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Ines Pelger:

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Gender, Investment Financing and Credit Constraints

Ines Pelger^{*,†}

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- first draft -

Abstract

This paper provides the first evidence on gender differences in investment financing, credit application and credit denial rates in Germany. The empirical analysis is carried out on a sample of firms drawn from the KfW Mittelstandspanel, a representative survey of German SMEs for the period from 2003 to 2009. Our results suggest that in female-owned firms the share of internal capital in investment financing is higher and the share of external funds is lower than for male-owned firms. An analysis of the supply- and demand-side on the credit market shows that women are not more likely to be denied credit but the probability that they apply for credit is on average lower. Yet, this gender difference in the probability of credit application is only evident when considering firms with negative or neutral sales expectations. There is no significant gender difference in credit application rates of firms with positive sales expectations.

Keywords: Gender Economics, Female Entrepreneurship, Investment Financing

JEL classification: G 11, J 16, L 26

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1 Introduction

In Pelger (2011) we have found that female-owned firms invest less than male-owned firms. This holds for the probability of investing, the extensive margin of investment, as well as for the investment rate, the intensive margin. Furthermore, women's investments seem to react less to a marginal increase in cash flow, which can be interpreted as women being effected less by financial constraints. An analysis of stated investment goals reveals that women less often indicate growth oriented goals for their investment. Hence, women's lower propensity to invest is rather driven by preferences than by financial constraints. Certainly, proxying financial constraints by cash flow has its limits in providing insights on a firm's financial possibilities. Restricted access to financial resources is one of the main obstacles for investing, therefore it is highly relevant to gain direct evidence on firms' financing behavior. In this paper we revisit the issue of financial constraints and take a closer look at gender differences in investment financing, credit application and denial.

To the best of our knowledge we are the first to empirically analyze gender differences in the composition of firm investment financing, the credit application behavior and application outcome of German firm owners. As in Pelger (2011), we use the KfW Mittelstandspanel, a data set on German SMEs for the years 2003-2009.¹ We analyze both the supply side and demand side of access to bank loans and we are able to control for various firm and owner characteristics.

Most of the few previous studies have not found that female firm owners are affected more by financial constraints than male owners (e.g. Cavalluzzo et al. 2002). However, women seem to have different financing patterns. Already at start-up stage female-owned firms use less external debt and rely more on personal sources (Carter et al. 2007). Also women are less likely to seek external finance for follow-up investments (Coleman and Robb 2009, Sena et al. 2010). Muravyev et al. (2009) find that on average female firm owners have a higher proportion of retained earnings and a smaller share of bank financing. Robb and Robinson (2010) reveal that the average female-owned firm holds about 5% less debt than a comparable male-owned business.

Our analysis on gender differences in financing structure confirms previous evidence on financing patterns. We examine the respective shares of equity capital, external capital, business development capital and other funds in investment financing. We find that in financing their investments female firm owners rely more on internal capital and less on external funds than male firm owners, irrespective of the relative size of the investment. This difference in firm financing could be either a result of individual preferences on getting into debt or of gender discrimination on the capital market. In our empirical

¹See Pelger (2011) for a detailed description of the data set.

analysis we address both approaches. We analyze the demand side and the supply side on the credit market. More precisely, we examine the impact of the firm owner's gender on the probability of applying for credit and the probability of a non-successful outcome. We consider only investing firms. Our analysis of credit application behavior reveals that female firm owners who invest are significantly less likely to apply for credit than investing male firm owners. After splitting the sample according to positive and non-positive sales expectations we find that the gender difference in the probability of applying for credit is only evident among firm owners that have non-positive sales expectations. Female-owned firms with neutral or negative sales expectations are less likely to apply for credit when they invest compared to their male counterparts. For firms with positive expectations the probability of applying does not significantly differ between men and women.

An analysis of application denial rates shows that female-owned firms are not more likely to be denied credit. This result however suffers from sample selection bias, as it is likely that the female-owned firms that apply for credit represent a positive subsample of all applying firms. Potentially successful female applicants may be more reluctant to apply for credit because they fear and misconceive a rejection (Sena et al. 2010).

Our results suggest that differences in investment financing are not attributable to discrimination against women on the credit market. Despite this finding, women might still be more credit constrained because they are more likely to be discouraged from applying and therefore self-constrain themselves. This result is probably attributable to certain personal traits that are associated typically with being female. Previous studies have found that women are more risk-averse, less self-confident and report more intense nervousness and fear than men in anticipation of negative outcomes (Croson and Gneezy 2009). In anticipation of non-positive sales development, these traits may prevent women more from securing external funds or even from applying for credit. Several robustness checks underpin our results.

2 Investment financing

2.1 Theoretical and empirical background

Several theories have tried to explain the complex issue of firm financing and capital structure. The starting point was the model of Modigliani and Miller (1958) who state that under the assumption of perfect and frictionless capital markets a firm's financial decisions do not affect the firm's market value and the cost of capital. In contrast, later theories on capital structure account for the fact that in an imperfect world financial decisions may be influenced by taxes, information asymmetries and agency costs.

The most prominent two competing theories are the pecking order theory and the trade-off theory. The pecking order theory focuses on information asymmetries between managers and external investors. Managers and firm owners have better information about their firms and prefer to keep control over the firm. This leads to a hierarchical order of financial resources in a firm's policy according to the involved level of information costs and risk. The preferred source of financing are internal funds as they involve no information costs, low risk and highest control. The second most preferred source is debt, and the last alternative is new equity capital, which is associated with the highest information costs and risks (Myers 1984, Myers and Majluf 1984).

The trade-off theory in contrast refers to an optimal capital structure resulting from a profit-maximizing balance of tax advantages and bankruptcy costs of debt. The implications of this theory are, particularly for Germany, not that straightforward as governmental subsidies for firm investment are very complex and generate different firm-specific financing incentives. Yet, there is empirical work supporting both theories (Shyam-Sunder and Myers 1999, Cole 2011).

