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Discussion
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Risk Attitudes and Private Business Equity

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Risk Attitudes and Private Business Equity¹

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Abstract:

Why do people engage in entrepreneurship and commit large parts of their personal wealth to their business, despite comparably low returns and high risk? This paper connects several streams of literature to shed some light on this puzzle and suggests possible future research avenues. Key insights from the literature are that entrepreneurs may operate in imperfect financial markets and that entrepreneurs are less risk-averse than the rest of the population. A focus of this paper is, therefore, on the role of heterogeneous risk attitudes in entrepreneurial decisions, specifically portfolio choice and the entry and exit decisions. Nonpecuniary benefits of entrepreneurship, such as being independent in the workplace, also contribute to an explanation of entrepreneurial behavior.

Keywords: Entrepreneurship, risk aversion, portfolio choice

JEL Classification: J23, G11, L26

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1 Introduction

Recent literature has greatly improved the understanding of entrepreneurship, including the determinants of entry and exit and of entrepreneurial investment and financing decisions. Yet despite the progress made, a fundamental question remains: Why do people engage in entrepreneurship and commit large parts of their personal wealth to their business, despite the fact that the monetary risk-return trade-off, on average, looks rather unattractive in comparison to alternative wage employment (Hamilton, 2000) and investment in a public equity portfolio (Moskowitz and Vissing-Jorgensen, 2002)? This chapter attempts to connect several streams of literature to shed some light on possible research avenues forward. Key insights from the literature are that entrepreneurs may operate in imperfect financial markets and that entrepreneurs seem to be less risk-averse than the rest of the population. Nonpecuniary benefits of entrepreneurship, such as utility from being independent in the workplace, also seem to play an important role.

In this chapter I examine the stylized facts behind what is sometimes called the “private equity premium puzzle,” which denotes the observation that returns to private business equity are low in spite of the high risk associated with it. I present literature providing possible theoretical explanations under the assumption of borrowing constraints and point out that empirical evidence on credit constraints remains controversial. I investigate the role of heterogeneous risk attitudes in entrepreneurial decisions, specifically the choice to be an entrepreneur and the entry and exit decisions, with an excursus on taxation. I also discuss portfolio choice and the financing decisions of entrepreneurs. The picture emerges that more risk-tolerant people self-select into entrepreneurship and are willing to put at risk a large share of their wealth. I conclude by suggesting how credit constraints and heterogeneous risk

attitudes may complementarily explain the private equity premium puzzle, and point to possible directions for further research.

2 The Private Equity Premium Puzzle

Throughout the world entrepreneurs tend to invest a large share of their wealth in their own firms. As a consequence they hold highly undiversified asset portfolios, which imply high risk. Moskowitz and Vissing-Jorgensen (2002) investigate whether the returns to private equity in the United States compensate entrepreneurs for the high risk, that is, if they earn an adequate risk premium. Their results indicate that the average returns to private equity are not higher than the returns to the public market equity index. Why, then, do entrepreneurs invest so much in the equity of a single private firm, which is likely to be much riskier than investing in the public equity index? The authors term their finding a “private equity premium puzzle,” albeit cautiously, with a question mark.

The classical *public* equity premium puzzle (Mehra and Prescott, 1985), in contrast, is concerned with the much *higher* returns to public equity stocks in comparison to safe government bonds. In standard models only an implausibly high degree of risk aversion could explain why people invest in safe bonds at all, given the spread in the returns. This makes even more puzzling the observation that entrepreneurs take on even larger risks in private equity without, on average, earning higher returns than on the public equity market.

Three stylized facts together constitute the private equity premium puzzle: the high shares in their wealth portfolio that entrepreneurs invest in their own firm equity, the high risk entrepreneurs bear as a result, and the low returns to private equity.

The first stylized fact, which describes the undiversified portfolios of entrepreneurs, is well documented. Moskowitz and Vissing-Jorgensen (2002) report that entrepreneurial households in the United States invest on average as much as 41.1 percent of their wealth in

private firm equity. Here entrepreneurial households are defined as households with positive private business equity holdings and positive net worth. Moreover this investment in private equity is typically devoted to a single private firm in which the household has an active management interest. According to the authors, the average household that owns private equity has 82 percent of its private equity invested in such a firm. The primary data source in this and a number of related studies is the Survey of Consumer Finances (SCF), a sample of about 4,000 U.S. households per survey year that includes information on individual household portfolio compositions, including investment in both private and publicly traded firms. In their study Moskowitz and Vissing-Jorgensen use the survey years 1989, 1992, 1995, and 1998. As supplementary data sources, they employ the Flow of Funds Accounts (FFA) and the National Income and Product Accounts (NIPA) over the longer time period of 1952 to 1999, and a number of other sources. Gentry and Hubbard (2004) analyze the role of entrepreneurship in household saving, using data from the 1983 and 1989 SCF. Consistent with the results of Moskowitz and Vissing-Jorgensen, they find that active businesses account for 41.5 percent of entrepreneurs' assets.

Similarly undiversified portfolios of entrepreneurs are observed in Germany, as documented by Fossen (2011). In 2002 entrepreneurs, that is, those with positive private business equity holdings, invested 48 percent of their gross wealth in their own enterprise, and in 2007 the share was 42.9 percent. This analysis is based on the German Socio-Economic Panel Survey (SOEP), a representative yearly panel survey that gathers information about more than 21,000 individuals living in 12,000 German households (cf. Wagner et al., 2007). The 2002 and 2007 waves included special modules collecting information about private wealth balance sheets. Table 1 shows the portfolio compositions of individuals in Germany in 2002 and 2007 and of households in the United States in 1989, based on Fossen (2011) and Gentry and Hubbard (2004), respectively. Apart from the

entrepreneurs' large portfolio shares of private business equity in both countries, another interesting observation from the table is that home property plays a more important role in Germany than in the United States, whereas Americans invest a greater share of their portfolio in financial assets, such as stocks and bonds. Consistent with that, Germans make more use of mortgage loans, while Americans resort to other forms of debt.

