Gender Diversity in Top Management and Firm Performance: An Analysis with the IAB-Establishment Panel

Marie-Christine Laible
Institute for Employment Research (IAB)
marie-christine.laible@iab.de

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Abstract

In recent years the political and empirical debate about female participation in top management has intensified. The questions as to how women contribute to a company's success and whether employing women in top management positions pays off on the bottom line remain to be conclusively answered, as the existing empirical evidence is ambiguous. Therefore, I propose a framework to help clarify the potential mediating and moderating effects of gender diversity and firm performance.

Thus far, few papers have analyzed the gender diversity-performance relationship for Germany. This study therefore aims to explore the effects of gender diversity in top management on firm performance in Germany using unique data from the Institute for Employment Research's Establishment Panel Survey. Various production functions reveal a slight, yet significant negative relationship between the proportion of women in top management positions in 2008 and establishment performance. An instrument variable approach is estimated to account for endogeneity, providing evidence for the robustness of the negative link. Further estimations highlight the importance of the moderating influences of the characteristics of the establishment, the industry and the environment, which shape the relationship between the share of women in top management positions and establishment performance.

JEL Classification: J16, L25

Keywords: gender diversity in top management positions, firm performance, corporate governance, establishment data

1. Introduction

In recent years, an increasing focus has been put on the issues of female participation in the labor market, as well as on gender equality in the workplace. Debates have been fueled by the empirical observation of the underrepresentation of women in the workforce and by their rarity in top management positions. This dearth of female managers is illustrated by the Federal Office of Statistics' estimate that overall female participation in top management in Germany increased slightly from 27% in 2001 to 30% in 2010 and remains below the EU-27 average (Mischke & Wingerter, 2012). Even more striking is the assessment that in Germany's top 200 firms only 4% of all executive board directors, and 13% of all supervisory board members, are women (Holst & Schimeta, 2013).

Subsequent to political and media discussions, the subject of female participation in top management has been introduced into governmental regulations. The Commission of the European Union, for example, has been supporting the promotion of women into top management positions and accepted a proposal for an EU-wide gender equality quota on supervisory boards (Reding, 2012). Accordingly, 40 percent of all board seats must be filled with the gender minority by 2020. With this law, the EU will follow in the footsteps of several European countries' initiatives requiring gender quotas, such as Norway, Sweden and Spain.

Political debates about female participation in top management mainly emphasize the ethical aspects of gender equality and focus on normative considerations. However, from an economic viewpoint the questions remain as to how women contribute to a company's success and whether employing women in top management positions pays off on the bottom line. Corporate governance theory turns the debate into an economic one by linking women in top management positions to firm performance and implying that *diversity in management teams* is a competitive advantage. Conversely, different theoretical approaches predict both positive and negative performance effects of gender diverse top management teams (TMTs). A survey of the existing literature shows that the gender diversity-performance link has multifaceted causes and effects that are contingent on the context and the firm's environment. In order to contribute to the current discussion about women in top management and to allow empirically founded discussions of the productivity effects of female managers, I analyze the relationship between the share of women in top management positions and establishment performance in Germany. I propose a theoretical model and implement several theoretical considerations in the empirical analysis.

As few previous studies on the gender diversity in management-firm performance link exist for the German labor market (exceptions are Joecks, Pull, Vetter, 2012 and Lindstädt, Wolff, Fehre, 2011), the present analysis will extend the body of literature based on data from the Institute for Employment Research's (IAB)-Establishment Panel Survey. This database is unique, as it measures performance indicators, as well as specifically inquires about gender equity in top management. Previous research had to primarily rely on compilations of different databases and internet sources in order to gather necessary information. Thus, this paper will contribute to the existing literature with results from a singular high quality database, reflecting all German establishments.

I use data from the 2008 wave of the IAB-Establishment Panel, as this wave contains information on the top management structure of establishments. Various production function

estimations indicate a robust, significant negative relationship between the share of women in top management positions and establishment performance. In order to account for endogeneity problems, an instrument variable approach is used to further assess the robustness of the estimations. An investigation of potential moderating effects shaping the relationship hint to the fact that performance effects may be contingent on the region, industry sector and the composition of an establishment's workforce.

The paper is structured as follows: Section 2 gives a short overview of the related literature and presents a theoretical framework. Section 3 describes the IAB-Establishment Panel Survey and discusses methodological issues. Then the results are presented and their implications are addressed in the fourth section. Section 5 concludes the paper.

2. Theoretical Considerations and Related Empirical Literature

Dezsö and Ross (2012, p. 1074ff.) develop a theoretical framework for the relationship between women in top management positions and firm performance. Their model focuses on informational and social diversity, differences in management behavior and effects on women in middle management. I propose a broader approach that includes several mediating and moderating effects, which shape the diversity-performance link.

Mediating Influences

The mediating effects that may influence the relationship between gender diversity and firm performance are depicted in figure 1.

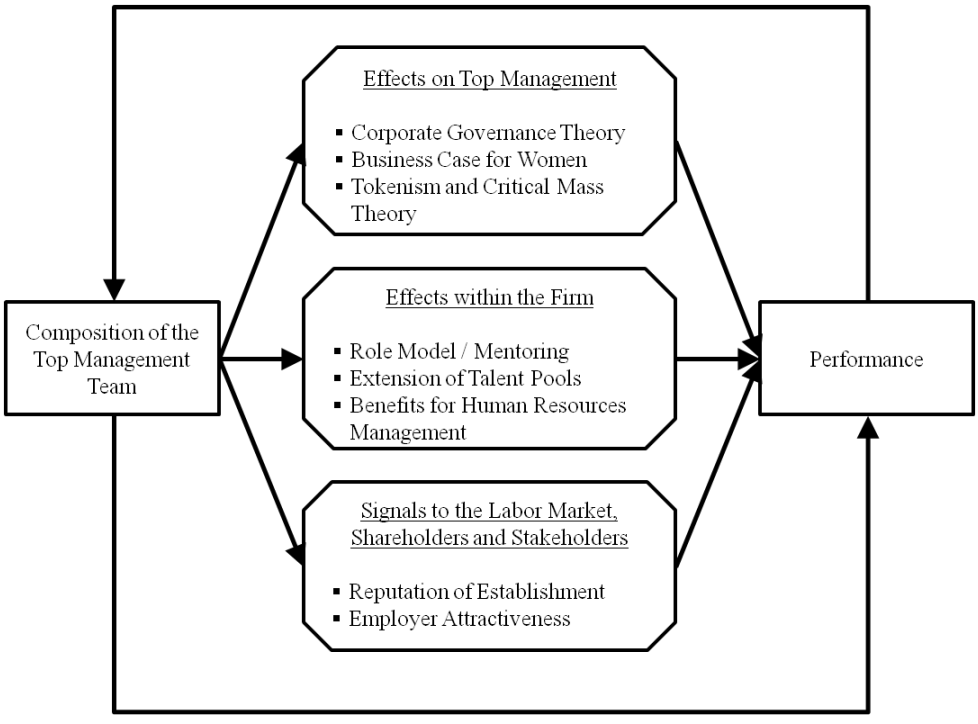

Figure 1: Mediating effects of the diversity-performance link
Source: Own illustration

Effects on Top Management. Literature on management quality has been pointing out the importance of good management for firm performance. Bloom and Van Reenen (2007; 2010) reveal strong significant associations between managerial practices and firm-level productivi-

ty and profitability. Corporate governance theory, which addresses the governance structures of firms, further provides a link between gender diversity in top management and firm performance. Managers are a focal point of corporate governance, because according to upper echelon theory "organizational outcomes – both strategies and effectiveness – are viewed as reflections of the values and cognitive bases of powerful actors in the organization" (Hambrick & Mason, 1984, p.194). This implies that managers matter because of the strategic choices they make and that the composition of TMTs, in terms of individual and relational characteristics, is a driving force behind performance. It is furthermore suggested that the TMT's demographic diversity, on the one hand, has direct effects on performance. On the other hand, team diversity is indirectly related to performance through processes and processes are directly related to performance (Smith et al., 1994).

Carter, Simkins and Simpson (2003) make a "business case for diversity"[1] and present arguments for and against a diverse board make-up. A first argument in favor of diversity is the idea that gender diversity in TMTs generates a better understanding and penetration of the marketplace and thereby enhances firm performance. Second, diversity may increase board independence (Adams & Ferreira, 2009; Carter et al., 2003). Furthermore, dynamics and processes in teams may be altered through diversity, leading on the one hand to the stimulation of creativity and innovation, efficient problem-solving and an increase in the effectiveness of leadership; but on the other hand to more conflicts, a more difficult decision-making process and slower decision-making. Richard, Kirby and Chadwick (2013, p. 4) "predict that group heterogeneity alone may not be advantageous": The outcomes of team diversity are dependent on several mediators, such as the culture of the firm and the right mix of members in a team. In this context, the organizational culture, i.e. the shared values and beliefs that help employees understand organizational functioning and corporate behavior, is deemed especially important (Dwyer, Richard, Chadwick, 2003). An organizational culture that is advantageous to diversity can positively mediate the gender diversity-firm performance link (Richard et al., 2013). Further contextual factors that shape the diversity-performance relationship are the demographic attributes of an occupation[2], team characteristics and the industry setting, in which diversity effects are found to be positive in the services industries and negative in manufacturing (Joshi & Roh, 2009).

