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Does female management influence firm performance? Evidence from Luxembourg banks

Regina M. Reinert[1] · **Florian Weigert**[2] · **Christoph H. Winnefeld**[3]

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Abstract In this study, we examine the relationship between the proportion of women in top management positions at banks and these institutions' financial performance. Using prudential data from supervisory reporting for all credit institutions in the Grand Duchy of Luxembourg from 1999 to 2013, we find a positive association between female management and firm performance. The economic effect is substantial: a 10 % increase in women in top management positions improves the bank's future return on equity by more than 3 % p.a. Moreover, we show that this positive relationship is (i) almost twice as large during the global financial crisis than in stable market conditions and (ii) non-linear, with banks having 20–40 % female management being the most successful.

Keywords Management diversity · Female management · Bank performance

JEL Classification G21 · J16 · L25 · M14

✉ Christoph H. Winnefeld
c.winnefeld@hochschule-trier.de

Regina M. Reinert
regina.reinert@hogrefe.ch

Florian Weigert
florian.weigert@unisg.ch

1 School of Management, University of St.Gallen and Hogrefe Consulting, Länggass-Strasse 76, 3012 Bern, Switzerland

2 School of Finance, University of St. Gallen, Rosenbergstrasse 52, 9000 St. Gallen, Switzerland

3 Commission de Surveillance Du Secteur Financier and Trier University of Applied Sciences, 283, route d'Arlon, 1150 Luxembourg, Luxembourg

1 Introduction

Several countries in the European Economic Area have already instituted (e.g., Norway) or will introduce (e.g., Germany) legally binding quotas for the gender composition of the management board and the board of directors of private firms. Norway passed a law in 2003 requiring that women make up 40 % of the boards of public companies. In Germany, 30 % of the members of the board of directors of 108 large listed companies are mandated to be women as from 2016 onwards. In addition, some 3500 small and medium enterprises (SMEs) were required to set own targets in 2015 for a higher proportion of women on the board of directors, the executive board, and in senior management.

Although there has been an increasing focus on how gender diversity on management boards impacts firm performance, findings remain inconclusive (Harrison and Klein 2007; Knippenberg and Schippers 2007; Joshi and Roh 2009; Ahern and Dittmar 2012). Pioneering studies were typically based on samples of large U.S. corporations listed on a stock exchange (Shrader et al. 1997; Adler 2001; Carter et al. 2003; Kochan et al. 2003; Catalyst 2004; Bell 2005) or based on samples with very short observation periods (Smith et al. 2006; Adams and Ragunathan 2012). In addition, according to Dezsö and Ross (2012), some studies do not sufficiently account for the impact of control variables (such as different corporate characteristics) in the empirical analysis (Terjesen et al. 2009). Consequently, the results of previous studies might not be representative of the true relationship between female management share and firm performance.[1]

With these mixed results and shortcomings of the existing empirical work in mind, our study analyzes whether gender diversity has a significant impact on the financial performance of 264 banks in the Grand Duchy of Luxembourg, the premier private banking center in the Eurozone. By focusing on these institutions and the data provided by their supervisory reporting, our analysis is based on reliable, comprehensive and consistent data, thus allowing the drawing of valid conclusions regarding gender diversity. During our sample period from January 1999 to December 2013, we document a strongly positive association between female management share and firm performance.[2] The economic significance is substantial: a 10 % increase of women in top management positions improves the bank's future return on equity by 0.86 % per quarter. Annualized, this change improves the bank's future return on equity by $0.86\,\% \times 4 = 3.44\,\%$ p.a. Our results are robust if we control for a wide array of different corporate characteristics, such as firm size, client deposits, staff expenditure, return on equity (RoE) volatility, bank activity, financial strength, firm age, the status of firm law, and the firm's country of origin, as well as if we apply alternative OLS regression techniques. We also address potential endogeneity concerns and find that our results are stable when we use a fixed-effect panel data model and the Arellano and Bond (1991) dynamic panel GMM estimator in our regression setup. Moreover,

[1] Exploiting exogenous retirements of board members due to death or illness, Schmid and Urban (2015) find that firms benefit from a corporate culture that fosters the promotion of women.

[2] Our result of a positive relationship between the proportion of women in top management and firm financial performance is in line with Carter et al. (2003) and Erhardt et al. (2003).

we show that the positive influence of the proportion of women in top management on bank performance almost doubles during the global financial crisis from 2007 to 2009 as compared to stable market conditions. This indicates that women's contributions to firm performance seem to be of particular value during periods of economic downturn.[3]

Although our results from regression analysis indicate a *positive* trend between female management share and firm performance, this does not necessarily mean that this trend is *monotonic*. Indeed, when performing non-parametric portfolio sorts, our results indicate that the association between the proportion of women in top management and firm performance is non-linear and that there is an *optimal* proportion of women in top management positions. Credit institutions with a female management share between 20 and 40 % deliver the highest future performance and outperform banks with a female management share smaller than 20 % or larger than 40 % in terms of future return on equity. This result is of particular relevance to the current discussion of imposing female quotas for new appointments to management boards (such as, e.g., in the European Economic Area).

The remainder of the paper is organized as follows. Section 2 summarizes the related literature. Section 3 introduces our dataset and the main variables. We present our empirical results in Sect. 4 and conclude in Sect. 5.

2 Related literature

Executive management is responsible for a bank's most important strategic and organizational decisions and thus, a bank's performance is to a large extent dependent on its top management team (Hambrick and Mason 1984; Carpenter et al. 2004). Dezsö and Ross (2012) argue the informational and social diversity that results from increased female representation in top management improves managerial performance, which translates into better firm performance. Carter et al. (2003) apply principal agent theory to diversity management and, inter alia, argue that heterogeneous teams benefit from more numerous evaluations of decision alternatives and have a better understanding of the company's market environment. In addition, higher female representation in management could enhance the firm's reputation (Bear et al. 2010) and consequently strengthen firm performance if the positive image translates into positive customer effects.

However, not all studies predict a positive association between the proportion of women in management and firm performance. Smith et al. (2006) argue that increased gender diversity decreases the efficiency of the decision-making process and complicates communication between executives. This situation is particularly severe for firms operating in a highly competitive environment where time to market is key. Ahern and Dittmar (2012) exploit a natural experiment in board structure created by an unprecedented exogenous change to Norwegian corporate boards. In December

[3] A plausible reason might be that women are more risk averse than men (Eckel and Grossman 2008) which is beneficial to firm performance during crisis periods. This idea is also consistent with recent research showing that stronger risk management-related corporate governance mechanisms improve bank performance mostly (or even only) in periods of financial crisis (Aebi et al. 2012; Ellul and Yerramilli 2013).

2003, Norway passed a law requiring all public-limited firms to have at least 40 % female representation on their boards of directors by July 2005; at the time, women held only 9 % of board seats. The authors find that institution of the quota caused a significant drop in stock prices when the law was announced and a large decline in Tobin‘s Q over the following years.