Table 1: Portfolio compositions of entrepreneurs and others (percentage of gross wealth)

Asset category	Entrepreneurs		
	Germany 2002	Germany 2007	U.S. 1989
Active private business			41.5
Passive private business			7.4
Private business	48.0	42.9	48.9
Owner-occupied housing	17.8	19.7	12.6
Other property	22.0	22.7	17.7
Financial assets	4.5	8.0	13.8
Life and private pension insurance	6.9	6.4	3.1
Tangible assets	0.8	0.4	4.1
<i>Gross wealth</i>	100	100	100
Mortgage	12.1	12.3	3.8
Other liabilities	3.1	4.5	8.1
<i>Net worth</i>	84.9	83.2	88.1
Asset category	Others		
	Germany 2002	Germany 2007	U.S. 1989
Active private business			0.0
Passive private business			1.7
Private business	0.0	0.0	1.7
Owner-occupied housing	60.5	58.2	41.1
Other property	14.0	18.5	15.1
Financial assets	11.1	12.1	28.1
Life and private pension insurance	13.4	10.5	6.7
Tangible assets	1.0	0.7	7.3
<i>Gross wealth</i>	100	100	100
Mortgage	21.0	21.5	10.8
Other liabilities	2.5	2.3	6.3
<i>Net worth</i>	76.5	76.2	82.9

Source: Modified from Gentry and Hubbard (2004a), based on the SCF (1989) for the United States, and Fossen (2011), based on the SOEP (2002/2007), for Germany.

The second stylized fact behind the private equity premium puzzle is that entrepreneurs bear substantial risk. It is clear from portfolio theory (Markowitz, 1952) that the lack of diversification in entrepreneurs' portfolios, as documented above, is risky. Returns to investment in small entrepreneurial firms are very volatile, and failure rates are high, as Moskowitz and Vissing-Jorgensen (2002) show for the United States. Representative data on

the returns to equity and the volatility of these returns in single proprietorships or partnerships are unavailable, as small nonpublic businesses are not usually obliged to publish their profit and loss accounts and typically prefer to keep operating figures confidential. To get an impression nevertheless, it is worthwhile to look at public market firms. Moskowitz and Vissing-Jorgensen report that the annual standard deviation of returns to public firms (market value) was 17 percent in the period 1953–1999, but as much as 41.1 percent in the smallest decile of public firm returns. A portfolio of even smaller private firms is likely to be at least as volatile. More important, since entrepreneurs typically own equity in a single private firm, as reported above, the risk faced by the average entrepreneur is likely to be still higher. The annual standard deviation of a typical single public firm’s equity return is 50 to 60 percent, according to Campbell et al. (2001) and cited by Moskowitz and Vissing-Jorgensen. Another indication is that log returns to venture capital investments are very volatile, with an 89 percent annualized standard deviation in the United States, as compared to only 14.9 percent annualized standard deviation of the log S&P return (Cochrane, 2005). Venture capital and private equity funds data from North and South America, Europe, and Asia confirm a high volatility of venture capital returns (Cumming and Walz, 2010). Furthermore Heaton and Lucas (2000) report that entrepreneurial households hold less wealth in stocks than nonentrepreneurial households. They argue that entrepreneurs avoid stocks as a risky form of investment (in comparison to bonds) because of the high background risk they already face as entrepreneurs.

The third stylized fact, which states that returns to private business equity are low in comparison to the public equity benchmark, is the most difficult one to verify, because accessible data on private business equity values and profits are very limited by nature, as mentioned before. The study by Moskowitz and Vissing-Jorgensen (2002), who conclude that the returns to private equity are no higher than those to public equity, represents the most

comprehensive published analysis to date. Table 2 summarizes some of their estimates. The first row shows the geometric average annual return from investing in private equity in the United States in different time periods. Adjusting the returns for the entrepreneurs' labor input and entries and exits of firms reduces the return estimates (second row). The authors compare the returns to private equity with returns to a value-weighted index of NYSE, AMEX, and NASDAQ public equity, using public stock return information from the Center for Research in Security Prices (CRSP). The public equity returns, which are shown at the bottom of the table, are similar to the unadjusted, and higher than the adjusted, private equity returns. As private firms are typically much smaller than public companies, Moskowitz and Vissing-Jorgensen argue that it is more appropriate to compare them with the smallest decile of publicly traded firms. The returns of these firms exceed the private equity returns for most and the adjusted private equity returns for all of the time periods considered (last row).

Table 2: Annual returns to private equity in the United States in percentages (geometric averages)

Time Period	1990-1992	1993-1995	1996-1998	1953-1999	1963-1999
Data source	SCF (all private equity)			FFA/NIPA (proprietorships and partnerships only)	
Private equity returns	12.3	17.0	22.2	12.8	12.8
Private equity returns (adjusted)	8.2	13.0	19.4	n/a	n/a
Data source	CRSP data				
Public equity returns, value-weighted index	11.0	14.6	24.7	12.7	15.6
Public equity returns, smallest decile	30.5	20.3	22.0	18.2	n/a

Note: The adjusted returns account for the entrepreneurs' labor input, firm entries, and firm exits. Source: Modified from Moskowitz and Vissing-Jorgensen (2002).

At first sight, high returns observed for venture capital investments seem to contradict the story of low returns to private equity. However, returns to venture capital investments can be measured only when a firm goes public, is acquired, or gets a new financing round. As Cochrane (2005) argues, these events are more likely when a firm has achieved a good return. His empirical analysis shows that correcting for selectivity bias dramatically reduces the

return estimates. Hall and Woodward (2010) analyze a database covering start-up companies backed by venture capital in the United States from 1987 to 2008, which were mainly involved in information technology and biotechnology. They find that the entrepreneurs' risk-adjusted payoffs were small on average, and three-quarters of the entrepreneurs even faced zero rewards. Even making an invention with the intention to commercialize it as an entrepreneur does not lead to very high returns on average. Based on a survey of 1,095 independent inventors in Canada, Astebro (2003) estimates that the pretax internal rate of return on a portfolio investment in independent inventions is 11.4 percent.

Hamilton's (2000) results also support the finding that monetary returns to entrepreneurship are low. He compares hourly earnings of the self-employed with those of the dependently employed and finds that most of the self-employed enter and persist in business despite the fact that they have both lower initial earnings and lower earnings growth in self-employment than they would have in dependent employment.