Traditional capital theories as well as most empirical studies focus on large, publicly traded firms and do not consider the influence of owner-characteristics on firm financing. However, there is evidence that both firm size and owner characteristics can have an influence on financing behavior.

López-Gracia and Sogorb-Mira (2008) show how small and medium sized enterprises (SMEs) differ from large firms in regards to financing. SMEs are affected more by information asymmetries and are usually not listed on the stock market. Therefore SMEs depend more on internal funds and their financing structure is less diversified. Female-owned firms are on average smaller than male-owned firms, therefore gender differences in capital structure could possibly also be attributed to size. Regarding owner-characteristics, Ang et al. (2010) demonstrate that individual socioeconomic and demographic factors of the firm owner (e.g. age, gender, education, wealth, experience etc.) can add to a better understanding of capital structure decisions. Individual preferences and risk tolerance of the owner have an important impact on the firm's capital structure if the personal financial situation is directly affected by the firm's outcome. Owners of small firms that are individually liable may opt for different financial decisions than owners of larger firms with limited liability. Typically, the smaller the firm the more financing decisions depend on the firm owner and his or her personal features.

Myers (2001, p. 99) points out that 'the theories (on capital structure) are not designed to be general' and that the understanding of firms' financing structures is still limited. There exists no universal theory as the topic of firm financing is too complex and diverse. Every firm has individual objectives and needs. Accordingly, we do not perform

a hypothesis test of a particular capital structure theory in our empirical analysis, as we do not expect any of the traditional theories to provide useful predictions. Instead, we opt for an explorative approach where we try to reveal the determinants of the composition of investment financing and particularly the correlation with gender. A firm's financing strategy is not self-determined but subject to external and internal constraints. In light of the findings discussed above we expect investment in female-owned firms to be financed by a higher share of internal funds than in male-owned firms.

2.2 Gender differences in financing patterns

Table 1 reports descriptive statistics on the composition of investment financing averaged over the years 2004-2009 for female and male-owned firms.² Investment financing consists of the sum of internal capital, external capital, business development capital and other funds that are used to finance the investment. All together the shares of these financing resources sum up to 100 percent. The category external capital contains all types of capital that are raised outside the firm, namely venture capital, mezzanine capital, bank loans and capital from external shareholders. Business development capital refers to subsidy loans provided by promotional institutions like e.g. the KfW Bankengruppe.

Table 1: Summary statistics investment financing

Percentage of	Male owner		Female owner		t-test
	Mean	St.dev.	Mean	St.dev.	p-value
~ internal capital	54.7	41.1	58.5	42.3	0.000***
~ external capital	30.2	37.3	26.8	37.1	0.000***
~ business development capital	8.0	20.3	7.6	21.1	0.348
~ other funds	7.1	21.3	7.1	21.7	0.963
total	100		100		

Notes: N=24,302. The category external capital consists of venture capital, mezzanine capital, bank loans and external shareholder capital. Business development capital refers to subsidy loans provided by promotional institutions. Comparison of means with two-sample t-test of equality of means under the assumption of equal variances. *** indicates significance at the 10% levels.

A two-sample t-test of equality of means reveals significant differences in the shares of external and internal capital used for investment financing. The share of internal capital is by 58.5% to 54.7% significantly higher for female-owned firms, while the share of external capital is lower (26.8% vs. 30.2%). For the share of business development capital and

²Table 4 in the Appendix contains descriptive statistics of all variables included in the regression on investment financing.

other funds there are no significant differences. However, this difference in the shares of internal vs. external capital is not necessarily a gender effect, it may be attributable to differences in firm characteristics such as size, industry etc.

In order to separate the impact of gender from other owner- and firm-specific characteristics we estimate a random effects panel tobit model for the share of each financing resource separately. The model has the following specification:

$$y_{it}^* = \alpha_i + \gamma f_i + \beta x_{it}' + v_i + u_{it} \quad (1)$$

$$y_{it} = \begin{cases} 0 & \text{if } y_{it}^* \leq 0 \\ y_{it} & \text{if } 0 < y_{it}^* < 100 \\ 100 & \text{if } y_{it}^* \geq 100 \end{cases} \quad (2)$$

with y_{it} denoting the share of internal, external, business development or other capital with left-censoring at the lower bound of 0 percent and right-censoring at the upper bound of 100 percent. f_i is a dummy variable for female ownership, v_i stands for time-invariant individual effects, and u_{it} is the remaining disturbance. x_{it} is a vector including firm- and owner-specific variables, i.e. firm size, firm age, age of the firm owner, graduation status of the owner, size of the management team, sales growth as a performance indicator, and cash flow as indicator for financial constraints. As a further control variable we add the investment rate to depict the relative size of the investment.

The regression results in Table 2 confirm the descriptive pattern. The share of internal capital in investment financing is higher in female-owned firms than in male-owned firms while the share of external capital is lower. For business development capital and other funds we observe no significant difference. These gender differences in the use of external vs. internal capital in investment financing could be either a result of gender differences in firm owner's willingness to get into debt or of differences in credit availability. In the following section we will address both approaches, differences in preferences and discrimination.

