Board Faultlines and Firm Innovativeness: The bridging role of women directors on co-determined supervisory boards

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Abstract: In this study, we analyze whether having women shareholder as well as employee representatives on a co-determined supervisory board is significantly related to firm innovativeness as measured by R&D intensity. Based on faultline theory, we hypothesize that it is not the mere presence of women on boards, but rather the presence of women in both functional groups, shareholder and employee representatives, that positively affects firm innovativeness as measured by R&D intensity. The underlying rationale is that the presence of women in both functional groups might cross-cut and thus *bridge* the representative faultline thereby enhancing boardroom interactivity and innovativeness. Our empirical analysis is based on a sample of 105 listed companies in the German indices DAX30, MDAX50, S-DAX and TecDAX30 from 2000–2015. We find that it is neither the share of women on the supervisory board as a whole nor the share of women in each of the two functional groups that affects firm innovativeness, but rather their presence in both groups, shareholder *and* employee representatives.

Keywords: innovativeness, faultline, corporate governance, women directors, supervisory board

JEL- Codes: G34, J16, O32

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1. Introduction

The potential link between women directors on corporate boards and firm financial performance has been studied extensively – with inconclusive results (for overviews see KIRSCH 2017, POST/BYRON 2015, or JOECKS/PULL/VETTER 2013). As a consequence, a growing strand of literature is concerned with more intermediate performance measures that are potentially closer linked to boardroom composition, for example firm innovativeness (e.g., TORCHIA/CALABRÒ/ HUSE 2011).

Further, recent studies on the effects of diversity in teams also highlight that it is important to not only regard one diversity dimension, but to also include further diversity dimensions in the analyses and also study their joint effect (JACKSON/JOSHI/ERHARDT 2003). Specifically, faultline theory (LAU/MURNIGHAN 1998, LI/HAMBRICK 2005) argues that orthogonal or cross-cutting diversity dimensions might enhance team effectiveness (e.g., ISEKE et al. 2015, CRUCKE/KNOCKAERT 2016).

In our paper, we focus on firm innovativeness as the dependent variable, and we tie in with the literature on faultines by investigating if it makes a difference for firm innovativeness whether or not the demographic faultline "gender" cuts across the functional faultline between shareholder and employee representatives in German co-determined supervisory boards. In the German two-tier board system, the supervisory board is responsible for the appointment and the supervision of the members of the management (DITTMANN/MAUG/SCHNEIDER, 2010) and is strictly separated from the management or executive board. Its task is similar to that of outside directors in a one-tier board system. Specifically, we ask: Does it matter for firm innovativeness whether women directors on co-determined supervisory boards are represented in both functional groups?

While our analysis is embedded in the context of a two-tier corporate governance system, our results potentially also extend to other governance structures and may hence be generalizable to situations beyond our specific study context. While board level employee representation is admittedly quite specific (albeit not unique) for the German institutional context, the idea that gender might cross-cut and thus bridge an existing boardroom faultline (e.g., in a one-tier board with no employee representatives, the existing faultline might be one between inside and outside directors) does have the potential of inspiring future research in the field.

The remainder of this paper is as follows: In section 2, we briefly review the relevant literature and highlight our contribution. In section 3, we develop our theoretical argument and derive our hypothesis. In section 4, we present the analyzed dataset as well as the descriptive statistics and bivariate correlations of our sample. The empirical methodology and findings are described in section 5. In section 6, we conclude.

2. State of research and contribution

The idea of faultline theory (LAU/MURNIGHAN 1998, LI/HAMBRICK, 2005) is that, regarding group composition, not only one attribute should be considered, but instead the combination of several dimensions should be looked at simultaneously (see JACKSON/JOSHI/ERHARDT 2003). In our specific institutional context of co-determined supervisory boards, we simultaneously regard two diversity dimensions: board directors' gender and board directors' representative function, and we analyze their joint link to firms' innovativeness.

In so doing, we speak to three strands of literature: *First*, the literature on gender diversity and innovativeness, *second*, the literature on employee representation and firm innovativeness, and *third*, by combining the two, the literature on faultlines (see section 3).