Tokenism and critical mass theory further examine the compositional structures of diverse teams and take effects of minorities into account. They suggest that the effects of women in TMTs are conditional on the composition of the team, and depending on the relative influence of the minority group, can be positive or negative. Tokenism assumes that a token, i.e. a minority individual, has symbolic value, but does not necessarily impact group decision-making processes in a substantial way (Kanter, 1977). Critical mass theory examines which percentage of a minority has to be reached in order for it to have a significant influence on the team.

[1] Carter et al. (2003, p. 38) admit that an "intuitive belief in a positive relationship appears to be strong in the corporate world" but that the question remains empirical until an adequate theoretical framework is developed. Thus, arguments for top management team effectiveness are often based on anecdotal evidence or observations (Bilimoria, 2000). This is due to the dearth of appropriate datasets, as well as to the so called black box of decision-making processes. Still, most up to date research on productivity effects of gender diverse TMTs is based on this concept.

[2] An example for this according to Joshi and Roh (2009) is stereotyping that women encounter in a male-dominated engineering sector. This stereotyping in turn constrains performance.

A recent investigation of the relationship between firm performance and critical mass comes from Germany: Joecks et al. (2012) examine the supervisory boards of 151 German stock exchange companies in the years 2000-2005. Their results indicate that gender diversity initially has negative effects on firm performance. Positive effects can only be observed after a critical mass has been reached. Thus, a u-shaped relationship is revealed, in which diverse teams negatively impact the return on equity (ROE) compared to uniform teams until a proportion of women of about 10% is reached in its minimum. Hence at very low levels of diversity, diversity can be associated with a decrease in firm performance. However, starting at a ratio of about 30%, diverse teams start to outperform uniform teams.

Effects within the firm. Kanter (1977) suggests that the appointment of women to top management positions has symbolic value that may influence firm performance through indirect channels. The business case for diversity states two possible internal symbolic effects: First, with the shortage of skilled workers, the acquisition and retention of qualified employees is a competitive advantage, and minorities embody a talent pool which should not remain untapped. Thus, diversity in TMTs contributes to the amelioration and enlargement of the talent pool. Second, women in top management positions may have a spill-over effect and positively contribute to increase women in mid-level management positions and throughout the firm due to mentor and role model effects (Bell, 2005; Konrad, Kramer, Erkut, 2008; Kurtulus & Tomaskovic-Devey, 2012).

Signals to the labor market, to stakeholders and to shareholders. Women in TMTs also have external symbolic value that affects the reputation of a corporation and in turn its attractiveness to investors, customers, suppliers and potential employees. Signaling theory suggests that visible signs are used to gain reputation among constituents and that the composition of the board can signal a certain quality of the firm (Miller & Triana, 2009). There is evidence that organizational attractiveness is higher in firms with explicit diversity management (Williams & Bauer, 1994) and that firms with a higher shares of females attract more qualified (female) applicants (Kurtulus & Tomaskovic-Devey, 2012). Furthermore, gender wage gaps are smaller in companies with more females in TMTs (Bell, 2005). However, diversity may also send signals that negatively affect performance: Lee and James (2007) show that shareholder responses to the appointment of female CEOs were more negative than for their male counterparts. Additionally, while investors demand greater diversity, they simultaneously punish it by reducing holdings in firms appointing female directors (Dobbin & Jung, 2011).

Moderating Influences

Several additional levels of influences can be identified, each of which contribute to the nature of the gender diversity-performance relationship, as illustrated in figure 2. Individual-level approaches investigate the characteristics of managers and focus on potential differences between men and women. According to human capital theory the characteristics of an individual are linked to its productivity and productive individuals are an asset leading to increased firm performance (Becker, 1964). Singh, Terjesen and Vinnicombe (2008) emphasize that men and women have *different* human capital, i.e. knowledge, skills and experiences, leading to a competitive advantage through diversity. This gender diversity can be found in different educational and work-related experiences (Ahern & Dittmar, 2012; Helfat, Harris, Wolfson, 2006; Simpson, Carter, D'Souza, 2010; Singh & Vinnicombe, 2004) as well as in management and risk-taking behaviors (Aspesteguia, Azmat, Iriberri, 2012; Charness &

Gneezy, 2012; Fenwick & Neal, 2001; Niederle & Vesterlund, 2007). Thus, one assumption is that team success can be enhanced when different skills, experiences and behaviors are combined.

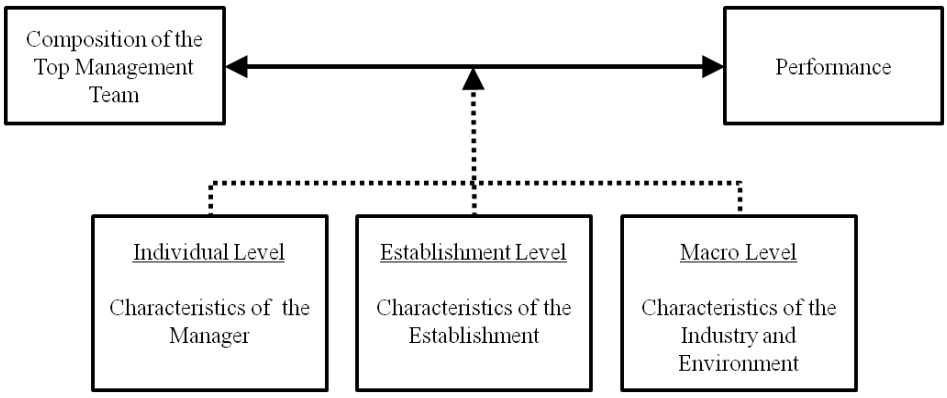

Figure 2: Moderating effects of the gender diversity-performance link
Source: Own illustration

Establishment-level considerations highlight structural characteristics of the firm which influence both performance and the share of women in TMTs. These characteristics include among others firm size, age and legal form, as well as export-orientation, ownership structures and the composition of the workforce. Establishment-level moderators are accounted for in the empirical estimations through several control variables.

Macro-level approaches focus on the characteristics of the environment, such as the international and national economic situation or regional and sectoral influences. Richard, Murthi and Ismail (2007) suggest that environmental instability negatively moderates the strength of the (racial) diversity-performance link. If a diverse team is able to overcome relational conflicts, diversity may be advantageous in a volatile environment, however, it is expected that conflicts and increased coordination efforts among TMTs delay decisions and as such are a detriment to the firm. Similarly, Dwyer et al. (2003) propose that diversity is advantageous in growth-oriented and expanding firms, but that the extra costs of diversity may be disadvantageous for downsizing strategies.

Furthermore, an establishment's location in East or West Germany is crucial, as the division of Germany resulted in different (institutional) developments. While shrinking, a considerable productivity gap between East Germany (formerly the German Democratic Republic, GDR) and West Germany still exists (Bellmann, Ellguth, Möller, 2006; Bellmann & Brussig, 1998). This is due, among other reasons, to historically different industry structures and firm sizes, as well as a lower export-orientation and capital intensity in East Germany. At the same time, East Germany seems to provide more gender equality and better career chances for women (Rosenfeld, Trappe, Gornick, 2004), which is reflected in the higher share of women in TMTs and the higher growth rate of female managers in East Germany (Kohaut & Möller, 2012). Female employment participation was an explicit goal of the GDR's (Kreyenfeld & Geisler, 2006), resulting in an earlier and better integration of women into the GDR's labor market (Trappe, 2006) and a different perception of the role of women in the labor market and as mothers (Kreyenfeld & Geisler, 2006; Rosenfeld et al., 2004). Even though they are becoming smaller, differences in female employment patterns in East and West Germany prevail

(Rosenfeld et al., 2004). West German women tend have longer labor force interruptions upon bearing children and reduce working hours more often after labor market reentry compared to East German women. In addition to institutional variations, these differing employment patterns can be explained by better work-life balance opportunities provided in East Germany, especially concerning a better infrastructure for child care (Kreyenfeld & Geisler, 2006). In turn, East German women were able to gain more work experience which, according to human capital theory, results in increased productivity. Overall, a hypothesis therefore is that the institutional set-up in East Germany combined with the integration of women in the GDR's labor market should be beneficial to positive diversity effects. It is therefore anticipated that gender diversity in TMTs affects performance differently in East and West Germany.

