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Employment Growth and Firm Innovativeness in Women- and Men-Owned Small Firms in Germany: An Effect of Endowments?

by

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Abstract

Analyzing 962 female- and 1945 male-owned businesses in Germany, we find that the former underperform the latter in terms of employment growth and firm innovativeness. Controlling for endogeneity, i.e. feedback effects between employment growth and innovation, we show that the lower employment growth in women-owned businesses is mainly due to women's lower commitment to product and process innovations, a phenomenon which is referred to as *"female-male innovation gap"* in this study. The female-male innovation gap goes apparently back to *occupational sex segregation*, with women occupying occupations and choosing fields of study or apprenticeship training which are less technical or technology-oriented and thus less likely to provide them with important resources (e.g. technical know-how) and favorable conditions needed for the development and implementation of product and process innovations. The results from the Blinder-Oaxaca decomposition show that we were able to explain an outstandingly high percentage of the raw differential in women and men business owners' firm innovativeness.

1 Introduction

Against the background of a high unemployment in Germany, the employment growth of small firms has recently become a hotly debated topic of policy. However, it remains a field where *gender-related research* is rather scarce and often lacks both a theoretical background and a sound empirical basis. The main questions to be answered in this context are as follows: Do female-owned businesses perform worse than male-owned businesses in terms of employment growth? If so, what are the underlying factors of this phenomenon? What are the major bottlenecks for the growth of women-owned enterprises in Germany? To what extent are person-specific, firm-specific or strategic factors responsible for the lower growth in women-owned businesses in Germany? What are the practical implications for the policy aiming at the support of women-owned businesses in Germany?

While previous research has mainly focused on firm- and person-specific factors that cause gender differences in employment growth (see more in the next chapter), this study considers *firm innovativeness*, i.e. the degree to which the firm implements or develops product and technological changes or improvements, as a major strategic factor of growth. The main hypothesis is that compared to men-owned small businesses women-owned small businesses are less likely to grow because women are less committed to the implementation and the development of process and product innovations. However, why may women be less committed to innovations than men? Why does a female-male innovation gap exist? The idea is put forward and tested empirically that the *"female-male innovation gap"* is mainly due to the gender-specific occupational segregation, with women predominantly operating in typically *female-dominated occupations* or choosing *female-typed fields of study* and *apprenticeship training*, which are rather person- and service-oriented but less technical or technology oriented and which, subsequently, do not provide women with resources (e.g. technical know-how and skills) needed for the implementation or development of innovations. Additionally, the owner's personal endowments and characteristics (e.g. educational attainment, managerial and financial skills, and time input) as well as the firm characteristics (size, age, industry) are taken into account as further determinants of employment growth and firm innovativeness.

The paper is organized as follows: Section 1 briefly describes the theoretical framework and discusses empirical studies concerning the growth of small firms, gender-specific segregation in current occupations as well as fields of study and apprenticeship training. Section 2 introduces the survey data, describes the variables and indices as well as econometric techniques used. Section 3 reports both descriptive findings and results from the econometric analysis. Section 4 summarizes our findings, gives suggestions for future research and concludes with policy implications.

2 What Makes a Small Firm Grow?

2.1 A Conceptual and Empirical View

Despite a bulk of studies on the growth of start-ups and mature firms, there is still no solid economic or sociological theory that could be used to explain the factors associated with the growth of small firms (Almus et al. 1999). Instead, *theoretical frameworks* exist which summarize the most important determinants of growth found in previous research in (what we call) eclectic or heuristic approaches. These heuristic concepts mainly differentiate between three main components underlying firm growth, namely the owner's personal characteristics and endowments (*entrepreneur*), firm characteristics (*firm*) as well as the owner's strategic orientation and decisions (*strategy*) (Storey 1994). Drawing on these eclectic growth approaches, this paper isolates the following three major determinants of small venture growth:

i) gender, educational attainment, the owner's managerial and financial skills as well as the owner's time input will be considered as determinants of the first group, namely the owner's personal characteristics and endowments *(entrepreneur);*
ii) firm size, firm age and firm industry will set up the second group, namely firm characteristics *(firm);*
iii) the owner's commitment to innovation, defined as the implementation or development of new products and technologies, will constitute the third group, namely the owner's strategic orientation *(strategy).*

Given the paucity of *comparative gender studies exploring the effect of innovation on employment growth*, this paper emphasizes firm innovativeness as a major determinant of employment growth while controlling additionally for the characteristics of the entrepreneur and the firm.

2.2 Employment Growth in Small Firms: Do Women Underperform Men?

Which enterprises generate more jobs, those owned or run by women or those owned or run by men? As pointed out earlier, previous research on employment growth in female- and male-owned small ventures is not extensive. As for existing studies, they deliver partly contradictory results for both Europe and the U.S. In this regard, four strands of literature can be distinguished which provide varying explanations for the amount and determinants of growth of women- and men-owned small firms.

The *first* strand focuses on performance differences between enterprises run by women and men at the aggregated level, arguing that women, in general, do not under-perform men in terms of employment growth (Chaganti and Parasuraman 1996, Johnson and Storey 1993).

The *second* strand suggests just the opposite, arguing that female-led small ventures underperform male-led small ventures both at the aggregated level (i.e. in terms of descriptive statistics) and after controlling for variables related to strategy, firm and owner characteristics. Analyzing a German sample of 481 female- and 1368 male-owned businesses, Jungbauer-Gans and Preisendörfer (1992) find that employment growth occurs considerably less frequently in female-owned enterprises both at the aggregated level and when allowing for the owner's human capital, business and industry-related experiences as well as firm size and industry in the regression models. Another German study on 1700 new businesses (with a sub-sample of 544 female-owned ventures in Upper Bavaria),[1] reports that female founders show significantly lower employment growth dynamics when controlling for the founder's ethnic affiliation, his or her level of human capital (educational attainment, management and industry-related know-how) as well as firm characteristics (e.g. start-up capital) (Brüderl and Preisendörfer 1998). Predicting the performance of 1053 new ventures in the U.S., Cooper et al.'s (1994) longitudinal analysis points out that female-owned businesses are less likely to grow, after controlling for industry, the owner's education, race and management experience. Similar results were reported in Fischer et al.'s (1993) Canadian study which finds that women's businesses tend to perform significantly less well with regard to employment growth both at the aggregated level and after adjusting for industry, the owner's education and his or her motivation.

[1] which is based on the same survey used in the Jungbauer and Preisendörfer's study mentioned above

The *third strand* of literature argues that women may underperform men at the aggregated level. Because women differ markedly from men with regard to the determinants of the entry into self-employment, they will necessarily have different levels of growth later on. However, these differences in growth should disappear when adjusting for control variables. Controlling for firm size, industry and sector, Du Rietz and Henrekson (2000) find support for their hypothesis showing that women entrepreneurs perform as well as men in terms of employment growth. Equally, Rosa et al.'s (1996) study of 300 women- and 300 men-owned Scottish small businesses finds that the negative "female effect" on employment growth disappears after controlling for firm sector, firm age, firm initial capital and the number of owners.

Finally, the *fourth strand* argues that a comparison between quantitative measures of the firm success of women- and men-owned small businesses is not appropriate at all, because female entrepreneurs pursue different, i.e. more intrinsic goals and motives when starting-up and developing their enterprises (Brush 1992, Buttner and Moore 1997). This argument is summarized by Brush (1992, p. 22) as follows: *"the assessment of business performance for women-owned businesses should include not only financial measures, but should incorporate other measures such as employee satisfaction, social contributions, goal achievement, and effectiveness."*

3 Female-Male Innovation Gap: Its Consequences and Causes

In empirical research, innovation has been widely acknowledged as a driving force behind the (net) creation of jobs (Acs and Audretch, 1990, Almus et al. 1999) and thus a mechanism for maintaining and improving the firm competitiveness in the market. More specifically, it has been suggested that innovative firms are more likely to grow than less-innovative firms. However, *gendered comparisons of the firm owner's commitment to innovations* and its consequences for employment growth in women- and men-owned firms are surprisingly scarce. Put another way: previous research has failed to examine whether women-owned businesses are less likely to develop or implement innovations (product and process) than men-owned businesses. And if so, what are the determinants of the "female-male innovation gap"? Assuming that innovations are important determinants of firm growth, it could be supposed that if women-owned businesses are less committed to innovations, which are defined as the implementation or the development of a new item (*product innovation*) or the process of developing new items *(process innovation)*, they will be less likely to grow.

