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Do banks learn from financial crisis? The experience of Nordic banks[☆]

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ABSTRACT

Using a large panel data set of Nordic (Finland, Norway and Sweden) and European banks for the period 1994–2010, we study whether banks can retain their lessons from the experience of a severe financial crisis. Our key finding is that the Nordic banks had better returns and greater financial stability compared to other European banks during the 2008 crisis, after controlling for key bank characteristics and macroeconomic factors. Our findings are consistent with the learning hypothesis of Fahlenbrach et al. (2012), suggesting that the Nordic banks were able to internalize the lessons from the Nordic systemic banking crisis of the early 1990s.

1. Introduction

A growing body of studies in finance suggests that the experiences of executives and investors significantly affect their subsequent behavior and performance (e.g. Bertrand and Schoar, 2003; Malmendier and Nagel, 2011; Malmendier et al., 2011). In a more general perspective an entire age cohort may share common economic experiences such as an episode of persistent high inflation that subsequently colors their inflation expectations (Malmendier and Nagel, 2015).

Learning by doing is a well known phenomenon in economics - production costs decline from more experience. In the context of an endogenous growth model economic implications of learning by doing are discussed in an early article by Arrow (1962). Alchian (1963) presents empirical evidence of learning by doing in airframe production. Irwin and Klenow (1994) analyze learning by doing in the semiconductor industry. Jovanovic and Nyarko (1996) provides a one-agent Bayesian model of learning by doing in which more extensive use of a technology by an agent accumulates experience that yields information to improve the agent's decisions and thus enhance productivity.

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Organizations, too, may learn from experience. An unexpected adverse event could lead an institution to reassess its future payoff probabilities and modify its risk culture (Gennaioli et al., 2012). Anecdotaly, the near-bust experience of the Nokia Corporation in the 1980s forced the conglomerate to focus on its mobile phone and network businesses, a transformation that enabled its global success in the 1990s. Similarly, Lou Gerstner attributes IBM's encounter with hard times in the early 1990s to its later success; the management team abandoned its internally focused process-driven approach in favor of a market-driven quality strategy (Gerstner, 2002).

While the scope for learning from experience is well documented in research, both empirically and theoretically, only two studies to the best of our knowledge considers whether banks retain the lessons of financial crisis; Berger and Udell (2004) and Fahlenbrach et al. (2012). Berger and Udell (2004) test an institutional memory hypothesis that may help to explain the procyclicality of bank lending. They consider how loan officer skills deteriorate over time following a loan bust and find that the trauma of the loan bust initially dominates the judgment of loan officers, but eventually credit standards ease. Fahlenbrach et al. (2012) (henceforth FPS) consider two competing hypotheses. Under their *learning hypothesis*, banks internalize the lessons of the crisis experience, while under the *risk culture hypothesis*, persisting risk culture prevents banks from internalizing their experiences, and if so, within a few years they are back to their old ways. FPS (2012) test these hypotheses using data on 280 banks listed on US exchanges by considering whether a bank's performance in a previous financial crisis predicts its performance in a subsequent crisis.¹ They find that a bank's poor stock return performance in the 1998 crisis is a strong predictor of poor performance and likelihood of failure in the later 2008 crisis. Specifically, for each percentage point of loss in value of equity in 1998, a bank lost 66 basis points in the 2007–2008 crisis. They see this finding as consistent with the risk culture hypothesis and inconsistent with the learning hypothesis.

This paper studies the scope of bank learning from a financial crisis using European data. Based on annual financial statements of individual banks, we construct a panel data set from 1994 to 2010. Following FPS (2012), we distinguish between the learning and risk culture hypotheses. In our analysis we exploit the fact that Finland, Norway and Sweden – three rather similar Nordic countries – experienced severe economic and systemic banking crises in the early 1990s (henceforth the Nordic crisis) that other European countries at that time largely avoided. The economic and social costs of the crisis to Finland, Norway, and Sweden were so large that in Reinhart and Rogoff's (2008) list the three countries all end up among the five worst post-World War II banking crises in industrialized countries before the 2008 Great Recession.²

Our main testable hypothesis is that banks in Finland, Sweden and Norway (henceforth the Nordic banks) were less exposed to the 2008 financial crisis than banks in other European countries. Evidence in the favor of strong performance by the Nordic banks in the 2008 crisis would indicate that these banks took the lessons of the Nordic crisis to heart and adjusted their business models accordingly. However, were we to observe only minor performance differences between the Nordic banks and other European banks during the 2008 financial crisis, this would be more consistent with a persistent risk culture or business model hypothesis. To account for the effects of confounding factors, we control for key bank characteristics (e.g. capital ratio, liquidity, managerial efficiency and size) and macroeconomic variables (e.g. government debt, inflation and GDP growth) that might have bearings on bank performance and financial stability. We find significant performance differences between Nordic banks and other European banks during the 2008 financial crisis. Most notably, Nordic banks were more profitable and less exposed to financial instability than other European banks during the 2008 financial crisis. This key result is consistent with the learning hypothesis. It is also robust to different panel data estimators, including the fixed effects estimator that allows us to control for unobserved heterogeneity across individual banks. This paper contributes to the learning from financial crises literature in four ways. First, using novel bank-level data, we present evidence on learning by banks from *severe* financial crisis experiences. Second, we analyze learning in European context using a *comprehensive* cross-section of retail-oriented banks (i.e. commercial, co-operative, and savings banks).³ Third, to the best of our knowledge, Nordic banks potential learning from the 1990s crisis has not analyzed previously. Fourth, our panel data cover individual banks for a relatively long period (1994–2010), which allow the use of fixed effects estimator to control for unobserved bank heterogeneity. Fifth, our rich panel data set enables us to control for crucial bank and macroeconomic factors *between two crises* in assessing bank performance and financial stability. The rest of paper is organized as follows. Section 2 provides a brief background regarding the Nordic crisis in the beginning of the 1990s. Section 3 reviews related studies. In Section 4, we discuss our data and empirical approach. Section 5 reports our key findings. The final section concludes with directions for future research.

2. A brief overview of the Nordic financial crisis of the early 1990s

The banking and financial crisis in Finland, Norway and Sweden in the early 1990s is well-documented. Laeven and Valencia (2008), who offer one of the more complete and detailed databases on the banking crisis, find that the banking crisis was systemic in Finland and Sweden for 1991–1995 and in Norway for 1991–1993. Drees and Pazarbaşıoğlu (1998) offer an early summary of the events leading up to, during, and after these crises. Stutts and Watts (2009) give an outside observer's perspective of the Finnish,

¹ The preceding crisis in their study is the 1998 crisis, which was triggered by Russia's default on foreign debt and the collapse of the hedge fund managed by Long-Term Capital Management (LTCM), which was heavily exposed to Russian debt. Their subsequent crisis is the 2008 global financial crisis, which began with the collapse of Lehmann Brothers in September 2008.

² The Nordic countries in this study include Finland, Norway and Sweden. We exclude two other Nordic countries, Iceland and Denmark, because neither country experienced systemic financial crisis in the early 1990s.

³ The number of listed Nordic and European banks is too small to provide a convincing empirical analysis. Adding stakeholder-oriented banks (cooperative and savings banks) into the sample is justified as these banks are major players in European banking.