Table 2: Random effects panel tobit model of investment financing

	(1)	(2)	(3)	(4)
Dependent variable: investment financing, share of ~	internal capital	external capital	business development capital	other funds
Female owner (d)	5.030** (2.458)	-5.842** (2.557)	-4.298 (2.864)	1.582 (4.167)
Lagged FTE (log)	-9.546*** (1.143)	7.701*** (1.195)	3.697*** (1.357)	13.94*** (2.035)
Lagged sales (log)	0.713 (1.030)	2.423** (1.079)	0.140 (1.227)	-6.169*** (1.815)
Investment rate (inv./sales)	-10.74*** (0.794)	6.680*** (0.802)	9.766*** (0.751)	4.775*** (1.154)
Cash flow	1.06e-05*** (1.03e-06)	-9.72e-06*** (1.09e-06)	1.92e-06* (1.13e-06)	-9.61e-06*** (1.90e-06)
Sales growth	0.380 (1.972)	-2.549 (2.110)	8.705*** (2.534)	7.163* (3.773)
Firm age 5-10 years (d)	-1.631 (2.224)	6.916*** (2.369)	-8.274*** (2.749)	-3.413 (4.111)
Firm age 11-20 years (d)	-4.323** (2.173)	9.834*** (2.290)	-4.906* (2.576)	-6.781* (3.849)
Firm age >20 years (d)	-4.938** (2.218)	10.88*** (2.325)	-7.531*** (2.609)	-9.248** (3.884)
2 managers/owners (d)	-2.406 (1.523)	1.318 (1.597)	2.054 (1.830)	4.495* (2.698)
3 or more managers/owners (d)	-0.102 (2.187)	-1.974 (2.295)	1.669 (2.609)	4.862 (3.840)
Graduate (d)	12.69*** (1.524)	-13.93*** (1.577)	-2.033 (1.756)	0.263 (2.579)
Age firm owner	0.186** (0.076)	-0.255*** (0.079)	-0.162* (0.088)	-0.173 (0.129)
Constant	84.59*** (12.21)	-51.03*** (12.81)	-66.15*** (14.51)	-78.41*** (21.45)
Observations	24,302	24,302	24,302	24,302
Female observations	2,347	2,347	2,347	2,347
left-censored	4,294	12,632	19,869	20,928
uncensored	10,578	9,165	4,197	2,894
right-censored	9,430	2,505	236	480
Number of firms	13,057	13,057	13,057	13,057
Avg. Obs. per firm	1.9	1.9	1.9	1.9

Notes: This table presents the results of a random effects panel tobit regression of investment financing for the years 2004-2009. Each regression includes industry, legal form and time dummies as well as the stratification variables. The reference category are manufacturing firms in sole proprietorship that are younger than 5 years. *,** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

3 Credit application and application outcome

Credit constraints can be driven by demand-side or supply-side factors (Coleman and Robb 2009, Bellucci et al. 2010, Verheul and Thurik 2001). On the demand-side, different preferences, higher risk and debt aversion as well as lower financial literacy may, *ceteris paribus*, prevent women more from applying for credit. On the supply-side, discrimination on the financial market may result in lower credit approval rates or worse credit conditions for women. In this paper we examine both sides of the credit application process of investing firms.

3.1 Previous evidence

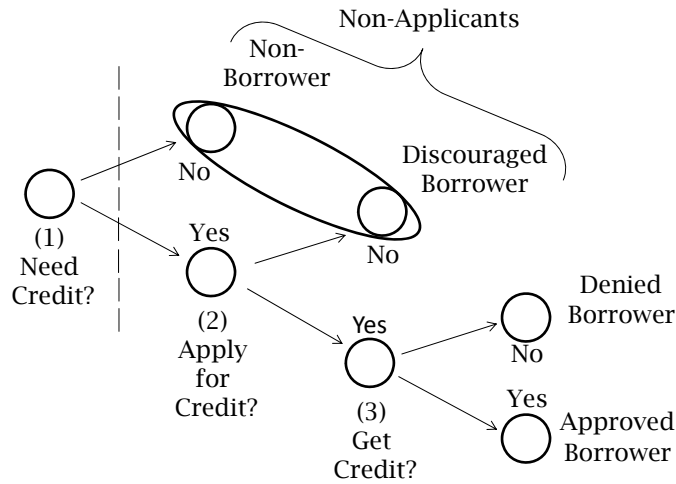
Previous empirical studies have focused mainly on the US economy and have not found strong evidence that female-owned firms have greater difficulties in funding their investments. Most authors use the same data base for their analysis, namely the Federal Reserve's Surveys of Small Business Financing (SSBFs). Cavalluzzo et al. (2002) find that denial rates of female owners increase to some extent with lender concentration but they find no evidence for discrimination in terms of interest rates. Blanchflower et al. (2003) and Blanchard et al. (2008) confirm that gender differences in denial rates are negligible. For Italy in contrast, Bellucci et al. (2010) reveal that female owned firms do not pay higher interest rates but are disadvantaged in terms of collateral requirements and credit availability. Muravyev et al. (2009) analyze gender differences in credit constraints with the World Bank's Business Environment and Enterprise Performance Survey (BEEPS) which contains data for 34 countries. They find that female entrepreneurs are more likely to be denied credit and pay higher interest rates, but that these differences vanish with increasing level of a financial development. Yet, their cross-country analysis does not allow to draw country-specific conclusions.

On the demand side, none of the authors cited above find clear evidence that women have lower application rates. Cole and Mehran (2009) find only very weak evidence of higher application discouragement for women. Regarding gender specific perceptions, Roper and Scott (2009) find that women in the UK at start-up stage - independent from their real financial situation - are more likely to perceive that they have problems in accessing external funds.

3.2 The credit application process

Figure 1 describes the credit application process in three conditional stages. According to Cole (2010), firms can be classified into four categories of ‘borrower types’: non-borrower, discouraged borrower, denied borrower and approved borrower. Unfortunately, we cannot observe the first stage of the application process in our data, we do not know whether firms need or do not need credit. We cannot differentiate between non-borrowers and discouraged borrowers, in our data they form one group, the non-applicants. We are constrained to analyzing the application process without its first stage and dealing with the problem of selection bias. Discouraged borrowers may decide not to apply because they anticipate or fear a loan denial. Their firm specific characteristics could be similar to applying firms that were not credit approved. We know from the literature that women are less over-confident, more risk-averse and also have a greater fear of negative outcomes when they get involved in a risky decision (Croson and Gneezy 2009). Consequently, women may be more reluctant and discouraged to apply than men are. As a result, female-owned firms which do apply could be a positively selected subgroup with better performance and creditworthiness than the average male-owned firm that applies for credit. As a consequence, our results suffer from sample selection bias, therefore discrimination in the form of credit denial could be underestimated.