Finally, the industry-level context and cross-sector variations in female representation are a key moderator for the diversity-performance link. Specifically, the differentiation between the service and manufacturing sectors serves as a situational enhancer or mitigator of diversity effects (Joshi & Roh, 2009; Richard et al., 2007). The service industry, i.e. customer-oriented industries (retail trade, hospitality, education), is characterized by close interactions with customers. Matching employee diversity to the constituent's diversity may lead to a competitive advantage ("reflection of the marketplace hypothesis"), because more outside pressure for diversity entails a better integration of the diverse workforce. However, in the manufacturing industry, which relies more heavily on physical capital, diversity plays a smaller role and diversity benefits may not be leveraged because male-based stereotypes prevail. Accordingly, in a meta-analysis, Joshi and Roh (2009) find positive performance effects for diversity in the service industries, but negative effects for manufacturing. Frink et al. (2003) only observe an inverted u-shaped relationship between the gender composition and performance with a peak at gender-balanced settings in the service industry, but not in manufacturing. They suggest that this reflects an inability to capitalize on diversity benefits in a male dominated context.

In this section I have proposed a framework that illustrates the complexity of the effects of gender diversity. Gender diverse TMTs affect firm performance directly by implementing strategic decisions. However, their effects are also more far-reaching through indirect and intangible mechanisms, which have an impact on the diversity-performance relationship. Therefore, a contingency approach may be meaningful, which allows the inclusion of moderating and mediating effects. In order to test this hypothesis, I empirically explore moderating effects on the establishment and the macro-levels.

Related Empirical Literature

In line with theoretical predictions, the state of the art in research about the productivity effects of gender diverse TMTs is ambiguous. Earlier studies find positive (for example: Carter, D'Souza, Simpkins, Simpson, 2010; Carter et al., 2003; Smith, Smith & Verner, 2006) and negative (for example: Ahern & Dittmar, 2012; Minguez-Vera & Martin, 2011; Kolev, 2012) effects of gender diversity on firm performance. This is reflective of data and methodological heterogeneity. Several further challenges can be identified: Most analyzed samples are based on data from publicly available reports (for example: Smith et al., 2006), and annual reports and other (internet) sources are examined for female names or pictures to determine the proportion of women on boards (for example: Joecks et al., 2012) or to account for individual characteristics of board members (for example: Ahern & Dittmar, 2012). Due to these data restrictions, the generalizability of results is limited as studies are typically based on the larg-

est firms listed on the stock market and only regard boards of directors (for example: Smith et al., 2006; Joecks et al., 2012; Ahern & Dittmar, 2012, Carter et al., 2010; Adams & Ferreira, 2009; Miller & Traina, 2009; Carter et al., 2003; Dezsö & Ross, 2012). Exceptions are Du Rietz and Henrekson (2000) and Minguez-Vera and Martin (2011): The first investigate Swedish entrepreneurs with up to 20 employees in a cross-sectional analysis and find negative effects on sales when the head of the firm is female. The latter study a panel of Spanish small and medium-sized firms (SMEs) and reveal a significant negative effect of the percentage of female directors on ROE.

Furthermore, few studies have specifically regarded mediating or moderating influences on the relationship. Dwyer et al. (2003) incorporate the organizational culture and the growth orientation in their analysis of the effects of diversity on ROE and employee productivity. Both, strategic growth orientation and the category "clan culture", an organizational culture that focuses on teamwork, participation and cohesiveness, positively moderate the diversity in management-performance link. However, no impact is found for the moderating effects of the environment (operationalized as munificence, complexity and dynamism) in a study of Fortune 1000 firms (Krishnan & Park, 2005). Miller and Triana (2009) reveal that innovations and firm reputation in Fortune 500 firms do not affect the relationship between the proportion of women on boards and return on investment (ROI) or return on sales (ROS). Yet, Dezsö and Ross (2012) examining a panel of S&P 1,500 firms find that female representation in top management only improves firm performance measured by Tobin's Q in firms that focus on innovation. They conclude that the environment in innovative firms is more conducive to the benefits of team diversity.

Ahern and Dittmar (2012) use the introduction of a Norwegian law requiring a female quota of 40% on boards of directors of public-limited firms as a natural experiment to investigate the diversity-performance link. The authors illustrate the repercussions of the quota: Some of the affected companies opted for evasion strategies, such as a change of the organization's legal form or the incorporation in another country. The firms which did comply showed a significant decline in the performance indicator Tobin's Q. This decreased performance may partly be attributed to human capital differences, especially concerning work experience, between newly appointed female directors and replaced male directors. This indicates that the quota may have constrained the firm's abilities to choose the overall best qualified individuals. Hence, the forced second-best option was detrimental to firm performance.

Smith et al. (2006) use Danish merged employer-employee data for the period of 1993-2001 and control for individual characteristics of the highest ranking managers. Depending on the method (pooled OLS, fixed and random effects) and the performance operationalization (gross profits/net sales, contribution margin/net sales, operating income/net assets, net income after taxes/net assets), varying results are found. To check for causality, an instrument variable (IV) approach is implemented. The chosen instrument "average length of education of the spouses of the other CEOs in the firm" reveals a positive relationship between gender diversity on boards and performance. Adams and Ferreira (2009) use the "fraction of male directors on the board who sit on other boards on which there are female directors" as instrument. They contradictorily find a negative, albeit insignificant, relationship between Tobin's Q and the fraction of women on the board of directors for US S&P's 500, Mid and Small Cap firms.

Two studies have so far examined the effects of gender diversity in management for Germany (Joecks et al., 2012; Lindstädt et al., 2011). While Joecks et al. (2012) demonstrate that the concept of critical mass determines productivity effects (see above); Lindstädt et al. (2011) show that positive significant performance effects of female supervisory board members are only attained in firms with a high proportion of females in the workforce or in firms in the business to customer (B2C) business. To sum up, regarding this empirical evidence, no decisive conclusion can be drawn for the relationship between gender diversity in top management positions and firm performance.

3. Data and Methods

Sample Description

The following analyses are based on the IAB-Establishment Panel, a representative survey of Germany's labor demand (cf. Fischer, Janik, Müller, Schmucker, 2008; 2009). The survey of German establishments began in 1993 in West Germany and has been carried out as a nationwide survey since 1996, when East Germany was added. Representing all industries and establishment sizes, the data can be used both on a cross-sectional and longitudinal basis, as approximately 16,000 establishments are surveyed annually by TNS Infratest Sozialforschung GmbH on behalf of the IAB. The sample is drawn from the population of all German establishments with at least one employee subject to social security as of June 30th of the previous year. An establishment is a "regionally and economically separate unit, in which employees liable to social security work" (Fischer et al., 2009, p. 135). Thus, the unit of observation in this sample is the individual establishment as opposed to the concept of a company that could comprise several establishments in different locations and separate economic units.

A random sample is drawn from the Federal Employment Agency's establishment file according to the principle of optimum stratification, taking into consideration the federal state, the industry sector and the establishment size. The result of this approach is a disproportionate stratification in which large establishments, small federal states, small industry sectors and the manufacturing industry in East Germany are overrepresented. Thus, the sample is designed to ideally reflect the employment structure of Germany. The survey is carried out as a face-to-face interview; additionally written surveys are used and the response rates vary between 63% and 73%. The field phase takes place in the third quarter of the year and data becomes available after an extensive monitoring and editing process, thereby guaranteeing high data quality.

The questionnaire, on the one hand, aims to gather information on an annual basis in order to measure developments; and on the other hand, it includes questions of current relevance. Thus the basic program consists of annually surveyed questions concerning for example business development, personnel structure and investments. Furthermore, specific subjects are included at certain intervals. Notably, the subject block "equality of opportunity" has been surveyed in 2004, 2008 and 2012. Within this block the number of female managers and the possibilities to enhance equal opportunities between men and women are inquired about.

The IAB-Establishment Panel has been chosen for the following analysis because it is comprised of high quality data and represents all establishments in Germany. As Minguez-Vera and Martin (2011) point out, it is important not only to analyze large listed companies, but rather to take into account SMEs, as they are a crucial part of the labor market. Further-

more the data not only provide performance indicators, but also the possibility to control for a large number of further variables. Finally, the IAB-Establishment Panel exceptionally offers the potential to analyze the effects of gender diversity in management, which makes the database quite unique and valuable for this kind of analysis. As opposed to many of the previous analysis of the diversity-performance link, a sample does not have to be pieced together; rather one database can be used to obtain all relevant information.

Previous studies for Germany use very specific firms, i.e. DAX companies, which do not allow generalizations. Additionally, the examination of gender diversity is limited to the highest positions in a company and both Joecks et al. (2012) and Lindstädt et al. (2011) analyze gender diversity in the specific setting of supervisory boards. Therefore, the following analysis contributes by analyzing representative German establishments, by broadening the definition of management and by being able to include a number of reliable control variables, which were not readily available to previous studies.