Norwegian, and Swedish experiences. More recently, [Honkapohja \(2014\)](#) provides an excellent summary of the Nordic crisis. The Swedish and the Finnish crises are compared in [Jonung et al. \(2009\)](#). The Norwegian case is discussed in [Steigum \(2010\)](#). The Finnish crisis is examined in detail in [Freystätter \(2011\)](#), [Gorodnichenko et al. \(2012\)](#) and [Gulan et al. \(2014\)](#).

Several common themes emerge from these studies. There is general agreement that the underlying causes and the development of the crises were the same for all countries. Their origins trace back to the financial market liberalization of the late 1980s that opened the door for rapid expansion of bank lending and soaring housing and equity prices. When the boom ended, loan losses quickly reached record levels,⁴ GDP plunged, and unemployment skyrocketed. Finland's crisis was compounded by the simultaneous collapse of the USSR that produced a severe loss of foreign trade. The systemic financial crisis in these Nordic countries was poignant. Governments had to intervene to rescue the operations of banks that were unable to raise sufficient private capital to cover their credit losses. For those running the banks, the crisis was a wake-up call. Bankers once praised for their aggressive lending practices found themselves being sued for negligence and complicity in fraud. Thus, if the learning hypothesis has any relevance for the behavior of Nordic banks, we would expect that the financial crisis of the early 1990s triggered fundamental changes in risk culture and business models of banks geared to reducing the chance of similar traumatic experiences in the future.

We recognize that the 1990s crisis might also have triggered changes in supervisory policies of the financial regulatory authorities in the three Nordic countries. Unfortunately, due to lack of appropriate data, we cannot assess the potential learning of the Nordic financial regulatory authorities, if any, from the experiences of the early 1990s. However, various considerations strongly indicate that bank regulation is rather uniform in the EU countries. First, the implementation of major EU directives in the banking and financial service industry means that, since about 1993, all banks in the EU, irrespective of their ownership structure, have operated within the same regulatory and competitive business environment. Second, financial deregulation in the EU has led to standardized procedures (e.g. acquisition of banking licenses), standardized capital requirements, and standardized supervision rules ([Schure et al., 2004](#)). Third, the European Commission in 2004 established the Committee of European Banking Supervisors. Composed of senior representatives of bank supervisory authorities and central banks of the European Union, its mission is to promote cooperation and convergence of banking supervision practices across the European Union. Fourth, to the best of our knowledge, there is no, not even anecdotal, evidence that the Nordic Financial Supervisory Authorities have performed significantly differently than their European counterparts in the period of our study.

3. Related studies

Our study is related to the growing literature on the scope for learning from experience. As mentioned, several studies find that prior experiences of executives and managers can strongly affect their subsequent behavior (e.g. [Bertrand and Schoar, 2003](#); [Malmendier and Nagel, 2011](#); [Malmendier et al., 2011](#)). [Malmendier and Nagel \(2015\)](#) show how an entire age cohort sharing common inflation experiences can have different inflation expectations than other cohort groups. The theoretical paper by [Gennaioli et al. \(2012\)](#) considers a model in which an unexpected adverse event forces an institution to reassess its future payoff probabilities, triggering a major change in its risk culture. [Berger and Udell \(2004\)](#) test an institutional memory hypothesis by considering how loan officer skills deteriorate over time following a loan bust. The trauma of the loan bust initially dominates the judgment of loan officers, but eventually credit standards ease. The empirical paper of [FPS \(2012\)](#), which is closest to this work, looks at the lessons of financial crisis absorbed by banks listed on US exchanges. In contradiction to the learning hypothesis, they find that bank performance in a previous crisis is a good *predictor* of its performance in a subsequent crisis. Our study is also related to research on the determinants of banking crises. Previous work in that area identifies several key, sometimes overlapping, macroeconomic determinants of banking crisis, including the asset price boom-bust cycle. For an overview of this literature, see e.g. [Scherbina \(2013\)](#). There are numerous discussions of specific macroeconomic determinants, including the credit boom-bust cycle ([Claessens et al., 2012](#); [Dell'Ariccia et al., 2014](#)), currency collapses and sovereign debt ([Frankel and Rose, 1996](#); [Calvo et al., 2006](#)), local economic conditions ([Aubuchon and Wheelock, 2010](#)), and weaknesses in regulation and supervision ([Čihák et al., 2012](#)). Other authors analyze the combination of bank-specific and macro factors as determinants of bank failures (e.g. [Gonzalez-Hermosillo, 1999](#); [Mare, 2015](#)). For a review of growing body of econometric studies on early warning indicators of banking crises since the late 1990s, see [Kauko \(2014\)](#).

In summary we contribute to these areas of research in five ways. To the best of our knowledge, no studies yet examine the scope of learning from prior crises in the European retail banking. Second, we are unaware of prior studies that consider the scope for learning using a comprehensive group of diverse ownership types of banks (i.e. not just exchange-listed banks). Third, we are unaware of any study that takes advantage of a rich set of panel data for individual banks over a relatively long period (1994–2010 here) to control for bank unobserved heterogeneity. Fourth, contrast to [FPS \(2012\)](#), our data allow us to control for important bank and macroeconomic factors in the years *between* crises. Fifth, when analyzing the determinants and early warning indicators of banking crises, no study has previously accounted for the scope of bank learning from prior crises. We hope to partly amend these research gaps.

⁴ Note that the growth of loan losses was not restricted to a specific ownership type of banks, although savings banks were the most severely hit in Finland.

4. Data and empirical approach

4.1. Data

We focus on the European retail-oriented banks in our analysis. These banks provide consumers with a relatively homogeneous set of financial products and services such as savings accounts and basic loans, payment intermediation and bank and credits cards to consumers and corporate customers. We exclude from our sample specialized commercial banks such as investment banks, which bear little resemblance to other banks.⁵ By focusing on a relatively homogenous group of banks, we try to eliminate differences in bank performance that could arise from differences in the business models (specialized vs. retail-oriented banks). We utilize in our analysis the fact that Finland, Norway and Sweden are small and institutionally, economically, culturally, and politically rather homogenous countries. Finland and Sweden were one country over 600 years until 1809. Sweden and Norway has a long history together since the Kalmar Union (1397–1523). The Nordic Council was established in 1952, and thereafter the Nordic countries have actively co-operated with each other – Nordic co-operation has been one of the most extensive forms of regional co-operation in the world (see e.g. www.norden.org). The Nordic welfare state model is well-known (e.g. Andersen et al., 2007). Lekvall, 2014 stress Nordic co-operation within a Nordic corporate governance model. Finland and Sweden are the members of the EU, while Norway is very closely linked to it through the European Economic Area (EEA) agreement and other bilateral agreements. Importantly, Norway has incorporated about three-quarters of all EU laws and policies, and is more closely integrated into many aspects of the EU than even some of the member countries.⁶

Our empirical analysis is based on annual consolidated financial accounts and ownership information of Nordic3 and EU12⁷ banks over the period 1994 to 2010.⁸ Our sample consists of 5452 (500) EU12 and 521 (51) NORDIC bank-year observations (banks). The original data are collected by Ferri, Kalmi and Kerola (2015)⁹ from the BankScope data provided by Bureau van Dijk.¹⁰ The sample construction, the number of observations by ownership type and the number of banks by ownership type is described in detail in the Appendix B.