Hamilton (2000) argues that significant nonpecuniary benefits, such as "being your own boss," may explain why some people choose to be entrepreneurs despite the low monetary returns. Consistent with this, both Blanchflower and Oswald (1998) and Benz and Frey (2008) report that the self-employed experience greater job satisfaction than other workers; the latter authors control for income gained and hours worked. Frey et al. (2004) extend the common utility concept, where individuals derive utility from outcomes such as consumption and leisure, and introduce procedural utility, where people additionally attach a value to the procedures that lead to the outcomes. Using this concept, Benz and Frey conclude that the self-employed receive procedural utility from being independent in the workplace, as opposed to being in a hierarchy. Based on the SOEP, Fuchs-Schündeln (2009) provides further support for this hypothesis by using the change in life satisfaction reported by East Germans after the transition from communism to democracy as a proxy for the individual

preference for being independent. She shows that those who value independence higher receive greater job satisfaction from self-employment.

It should be noted that the empirical results of Moskowitz and Vissing-Jorgensen (2002) about the low monetary returns to private business equity have not remained unchallenged. In a working paper, Kartashova (2011) extends the SCF data used by those authors by additionally employing the waves 2001, 2004, and 2007. She reports that the finding of comparably low returns to private equity does not hold beyond the period of high public equity returns in the 1990s. According to Kartashova, the returns to entrepreneurial equity remained largely unaffected when public equity returns plunged between 1999 and 2001. The inconclusive evidence calls for more empirical research into the returns to private equity, both over longer time periods and over different countries.

3 Liquidity Constraints as a Possible Explanation

If it is taken for granted that entrepreneurs typically face an unfavorable risk-return trade-off, the question is why they invest such a large share of their wealth in their own business.

One possible explanation for the private equity premium puzzle is that external financing may be costly in imperfect financial markets due to asymmetric information. In other words, entrepreneurs would like to diversify, but face binding credit constraints. Gentry and Hubbard (2004) suggest that this is a possible explanation for the undiversified entrepreneurial portfolios they observe.

Some theories explain the empirical outcome under the assumption of borrowing constraints. Polkovnichenko (2003) develops such a model, which is able to reproduce the empirical findings after calibration. A key insight provided by this paper is that entrepreneurs do not put at risk their human capital, which, according to the author, represents the largest and safest asset for most entrepreneurs at the time of starting their business. Consequently

small private benefits from entrepreneurship are sufficient to explain why people become entrepreneurs despite facing restrictions in risk diversification. These may be nonpecuniary benefits of control, such as “being your own boss,” as mentioned earlier. Hintermaier and Steinberger (2005) present a theoretical model of occupational choice over the life cycle under borrowing constraints and imperfect information about the profitability of potential businesses, which is also able to fit the empirical observation. Vereshchagina and Hopenhayn (2009) develop a dynamic occupational choice model that allows entrepreneurs to choose projects with different degrees of risk. Due to the assumptions of borrowing constraints, those with sufficient funds for investment decide to become entrepreneurs, while the less wealthy prefer wage employment. The possibility of a discrete occupational switch in the future implies that agents with wealth close to the occupational switch threshold find it optimal to invest in risky projects without requiring a risk premium if they are sufficiently impatient.

Bitler et al. (2005), among others, demonstrate how principal-agent problems between insiders and outsiders may help to explain the concentrated ownership of entrepreneurs. In their model, a risk-averse entrepreneur seeking financing wishes to sell part of her equity stake in her firm to outside investors, who are concerned with moral hazard. To align the entrepreneur’s incentives with the outside investors’ objectives, the entrepreneur is forced to hold a large ownership share in her own firm. The authors test and confirm the implications of their theory using various waves of the SCF and the (National) Survey of Small Business Finances of 1993 and 1998.

Cagetti and De Nardi (2006) construct and calibrate another model of occupational choice, where borrowing constraints are crucial determinants of entrepreneurial decisions, including investment. A key ingredient to their model is a potentially high rate of return to entrepreneurship, which differs from the empirical findings of Moskowitz and Vissing-

Jorgensen (2002). Cagetti and De Nardi (2009) employ a similar framework with business investment and borrowing constraints to study estate taxation.

Complementarily to the theoretical work, a sizable empirical literature has presented evidence that suggests that credit constraints for entrepreneurs are real. Such credit constraints may prevent a certain fraction of would-be entrepreneurs from starting a business. In the presence of imperfect financial markets, own wealth should decrease the probability of being constrained and thus increase the probability of becoming an entrepreneur. Consistent with this, Evans and Jovanovic (1989), for instance, document a positive relationship between initial wealth and subsequent entry into self-employment. They use data from the National Longitudinal Survey of Young Men in the United States. Blanchflower and Oswald (1998) address concerns that these kinds of estimations may be distorted because wealth may be endogenous in the entrepreneurship decision. They exploit information provided by the National Child Development Study in Great Britain that indicates whether someone has ever received an inheritance or gift. These are regarded as exogenous windfall gains. Consistently with the presence of liquidity constraints, the authors find that inheritances or gifts increase the probability of self-employment. Similarly Holtz-Eakin et al. (1994a, 1994b), using individual income tax return data from the United States, report that those who receive an inheritance are more likely to enter and to stay in entrepreneurship.

Subsequent studies question the interpretation of these empirical results as evidence for credit constraints. As Cressy (2000) shows, an alternative theoretical explanation for the finding that more wealthy agents choose to become entrepreneurs may be that absolute risk aversion decreases with wealth. Hurst and Lusardi (2004) reestimate the empirical relationship between wealth and the entry probability using the U.S. Panel Study of Income Dynamics. They report that this relationship is not significant throughout most of the wealth distribution, and that a positive correlation exists only for the top 5 percent of the wealthiest

households. According to the authors, this nonlinear relationship was overlooked by previous literature. Moreover they argue that inheritances are not a valid instrument for wealth, as they might be correlated with other, unobserved background factors that might directly influence entrepreneurial choice.