Gender diversity and innovativeness: While previous research on gender diversity and innovativeness mainly focuses on the effects of gender diversity in R&D teams (e.g., TURNER

2009, DÍAZ-GARCÍA/GONZÁLEZ-MORENO/SÁEZ-MARTÍNEZ 2013, ØSTERGAARD/ TIMMERMANS/KRISTINSSON 2011, SASTRE 2015), there is also literature on the link between gender diversity in top management teams or boards and firm innovativeness (e.g., RUIZ-JIMÉNEZ/FUENTES-FUENTES/RUIZ-ARROYO 2016, DWYER/RICHARD/CHADWICK 2003). Concerning boards of directors, MILLER/TRIANA (2009) find a positive link between board gender diversity and firm innovativeness in a one-tier corporate governance system for a sample of Fortune 500 firms. They argue that women directors provide strategic human and social capital resources to the firm which both influence firm innovativeness. TORCHIA/CALABÒ/HUSE (2011) argue in a similar way. In more detail, they find for a sample of Norwegian firms that a critical mass of at least three women directors is necessary to significantly increase the innovativeness of a firm. Recent studies on supervisory boards in two-tier governance systems for French firms also find a significant positive link between the presence of women directors and firm innovativeness (e.g. see GALIA/ZENOU/INGHAM 2015, GALIA/ZENOU 2012).

Employee representation and innovativeness: While previous research on employee representation and innovativeness mainly focuses on the effects of union representation (ACS/AUDRETSCH 1987, 1988, HIRSCH 1992, HIRSCH/LINK 1987, SCHNABEL/WAGNER, 1994) and works councils (ADDISON/SCHNABEL/WANGER 2001, ADDISON et al. 2007, ANDRIES/CZARNITZKI 2014, ASKILDSEN/JIRJAHN/SMITH 2007, HÜBLER 2003, and JIRJAHN 1998; see MENEZES-FILHO/VAN REENEN 2003 for a review), there is also – albeit scarce – literature on the link between employee board representation and firm innovativeness. Most of these studies, however, focus on employee board representation and its link to employee participation in day to day innovation or on employee innovation resistance but not on strategic issues related to firm innovativeness (see the survey by BELLOC 2012). By contrast, KRAFT/STANK/DEWENTER (2011) analyze for German (co-determined) and publicly listed firms whether there are significant changes in the firm innovativeness (measured by the num-

ber of granted patents) before and after the enactment of the German Codetermination Act 1976 (*Mitbestimmungsgesetz*) which prescribed a 50 percent share of employee representatives on the supervisory boards of public limited companies with more than 2,000 employees. KRAFT/STANK/DEWENTER (2011) find tentative evidence that employee-representation on German supervisory boards has a positive impact on firm innovativeness.

By *simultaneously* regarding two diversity dimensions in the boardroom, gender and representative function, and their link to firm innovativeness, we contribute to both, the literature on gender diversity and firm innovativeness *and* the literature on employee representation and firm innovativeness. Neither did the literature on board gender composition and firm innovativeness so far regard a potential interaction with employee representation nor did the literature on board level employee representation and firm innovativeness so far acknowledge a potential interaction with board directors' gender. We are the first to analyze a potential interaction between the two diversity dimensions gender and representative function and their link to firm innovativeness: By analyzing whether it is important for one diversity dimension to cross cut and thus bridge the other, we further add to the literature that aims at testing faultline theory (e.g. ISEKE et al. 2015, CRUCKE/KNOCKAERT 2016).

3. Theoretical Background and Hypothesis

In our paper, we ask if it makes a difference whether women are only represented in one functional group or in both functional groups of a co-determined supervisory board. Relying on faultline theory and following ISEKE et al. (2015), we argue that the presence of women in both functional groups might bridge an existing representative faultline between shareholder and employee representatives. Such a representative faultline will mirror – at least partly – diverging interests of the two functional groups (e.g. see GORTON/SCHMID 2004,

BAUMS/FRICK 1998, FAUVER/ FUERST 2006), and bridging this faultline thus has the potential to enhance boardroom interaction.