4.2. Descriptive analysis

We first investigate the disparity between the Nordic banks and other European banks by testing whether the sample means of selective key variables differ in the sub-periods 1994–2007 and 2008–2010. These sub-periods are selected for testing whether the Nordic banks differ from other European banks in the period preceding the 2008 crises (1994–2007) and during the 2008 crisis (2008–2010). Table 1 shows sample means and *p*-values for selected key variables.¹¹ The cost structure of banks and their efficiency levels are quite similar for Nordic banks and other European banks. We find no statistically significant difference for operating expenses to total costs or interest expenses to total costs. On the other hand, personnel expenses to total costs are significantly higher in European banks. In line with this finding, the cost-to-income ratio (CIR), a proxy for bank managerial efficiency, is significantly better for Nordic banks in both sub-periods. During the recent crisis in 2008–2010, the initial impact on costs followed a rather similar pattern in both groups of banks. The difference over the sub-period is mostly explained by a more rapid income recovery from the initial shock for the Nordic banks. Traditional banking consists of attracting customer deposits in exchange for interest payments and lending the deposited funds to other customers at higher rates. Table 1 shows that the Nordic banks base their business more on customer loans than other European banks. This may partly depend on how residential investments are financed. In the Nordic countries, banks are the main suppliers of mortgage loans, while in other European countries special housing finance institutes are more common. Further, for small and medium-sized firms, bank loans constitute the main source of external funding in the Nordic countries. On the liability side of the bank balance sheet, customer deposits are significantly lower in the Nordic banks. The loan-to-deposit ratio (LDR), i.e. the average percentage of customer loans to customer deposits, is approximately 130% in the Nordic countries, compared to around 90% for banks elsewhere in Europe. This implies that the Nordic banks rely heavily on the availability of the interbank liquidity in funding their customer loans. During the 2008 financial crisis the risk from this strategy became painfully evident, when interbank rates surged and banks that relied on the continuous flow of interbank market liquidity in their funding were suddenly forced to pay much higher rates than before the crisis. For non-interest income we do not find a statistically significant

⁵ Investment banks' business model largely differs from retail-oriented banks. First, investment banks typically serve large corporations and institutional clients, while retail-oriented banks mostly provide services for SMEs and individuals. Second, an important feature of investment banks' business model is issuance of securities and other fee-based services, whereas retail-oriented banks primarily focus on lending and deposit-taking business. In BankScope's original data investment banks, on average, have about sevenfold higher ratio of non-interest income to total assets compared to retail-oriented banks included in our sample. Also these investment banks, on average, are more profitable (ROA) and much efficient (CIR) than the retail-oriented banks included in our sample.

⁶ E. Eide, a former foreign minister of Norway, in the Guardian, 27 October, 2015.

⁷ EU12 = Austria, Belgium, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom.

⁸ The BankScope data were not available for the years prior to 1994.

⁹ We are grateful to them for providing the refined bank data.

¹⁰ BankScope is used in many previous cross-country banking studies (e.g. Altunbas and Chakravarty, 1998; Iannotta et al., 2007). The coverage of BankScope data is good for most banking sectors within the EU, perhaps Austria, Belgium and Luxembourg being the exceptions (e.g. Schure et al., 2004).

¹¹ Based on the equality of sample means *t*-tests.

Table 1

Sample means for selective key bank-level variables.

Source: BankScope; authors' calculations.

	1994–2007		2008–2010			
	(1) European banks	(2) Nordic banks	(3) Test on the equality of sample means (<i>p</i> -values)	(4) European banks	(5) Nordic banks	(6) Test on the equality of sample means (<i>p</i> -values)
<i>Costs</i>						
Ratio of total operating expenses to total costs (%)	40.99	40.71	0.76	48.64	47.50	0.56
Ratio of interest expenses to total costs (%)	59.01	59.29	0.76	51.35	52.50	0.56
Ratio of personnel expenses to total costs (%)	20.14	18.85	0.01 ***	25.19	22.77	0.02 **
<i>Outputs</i>						
Ratio of total deposits to total assets (TA, %)	70.52	60.60	0.00 ***	70.14	59.86	0.00 ***
Ratio of total loans to TA (%)	58.51	76.48	0.00 ***	60.71	74.80	0.00 ***
LDR (loan-to-deposit ratio, %)	90.69	133.41	0.00 ***	93.37	127.69	0.00 ***
Ratio of non-interest income to TA (%)	1.31	1.37	0.67	1.14	0.95	0.37
<i>CAMEL variables</i>						
Capital ratio (ratio of equity to TA, %)	7.27	7.60	0.13	6.76	8.08	0.01 ***
Credit quality (ratio of loan loss provisions to total loans, %)	0.52	0.21	0.00 ***	0.88	0.38	0.00 ***
Cost-to-income ratio (CIR, %)	65.01	61.86	0.00 ***	68.64	62.53	0.02 **
ROA (return on average assets, %)	0.64	0.78	0.00 ***	0.28	0.56	0.00 ***
LAR (ratio of liquid assets to TA, %)	22.63	9.60	0.00 ***	19.94	10.68	0.00 ***

difference between these two groups of banks, however.¹² Table 1 also reports results from tests of differences in bank capital, credit quality, liquid assets and return on assets.¹³ While the capital ratio (equity-to-total assets ratio) is higher in the Nordic banks in 1994–2007, it is significant only at a 13% level. What we find, though, is a noticeable difference in the capital ratio in favor of the Nordic banks during the recent financial crisis. Customer credit quality (the ratio of loan loss provisions to total loans) also appears to be better for the Nordic banks.

A striking finding is that there is a major difference in the liquid assets ratio (LAR), i.e. cash and other assets that a bank can be expected to convert into cash quickly relative to total assets.¹⁴ The LAR is significantly higher for other European banks. The LAR decreased from 22.63 in 1994–2007 to 19.94 in 2007–2010 for European banks, while for the Nordic banks the LAR increased from 9.60 to 10.68. Profitability (ROA) was significantly higher in the Nordic banks, both in the 1994–2007 and 2008–2010 sub-periods.

Overall, the results in Table 1 strongly indicate that the Nordic banks performed better than other European banks. This holds for the period between crises and for the recent financial crisis.

We now turn to key financial variables that might indicate how Nordic banks may have retained the lessons of the 1990s crisis. Fig. 1 shows the development from 1994 to 2010 of capital ratio, CIR, credit quality, and ROA for Nordic and other European banks. Importantly, the Nordic banks have systematically strengthened their capital cushions after the early 1990s crisis. The *capital ratio* was mostly higher in the non-Nordic banks during 1994–2004, but thereafter markedly higher for the Nordic banks. During the 2008 crisis, there is a significant difference in the favor of the Nordic banks. The upward trend of the capital ratio in the period for Nordic banks is consistent with the learning hypothesis.

The remaining three series in Fig. 1 show that the *CIR* (cost-to-income ratio), a proxy for bank managerial efficiency, is overall better in the Nordic banks in the period. The Nordic banks were able to improve their CIRs faster than other European banks in the years after the dot-com bubble. More importantly, the Nordic banks have fared much better during the 2008 crisis than the non-Nordic banks. Because costs followed a rather similar pattern in both groups of banks, the difference largely stems from the faster income recovery of the Nordic banks. *Credit quality* is also better for the Nordic banks, even if both the Nordic and non-Nordic banks improved their credit quality in the 1994–2007 period. However, Fig. 1 shows a significant decrease in credit quality in other European banks during the 2008 crisis. This difference reflects more prudent credit quality management in the case of the Nordic banks, which is consistent with the learning hypothesis. Except for the dot-com bubble aftermath, *profitability* (ROA) appears to be

¹² Using non-interest income, we try to capture non-traditional banking activities (such as off-balance sheet business, fees, and service charges) that have become increasingly common among banks.