To date, empirical studies have failed to deliver consistent results about whether female management share has an impact on firm performance (see Harrison and Klein 2007; Jonsen et al. 2011; Joshi and Roh 2009; Knippenberg and Schippers 2007; Apesteguia et al. 2012). Joshi and Roh (2009) state that a majority of studies report a non-significant correlation between gender diversity in management and firm performance. In addition, very little empirical work involves countries or areas other than the USA (Smith et al. 2006).[4] For Sweden, Rietz and Henrekson (2000) find no empirical evidence of a statistically significant relationship between the percentage of women on boards and financial performance. Rose (2004) finds similar results for Danish firms. Based on the importance of management teams throughout organizations (Kirchmeyer and McLellan 1991) and inconsistent results of previous empirical work, Richard et al. (2013) call for further studies on the economic impact of gender diversity on firm performance.

In answering this call, our paper makes the following contributions. First, we document a positive and statistically significant relationship between the proportion of women in top management and firm performance. By focusing on banks and their supervisory reporting we analyze reliable, comprehensive and consistent data over a set period of time. Unlike prior studies, our data encompass all credit institutions in Luxembourg (264 banks in total) with a long sample period of 15 years. Data were obtained directly from the banks and external auditors ensure their quality. Therefore, our data sample is free from biases and includes non-exchange listed credit institutions as well. Second, we provide evidence that gender diversity on management boards is particularly valuable for companies in times of economic downturn. Our results indicate that during the global financial crisis from 2007 to 2009 the positive impact of gender diversity is almost twice as high as during the rest of our sample period. Finally, our study documents that the relationship between the proportion of women in top management and bank financial performance is not monotonic. Banks with a female management share between 20 and 40 % outperform banks with a female management share smaller than 20 % or larger than 40 % in terms of future return on equity. All our results are robust if we control for different corporate characteristics and employ alternative empirical estimation setups.

3 Data and key variables

We obtain data at the firm level from all credit institutions established in the Grand Duchy of Luxembourg: all Luxembourg public institutions, public-limited companies

[4] Most studies from outside the USA cover Scandinavia (e.g., Sweden, Norway, and Denmark). This is not surprising since these countries were the first to introduce quotas for female representation on management boards.

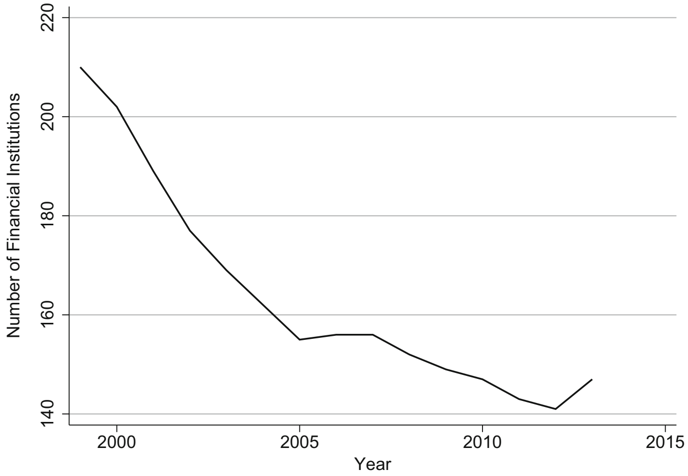

Fig. 1 Number of financial institutions over time. This figure reports the annual number of all financial institutions in our sample. The sample covers all credit institutions established in Luxembourg and the sample time period is from 1999 to 2013

under Luxembourg law (S.A.), partnerships limited by shares under Luxembourg law, co-operative banks under Luxembourg law, rural banks, banks issuing mortgage bonds, branches of credit institutions originating from a non-Member State of the European Union, and branches of credit institutions originating from a Member State of the European Union—264 banks in total. The sample time period ranges from the first quarter of 1999 to the last quarter of 2013.[5]

Banks enter or leave the dataset from the first quarter of 1999 to the fourth quarter of 2013 based on the beginning or ending of banking activity in Luxembourg, spin-offs, mergers, or takeovers—hence, our dataset is free from survivorship bias. Due to prudential requirements of the Grand Duchy of Luxembourg, all resident credit institutions regardless of their legal status (subsidiary or branch) must provide financial information (following Financial Reporting Framework (FINREP) and Common Reporting Framework (COREP)) and we also obtained financial information from small, non-exchange listed corporations. Most of the 264 credit institutions appear for multiple years resulting in more than 8000 bank quarters in the sample. Figure 1 displays the annual number of all financial institutions in Luxembourg over our sample period.

[5] The observation period of 15 years from 1999 to 2013 serves two purposes. First, measuring bank performance throughout several years enables us to observe performance during different states of the economy and provides more consistent results in comparison to very short sample periods (Adams and Ragunathan 2012; Smith et al. 2006). Second, the impact of strategic decision-making on organizational performance typically requires several years to observe. Thus, a multi-year interval allows observing and evaluating diverse candidates' potential contributions to strategic decision-making. We are consequently able to provide a remarkably robust analysis of the financial impact of female representation in bank management.

The number of financial institutions in Luxembourg has decreased over time from a peak of 210 in 1999 to a low of 147 in 2013. It is likely that dilution of Luxembourg's banking secrecy laws and thus its value as a tax haven—which occurred at the turn of the century—were responsible for this decline.

The entities in our sample can be split into two banking institutions with 50 billion EUR or more in average total assets, 44 banking institutions with 5–40 billion EUR in average total assets and 218 banking institutions with 5 billion EUR or less in average total assets. The average amount of total assets is 4.8 billion EUR. The mean number of banking staff in the sample is 93 with 35 of these being managers; 20 % of the companies have more than 100 staff members.

Return on Equity (RoE) and Female Management Share (FMS) are the key variables used in the empirical analysis of Sect. 4. We provide summary statistics of these variables and other firm characteristics in Table 1. All variable definitions (key variables and other firm characteristics) are described in the "Appendix".

Our main dependent variable and measure of firm performance is Return on Equity (RoE). RoE of bank i in quarter t is defined as the net income at the end of quarter t divided by bank i's equity capital at the end of quarter $t-1$. The measure provides useful information about how much the bank is earning on the owners' equity investment and is frequently used by market and financial analysts in assessing a company's performance (Rose 2004). To deal with the impact of outliers in our analysis, we winsorize RoE at the 1 % level.[6] We find that average (median) value of RoE over all firms in our sample is 11.69 % (5.82 %) with a standard deviation of 19.66 %.

Female management share (FMS) is our main independent variable in the empirical analysis. We define FMS of bank i in quarter t as the proportion of women among all managers, including senior executives as well as members of the board. Therefore, its value must lie between 0 and 100 %. The average (median) value of FMS is 18.04 % (17.31 %) with a standard deviation of 16.89 %.