Several steps have to be taken to construct a sample allowing the analysis of performance effects of gender diverse management teams. Data from 2008 serves as the basis for the sample, as this is the year that contains information on the proportion of female managers[3]. As business volume and investments are asked in retrospect, data from adjoining years has to be merged to the data of 2008. Thus, the constructed sample is rather specific as it merges data from the questionnaires of 2007-2009 (and 2007-2010 to check for robustness during the crisis years) and excludes establishments which are not observed in all relevant years. Furthermore, the sample is limited to the private sector. These restrictions have to be fulfilled in all three years; therefore establishments changing their status within the period of observation are not included in the sample. The establishments in the non-private sector are dropped, as they may have different organizational goals and do not necessarily strive for profit maximization. Furthermore, establishments are excluded if they stated having a budget volume for a business volume, making them a non-industrial organization or a regional or local authority. Hence, only establishments having a business volume consisting of sales, total assets or total premium paid are relevant in this context. Finally, establishments claiming to have no manager in a top management position are excluded from the sample. Thus a total number of 7,673 observations remain for the dataset of 2007-2009 and a total number of 6,473 observations remain for the dataset of 2007-2010.

The Model and Methods

The relationship between the share of women in top management positions and establishment performance is estimated through production functions. It is assumed that an establishment's goal is to maximize profits. In order to do this, it combines input factors in a way to achieve the highest output at the lowest possible cost. The production function models this combination of inputs. To address the concern that a specific functional form chosen a priori does not fit the data (Griliches & Mairesse, 1995), different functional forms (Cobb-Douglas, CES and transcendental logarithmic [translog]) are regarded and evaluated through a series of specification tests. The translog production function, which relaxes the assumption of a unitary elasticity of substitution (Greene, 1993), is found to be superior. It can be approximated

[3] Data from 2012 cannot yet be use, as the performance indicators are surveyed in retrospect and the business volume for 2012 will only become available with the data from the survey of 2013.

from the general logarithmic production function $lnY = f(lnL, lnK)$ through a Taylor series (Franz, 2009, p. 139):

$$lnY = \beta_0 + \beta_1 lnK + \beta_2 lnL + \beta_3 \frac{(lnL)^2}{2} + \beta_4 \frac{(lnK)^2}{2} + \beta_5 (lnL \times lnK) + \beta_6 womentop + \beta' X + \epsilon$$

in which lnY is the establishment's log business volume, operationalized as (1) turnover, (2) turnover per head, computed as turnover divided by the number of employees, (3) sales exclusive sales tax and (4) gross value added, which is calculated from the establishment's reported sales minus intermediates. To measure labor inputs (lnL), the logarithm of the total number of employees in 2008 is computed. As direct information on the capital input (lnK) is not available, capital is approximated through investments. According to the proportionality approach, investment expenditures reflect depreciation and are proportional to the unknown capital stock (Müller, 2008). The idea behind this approach is that given a linear depreciation rate, depreciations are proportional to the capital stock and (replacement) investments are proportional to capital because they replace the capital stock. Combining the approaches of Addison, Schank, Schnabel and Wagner (2006), who use observations with an average replacement investment sum of the past two years that is greater than zero, and Bellmann et al. (2006), who draw on the sum of investments of the past two years and include zero values, the capital stock is approximated through the average sum of investments of the past two years.

This approach assumes that every establishment completely replaces all depreciated capital every year. However, establishments tend to make lumpy investments, which may lead to implausible values for the approximated capital stock variable. Thus, zero investments in one year lead to capital stock measures of zero for that year and establishments are assumed to have no capital. As this leads to a non-normal distribution, zero investments are not included in the main analysis. However, this also excludes a considerable number of observations and the resulting bias could affect regression results, hence robustness is checked through a capital approximation including zero values.

The key independent variable (womentop*)* is defined as the share of female managers in top management positions on all managers in top management positions in 2008[4]. Additionally, a dummy that is zero, when no woman is found in a top management position, and one, when at least one woman is in a top management position, is used to check results for robustness. The definition of the top management level differs in the IAB-Establishment Panel from those of most previous studies, i.e. a comparatively wide definition is used in this analysis, as opposed to a much narrower definition that only includes the composition of boards of directors, boards of advisors and CEOs. While heterogeneity in management is certainly a given within this analysis, a wider definition of management may also better reflect the complex processes in an establishment and account for management positions below the very top that are crucial to firm performance and should therefore not be neglected (Dwyer et al., 2003).

[4] The IAB-Establishment Panel "equality of opportunity" section of 2008 inquires about the management structure in German establishments as follows: "The following question refers to the management structure of your establishment/office. There are often different management hierarchies. The management personnel of each level have a hierarchical relationship to the levels below. a) How many persons in your establishment/office have a supervisory position at top management level (management, proprietor, director, branch manager, and works manager)? b) And how many of these are women?"

The vector X represents further variables, which account to some degree for moderating effects on the establishment-level. As characterization of the composition of the workforce, the share of female employees is included. Furthermore, the share of part-time employees is estimated to control for the reduced input of part-time employees and the percentage of apprentices is included to control for the quality of the labor inputs, as well as the percentage of skilled workers which reflects productivity differences due to different human capital stocks. To account for the attributes of the establishments, dummies denominating the legal form of the establishment, its affiliation in a larger corporate group and its age (which equals one if the establishment was founded after 1990) are included in the analysis. Dummy variables indicating the profitability in the previous year, whether or not employees worked overtime and the perceived pressure from competitors further describe the competitiveness of the establishments. Following Bloom and Van Reenen (2006; 2007; 2010), fiercer (product market) competition increases management quality and managerial efforts and in turn is favorable to performance. Additionally, foreign-ownership and export-orientation are accounted for, with the expectation that exporting firms are more productive (Wagner, 2007). Finally, the region, in which the establishment is operating (East or West Germany), is incorporated with the assumption that firms in the West are more productive than those in the East. To control for qualitative differences in the establishment's equipment, a dummy is computed from the self-reported perception on the current state of technology and machinery. In addition, several controls indicating the employee-centeredness of an establishment, i.e the existence of a works council, a collective agreement and measures to enhance equal opportunity, are built in. Finally the industry sector, the firm size and the state are used to correct for the sample stratification. This approach is used as opposed to a weighted OLS estimation, because "where sampling weights are solely a function of independent variables included in the model, unweighted OLS estimates are preferred because they are unbiased, consistent and have smaller standard errors than weighted OLS estimates" (Winship & Radbill, 1994, p. 230).

In a first step, OLS regressions are used to estimate the impact of the share of women in top management positions and firm performance. To check for robustness and to account for some of the moderating effects highlighted above, various interaction terms are included.

Due to problems of endogeneity and reverse causality, it is difficult to regard the estimated relationship as causal. On the one side, general causality issues arise with the estimation of production functions – such as the simultaneous determination of inputs and outputs and the problem of omitted variables which influence both performance and gender diversity[5] - and on the other side specific problems are cited in the diversity-performance context. Most importantly the question whether women in top management positions increase (decrease) firm performance or select into firms with higher (lower) performance remains to be solved. There may be reason to assume that women self-select into better performing firms because they are highly qualified and because successful firms have more resources and receive more pressure to conform to good governance codices and therefore aim to employ more female managers (Dezsö & Ross, 2012; Farrell & Hersch, 2005; Minguez-Vera & Martin, 2011; Rhode & Packel, 2010). This would mean that the fundamental assumption that the error term is unrelated to the regressors is breached. Therefore to assess the robustness of the estimated coefficients, an IV approach is adopted in a second step to obtain consistent parameters.

[5] For a detailed discussion of endogeneity in production functions see Griliches & Mairesse (1995).

Finding an appropriate instrument, which is correlated with the share of women in top management positions, but does not affect firm performance, is crucial for this approach. In this case the panel character of the IAB-Establishment Panel can be exploited: I follow the ideas of Boeri and Bruecker (2011), who use information on short-time work in prior waves of the IAB-Establishment Panel to construct an instrument for short-time work in the focal wave. Analogously, I use the share of women in top management positions in 2004, as well as the share of women in second level management positions in 2004, to instrument the share of women in top management positions in 2008.

Descriptive Statistics

The IAB-Establishment Panel Survey of 2008 provides an overview of gender diversity in Germany. This wave contains 15,456 cross-sectional observations. An establishment has an average number of 17 employees (std. dev. = 106). Furthermore, most establishments in the sample have less than 10 employees (72%). As most of Germany's establishments are SMEs it could be concluded that an analysis including only larger listed companies may be restrictive. The inclusion of SMEs should therefore contribute to the generalizability of the gender diversity-performance link. Women make up almost half of the workforce in 2008 (45%). However, they are also predominant in fixed-term and part-time employment. These descriptive results indicate that women, compared to men, are less likely to work in "traditional" full-time employment. At the same time, women contribute to a considerable amount of human capital in the establishments: 45% of all vocational qualifications and 38% of all university degrees are held by women, implying that a shortage of women in top management positions cannot be attributed to a lack of formal training.

