standard errors estimate the variance when variables are identified across entities but are potentially auto correlated within an entity. I ensure that the error term is uncorrelated with explanatory variables by correlation analysis.

Estimated equations with standard errors in parenthesis:

(a): $$\widehat{ROA_{i,t}} = \underset{(0.0006)}{0.0016DEP} - \underset{(0.0004)}{0.0013SYLD} - \underset{(0.0014)}{0.0028\ln(SIZE)} - \underset{(0.0004)}{0.0002GRW} - \underset{(0.00005)}{0.0001CRD}$$
$$\underset{(0.0292)}{-0.0627\ln(POP)}$$

(b): $$\widehat{ROE_{i,t}} = \underset{(0.0155)}{0.0302DEP} - \underset{(0.0114)}{0.0325SYLD} + \underset{(0.0847)}{0.0403\ln(SIZE)} - \underset{(0.0146)}{0.0086GRW} - \underset{(0.0017)}{0.0005CRD}$$
$$\underset{(0.868)}{-0.2306\ln(POP)}$$

The Durbin-Watson statistic is low, 1.55 for ROA and 1.16 for ROE, indicating serial correlation. However, some correlation is to be expected from panel data where each bank is observed over 48 periods, and in this case it is acceptable. Scatterplots of residuals for both ROA and ROE displayed homoscedasticity validating the models' assumptions. See appendix (A.10) and (A.11).

Consequently, commercial banks under the implementation of negative interest rates have had an increase in expense on deposits at the central bank. Banks with reserves in excess of the required have responded by participating in interbank lending in effort to circumvent the deposit facility rate. Excess reserves deposited since the creation of NIRP have been subject to negative rates and consequently, for commercial banks, a negative return. As commercial bank expenses on deposits rise, the interest margin is squeezed, effectively reducing profitability. It follows that profits decrease as interest rates move into negative territory. This decrease in profits supports the decision to reject the null hypothesis.

4. Conclusion

Negative nominal interest rates have an adverse effect on bank profitability. However, these adverse effects have been mitigated by bank lending volumes and asset valuations, which have increased overall portfolio balances. Additionally, banks are storing large sums of cash in vaults to avoid the expense of depositing excess reserves at the central bank. According to Bloomberg's Christian Zimmerman (2014) some commercial banks are charging, for the first time ever, corporate clients' interest on their deposit accounts. Commission income and net fees have also increased and interest paid on retail deposits have been lowered. These measures all reduce the expense of central bank short term policy and positively influence both ROA and ROE while dampening the effect of negative rates. The idea behind negative interest rate policy (NIRP) was for an incentive to be in place to encourage banks not to sit on excess liquidity but rather to lend out and take greater investment risks. NIRP has not, as of yet, had the intended effect of creating money in the real economy. These negative interest rates were designed to create upward pressure on inflation and growth while depressing unemployment. Unfortunately, this goal has yet to materialize. World bank data on macroeconomic factors for 2016 have yet to be released, limiting this model up to and including the fourth quarter 2015.