Hypothesis 1: *More innovative firms are more likely to grow than less innovative firms.*

In this context, Brush and Hisrich (1988) also point out that future research needs to explore innovation, the way it affects the success of ventures as well as the differences between women and men entrepreneurs' commitment to innovation. Studies analyzing the impact of the owner's commitment to innovation on firm employment growth are scarce. Most importantly, with the exception of the study by Brüderl and Preisendörfer (2000), the results of the previous research are hardly generalizable to other samples and contexts since they are either based on small samples, often comprised only of women entrepreneurs, or are conducted in selected industries. Besides, they have mainly employed descriptive methods of analysis thus ignoring important variables that should be controlled for.[2] Examining the patterns and factors underlying 590 female-owned and 1259 male-owned fast-growing businesses in Upper Bavaria, Brüderl and Preisendörfer (2000:63-68) demonstrate that the lower outcome of female-owned small ventures is due to the fact that "female founders have innovative and full-time businesses less often" than

[2] Kalleberg and Leicht's (1991) longitudinal study of 362 male- and 114 female-owned companies in three selected industries in South Central Indiana concludes that men are not more likely to introduce and develop business innovations than women. Moreover, the authors reject the hypothesis that innovation is positively related to the firm success. Analyzing a small sample of 127 female- and 59 male-business owners, Brush and Hisrich (2000) show that innovation strategies increase the likelihood for firms to grow faster in terms of employment growth. Moreover, they argue that female-owned businesses are more likely to pursue high quality innovation strategies than male-owned businesses. Additionally, women and men business owners do not seem to differ in terms of employment growth (Brush and Hisrich 2000). A discriminant analysis of the growth strategies of 344 U.S. women entrepreneurs by Brush and Hisrich (1988:620) shows that innovation is indeed an important growth strategy of women entrepreneurs. Stressing upon these results, the authors point out that they are largely concomitant with Chaganti and Chaganti's (1983) finding that innovation, i.e. the frequency with which old products are modified or new products are introduced, is a key to success for small Canadian businesses in manufacturing. An earlier study of 468 women entrepreneurs by Hisrich and Brush (1984) argues that women do not develop or implement product innovations, but rather tend to slightly modify existing products for the market. Sonfield et al. (2001) report descriptive evidence that there are not significant gender differences in venture innovation. A descriptive analysis of the German IAB-Establishment Panel (2000) by Fehrenbach and Leicht (2002) finds that substantial differences between women- and men-owned small firms exist with regard to the implementation of organizational innovations.

their male counterparts. The authors conclude that an innovative strategy drastically increases the probability of fast growth. Moreover, innovation "survives" all multivariate controls of founder and firm characteristics as well as the other elements of firm strategy.[3]

Hypothesis 2: *Women-owned businesses are less likely to grow because women in comparison to men are less likely to introduce or implement innovations.*

However, why may women be less likely to develop or implement innovations than men? First, we suppose that this might be due to ***occupational sex segregation***, with self-employed women operating in *current occupations* which are less favorable for the development and implementation of process or product innovations. Second, gender-specific differences in the *choice of fields of study* and *vocational training* may also cause women's lower commitment to innovations. If women business owners want to develop and implement innovations, they should not be deterred by apparent obstacles, which, in our opinion, are structurally embedded in women-typed occupations, choices of fields of study and vocational training. What are these obstacles, and *why exactly* does gender-based occupational segregation as well as gender-differences in the choice of fields of study and vocational training impede women's commitment to innovations?

3.1 Occupational Sex Segregation

Research speaks of *gender-based occupational segregation or occupational sex segregation*, when occupations exist in which the percentage of workers of either sex is so high that they could be called either "male" or "female" occupations (Melkas and Anker 1997:350). Gender-based occupational segregation concerns the tendency of women and men to be employed in different occupations (*horizontal segregation*) as well as different positions within the same occupation or occupational groups (*vertical segregation*).[4]

Across industrialized countries, most feminized occupations include clerical, sales and service activities such as housekeeper in private service, childcare in the home, sewer, home helper, nurse, secretary, typist or stenographer as well as directors and nursing staff at childcare and nursery institutions. These female occupations are largely consistent with abilities and characteristics that are typically attributed to women in the society and are highly gender stereotyped (Melkas and Anker 1997:355, Charles 1992, 2003).[5] Quite the contrary, men predominate in managerial and production occupations.

Does occupational sex segregation have important implications for *women's entrepreneurship*? Few studies (Lohmann and Luber 2002, Lauxen-Ulbrich and Leicht 2002, Kraus 2003, Strohmeyer and Tonoyan 2005) exist that have examined the impact of occupational sex segregation (in wage-and-salaried work) on *women's propensity to become self-employed.* An empirical examination for Germany and the United Kingdom by Lohmann and Luber (2000:22) suggests that the likelihood of being self-employed is lower, if women and men employees perform in female-dominated occupations, a result which is robust after controlling for the respondent's socio-demographic characteristics (age, number of children in the household, nationality and family status) and fields of work (manufacturing, construction, trade, service etc.). A tentative conclusion reached by a descriptive analysis by Lauxen-

[3] Despite a profound theoretical basis and sound methods of analysis, the study by Brüderl and Preisendörfer (2000) has two drawbacks. First, when examining the impact of innovation on employment growth, the endogeneity between these two variables, i.e. the cause-effect problem (Greene 2000) has not been taken into account. Moreover, the study does not explain *why* women are less likely to develop or implement innovations than men.

[4] It should be noted that the examination of *vertical segregation* is beyond the scope of this study.

[5] An examination of the *causes of gender-based occupational segregation* is beyond the scope of this paper. Briefly, the analysis of segregation within lines of work pursued by women and men reveals the relevance of supply- and demand-side factors. By *supply-side factors*, research highlights the determinants of the decisions of labor suppliers, pointing to the overall importance of women's and men's tastes, abilities, sex role socialization and the division of labor in the home between women and men for their later distributions over different occupations. By *demand-side factors*, research covers the determinants of labor-demanders (employers), emphasizing e.g. factors such as employer's discrimination on the basis of gender, when employers reserve some jobs for men and other for women. In sum, it is argued that women are either pushed or pulled into a narrow range of occupations, although the causes of this "crowding" out are still debated (Bielby and Baron 1991:760). For an excellent and detailed overview over theories on this topic see e.g. Jonung (1996), Preston (1999) or Anker (1997).

Ulbrich and Leicht (2002:50-51) is that integrated and men-dominated occupations in Germany are more favorable for the entry into self-employment than women-dominated occupations. By the same token, Israeli_women employees' likelihood of entering self-employment is significantly higher if they perform in integrated and male-dominated occupations (Kraus 2003). A cross-national analysis of 14 European countries by Strohmeyer and Tonoyan (2005) finds that that the authority and power gaps between women and men employees (*vertical occupational sex segregation*), with women being over-represented in lower-status hierarchical positions in wage-and-salaried work and under-represented in managerial or supervisory positions, are responsible for the gender-gap in the perceived difficulty of becoming self-employed.[6] Equally, women employees perceive entering self-employment as significantly more difficult than men because they operate in highly segregated female-typed occupations such as clerical and assistant jobs (*horizontal sex segregation*), which apparently do not provide them with sufficient business and management related know-how as well as financial and social capital needed for the transition from dependent employment into self-employment.