To see how FMS has evolved over time, we plot average FMS over all banks for each quarter in Fig. 2. There is a steady upward trend for FMS in our sample with a peak in the first two quarters of 2010.

Figure 3 is a histogram of the distribution of our main independent variable. It reports that a large part of financial institutions has an FMS of zero.

Cross-correlations between RoE, FMS, and other time-varying firm characteristics used in our study are shown in Table 2.

Table 2 reports that the correlations between FMS and other variables are mainly moderate to small. Among the dependent variables, we find that FMS is positively related to firm size, client deposits (log CD), RoE volatility, RoA volatility, bank activity, and financial strength. FMS is negatively correlated to total staff expenditures per capita (log SEPC) and total staff expenditures per manager (log SEPM).

[6] Winsorization does not affect our results. We obtain very similar results when we do not winsorize the dependent variable or employ different cutoff points.

Table 1 Summary statistics

	Observations	Mean	25 %- Percentiles	Median	75 %-Percentiles	Standard deviation	Skewness	Kurtosis
RoE	8745	11.69 %	1.83 %	5.82 %	13.71 %	19.66 %	3.19	15.78
RoA	8914	0.70 %	0.12 %	0.33 %	0.77 %	1.49 %	3.76	22.67
FMS	8604	18.04 %	0.00 %	17.31 %	29.03 %	16.89 %	0.96	4.69
Firm size	9031	7.06	5.75	7.02	8.51	1.89	–0.26	2.79
log CD	8366	6.15	5.03	6.12	7.43	1.79	–0.37	3.43
log SEPC	8080	10.01	9.79	9.99	10.21	0.39	0.35	4.74
log SEPM	7871	11.49	10.98	11.36	11.92	0.86	0.15	6.31
Vola RoE	10,668	7.25 %	0.85 %	3.00 %	7.48 %	14.72 %	4.33	24.87
Vola RoA	7465	0.85 %	0.15 %	0.31 %	0.67 %	1.81 %	4.62	26.72
Activity	8460	0.49	0.21	0.51	0.77	0.31	–0.04	1.75
Financial strength	6706	23.06 %	12.26 %	16.97 %	27.62 %	16.44 %	1.94	6.98
log Bank Age	263	2.97	2.71	3.13	3.55	0.91	–1.46	5.71
Dummy SL	264	0.69	0.00	1.00	1.00	0.46	–0.83	1.70
Dummy CO	264	0.96	0.00	1.00	1.00	0.19	–4.84	24.43

This table displays summary statistics for the main variables used in this study. The first column shows the number of observations for each variable. Columns 2–8 depict the mean, the 25 %-quantile, the 50 %-quantile (median), the 75 %-quantile, the standard deviation, and skewness, as well as the kurtosis of each variable. All variables are described in detail in the “Appendix”. The sample covers all credit institutions established in Luxembourg and the sample period is from 1999 to 2013

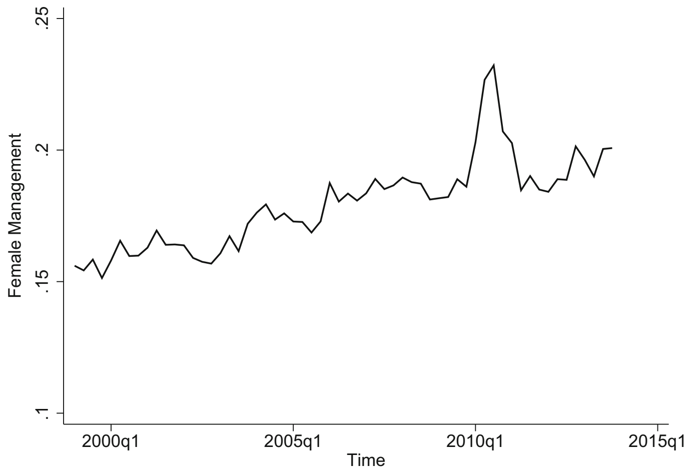

Fig. 2 Time variation of female management share (FMS) over time. This figure shows the evolution of average female management share (FMS) over all firms over time. The sample covers all credit institutions established in Luxembourg and the sample time period is from 1999 to 2013

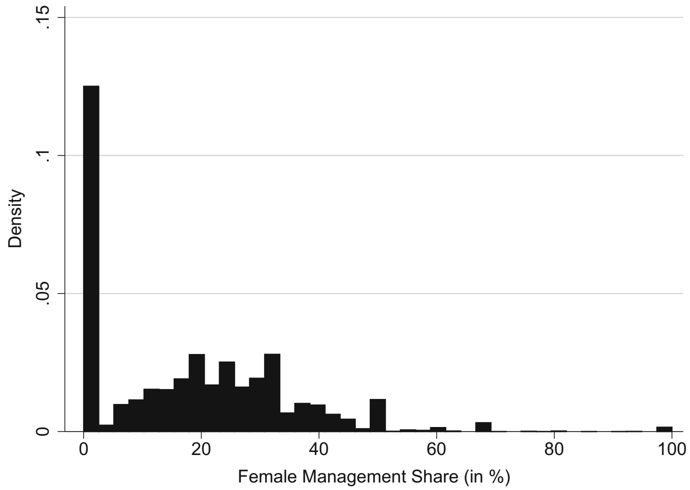

Fig. 3 Histogram of female management share (FMS). This figure shows a histogram of female management share (FMS) over all firms and quarters. The sample covers all credit institutions established in Luxembourg and the sample time period is from 1999 to 2013

4 Empirical Results

This section provides the main results of our empirical analysis. We start in Sect. 4.1 by investigating the impact of female management share (FMS) on future bank performance using multivariate regression analysis. We then confirm the stability of our findings by conducting a battery of robustness tests in Sect. 4.2.1 and address potential endogeneity issues in Sect. 4.2.2. In Section 4.3, we analyze the relationship between

Table 2 Correlations

	RoE	RoA	FMS	Firm size	log CD	log SEPC	log SEPM	Vola RoE	Vola RoA	Activity	Financial strength
RoE	1.00	–	–	–	–	–	–	–	–	–	–
RoA	0.57	1.00	–	–	–	–	–	–	–	–	–
FMS	0.08	0.06	1.00	–	–	–	–	–	–	–	–
Firm size	0.03	−0.18	0.04	1.00	–	–	–	–	–	–	–
log CD	0.06	−0.11	0.03	0.79	1.00	–	–	–	–	–	–
log SEPC	−0.03	−0.04	−0.01	0.04	0.06	1.00	–	–	–	–	–
log SEPM	−0.01	−0.06	−0.31	0.10	0.13	0.05	1.00	–	–	–	–
Vola RoE	0.49	0.16	0.08	0.02	−0.00	0.06	−0.05	1.00			–
Vola RoA	0.19	0.34	0.08	−0.26	−0.21	0.04	−0.08	0.44	1.00		
Activity	0.06	0.03	0.05	−0.38	0.16	0.05	0.05	0.16	0.14	1.00	–
Financial strength	−0.08	0.02	0.05	−0.34	−0.31	0.01	−0.09	−0.00	0.17	0.00	1.00

This table shows linear cross-correlations between the dependent and time-varying independent variables used in our study. A detailed description of these variables can be found in the “Appendix”. The sample covers all credit institutions established in Luxembourg and the sample period is from 1999 to 2013

FMS and future performance during the global financial crisis from 2007 to 2009. Sect. 4.4 investigates non-linearities in the relationship between FMS and future firm performance and derives an optimal range for FMS in management boards.