¹³ Return on assets (ROA) is the ratio of net income to total assets, calculated as return on average assets in BankScope.

¹⁴ Includes sovereign bonds, short-term claims on other banks, and own trading portfolio.

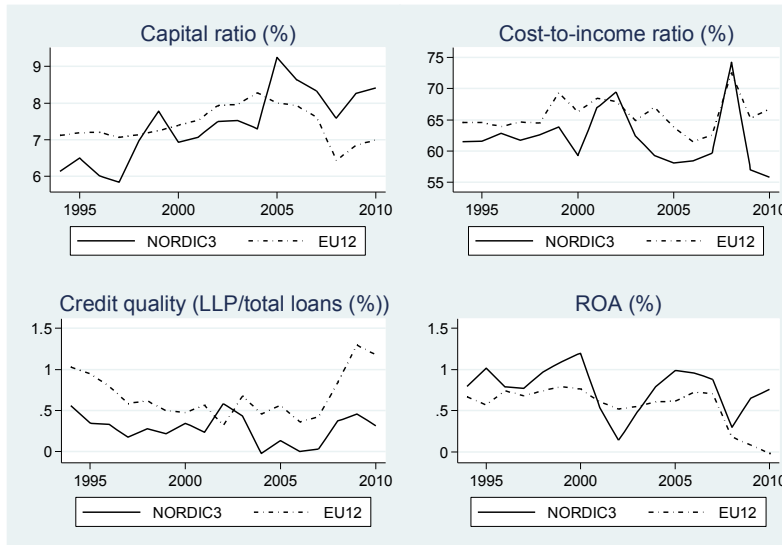


Fig. 1. Capital ratio, CIR, credit quality and ROA.

higher in the Nordic banks for most of the 1994–2007 period. During the 2008 crisis profitability increases for the Nordic banks while it decreases for other European banks indicating the Nordic banks’ business model was more resilient to the consequences of the 2008 crisis. Again, this finding is consistent with the learning hypothesis.

4.3. Empirical approach

This section discusses our empirical approach and defines the main variables that we use in the empirical analysis. First we focus on bank returns, thereafter we analyze bank financial stability. Our main interest is in whether Nordic banks (i) were more profitable and (ii) retained better financial stability than other European banks during the 2008 financial crisis. In the both settings we use linear panel data models, including pooled OLS regressions and fixed-effects panel data regressions. We include a rich set of bank and macroeconomic control variables in order to account for standard drivers of bank performance. To facilitate a comparison between these two settings, we use the same set of covariates throughout the models. We measure bank profitability using ROA, the ratio of net income to total assets. To deal with potential outliers, we winsorize observations in the first as well as the last percentile of the ROA distribution. Related to bank profitability is bank risk. An interesting question, from a risk management point of view, is whether the Nordic banks differ from other European banks in this respect. Since share market values are not available for cooperative and savings banks, or non-listed commercial banks, we cannot use market-value based variables for this purpose. We therefore proxy individual financial stability (bank risk) using the Z-score, which can be computed using publicly available accounting data only. While the Z-score is a commonly used risk measure for a bank’s probability of insolvency in the prevailing literature (e.g. Laeven and Levine, 2009), there seems to be lack of consensus in the empirical banking literature how to construct time-varying Z-score measures (for a review, see Lepetit and Strobel (2013)). We follow the methodology used by Fiordelisi and Mare (2014), which is similar to Hesse and Cihák (2007):

$$Z - score_{i,t} = \frac{\mu(ROA_{c,t}) + CAR_{i,t}}{\sigma(ROA_{c,t})} \tag{1}$$

where $\mu(ROA_{c,t})$ is the mean of ROA within country c in year t , $CAR_{i,t}$ the capital asset ratio for bank i in year t and $\sigma(ROA_{c,t})$ the standard deviation of ROA within country c in year t .¹⁵As in Fiordelisi and Mare (2014), we take the natural logarithm of the Z-score to smooth out extreme values in the Z-distribution. We also use a broad set of bank and macro controls in order to account for confounding factors. Because stock market values are unavailable for non-listed commercial, cooperative, and savings banks, we pick our control variables from bank financial statements (internal factors) and macroeconomic indicators (external factors). Our internal factors include capital ratio, the size of lending activity, exposure to interbank finance, liquidity, managerial efficiency, bank size and listing status.¹⁶ To capture differences in external factors across countries, we use government debt per GDP (a proxy for government

¹⁵ According to Fiordelisi and Mare (2014), one benefit of using the standard deviation of ROA within country c in year t in the denominator in Eq. (1) is that in this way $Z-score_{i,t}$ does not suffer from endogeneity concerns. Using the mean of ROA within country c in year t in the numerator is justified since otherwise $ROA_{i,t}$ and $\sigma(ROA_{c,t})$ would arise from different distributions, potentially creating an inconsistency problem.

¹⁶ Our bank-level covariates roughly follow the CAMELS categories used by many bank regulators and supervisors to assess individual banks’ soundness. CAMELS categories are capital adequacy, asset quality, management quality, earnings, liquidity, and sensitivity to market risk. Unfortunately, we cannot apply CAMELS here since we lack adequate measures for asset quality and sensitivity to market risk.

policies), GDP per capita (a proxy for economic development), real GDP growth (a proxy for business cycle) and inflation (a proxy inflation pressures) measures. We control for ownership form differences across banks with two dummy variables for stakeholder-oriented banks (i.e. savings banks and cooperative banks).¹⁷ Control variable definitions are detailed in Appendix A. Table 2 represents summary statistics for our key variables over the full sample [1...NT].

To mitigate potential endogeneity concerns in our empirical models, we use one-year lagged values of bank- and country-level explanatory variables. Specifically, we analyze the difference in bank returns between the Nordic and other European banks during the 2008 financial crisis by estimating the following regression model:

$$\begin{aligned} ROA_{i,t} = & \beta_0 + \beta_1 CAP_{i,t-1} + \beta_2 LEND_{i,t-1} + \beta_3 LDR_{i,t-1} + \beta_4 LAR_{i,t-1} + \beta_5 SIZE_{i,t-1} + \beta_6 LIST_{i,t-1} + \beta_7 CIR_{i,t-1} + \beta_8 SAVBANK_i \\ & + \beta_9 COPBANK_i + \beta_{10} GOVDEBT_{c,t-1} + \beta_{11} GDPCAP_{c,t-1} + \beta_{12} GDPGROW_{c,t-1} + \beta_{13} INF_{c,t-1} + \beta_{14} NORDIC_i + \beta_{15} YEAR_t \\ & + \beta_{16} NORDIC * YEAR2008_{it} + \beta_{17} NORDIC * YEAR2009_{it} + \beta_{18} NORDIC * YEAR2010_{it} + \beta_{19} BANK_FE_i + \varepsilon_{i,t}. \end{aligned} \quad (2)$$