However, to our knowledge, virtually no studies exist which have explicitly analyzed *the impact of gender-specific occupational segregation in self-employment on the performance of women-owned businesses.* An important question in this context is whether and in which way the gender-specific occupational sex segregation in self-employment affects the performance and the success of women-owned businesses, and more specifically, the innovative behavior of women entrepreneurs. Before answering this question, another question has to be clarified, i.e. to what extent can the above described pattern of gender-specific occupational segregation in dependent employment be found in self-employment? In other words, is the tendency that women in dependent employment are typically enrolled in "sex-typical occupations" also true for self-employment (Kraus 2003:7)?

Confirming the results obtained by Hakim (1998), a German (Lauxen-Ulbrich and Leicht 2002: 49-53) and an Israeli (Kraus 2003:6-7) study show that, on the one hand, the scope of occupational sex segregation in self-employment is not as extensive as in dependent employment.[7] However, the most common occupations for self-employed women still refer to jobs that *are person- and service-oriented* and are performed either in female-dominated (typically "female jobs" include nurses, sales-persons, barbers, beauticians, managers of kindergartens etc.) or integrated occupations (lawyers, consultants, economists etc.). Instead, only a very small proportion of the self-employed women (e.g. in Germany every fifth female self-employed, in Israel every tenth female self-employed) perform in male-dominated occupations that mainly refer to production, manufacturing and technical jobs, which in turn impart specific know-how (e.g. technical skills, production know-how) required for the development or implementation of innovations (product, process or organizational). Summing up, the major proportion of self-employed women is thus located in occupations which are less technical or technology oriented and subsequently are not able to provide women with favorable conditions for the development or implementation of process and product innovations. This argumentation leads us to conclude that

Hypothesis 3: *Women business owners will be less committed to innovations than men business owners because women predominantly operate in occupations which are less production and above all less technical or technology-oriented.*

[6] More specifically, when asked how difficult it would be to become self-employed, women employees across 14 Western European economies tend to perceive entering self-employment as significantly more difficult than men. Studies by Tonoyan Strohmeyer & Leicht (2007), Strohmeyer and Tonoyan (2005) as well as Tonoyan, Strohmeyer & Wittmann (2005) reveal that the gender gap in entrepreneurship originates before deciding to enter into self-employment and even before becoming a nascent entrepreneur. Rather, it becomes salient in the individual's *perception of the difficulty of becoming self-employed*, the latter construct largely overlapping with Ajzen's concept of "perceived behavioral control" (Ajzen 1991) and Bandura's concept of "perceived self-efficacy (Bandura 1977)".

[7] On the one hand, roughly three quarter (73%) of all German women employees but only one quarter (31%) of women entrepreneurs perform in female-dominated occupations. On the other hand, the rate of women's entrepreneurship is much higher (46,5% and 22,1%, respectively) relative to the rate of women employment (17,5% and 9,4% respectively) in integrated and men-dominated occupations (Lauxen-Ulbrich and Leicht 2002: 50). Equally, in Israel while almost two third of women employee work in female-dominated occupations (63.7%), the majority of self-employed women work in mixed-occupations (55.1 % compared to 27.9% of female employees). Only 30.4 of self-employed women operate in female-dominated occupations (Kraus 2003:7). A much higher percentage among the self-employed (14.5%) are enrolled in male-dominated occupations than among the employees (8.4 %) (ibid.). Despite a similarity in this finding, one has to keep in mind that the definitions of female-, mixed-, and male-typed occupations differ slightly between these two studies. For example, while female-dominated occupations are considered as those with more than 58 percent of women in the study by Lauxen-Ulbrich and Leicht (2002:50), they are referred to those with more than 70 percent in the study by Kraus (2003:7).

3.2 Sex Segregation in Fields of Study and Vocational Training

Furthermore, *gender-specific segregation in the fields of study* as well as *in vocational or apprenticeship training* may also affect women and men firm owner's commitment to innovations. A unique German evidence states that the gender-specific differences in the self-employment ratios, a phenomenon related to the "gender gap" in self-employment, can be seen as a structural result of the German educational system (Strohmeyer 2003). It has been shown that *women's choices of fields of study* differ considerably from those of men in Germany, which later result in women's lower self-employment rates. More specifically, using German Micro Census Data from 1991 to 2000, Strohmeyer (2003, 2004) demonstrates that *typically female fields of study include education and humanities*, while typically *male fields of study refer to natural sciences and business administration*. More precisely, while virtually every third woman (33%) in Germany studies education and each tenth woman (10%) chooses humanities as her major, only each tenth man (10%) and each 20tenth man (5%) majors in education and humanities, respectively (ibid: 10-11). Quite the contrary, women are disproportionately underrepresented in natural sciences, engineering and business administration. The proportion of men who major in natural sciences (42 %) is three times higher than that of women (14%). Most interestingly, the likelihood that a female university graduate becomes self-employed depends crucially on her choice of the field of study, a result which is robust after controlling for other determinants of the entry into self-employment. This becomes also evident when looking at the basic descriptive statistics: While 36% of the medical students later set up their own businesses, only 4.7% of the students who major in education enter later self-employment (ibid:15). This result has been supported by the idea that *"the subject of study provides individuals with specific resources, economic, communicative, and technical know-how, which are strongly related to the individual's positions in the labor market and the entry into self-employment (ibid: 9)."*

Applying Strohmeyer's findings on the gendered differences in the fields of study to the firm owner's innovative behavior, a further hypothesis can be put forward that the gender-specific choices of fields of study may result in women's lower commitment to innovations. More specifically, the idea that fields of study such as humanities and education do not impart know-how and skills needed for the development and the implementation of process and product innovations seems quite plausible. In contrast, men's higher commitment to innovations may be (at least) partially explained by the stock and the specificity of their human capital, which is gathered in majors strongly related to innovations, such as natural sciences and business administration.

Hypothesis 4: *Women business owners will be less committed to innovations than men business owners because women choose fields of study (such as humanities or education) which do not impart them the knowledge and know-how necessary for the development and the implementation of innovations. Quite the contrary, men's choice of fields of study (such as natural sciences, engineering and business administration) increases the likelihood of becoming engaged in the development or implementation of innovations.*

Furthermore, it could be supposed that the gendered differences in *vocational or apprenticeship training* may impact women's and men's inclination to innovation differently. However, an important question is how the choice of vocational training, which takes place in the early years of women's and men's entry into career, with 15-18 year old girls and boys choosing fields of study, vocational or apprenticeship training, may impact their behavior as firm owners about twenty years later.