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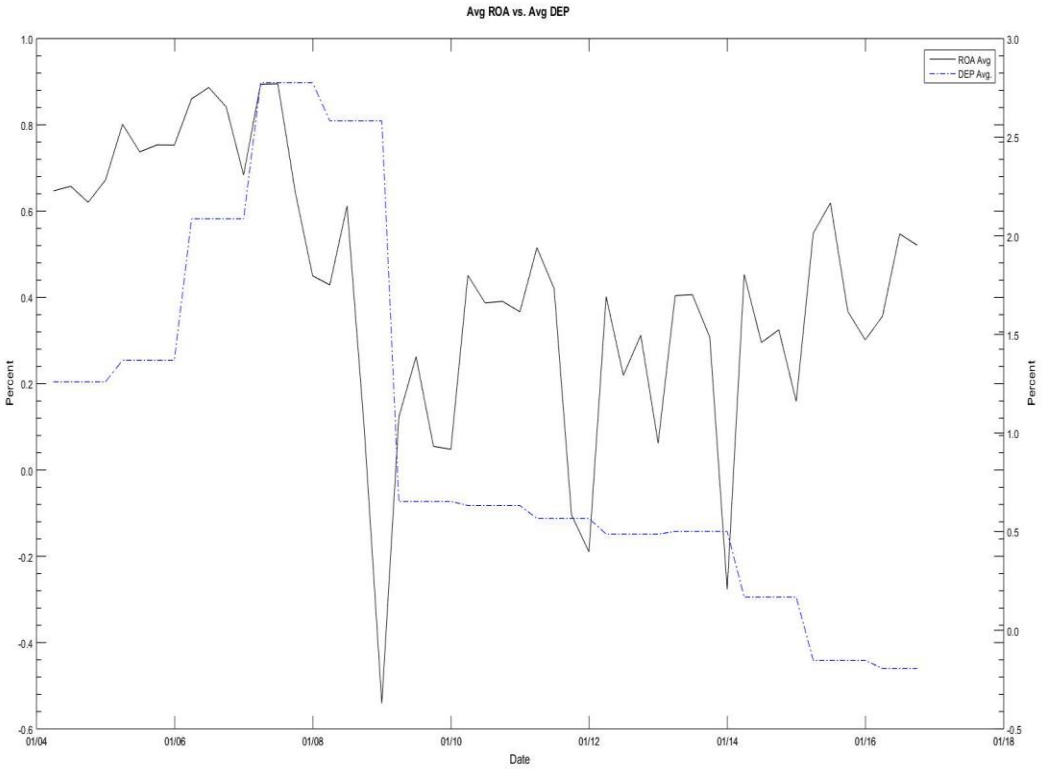
Tables and graphs

Graph 1. Average return on assets vs. average deposit facility interest rate over time



Graph 2. Average return on equity vs. average deposit facility interest rate over time