Figure 1: Credit application process



Source: Borrowed and customized from Cole (2010)

The issue of sample selection is a well known problem in econometric modeling of discrimination as well as the omitted variable bias. The problem can be tackled to some extent if the necessary information on all application stages is available. Cavalluzzo et al. (2002) regard discouraged borrowers as potential applicants and model this self-selection into applying by estimating the two models jointly with a selection model. Then, the

main equation models the application outcome while the selection equation models the decision whether to apply or not. Alternatively, successful credit applicants can be compared to all firms with unmet credit needs, the rejected and discouraged. Blanchflower et al. (2003), Blanchard et al. (2008), Cole (2010) and Cole and Mehran (2009) employ similar approaches to deal with sample selection. Muravyev et al. (2009) point to the fact that - in contrast to not considering the discouraged applicants - this approach overestimates discrimination. The results are however often similar to the single equation model employed by us.

3.3 Empirical analysis

We estimate the following two equations separately, each with a linear probability random effects panel GLS model.

$$Prob(Applied = 1) = \alpha + \beta_1 f_i + \gamma_1 X_{it} + \delta_1 D_{it} + u_{it} \quad (3)$$

$$Prob(Denied = 1) = \alpha + \beta_2 f_i + \gamma_2 X_{it} + \delta_2 D_{it} + e_{it} \text{ if } Applied = 1 \quad (4)$$

With the first equation we estimate the demand-side of the application process, the probability of applying for credit, and with the second equation we estimate the supply-side, the application outcome. The dependent variable is binary in both equations. In the application decision it takes the value 1 if a firm has applied for credit and 0 if the firm did not apply. For the application outcome it takes the value 1 if a firm's application was denied and 0 if the firm's application was approved. f denotes a dummy variable for female ownership, X is a vector of firm-specific characteristics (size in terms of sales and employees, cash flow, firm age, team size, sales expectations, innovation activity and sales growth) and D is a vector of further owner-specific characteristics (age of the firm owner and graduate status). For our analysis we consider only investing firms.³ Table 3 shows the results of five regression for the application decision and one for the application outcome.

³see Appendix Table 5 for descriptive statistics of all variables included in the regression.

Table 3: Linear probability RE panel GLS model of credit application and outcome

Dependent Variable (1/0)	<i>sample split</i>					
	(1) applied for credit	(2) application denied	(1A) applied for credit with expect.	(1B) applied for credit with exp. interact.	(1C) applied for credit firms with pos. exp.	(1D) applied for credit firms without pos. exp.
Female owner (d)	-0.047*** (0.017)	0.001 (0.017)	-0.047*** (0.017)	-0.067*** (0.020)	-0.010 (0.027)	-0.068*** (0.020)
Positive sales expect. (d)			0.023** (0.009)	0.018* (0.010)		
Interact fem.*pos. exp. (d)				0.055* (0.030)		
Lagged FTE (log)	0.036*** (0.008)	0.005 (0.007)	0.036*** (0.008)	0.036*** (0.008)	0.051*** (0.013)	0.023** (0.010)
Lagged sales (log)	0.045*** (0.008)	-0.018** (0.007)	0.044*** (0.008)	0.044*** (0.008)	0.034*** (0.012)	0.054*** (0.010)
Planned investment rate	0.802*** (0.031)	0.014 (0.022)	0.797*** (0.031)	0.795*** (0.031)	0.734*** (0.046)	0.851*** (0.042)
Cash flow	-4.99e-08*** (7.46e-09)	-1.96e-08*** (4.71e-09)	-4.97e-08*** (7.45e-09)	-4.98e-08*** (7.44e-09)	-4.39e-08*** (1.11e-08)	-5.89e-08*** (9.67e-09)
Return on sales (lag)	-0.011** (0.005)	-0.161*** (0.035)	-0.010** (0.005)	-0.011** (0.005)	-0.014 (0.050)	-0.012*** (0.003)
Sales growth	0.038** (0.017)	-0.044*** (0.016)	0.038** (0.017)	0.037** (0.017)	0.042 (0.029)	0.038* (0.021)
Firm age 5-10 years (d)	0.022 (0.017)	-0.032** (0.016)	0.024 (0.017)	0.024 (0.017)	0.024 (0.028)	0.019 (0.021)
Firm age 11-20 years (d)	0.028* (0.016)	-0.019 (0.016)	0.031* (0.016)	0.031* (0.016)	0.045* (0.027)	0.029 (0.020)
Firm age >20 years (d)	0.033** (0.016)	-0.037** (0.015)	0.037** (0.016)	0.037** (0.016)	0.043 (0.027)	0.039* (0.020)
2 managers/owners (d)	0.031*** (0.011)	-0.039*** (0.009)	0.031*** (0.011)	0.031*** (0.011)	0.028 (0.018)	0.036** (0.014)
3 or more manag./own. (d)	0.032** (0.015)	-0.048*** (0.011)	0.032** (0.015)	0.032** (0.015)	0.023 (0.024)	0.045** (0.019)
Graduate (d)	-0.090*** (0.011)	0.005 (0.009)	-0.090*** (0.011)	-0.090*** (0.011)	-0.102*** (0.017)	-0.087*** (0.013)
Age firm owner	-0.002*** (0.001)	0.0004 (0.0004)	-0.002*** (0.001)	-0.002*** (0.001)	-0.003*** (0.001)	-0.001** (0.001)
Innovation activities (d)	0.031*** (0.009)	0.035*** (0.008)	0.029*** (0.009)	0.028*** (0.009)	0.017 (0.017)	0.031*** (0.012)
Constant	-0.088 (0.092)	0.373*** (0.086)	-0.089 (0.092)	-0.087 (0.092)	0.053 (0.148)	-0.186* (0.113)
R-squared	0.210	0.048	0.211	0.211	0.187	0.225
Observations	10,796	5,599	10,796	10,796	3,824	6,972
Female observations	1,018	450	1,018	1,018	366	652
Firms	6,334	3,778	6,334	6,334	2,834	4,630
Avg. obs. per firm	1.7	1.5	1.7	1.7	1.3	1.5

Notes: This table presents the results of random effects panel GLS regressions for the years 2003-2009 with firm-level cluster-robust standard errors. The regression includes time, industry and legal form dummies as well as the stratification variables. The reference category are manufacturing firms in sole proprietorship that are younger than 5 years and have one owner-manager. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively. The number of firms in (1C) and (1D) does not add up to the number of firms in the full sample (N=10,796), as the firms may have differing expectations over the years and therefore may be present in both samples after the split.