The literature from the United States has triggered similar research in other countries. Disney and Gathergood (2009) account for the critique of Hurst and Lusardi (2004) in their empirical analysis and conclude that the evidence for financial constraints is weak in the United Kingdom as well. Cosh et al. (2009) use survey data on 2,520 entrepreneurial firms in the United Kingdom and find that the firms that seriously sought external finance were able to obtain, on average, 84.5 percent of the desired capital; the median was even 100 percent. However, they also report that the firms could not always obtain the desired type of capital and had to resort to less preferred sources in these cases. In contrast, Nykvist (2008) provides evidence for the existence of credit constraints in Sweden that is robust to the critique of Hurst and Lusardi. She finds a positive but diminishing relationship between wealth and transitions into entrepreneurship for the major part of the Swedish wealth distribution. Table 3 provides a nonexhaustive summary of the empirical literature on the relationship between credit constraints and entrepreneurial status and transitions.

Table 3: Summary of selected empirical studies of credit constraints and entrepreneurship (state or transitions)

Author(s) & Data publication year	Main method of analysis	Identification of credit constraints	Summary of findings
Evans and Jovanovic (1989)	National Longitudinal Survey of Young Men, U.S., 1976, 78 1) Reduced-form probit estimation of probability of entering self-employment 2) Maximum likelihood estimation of structural model of entrepreneurial selection under liquidity constraints	1) Initial asset holdings (level and quadratic terms) as explanatory variables in reduced-form equation 2) Estimation of capital constraint parameter	1) Assets have a positive effect on the entry probability, which is interpreted as evidence for liquidity constraints 2) Liquidity constraints are binding for virtually all the individuals who are likely to start a business
Holtz-Eakin et al. (1994a)	Matched sample of federal individual estate and personal income tax returns, U.S., 1981, 85 Probit estimation of probability of entering entrepreneurship	Inheritances as exogenous windfall gains	A \$100,000 inheritance increases the probability of entry into entrepreneurship by 3.3 % points, which is consistent with capital constraints
Holtz-Eakin et al. (1994b)	See above Multinomial logit analysis of transition probabilities of entrepreneurs	Inheritances as exogenous windfall gains	A \$150,000 inheritance increases the probability of survival as a sole proprietor by 1.3 % points, which is consistent with capital constraints again
Blanchflower and Oswald (1998)	1) National Child Development Study, Great Britain, 1981, 91 2) British Social Attitudes Survey series (1983, 84, 86) and National Survey of the Self-Employed, U.K., 1987 1) Probit estimation of self-employment at age 23 (in 1981) and 33 (in 1991) 2) Shares of survey responses related to credit constraints	1) Inheritances and gifts as exogenous windfall gains 2) Direct interview evidence	1) The receipt of an inheritance or gift increases the probability of being self-employed 2) Survey responses indicate that shortage of capital constrains many people from becoming self-employed, and that most entrepreneurs began their businesses with own or family money
Hurst and Lusardi (2004)	Panel Study of Income Dynamics, U.S., 1984-94 1) Probit estimation of business entry 2) Instrumental variable estimation of business entry	1) Wealth (fifth-order polynomial or interval dummies) as explanatory variable 2) Past and future inheritances and regional differences in house price appreciations as instruments for net worth	1) Flat relationship between wealth and entry; only after the 95 th percentile is a positive relationship found 2) Both past and future inheritances predict current business entry, which shows that inheritances capture more than simply liquidity and invalidates them as instruments. Using regional house price appreciations, no significant effects of wealth on entry are found. Liquidity constraints are not a major deterrent to small business creation in the U.S.

Table 3 continued

Author(s) & Data publication year	Main method of analysis	Identification of credit constraints	Summary of findings	
Nykvist (2008)	Register-based representative data set LINDA, 1999-2001, Sweden	Probit estimates of entry into entrepreneurship	Assets (polynomials of various orders or interval dummies) as explanatory variables	Positive but diminishing relationship between wealth and entry. The majority of new potential entrepreneurs in Sweden are liquidity-constrained.
Cosh et al. (2009)	Survey of 2,520 entrepreneurial firms collected by the Centre for Business Research at the University of Cambridge, U.K., 1996-97	OLS, tobit, probit, and Heckman selection models of amount of external finance sought by firms and percentage obtained; distinction between specific sources of capital	Direct survey questions on finance sought and obtained, distinguishing between various types of capital	Firms that had seriously sought external finance were able to obtain on average 85% of the desired capital; the median was even 100%. However, often firms could not obtain the type of capital they preferred. Evidence for the pecking order theory.
Disney and Gathergood (2009)	British Household Panel Survey, U.K., 1995 and 2000	As in Hurst and Lusardi (2004)	As in Hurst and Lusardi (2004), but with a more disaggregated measure of unexplained house price movements	Results similar to those of Hurst and Lusardi (2004), only little evidence of financial constraints

Besides credit constraints, various authors mentioned in this section note that another possible explanation for the private equity premium puzzle may be lower risk aversion of entrepreneurs in comparison to the remainder of the population (Moskowitz and Vissing-Jorgensen, 2002; Polkovnichenko, 2003; Gentry and Hubbard, 2004). If entrepreneurs are more risk-tolerant, their wealth portfolios may result from unconstrained individual optimization, especially if nonpecuniary returns to entrepreneurship also play a role. In this case, the private equity premium puzzle does not necessarily indicate frictions in the capital market. The possibility of heterogeneous risk attitudes as an explanation for the puzzle is explored in the following sections.

4 Risk Attitudes and Entrepreneurial Choice

The results presented so far indicate that the combination of high risk and low returns to entrepreneurship can hardly be rationalized at a level of risk aversion deemed plausible for the population, at least not as the outcome of free choices in a functioning market. A possible explanation may be that risk attitudes are heterogeneous, and that less risk-averse people self-select into entrepreneurship.

The roots of such considerations lie in the work of Knight (1921), according to whom the central role of entrepreneurs is to bear uncertainty. Kihlstrom and Laffont (1979) theoretically model entrepreneurial choice as trading off risk and returns. In the equilibrium the less risk-averse individuals become entrepreneurs. Similarly Rees and Shah (1986) model the choice to be self-employed based on the risk-adjusted earnings differential between self-employment and dependent employment. They estimate an econometric model using the British General Household Survey for 1978, but without an explicit measure of risk attitudes.