To investigate the difference in bank financial stability between the Nordic and other European banks during the 2008 financial crisis, we use again one-year lagged values of included explanatory variables and estimate:

$$\begin{aligned} Z\text{-score}_{i,t} = & \beta_0 + \beta_1 CAP_{i,t-1} + \beta_2 LEND_{i,t-1} + \beta_3 LDR_{i,t-1} + \beta_4 LAR_{i,t-1} + \beta_5 SIZE_{i,t-1} + \beta_6 LIST_{i,t-1} + \beta_7 CIR_{i,t-1} + \beta_8 SAVBANK_i \\ & + \beta_9 COPBANK_i + \beta_{10} GOVDEBT_{c,t-1} + \beta_{11} GDPCAP_{c,t-1} + \beta_{12} GDPGROW_{c,t-1} + \beta_{13} INF_{c,t-1} + \beta_{14} NORDIC_i + \beta_{15} YEAR_t \\ & + \beta_{16} NORDIC * YEAR2008_{it} + \beta_{17} NORDIC * YEAR2009_{it} + \beta_{18} NORDIC * YEAR2010_{it} + \beta_{19} BANK_FE_i + \varepsilon_{i,t}. \end{aligned} \quad (3)$$

In Eqs. (2) and (3) the definitions of the explanatory variables are the same. $CAP_{i,t-1}$ is ratio of capital to total assets for bank i in year t , $LEND_{i,t-1}$ is ratio of total loans to total assets (a proxy for the importance of traditional lending business for the bank), $LDR_{i,t-1}$ is the loan-to-deposit ratio (a proxy for exposure to interbank finance), $LAR_{i,t-1}$ is the liquid assets-to-total assets ratio, $SIZE_{i,t-1}$ is \log (total assets) $_{i,t-1}$, and $CIR_{i,t-1}$ is ratio of cost to income (a proxy for managerial efficiency). For $LIST_{i,t-1}$, 1 if bank publicly listed, 0 otherwise. For $SAVBANK_i$, 1 if savings bank, 0 otherwise. For $COPBANK_i$, 1 if cooperative bank, 0 otherwise. For macroeconomic controls in the bank's home country, $GOVDEBT_{c,t-1}$ is general government debt as % of GDP (a proxy for government policies), $GDPCAP_{c,t-1}$ is GDP per capita (a proxy for economic development), $GDPGROW_{c,t-1}$ is real GDP annual growth (a proxy for business cycle), and $INF_{c,t-1}$ is the annual CPI (a proxy for inflation pressure). $BANK_FE_i$ and $YEAR_t$ are bank and time fixed effects, respectively.¹⁸ Our main interest lies in the coefficients of the interaction terms of $NORDIC * YEAR2008$, $NORDIC * YEAR2009$, and $NORDIC * YEAR2010$ (i.e. β_{16} , β_{17} and β_{18}). For a finding that comports with the learning hypothesis, our initial expectation is that we should see significant differences in returns between the Nordic banks and European banks during the 2008 financial crisis in 2008–2010, after controlling for the key bank-level characteristics and macroeconomic variables in a country of origin of bank. This is tested by including the interaction terms between YEAR2008–YEAR2010 and NORDIC (= 1 if Nordic bank, 0 otherwise).

5. Estimation results

5.1. Bank returns

Table 3 shows our estimation results for bank profitability in 1994–2010. In column (1), we use a pooled OLS estimator for comparison. Consistent with the learning hypothesis, we find positively significant coefficients for the interaction terms $NORDIC * 2009$ and $NORDIC * 2010$, whereas the coefficient of $NORDIC * 2008$ is insignificant. A possible explanation for this finding could be in that there is no significant difference in the way the onset of the 2008 crisis hit Nordic banks and other European banks, but because the Nordic banks had learned from their crisis experiences in the early 1990s, they emerged from the crisis faster than other European banks. Alternatively, it could be that the recovery of other European banks in 2009 and 2010 was curtailed by their higher exposure to the eurozone crisis (e.g. due to higher share of various liquid assets in their balance sheet such as sovereign bonds issued by the crises countries) than Nordic banks. While our data do not allow teasing out these two potential explanations, both are consistent with the learning hypothesis. Importantly, the joint tests for exclusion of $NORDIC * 2008$, $NORDIC * 2009$ and $NORDIC * 2010$ are clearly rejected.

In columns (2)–(3) we control for unobserved bank characteristics (i.e. unobserved heterogeneity) using the fixed effects (FE) and the random effects (RE) estimators. The key difference between these two estimators is that the FE estimator is consistent when the unobserved bank effects are correlated with the error term, while the RE estimator is more efficient when the unobserved bank effects are uncorrelated with the error term.¹⁹ In column (2), where we use the fixed effects estimator, we continue to find that the estimated coefficients of $NORDIC * 2009$ and $NORDIC * 2010$ are positively significant, which is consistent with the “faster recovery” interpretation for the Nordic banks discussed earlier. Likewise, the interaction term $NORDIC * 2008$ stays insignificant. In column (3) we

¹⁷ Commercial banks are the reference category.

¹⁸ When we estimate the random effects model, we replace bank fixed effects in Eqs. (2) and (3) by bank random effects. Similarly, we exclude bank fixed effect in the pooled OLS model.

¹⁹ By using the FE estimator, we cannot include time-constant variables such as dummy variables for bank ownership types and Nordic banks (NORDIC) in our model. However, we can still use the interaction terms between YEAR2008–YEAR2010 and NORDIC to test the learning hypothesis. By the same token, using the RE estimator allows us to include time-constant covariates in the model such as the NORDIC dummy variable.

Table 2

Summary statistics.

Source: BankScope; OECD: World Bank; authors' calculations.

Variable	Definition	Mean	Standard deviation	Min	Max
<i>Bank-level variables</i>					
1. ROA	Return on assets (%)	.599	.637	−2.68	4.19
2. Z-score	$Z\text{-score} = (\mu(ROA)_{c,t} - CAR_t) / \sigma(ROA)_{c,t}$	12.30	7.52	−1.98	148.33
3. Capital ratio	Ratio of equity to total assets (%)	7.23	4.79	−1.86	93.9
4. Size of lending activity	Ratio of total loans to total assets (%)	60.7	21.5	1.06	99.9
5. Exposure to interbank finance	LDR (loan-to-deposit ratio, %)	95.1	52.1	1.33	496
6. Liquidity	LAR (liquid assets-to- total assets ratio, %)	20.8	17.8	.010	96.5
7. Managerial efficiency	Cost-to-income ratio (%)	65.3	27.7	.34	819
8. Bank size	$\log(\text{total assets})$; a proxy for “too big to fail”	16.1	2.01	10.4	21.8
9. Publicly listed	= 1 if bank publicly listed, 0 otherwise	.208	.406	0	1
10. Nordic bank	= 1 if Nordic bank, 0 otherwise	.088	.284	0	1
11. Commercial bank	= 1 if commercial bank, 0 otherwise	.48	.50	0	1
12. Savings bank	= 1 if savings bank, 0 otherwise	.21	.41	0	1
13. Cooperative bank	= 1 if cooperative bank, 0 otherwise	.31	.46	0	1
<i>Country-level variables</i>					
14. Government policy	General government debt/GDP (%)	60.9	22.8	6.5	146
15. Economic development	$\log(\text{GDP/capita})$	10.3	.26	9.6	11.4
16. GDP growth	Real GDP growth (% p.a.)	2.17	2.24	−8.3	10.9
17. Inflation pressures	Annual change of CPI (consumer price index, %)	2.12	1.1	−4.48	8.93

Table 3

The estimates for bank returns in 1994–2010.