Regression (1) is the basic specification of the application decision. We find that female owners are significantly less likely to apply for a credit. The probability that an investing female-owned firm applies for credit is on average 4.7 percentage points lower than for a male-owned firm with the same characteristics. Yet, the results from regression (2) show that if women apply, there is no difference in the probability of being denied credit as compared to male-owned firms. This result may be suggestive but for the above stated reasons of self selection it cannot be interpreted as absence of discrimination. Given that women apply significantly less often for credit, it is very likely that the female-owned firms that do apply represent a positive selection.

This raises the question on the underlying reasons for women’s lower probability of applying for credit. Croson and Gneezy (2009) conclude that women’s higher risk aversion can be traced back to different evaluations of risk, differences in the perceptibility of emotions and male overconfidence. Furthermore, women report more intense nervousness and fear than men in anticipation of negative outcomes. The application for credit involves the possibility of being rejected and borrowing money involves the risk of not to be able to bear the costs. This suggests that women may be less likely to apply for credit because they are more risk averse and would cope worse with a credit denial. We cannot test for this assumption as our data do not provide a valid measure for risk aversion. Instead, we try to better understand this fact by accounting for the sales expectations of the firm owner. The firms were asked about their sales expectations for the next year and had to answer in three categories, ‘positive’, ‘negative’ or ‘neutral’ expectations. These expectations may be realistic, overoptimistic or even too pessimistic. Interesting for our analysis are gender differences in credit application that go together with these expectations. If women indeed have a stronger fear in anticipation of negative outcomes, they should be more reluctant to apply for credit when they do not have positive expectations about the future.

In regression (1A) we re-estimate regression (1) with an additional explanatory dummy variable for positive sales expectations. We find that firms with positive expectations are significantly more likely to apply for a credit while the quantitative impact of our dummy variable for female ownership does not change. Next, we include an interaction term for positive sales expectations and female ownership in regression (1B). As a further sensitivity check we split the sample into firms that have positive expectations in a given year and firms with neutral or negative expectations (regressions (1C) and (1D)). The results show that female-owned firms with positive expectations do not differ significantly from male owned firms in their probability of applying for a credit. But, as expected, female-owned firms with non-positive expectations exhibit higher reluctance of applying for credit. The probability that a female-owned firm with non-positive expectations applies for credit is

6.8 percentage points lower than for a male-owned firm with non-positive expectations. We interpret this result as evidence of higher risk aversion and higher fear of failure for female business owners that have non-positive expectations. We also observe that the model has a higher explanatory power for firms with non-positive expectations (R^2 of 0.225 vs. 0.187).

4 Robustness Checks

We run several robustness checks for each regression in order to test for reliability of our findings. These robustness checks essentially confirm our central findings, as the signs and the significances do not differ substantially.

1. check: other model specification, GLS instead of tobit.

The tobit approach is based on strong assumptions about the conditional data distribution and functional form. As these strong assumptions are likely to be violated, tobit is a non-robust estimator (Cameron and Trivedi 2009). We therefore re-run the regressions of the composition of investment financing with a more robust simple random effects panel GLS model (see Appendix Table 6) which confirms the results from the tobit regression (Table 2).

2. check: other model specification, probit instead of GLS.

The decision to apply as well as the application outcome are both binary dependent variables. These are usually estimated with a non-linear regression model. We therefore repeat all regressions on credit application with a random effects panel probit approach (see Appendix Table 7).

3. check: considering only firms with one owner.

In the main regressions the dummy variable on female ownership refers to the gender of the principal owner. To make sure that the decision maker in the firm is indeed the principal owner, we repeat the estimations on the composition of investment financing and on credit application and its outcome considering only firms with one owner-manager (see Appendix Tables 8 and 9). The results do not substantially differ from our main regressions, except for the regression on investment financing where the gender variable in the regression for internal capital turns out to be not significant. However, the magnitude of the coefficients is approximately the same, the insignificance is probably driven by a higher standard error.

5 Conclusion

In this paper we investigate how male-owned and female-owned firms differ in investment financing, credit application behavior and application outcome. Our analysis shows that women rely more on internal funds and finance their investment with a lower share of external capital than male-owned firms, independently of the magnitude of the investment. Female firm owners are significantly less likely to apply for credit but not more likely to be credit denied. However, the last result may underestimate discrimination on the credit market as applying female-owned firms might represent a positively selected sample. Interestingly, gender differences in credit application behavior depend on the firm owner's expectation of future sales outcomes. We find that female-owned firms with non-positive sales expectations are significantly less likely to apply for credit than male-owned firms. For firms with positive sales expectations we find no gender difference in the probability to apply for credit. This points to the fact that female risk aversion is only prominent in anticipation of decreasing or constant sales volume. With positive sales prospects female firm owners are not more hesitant than male owners to bear the risks and the costs of a credit.

Yet, with our data we cannot judge whether women's more retentive or men's more offensive behavior leads to a better outcome for the firm as we have no information on credit repayment behavior and return on investment. On one hand side, through more cautious investment behavior a firm could miss growth opportunities. On the other hand, a too optimistic investment behavior could result in financial losses or even in business failure. Whether women's more cautious or men's more risky investment and application behavior generates better business outcomes remains a question to be answered by future research. A further analysis of gender differences in firm performance after investment with more appropriate data could shed more light on this question. Regarding the supply side on the credit market, our results may motivate future empirical research to gain more insights into gender differences in interest rates, credit conditions and collateral requirements.