4.1 Female management share (FMS) and bank performance

Table 3 contains several regressions that analyze the impact of FMS on future firm performance. As the dependent variable, we use RoE of bank i in quarter $t + 1$. All dependent variables in the regressions (see Sect. 3) for bank i are measured in quarter t. As our empirical setup we use OLS (ordinary least squares) regressions with (quarterly) time dummies and heteroscedasticity-robust (White 1980) standard errors.

Regression (1) is a univariate regression of future RoE on FMS. We find that FMS has a positive coefficient of 0.086 and is statistically significant at the 1 % level with a t statistic of 6.18. Turning to economic significance, our results indicate that a 10 % increase in women in top management increases a bank's future RoE by 0.86 % per quarter. Annualizing this number, we find that a 10 % increase in FMS increases a bank's future return on equity by 3.44 % p.a.

In regressions (2)–(8), we add different corporate characteristics to our model. These variables are described in the "Appendix" and include firm size, log CD, log SEPC, log SEPM, Vola RoE, bank activity, financial strength, and the natural logarithm of a bank's age, as well as dummy variables that equal one if the bank is a Luxembourg subsidiary of a foreign bank (Dummy SL) and if the bank's country of origin is Luxembourg (Dummy CO). This is done so as to investigate the impact of FMS on future RoE controlling for the influence of these corporate characteristics at the same time. Our results indicate that log CD, Vola RoE, and Dummy CO are positively associated with future RoE, whereas log Bank Age is negatively related. In line with recent research for financial institutions in the USA, we document a positive relationship between a bank's activity and future RoE (Demirgüc-Kunt and Huizinga 2010) and a negative relationship between financial strength and future RoE (Saunders et al. 2015).[7] More importantly for our analysis, we find that the impact of FMS on RoE is positive and statistically significant at least at the 5 % level in each specification (with t-statistics ranging from 2.32 to 6.14). The last column presents the economic significance based on a one standard deviation change of each explanatory variable based on the results from regression (8): a one standard deviation increase in FMS leads to an economically meaningful increase in future RoE of 0.82 % per quarter (3.28 % p.a.). This is the sixth largest effect in absolute numbers among all independent variables.[8]

[7] Interestingly, the inclusion of financial strength reduces the impact of FMS on future RoE by approximately 30 %. Hence, a potential channel through which female representation creates value is the management of the Tier 1 capital ratio. However, this channel cannot fully explain the value of female management—the positive relationship between FMS and future RoE is still statistically significant at the 5 % significance level.

[8] We do not find evidence of a significant relationship between any squared terms of the control variables and future bank performance (results are available upon request). We investigate the possible non-linear association between FMS and future RoE separately in Sect. 4.4.

Table 3 Multivariate regressions

	(1) RoE	(2) RoE	(3) RoE	(4) RoE	(5) RoE	(6) RoE	(7) RoE	(8) RoE	Econ. Sign. (%)
FMS	0.0860***	0.0854***	0.0773***	0.0819***	0.0727***	0.0728***	0.0512**	0.0476**	+0.82
	(6.18)	(6.14)	(5.35)	(5.47)	(4.66)	(4.63)	(2.35)	(2.32)	
Firm size		0.516***	−0.443**	−0.624***	−1.014***	−1.054**	−0.790*	−0.694	−1.33
		(4.43)	(−2.04)	(−2.86)	(−4.16)	(−2.17)	(−1.77)	(−1.55)	
log CD			1.058***	1.140***	1.582***	1.618***	0.865**	0.949**	+1.68
			(5.43)	(5.69)	(6.56)	(3.67)	(2.21)	(2.43)	
log SEPC				−0.885	−2.567***	−2.569***	0.489	−0.0540	−0.02
				(−1.18)	(−3.52)	(−3.53)	(0.74)	(−0.08)	
log SEPM				0.480	1.211***	1.211***	−0.115	−0.0480	−0.05
				(1.51)	(4.08)	(4.08)	(−0.41)	(−0.17)	
Vola RoE					0.671***	0.671***	0.667***	0.663***	+3.69
					(16.48)	(16.42)	(11.89)	(11.85)	
Activity						−0.163	2.599	2.581	+0.80
						(−0.10)	(1.58)	(1.56)	
Financial strength							−0.0814***	−0.0804***	−1.32
							(−5.61)	(−5.56)	
log Bank Age								−1.073**	−1.42
								(−2.45)	
Dummy SL								2.216	+0.81
								(1.49)	
Dummy CO								2.088***	+0.39
								(3.16)	

Table 3 continued

	(1) RoE	(2) RoE	(3) RoE	(4) RoE	(5) RoE	(6) RoE	(7) RoE	(8) RoE	Econ. Sign. (%)
Constant	10.40***	6.739***	7.430***	11.54	12.68*	12.85*	2.197	5.017	
	(35.44)	(7.82)	(8.18)	(1.54)	(1.75)	(1.78)	(0.31)	(0.68)	
N	7672	7648	7311	7082	5394	5394	4585	4585	
Adj. R^2	0.067	0.069	0.073	0.074	0.337	0.337	0.302	0.304	

This table reports the main results of various multivariate OLS regressions with quarterly time dummies and White (1980) robust standard errors. As dependent variable, we use return on equity (RoE) in quarter $t + 1$. All dependent variables are measured in quarter t and defined in the "Appendix". The sample covers all credit institutions established in Luxembourg and the sample period is from 1999 to 2013. t Statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 % level, respectively

4.2 Stability checks

4.2.1 Robustness

Table 3 reveals a positive and statistically significant relationship between FMS and firm performance (measured by future RoE). To check the robustness of this result we now perform various stability checks with the full set of dependent variables as in regression (8) of Table 3. In particular, we investigate robustness when using an alternative dependent variable or modifying the regression technique. Results of the stability checks are reported in the first six columns of Table 4.

In regression (1) of Table 4, we apply future RoA instead of future RoE as our measure of firm performance. Regressions (2) and (3) use RoE in quarter $t + 2$ and quarter $t + 3$ (instead of quarter $t + 1$) as the dependent variable, respectively. Specifications (4)–(7) are modifications of our baseline OLS regression technique with time dummies. In specification (4), we do not include time dummies in the regression setup. Regressions (5) and (6) cluster standard errors by quarter and firm, respectively. Finally, in regression (7), we adjust standard errors for serial correlation using the Newey and West (1987) technique with four time lags.