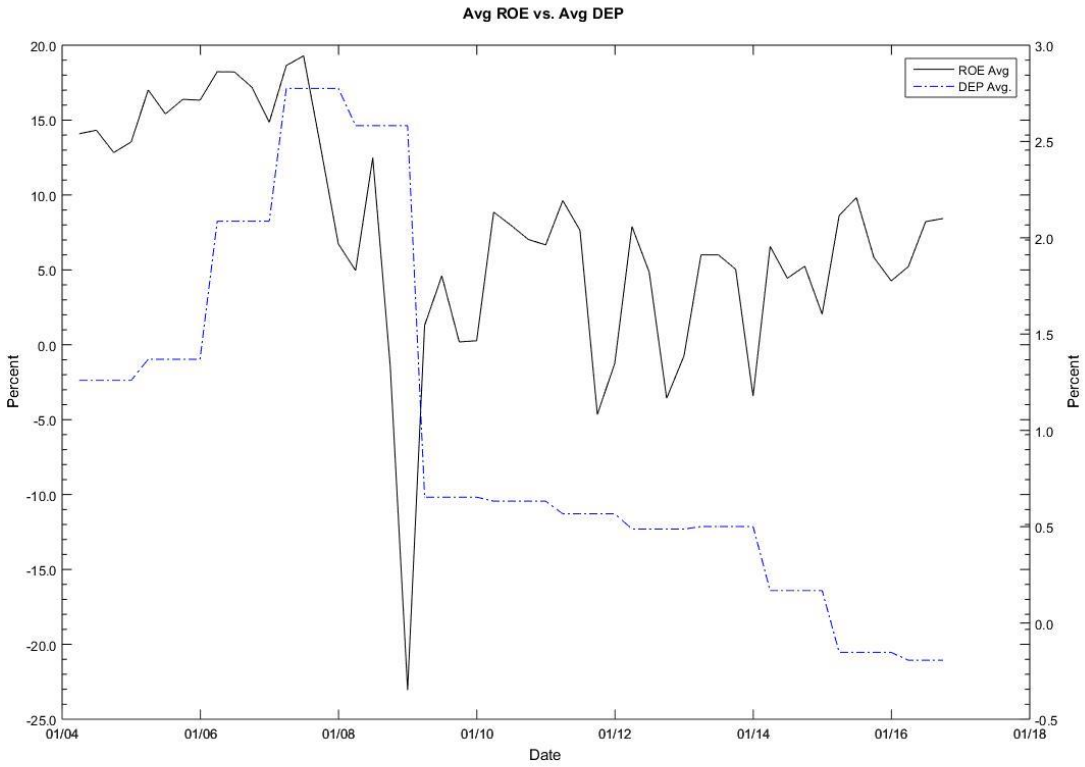


Table I
Summary of Central Banks with Negative Deposit Facility Interest Rates

Central Bank and Governing Area	Date of effect	Motivation for monetary policy	The Current Rate on excess reserve deposit in basis points	10-Year Government bond current yield
European Central Bank (ECB) euro Area	June 11th, 2014	Secure inflation expectations and achieve price stability	-40	3.21 As of July 1st, 2016
Sveriges Riksbank (SR) Sweden	February 12th, 2015	Secure inflation expectations and achieve price stability	-125	0.66 As of January 1st, 2015
Danmarks Nationalbank (DN) Denmark	July 2012-April 2014, September 2014	Counter exchange rate pressures	-65	1.03 As of January 1st, 2015
Swiss National Bank (SNB) Switzerland	January 15th, 2015	Lower appreciation and deflationary pressures (Jobst & Lin, 2016)	-75	-0.02 As of January 1st, 2015
Magyar Nemzeti Bank (MNB) Hungary	March 23rd, 2014	Counter exchange rate pressures and achieve price stability	-5	4.80 As of January 1st, 2014

Bank of Japan (BoJ) Japan	February 16th, 2016	Secure inflation expectations and achieve price stability	-10	0.504 As of July 1st, 2014
Norges Bank (NB) Norway	September 24th, 2015	Price stability measures	-50	1.46 As of January 1st, 2015

Table II
Commercial Banks and Total Assets USD

Banks Analyzed (sorted by size)	Current Total Assets in Billions USD[3]	Country of Location	Balance Sheet Date	Central Bank
Deutsche Bank AG DB DBK	1,897.35	Germany	30.09.2016	ECB
Credit Agricole S A ENXTPA ACA	1,763.39	France	30.09.2016	ECB
Societe Generale Group ENXTPA GLE	1,578.25	France	30.09.2016	ECB
Banco Santander S A BME SAN	1,493.59	Spain	30.09.2016	ECB
UniCredit S p A BIT UCG	982.434	Italy	30.09.2016	ECB
ING Groep N V ENXTAM INGA	977.958	Netherlands	30.09.2016	ECB
UBS Group AG SWX UBSG	962.948	Switzerland	30.09.2016	SNB
Credit Suisse Group AG SWX CSGN	830.641	Switzerland	30.09.2016	SNB
Banco Bilbao Vizcaya Argentaria, S.A. (BME:BBVA)	814.038	Spain	30.09.2016	ECB
Intesa Sanpaolo S p A BIT ISP	802.546	Italy	30.09.2016	ECB
CoÃ¶peratieve Rabobank U A	762.557	Netherlands	30.06.2016	ECB
Nordea Bank AB publ OM NDA SEK	738.28	Sweden	30.09.2016	RB
Commerzbank AG DB CBK	576.797	Germany	30.09.2016	ECB
Danske Bank A S CPSE DANSKE	531.525	Denmark	30.09.2016	DN
Svenska Handelsbanken AB publ OM SHB A	339.791	Sweden	30.09.2016	RB
Skandinaviska Enskilda Banken AB publ OM SEB A	333.019	Sweden	30.09.2016	RB
KBC Group NV ENXTBR KBC	298.839	Belgium	30.09.2016	ECB
Swedbank AB publ OM SWED A	279.612	Sweden	30.09.2016	RB
Dexia SA ENXTBR DEXB	261.985	Belgium	30.06.2016	ECB
Bayerische Landesbank	252.761	Germany	30.09.2016	ECB
Erste Group Bank AG WBAG EBS	232.329	Austria	30.09.2016	ECB
Banco de Sabadell, S.A. (BME:SAB)	231.241	Spain	30.09.2016	ECB
Raiffeisen Schweiz Genossenschaft	218.799	Switzerland	30.06.2016	SNB
ZÃ¼rcher Kantonalbank	155.345	Switzerland	30.06.2016	SNB
Banque Cantonale Vaudoise SWX BCVN	46.074	Switzerland	30.06.2016	SNB
Basler Kantonalbank SWX BSKP	39.822	Switzerland	30.06.2016	SNB
Nykredit Bank A S	28.976	Denmark	30.09.2016	DN
Sydbank A S CPSE SYDB	21.902	Denmark	30.09.2016	DN
Spar Nord Bank A S CPSE SPNO	11.826	Denmark	30.09.2016	DN