Table 1: The development of the share of women in top and second level management positions

	Share of women in top management positions in percent			**Share of women in second level management positions in percent**		
	2004	**2008**	**2012**	**2004**	**2008**	**2012**
Region						
West Germany	23.9	23.9	26.0	32.1	43.4	36.7
East Germany	28.6	30.0	31.1	39.6	33.1	46.4
Total	24.7	25.1	27.0	33.1	35.4	38.4

Note: Descriptive results are weighted with the cross-sectional weighting factor for each year respectively.
Source: IAB-Establishment Panel Survey 2004, 2008, 2012.

Most establishments (80%) only have one top manager and overall, 70% of all establishments do not employ a woman in a top management position. Of all top managers, 25% are female and of all second level managers 35% are female in 2008. Of the establishments with a second level of management (23%), more than half (55%) have at least one female manager. Over time, some developments have taken place (see table 1). The share of women in top and second level management positions is slowly increasing, most notably in East Germany. Nevertheless, a gender-equal distribution in management has yet to be reached.

As expected, the share of women in the workforce varies with the industry sector and larger shares of female employees are found in traditional female-dominated occupations such as health and social work, education, and non-industrial or non-profit organizations and the public administration (see table 2). Furthermore, the share of women in the workforce is higher in

East Germany compared to West Germany and it decreases with increased establishment size. As was expected, more female managers on both levels can be found in East Germany compared to West Germany, which may hint at the better integration of women in the workforce and in management in East Germany. The highest share of female top managers can be found in education and in other services, which is not unexpected, as the latter category includes, among others, washing and dry-cleaning, hairdressing and other beauty treatments and physical well-being activities. These are traditional female-dominated occupations with high shares of female customers, suggesting that there might be some evidence for the "reflection of the marketplace" hypothesis. Surprising however, is the small share of female top managers in health and social services as well as in finance compared to the relatively large share of women in the workforce in these sectors. The overall higher percentage of women in the workforce and in second level management could be interpreted as an indication for the existence of a glass ceiling. This glass ceiling would accordingly be especially strong in finance. Thus, overall the descriptive results suggest that moderating effects of the industry and the region need to be taken into account in the following analysis.

Table 2: The share of women in the workforce and in management in 2008

	Share of women in the workforce in percent	**Share of women in top management positions in percent**	**Share of women in second level management in percent**
Sector			
Health and social work	77	42	69
Non-industrial organizations	65	41	46
Education	64	50	59
Hospitality	61	34	56
Finance and insurance	56	9	22
Other services	55	48	41
Public administration	53	20	29
Food/luxury	50	21	35
Trade and repair	49	27	40
Services	43	20	29
Consumer goods	39	18	25
Agriculture/Forestry	35	18	36
Transportation and News	24	20	24
Industrial goods	21	19	14
Durable goods	21	12	12
Mining/Energy	20	13	9
Construction	15	9	15
Region			
West Germany	44	24	34
East Germany	47	30	43
Total	**45**	**25**	**35**

Note: The maximum number of observations of 15,456 varies due to missing values and filters in the survey. Descriptive results are weighted with the cross-sectional weighting factor.
Source: IAB-Establishment Panel Survey 2008.

4. Results

The means, standard deviations and number of observations for the relevant variables in the sample are presented in table A1 of the appendix.

Baseline Regressions

The results for the baseline models are reported in table 3. The translog production functions were estimated with OLS and robust standard errors. The basic models report results for the performance measures of 2008 and the models for the four dependent variables are significant. The number of observations varies between 3,435 and 3,724 and the adjusted R^2 indicates a good model fit. Capital is approximated without zero investments.

The coefficient for the proportion of women in top management positions is negative and significant on the 1% level for all four performance measures. Moreover the coefficients are similar in size for all dependent variables, indicating that a 1% increase in the proportion of women in top management is associated with a 0.098%-0.112% decrease in performance. Similar results are obtained when a capital input approximation with zero investments is used. In this case, the directions of the estimated coefficients of the control variables follow the expected patterns. The estimated coefficient for the share of women in top management positions is statistically significant for all four performance measures and robust in size, ranging from -0.00132 to -0.00142.

Overall the estimated coefficients for the control variables point in the directions deduced from theoretical deliberations, hinting to the importance attributed to the moderating role of the establishment-level, as proposed in figure 2: The shares of part-time employees[6] and apprentices have a significant negative impact on establishment performance. The share of skilled employees is positive and significant, as is the dummy variable indicating whether employees participated in further training activities. Hence, these estimated coefficients are in line with the expectations formulated according to human capital theory.

With respect to the characterization of the establishment, the anticipated pattern also emerges: Younger establishments are less performing compared to older ones. The dummy variable describing the state of the art of technology and machinery is positively and significantly associated with firm performance, as are the dummy variables for foreign-ownership and export-orientation. The latter two estimates may indicate that more internationally oriented establishments compete in bigger markets and may be able to exploit performance benefits of international markets. The dummy variables indicating the legal form of the establishment are jointly significant, as are the dummies for the affiliation in a larger corporate group. Furthermore, the estimated coefficients that designate the competitiveness of the establishments, i.e. the perceived pressure from competitors, the profitability in 2007 and the dummy for overtime are all positive. This result is in line with Bloom and Van Reenen's (2010) findings that a competitive environment increases management quality and thereby productivity.

The estimated coefficient for the dummy variable denominating the region (West/East) is positive for all four performance measures. This suggests that establishments in West Germa-

[6] To address the concern that the share of part-time employees mainly measures the share of female employees, the baseline regressions have additionally been estimated without the share of part-time employees. The estimated coefficients for the share of women in top management positions are robust and the same pattern persists for the results of the control variables.

ny tend to have better firm performance than establishments in East Germany, illustrating a productivity gap. Finally, the dummy variables controlling for the state and the industry sector are respectively jointly significant, signaling regional and sectoral differences.

Table 3: Coefficients and robust standard errors in the basic model for each dependent variable

	Dependent variables: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Share of women in top management positions	-0.00099***	-0.00099***	-0.00098***	-0.00112***
	(0.00038)	(0.00038)	(0.00038)	(0.00039)
Share of part-time employees	-0.00688***	-0.00688***	-0.00686***	-0.00745***
	(0.00080)	(0.00080)	(0.00080)	(0.00086)
Share of apprentices	-0.00386**	-0.00386**	-0.00358**	-0.00430***
	(0.00156)	(0.00156)	(0.00155)	(0.00162)
Share of women in the workforce	-0.00095	-0.00095	-0.00092	-0.00027
	(0.00062)	(0.00062)	(0.00062)	(0.00065)
Share of skillled employees	0.00387***	0.00387***	0.00384***	0.00395***
	(0.00053)	(0.00053)	(0.00053)	(0.00056)
Further training (dummy)	0.06395**	0.06395**	0.06630**	0.05645**
	(0.02735)	(0.02735)	(0.02703)	(0.02858)
State-of-the-art technology (dummy)	0.04819**	0.04819*	0.04842**	0.05386**
	(0.02450)	(0.02450)	(0.02423)	(0.02502)
Age of the establishment (dummy)	-0.08656***	-0.08656***	-0.08598***	-0.09112***
	(0.02504)	(0.02504)	(0.02485)	(0.02764)
Foreign ownership (dummy)	0.23581***	0.23581***	0.23924***	0.09863*
	(0.05772)	(0.05772)	(0.05568)	(0.05327)
West Germany (dummy)	0.06645	0.06645	0.18856***	0.32158***
	(0.06564)	(0.06564)	(0.06531)	(0.07098)
Works council (dummy)	0.20794***	0.20794***	0.20508***	0.19850***
	(0.03491)	(0.03491)	(0.03456)	(0.03540)
Collective agreement (dummy)	-0.00972	-0.00972	-0.01183	-0.03949
	(0.02585)	(0.02585)	(0.02574)	(0.02797)
Measures to enhance equality (dummy)	0.01632	0.01632	0.02038	-0.00793
	(0.03106)	(0.03106)	(0.03071)	(0.03171)
Export-orientation (dummy)	0.22883***	0.22883***	0.23001***	0.17340***
	(0.03056)	(0.03056)	(0.03031)	(0.03109)
Pressure from competitors (dummy)	0.02539	0.02539	0.02050	-0.07089***
	(0.02242)	(0.02242)	(0.02222)	(0.02367)
Good profitability in 2007 (dummy)	0.14081***	0.14081***	0.14449***	0.16644***
	(0.02297)	(0.02297)	(0.02288)	(0.02427)
Overtime (dummy)	0.10528***	0.10528***	0.10387***	0.08393***
	(0.02635)	(0.02635)	(0.02627)	(0.02784)
Capital (ln)	-0.24521 ***	-0.24521***	-0.24313***	-0.23499***
	(0.06318)	(0.06318)	(0.06318)	(0.05985)
Labor (ln)	1.01354***	0.01353	1.01790***	1.03951***
	(0.07504)	(0.07504)	(0.07517)	(0.07025)
$\text{lnlabor}^2/2$	-0.01325	-0.01325	-0.01115	0.00462
	(0.01890)	(0.01890)	(0.01885)	(0.01807)
$\text{lncapital}^2/2$	0.03982***	0.03982***	0.04006***	0.03840***
	(0.00834)	(0.00834)	(0.00834)	(0.00771)
lnlabor x lncapital	-0.01440	-0.01440	-0.01546	-0.02112**
	(0.01083)	(0.01083)	(0.01083)	(0.00985)