In various studies that use survey data to investigate the relationship between risk attitudes and entrepreneurship, the concept of self-employment is used as an indicator for entrepreneurship. Entrepreneurship may differ from self-employment. First, in definitions

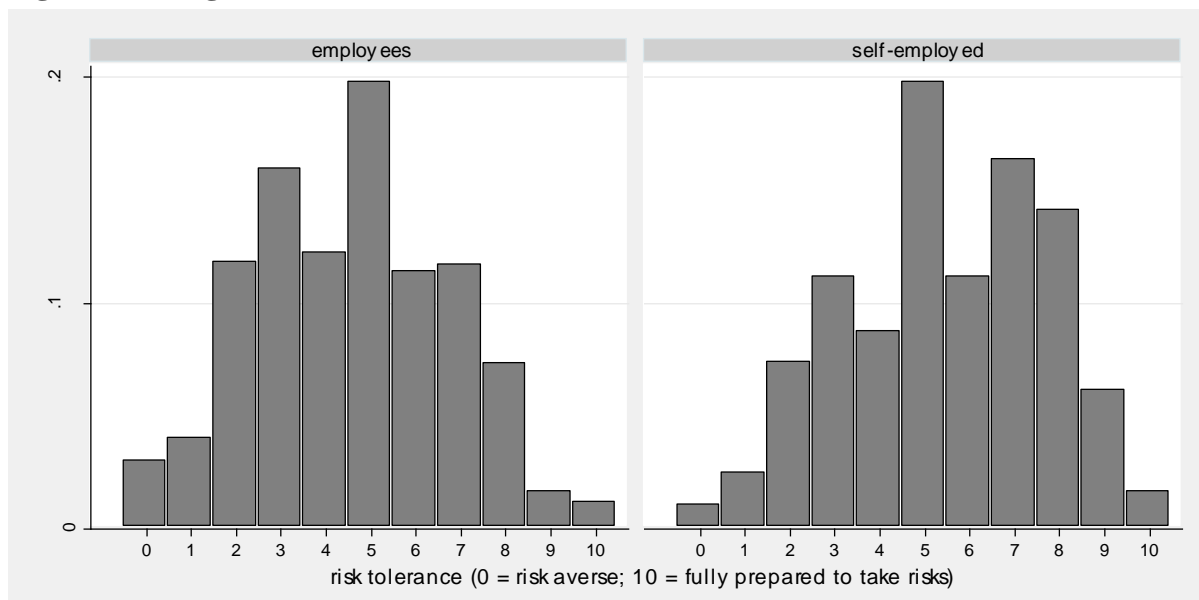
commonly used, entrepreneurship usually implies risk bearing and innovation, sometimes also the creation of new jobs, whereas self-employment goes along with income risk but not necessarily with innovation and hiring employees. In the context of investment, as discussed earlier, an entrepreneur is usually defined as someone with private business equity holdings in a firm where she has an active management interest. The different concepts are certainly overlapping to a large extent. In the German SOEP waves for 2002 and 2007, about 75 percent of the entrepreneurs, defined as individuals with a positive amount of private business equity, also report self-employment as their primary activity, and about 70 percent of the self-employed business owners employ at least one worker (Fossen, 2011).

Figure 1 provides some suggestive evidence that risk attitudes are heterogeneous and that the self-employed are more risk-tolerant than the dependently employed. The histograms are based on the 2008 SOEP, which included a question about personal willingness to take risks (as did the 2004 and 2006 waves). Respondents were asked to indicate their willingness to take risks on an 11-point scale ranging from 0 (complete unwillingness) to 10 (complete willingness). In a field experiment with real money at stake, based on a representative sample of 450 persons, Dohmen et al. (2011) find that this survey measure of risk attitudes is a good predictor of actual risk-taking behavior. Individuals are classified as self-employed if they report self-employment as their primary activity.

The histograms show that the risk tolerance distribution of the self-employed is shifted to the right, in comparison with employees. The mean risk tolerance of the self-employed on the 11-point scale is 5.50, compared with 4.59 for employees; the difference is statistically significant at the 0.1 percent level. Using population weights the difference is even larger (5.58 versus 4.56). The sample consists of 1,030 self-employed and 8,570 dependently employed persons between eighteen and sixty-five and excludes farmers, family members working for a self-employed relative, civil servants, and those currently in vocational training or military service. Similar pictures emerge if the waves of 2004 or 2006 are used, or if

instead of the self-employed one focuses on entrepreneurs, defined as those reporting positive private business equity holdings (see Fossen, 2011).

Figure 1: Histograms of risk tolerance.



Source: Author's calculations based on the SOEP (2008).

Table 4 provides additional descriptive statistics of the self-employed in comparison to employees in Germany in 2008 (both full time and part time), accounting for population weights. Results of adjusted Wald tests of equal means between the two groups are shown in the last column; a p-value smaller than 0.01 indicates that a difference is significant at the 1 percent level. In Germany 39 percent of the self-employed have a university degree, as opposed to only 18 percent of the employees. Only 34 percent of the self-employed are women. On average, the self-employed are older than employees, and they are more likely to have had a self-employed father when they were fifteen years old. A higher share of the self-employed are involved in service activities for business and in the construction sector, and a lower share work in the manufacturing industry. The self-employed receive much higher capital income (from interests, dividends, and rent and lease) than employees.

Table 4: Descriptive statistics by employment status and tests of equal means

	Employees	Self-employed	Adjusted Wald tests of equal means (p-values)
Characteristics (weighted shares in percent)			
Higher secondary school degree	24.73	48.53	0.000
Apprenticeship	52.01	36.78	0.000
Higher technical college degree	23.67	27.04	0.124
University degree	17.67	39.09	0.000
Female	48.85	33.86	0.000
Married	53.76	58.49	0.059
German nationality	90.65	95.15	0.000
East Germany	16.78	21.21	0.021
Self-employed father	7.79	14.68	0.000
Characteristics (weighted means)			
Age (years)	41.85	45.30	0.000
Work experience (years)	17.36	19.09	0.001
Unemployment experience (years)	0.74	0.73	0.834
Income from interests and dividends (euro)	1,039.71	5,535.47	0.000
Children below 17 in household (number)	0.50	0.59	0.063
Willingness to take risks (scale 0-10)	4.56	5.58	0.000
Industries (weighted shares in percent)			
Mining and quarrying	0.15	0.01	0.006
Manuf. of intermed. / nondurable goods	13.56	3.16	0.000
Manuf. of investment / durable goods	10.42	3.06	0.000
Electricity, gas, and water supply	1.12	0.13	0.000
Construction	4.83	11.19	0.000
Trade, maintenance, and repair	13.19	11.04	0.139
Hotels and restaurants	2.81	3.86	0.238
Transport, storage, and communication	4.88	3.76	0.274
Financial intermediation, real estate, renting	4.60	5.80	0.286
Business service activities	7.48	21.86	0.000
Public and personal service activities	24.33	21.90	0.206
Not categorized	12.63	14.22	0.415
Population	30,309,391	3,100,431	
Number of observations	8570	1030	

Note: Weighted by population weights. Source: Author's calculations based on the SOEP (2008).