Research on the gendered differences in the choice of fields of study and apprenticeship in Germany and their consequences for women's entrepreneurship is scarce. However, a recent study by Strohmeyer (2005:39-41), which uses the BIBB/IAB survey (1998/1999) as the database, indicates that the majority of the self-employed women in Germany have been trained in either female-typed *service-* and *arts-oriented occupations* ("persönliche und künstlerische Berufe") (27%) or *commercially oriented occupations* ("kaufmännische Berufe") (45%). That is, women most likely become trained in service- and person-oriented occupations, which are less production- and technology-oriented.[8]

[8] For example, service- and arts-oriented occupations include 10% of self-employed women who have been trained in health-oriented occupations ("Gesundheitsberufe"), 9 % of self-employed women trained for as barbers (Friseure), 5% trained for as guests supervisors and personal service providers ("Gästebetreuung, persönliche Dienstleistungen"), 2% of women trained in educational occupations ("pädagogische, erzieherische Berufe") as well as (1%) of women trained in arts ("Gestalterische, künstlerische Berufe"). Furthermore, 19% out of 45% of all self-employed women have been trained in commercially-

What occupations do men become trained for? A retrospective analysis by Strohmeyer (2005) shows that the major part of self-employed men in Germany (61%) have been trained in *production and industrial occupations* ("gewerbliche Berufe"), among them 15% in construction ("Bauberufe"), 15% in industrial occupations and locksmith ("Metallberufe, Schlosser"), 11% in mechanical ("Mechaniker"), 10% in electrical occupations ("Elektriker"), 7% in agricultural ("Agrarberufe") and food occupations ("Ernährungsberufe") etc.[9]

Summing up, in contrast to men, who become trained in production and industrial occupations, women typically choose female-dominated service-oriented training fields which are less associated with production and which, most importantly, do not necessarily impart know-how and skills with regard to the development and implementation of technology as well as innovations in the later stages of labor market participation. This argument brings about our next hypothesis which is as follows:

Hypothesis 5: *Women business owners will be less committed to innovations than men business owners because women (in their earlier stages of life) become trained in occupations which are less production and technology oriented, and which, consequently, do not impart know-how and skills needed for the development and the implementation of innovations in the later stages of their participation in the labor market.*

4 Control Variables

Firm Size. There is consistent evidence that employment growth is conversely related to firm size, i.e. small firms are more likely to grow than large ones (Heshmati, 2001, Lessat and Woywode 2001). However, small firms with more than 10 employees grow faster than micro-firms with less than 10 employees. The most prevalent explanation for this finding rests on the lacking potential of micro firms to mobilize resources such as human and financial capital needed for employment growth. It is also a stylized fact that companies led by women start with a smaller size than those led by men (Jungbauer and Gans 1992, Brüderl and Preisendörfer 1996).

Firm Age. Younger firms are more likely to achieve significant growth than older firms. This may partly reflect the need of younger firms to achieve minimum efficient scale (MES). Once the MES is achieved, businesses may grow less rapidly because the owner might have no motivation to continue to grow. It can also be traced back to the diseconomies that emerge from the need to employ and manage others (Storey 1994).

Firm Industry. Firm industry has been acknowledged as a central determinant of employment growth (Davidsson et al. 2002). The fact that only a low proportion of women is concentrated in rewarding and growth-oriented sectors, such as professional practice and highly technological branches (Lessat and Woywode 2001), may explain their lower growth. Instead, the bulk of studies have shown that women rather operate in relatively unrewarding, i.e. highly female-typed fields, such as retail sales as well as personal and educational service industries (Kalleberg and Leicht 1991, Lohmann and Luber 2000, Lauxen-Ulbrich and Leicht 2002).

Human Capital. The business owner's human capital, i.e. his or her educational attainment as well as the specific managerial and financial skills are considered as "productive resources" that are highly likely to affect firm employment growth (Penrose 1959, Cooper et al. 1994, Bruederl and Preisendörfer 2000). Many studies have shown that women business owners' educational attainment is (at least) as good as that of men business owners. On the other hand, research demonstrates that women are less likely to have specific managerial and financial skills and thus less likely to grow (Brush and Hisrich 1988).

Time Input. Empirical evidence indicates that time input differs significantly between female and male business owners. Research from the U.S., UK and Germany indicates that women are significantly less likely to invest as

oriented occupations which account for office and administration ("Büro- und Verwaltungsfachkräfte"), 13% in commercial occupations ("kaufmännische Berufe") and 9% as salespersons ("Verkäuferinnen").

[9] This finding largely overlaps with the governmental statistics on the distribution of girls and boys across occupations trained for displayed in "The Report on Vocational Training 2003" by the Federal Ministry for Education and Research (Bundesministerium für Bildung und Forschung, BMBF) (see pp. 106-108).

much work- and over-time in their businesses as men because of the reconciliation of family and work responsibilities (Brush 1992, Hakim 1997, Brüderl & Preisendörfer 2000, Lohmann 2001, Strohmeyer and Lauxen-Ulbrich 2003).

5 Data, Variables and Methods

The database is the BIBB/IAB cross-sectional survey data (1998/1999) on "Acquisition and Application of Occupational Qualifications" which has been collected by the Federal Institute for Vocational Training in collaboration with the Institute for Employment Research. The sample analyzed in this paper includes 2900 self-employed persons, among them 962 self-employed women and 1945 self-employed men.

Firm owners were asked retrospectively about the changes in their business performance and business patterns during the last two years before the survey was conducted. Business and personal characteristics refer to the year when the survey was conducted. The questions on the changes in employment level and the implementation or development of innovations were asked in such a way as to provide answers in a discrete form. In the questionnaire, the corresponding question for "*employment growth*" was as follows: "Please tell me whether or not there was an employment growth in your firm during the last two years." The question concerning *"process innovation"* was as follows: "Please tell me whether or not there was an implementation or development of new production techniques, machines, materials or new computer programs in your firm during the last two years." Finally, the question concerning *"product innovation"* was as follows: "Please tell me whether or not there was an implementation or development of significantly improved products or new services in your firm during the last two years."

An *"innovation index"* has been computed in an "additive" way so that it subsumes three types of innovative behavior. The index runs from the lowest value 0 to the highest value 2. Value "0" implies that neither a product nor a process innovation was developed or introduced in the last two years. Value "1" implies that the firm has developed or introduced either a product or a process innovation during the last two years. Value "2" implies that the firm has introduced both kinds of innovations (i.e. process and product) during the last two years.

Current occupations were classified using a 3-digit occupational classification (NAMEN). Totally, 5 groups of occupations have been utilized. The first group refers to "highly female-dominated occupations" which are comprised of 80-100% women. The second group refers to "slightly female-dominated occupations" which are comprised of 60-80% women. The third group refers to "mixed or integrated occupations" which are comprised of 40-60% women. The fourth group refers to "slightly men-dominated occupations" which are comprised of 29-40% women. Finally, the fifth group refers to "highly men-dominated occupations" which are comprised of 0-20% women.

Occupations trained for, which include both fields of study and apprenticeship training, are classified according to the same scheme applied for the classification of the current occupations (see above). Only those persons which have either graduated from a high school or have done a vocational training have been included in the classification of occupations trained for. The basis of the classification for academics is the field of study. The basis of the classification for non-academics is the type of vocational training.

Industrial sex segregation, which refers to the gender-specific distribution over industries, is utilized according to the same principle that was applied for the classification of current occupations (see above). Totally, four types of industries are utilized, namely industries with 80-100% of women (first), industries with 50-75% of women (second), industries with 25-50% of women (third), and, finally, industries with 0-25% of women (fourth).

In the first step, a descriptive analysis of the gendered differences in the firm owner's commitment to innovations is performed (Figure 1). Additionally, basic descriptive statistics on the firm and the firm owner's characteristics such as firm size, firm industry, firm age, the owner's human capital endowments and working time input are calculated (Table 1). In the second step, a bivariate probit estimation on employment growth is employed, a statistical tool which controls for endogeneity, i.e. a cause-effect problem between employment growth and innovations (Table 2). In the third and the final step, probit regressions on the determinants of product and process innovations in women- and men-owned small ventures in Germany are estimated (Table 3 and Table 4).

Table 3 subsumes the results of 2 probit regressions on process innovation (Model 4) and product innovation (Model 6), respectively, with *current occupations* controlled for as main determinants of the "female-male innovation gap". Additionally, firm and firm owner's characteristics, which refer to firm industry, firm size and the owner's time input, are introduced into the regressions as control variables. To find out whether the predictors included into the regression explain the gendered differences in the firm owner's commitment to innovations, the gender dummy is included into the regression separately (Model 3 und Model 5). If the gender dummy becomes insignificant, the conclusion is made that the independent variables introduced into the regression could explain the gendered differences in the firm owner's commitment to innovations.