	Dependent variables: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Constant	12.37871*** (0.42902)	12.3787*** (0.42902)	11.92033*** (0.40203)	11.9635*** (0.38909)
Legal form dummies	yes	yes	yes	yes
Affiliation in a larger corporate group dummies	yes	yes	yes	yes
State dummies	yes	yes	yes	yes
Industry sector dummies	yes	yes	yes	yes
Number of observations	3,724	3,724	3,712	3,435
Adjusted R^2	0.91	0.54	0.91	0.90

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

In a second model specification, the share of women in top management positions is replaced by a dummy variable, which is zero when an establishment has no women in top management positions and becomes one when the establishment has at least one woman in a top management position. The models for the four dependent variables are significant and have a good model fit. The estimated coefficients for the women in top management dummy are negative, significant and larger compared to the model with the share of women in top management positions as focal regressor (see table A2 of the appendix).

Instrument Variable Approach

A further robustness check is made to account to some extend for the present endogeneity problems. As it is plausible that the error term is not unrelated to the regressors due to the cross-sectional character of the data, an instrument-variables estimator can provide a more consistent estimator. However, the strong assumption of valid instruments has to be fulfilled. Following Boeri and Bruecker (2011), I use the share of women in top and second level management positions in 2004 as instruments, which enables me to exploit the panel character of the data. The experiences made with women in management positions in past years should positively influence the effects of women in top management positions in 2008. One explanation for this could be that learning processes facilitate gender diverse teams to work efficiently and to reduce conflicts, thereby allowing positive gender diversity effects to unfold. However, women in management positions in 2004 should not directly determine establishment performance several years later.

I use a GMM estimator and robust standard errors. Tables A3 and A4 of the appendix present the results for all dependent variables. Overall, I conclude that my instruments are acceptable. Table A4 presents the instrument variable estimations for the focal regressor. The control variables not reported in the table point in the expected directions. The coefficient for the share of women in top management positions remains negative and highly significant for all four models. Compared to the basic OLS model, the coefficients in the instrument variable regressions are larger. Overall this reinforces the robustness of the presented results and strongly suggests that a negative link between the share of women in top management positions and establishment performance exists for Germany.

Investigation of Moderating Effects

For the following analyses, I draw on the proposed theoretical framework for the gender diversity-performance relationship and focus on the moderating influences of the establishment and macro-levels (see figure 2).

First, I assume that the historically different developments in East and West Germany are reflected in the productivity effects of women in TMTs. In order to evaluate the moderating influence of the region, the sample is split into separate subsamples for East and West Germany. Table 4 reports relevant results for the split sample and makes regional differences apparent: The estimated coefficients for West Germany are negative and significant on the 1% level and they are also slightly larger than those of the baseline sample (compare table 3). However, the estimated coefficients for East Germany are not significant and additionally even smaller than those estimated for the basic sample, which confirms the hypothesis that gender diversity in management affects productivity differently in West and East Germany.

Table 4: Split samples for East and West Germany

	Dependent Variable: Establishment performance in 2008			
	Turnover (ln)		Value added (ln)	
	East	West	East	West
Share of women in top management positions	-0.00003 (0.00061)	-0.00184*** (0.00048)	-0.00015 (0.00060)	-0.00203*** (0.00052)
Number of observations	1,453	2,271	1,353	2,282
Adjusted R^2	0.89	0.92	0.88	0.91

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level. Control variables as reported in table 3. The results for turnover per head (ln) and sales (ln) are not reported for clarity reasons but are similar to the presented estimates.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

Second, I follow the assumption that the sectoral composition plays a moderating role in the gender-diversity performance link. It is expected that the influence of the industry is positive for services sectors and sectors, in which the share of female employees is comparatively high; and negative for the manufacturing and construction sectors. Therefore an interaction term between the share of women in top management positions and a dummy, which is zero when an establishment is in the manufacturing industries (including agriculture, energy, construction, consumer, industrial and durable goods) and one when it is in the service industries (including trade and repair, transportation and news, finance, hospitality, education, health and social services, as well as services), is added. It yields the expected results, which are presented in table 5. The interaction term is positive and significant (except for value added), which is indicative for the validity of the assumption that the industry sector has a moderating influence on the gender diversity and establishment relationship.

To further explore the influence of establishment characteristics, I respectively include further interaction terms for the export-orientation and the foreign-ownership of the establishments. The coefficient for the export-orientation of the establishment is positive and significant for all four dependent variables and the coefficient for the share of women in top management positions remains small, negative and significant. While joint significance is given, the interaction term is not significant, but positive and therefore provides a hint that women in

top management positions may be able to positively influence firm performance in export-oriented establishments. The same pattern emerges for the foreign-ownership interaction. It could be hypothesized that internationally-oriented establishments may differ from those concentrated on the domestic market, for example in their organizational cultures or in external pressures for diversity, providing a working environment that is more suitable to gender diversity. Overall, there is some evidence that the sector affiliation and the international orientation play a moderating role in the gender diversity-performance relationship, which indicates that a differentiation of the effects of women in top management positions on firm performance can be meaningful and that general (cross-sectoral) statements may not reflect the complexity of the research topic.

Table 5: Basic model with industry interaction

	Dependent Variable: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Share of women in top management positions	-0.00199*** (0.00063)	-0.00199*** (0.00063)	-0.00201*** (0.00063)	-0.00156** (0.00064)
Interaction term	0.00146* (0.00078)	0.00146* (0.00078)	0.00152* (0.00078)	-0.00065 (0.00081)
Number of observations	3,724	3,724	3,712	3,435
Adjusted R^2	0.91	0.55	0.91	0.89
F-Test statistic for joint significance	43.35***	43.35***	43.54***	8.75***

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level. Control variables as reported in table 3.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

Third, I examine the composition of the workforce. Therefore, the additional control "share of women in second level management positions" is added to the baseline regression. This restricts the analysis to a limited number of observations as fewer establishments have a second level of management. Table 6 reports the relevant results for the regressions. When adding second level management to the estimations, the coefficients for the share of women in top management positions become insignificant with the exception of the model for value added. However, the coefficients for the share of women in second level management positions are negative and significant. It seems that establishments with a second level management structurally (and culturally) differ from the establishments in the baseline regression[7].

[7] Following Lindstädt et al.'s (2011) finding of a positive link between gender diversity in top management and firm performance in firms with a high proportion of women in the workforce, an additional model with an interaction term between the share of women in top management positions and the share of women in the workforce is estimated. For all four performance measures, the coefficient for women in top management positions is negative and significant on the 10% level and the interaction term is positive, but very small and insignificant. Therefore, while Lindstädt et al.'s (2011) results cannot be conclusively confirmed, they cannot be refuted either.

Table 6: Baseline regression model with the share of women in second level management positions

	Dependent Variable: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Share of women in top management positions	-0.00083 (0.00056)	-0.00083 (0.00056)	-0.00083 (0.00056)	-0.00109* (0.00056)
Share of women in second level management positions	-0.00159*** (0.00053)	-0.00159*** (0.00053)	-0.00165*** (0.00053)	-0.00112* (0.00058)
Number of observations	2,185	2,185	2,174	2,019
Adjusted R^2	0.88	0.51	0.88	0.87

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level. Control variables as in table 3.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

Fourth, the moderating effects of the environment, and specifically of the economic crisis in 2008/2009, are investigated. Therefore, information from the survey of 2010 is additionally merged to the original sample in order to estimate productivity effects with a lag, as well as to explicitly control for the economic crisis. The regressions are run for the baseline model for all four dependent variables. Each model is significant and the adjusted R^2 indicates a good model fit. Table 6 shows the results for the focal regressors. When performance is measured for 2009 with lagged independent variables, the main insights gained from the basic model for 2008 do not change. The directions of the estimated coefficients reported in table A5 of the appendix are as theory predicts. The crisis indicator is negative and significant on the 1% level for each dependent variable. Hence, being negatively affected by the economic crisis of 2008/2009, leads to a 16%-21% decreased establishment performance compared to establishments which were not at all or positively affected by the crisis. Upon including the crisis indicator the coefficient for the share of women in top management positions does not change critically: It is negative and significant. In additional estimations, the share of women in top management is replaced with the diversity dummy and subsamples for East and West Germany are regarded. All lagged models confirm the robustness of the results.