Table 5 shows the pairwise correlation coefficients for some of the key variables. All the correlations shown are statistically significant at the 0.1 percent level. As expected, self-employment is positively correlated with risk tolerance; capital income, which is an indicator of wealth; and age. Risk tolerance is positively correlated with capital income and negatively correlated with age, but these correlations are comparably small.

Are the self-employed more risk-tolerant than employees even when all the other characteristics, such as wealth and age, are equal? The answer is yes. This is shown by several

econometric studies that control for observed differences when comparing the risk attitudes between the self-employed and other groups, based on data sets from various countries. Hartog et al. (2002) use three Dutch data sets, while Barsky et al. (1997) employ the Health and Retirement Study (HRS) in the United States. Both studies find the self-employed to be less risk-averse than employees, *ceteris paribus*, although the difference is not statistically significant in the paper by Barsky et al. The psychological literature focuses on differences in the risk attitudes between entrepreneurs and hired managers and also confirms higher risk tolerance of entrepreneurs. Stewart and Roth (2001) provide a meta-analysis of the empirical psychological literature.

Table 5: Pairwise correlation coefficients

	Self-employment	Risk tolerance	Capital income	Age
Self-employment	1			
Risk tolerance	0.1274	1		
Capital income	0.1276	0.0458	1	
Age	0.1087	-0.0746	0.0887	1

Note: All the correlations are significantly different from zero at the 0.1 percent significance level. Self-employment is a dummy variable that equals 1 if a person is self-employed, and zero otherwise. Risk tolerance is the willingness to take risks on an 11-point scale. Capital income refers to income from interests and dividends in euros. Source: Author's calculations based on the SOEP (2008).

Cramer et al. (2002) use Dutch survey data (which are also used in the study by Hartog et al., 2002), where a cohort of schoolchildren were interviewed first in 1952, at the age of twelve, and again in 1983 (when forty-three) and 1993 (when fifty-three), as far as they could be traced. The 1993 interview included a measure of risk attitudes. By means of a probit analysis, the authors find a negative correlation between risk aversion and having been self-employed at any time in adult life. Van Praag and Cramer (2001) use the same data to estimate a structural model of business formation and entrepreneurs' labor demand. The results indicate that risk aversion deters people from entrepreneurship. The shortcoming of these studies is that risk aversion is observed many years after the entrepreneurship decision in most cases. This is addressed in a study by Caliendo et al. (2009) based on the SOEP.

These panel data allow estimating the impact of risk attitudes observed before becoming self-employed on the subsequent decision to enter self-employment, controlling for wealth, age, and other relevant characteristics. The results indicate a positive and significant influence of risk tolerance on the probability of entry. This allays possible reverse causality concerns, that is, concerns that the higher risk tolerance of existing entrepreneurs may be a result of entrepreneurial experience.

At the equilibrium the self-employment rate is determined both by the entry rate into self-employment and the exit rate. By estimating discrete time hazard rate models based on the SOEP, Caliendo et al. (2010) find an inverse U-shaped relationship between risk tolerance and the duration of spells in self-employment, as also suggested by psychological research (Chell et al., 1991). A possible explanation is that entrepreneurs who are excessively risk-tolerant engage in very risky projects with high failure rates, whereas too high risk aversion leads to low expected returns from low-risk projects and makes self-employment unattractive in comparison to wage work.

Considering jointly the evidence from the various studies on entry, exit, and the probability of being self-employed, one can conclude that the positive effect of risk tolerance on entry outweighs the negative effect of excessive risk tolerance on survival, such that on balance higher risk tolerance has a consistently positive effect on the probability of being self-employed. Table 6 summarizes the empirical literature on risk attitudes and entrepreneurship using survey measures.

Entrepreneurs may not only exhibit comparably low risk aversion, but they may also have a preference for the skewed distribution of returns that entrepreneurs face: although the average returns are low, a small number of entrepreneurial superstars become extremely rich. Entrepreneurs may accept a low or even negative expected return if they are offered a small probability of a very high return. This skewness affection is suggested by Hartog and Vijverberg (2007) and Astebro (2003), for example.

Table 6: Summary of studies linking survey measures of risk attitudes with entrepreneurship

Author(s) & Data publication year	Data	Outcome studied	Main method of analysis	Summary of findings
Barsky et al. (1997)	Health and Retirement Study, U.S., 1992	Self-employment (among various others)	Regression analysis (here and in most of the other studies summarized in this table, risk aversion is included as an explanatory variable)	The self-employed are more risk-tolerant than employees, but the difference is not statistically significant
Van Praag and Cramer (2001)	Brabant survey, Dutch province Noord-Brabant, 1952, 83, 93	Business formation and entrepreneurs' labor demand	Maximum likelihood estimation of empirical structural model	Risk aversion is a serious impediment to entrepreneurship
Cramer et al. (2002)	Brabant survey (see above)	Having been self-employed in adult life	Probit analysis	Risk aversion discourages entrepreneurship
Hartog et al. (2002)	Brabant survey (see above); Accountants Survey, 1990; GPD Newspaper Survey (all in the Netherlands)	Risk aversion	Regression analysis with and without Heckman selection correction (self-employment as one of the explanatory variables)	Risk aversion is lower for the self-employed; the difference is significant in the Brabant and GPD Newspaper surveys
Caliendo et al. (2009)	Socio-Economic Panel Study (SOEP), Germany, 2004-05	Entry into self-employment	Rare events logit estimation	Higher risk tolerance increases the probability of entry into self-employment
Caliendo et al. (2010)	SOEP, Germany, 2000-05	Exit from self-employment	Discrete time hazard rate model	Inverse U-shaped relationship between risk tolerance and the duration of spells in self-employment
Fossen (2011)	SOEP, Germany, 2002, 07	Portfolio share of private business equity	Random effects tobit and Heckman selection models, instrumental variable method	Higher risk tolerance increases both the probability of owning private business equity and its portfolio share conditional on being an entrepreneur