[3] Exchange rate on balance sheet date.

Table III
Dependent and Independent Variable Description

Dependent Variables	*Name*	*Description*	*Source*	*Unit of measure*
ROA	Return on Assets	Measure of profitability	S&P Capital IQ & Proprietary Data	Ratio
ROE	Return on equity	Alternative measure of profitability	S&P Capital IQ & Proprietary Data	Ratio
Independent Variables	*Name*	*Description*	*Source*[4]	*Unit of measure*
DEP	Deposit facility interest rate	Interest rate on excess reserves held at central bank	European Central Bank, http://www.ecb.europa.eu/stats/monetary/rates/html/index.en.html Denmark National Bank http://nationalbanken.statbank.dk/nbf/97926 Sveriges Riksbank http://www.riksbank.se/en/Interest-and-exchange-rates/search-interest-rates-exchange-rates/ Swiss National Bank https://data.snb.ch/en/topics/ziredev#!/cube/zimoma	Rate
SYLD	Slope of the yield curve	Difference between 10-year Government bond rate and 3-month Libor rate	European Central Bank http://sdw.ecb.europa.eu Denmark National Bank http://nationalbanken.statbank.dk/nbf/97926 Sveriges Riksbank http://www.riksbank.se/ Swiss National Bank https://data.snb.ch/en	Rate
Ln (SIZE)	Log of total assets	The natural logarithm of banks' total assets converted to USD	S&P Capital IQ & Proprietary Data	Logarithmic scale
GRW	Growth rate a percentage of real GDP	Indicates economic growth, measured as a percentage of real GDP	The World Bank http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators&Type=TABLE&preview=on	Rate
CRD	Domestic credit	Domestic credit issued by the financial sector (% of GDP)	The World Bank http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators	Percentage %
Ln (POP)	Log of population	The natural logarithm of the population in geographical area	The World Bank http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators	Logarithmic scale

[4] Link validity date 12/31/2016

Table IV
Expected Signs of Independent Variables

Variable Name	Expected Sign of Regressor (-/+)	Reasoning
Deposit facility interest rate (DEP)	+	Profitability is expected to decrease as interest rates on deposit decline
Slope of the yield curve (SYLD)	+	An upward sloping curve will drive bank profitability; the interest margin spread increases performance measures
Logarithm of size ln(SIZE)	-	Larger banks are expected to have large amounts of excess reserves and subject to greater expense.
Growth (GRW)	+	Growth will attract depositors and borrowers, increasing profits
Domestic credit (CRD)	+	Domestic lending volumes will increase profitability
Logarithm of population ln(POP)	+	Higher areas of population have increased probability a portion of the local economy will borrow and hold savings accounts increasing bank performance