Table 7: Lagged regression and crisis indication

	Dependent Variable: Establishment performance in 2009			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Share of women in top management positions	-0.00082* (0.00043)	-0.00085** (0.00042)	-0.00080* (0.00043)	-0.00132*** (0.00047)
Economic crisis indication	-0.18454*** (0.02492)	-0.15511*** (0.02431)	-0.18478*** (0.02485)	-0.21060*** (0.02718)
Number of observations	3,177	3,177	3,169	2,911
Adjusted R^2	0.91	0.52	0.91	0.89

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level. Control variables as in table A5 of the appendix.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009, 2010.

Finally, according to Richard et al. (2007) a bad economic environment negatively moderates the diversity-performance relationship. In order to test this hypothesis, an interaction term between the share of women in top management positions and the crisis indication is included

in the baseline regression. Joint significance is given for all four dependent variables. The interaction term is negative for all four models, but only significant for value added. Thus, while I cannot confirm Richard et al.'s (2007) assumption, I cannot refute it either.

5. Conclusion

I contribute to the current discussion about women in top management positions and firm performance in two ways: I develop a theoretical framework that shows the different tangible and intangible channels which shape the relationship between women in top management positions and firm performance. Then I use this framework to empirically analyze the relationship using high quality data from Germany.

The analysis is not restricted to specific sub-samples, such as for example large DAX companies, but is representative for establishments in Germany. Additionally, the IAB-Establishment Panel enables the use of a singular database and the analysis does not have to rely on information pieced together from different sources or the subjective identification of the manager's gender through names or pictures.

Regarding the influence of the participation of women in top management positions on firm performance, previous findings for Germany led to the expectation of a positive gender diversity-performance relationship (Joecks et al., 2012; Lindstädt et al., 2011). However, these studies concentrated on the examination of board members of large stock traded companies, neglecting the economic salience of SMEs. Therefore, I particularly contribute by investigating performance effects of gender diversity over the whole range of small, medium and large establishments. Overall, I reveal a negative relationship between gender diversity and establishment performance for the private sector in 2008. This negative link is consistent with the previous literature and especially with Minguez-Vera and Martin's (2011) and Du Rietz and Henrekson's (2000) findings for SMEs.

To conclude, at a first glance the share of women in top management positions in German establishments can be negatively linked to firm performance. However, upon closer examination, several indications are found that this statement has to be qualified, suggesting that the gender diversity-performance relationship in Germany may be dependent on the context. This interpretation is in line with previous findings and the theoretical prediction that the relationship between diversity and performance is dependent on the mediating and moderating influences highlighted in section 2. Specifically the moderating effects of establishment characteristics, such as the international orientation and the structure of the workforce, as well as macro-level characteristics of the industry and the environment seem to play a meaningful role in the determination of the relationship between gender diversity in top management and firm performance.

6. Appendix

Table A1: Description of the sample

Variable	Obs.	Mean	Std. Dev.
Diversity in the establishment			
Share of women in top management positions (0/100)	7,555	17.12	34.14
Share of women in second level management (0/100)	3,508	27.90	35.80
Performance of the establishment			
Turnover in 2008 (ln)	6,384	14.46	2.19
Turnover per head in 2008 (ln)	6,384	11.39	0.97
Sales in 2008 (ln)	6,362	14.45	2.18
Gross value added in 2008 (ln)	5,824	13.65	2.10
Characterization of the establishment's workforce			
Labor input (ln)	7,673	3.05	1.69
Share of part-time employees (0/100)	5,796	25.28	23.91
Share of apprentices (0/100)	7,673	4.93	8.58
Share of women in the workforce (0/100)	7,673	37.90	29.42
Share of skilled employees (0/100)	7,673	66.55	25.87
Further trainings in 2007 (0/1 dummy)	7,662	0.65	0.48
Characterization of the establishment			
Capital input (ln):			
- with zero investments	7,348	8.47	5.16
- without zero investments	5,607	11.10	2.40
Age of the establishment (0/1 dummy)	7,663	0.53	0.50
Foreign ownership (0/1 dummy)	7,632	0.06	0.23
State-of-the-art technology (0/1 dummy)	7,657	0.69	0.46
West Germany (0/1 dummy)	7,673	0.57	0.49
Legal Form of the establishment:			
-Individually-owned firm (0/1 dummy)	7,659	0.34	0.47
-Partnership (0/1 dummy)	7,659	0.06	0.23
-Limited liability company (0/1 dummy)	7,659	0.56	0.49
-Limited by shares (0/1 dummy)	7,659	0.04	0.20
Affiliation in a larger corporate group:			
-Independent organization (0/1 dummy)	7,646	0.80	0.41
-Head office of an enterprise (0/1 dummy)	7,646	0.07	0.25
-Office/branch of larger enterprise (0/1 dummy)	7,646	0.14	0.35
-Regional/mid-level authority (0/1 dummy)	7,646	0.003	0.054
Indicators for employee-centered establishments			
Works council (0/1 dummy)	7,660	0.23	0.42
Collective agreement (0/1 dummy)	7,657	0.43	0.50
Measures to enhance equality (0/1 dummy)	7,646	0.14	0.35

Variable	Obs.	Mean	Std. Dev.
Competitiveness of establishment			
Export-orientation (0/1 dummy)	7,533	0.26	0.44
High pressure from competitors (0/1 dummy)	7,663	0.44	0.50
(Very) good profitability in 2007 (0/1 dummy)	7,616	0.44	0.50
Overtime (0/1 dummy)	7,647	0.62	0.49
Sector indicators (0/1 dummies)			
Agriculture/Forestry	7,673	0.027	0.161
Mining/Energy	7,673	0.018	0.132
Food/Luxury	7,673	0.038	0.192
Consumer goods	7,673	0.041	0.198
Industrial goods	7,673	0.103	0.304
Durable goods	7,673	0.152	0.359
Construction	7,673	0.104	0.306
Trade and repair	7,673	0.177	0.382
Transportation and news	7,673	0.048	0.214
Finance and insurance	7,673	0.015	0.120
Hospitality	7,673	0.043	0.202
Education	7,673	0.007	0.084
Health and social services	7,673	0.053	0.224
Services	7,673	0.133	0.340
Other services	7,673	0.041	0.199
State indicators (0/1 dummies)			
Schleswig-Holstein	7,673	0.032	0.175
Hamburg	7,673	0.015	0.120
Lower Saxony	7,673	0.070	0.255
Bremen	7,673	0.071	0.256
Northrhine Westfalia	7,673	0.102	0.303
Hessen	7,673	0.060	0.237
Rhineland-Palatinate	7,673	0.047	0.212
Baden-Wuerttemberg	7,673	0.079	0.270
Bavaria	7,673	0.069	0.253
Saarland	7,673	0.029	0.168
Berlin	7,673	0.046	0.210
Brandenburg	7,673	0.074	0.261
Mecklenburg-Western Pomerania	7,673	0.060	0.238
Saxony	7,673	0.089	0.285
Saxony-Anhalt	7,673	0.071	0.256
Thuringia	7,673	0.088	0.283

*Notes***:** Means and standard deviations are reported for the unweighted sample. The maximum number of observation is reported for each variable and the number of observations can vary for each variable.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

Table A2: Baseline model with women in top management dummy

	Dependent variables: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Women in top management positions dummy	-0.07518*** (0.02626)	-0.07518*** (0.02626)	-0.07508*** (0.02624)	-0.07315*** (0.02699)
Share of part-time employees	-0.00687*** (0.00080)	-0.00687*** (0.00080)	-0.00686*** (0.00080)	-0.00743*** (0.00086)
Share of apprentices	-0.00387** (0.00156)	-0.00387** (0.00156)	-0.00359** (0.00155)	-0.00432*** (0.00163)
Share of women in the workforce	-0.00102* (0.00062)	-0.00102* (0.00062)	-0.00098 (0.00062)	-0.00040 (0.00065)
Share of skillled employees	0.00384*** (0.00053)	0.00384*** (0.00053)	0.00381*** (0.00053)	0.00392*** (0.00056)
Further training (dummy)	0.06296** (0.02732)	0.06296** (0.02732)	0.06535** (0.02701)	0.05503* (0.02852)
State-of-the-art technology (dummy)	0.04839** (0.02451)	0.04839** (0.02451)	0.04859** (0.02425)	0.05402** (0.02505)
Age of the establishment (dummy)	-0.08794*** (0.02506)	-0.08794*** (0.02506)	-0.08736*** (0.02487)	-0.09210*** (0.02767)
Foreign ownership (dummy)	0.23861*** (0.05792)	0.23861*** (0.05792)	0.24183*** (0.05587)	0.10056* (0.05338)
West Germany (dummy)	0.06745 (0.06555)	0.06745 (0.06555)	0.18585*** (0.06535)	0.31943*** (0.07098)
Works council (dummy)	0.20641*** (0.03495)	0.20641*** (0.03495)	0.20354*** (0.03460)	0.19709*** (0.03545)
Collective agreement (dummy)	-0.01008 (0.02586)	-0.01008 (0.02586)	-0.01218 (0.02575)	-0.03974 (0.02799)
Measures to enhance equality (dummy)	0.01776 (0.03109)	0.01776 (0.03109)	0.02185 (0.03074)	-0.00674 (0.03177)
Export-orientation (dummy)	0.22941*** (0.03057)	0.22941*** (0.03057)	0.23069*** (0.03032)	0.17397*** (0.03109)
Pressure from competitors (dummy)	0.02534 (0.02241)	0.02534 (0.02241)	0.02044 (0.02222)	-0.07087*** (0.02368)
Good profitability in 2007 (dummy)	0.14154*** (0.02298)	0.14154*** (0.02298)	0.14517*** (0.02290)	0.16712*** (0.02430)
Overtime (dummy)	0.10594*** (0.02637)	0.10594*** (0.02637)	0.10455*** (0.02629)	0.08448*** (0.02785)
lncapital	-0.24362*** (0.06306)	-0.24362*** (0.06306)	-0.24156*** (0.06306)	-0.23293*** (0.05976)
lnlabor	1.01661*** (0.07501)	0.01661 (0.07501)	1.02101*** (0.07514)	1.04241*** (0.07021)
$lnlabor^2/2$	-0.01394 (0.01889)	-0.01394 (0.01889)	-0.01182 (0.01884)	0.00368 (0.01809)