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Appendix

Table 4: Summary statistics regression sample investment financing

Gender variable	Mean	St.dev.	Min.	Max.					
Female owner (d)	0.096	0.295	0	1					
Firm characteristics	Male owner				Female owner				t-test
	Mean	St.dev.	Min.	Max.	Mean	St.dev.	Min.	Max.	p-value
Investment financing in %									
~ internal capital	54.7	41.1	0	100	58.5	42.3	0	100	0.000***
~ external capital*	30.2	37.3	0	100	26.8	37.1	0	100	0.000***
~ development capital	8.0	20.3	0	100	7.6	21.1	0	100	0.348
~ other funds	7.1	21.3	0	100	7.1	21.7	0	100	0.963
FTE (number of employees)	42.7	64.9	0.5	1,501	29.3	44.3	0.5	462	0.000***
Sales (in million Euro)	6.808	11.700	0.010	104	4.023	8.839	0.010	102	0.000***
Investment rate (Inv./Sales)	0.125	0.713	0.1	1.497	0.120	0.191	0.1	1.125	0.243
Cashflow (in thousand Euro)	433	778	-324	8,224	273	619	-251	7,400	0.000***
Sales growth	0.089	0.284	-1.540	2.037	0.092	0.297	-1.539	1.997	0.546
Firm age	32	37	1	384	29.2	37	1	377	0.001***
Firm age <5 years (d)	0.150	0.357	0	1	0.236	0.425	0	1	0.000***
Firm age 5-10 years (d)	0.135	0.342	0	1	0.155	0.362	0	1	0.008***
Firm age 11-20 years (d)	0.302	0.459	0	1	0.242	0.428	0	1	0.000***
Firm age >20 years (d)	0.412	0.492	0	1	0.367	0.482	0	1	0.000***
1 owner-manager (d)	0.548	0.498	0	1	0.548	0.498	0	1	0.516
2 owners/managers (d)	0.303	0.459	0	1	0.317	0.466	0	1	0.146
3 or more owners/managers (d)	0.117	0.321	0	1	0.103	0.304	0	1	0.040**
Owner characteristics									
Graduate (d)	0.559	0.496	0	1	0.547	0.498	0	1	0.256
Age firm owner	48.6	10.1	20	80	45.1	9.3	23	78	0.000***

Notes: This table provides summary statistics for the sample used in the estimation of a random effects panel tobit model of investment financing in Table 4.2. N = 20,254. Comparison of means with two-sample t-test of equality of means under the assumption of equal variances. *,** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 5: Summary statistics regression sample credit application and outcome

Gender variable	Mean	St.dev.	Min.	Max.					
Female owner (d)	0.094	0.292	0	1					
Firm characteristics	Male owner				Female owner				t-test
	Mean	St.dev.	Min.	Max.	Mean	St.dev.	Min.	Max.	p-value
Applied for credit	0.527	0.499	0	1	0.442	0.497	0	1	0.000***
Credit denied (only applying firms)	0.082	0.275	0	1	0.096	0.295	0	1	0.320
Sales expectations positive (d)	0.354	0.478	0	1	0.359	0.480	0	1	0.709
FTE (number of employees)	44.2	64.3	0.5	1253	30.5	46.3	1	462	0.000***
Sales (in million Euro)	7,177	12,100	0,010	104	4,111	8,850	0,010	102	0.000***
Planned investment rate	0.104	0.167	0.1	1.497	0.120	0.191	0.1	1.455	0.003***
Cashflow (in thousand Euro)	457	794.7	-320	8,150	296	670.2	-251	6,800	0.000***
Return on sales	0.067	0.118	-3.523	1.522	0.099	0.167	-0.449	1.348	0.000***
Sales growth	0.065	0.269	-1.540	2.019	0.063	0.261	-1.522	1.923	0.881
Firm age	33.3	37.6	1	384	30.4	37	1	312	0.000***
Firm age <5 years (d)	0.129	0.335	0	1	0.207	0.406	0	1	0.000***
Firm age 5-10 years (d)	0.132	0.339	0	1	0.171	0.377	0	1	0.001***
Firm age 11-20 years (d)	0.313	0.464	0	1	0.256	0.437	0	1	0.000***
Firm age >20 years (d)	0.426	0.494	0	1	0.365	0.482	0	1	0.000***
1 owner-manager (d)	0.538	0.499	0	1	0.509	0.016	0	1	0.077*
2 owners/managers (d)	0.306	0.461	0	1	0.345	0.475	0	1	0.011**
3 or more owners/managers (d)	0.128	0.334	0	1	0.111	0.314	0	1	0.122
Innovation (d)	0.505	0.500	0	1	0.399	0.490	0	1	0.000***
Owner characteristics									
Graduate (d)	0.593	0.491	0	1	0.568	0.496	0	1	0.113
Age firm owner	48.8	10	20	80	45.1	9	23	78	0.000***

Table 6: Random effects panel GLS regressions of investment financing

	(1)	(2)	(3)	(4)
Dependent variable: investment financing, share of ~	internal capital	external capital	business development capital	other funds
Female owner (d)	2.428** (1.083)	-2.302** (0.950)	-0.291 (0.543)	0.225 (0.544)
Lagged FTE (log)	-4.051*** (0.524)	2.377*** (0.460)	0.349 (0.272)	1.362*** (0.260)
Lagged sales (log)	0.005 (0.566)	1.050** (0.435)	-0.263 (0.279)	-0.775*** (0.244)
Investment rate (inv./sales)	-5.789* (3.065)	2.388* (1.302)	2.900* (1.505)	0.417 (0.307)
Cash flow	4.77e-06*** (4.53e-07)	-3.58e-06*** (3.94e-07)	2.06e-07 (2.37e-07)	-1.45e-06*** (2.09e-07)
Sales growth	0.763 (1.163)	-1.858** (0.862)	0.942 (0.594)	0.254 (0.539)
Firm age 5-10 years (d)	-0.592 (0.990)	2.296** (0.900)	-1.392*** (0.520)	-0.438 (0.538)
Firm age 11-20 years (d)	-1.785* (0.966)	3.407*** (0.855)	-0.850* (0.503)	-0.753 (0.512)
Firm age >20 years (d)	-1.481 (0.986)	3.676*** (0.880)	-1.468*** (0.511)	-0.736 (0.509)
2 managers/owners (d)	-1.213* (0.695)	0.329 (0.620)	0.305 (0.343)	0.522 (0.386)
3 or more managers/owners (d)	-0.315 (0.995)	-1.060 (0.890)	0.486 (0.486)	0.844 (0.568)
Graduate (d)	5.540*** (0.676)	-5.231*** (0.613)	-0.460 (0.328)	0.117 (0.345)
Age firm owner	0.095*** (0.034)	-0.077** (0.030)	-0.023 (0.016)	0.003 (0.018)
Constant	65.05*** (6.988)	9.927* (5.203)	12.04*** (3.452)	12.66*** (2.927)
R-squared	0.047	0.057	0.025	0.072
Observations	24,302	24,302	24,302	24,302
Female observations	2,347	2,347	2,347	2,347
Firms	13,057	13,057	13,057	13,057
Avg. obs. per firm	1.9	1.9	1.9	1.9