The concept of risk aversion refers to rational choices under the assumption that individuals know the objective probability distribution of the returns to an entrepreneurial venture. However, literature suggests that entrepreneurs tend to be over-optimistic and systematically overestimate their likelihood of success (Camerer and Lovallo, 1999; Forbes, 2005; Koellinger et al., 2007). The risk-adjusted returns to entrepreneurship may thus be lower on average ex post than perceived ex ante, which may add to the explanation of the private equity premium puzzle.

The finding that risk aversion plays an important role in entrepreneurial choice may have implications for tax policy, as taxes influence both the expected level of the after-tax returns to entrepreneurship and the risk associated with these returns. The direction of the effect of taxes on entrepreneurship is not unambiguous from economic theory. On the one hand, Gentry and Hubbard (2000, 2005) argue that a progressive tax schedule reduces the expected after-tax return from a risky project and thus discourages entry into entrepreneurship. This “success tax” feature of a progressive tax emerges under the assumptions of risk-neutral agents and imperfect loss offset. On the other hand, in their classic article Domar and Musgrave (1944) demonstrate that governments may encourage entrepreneurship by sharing risk through taxation if agents are risk-averse. While the original paper focuses on a proportional tax system, a progressive tax exhibits an even stronger “insurance” effect by reducing the variance of after-tax income. Cullen and Gordon (2007) present a more comprehensive model that integrates the two effects, and a third effect, the “income shifting” effect. This effect is implied by the option to incorporate ex post based on realized earnings, which is available in the United States. Typically if a business makes a profit, it incorporates to benefit from the lower corporate tax rates; if it suffers a loss, it chooses not to incorporate in order to deduct the loss from other income under the personal income tax. The higher the personal tax rates, the more entrepreneurs benefit from this option.

Based on a series of cross-sectional tax return data from the United States, Cullen and Gordon (2007) estimate that a reduction in personal tax rates would lead to a fall in entrepreneurial risk taking, which they attribute to the income shifting and the insurance effects. Using the SOEP, Fossen (2009) estimates a structural microeconomic model of transition probabilities into and out of self-employment for Germany, which includes a risk-aversion parameter. In the model individuals make their decisions by trading off risk and returns. Simulation results based on the estimated model indicate that a hypothetical revenue-neutral tax reform in Germany, which would convert Germany’s progressive income tax

schedule into a flat-rate tax, would reduce the entry rate into self-employment and not have a significant effect on the exit rate. This is consistent with the insurance effect of taxes outweighing the success tax feature, as the estimated risk-aversion parameter indicates that the individuals in the sample are risk-averse. Other empirical studies (e.g., Parker, 2003; Bruce, 2000, 2002; Schuetze, 2000; Fossen and Steiner, 2009) find mixed results for the responsiveness of entrepreneurial choice to taxation (see Schuetze and Bruce, 2004, for a survey).

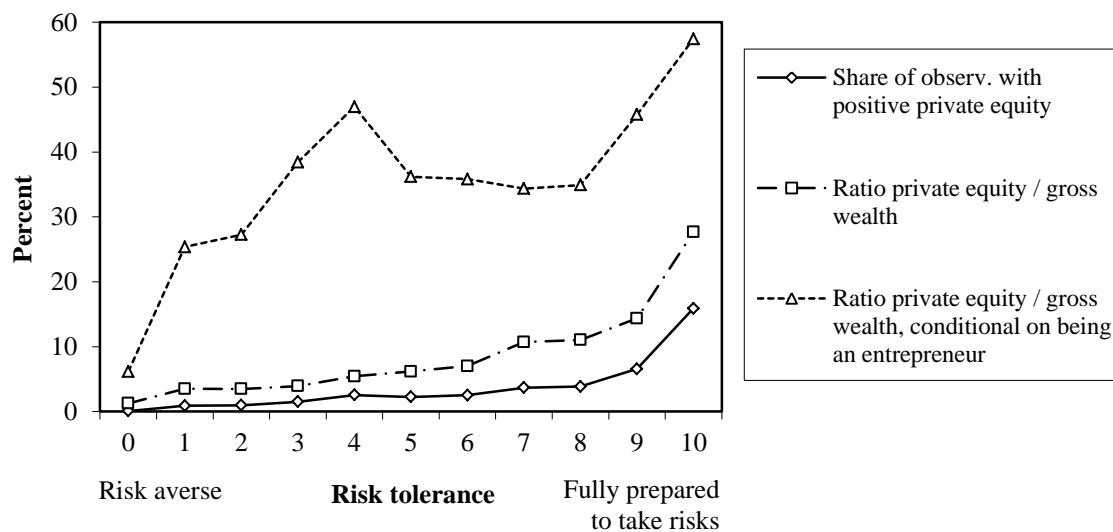
5 Risk Attitudes and Portfolios of Entrepreneurs

The evidence discussed in the previous section indicates that more risk-tolerant people are more likely to become and to be entrepreneurs. This section addresses the question of whether risk attitudes also influence entrepreneurial behavior beyond the general binary decision. Do risk attitudes influence entrepreneurial investment and financing decisions?