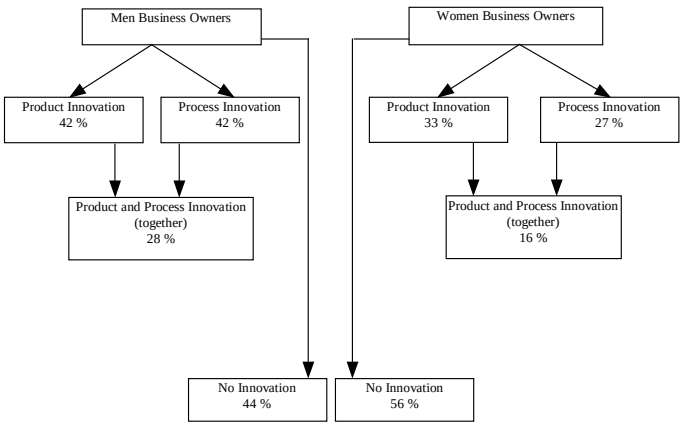
Table 4 subsumes the results of two probit regressions on process and product innovations, with *occupations trained for (i.e. field of study and apprenticeship training)* adjusted for as main predictors of the firm owner's commitment to process and product innovations in models 8 and 10. Besides, firm and firm owner's characteristics, which refer to firm industry, firm size and the owner's time input, are introduced into the regressions models as control variables. To find out whether the predictors included into the regression have explained gendered differences in the firm owner's commitment to innovations, the gender dummy is included into the regression separately (Model 7 and Model 9). If the gender dummy "disappears", the conclusion is made that the independent variables introduced into the regression models were able to explain the gendered differences in the firm owner's commitment to innovations.

6 Empirical Findings

6.1 Descriptive Results

Looking at Figure 1, it becomes clear that the likelihood for women to perform product, process, or product and process innovations (jointly) is significantly lower than that for men. More specifically, the likelihood of the implementation or development of process innovations in men-owned firms is almost twice as high as in women-owned firms (42% vs. 27%). Differences between female- and male-owned businesses in terms of product innovation are somewhat low, but still significant at a 1% level (33% vs. 42%). Last but not least, product and process innovations (jointly) were introduced in 28% of the men-owned, but only in 16% of the women-owned businesses in Germany.

Figure 1: Implementation of Product and Process Innovations in Women- and Men-Owned Firms Within the Last Two Years*



Source: BIBB/IAB Survey 1998/1999; Own Calculations
*All t-tests for gender differences are statistically significant ($p < 0.01$). The corresponding t-values are -5.1 for product innovation, -9.0 for process innovation, and -8.2 for product and process innovation (jointly)

The descriptive statistics for the variables and indices of interest are displayed in Table 1. Employment growth occurs significantly less frequently in female-owned businesses than in male-owned businesses. More specifically, it has taken place in 17.5% of the women-owned firms, which is significantly lower compared to employment growth that has taken place in 22% of the men-owned firms in Germany. Another descriptive finding is that women own younger firms, a finding that reflects the catching up process of women entrepreneurs during the last decades (see Table 1).

Table 1: Descriptive Resulsts on the Characteristics of Women- and Men-Owned Small Firms

	Mean		Difference-Tests*
	Women	Men	
Dependent Variables			
Employment growth (dummy: yes=1)	0.175	0.219	-3.04***
Innovation index (continuous: 0 – 2)	0.597	0.844	-8.43***
Process innovation (dummy: yes=1)	0.269	0.424	-8.97***
Product innovation (dummy: yes=1)	0.329	0.420	-5.07***
Independent Variables			
Business Characteristics			
Number of employees:			Chi^2 42.14***
1 - 2 employees	0.650	0.520	
3 - 4 employees	0.165	0.209	
5 - 9 employees	0.107	0.158	
10 - 49 employees	0.055	0.089	
> 50 employees	0.024	0.024	
Branches with rates of females of			Chi^2 465.34***
75% - 100%	0.125	0.024	
50% - 75%	0.459	0.227	
25% - 50%	0.309	0.340	
0% - 25%	0.107	0.408	
Firm age (continuous: in years)	10.30	12.30	-5.61***
Human Capital			
University degree (dummy: yes=1)	0.241	0.244	-0.16
Management knowledge(dummy: yes=1)	0.290	0.366	-4.36***
Knowledge of financing (dummy: yes=1)	0.290	0.337	-2.73***
Working hours per week (in hours)	41.62	52.87	-16.91***
Occupational Segregation			
Current occupation with rates of females of			Chi^2 875.63***
80% - 100%	0.180	0.008	
60% - 80%	0.158	0.039	
40% - 60%	0.282	0.142	
20% - 40%	0.287	0.299	
0% - 20%	0.093	0.513	
Occupations trained for with rates of females of			Chi^2 1037.35***
80% - 100%	0.356	0.029	
60% - 80%	0.233	0.096	
40% - 60%	0.209	0.152	
20% - 40%	0.163	0.231	
0% - 20%	0.038	0.492	
Instrument Variables (IV)			
Research and development (dummy: yes=1)	0.150	0.247	-6.79***
Trying new things (continuous: 1 to 5)	2.866	3.050	-4.76***
Number of observations	2207	1075	

Source: BIBB/IAB Survey 1998/1999; Own Calculations

* For continuous and dummy variables a t-test is performed, for multinomial variables a chi-square test is performed

Although women are almost as likely to have a *university degree* as men (24.1% vs. 25.3%), other aspects of their human capital endowments, such as *managerial and financial skills*, tend to be significantly lower. 29% of the female vs. 37% of the male business owners have management know-how. The picture is not reversed when looking at the financial skills: 34% of men, but only 29% of women (self-asses to) have profound financial skills. Eventually, *time input* differs markedly between female- and male-business owners because women invest almost 11 weekly working hours less than men do (41.62 hours vs. 52.87 hours) (see Table 1).

6.2 Bivariate Probit Estimation of Employment Growth and Firm Innovativeness (Controlling for Endogeneity)

As pointed out above, a major pitfall that may significantly distort our results is the problem of *endogeneity*, i.e. the reverse causality between employment growth and innovation. A legitimate criticism is that it is not the innovation that causes the firm growth, but growth itself that leads to the implementation and development of new products, technologies or organizational modifications. To control for endogeneity, a *bivariate probit model* (Greene 2000) is employed (see Table 2), which simultaneously estimates factors underlying employment growth, on the one hand, and the interdependence between innovation and employment growth, on the other. The owner's commitment to "R&D" as well as his or her inclination to "try new things" are employed as instrumental variables (IV) because they highly correlate with the innovation index, but not with employment growth.

Table 2: Bivariate Probit Estimation of Employment Growth

	Model 1	Model 2
		Employment Growth
Gender	0.154	-0.031
	(2.72)**	(0.44)
Innovation (index)		0.251
		(3.83)**
Firm size		
3 - 4 employees		0.950
		(11.48)**
5 - 9 employees		1.513
		(17.22)**
10 - 49 employees		1.670
		(15.91)**
> 50 employees		1.539
		(9.27)**
Branches with rates of females of ...		
50 - 75%		0.307
		(1.52)
25 - 50%		0.421
		(2.07)*
0 - 25%		0.330
		(1.63)
Firm age		-0.027
		(6.30)**
College degree		-0.013
		(0.18)
Management skills		0.183
		(2.66)**
Financial skills		0.154
		(2.22)*
Working hours per week		0.006
		(3.18)**
Constant	-1.010	-2.354
	(21.34)**	(10.07)**
		Innovation Activity (Instruments)
R&D		0.270

		(12.33)**
Trying new things		0.360
		(5.96)**
Constant		-0.849
		(12.65)**
Observations	3024	3024

Source: BIBB/IAB Survey 1998/1999; Own Calculations
Robust z-statistics in parentheses, * significant at 5%; ** significant at 1%
Reference categories: sectors with 75%-100% women, firm size with 0-2 employees

Looking at the highly significant value of the gender dummy in Model 1, it becomes clear that women-owned businesses are significantly less likely to grow than men-owned businesses. Introducing the index for innovation as well as other explanatory variables into Model 2, it becomes evident that the firm owner's commitment to innovations, i.e. the issue whether the firm implements or develops product innovation, process innovation or product and process innovations (jointly), is strongly positively linked to employment growth. This clearly confirms hypothesis 1 that states that more innovative firms are more likely to grow than less innovative firms. Most importantly, when controlling for innovation, the gender dummy becomes insignificant in model 2, which implies that women-owned businesses are less likely to grow than men-owned businesses because the former are less likely to introduce or implement product innovation, process innovation as well as both product and process innovations. The "female-male innovation gap" is thus responsible for the lower employment growth in women-owned businesses. This is a clear support for hypothesis 2.