Since innovation is an interactive process and since diversity among those who interact promotes innovative thinking (see ØSTERGAARD/TIMMERMANS/KRISTINSSON 2011), cross cutting an existing faultine might stimulate such an interactive process. Thus, we hypothesize that it is not the mere presence of women, but rather the presence of women in both functional groups, shareholder and employee representatives, that positively affects firm innovativeness.

Hypothesis: The joint presence of both women shareholder and employee representatives positively influences firm innovativeness.

In order to distinguish our hypothesis based on faultline theory from other potential explanations of the link between women directors and firm performance, we also analyze (a) whether the share of women directors in general (irrespective of whether or not they are present in both functional groups) are related to firm innovativeness, and (b) we also analyze whether the shares of women directors in the two functional groups are linked to firm innovativeness.

4. Dataset and Descriptive Statistics

Sample

Our initial sample consists of the 105 companies listed in one of the German stock exchange indices DAX30, MDAX50, SDAX and TecDAX30 on December, 31st 2015 over a sixteen year-period (2000-2015). Co-determined supervisory boards of German firms represent an ideal test case for our analysis because they are characterized by a clear functional faultline between shareholder representatives on the one hand and employee representatives on the other – the latter group constituting, depending on firm size, up to one half of the supervisory board members.

Dependent variable: Firm innovativeness

Following, e.g., MILLER/TRIANA (2009), and CHEN/NI/TON (2016), we measure firm innovativeness by R&D intensity, i.e. by a firm's expenditures for research and development divided by total sales (*R&D/Sales*). Mean *R&D/Sales* in our sample is 7.22 with a standard deviation of 22.10. That is, on average, firms in our data spend 7.22 percent of their sales on research and development. Information on *R&D/Sales* is retrieved from Datastream, a database provided by Thomson Reuters that contains information from firms' annual reports and homepages. 74 companies report their R&D expenditures for at least one year. For our identification strategy, it is important that we use time lags in our analysis. Hence, we use data on R&D intensity for the years 2001-2016, which leaves us with 74 companies and 745 observations.

Main explanatory variables: Gender composition of the board

Regarding female board representation, we use the following variables: (1) the overall share of women on the board (*women – percent*), (2) the share of women on the shareholders' side (*women shareholder side – percent*), the share of women on the employees' side (*women employee side – percent)* and (3) a set of dummy variables capturing whether women are only represented in one of the two functional groups or in both (*women shareholder side only – dummy, women employee side only – dummy, women both sides – dummy*). The variable *women employee side only – dummy* takes the value of 1 if at least one employee representative in a given board is a woman, but all shareholder representatives are men. Likewise, the variable *women shareholder side only – dummy* takes the value of 1 if at least one shareholder representative in a given board is a woman and all employee representatives are men, and the variable *women on both sides – dummy* takes the value of 1 if there is at least one woman in each of the two functional groups.

The average share of women on boards (*women – percent*) is 12.77 percent with a standard deviation of 10.72. The highest share of women in a board is 50 percent. The average share of women shareholders (*women shareholder side – percent*) is 8.39 percent with a maximum of 50 percent implying that the largest share of women directors among shareholder representatives is 50 percent. The average share of women employee representatives (*women employee side – percent)* is 18.12 percent with a maximum of 100 percent meaning that in the respective supervisory board all employee representatives are women. With respect to the dummy variables, we find women on both sides in the majority of supervisory boards (36 percent), and we find more boards with women on the employee side only (31 percent) than we find boards with women on the shareholder side only (10 percent). The data on the gender composition of boards was hand-collected from firms' annual reports (for the details of the data collection see WECKES 2016).