The relationship between risk attitudes and the share of private business equity in individual wealth portfolios is analyzed by Fossen (2011). The study relies on the self-assessed willingness to take risks, which was elicited by the SOEP in its 2004 and 2006 waves, and on the private wealth balance sheet data from the SOEP 2002 and 2007 waves (see earlier discussion). Figure 2 presents descriptive results from the paper. The data clearly suggest a positive relationship between risk tolerance and entrepreneurial investment. First, with increasing risk tolerance, the share of observations with a positive amount of private business equity increases; here ownership of private business equity is used as the definition of entrepreneurship. The positive relationship is consistent with the finding that risk-tolerant people have a higher probability of being self-employed, as established in the previous section. Second, higher risk tolerance also increases both the unconditional share of private business equity in the wealth portfolio and the portfolio share of private business equity conditional on being an entrepreneur, although the latter relationship is not monotonic in the

graph. In Fossen (2011) econometric methods control for observed and unobserved factors influencing selection into entrepreneurship and portfolio choice, and deal with potential endogeneity of the risk attitude in the portfolio choice equation. The estimation results confirm that higher individual risk tolerance significantly increases both the probability of holding private business equity and its share in the wealth portfolio conditional on ownership. According to these results, the most risk-tolerant individuals have an eight times higher probability of owning private business equity than the most risk-averse individuals, and the portfolio share of private business equity of the most risk-tolerant entrepreneurs is 31.5 percent higher than that of the most risk-averse entrepreneurs.

Figure 2: Risk attitudes and private business equity.



Source: Fossen (2011), based on the SOEP (2002/2007; risk questions from 2004/2006).

The entrepreneur's decision about her portfolio composition is likely to be interlinked with her leverage decision, which is also likely to be influenced by individual risk attitudes. For example, Lewellen's (2006) model shows how leverage affects a risk-averse manager

who is exposed to firm-specific risk through stock-based compensation.³ This is comparable to the situation of an entrepreneur who holds private business equity in her firm. Numerical simulations of the model reveal that lower assumed risk aversion of the manager leads to higher leverage. Risk-averse managers avoid leverage because of the higher volatility of the returns. Analogously for risk-averse entrepreneurs this implies that, if possible, they would rather sell parts of their business to reduce their risk exposure than take on debt which is risk-free to the creditor, apart from the default risk.

The positive relationship between risk attitudes and the portfolio share of private business equity found in Fossen (2011) remains unchanged whether or not the debt ratio is included as a control variable in the portfolio share equation. The coefficient of the debt ratio is statistically insignificant. The debt ratio is calculated as *(mortgage + other liabilities)/gross wealth*. Table 1 presents descriptive statistics on these items.

If an entrepreneur who plans to invest in her firm faces credit constraints, as discussed earlier, one possible way to sidestep arranging an explicit credit for her business may be to take on mortgage debt on home property or to use consumer credit (e.g., credit card debt) to finance the business investment. Thus if entrepreneurs make heavier use of these forms of credit than do other people, this may be interpreted as an indication of imperfect business credit markets.

In the SOEP sample mentioned before in this section, two-thirds of the entrepreneurs indeed report debt in the form of mortgage or consumer credits, as compared to only half of the nonentrepreneurs. The difference is statistically significant. However, the average debt ratio is 27.5 percent among entrepreneurs and 32.5 percent among nonentrepreneurs (after having removed outliers), and the hypothesis that the average debt ratio is the same for the

³ In a related paper Ross (2004) analytically derives how compensation contracts affect a risk-averse manager's incentives to take risks.

two groups cannot be rejected statistically.⁴ The SOEP data do not allow for observing the amount of debt held in the balance sheets of the firms, however. Respondents were asked for the net market value of their enterprise, and they were explicitly asked to take into account any remaining financial burdens when estimating the value. The debt ratio of entrepreneurs would most likely be larger if business liabilities were included. Further research is required to analyze the relationship between risk attitudes, portfolio choice, and the leverage decision. For a thorough analysis, data on total assets and liabilities within enterprises would be highly desirable. A possible step forward could be made if survey data about individual risk attitudes could be integrated with enterprise balance sheet data.

6 Conclusions and Further Research

This chapter started with the observation reported in the literature that entrepreneurs, on average, invest a large share of their wealth portfolio in their own business, despite comparably low returns and high risk. This observation may be called a private equity premium puzzle (Moskowitz and Vissing-Jorgensen, 2002).

There is some evidence suggesting that entrepreneurs face credit constraints, although this remains controversial. In this case the constraints may force entrepreneurs to invest larger shares of their wealth in their own businesses than desired. Capital market frictions may arise from agency problems. Outside investors require that entrepreneurs own a substantial share of their firms, as they find it hard to monitor an entrepreneur's effort, and ownership represents an entrepreneur's primary incentive to perform her job. Theoretical work demonstrates that models allowing for borrowing constraints are able to fit the empirical outcome when they are calibrated, even if the degree of risk aversion in the population is assumed to be homogeneous.

⁴ These averages are taken after calculating individual debt ratios, which yields different results than calculating the ratio of aggregate debt over aggregate gross wealth, using the numbers in Table 1.

Another strand of literature shows that lower risk aversion increases the probability of becoming and of being an entrepreneur. If entrepreneurs are more risk-tolerant than others, as suggested by the evidence, their risky portfolios may result from unconstrained individual optimization and do not necessarily indicate frictions in the financial markets. Survey data confirm that less risk-averse entrepreneurs devote a larger share of their wealth to their own business. Over-optimism of entrepreneurs may contribute to an explanation of their behavior. With or without capital constraints, nonpecuniary benefits of entrepreneurship, such as utility derived from independence in the workplace, are likely to supplement the low average monetary returns and may thus induce the decision to be an entrepreneur.

The explanations of credit constraints and heterogeneous risk attitudes do not exclude each other, but may rather be complementary. In the presence of capital constraints, potential entrepreneurs know that if they become entrepreneurs they have to invest a large share of their wealth in their own business, since availability of external finance is limited. The high risk involved in the resulting undiversified portfolio may explain why only the more risk-tolerant individuals enter entrepreneurship in the first place. The self-selected group of existing entrepreneurs may voluntarily choose their risky portfolios, so the credit constraints may not be binding for them; those constrained by lack of credit may be the would-be entrepreneurs who are discouraged from entry. While the joint consideration of the literature reviewed in this chapter may suggest these conclusions, they are certainly speculative at this point. More theoretical and empirical research is necessary to investigate the relationship between imperfect financial markets, heterogeneous risk attitudes, entrepreneurial self-selection, and entrepreneurial portfolio investment and financing decisions. Further research along these lines may make it possible to better evaluate the effects of government interventions in the credit market and of tax policy, which also influences risk, on entrepreneurial choice and investment behavior.

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