Furthermore, slightly men-dominated sectors with 25-50% of women favor employment growth. Firm age is negatively related to employment growth implying that younger firms grow faster. Firms with 4-9 employees are more likely to grow than those with 1-2 employees.

Additionally, no correlation is found between university education and employment growth. However, employment growth is strongly positively linked to the owner's managerial and financial skills. Besides, the likelihood that a small venture grows depends on the firm owner's time input: The higher the owner's time input, the higher the likelihood that the firm will grow. Because women business owners invest considerably less time than men, their firms are significantly less likely to grow than those owned by men.

However, up to this point, the "female-male innovation" gap, i.e. the question *why* women are significantly less likely to engage in innovation than men remains unexplained. To answer this question, i.e. to utilize the determinants which are responsible for the gender-gap in process and product innovations, several probit estimations are employed. The results of the corresponding regressions are displayed in Table 3 and Table 4.

6.3 Probit Regressions of Firm Owner's Commitment to Innovations: Current Occupations as Determinants of Female-Male Innovation Gap

6.3.1 Process Innovation

Introducing the gender dummy into Model 3 (b-coeff.= 0.424), significant gendered differences can be observed in the firm owner's commitment to process innovations (Table 3). More exactly, women firm owners are significantly less likely to develop or implement process innovations than men. What factors are responsible for this outcome? To answer this question, current occupations and control variables (firm industry, firm size, owner's working time input) are introduced as explanatory factors into Model 4. Comparing the value of the gender dummy in Model 4, which is insignificant (b-coeff.=0.096), it becomes clear that the variables introduced into regression model 4 were able to explain female-male differences in process innovations. It clearly shows that the gender-gap in process innovation goes partly back to *occupational sex segregation*, as supposed in hypothesis 3. More specifically, process innovations are highly likely to be developed or implemented in both *highly men-dominated occupations*, i.e. those with 0-20% of women, and *slightly men-dominated occupations*, i.e. those with 20-40% of women. However, integrated (with 40-60% of women), slightly female-dominated (with 60-80% of women) and highly female-dominated occupations (more than 80% of women) seem to be "pitfalls" for innovations. In other words, these occupations tend to provide worse conditions for the development or implementation of process innovation.

The same is true for *industrial sex segregation.* Men-dominated industries are more supportive for the development of process innovations than women-dominated industries. Especially, those men-dominated industries, where the percentage of women does not exceed 50%, tend to implement process innovations as significantly more frequently than typical women-dominated industries.

Furthermore, *firm size* is also an important determinant of process innovation. The higher the number of employees is, the higher the likelihood that process innovations will be implemented. Since women tend to own smaller firms, they are less likely to implement process innovations. Last but not least, the *owner's time input* is also positively associated with the likelihood of the development of process innovations. Because women tend to invest significantly less time in their businesses than men, they are significantly less likely to develop process innovations.

6.3.2 Product Innovation

When introducing the gender dummy into Model 5 (b-coeff.= 0.240), significant gendered differences can be observed in the firm owner's commitment to product innovations (Table 3). Again, women firm owners are significantly less likely to develop or implement product innovations than men. Moreover, as discovered in the descriptive statistics, it becomes apparent that the gendered differences in the owner's commitment to product innovations are somewhat lower than those in process innovations: The b-coefficient for product innovation is much lower than the b-coefficient for process innovation (0.240 vs. 0.424).

However, why are women less likely to implement product innovations than men? Looking at Model 6, which indicates an insignificant value of the gender dummy (b-coeff. = 0.089), it becomes clear that the gendered differences in product innovations could be explained by the explanatory factors controlled for in this model. Summing up, there is a lot of similarity between the explanatory factors responsible for women's lower commitment to product and process innovations. Above all, this is the case for the *gender-specific segregation in current occupations*. This means that self-employed women, who operate in highly female-dominated (with 80-100% of women) and integrated occupations (with 40-60% of women), tend to implement product innovations much less often than their counterparts performing both in highly male-dominated (with 0-20% of women) and slightly male-dominated occupations (with 20-40% of women). This clearly supports hypothesis 3. Surprisingly, and in contrast to process innovations, self-employed women who operate in slightly women-dominated occupations (with 60-80% of women) are slightly more likely to implement product innovations than their counterparts operating in highly women-dominated occupational fields.

In contrast to process innovation, *industrial sex segregation* has only minor effects on the female-male gap in product innovations since only a small effect of mixed industries (with 25-50% of women) is observable in Model 6. The latter implies that self-employed women operating in mixed industries are slightly less likely to develop or implement product innovations than self-employed women operating in highly female-segregated branches, a phenomenon which cannot be explained in this study and needs to be explored in the future research.

In the end, the "women-men gap" in product innovation is due to the fact that women run *smaller ventures* and tend to invest *significantly less time* in their businesses than men.

Table 3: Probit Estimation of Process and Product Innovation
(With Focus on Current Occupations)

	Model 3	Model 4	Model 5	Model 6
Dependent Variable	Process Innovation		Product Innovation	
Gender	0.424	0.096	0.240	0.089
	(8.58)**	(1.55)	(4.98)**	(1.49)
Occupations of the self-employed with rates of females of				
60% - 80%		0.137		0.332
		(0.99)		(2.57)*
40% - 60%		0.062		0.108
		(0.49)		(0.90)
20% - 40%		0.408		0.388
		(3.34)**		(3.29)**
0% - 20%		0.438		0.324
		(3.37)**		(2.59)**
Branches with rates of females of ...				

females of ...				
50% - 75%		0.112		-0.191
		(0.92)		(1.73)
25% - 50%		0.441		-0.233
		(3.60)**		(2.06)*
0% - 25%		0.366		-0.177
		(2.85)**		(1.48)
Firm size				
3 - 4 employees		0.174		0.091
		(2.81)**		(1.49)
5 - 9 employees		0.482		0.224
		(6.99)**		(3.30)**
10 - 49 employees		0.723		0.331
		(8.13)**		(3.84)**
> 50 employees		0.750		0.404
		(4.86)**		(2.73)**
Working hours		0.004		0.006
		(2.72)**		(3.97)**
Constant	-0.615	-1.382	-0.441	-0.807
	(14.84)**	(9.36)**	(11.01)**	(6.21)**
Observations	3250	3164	3243	3157

Source: BIBB/IAB Survey 1998/1999; Own Calculations
Robust z-statistics in parentheses, * significant at 5%; ** significant at 1%
Reference categories: occupations with 80%-100% women, sectors with 75%-100% women, firm size with 0-2 employees

6.4 Probit Regressions of Firm Owner's Commitment to Innovations: Occupations Trained for as Determinants of the Female-Male Innovation Gap

While in previous regressions (Table 3, Models 3-6), we were interested in finding out the effects of current occupations on the gendered differences in innovative behavior, we will now focus on the impact of *occupations trained for*, which include *fields of study* and *apprenticeship training*, on the gendered differences in firm owner's commitment to innovations (Table 4, Models 7-10). Put another way: We want to find out whether and to what extent gender-based segregation in occupations trained for, which takes place mostly at the beginning of women's and men's career, influences women's and men's behavior as firm owners in the later stages of their career.