Source: BankScope and OECD.

	(1) Pooled OLS	(2) Fixed effects	(3) Random effects
<i>Bank-level variables</i>			
Capital ratio _{t-1}	0.062 *** (0.00)	0.034 *** (0.00)	0.049 *** (0.00)
Lending activity _{t-1}	0.000 (0.85)	0.000 (0.30)	0.001 (0.57)
Exposure to interbank lending _{t-1}	−0.000 (0.96)	0.000 (0.84)	−0.000 (0.95)
Liquidity _{t-1}	0.002 (0.23)	0.003 (0.23)	0.002 (0.23)
Publicly listed _{t-1} (0/1)	0.046 (0.23)	0.055 (0.82)	0.093 ** (0.03)
Inefficiency _{t-1}	−0.007 *** (0.00)	−0.004 *** (0.00)	−0.005 *** (0.00)
Size _{t-1}	0.022 ** (0.02)	−0.151 ** (0.02)	−0.003 (0.79)
Nordic bank (0/1)	0.118 ** (0.04)	−	0.098 (0.14)
Savings bank (0/1)	0.027 (0.48)	−	0.023 (0.58)
Cooperative bank (0/1)	−0.042 (0.25)	−	−0.028 (0.50)
Nordic bank*2008	−0.020 (0.84)	0.030 (0.80)	−0.018 (0.87)
Nordic bank*2009	0.298 *** (0.00)	0.371 *** (0.00)	0.318 *** (0.00)
Nordic bank*2010	0.225 *** (0.00)	0.254 *** (0.00)	0.214 *** (0.00)
<i>Macroeconomic variables</i>			
Government debt/GDP _{t-1} (%)	−0.002 (0.14)	−0.002 (0.48)	−0.001 (0.30)
Level of development _{t-1} ($\log(\text{GDP/capita})$)	−0.233 *** (0.01)	−0.664 ** (0.02)	−0.260 ** (0.02)
GDP growth _{t-1} (%)	0.029 *** (0.01)	0.053 *** (0.00)	0.049 *** (0.00)
Inflation _{t-1}	0.043 ** (0.02)	0.043 * (0.06)	0.039 ** (0.04)
<i>p</i> -value testing exclusion of interaction terms NORDIC*2008, NORDIC*2009 and NORDIC*2010	0.01 ***	0.00 ***	0.00 ***
Bank fixed effects	No	Yes	No
Bank random effects	No	No	Yes
Number of banks	551	551	551
Number of observations	5,268	5,268	5,268
R ²	0.33	0.19 (within)	0.47 (between)

Notes: The dependent variable is ROA in all columns. Standard errors are adjusted for clustering at the bank level. *p*-values in parentheses. Significance levels: * 10%; ** 5%; *** 1%, respectively. All models also include a constant term and year dummies. We require that each bank has at least three consecutive observations. The sample period is 1994–2010.

Table 4

The estimates for bank stability in 1994–2010.

Source: BankScope and OECD.

	(1) Pooled OLS	(2) Fixed effects	(3) Random effects
<i>Bank-level variables</i>			
Capital ratio _{<i>t-1</i>}	0.064 *** (0.00)	0.037 *** (0.00)	0.049 *** (0.00)
Lending activity _{<i>t-1</i>}	0.000 (0.76)	0.000 (0.77)	0.001 (0.36)
Exposure to interbank lending _{<i>t-1</i>}	−0.000 (0.53)	0.000 (0.26)	0.000 (0.98)
Liquidity _{<i>t-1</i>}	0.000 (0.94)	0.001 (0.53)	0.001 (0.63)
Publicly listed _{<i>t-1</i>} (0/1)	0.042 (0.24)	−0.239 (0.23)	0.085 ** (0.05)
Inefficiency _{<i>t-1</i>}	−0.001 *** (0.00)	−0.001 * (0.06)	−0.001 ** (0.03)
Size _{<i>t-1</i>}	−0.039 *** (0.00)	−0.142 *** (0.00)	−0.063 *** (0.00)
Nordic bank (0/1)	0.221 ** (0.04)	−	0.204 ** (0.03)
Savings bank (0/1)	0.179 *** (0.00)	−	0.144 *** (0.00)
Cooperative bank (0/1)	0.076 ** (0.03)	−	0.090 *** (0.01)
Nordic bank*2008	−0.136 * (0.07)	−0.010 (0.88)	−0.091 (0.17)
Nordic bank*2009	0.106 * (0.09)	0.232 *** (0.00)	0.164 *** (0.00)
Nordic bank*2010	0.177 ** (0.02)	0.148 ** (0.04)	0.177 *** (0.00)
<i>Macroeconomic variables</i>			
Government debt/GDP _{<i>t-1</i>} (%)	0.001 ** (0.03)	−0.007 *** (0.00)	−0.001 * (0.06)
Level of development _{<i>t-1</i>} (log(GDP/capita))	0.433 *** (0.00)	−0.568 *** (0.01)	0.094 (0.36)
GDP growth _{<i>t-1</i>}	0.015 ** (0.06)	0.015 (0.25)	0.013 (0.26)
Inflation _{<i>t-1</i>}	0.022 * (0.07)	0.001 (0.93)	0.006 (0.62)
<i>p</i> -values testing exclusion of interaction terms NORDIC*2008, NORDIC*2009 and NORDIC*2010	0.00 ***	0.00 ***	0.00 ***
Number of banks	551	551	551
Number of observations	5,259	5,259	5,259
R ²	0.46	0.19 (within)	0.61 (between)

Notes: The dependent variable the Z-score in all columns. Standard errors are adjusted for clustering at the bank-level. *p*-values in parentheses. Significance levels: * 10%; ** 5%; *** 1%, respectively. The models also include a constant term and year dummies. We require that each bank has at least three consecutive observations.

use the random effects (RE) estimator.²⁰ We find that the estimated coefficients of NORDIC*2009 and NORDIC*2010 remain positively significant, which support the “faster recovery” interpretation as in columns (1) and (2). Similarly, we find that the interaction term NORDIC*2008 remains insignificant. Concerning other explanatory variables in Table 3, a short review of the main findings is the following. First, capital ratio is significant and positively related to bank returns. The estimated coefficients are in the range of .03–.06. The impact of bank lending activity is insignificant. Traditional lending thus has not reduced bank returns, indicating that banks managed to screen their loan customers to prevent lower returns through credit losses. Exposure to interbank lending is consistently insignificant, as is the liquid assets ratio. The estimated coefficients for publicly listed banks are positive but significant only in column (3). More inefficient banks consistently perform significantly worse. Bank size is inconsistently related to returns. We do not find significant disparities in returns across different ownership types of banks. With respect to macro factors, higher GDP growth and inflationary pressures imply significantly higher returns. Government debt is insignificantly associated with bank returns, while the level of development of the country is negatively significant.