Controls

Besides year and industry dummies and in accordance with the literature (e.g. see MILLER/TRIANA 2009, CHEN/NI/TONG 2016), we control for potentially important board related variables: We control for *board size* (as measured by the number of board members) and for an indicator of multiple directorships (*directorships*). The variable for multiple directorships is calculated as the average number of board memberships a supervisory board member holds in one of the listed companies of our data set – besides the one in the supervisory board under consideration. Average *board size* is 14.39 ranging from 5 to 22 board members. The average number of other *directorships* is 1.3. Further and in accordance with the innovation literature, we control for a firm's *market value*, return on equity (*ROE*) and *leverage ratio*, measured as long-term debt divided by total capital. *Market value* is on average 11.46 billion Euros, *ROE* is 11.41 percent, and the *leverage ratio* is 29.89 percent. Information on the different controls

is taken from Thomson Financial Datastream (*market value*, *ROE* and *leverage ratio*) and from the data hand-collected by WECKES (2016) (*board size*, *directorships*).

Table 1:Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
R&D/Sales	746	7.221	22.101	0	576.11
Women – percent	746	.128	.107	0	.5
Women shareholder side – percent	746	.084	.103	0	.5
Women employee side – percent	746	.181	.181	0	1
Women shareholder side only – dummy	746	.102	.303	0	1
Women employee side only – dummy	746	.312	.464	0	1
Women on both sides – dummy	746	.363	.481	0	1
Board Size	746	14.39	4.85	5	22
Directorships	746	1.342	.334	1	2.6
Market Value (in thousand EUR)	746	11460.27	18636.04	30.6	100762.1
ROE	746	11.41	15.235	-112.8	99.77
Leverage ratio	746	29.894	20.706	0	114.32

Source: Own compilations

Correlations

Table 2 shows the Pearson correlation matrix. Concerning correlations with our dependent variable *R&D/Sales (t+1)*, we find it to be significantly positively related to corporate financial performance in terms of *ROE* (R=0.152***) and negatively related to *board size* (r= -0.160***), *market value* (r = -0.132***) and *leverage ratio* (r = -0.066**).

Concerning our main explanatory variables on the gender composition of the board, we do not find them to be correlated with *R&D/Sales (t+1)*. Board gender composition, however, is significantly related to several of the controls: The overall share of women on the board (*women – percent*) is positively related to *market value* (r = 0.076**) and negatively related to *directorships* (r = -0.246***). The share of women among shareholder representatives (*wom-*

en on shareholder side – percent) is negatively related to board size (r = -0.060*) and to directorships (r = -0.196***). The same is true for the share of women among employee representatives (*women on employee side – percent*): r = - 0.062* for the link to board size and r = -0.213*** for the link to directorships. The dummy variable women on shareholder side only (*women shareholder side only – dummy*) is negatively linked to *board size* (r = -0.116***) and *market value* (r = -0.084**). The dummy variable women on employee side only (*women employee side only – dummy*) is positively linked to *board size* (r = 0.078**), *directorships* (r = 0.112***) and *market value* (r = 0.075**) and negatively linked to the *leverage ratio* (r = -0.091**). The dummy variable women on both sides is positively linked to *board size* (r = 0.181***), *market value* (r = 0.127***) and *leverage ratio* (r = 0.118***), but negatively linked to *directorships* (r = -0.143***).

Concerning interrelations among the different controls, the most striking correlations concern board size: Board size is strongly positively related to *directorships* (r = 0.471***) and *market value* (r = 0.525***).

We tested for potential multicollinearity in all of our following multivariate estimations by calculating variance inflation factors (VIF). As all VIF values were below 3.23, we can exclude multicollinearity problems (O'Brien 2007).

Table 2: Bivariate correlations

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)	**RND/Sales (t+1)**	1										
(2)	**Women – percent**	.003	1									
(3)	**Women shareholder side – percent**	.038	.702***	1								
(4)	**Women employee side – percent**	-.035	.847***	.249***	1							
(5)	**Women shareholder side only – dummy**	.035	-.073**	.351***	-.341***	1						
(6)	**Women employee side only – dummy**	-.047	-.099***	-.544***	.237***	-.232***	1					
(7)	**Women on both sides – dummy**	-0.047	-.703***	.685***	.461***	-.252***	.502***	1				
(8)	**Board size**	-.160***	-.048	-.060*	-.062*	-.116***	.078**	.181***	1			
(9)	**Directorships**	-.047	-.246***	-.196***	-.213***	-.026	.112***	-.143***	.471***	1		
(10)	**Market Value**	-.132***	.076**	.026	.056	-.084**	.075**	.127***	.525***	.424***	1	
(11)	**ROE**	.152***	-.003	-.069*	.036	-.003	.043	-.06*	-.096***	-.068*	.073**	1
(12)	**Leverage ratio**	-.066**	.016	.014	.016	.018	-.091**	.118***	.354***	.14***	.215***	-.134***