We find—regardless of the specification—that there is a positive and statistically significant impact of FMS on future firm performance. In all specifications the FMS coefficient is statistically significant at least at the 10 % level with t statistics ranging from 1.72 to 3.01. Hence, our main result of a positive and statistically significant relationship between FMS and future firm performance is robust to different measures of firm performance and alternative regression setups.

4.2.2 Addressing endogeneity concerns

Although our empirical results document a positive significant relationship between FMS and future firm performance, we cannot claim that this relationship is strictly causal. In particular, it could be argued that (i) our analysis suffers from omitted variable bias and (ii) banks self-select into having boards with different characteristics (including the fraction of females among all managers), that is, better performing firms are more likely to hire women.

To address endogeneity issue (i), we exploit variation in FMS *within* financial institutions over time and run a fixed-effect panel data regression. This fixed effects estimator will be robust to any (un)observed, time-invariant omitted variables. Results are shown in specification (8) of Table 4. We find that the coefficient estimate on FMS is slightly smaller than before. Amounting to 0.035, it is still statistically significant at the 10 % level with a t statistic of 1.82. Hence, the relationship between FMS and future bank performance continues to be robust to any (un)observed, time-invariant omitted variables.

To address endogeneity issue (ii), we take into account past realizations of a bank's RoE in our regression setup. If the significantly positive relationship between FMS (at quarter t) and bank performance (at quarter $t+1$) is driven by reverse causality (i.e., due to self-selection bias), we expect the relationship to disappear once we control for prior

Table 4 Stability

	OLS							Panel	
								FE	Dynamic
	(1) RoA	(2) RoE_{t+2}	(3) RoE_{t+3}	(4) RoE	(5) RoE	(6) RoE	(7) RoE	(8) RoE	(9) RoE
FMS	0.003***	0.057***	0.046**	0.047**	0.049**	0.049*	0.042**	0.035*	0.037*
	(2.94)	(3.01)	(2.46)	(2.24)	(2.13)	(1.76)	(2.41)	(1.82)	(1.72)
Firm size	−0.0163	−0.829*	−0.963**	−1.185***	−0.694*	−0.694	−1.185	2.511***	1.331**
	(−0.50)	(−1.80)	(−2.07)	(−2.69)	(−1.91)	(−0.61)	(−1.62)	(5.26)	(2.43)
log CD	−0.0198	1.063***	1.123***	1.187***	0.949***	0.949	1.187*	0.711**	0.621**
	(−0.67)	(2.63)	(2.74)	(2.98)	(2.88)	(1.11)	(1.94)	(2.31)	(2.11)
log SEPC	−0.0112	0.746	0.703	−2.255***	−0.0540	−0.0540	−2.255**	−0.331	−0.417
	(−0.19)	(1.09)	(0.91)	(−3.13)	(−0.08)	(−0.03)	(−2.33)	(−0.99)	(−0.81)
log SEPM	−0.0545***	0.0197	−0.0562	−0.115	−0.0480	−0.0480	−0.115	0.123	−0.098
	(−2.78)	(0.06)	(−0.17)	(−0.38)	(−0.21)	(−0.05)	(−0.22)	(−0.23)	(−0.61)
Vola	0.521***	0.664***	0.663***	0.637***	0.663***	0.663***	0.637***	0.311***	0.135
	(6.41)	(11.89)	(11.55)	(30.91)	(7.57)	(4.29)	(6.09)	(7.62)	(1.50)
Activity	0.412***	1.855	1.360	0.959	2.581**	2.581	0.959	1.532	1.822
	(3.81)	(1.08)	(0.77)	(0.61)	(2.08)	(0.60)	(0.32)	(1.12)	(1.05)
Financial strength	0.00805	−0.0709***	−0.0829***	−0.0986***	−0.0804***	−0.0804*	−0.0986***	−0.0732*	−0.0911***
	(0.56)	(−4.58)	(−5.11)	(−6.18)	(−5.98)	(−1.85)	(−4.17)	(−1.92)	(−3.65)
log Bank Age	0.129***	−0.789*	−0.686	−0.679	−1.073***	−1.073	−0.679	–	–
	(4.13)	(−1.68)	(−1.44)	(−1.49)	(−2.80)	(−0.93)	(−0.90)		
Dummy SL	0.200**	2.272	2.147	2.503	2.216	2.216*	2.503	–	–
	(2.40)	(1.42)	(1.31)	(1.17)	(1.40)	(1.74)	(1.04)		

Table 4 continued

	OLS							Panel	
								FE	Dynamic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RoA	RoE_{t+2}	RoE_{t+3}	RoE	RoE	RoE	RoE	RoE	RoE
Dummy CO	0.259***	2.238***	2.256***	3.020**	2.088***	2.088	3.020***	–	–
	(3.86)	(3.20)	(3.16)	(2.35)	(3.38)	(1.30)	(2.98)		
RoE_t									0.432***
									(12.32)
RoE_{t-1}									0.212***
									(6.01)
RoE_{t-2}									0.165***
									(7.43)
Constant	0.106	−4.329	−1.890	29.18***	5.017	5.017	29.18***	−3.421	−6.110
	(0.17)	(−0.56)	(−0.22)	(3.70)	(0.65)	(0.27)	(2.70)	(−0.54)	(−1.54)
Time dummies	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Standard errors	Robust	Robust	Robust	Robust	Clustered	Clustered	Newey-West	Robust	Robust
					Time	Firm	(4 Lags)		
N	4588	4460	4338	4585	4585	4585	4585	5385	5298
Adj. R^2	0.243	0.286	0.275	0.206	0.304	0.304		0.311	0.399

This table reports the results of stability checks using different OLS and panel data regression techniques. We include the same independent variables as in regression (8) of Table 3. In regression (1) we use return on assets (RoA) instead of RoE as our independent variable (and use Vola RoA instead of Vola RoE as independent variable). Regressions (2) and (3) use RoE in quarters $t + 2$ and $t + 3$ (instead of RoE in quarter $t + 1$) as the dependent variable, respectively. In specification (4) we perform an OLS regression without quarterly time dummies and robust White (1980) standard errors. Specifications (5) and (6) are OLS regressions with time dummies and clustered standard errors by quarter and firm, respectively. In specification (7) we perform a OLS regression with time dummies and Newey–West (1987) corrected standard errors. We use four lags for the adjustment of autocorrelation. In specification (8), we run a fixed-effect panel data regression. Finally, in specification (9), we use the Arellano and Bond (1991) dynamic panel GMM (generalized method of moments) estimator in our regression setup. The sample covers all credit institutions established in Luxembourg and the sample period is from 1999 to 2013. t Statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 % level, respectively bank performance. Accordingly, we add the previous bank performance measures, i.e., RoE in quarters t, $t-1$, and $t-2$ to our list of explanatory variables.