5.2. Bank financial stability

If the learning hypothesis applies, our second expectation is that bank financial stability should be better for the Nordic banks during the 2008 financial crisis. As previously, we use the interaction terms between YEAR2008–YEAR2010 and NORDIC (= 1 if Nordic bank, 0 otherwise) to capture the difference between the Nordic banks and other European banks during the crisis. Table 4 shows the estimation results for bank stability. For comparison, we first report the estimation results using the pooled OLS model. Consistent with the learning hypothesis, we find positively significant coefficients for the interaction terms NORDIC*2009 and NORDIC*2010. This finding implies that the level of bank stability was higher (risk was lower) in Nordic banks in 2009 and 2010 compared to European banks. Further, now the coefficient of NORDIC*2008 is negatively significant, which implies the opposite (i.e. higher risk for the Nordic banks in 2008). As stated earlier, a possible explanation for this finding could be in that the onset of the 2008 crisis hit Nordic banks more severely. But because the Nordic banks had learned from their crisis experiences in the early 1990s, they thereafter emerged from the crisis faster than other European banks. Alternatively it could be that the recovery of other

²⁰ While not reported here (but available on request), our Hausman test suggests that the individual-specific effects are correlated with the covariates, implying the RE estimator is inconsistent and the FE estimator is preferred. A shortcoming of the Hausman test, however, is that it requires the RE estimator to be efficient, which is an assumption that cannot be tested in the Hausman test. Given that we are primarily interested in the coefficients of the interaction terms NORDIC*2008, NORDIC*2009 and NORDIC*2010 in columns (2) and (3), we use an alternative to the Hausman test, single *t* tests, that ignore the other parameters. These tests (also not reported, but available on request) suggest there is no difference between the FE and the RE interaction parameters. We therefore report the estimates based on the RE estimator in column (3).

European banks in 2009 and 2010 was curtailed by their higher exposure to the eurozone crisis (e.g. due to higher share of various liquid assets in their balance sheet such as sovereign bonds issued by the crises countries) than Nordic banks. Our data do not allow teasing out these two potential explanations but both are consistent with the learning hypothesis.²¹ Importantly, the joint tests for exclusion of NORDIC*2008, NORDIC*2009 and NORDIC*2010 are rejected.

As we do not control for unobserved heterogeneity across banks in column (1), this may also explain why we find contrasting results for the interaction terms NORDIC*2008, NORDIC*2009 and NORDIC*2010. Thus, in columns (2)–(3) use the fixed effects (FE) and the random effects (RE) estimators. In column (2), where we use the fixed effects estimator, we continue to find that the estimated coefficients of NORDIC*2009 and NORDIC*2010 are positively significant, which is consistent with the “faster recovery” interpretation for the Nordic banks discussed earlier. However, the interaction term NORDIC*2008 is now insignificant. In column (3), where we use the random effects (RE) estimator, we find that the estimated coefficients of NORDIC*2009 and NORDIC*2010 remain positively significant, which support the “faster recovery” interpretation as in columns (1) and (2). Similarly, we find that the interaction term NORDIC*2008 stays insignificant.

For the other bank-level explanatory variables in Table 4, we briefly note the following. Consistent with our prior expectations, a higher capital ratio implies a significantly higher bank stability (lower risk). Our findings for bank lending activity, exposure to interbank lending and liquidity, remain insignificant. Publicly listed banks seem to be more stable than non-listed banks, while inefficiency and bank size are negatively associated with bank stability. Nordic banks in general are more stable than non-Nordic banks. Stakeholder-oriented savings and co-operative banks are more stable compared to commercial banks.

Concerning macro factors, our findings are inconclusive. In column (1) the pooled OLS estimator implies that all included macro factors significantly increase bank stability (lower risk). In column (2), where we control for bank fixed effects, government debt and the level of development of country are negatively significant with bank stability only. In column (3) the random effects estimator indicates government debt is negatively related bank stability only.

6. Conclusions and discussion

In this paper we examine a large panel data set of Nordic and European retail-oriented banks from 1994 to 2010 in light of two hypotheses originally put forth by Fahlenbrach et al. (2012). If their *risk culture or business model hypothesis* is applicable in European context, our data should show that Nordic banks were subject to an inflexible business model and unable to alter their risk exposure in the years after the 1990s crisis. Under that hypothesis we would expect insignificant performance differences in the 2008 crisis. Under the *learning hypothesis*, however, we would expect the Nordic banks to have learned from the initial crisis and evidence of permanent adjustment of their banking practices and corporate culture. If the learning hypothesis applies, we expect that the Nordic banks should show significantly higher profitability and greater financial stability than other European banks during the peak years of the Great Recession (2008–2010). We find that banks in the three Nordic countries outperformed other European banks during the 2008 crisis. Our descriptive analysis reveals that the Nordic banks since 1994 have done a better job than their European counterparts of steadily enhancing their capital ratios. Although our evidence is inevitably non-experimental, we control for in our estimations the most important observable differences across individual banks and macroeconomic environments that the previous studies find important drivers of bank performance and financial stability. Specifically, we control for the level of government debt, a proxy for government learning pattern. Similarly, we control for differences in managerial efficiency among banks. In some of our models we also control for unobserved heterogeneity across individual banks. Our findings are consistent with the view that the Nordic crisis of the 1990s have had a major impact on the behavior of the Nordic banks, and the Nordic banks today have taken to heart the lessons of a painful and traumatic crisis nearly two decades ago.

Our findings differ from those of Fahlenbrach et al. (2012), who find that listed US banks that performed poorly during the 1998 financial crisis (which in the US was initiated by the collapse of the LTCM hedge fund with heavy exposure to Russia’s bond market) also performed poorly during the Great Recession of 2008. A potential explanation might be that the initial crisis needs to be systemic and sufficiently severe, as it most certainly was in the Nordic crisis of the early 1990s, for banks to see the point of altering their risk culture. When large financial losses are limited to a small number of investors as in the 1998 crisis in the US, it may not be a sufficient to trigger for a major re-evaluation of bank business models.

Interestingly, the idea “severe enough” crisis requirement is consistent with illustrative evidence from Denmark and Iceland. Denmark, unlike Finland, Norway, and Sweden, did not face a large-scale systemic financial crisis in the early 1990s. While Danish banks were hit by financial challenges, only a few went bankrupt. During the 2008 crisis, the entire Danish banking sector was brought to its knees, mostly due to a real-estate collapse cycle fueled by excessive lending. As a result, several banks required extensive financial support from the Danish government to continue their business. Iceland, too, plunged into an exceptionally severe crisis in 2008, when all three of the country’s major private banks went bankrupt almost simultaneously. Had banks in Denmark and Iceland been largely exposed to a systemic banking crisis in the early 1990s, more prudent lending behavior prior to the 2008 crisis, could well have been the result. We recognize the limitations of this study. First, even with rich bank-level panel data, differences in the findings between Fahlenbrach et al. (2012) and ours may reflect differences in the composition of the samples. We focus on the retail-oriented banking sector, a broader category of banks than the list banks examined by Fahlenbrach et al. (2012). The number of listed Nordic and European banks, however, is too small for convincing empirical analysis in our case. Adding other stakeholder-

²¹ We recognize that this finding may also arise if the 2008 crisis hit at full stretch Nordic banks and other European banks in 2009 and 2010, since the Lehman brothers had collapsed in September 15, 2008. But this explanation is also consistent with the learning hypothesis.

oriented banks (cooperative and savings banks) into the sample is justified by the fact that these banks are major players in the European banking system. Second, due to lack of appropriate data, we cannot control for the potential learning of the financial regulatory authorities in three Nordic countries from the experiences of the early 1990s. However, as we discuss in Section 2, various considerations indicate that this unlikely explain the performance differences we find during the 2008 crisis between the Nordic and other European banks. Nevertheless, a detailed examination to determine the extent to which Nordic regulatory authorities explicitly have taken lessons of the 1990s Nordic crisis into account, and in particular whether these “Nordic lessons” differ from banking supervision practices within the European Union during our sample period, would undoubtedly provide valuable insights into forces that impact the development and enforcement of financial regulation.