Notes: This table presents the results of a random effects GLS regression of investment financing for the years 2004-2009. Each regression includes industry, legal form and time dummies as well as the stratification variables. The reference category are manufacturing firms in sole proprietorship that are younger than 5 years. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 7: Random effects panel probit regressions of credit application and outcome

Dependent Variable (1/0)	<i>sample split</i>					
	(1) applied for credit	(2) application denied	(1A) applied for credit with expect.	(1B) applied for credit with exp. interact.	(1C) applied for credit firms with pos. exp.	(1D) applied for credit firms without pos. exp.
Female owner (d)	-0.196*** (0.074)	0.019 (0.182)	-0.197*** (0.074)	-0.290*** (0.089)	-0.042 (0.116)	-0.303*** (0.092)
Positive sales expectat. (d)			0.068* (0.041)	0.045 (0.043)		
Interact female*pos. exp. (d)				0.258* (0.136)		
Lagged FTE (log)	0.143*** (0.037)	0.059 (0.087)	0.141*** (0.037)	0.141*** (0.037)	0.201*** (0.056)	0.091** (0.046)
Lagged sales (log)	0.221*** (0.034)	-0.104 (0.082)	0.220*** (0.034)	0.220*** (0.034)	0.173*** (0.052)	0.262*** (0.043)
Planned investment rate	4.263*** (0.180)	0.219 (0.247)	4.237*** (0.181)	4.228*** (0.181)	3.747*** (0.274)	4.679*** (0.256)
Cash flow	-2.29e-07*** (3.22e-08)	-8.71e-07*** (1.74e-07)	-2.28e-07*** (3.22e-08)	-2.29e-07*** (3.22e-08)	-2.00e-07*** (4.76e-08)	-2.67e-07*** (4.37e-08)
Return on sales (lag)	-0.051 (0.076)	-2.042*** (0.435)	-0.048 (0.073)	-0.049 (0.074)	0.021 (0.130)	-0.348 (0.230)
Sales growth	0.141** (0.072)	-0.471*** (0.176)	0.140* (0.072)	0.138* (0.072)	0.178 (0.117)	0.125 (0.094)
Firm age 5-10 years (d)	0.103 (0.077)	-0.319* (0.183)	0.108 (0.077)	0.110 (0.077)	0.100 (0.119)	0.099 (0.099)
Firm age 11-20 years (d)	0.129* (0.071)	-0.161 (0.166)	0.137* (0.071)	0.137* (0.071)	0.168 (0.112)	0.146 (0.090)
Firm age >20 years (d)	0.150** (0.071)	-0.390** (0.174)	0.162** (0.072)	0.161** (0.071)	0.188* (0.112)	0.170* (0.090)
2 managers/owners (d)	0.140*** (0.049)	-0.441*** (0.123)	0.140*** (0.049)	0.140*** (0.049)	0.129* (0.076)	0.161*** (0.061)
3 or more manag./own. (d)	0.144** (0.067)	-0.675*** (0.187)	0.144** (0.067)	0.143** (0.067)	0.106 (0.103)	0.198** (0.085)
Graduate (d)	-0.398*** (0.048)	0.0303 (0.111)	-0.400*** (0.048)	-0.400*** (0.048)	-0.449*** (0.077)	-0.396*** (0.059)
Age firm owner	-0.008*** (0.002)	0.006 (0.006)	-0.008*** (0.002)	-0.008*** (0.002)	-0.012*** (0.004)	-0.006** (0.003)
Innovation activities (d)	0.135*** (0.041)	0.457*** (0.105)	0.128*** (0.041)	0.128*** (0.041)	0.083 (0.070)	0.136*** (0.051)
Constant	-3.012*** (0.409)	-0.551 (0.981)	-3.008*** (0.408)	-3.002*** (0.408)	-2.362*** (0.627)	-3.392*** (0.525)
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Observations	10,796	5,599	10,796	10,796	3,824	6,972
Female observations	1,018	450	1,018	1,018	366	652
Firms	6,334	3,778	6,334	6,334	2,834	4,630
Avg. obs. per firm	1.7	1.5	1.7	1.7	1.3	1.5

Notes: This table presents the results of random effects panel probit regressions for the years 2003-2009 with firm-level cluster-robust standard errors. The regression includes time, industry and legal form dummies as well as the stratification variables. The reference category are manufacturing firms in sole proprietorship that are younger than 5 years and have one owner-manager. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively. The number of firms in (1C) and (1D) does not add up to the number of firms in the full sample (N=10,796), as the firms may have differing expectations over the years and therefore may be present in both samples after the split.