Adding lagged values of the dependent variable to a panel data regression can give rise to problems with serial correlation and dynamic endogeneity (see Arellano and Bond 1991). To address this possibility, we use Arellano and Bond's (1991) dynamic panel GMM (generalized method of moments) estimator and report the results in specification (9) of Table 4. As expected, we find that past performance measures are positively linked to future bank performance. Moreover, we document that the association between FMS (at quarter t) and future bank performance (at quarter $t+1$) is robust to the inclusion of past performance measures. Hence, these results suggest that reverse causality is not the chief driver of the positive association between FMS and future bank performance.

To summarize, we provide evidence that FMS seems to have a direct impact on future firm performance, and that endogeneity issues (related to omitted variable bias and reverse causality) are not major concerns in our empirical analysis.

4.3 FMS and bank performance in the global financial Crisis

Is gender diversity especially important to firm performance during periods of financial crisis? As Neelie Kroes, E.U. Commissioner for Competition from 2004 to 2010, famously remarked: "My clear line is that if Lehman Brothers had been 'Lehman Sisters', would the crisis have happened like it did? No." (Adams and Ragunathan 2012). It was, *inter alia*, this speech that galvanized a—still continuing—public debate on improving and reforming governance arrangements in banking, and over which factors influence a bank's risk appetite (Berger et al. 2014; Laeven and Levine 2009). Indeed, many experimental and survey-based studies find that women are more risk averse than men (Croson and Gneezy 2009; Eckel and Grossman 2008). We, therefore, find it particularly worthwhile to examine the role of gender diversity on firm performance during the recent global financial crisis from 2007 to 2009.[9] Table 5 reports the results.

To investigate whether gender diversity especially matters for firm performance during financial crises, we run regression (8) from Table 3 for two subperiods: the "Crisis" period from Quarter 3 in 2007 to Quarter 4 in 2009 and the "Non-crisis" period, which includes all the other quarters. Our results indicate that the impact of FMS is positive and statistically significant at the 1 % level for both subperiods. However, the economic significance based on a one standard deviation change implies that FMS has a much greater impact during the global financial crisis. A one standard deviation in FMS in the "Crisis" period increases future RoE by 1.43 % per quarter,

[9] For the last two decades, the role and the impact of the board of directors have been a special focus of corporate governance research (Berger et al. 2014). Corporate governance literature reports a positive correlation between women's presence on the board of directors and financial performance (Adams and Ferreira 2009; Hartarska 2005; Hartarska and Mersland 2012; Hartarska and Nadolnyak 2012). Yet there are very few studies on the financial impact of the gender composition of a bank's top management team, i.e., the managers charged with the day-to-day running of the bank such as the Chief Executive Officer, the Chief Financial Officer, the Chief Operating Officer, the Chief Risk Officer, the Chief Compliance Officer, the Chief Internal Auditor, and the executives of other subdivisions (Adams and Ragunathan 2012; Beck et al. 2013; Berger et al. 2014; Hartarska et al. 2013).

Table 5 Financial crisis

	(1)		(2)		(3)	
	RoE Crisis	Econ. Sign. (%)	RoE Non-crisis	Econ. Sign. (%)	RoE Full sample	Econ. Sign. (%)
FMS	0.0911***	+1.43	0.0458**	+0.77	0.402*	+0.71
	(3.78)		(2.29)		(1.89)	
Crisis dummy					−3.024**	−1.21
					(−2.45)	
Crisis dummy × FMS					0.107***	+1.39
					(2.89)	
Firm size	1.234	+2.03	−1.084**	−1.82	−0.681	−1.31
	(1.29)		(−2.39)		(−1.63)	
log CD	−0.199	−0.41	1.101***	+1.86	0.939**	+1.66
	(−0.23)		(2.71)		(2.51)	
log SEPC	−3.828**	−2.02	1.158	−0.52	−0.0548	−0.03
	(−2.24)		(1.53)		(−0.08)	
log SEPM	−0.779	−0.74	0.0495	+0.03	−0.0515	−0.05
	(−1.07)		(0.16)		(−0.18)	
Vola RoE	0.397***	+1.84	0.791***	+3.56	0.664***	+3.69
	(9.79)		(35.24)		(33.83)	
Activity	10.46***	+4.02	0.894	+0.36	2.622*	+0.89
	(3.01)		(0.56)		(1.77)	
Financial strength	−0.0554	−1.01	−0.0926***	−1.98	−0.0802***	−1.32
	(−1.22)		(−5.93)		(−5.29)	
log Bank Age	0.0189	+0.01	−1.355***	−1.57	−1.077**	−1.43
	(0.02)		(−2.94)		(−2.49)	
Dummy SL	−5.402	−1.64	3.816*	−0.96	2.215	+0.81
	(−1.05)		(1.81)		(1.11)	
Dummy CO	5.136*	+0.93	0.908	+0.21	2.081*	+0.39
	(1.74)		(0.70)		(1.72)	
Constant	42.42**		−5.501		−0.180	
	(2.20)		(−0.67)		(−0.02)	
N	937		3648		4585	
Adj. (R^2)	0.231		0.351		0.304	

This table reports the results of OLS regressions with time dummies and White (1980) robust standard errors as in regression (8) of Table 3. We first provide results for two subsamples: the "Crisis" subsample containing the period from Quarter 3 in 2007 to Quarter 4 in 2009 and the "Non-crisis" subsample containing the remaining quarters of our sample period. We also investigate the impact of the global financial crisis based on our full data sample. To do so, we define a "Crisis" dummy that takes the value of one if the period of investigation ranges from Quarter 3 in 2007 to Quarter 4 in 2009 and zero otherwise. We interact this dummy with our main variable of interest—FMS—and examine whether the coefficient estimate on this interaction term is positive and statistically significant. We also show the percentage change in quarterly RoE for a one standard deviation change of the independent variables. The sample covers all credit institutions established in Luxembourg and the sample period is from 1999 to 2013. t Statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 % level, respectively whereas the increase during "Non-crisis" periods is 0.77 % per quarter. Consequently, the impact of FMS on future performance is around 0.76 higher during the global financial crisis than in the remaining periods.[10]

We also investigate the impact of the global financial crisis based on our full data sample. For this purpose, we define a "Crisis" dummy that takes the value of one if the period of investigation ranges from Quarter 3 in 2007 to Quarter 4 in 2009 and is otherwise zero. We interact this dummy with our main variable of interest—FMS—and examine whether the coefficient estimate on this interaction term is positive and statistically significant. Specification (3) of Table 5 reports the results. The coefficient estimate on the interaction term is 0.107 and statistically significant at the 1 % level with a t statistic of 2.89. We again conclude that the relationship between FMS and future bank performance is significantly higher during the global financial crisis than in the remaining periods.