Table V
Summary Statistics

Variable Name	Variable	Observations	Mean	Std. Dev.	Max	Min
Return on assets	ROA	1375	0.0042	0.0065	0.0326	-0.0661
Return on equity	ROE	1401	0.0752	0.1668	0.6132	-2.5844
Deposit facility interest rate	DEP	1427	0.861	1.209	4.25	-1.25
Slope of the yield curve	SYLD	1166	1.4337	1.1954	4.1977	-1.8176
Logarithm of size	ln(SIZE)	1445	12.7114	1.4546	15.0963	8.6103
Growth	GRW	1392	1.3579	2.4794	5.9889	-5.1847
Domestic credit	CRD	1392	163.2541	28.9543	239.6422	108.6077
Logarithm of population	ln(POP)	1392	17.6616	1.9064	19.6427	15.5027

Table VI
Analysis of Moments

Variable	Mean	Standard Deviation	Skewness	Kurtosis
ROA	0.0042	0.0065	-3.4223	28.1725
ROE	0.0751	0.1668	-6.1516	66.0602
DEP	0.8610	1.209	0.8217	-0.0639
SYLD	1.4337	1.1954	-0.1108	-0.8298
LSIZE	12.7114	1.4546	-0.8153	-0.2649
GRW	1.3579	2.4794	-0.9501	1.0792
CRD	163.2541	28.9543	0.7891	0.8638
LPOP	17.6616	1.9064	0.0521	-1.9768

Table VII
Main Results

	Model I		Model II		Model III		Model IV	
Explanatory variables	*Dependent variables*							
	ROA	ROE	ROA	ROE	ROA	ROE	ROA	ROE
Deposit facility interest rate x 10^{-4}	10*	311**	16***	302**	15**	299**	17***	302*
	(1.76)	(2.25)	(2.72)	(2.37)	(2.42)	(2.19)	(2.67)	(1.94)
Slope of the Yield Curve x 10^{-4}			-8*	-330**	-9.67**	-322**	-12.81***	-325***
			(-1.68)	(-2.11)	(-2.3)	(-2.43)	(-3.04)	(-2.86)
ln(Size) x 10^{-4}					-31.36**	370.31	-27.77*	403.49
					(-2.47)	(0.46)	(-1.95)	(0.48)
Growth Rate x 10^{-4}					-0.51	-71.9	-1.96	-86.36
					(-0.16)	(-0.64)	(-0.51)	(-0.59)
Domestic Credit x 10^{-4}							-0.6	-5.46
							(-1.25)	(-0.33)
ln(Population) x10^{-4}							-626.72**	-2306.16
							(-2.15)	(-0.27)
Number of banks / observations	29/1326	29/1352	29/1037	29/1055	29/1034	29/1041	29/1034	29/1041
Adjusted R^2	0.35	0.27	0.37	0.26	0.38	0.26	0.38	0.26
F-statistic	9.86	7.18	8.60	5.63	8.95	5.62	8.79	5.48
Prob(F-statistic)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: T-statistics in parenthesis. *** indicates significance at the 1% level, ** indicates significance at the 5% level, * indicates significance at the 10% level. All models include state fixed and time fixed variables.

Appendix

(A.1.) *Correlation matrices*

View Proc Object Print Name Freeze Sample Sheet Stats Spec

Correlation

	ROA	DEP	SYLD	LSIZE	FDI	GRW	CRD	POP	POP_2
ROA	1.000000	0.159646	-0.128119	-0.295448	-0.142092	0.271256	-0.109646	-0.206687	-0.209747
DEP	0.159646	1.000000	-0.627277	-0.034086	0.287589	0.153765	-0.167377	0.126056	0.124428
SYLD	-0.128119	-0.627277	1.000000	0.166162	0.052784	-0.139886	-0.001279	0.292909	0.296709
LSIZE	-0.295448	-0.034086	0.166162	1.000000	0.440689	-0.094760	-0.329917	0.482332	0.481766
FDI	-0.142092	0.287589	0.052784	0.440689	1.000000	0.008795	-0.357866	0.869707	0.870185
GRW	0.271256	0.153765	-0.139886	-0.094760	0.008795	1.000000	-0.247824	-0.141845	-0.145530
CRD	-0.109646	-0.167377	-0.001279	-0.329917	-0.357866	-0.247824	1.000000	-0.416389	-0.407122
POP	-0.206687	0.126056	0.292909	0.482332	0.869707	-0.141845	-0.416389	1.000000	0.999905
POP_2	-0.209747	0.124428	0.296709	0.481766	0.870185	-0.145530	-0.407122	0.999905	1.000000