A comparison of the values of the gender dummies in Model 7 and Model 8 shows that the gender gap in ***process innovations*** could be explained with the explanatory variables controlled for (Table 4). More precisely, occupations trained for have highly significant effects on the owner's commitment to process innovations. Our results reveal that the occupations trained for that impede women's commitment to innovations most are the *highly female-dominated ones*, i.e. those consisting of 80-100% of women. In contrast to highly female-dominated fields of study and apprenticeship training, all remaining occupations trained for, i.e. slightly women-dominated (with 60-80% of women), mixed (with 40-60% of women) as well as both slightly (with 20-40% of women) and highly men-dominated (with 0-20% of women) ones show a positive and a highly significant effect on the probability of the implementation of process innovations.

Table 4: Probit Estimation of Process and Product Innovation
(With Focus on Fields of Study and Apprenticeship)

	Model 7	Model 8	Model 9	Model 10
Dependent Variable	Process Innovation		Product Innovation	
Gender	0.433	0.081	0.228	0.114
	(8.45)**	(1.20)	(4.55)**	(1.73)
Occupations trained for with rates of females of				
60% - 80%		0.314		0.106
		(2.99)**		(1.09)
40% - 60%		0.571		0.299
		(5.50)**		(3.08)**
20% - 40%		0.316		0.026

		(3.04)**		(0.27)
0% - 20%		0.462		0.120
		(4.40)**		(1.22)
Branches with rates of females of ...				
50% - 75%		0.050		-0.189
		(0.40)		(1.70)
25% - 50%		0.431		-0.203
		(3.45)**		(1.78)
0% - 25%		0.402		-0.122
		(3.14)**		(1.04)
Firm size				
3 - 4 employees		0.207		0.115
		(3.20)**		(1.81)
5 - 9 employees		0.508		0.262
		(7.16)**		(3.76)**
10 - 49 employees		0.740		0.350
		(8.04)**		(3.94)**
> 50 employees		0.794		0.442
		(4.91)**		(2.87)**
Working hours		0.005		0.006
		(3.29)**		(4.02)**
Constant	-0.592	-1.454	-0.405	-0.680
	(13.74)**	(11.33)**	(9.72)**	(5.81)**
Observations	2955	2955	2948	2948

Source: BIBB/IAB Survey 1998/1999; Own Calculations
Robust z-statistics in parentheses, * significant at 5%; ** significant at 1%
Reference categories: occupations with 80%-100% women, sectors with 75%-100% women, firm size with 0-2 employees

The relationship between occupations trained for and the likelihood of the implementation of ***product innovation*** (Model 10) is different from the relationship between current occupations and product innovation observed in Model 6 in one respect. While slightly and highly men-dominated types of current occupations favor the implementation of product innovation most, occupations trained for that encourage the implementation of product innovation most are the mixed ones with 40-60 percentage of women.[10]

6.5 Results from Blinder-Oaxaca Decomposition

Blinder (1973) and Oaxaca (1973) decomposition is employed to explain the extent to which the "female-male innovation gap" can be decomposed into two parts, namely one part which is driven by the differences in the so-called "*endowments*" (Blinder 1973, Oaxaca 1973) and the second part which is driven by the rest. Important questions to be answered are as follows. How large is the part of the difference between women and men business owners' firm innovativeness that can be explained by the differences in individual resources and characteristics - or, for short, "endowments", which are (first) occupations (current occupations as well as field of study and apprenticeship training), (second) industries, (third) working time and (fourth) firm size.

The standard Blinder-Oaxaca technique cannot be used for a dependent variable which has not a continuous scale measurement but is binary, i.e. when the regression coefficients are from a logit or probit model. Therefore, we employ a ***Fairlie extension to the Blinder-Oaxaca decomposition*** (Fairlie 2003).

Furthermore, two statistical modifications to the Blinder-Oaxaca decomposition are implemented in this study to address ***non-invariance problems*** of this methodology, as discussed in Newmark (1988), Cotton (1988), Oaxaca and Ransom (1994) as well as Oaxaca and Ransom (1999). First, since the results from the standard Blinder-Oaxaca (1973) decomposition models are sensitive to the choice of the reference category of the dependent variable, the so-called ***"pooled regression"*** (Neumark 1998, Oaxaca & Ransom 1994) is employed.

[10] The effects of the remaining explanatory variables (e.g. firm size and owner's time input) on product and process innovations are almost identical to those explained in the previous chapter. Therefore, no detailed descriptions of them will be given here.

Second, another non-invariance problem occurs in the standard Blinder-Oaxaca (1973) in the presence of independent variables with a categorical-scale measurement (in this study, these variables refer to current occupations; field of study and apprenticeship training; industries; and firm size). The standard Blinder-Oaxaca (1973) decomposition methodology produces arbitrary results when attempting to estimate the separate contributions of the dummy/categorical variable sets to the unexplained portion of the dependent variable which needs to be decomposed into the "endowments" and "unexplained" parts. The problem with this approach is that the estimates are not invariant with respect to the choice of the reference category of independent variables. To avoid this problem, the so-called ***"effects coding"*** (Cohen et al. 2003: 320-328) of independent categorial variables is used.

Table 5 and 6 lists out results from the non-linear Blinder-Oaxaca decomposition model. The analysis shows that an outstandingly high percentage of women and men business owners' innovativeness can be attributed to women's and men's differing endowments (this varies from 52% to 85%), namely differences in individual characteristics associated with "current occupations", "occupations trained for"(field of study and apprenticeship training), "industry", "part-time work" and "firm size".

Our models explain the female-male gap in the implementation and/or development of process innovations due to differing endowments (the corresponding figures are 85% for the model with "occupations trained for" and 81% for the model with "current occupations", respectively) better than the female-male gap in the implementation/development of product innovations (the respective figures are 52% and 65%).

Which factors explain the raw differential in women's and men's firm innovativeness most? First, ***horizontal occupational segregation*** in self-employment plays a crucial role. Highly segregated current occupations in self-employment explain 37% of the raw differential in female-male process innovations and 34% of the gender gap in female-male product innovations. Furthermore, women and men have differing endowments concerning occupations trained for (e.g. field of study for female and male academics). About 32% of the gap in the implementation of process innovations in women- and men-owned businesses can be attributed to women's and men's different choice of field of study. However, the contribution of this variable for explaining the gender gap in product innovativeness is somewhat low (10%). Second, ***industrial sex segregation*** is also important. However, our results show that the fact that women business owners operate in different industries than men business owners explains the female-male process innovation gap (19,7% and 25,8%). But, it is does *not* contribute to the understanding of the gender differences in the product innovativeness. Third, women and men business owners differ in their ***firm characteristics***, e.g. women tend to employ fewer workers than men. As our decomposition results suggest, firm size has implications for the business owner's innovative behavior. More specifically, between 12% and 15% of the difference in female and male firm innovativeness can be traced back to smaller firm sizes of women business owners. Fourth and finally, ***part-time work*** is a significant factor which is responsible for women business owners's lower innovativeness. Part-time work explains female-male differences in the development/implementation of "product innovations" (26% and 29%), but its contribution is somewhat lower for de-composing the gender-specific differences in the development/implementation of "process innovations" (11,6% and 9,5%).