In summary, our results point towards the notion that the more risk-averse decision-making of females (compared to that of men) is beneficial to bank performance during the global financial crisis from 2007 to 2009. Interestingly, our results are also related to recent research by Aebi et al. (2012) and Ellul and Yerramilli (2013). These studies show that stronger risk management especially improves bank performance during periods of economic downturn.

4.4 Is there an optimal FMS to maximize firm performance?

Section 4.1 documents that there is a *positive* relationship between FMS and firm performance. However, it is not clear whether this trend is *monotonically* increasing or whether non-linearities play a determining role.

To check whether the association between FMS and future firm performance is monotonic, we first look at non-parametric univariate portfolio sorts. Each quarter t we sort firms into four portfolios based on their current FMS: portfolio Q1 consists of banks with an FMS of 0 %, portfolio Q2 consists of banks with an FMS between 0 and 20 %, portfolio Q3 consists of banks with an FMS between 20 and 40 %, and portfolio Q4 comprises banks with an FMS larger than 40 %. For each portfolio we compute the equal-weighted and value-weighted average RoE in quarter $t + 1$ over our sample period.[11] Panel A of Table 6 reports the results.

We find that (both on an equal-weighted and on a value-weighted scheme) the relationship between FMS and future RoE is not monotonic. Instead, our results indicate that portfolio Q3 has the highest average RoE with a value of 15.64 % (16.38 %) with regard to the equal-weighted (value-weighted) sorting procedure. The difference between the average RoE of portfolio Q3 and that of the remaining portfolios lies between 3.76 and 7.34 % per quarter (2.56 and 6.81 % per quarter) and is statistically significantly different from zero at least at the 10 % level in all cases. Hence, banks

[10] Therefore, in the same vein as Berger et al. (2014), our empirical analysis suggests that it is not only a bank's corporate governance structure that influences financial performance, but also the gender diversity of the management team in a given credit institution.

[11] We compute the value-weighted average RoE in quarter $t + 1$ by weighting each financial institution by its total assets in quarter t.

Table 6 Optimal female management share (FMS)

Portfolio	FMS	Avg. no.	Equal-weighted		Value-weighted	
	Share (%)	Entities	FMS (%)	RoE (%)	FMS (%)	RoE (%)
Panel A: Univariate portfolio sorts						
Q1	0 %	45.7	0.00	8.30	0.00	9.57
Q2	0–20 %	32.0	13.24	10.35	13.03	9.92
Q3	20–40 %	51.3	28.04	15.64	27.28	16.38
Q4	>40 %	18.2	50.80	11.88	49.84	13.82
Portfolio	P1: log CD (%)	P2: log CD (%)	P3: log CD (%)	P4: log CD (%)	Average	
Panel B: Equal-weighted bivariate portfolio sorts: log CD and FMS						
Q1: FMS	4.72	11.37	14.72	14.12	11.23	
Q2: FMS	9.48	13.87	9.75	9.77	10.72	
Q3: FMS	10.15	13.69	18.06	18.47	15.09	
Q4: FMS	12.82	12.16	16.22	12.86	13.51	
Portfolio	P1: Vola RoE (%)	P2: Vola RoE (%)	P3: Vola RoE (%)	P4: Vola RoE (%)	Average	
Panel C: Equal-weighted bivariate portfolio sorts: Vola RoE and FMS						
Q1: FMS	2.41	3.48	6.26	14.62	6.69	
Q2: FMS	2.54	5.26	6.82	11.87	6.62	
Q3: FMS	2.41	3.98	6.39	27.37	10.04	
Q4: FMS	2.22	4.39	6.28	26.51	9.85	
Portfolio	P1: Bank age (%)	P2: Bank age (%)	P3: Bank age (%)	P4: Bank age (%)	Average (%)	
Panel D: Equal-weighted bivariate portfolio sorts: log Bank Age and FMS						
Q1: FMS	13.35	5.02	6.91	8.88	8.54	
Q2: FMS	8.44	16.26	8.45	9.10	10.56	
Q3: FMS	19.20	25.83	16.30	10.34	17.92	
Q4: FMS	15.99	21.15	8.77	15.32	15.31	

This table reports results from univariate and bivariate portfolio sorts. Panel A reports the results from equal-weighted and value-weighted portfolio sorts based on female management share (FMS). In each quarter, we sort banks into four portfolios (Q1–Q4) and create equal- and value-weighted portfolios. We report the average number of entities in each portfolio, average FMS, and average return on equity (RoE) over the following quarter. Panel B–Panel D show the results of dependent equal-weighted portfolio sorts based on FMS and log CD (Panel B), FMS and Vola RoE (Panel C), as well as FMS and log Bank Age (Panel D). First, we form quartile portfolios sorted on log CD, Vola RoE, and log Bank Age, respectively. Then, within each of those quartiles, we sort stocks into portfolios Q1–Q4 based on FMS. We report the average RoE for each of the 16 portfolios over the next quarter. The sample covers all credit institutions established in Luxembourg and the sample period is from 1999 to 2013. *t* Statistics are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 % level, respectively

with an FMS between 20 and 40 % deliver the highest future financial performance. Figure 4 illustrates the hump-shaped relationship between FMS and future RoE.

The hump-shaped relationship between FMS and future RoE could be driven by differences in corporate characteristics correlated to FMS. Thus, we conduct dependent

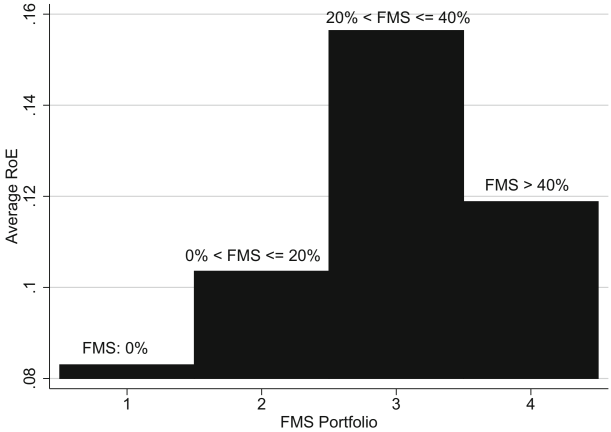

Fig. 4 Optimal Female Management Share. This figure displays the results from univariate portfolio sorts based on female management share (FMS). In each quarter, we rank companies into four equal-weighted portfolios (Q1–Q4). We show the average return on equity (RoE) over the following quarter for each portfolio. The sample covers all credit institutions established in Luxembourg and the sample time period is from 1999 to 2013

double-sorts based on FMS and log CD (Panel B), FMS and Vola RoE (Panel C), as well as FMS and log Bank Age (Panel D). We focus on these variables because they are the ones that, according to regression (6) in Table 3, have the largest economic impact on firm performance.