	Dependent variables: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
$lncapital^2/2$	0.03967*** (0.00833)	0.03967*** (0.00833)	0.03992*** (0.00833)	0.03818*** (0.00771)
lnlabor x lncapital	-0.01430 (0.01083)	-0.01430 (0.01083)	-0.01537 (0.01083)	-0.02089** (0.00986)
Constant	12.36023*** (0.42796)	12.36023*** (0.42796)	11.90554*** (0.40096)	11.94826*** (0.38736)
Legal form dummies	yes	yes	yes	yes
Affiliation in a larger corporate group dummies	yes	yes	yes	yes
State dummies	yes	yes	yes	yes
Industry sector dummies	yes	yes	yes	yes
Number of observations	3,724	3,734	3,712	3,435
Adjusted R^2	0.91	0.55	0.91	0.90

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

Instrument Variable Approach

Both instruments, i.e. the share of women in top management positions in 2004 and the share of women in second level management positions in 2004, are positively and significantly correlated with the key regressor, indicating that the instruments are relevant. Additionally, Shea's Parital R^2 is high enough that no need for caution is given. Table A3 presents the results of the necessary tests for the instrument variable estimations (Cameron & Trivedi, 2009): It demonstrates that the F-test for joint significance of the instruments and the Stock-Yogo tests reject the null hypothesis that the instruments are weak. The F-statistic is larger than the suggested rule of thumb value of 10. While theory assumes homoskedastic errors, the minimum eigenvalue statistic strongly exceeds the critical value of the Stock-Yogo tests, hence the null hypothesis of weak instruments can comfortably be rejected. Furthermore, the test of endogeneity rejects the null hypothesis that the variables are exogenous. Finally, the Sargan test for overidentifying restrictions cannot reject the null hypothesis that there is no correlation between the error terms. While this does not imply that the instruments are valid, it does indicate that at least one of the instruments would have a significant effect in the structural equation given that the other instrument is valid. Overall, the conclusion can be drawn that the instruments are acceptable.

Table A3: Tests for the instrument variable estimation

	Dependent variables: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Tests for weak instruments:				
F-test statistic	121.38***	121.38***	121.36***	128.83***
Test for endogeneity:				
Chi^2-test statistic	4.78**	4.78**	4.60**	6.93***
Test for overidentifying restrictions				
Chi^2-test statistic	1.85	1.85	1.58	3.87**

Notes: *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

Table A4: Coefficient and standard error for the key regressor in the instrument variable estimation

	Dependent Variable: Establishment performance in 2008			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Share of women in top management positions	-0.00314*** (0.00110)	-0.00314*** (0.00110)	-0.00311*** (0.00110)	-0.00407*** (0.00105)
Number of observations	1,359	1,359	1,354	1,276
Adjusted R^2	0.87	0.48	0.88	0.87

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level. Control variables as in table 3.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009.

Table A5: Baseline model with lagged variables and crisis

	Dependent variables: Establishment performance in 2009			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Share of women in top management positions	-0.00082*	-0.00085**	-0.00080*	-0.00132***
	(0.00043)	(0.00042)	(0.00043)	(0.00047)
Crisis indicator (dummy)	-0.18454***	-0.15511***	-0.18478***	-0.21060***
	(0.02492)	(0.02431)	(0.02485)	(0.02718)
Share of part-time employees	-0.00628***	-0.00648***	-0.00627***	-0.00727***
	(0.00086)	(0.00085)	(0.00086)	(0.00096)
Share of apprentices	-0.00136	-0.00229	-0.00134	-0.00217
	(0.00160)	(0.00160)	(0.00160)	(0.00175)
Share of women in the workforce	0.00003	-0.00020	0.00003	0.00091
	(0.00070)	(0.00068)	(0 .00070)	(0.00074)
Share of skillled employees	0.00386***	0.00340***	0.00385***	0.00413***
	(0.00059)	(0.00058)	(0.00059)	(0.00065)
Further training (dummy)	0.10256***	0.10794***	0.09933***	0.10577***
	(0.02978)	(0.02914)	(0.02973)	(0.03210)
State-of-the-art technology (dummy)	0.06100**	0.06060**	0.06063**	0.06968**
	(0.02666)	(0.02628)	(0 .02666)	(0.02815)
Age of the establishment (dummy)	-0.06606**	-0.06196**	-0.06551**	-0.07587**
	(0.02769)	(0.02689)	(0.02739)	(0.03060)
Foreign ownership (dummy)	0.25233***	0.25792***	0.25306***	0.12075*
	(0.06168)	(0.06110)	(0.05930)	(0.06170)
West Germany (dummy)	0.16623**	0.15993**	0.03932	0.11631*
	(0.07321)	(0.07156)	(0.06645)	(0.06879)
Works council (dummy)	0.21055***	0.18235***	0.21530***	0.25299***
	(0.03847)	(0.03741)	(0.03828)	(0.04072)
Collective agreement (dummy)	-0.02764	-0.00639	-0.02792	-0.05163*
	(0.02805)	(0.02720)	(0.02800)	(0.03087)
Measures to enhance equality (dummy)	-0.00459	-0.00972	0.00101	-0.03373
	(0.03528)	(0.03433)	(0.03505)	(0.03604)
Export-orientation (dummy)	0.21526***	0.21013***	0.21325***	0.13409***
	(0.03306)	(0.03254)	(0.03284)	(0.03621)
Pressure from competitors (dummy)	0.02630	0.04070*	0.02277	-0.05161**
	(0.02420)	(0.02361)	(0.02403)	(0.02623)
Good profitability in 2007 (dummy)	0.08632***	0.08565***	0.08849***	0.10951***
	(0.02426)	(0.02365)	(0.02422)	(0.02682)
Overtime (dummy)	0.10660***	0.08628***	0.10433***	0.08069**
	(0.02943)	(0.02898)	(0.02928)	(0.03199)
lncapital	-0.25176***	-0.26602***	-0.24672***	-0.17539**
	(0.07331)	(0.06981)	(0.07331)	(0.07259)
lnlabor	1.02224***	0.07940	1.02471***	0.94312***
	(0.09132)	(0.08583)	(0.09144)	(0.08933)
$lnlabor^2/2$	0.00783	0.00524	0.00798	0.01206
	(0.02530)	(0.02384)	(0.02529)	(0.02513)
$lncapital^2/2$	0.04134***	0.04245***	0.04103***	0.03096***
	(0.01006)	(0.00951)	(0.01007)	(0.00974)
lnlabor x lncapital	-0.02086	-0.02338*	-0.02106	-0.015631
	(0.01417)	(0.01323)	(0.01418)	(0.01375)
Constant	12.62828***	12.68646***	12.53168***	12.16755***
	(0.61913)	(0.61524)	(0.58864)	(0.65309)

	Dependent variables: Establishment performance in 2009			
	Turnover (ln)	Turnover per head (ln)	Sales (ln)	Value added (ln)
Legal form dummies	yes	yes	yes	yes
Affiliation in a larger corporate group dummies	yes	yes	yes	yes
State dummies	yes	yes	yes	yes
Industry sector dummies	yes	yes	yes	yes
Number of observations	3,177	3,177	3,169	2,911
Adjusted R^2	0.91	0.52	0.91	0.89

Notes: Robust standard errors are presented in parentheses. *: significance at the 10% level; **: significance at the 5% level; ***: significance at the 1% level.
Source: IAB-Establishment Panel Survey 2007, 2008, 2009, 2010.

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