Table 8: Random effects panel tobit regressions of investment financing (only firms with 1 owner-manager)

	(1)	(2)	(3)	(4)
Dependent variable: investment financing, share of ~	internal capital	external capital	business development capital	other funds
Female owner (d)	5.405 (3.340)	-7.795** (3.524)	-0.849 (3.978)	1.911 (5.968)
Lagged FTE (log)	-10.41*** (1.564)	6.969*** (1.647)	5.424*** (1.888)	17.31*** (2.898)
Lagged sales (log)	-0.637 (1.399)	3.940*** (1.477)	1.316 (1.703)	-8.143*** (2.557)
Investment rate (inv./sales)	-20.72*** (1.416)	12.21*** (1.396)	18.24*** (1.351)	9.453*** (2.076)
Cash flow	1.34e-05*** (1.69e-06)	-1.07e-05*** (1.78e-06)	8.13e-07 (1.91e-06)	-8.79e-06*** (3.12e-06)
Sales growth	3.850 (2.702)	-4.058 (2.906)	6.991** (3.535)	1.377 (5.277)
Firm age 5-10 years (d)	-3.947 (2.927)	11.33*** (3.142)	-12.57*** (3.728)	-2.524 (5.564)
Firm age 11-20 years (d)	-4.818* (2.863)	11.05*** (3.048)	-6.717* (3.468)	-8.950* (5.257)
Firm age >20 years (d)	-6.548** (2.942)	14.23*** (3.112)	-7.772** (3.522)	-11.63** (5.356)
Graduate (d)	14.34*** (2.079)	-15.13*** (2.175)	-3.101 (2.465)	-1.183 (3.700)
Age firm owner	0.310*** (0.109)	-0.339*** (0.115)	-0.264** (0.131)	-0.323* (0.195)
Constant	107.0*** (16.63)	-76.92*** (17.59)	-85.45*** (20.24)	-54.17* (30.14)
Observations	13,294	13,294	13,294	13,294
Female observations	1,269	1,269	1,269	1,269
left-censored	2,425	7,023	10,981	11,576
uncensored	5,567	4,820	2,170	1,453
right-censored	5,302	1,451	143	265
Number of firms	7,847	7,847	7,847	7,847
Avg. Obs. per firm	1.7	1.7	1.7	1.7

Notes: This table presents the results of a random effects panel tobit regression of investment financing for the years 2004-2009. Only firms with one owner/manager included. Each regression includes industry, legal form and time dummies as well as the stratification variables. The reference category are manufacturing firms in sole proprietorship that are younger than 5 years. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.

Table 9: Random effects panel GLS regressions of credit application and outcome (only firms with 1 owner-manager)

Dependent Variable (1/0)	<i>sample split</i>					
	(1) applied for credit	(2) application denied	(1A) applied for credit with expect.	(1B) applied for credit with exp. interact.	(1C) applied for credit firms with pos. exp.	(1D) applied for credit firms without pos. exp.
Female owner (d)	-0.044*	-0.017	-0.044*	-0.053**	-0.014	-0.056**
	(0.023)	(0.025)	(0.023)	(0.026)	(0.038)	(0.027)
Positive sales expectat. (d)			0.027**	0.025*		
			(0.013)	(0.013)		
Interact female*pos. exp. (d)				0.026		
				(0.042)		
Lagged FTE (log)	0.030***	0.016	0.029***	0.028***	0.064***	0.013
	(0.011)	(0.010)	(0.011)	(0.011)	(0.018)	(0.013)
Lagged sales (log)	0.053***	-0.023**	0.053***	0.053***	0.031*	0.065***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.016)	(0.013)
Planned investment rate	0.778***	0.044	0.772***	0.771***	0.747***	0.791***
	(0.040)	(0.030)	(0.040)	(0.040)	(0.065)	(0.051)
Cash flow	-4.87e-08***	-3.45e-08***	-4.85e-08***	-4.85e-08***	-4.40e-08**	-5.94e-08***
	(1.29e-08)	(8.31e-09)	(1.28e-08)	(1.28e-08)	(1.82e-08)	(1.74e-08)
Return on sales (lag)	-0.010**	-0.185***	-0.010**	-0.010**	0.021	-0.014***
	(0.005)	(0.054)	(0.005)	(0.005)	(0.052)	(0.004)
Sales growth	0.025	-0.073***	0.025	0.025	-0.014	0.042
	(0.022)	(0.024)	(0.022)	(0.022)	(0.040)	(0.028)
Firm age 5-10 years (d)	-0.0007	-0.054**	0.002	0.002	0.004	-0.005
	(0.022)	(0.022)	(0.022)	(0.021)	(0.035)	(0.027)
Firm age 11-20 years (d)	0.007	-0.027	0.011	0.011	-0.034	0.036
	(0.021)	(0.023)	(0.021)	(0.021)	(0.035)	(0.025)
Firm age >20 years (d)	0.018	-0.061***	0.023	0.023	0.007	0.033
	(0.021)	(0.022)	(0.021)	(0.021)	(0.035)	(0.026)
Graduate (d)	-0.104***	0.009	-0.104***	-0.104***	-0.110***	-0.103***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.023)	(0.017)
Age firm owner	-0.001	0.001	-0.001	-0.001	-4.42e-05	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Innovation activities (d)	0.033***	0.049***	0.031**	0.030**	0.007	0.041***
	(0.013)	(0.011)	(0.013)	(0.013)	(0.023)	(0.015)
Constant	-0.175	0.413***	-0.178	-0.179	0.008	-0.270*
	(0.121)	(0.119)	(0.121)	(0.121)	(0.197)	(0.148)
R-squared	0.231	0.060	0.232	0.232	0.212	0.243
Observations	5,777	2,875	10,796	10,796	1,964	3,813
Female observations	518	210	1,018	1,018	174	344
Firms	3,635	2,046	6,334	6,334	1,527	2,652
Avg. obs. per firm	1.6	1.4	1.7	1.7	1.3	1.5

Notes: This table presents the results of random effects panel GLS regressions for the years 2003-2009 with firm-level cluster-robust standard errors. Only firms with one owner-manager included. The regression includes time, industry and legal form dummies as well as the stratification variables. The reference category are manufacturing firms in sole proprietorship that are younger than 5 years and have one owner-manager. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively. The number of firms in (1C) and (1D) does not add up to the number of firms in the full sample (N=10,796), as the firms may have differing expectations over the years and therefore may be present in both samples after the split.