To perform double-sorts, we first create quartile portfolios sorted on log CD, Vola RoE, and log Bank Age, respectively. Then, within each portfolio, we again sort banks into portfolios Q1–Q4 based on FMS. Panels B–D of Table 6 report the equal-weighted RoE in quarter $t+1$ of the 4×4 portfolios with the respective row average. Looking at the row averages of Panels B–D, we find that the hump-shaped relationship between FMS and future RoE prevails in each panel and is not explained by log CD, Vola RoE, or log Bank Age. The row average of portfolio Q3 again has the highest average RoE when controlling for these different corporate characteristics.

To sum up, we find strong evidence that the relationship between FMS and firm performance is non-linear. Banks with an FMS between 20 and 40 % appear to be the most successful in terms of financial performance.

5 Conclusion

This paper analyzes the relationship between female management share and financial performance of banks. Using a sample of all credit institutions in the Grand Duchy of Luxembourg from 1999 to 2013, we find strong evidence of a positive and statistically significant relationship between the proportion of women in top management positions and future firm performance. In terms of economic significance, our results indicate that a 10 % increase in women in top management improves the bank's future return on equity by more than 3 % p.a. Our results cannot be explained by the impact of different corporate characteristics (such as firm size, age, or return volatility) and do not hinge on a specific regression setup. Furthermore, our results are robust to the impact of any (un)observed, time-invariant omitted variables and do not appear to be driven by reverse causality issues.

In addition, we contribute to the literature with two novel findings: first, we document that the positive relationship between female management share and financial performance was particularly strong during the global financial crisis from 2007 to 2009 which indicates that gender diversity seems particularly valuable during periods of economic downturn. Second, we show that the optimal range of female management share lies between 20 and 40% and that banks having a proportion of women in top management within that range deliver sustainable future financial outperformance.

Our results are important to and align nicely with the current discussion of imposing female quotas for new appointments to board of directors and management boards. Our empirical findings suggest that a more gender balanced management can increase future performance of financial institutions, particularly during times of financial crisis and economic downturn.

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Appendix: Definitions and data sources of main variables

This table briefly defines the key variables and firm characteristics used in the empirical analysis. Our data were obtained from the Commission de Surveillance du Secteur Financier (CSSF) and includes firm-level data from all credit institutions in Luxembourg. EST: indicates that the variable is estimated or computed based on original variables from the respective data sources

Variable name	Description	Source
Panel A: Dependent variables		
RoE	RoE of bank i in quarter t defined as the net income at the end of quarter t divided by bank i's equity capital at the end of quarter $t-1$. To deal with the impact of outliers in our analysis, we winsorize RoE at the 1 % level	CSSF
RoA	RoA of bank i in quarter t defined as the net income at the end of quarter t divided by bank i's total assets at the end of quarter $t-1$. To deal with the impact of outliers in our analysis, we winsorize RoA at the 1 % level	CSSF
Panel B: Key variable and independent, time-varying firm characteristics		
FMS	Female Management Share (FMS) of bank i in quarter t defined as the proportion of women among all managers, including senior executives as well as members of the board	CSSF

Variable name	Description	Source
Firm size	Firm size of bank i in quarter t calculated as the natural logarithm of the winsorized total assets (in million of EUR) at the end of quarter $t-1$	CSSF, EST
log CD	Client Deposits (log CD) of bank i in quarter t computed as the natural logarithm of the winsorized client deposits (in million of EUR) at the end of quarter $t-1$	CSSF, EST
log SEPC	Total Staff Expenditures per Capita (log SEPC) of bank i in quarter t calculated as the natural logarithm of the winsorized personnel expenditures, including remuneration and social security contributions, as well as expenses for pension plans (in EUR) at the end of quarter $t-1$	CSSF, EST
log SEPM	Total Staff Expenditures per Manager (log SEPM) of bank i in quarter t calculated as the natural logarithm of the winsorized manager expenditures, including remuneration and social security contributions, as well as expenses for pension plans (in EUR) at the end of quarter $t-1$	CSSF, EST
Vola RoE	Volatility of RoE of bank i in quarter t calculated as the firm's historical standard deviation of RoE over the past 12 quarters. We require a firm to have at least six non-missing RoE observations in the past 12 quarters	CSSF, EST
Vola RoA	Volatility of RoA of bank i in quarter t calculated as the firm's historical standard deviation of RoA over the past 12 quarters. We require a firm to have at least six valid RoA observations in the past 12 quarters	CSSF, EST
Activity	Bank activity of bank i in quarter t calculated as the winsorized client deposits (in million of EUR) divided by the winsorized total assets (in million of EUR) following Demirgüc-Kunt and Huizinga (2010)	CSSF, EST
Financial Strength	Financial Strength defined as the Tier 1 capital ratio of bank i in quarter t, which is the bank's core equity capital divided by its total risk-weighted assets	CSSF
Panel C: Independent, time-invariant firm characteristics		
log Bank Age	log Bank Age of bank i measured as the natural logarithm of the number of years that the credit institution has provided services in Luxembourg (= log(2014 - starting year of entity)). If the bank drops out of our dataset before 2014, we use the delisting year (instead of 2014) in our computation instead	CSSF, EST
Dummy SL	Dummy SL of bank i representing a dummy variable that takes on the value 0 if the credit institution under review is a branch of a foreign bank; the variable takes on the value 1 if the credit institution is a Luxembourg parent company or a Luxembourg subsidiary of a foreign bank. The sample includes 183 subsidiaries and 81 foreign branches	CSSF, EST
Dummy CO	Dummy CO of bank i representing a dummy variable taking on the value 0 if the bank's country of origin is Luxembourg and 1 otherwise (indicating all foreign banks). 10 Credit institutions are banks originating from Luxembourg (representing 4 % of the sample); the country of origin most frequently represented in Luxembourg is Germany with 68 banks (26 % of the sample), followed by France with 27 banks (10 %), Italy with 24 banks (9 %), Switzerland with 23 banks (9 %) and Belgium with 15 banks (6 %)	CSSF, EST

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Regina M. Reinert received her diploma in industrial and organizational psychology from the University of Tuebingen, Germany. She currently works as a consultant for personnel selection and HR diagnostics in Switzerland and is an external Ph.D. candidate at the University of St. Gallen. Her research interests are in the field of human resource management, health-oriented leadership, numerical cognition, and diversity. She has published articles in international peer-reviewed journals such as *Psychological Research* and *Cognitive Processing*.

Florian Weigert is an Assistant Professor at the School of Finance of the University of St. Gallen, Switzerland. He obtained his Ph.D. in Finance from the University of Mannheim, Germany. His major fields of interest and research are empirical asset pricing, mutual funds, hedge funds, and behavioral finance.

Christoph H. Winnefeld received his degree as Dr. rer. pol. (German Ph.D. equivalent) in Economics and Finance from the University of Trier, Germany. He works as a Financial Expert at the Commission de Surveillance du Secteur Financier in Luxembourg. Christoph is a lecturer at Trier University of Applied Science, Germany. His major fields of interest and research are compliance, anti-money laundering and the prevention of fraud and corruption. His works have been published in various journals and newspapers.