Appendix A. Description of control variables

Capital ratio

The ratio of total equity to total assets. Total assets is the sum of common equity, non-controlling interest, securities revaluation reserves, foreign exchange revaluation reserves and other revaluation reserves. Our assumption here is that higher capital reserves improve a bank’s ability to tolerate financial losses. The capital ratio should thus be positively related to ROA and negatively related to the probability of financial distress.²²

Lending activity

This measures the importance of traditional lending businesses for the bank, and is captured by the ratio of total loans to total assets. ROA can be positively or negatively related to lending activity, depending on the quality of borrowers in the bank’s loan portfolio. If lending activity is positively related to the probability of distress, a sizeable loan portfolio indicates higher exposure to losses. We assume this is the case when a sizeable loan portfolio is the result of aggressive lending using lax credit standards (see e.g. Dell’Ariccia and Marquez, 2006).

Exposure to wholesale market funding in lending

Customer deposits are a traditional source of funding for bank lending. However, deregulation, intensified competition, and financial innovations combined with relatively low interest rates has increased the dependence of banks on the wholesale market as a funding source. Although banks normally can raise funds from the wholesale market at low costs, wholesale market loans may become excessively expensive in a severe financial crisis. Availability may even dry up completely due to adverse selection. We assume such conditions aggravate financial distress and reduce profitability. A bank’s exposure to the wholesale market funding in lending is captured using the loan-to-deposit ratio (LDR). An increase in the LDR implies increased exposure to wholesale market liquidity in lending.

Liquid assets

includes cash and other assets that the bank expects to be able to convert into cash quickly; such as sovereign bonds, short-term claims on other banks, and trading portfolio. Liquid assets, which normally are rather safe assets for banks, can become risky during a severe financial crisis when e.g. sovereign bonds or claims on other banks caused by increased distress risk reflect issuer solvency problems. We measure the relative magnitude of liquid assets by the ratio of liquid assets to total assets (LAR).

Bank ownership type

The nature of the banking business may be related to the form of incorporation of the bank (commercial, savings, and cooperative bank formats). The form of incorporation can thus have important implications on profitability and the risk of distress. As a rule, commercial banks are more willing to take on high-risk/high-return business activities, while stakeholder-oriented cooperative and savings banks are likely to follow fairly conservative business practices. They prefer overall security over risk and emphasizes prudent long-run strategies. Unlike commercial banks, cooperative and savings banks do not focus on profit maximization exclusively, but also strive to serve the needs of their principals (usually a customer base close to the bank). In general, shareholders in commercial banks have more immediate interest in governance policies that safeguard bank value than stakeholders in cooperative and savings banks. To control for the form of incorporation, we add savings bank and cooperative bank dummy variables into the models (with commercial banks as the reference category).

²² A positive association may also exist between capital ratio and risk. For example, increased leverage (decreased capital) may reduce agency conflicts between bank managers and shareholders because leverage pressures managers to be more efficient (e.g. Jensen and Meckling, 1976). Likewise, a positive relationship may occur if riskier banks are forced to raise capital, or if more capitalized banks have a greater risk absorption capacity and, because of this, are willing to take on more risk (e.g. Berger and Bouwman, 2013).

Bank size

We also control for bank size, which may bear upon bank performance. Likewise, the likelihood of failure may be lower for larger banks through the “too big to fail” argument. We measure bank size by the logarithm of total assets.

Macroeconomic factors

We include four country-specific macroeconomic variables. We use changes in the *consumer price index* (CPI) as a proxy for inflationary pressure, and changes in the *real GDP growth* as a proxy for the business cycle. *Government debt/GDP* is a proxy for government policies (and potential learning), while *GDP per capita* is a proxy for economic development.

Appendix B. Sample construction

Our sample of European retail-oriented banks is constructed as follows. First, banks that were classified in BankScope as commercial banks, savings banks, cooperative banks, real estate/mortgage banks, bank holdings and holding companies, and specialized governmental credit institutions were retrieved. UK and Irish building societies are included as they provide a broad range of financial services. Other mortgage banks are excluded, however. Some large commercial banks are classified as “bank holdings and holding companies.” A “specialized governmental credit institution” is included if it is a savings bank. To mitigate the effects of extreme values in our covariates, we exclude the observations for a bank if the ratio of total loans to total assets for that bank is less than 1%, the ratio of total deposits to total assets is less than 1%, the ratio of total loans to total deposits (LDR) is more than 500%, the ratio of total costs to total assets is more than 100%, or the ratio of personnel expenses to total costs is less than 1%. To deal with potential extreme values in ROA, we winzorize this continuous variable at the 1% and 99% levels. Finally, we require that each bank has at least three consecutive observations. We have had to recode BankScope ownership type classifications in a few cases. Mostly this applies to savings banks. Many such banks have changed their mission and can no longer be reasonably be viewed as savings banks, even if they are still classified as such (e.g. Lloyds TSB and Swedbank). We also recode for certain Belgian and Italian banks where the non-profit foundation is no longer the dominant shareholder.²³ Likewise, the savings bank classification of French Caisse d’Espargne banks in BankScope is changed since their ownership structure has been cooperative since the late 1990s. Other cooperative banks are appropriately classified. A challenge specific to cooperative banks is they may be included at different levels of aggregation. For instance, the French cooperative banks are represented by their regional banks, but also on the group level as well as by their subsidiaries. The same regional-level aggregation applies to German and Austrian cooperative banks. In contrast, for the Netherlands and Finland (countries that have large cooperative banks) only group-level data are available. In cases where regional data is available, [Ferri et al. \(2015\)](#) include the regional level data to increase the comparability with savings banks that are also regionally defined (especially government-owned ones), otherwise group level data are used. Commercial banks fall into a relatively straightforward category, and no recoding of ownership type was required.²⁴ [Table A1](#) shows the number of bank-year observations

Table A1

The number of bank-year observations by ownership type.

Source: BankScope, authors’ calculations.

Ownership type	EU12	Nordic3	Total
Commercial banks	2,704	206	2910
Savings banks	960	280	1240
Cooperative banks	1,788	35	1823
Total	5452	521	5973

Table A2

The number of banks by ownership type.

Source: BankScope, authors’ calculations.

Ownership type	EU12	Nordic3	Total
Commercial banks	249	18	267
Savings banks	89	30	119
Cooperative banks	162	3	165
Total	500	51	551

²³ Because savings banks may differ in their legal forms, it is difficult to give a uniform criterion for savings banks. [Ferri et al. \(2015\)](#) use the following criterion: if a savings bank is majority controlled by a foundation and there are no other large owners, then it is classified as a savings bank even if incorporated as a joint-stock company.

²⁴ For a more detailed description of data and refinements, see [Ferri et al. \(2015\)](#).

by ownership type and Table A2 displays the number of banks by ownership type in our sample.

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