Table 5: Blinder-Oaxaca Decomposition for Binary Choice Models*
(With Focus on Current Occupation)

		Process Innovation		Product Innovation
Total Results				
Male		0,428		0,419
Female		0,270		0,328
Difference		0,158		0,091
Total explained		0,128		0,059
Total explained in %		81,3		65,16
Detailed Results	Coef. (Std.Err)	Explained in %	Coef. (Std.Err.)	Explained in %
Current Occupation**	0,058	36,7	0,031	33,6
	(0,012)		(0,012)	
Industry**	0,031	19,7	-0,006	-6,6
	(0,008)		(0,009)	
Firm Size**	0,024	15,1	0,011	12,2
	(0,003)		(0,003)	
Working Hours	0,015	9,5	0,024	26,0
	(0,005)		(0,006)	
Total	0,128	81,1	0,059	65,3

* Pooled Regression
** Effects Coding

Table 6: Blinder-Oaxaca Decomposition for Binary Choice Models*
(With Focus on Field of Study and Apprenticeship Training)

		Process Innovation		Product Innovation
Total Results				
Male		0,440		0,428
Female		0,277		0,341
Difference		0,163		0,088
Total explained		0,139		0,046
Total explained in %		85,1		52,8
Detailed Results	Coef. (Std.Err)	Explained in %	Coef. (Std.Err.)	Explained in %
Occupation trained for **	0,052	31,6	0,009	10,0
	(0,013)		(0,015)	
Industry **	0,042	25,8	0,000	-0,2
	(0,008)		(0,009)	
Firm Size **	0,026	15,8	0,012	14,0
	(0,003)		(0,003)	
Working Hours	0,019	11,6	0,025	28,9
	(0,006)		(0,006)	
Total	0,138	84,8	0,046	52,7

* Pooled Regression
** Effects Coding

7 Conclusion and Discussion

The main purpose of this study was to examine the patterns and determinants of employment growth in women- and men-owned small ventures in Germany. More specifically, it has set out to explore the gendered differences in the level of employment growth between women- and men-owned businesses in Germany as well as the factors underlying them. The questions analyzed in this paper included the following: Are women-owned businesses less likely to grow than men-owned businesses? If so, what firm- and owner-specific characteristics and what strategic determinants are responsible for the gender gap in employment growth?

Examining the causes of lower employment growth in women-owned businesses, previous research has mainly focused either on firm-specific (firm age, firm size and firm industry) or person-specific characteristics (firm owner's level of human capital, his or her working experience etc.). In contrast to previous research, the main hypothesis of this study was that not only firm-and person-specific characteristics may cause gendered differences in employment growth, but also factors related to firm strategy. The *firm owner's commitment to innovations*, i.e. the degree to which he or she has implemented or developed product or process innovations (or both) was considered as a major strategic factor of firm growth in this study. More specifically, the idea has been put forward and tested empirically that women-owned businesses are less likely to grow because they are less likely to introduce or develop product and process innovations than men-owned businesses.

Our descriptive findings show that women-owned businesses are, indeed, less likely to grow than men-owned businesses. Most importantly, the former are also less likely to implement or develop product or process innovations as well as product and process innovations (jointly). That is, the *"female-male innovation gap"* becomes already apparent at the aggregated level. Moreover, women-owned firms are, on the average, younger and smaller. Besides, women owners often lack profound managerial and financial skills. Additionally, they tend to invest considerably less time in running and developing of their own businesses than their male counterparts.

Controlling for endogeneity, i.e. a cause-effect problem between employment growth and innovations, we find that innovation is strongly positively related to employment growth and thus can be considered as its robust explanatory factor. Moreover, the striking result of this study is that the lower employment growth in women-owned small ventures in Germany is due to the fact that women are significantly less likely to engage in the development or implementation of product or process innovations as well as product and process innovations (jointly) than men. Put another way, the "*female-male innovation gap"*, with women business owners being significantly less committed to innovations than men, results in lower employment growth in women-owned small businesses. This strongly supports the results of Brüderl and Preisendörfer (2000). Furthermore, employment growth is positively affected by the level of the owner's (self-assessed) managerial and financial skills. The better the owner's business-, and finance-related know-how is, the more likely is employment growth. Because women business owners' level of (self-assessed) managerial and financial skills is significantly lower than that of men business owners, their firms are less likely to grow. Additionally, employment growth is also positively associated with the firm owner's time input. The more hours are invested in the firm, the higher the likelihood for employment growth. In this regard, women-ownes small firms are less likely to grow since women invest considerably less time in their businesses than men do. Finally, younger and larger ventures (with more than 2 employees) are more likely to grow than older and micro-ventures (with 2 or less employees).

Having found that women's lower commitment to innovations results in lower employment growth of their firms, we were also interested in explaining the causes of the "female-male innovation gap", i.e. the issue *why* women are significantly less likely to develop or introduce product and process innovations than men. Two hypotheses have been put forward in this regard. Summing up, it has been suggested that apparent obstacles which deter women's commitment to innovations may lie in the structural character of their current occupations as well as fields of study and apprenticeship training, which they have choosen in the early stages of their career. First, women's lower commitment to innovations may be due to *occupational sex segregation*, with women performing in occupations which are less favorable for the development and implementation of innovations. Second, the gendered differences in the firm owner's commitment to innovations may also go back to the gender-specific differences in the *choice of fields of study* as well as *vocational training*.

Examining the determinants of the firm owner's commitment to innovations in probit regressions, the hypotheses mentioned above could largely be supported. It appeared, indeed, that the gender-gap in process and product innovations goes (partly) back to the gender-specific segregation in current occupations as well as choices of fields of study and apprenticeship.

First, process and product innovations are highly likely to be developed or implemented in both *highly men-dominated occupations*, i.e. those with 0-20% of women, and *slightly men-dominated occupations*, i.e. those with 20-40% of women. Quite the contrary, integrated (with 60-80% of women) and highly female-dominated occupations (with more than 80% of women) do not provide favorable conditions for the development or implementation of process and product innovations. An explanation for these phenomena is that typically women-dominated occupations such as nurses, sales-persons, barbers, beauticians, lawyers and consultants etc., are rather *person-and service-oriented* (Lauxen-Ulbrich and Leicht 2002, Kraus 2003), but less technically or technologically oriented.[11]

Second, gender-specific choices of fields of study and apprenticeship, with women typically choosing female majors such as education or humanities (Strohmeyer 2003, 2004), results in women's lower commitment to innovations. In brief, *fields of study and apprenticeship* that impede women's commitment to process innovations most are highly female-dominated ones (such as humanities and education), i.e. those consisting of 60-80% of women. Slightly women-dominated (with 60-80% of women), integrated (with 40-60% of women) as well as slightly (with 20-40% of women) and highly men-dominated (with 0-20% of women) occupations turned out to be positively and highly significantly related to process innovations. However, the picture is slightly reversed when looking at product innovations. Fields of study and apprenticeship that favor the owner's commitment to product innovations most are mixed or integrated ones. Summing up, men's higher commitment to innovations is partially explained by the stock and the specificity of their human capital, which is gathered in majors strongly related to innovations, such as natural sciences, engineering and business administration.

Important implications for policy and business consultants, aiming at supporting women business owners to catch up with their male counterparts in terms of firm success, can be drawn from this study. First, it becomes apparent that fostering employment growth in women-owned businesses needs to be closely related to supporting women's commitment to innovations. How can women entrepreneurs in Germany be encouraged to become engaged in the

[11] However, this may be one of explaining mechanisms of the relationship between "occupational sex segregation" and "female-male innovation gap". Further research is needed to better highlight the mechanisms underlying this relationship.

development or implementation of product and process innovations? As we have seen, the reason why women are significantly less likely to implement or develop product and process innovations is primarily due to women's structural embeddedness in occupations but not their personal characteristics. More exactly, the gender-specific segregation in current occupations as well as fields of study and apprenticeship training cause women's lower commitment to innovations. Creating business environments where women entrepreneurs grow as rapidly as men entrepreneurs thus presupposes helping and encouraging young girls and women to position themselves in occupations and fields of study (or apprenticeship training) that are not primarily women-dominated.

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