View Proc Object Print Name Freeze Sample Sheet Stats Spec

	ROE	DEP	SYLD	LSIZE	FDI	GRW	CRD	POP	POP_2
ROE	1.000000	0.123975	-0.087118	-0.108867	-0.085222	0.228690	-0.134291	-0.141394	-0.144589
DEP	0.123975	1.000000	-0.628254	-0.026716	0.294852	0.155375	-0.168842	0.132562	0.130973
SYLD	-0.087118	-0.628254	1.000000	0.159946	0.043839	-0.139987	-0.001683	0.285281	0.289050
LSIZE	-0.108867	-0.026716	0.159946	1.000000	0.444762	-0.092182	-0.333983	0.487273	0.486699
FDI	-0.085222	0.294852	0.043839	0.444762	1.000000	0.013078	-0.362782	0.868578	0.869065
GRW	0.228690	0.155375	-0.139987	-0.092182	0.013078	1.000000	-0.247598	-0.138172	-0.141880
CRD	-0.134291	-0.168842	-0.001683	-0.333983	-0.362782	-0.247598	1.000000	-0.422904	-0.413646
POP	-0.141394	0.132562	0.285281	0.487273	0.868578	-0.138172	-0.422904	1.000000	0.999905
POP_2	-0.144589	0.130973	0.289050	0.486699	0.869065	-0.141880	-0.413646	0.999905	1.000000

(A.2.) Model IV Six predictor variables run against return on assets

Dependent Variable: ROA
Method: Panel Least Squares
Date: 01/03/17 Time: 20:29
Sample (adjusted): 2004Q1 2015Q4
Periods included: 48
Cross-sections included: 29
Total panel (unbalanced) observations: 1034
White period standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.147374	0.519850	2.207125	0.0275
DEP	0.001699	0.000637	2.667127	0.0078
SYLD	-0.001281	0.000422	-3.036030	0.0025
LSIZE	-0.002777	0.001426	-1.947865	0.0517
GRW	-0.000196	0.000378	-0.519070	0.6038
CRD	-5.97E-05	4.77E-05	-1.251708	0.2110
LPOP	-0.062672	0.029180	-2.147791	0.0320

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.427835	Mean dependent var	0.004400
Adjusted R-squared	0.379153	S.D. dependent var	0.006497
S.E. of regression	0.005119	Akaike info criterion	-7.635559
Sum squared resid	0.024951	Schwarz criterion	-7.243704
Log likelihood	4029.584	Hannan-Quinn criter.	-7.486868
F-statistic	8.788335	Durbin-Watson stat	1.546094
Prob(F-statistic)	0.000000		

(A.3) Model IV Six predictor variables run against return on equity

Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/04/17 Time: 16:03
Sample (adjusted): 2004Q1 2015Q4
Periods included: 48
Cross-sections included: 29
Total panel (unbalanced) observations: 1041
White period standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.719231	15.83350	0.234896	0.8143
DEP	0.030187	0.015524	1.944469	0.0521
SYLD	-0.032500	0.011360	-2.860828	0.0043
LSIZE	0.040349	0.084737	0.476164	0.6341
GRW	-0.008636	0.014637	-0.590027	0.5553

CRD	-0.000546	0.001664	-0.327881	0.7431
LPOP	-0.230616	0.867963	-0.265698	0.7905

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.316364	Mean dependent var	0.079283
Adjusted R-squared	0.258622	S.D. dependent var	0.182189
S.E. of regression	0.156871	Akaike info criterion	-0.791291
Sum squared resid	23.59957	Schwarz criterion	-0.401540
Log likelihood	493.8667	Hannan-Quinn criter.	-0.643447
F-statistic	5.478937	Durbin-Watson stat	1.155811
Prob(F-statistic)	0.000000		