*Source: Own compilations; Note: *p<.10, **p<.05, ***p<.01*

5. Methodology and Empirical Results

Methodology

For our analysis, we employ fixed effects regressions with a time lag of one year to analyze the link between board composition and subsequent firm innovativeness. We run our analysis with a time lag of one year to account for potential reversed causality as we cannot exclude that more innovative firms are more likely to appoint women to their boards or that women self-select into the boards of more innovative firms. A similar approach is applied by DITTMANN/MAUG/SCHNEIDER (2010) and FARRELL/HERSCH (2005). To address the issue that unobserved time-invariant factors may influence both the percentage of women on boards and innovation, we use fixed effect regressions.

Empirical Results

Table 3 presents the results of the fixed effects regression analyses. As model 1 shows, the percentage of women on supervisory boards (*women – percent*) is not significantly related to firm innovativeness as measured by *R&D/Sales*. Hence, our result does not support those previous studies that find a positive relation between women directors and firm innovativeness (e.g. MILLER/TRIANA 2009). In model 2, we find that likewise neither the share of women shareholder representatives (*women shareholder side – percent*) nor the share of women employee representatives (*women employee side – percent*) significantly relates to firm innovativeness.

Model 3, however, points to a significant link between firm innovativeness and the simultaneous presence of women in *both* functional groups (*women on both sides – dummy*) as compared to an all-male board (reference category). On the contrary, firms with a board where women are only present in one functional group (*women shareholder side only – dummy. women employee side only – dummy*) do not have a higher R&D intensity compared to

firms with an all-male board. In our models, R^2 varies between 0.04 and 0.06 and is comparable to the R^2 of about 0.11 in the OLS-estimations of MILLER/TRIANA (2009).

Table 3: Fixed Effects Regression Results

	(1) R&D/Sales (t+1)	(2) R&D/Sales (t+1)	(3) R&D/Sales (t+1)
Women – percent	13.90		
	(1.32)		
Women shareholder side – percent		4.085	
		(1.09)	
Women employee side – percent		7.169	
		(1.03)	
Women shareholder side only – dummy			-2.986
			(-1.11)
Women employee side only – dummy			0.283
			(0.31)
Women on both sides – dummy			**2.449****
			(2.37)
Board size	-0.303	-0.280	-0.382*
	(-1.61)	(-1.64)	(-1.97)
Directorships	4.494	4.432	4.475*
	(1.52)	(1.55)	(1.72)
Market Value	-0.00000357	-0.00000357	-0.0000171
	(-0.20)	(-0.20)	(-0.71)
ROE	-0.0011	-0.00327	-0.00135
	(-0.07)	(-0.21)	(-0.09)
Leverage ratio	-0.0238	-0.0252	-0.0364
	(-1.01)	(-1.02)	(-1.25)
_cons	3.368	3.252	6.509
	(0.81)	(0.79)	(1.62)
R^2	0.04	0.04	0.06
N(obs)	745	745	745
N(firms)	74	74	74

Note: t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6. Conclusion

In this study, we analyze whether having women shareholder *and* women employee representatives on a co-determined supervisory board is significantly related to firm innovativeness as measured by R&D intensity. The key findings of our analysis are the following: With respect to the overall share of women on co-determined supervisory boards, we do not find any

link to firm innovativeness. However, we do find a significant link between firm innovativeness and the presence of women in both functional groups, shareholder and employee representatives, hinting at a potentially bridging role of women when they are present on both sides of a co-determined supervisory board, shareholder representatives *and* employee representatives.

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