(A.4) Model I Hypothesized predictor variable run against return on assets

Dependent Variable: ROA
Method: Panel Least Squares
Date: 01/07/17 Time: 08:06
Sample: 2004Q1 2016Q3
Periods included: 51
Cross-sections included: 29
Total panel (unbalanced) observations: 1326
White period standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003523	0.000484	7.282060	0.0000
DEP	0.001001	0.000568	1.760572	0.0786

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.384656	Mean dependent var	0.004374
Adjusted R-squared	0.345641	S.D. dependent var	0.006251
S.E. of regression	0.005056	Akaike info criterion	-7.677897
Sum squared resid	0.031856	Schwarz criterion	-7.364779
Log likelihood	5170.446	Hannan-Quinn criter.	-7.560530
F-statistic	9.859289	Durbin-Watson stat	1.515365
Prob(F-statistic)	0.000000		

(A.5) Model I Hypothesized predictor variable run against return on equity

Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/07/17 Time: 08:07
Sample: 2004Q1 2016Q3
Periods included: 51
Cross-sections included: 29
Total panel (unbalanced) observations: 1352
White period standard errors & covariance (d.f. corrected)

WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.051982	0.011417	4.553119	0.0000
DEP	0.030112	0.013373	2.251747	0.0245

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.308403	Mean dependent var	0.077690
Adjusted R-squared	0.265450	S.D. dependent var	0.166339
S.E. of regression	0.142562	Akaike info criterion	-1.000728
Sum squared resid	25.85211	Schwarz criterion	-0.692483
Log likelihood	756.4921	Hannan-Quinn criter.	-0.885299
F-statistic	7.180006	Durbin-Watson stat	1.157652
Prob(F-statistic)	0.000000		

(A.6) Model II Two predictor variables run against return on assets

Dependent Variable: ROA
Method: Panel Least Squares
Date: 01/07/17 Time: 08:17
Sample: 2004Q1 2016Q3
Periods included: 51
Cross-sections included: 29
Total panel (unbalanced) observations: 1037
White period standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003552	0.001048	3.389649	0.0007
DEP	0.001634	0.000601	2.721407	0.0066
SYLD	-0.000798	0.000474	-1.683887	0.0925

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.418437	Mean dependent var	0.004406
Adjusted R-squared	0.369771	S.D. dependent var	0.006489
S.E. of regression	0.005152	Akaike info criterion	-7.624100
Sum squared resid	0.025372	Schwarz criterion	-7.237918
Log likelihood	4034.096	Hannan-Quinn criter.	-7.477583
F-statistic	8.598092	Durbin-Watson stat	1.517073
Prob(F-statistic)	0.000000		

(A.7) Model II Two predictor variables run against return on equity

Dependent Variable: ROE
Method: Panel Least Squares

Date: 01/07/17 Time: 08:17
Sample: 2004Q1 2016Q3
Periods included: 51
Cross-sections included: 29
Total panel (unbalanced) observations: 1055
White period standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.088797	0.029089	3.052620	0.0023
DEP	0.030171	0.012744	2.367369	0.0181
SYLD	-0.032987	0.015670	-2.105071	0.0355

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.316015	Mean dependent var	0.080075
Adjusted R-squared	0.259836	S.D. dependent var	0.181300
S.E. of regression	0.155977	Akaike info criterion	-0.804545
Sum squared resid	23.69630	Schwarz criterion	-0.423631
Log likelihood	505.3977	Hannan-Quinn criter.	-0.660148
F-statistic	5.625106	Durbin-Watson stat	1.148652
Prob(F-statistic)	0.000000		

(A.8) Model III Four predictor variables run against return on assets

Dependent Variable: ROA
Method: Panel Least Squares
Date: 01/07/17 Time: 08:57
Sample (adjusted): 2004Q1 2015Q4
Periods included: 48
Cross-sections included: 29
Total panel (unbalanced) observations: 1034
White period standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.043607	0.016038	2.719021	0.0067
DEP	0.001538	0.000635	2.421278	0.0157
SYLD	-0.000967	0.000421	-2.297708	0.0218
LSIZE	-0.003136	0.001271	-2.466949	0.0138
GRW	-5.06E-05	0.000311	-0.162566	0.8709

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.425786	Mean dependent var	0.004400
Adjusted R-squared	0.378235	S.D. dependent var	0.006497
S.E. of regression	0.005123	Akaike info criterion	-7.635852
Sum squared resid	0.025040	Schwarz criterion	-7.253555

Log likelihood	4027.735	Hannan-Quinn criter.	-7.490788
F-statistic	8.954432	Durbin-Watson stat	1.543903
Prob(F-statistic)	0.000000		

(A.9) Model III Four predictor variables run against return on equity

Dependent Variable: ROE
Method: Panel Least Squares
Date: 01/07/17 Time: 08:58
Sample (adjusted): 2004Q1 2015Q4
Periods included: 48
Cross-sections included: 29
Total panel (unbalanced) observations: 1041
White period standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

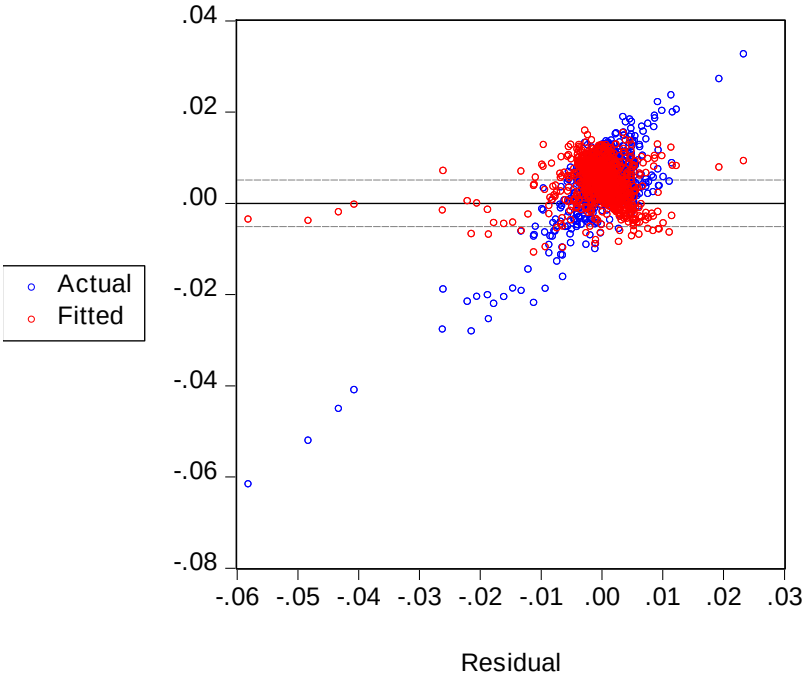
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.371949	0.996710	-0.373177	0.7091
DEP	0.029915	0.013654	2.190913	0.0287
SYLD	-0.032200	0.013243	-2.431561	0.0152
LSIZE	0.037031	0.080818	0.458204	0.6469
GRW	-0.007190	0.011248	-0.639211	0.5228

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.316158	Mean dependent var	0.079283
Adjusted R-squared	0.259942	S.D. dependent var	0.182189
S.E. of regression	0.156731	Akaike info criterion	-0.794831
Sum squared resid	23.60670	Schwarz criterion	-0.414586
Log likelihood	493.7096	Hannan-Quinn criter.	-0.650594
F-statistic	5.623989	Durbin-Watson stat	1.155256
Prob(F-statistic)	0.000000		

(A.10) ROA model residuals plot against Y hat:



(A.11) ROE model residuals plot against Y hat: