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Risk Preference and Entrepreneurial Investment at the Top of the Wealth Distribution*

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Abstract

We present first evidence how individual risk preferences shape entrepreneurial investment among the very wealthy using novel survey data from the top of the wealth distribution, which have been added to the 2019 German Socio-economic Panel Study. The data include private wealth balance sheets, in particular the value of own private business assets, and a standard measure of risk tolerance. We find that wealthy individuals are more likely to be entrepreneurs and invest a larger share of their wealth in their own businesses when they are more willing to take risks. These associations are stronger among wealthy than among less wealthy individuals. The results imply that policies affecting the riskiness of income and wealth, such as tax policy and bankruptcy law, affect risky investment decisions at the top of the wealth distribution in ways strongly determined by individual risk tolerance. Since the wealthy dominate aggregate risky investment, their risk preferences must be taken into account for theory development, empirical analysis, and policy evaluations.

Keywords: wealth, entrepreneurship, risk, portfolio choice
JEL Classifications: J22, J23, L26, D14

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1 Introduction

Risk tolerance is positively associated with the choice to become an entrepreneur. This relationship has been hypothesized in theoretical work (Knight, 1921; Kihlstrom and Laffont, 1979) and has been empirically confirmed for the general population (e.g. Cramer et al., 2002; Caliendo et al., 2009, 2010; Ahn, 2010; Skriabikova et al., 2014). Further, risk tolerance influences the extent of entrepreneurial activity, measured by the portfolio share invested in one's own business. Fossen (2011) shows that—conditional on being an entrepreneur—those who are more risk tolerant invest a larger share of their wealth portfolio in their own business. Due to credit constraints, primarily caused by asymmetric information, especially in the case of innovative start-ups, businesses started by entrepreneurs may often only be able to grow if the owners are willing to put up their own wealth and expose themselves to risk (Evans and Jovanovic, 1989; Blanchflower and Oswald, 1998). Thus, entrepreneurship links individual risk preferences to economic growth.

Rich lists in many countries are dominated by entrepreneurs.[1] Despite the importance of wealthy entrepreneurs in the economy, little is known about the individual determinants of their entrepreneurial investment behavior. An important reason is that the data used in studies of entrepreneurial investment so far—household surveys—include only few individuals that can be considered wealthy, and the frequency of wealthy entrepreneurs is even lower.[2] As a result, for wealthy individuals, little evidence exists on the relationship between the willingness to take risk and entrepreneurship.

Studying the risk preferences of the very wealthy is important as their risk taking and investment choices dominate the aggregate amount of risky investment in the economy (Grüner, 2003). Some of the fundamental questions regarding risk preferences need to be answered for the very wealthy: Does risk tolerance affect entrepreneurial choice, i.e., the choice to be an entrepreneur? Further, among wealthy entrepreneurs, does risk tolerance affect the portfolio share that they invest in their own business the same way it does among less wealthy entrepreneurs?

[1] For example, the top 10 in the Forbes list for 2019 (Forbes, 2019) predominantly consist of entrepreneurs, such as Jeff Bezos and Mark Zuckerberg from the U.S., while the ten richest Germans and their families all made their fortunes by founding firms and entrepreneurship (Welt, 2020).

[2] For instance, the US Survey of Income and Program Participation used by Hamilton (2000) to analyze entrepreneurial earnings oversamples low-income households, but not high-wealth households. Quadrini (1999) uses the 1984 and 1989 waves of the US Panel Study of Income Dynamics (PSID) to analyze entrepreneurial wealth, which does not oversample wealthy households either. Pfeffer et al. (2016) show that estimates of average net worth, especially of business assets, are significantly underestimated in the PSID, primarily in the top 2% of the wealth distribution.

The German Socio-Economic Panel (SOEP) opens up new possibilities to answer these questions. Since 2019, the SOEP has included a novel sub-sample, SOEP-P, which samples from the segment of very wealthy individuals in Germany. SOEP-P comprises 1956 adult anchorpersons plus 484 adult household members (mainly spouses). Of the 1956 adult anchorpersons about 45% hold an individual net worth of at least one million euro and 74% are self-employed. For the purpose of this paper, we define individuals with net worth (total assets minus liabilities) of one million euro or above as wealthy.

Our data show that the wealthy differ from the less wealthy population in terms of their risk preferences and personality. In particular, the wealthy are significantly more willing to take risk than the non-wealthy.[3] This difference in risk tolerance is reflected in more risky entrepreneurial behavior among the wealthy. Wealthy entrepreneurs invest 52% of their personal wealth in their own businesses, as opposed to only 29% among non-wealthy entrepreneurs. For the first time, we document that the willingness to take risk increases the probability of being an entrepreneur among the wealthy.[4] Furthermore, conditional on being a wealthy entrepreneur, a higher willingness to take risk is associated with a larger portfolio share invested in one's business, controlling other relevant factors. Finally, these relationships of risk tolerance with entrepreneurial activity are stronger among the wealthy than among the non-wealthy. Thus, risky entrepreneurial investment at the top of the wealth distribution is even more strongly determined by individual risk preferences than what results from the general population would have suggested.

Our results are relevant for several reasons. First, they inform central debates on redistributive public policies affecting the riskiness of income and wealth, such as taxation and bankruptcy law. As the riskiness of after-tax income influences how much wealthy entrepreneurs invest in their business, these policies will affect aggregate entrepreneurial risk-taking, which is crucial for innovation and economic growth (Van Stel et al., 2005; Carree and Thurik, 2010; Acs and Armington, 2006). Our results imply that policies affecting the riskiness of income and wealth shape risky investment decisions at the top of the wealth distribution in ways strongly determined by individual risk preferences. Thus, the higher risk tolerance of the wealthy and the heterogeneity among them must be taken into account for theory development, future empirical

[3] Our finding is consistent with Brenner (2015), who reports that senior managers are more risk tolerant than less senior managers, given that senior managers are more wealthy on average.

[4] For the purpose of this paper, we define entrepreneurs as owners of one or multiple private businesses. In a robustness check, we use self-employment in the main job as an alternative definition.

analysis and policy evaluations. Further, the rate at which wealthy entrepreneurs invest in their businesses is crucial to understand both the shape and dynamics of the wealth distribution, since entrepreneurs dominate the top of this distribution (Cagetti and De Nardi, 2006; De Nardi and Fella, 2017).

2 Top Wealth Data

Data Requirements and Data Overview. Studying wealthy entrepreneurs is difficult for a number of reasons. First, they constitute only a very small fraction of the overall population. As a result, their numbers in standard household surveys, which traditionally build on random draws from the base population, are small. Second, the data must provide simultaneous information on entrepreneurial activity, portfolio composition, and a reliable measure of risk tolerance, which is also very rare. Most datasets providing wealth information inform about financial assets such as stocks and bonds, plus, less frequently, non-financial assets such as real estate. Very few datasets include the value of own private businesses.

With its new high-wealth subsample, SOEP-P, first collected in 2019 (see Schröder et al., 2020), the German Socio-Economic Panel (SOEP) is unique in fulfilling the aforementioned data requirements. SOEP is a representative survey of German households (Goebel et al., 2019; Schröder et al., 2020). The new high-wealth sample SOEP-P is a fully integrated subsample of the SOEP. The same interviewing method (computer-assisted personal interviews) and the same questionnaire were used for SOEP-P and SOEP. Thus, variables are fully harmonized between the two datasets, which makes them ideal for comparisons of wealthy and non-wealthy populations. The fully integrated dataset, which we call SOEP v36_beta[5], comprises about 2189 entrepreneurs with strictly positive private business holdings, of which 817 hold an individual net worth of at least one million euro.

As regards wealth, the SOEP-questionnaire contains a module about respondents' asset portfolios. Surveyed assets include: Owner-occupied housing, rental property, financial assets, building-loan contracts, life and private pension insurance, tangible assets, vehicles, and, most importantly for this analysis, own private businesses (market value). In case an asset such as a home or a business are owned by multiple individuals such as spouses or business partners, the respondent is asked about his or her individual share. The survey also collects the individual's

[5]This is because the official data release is still to come. We have generated the variables relevant to our analysis, but many more variables must be generated before the official release.

liabilities: the mortgage on owner-occupied housing, mortgages on rental property, consumer debt, and education debt.

Focal Variables. Our main outcome of interest is entrepreneurial activity, which we define based on own business assets. An individual is classified as an entrepreneur if the value of own private businesses is strictly positive. In a robustness check, we alternatively define entrepreneurs as those who indicate that their primary occupation is self-employment.[6] The extent of entrepreneurial activity is captured by the portfolio share of own business assets (like in Fossen, 2011). We calculate the portfolio share of business assets as the value of own business assets divided by total gross wealth. An individual's total gross wealth is the sum of all assets, and net worth is gross wealth minus the sum of all individual liabilities. Accordingly, the portfolio share of own business assets in total gross wealth ranges between zero and one. The portfolio share of own business assets provides much richer information on the extent of entrepreneurial activity than a binary variable of entrepreneurship used in almost all prior studies of the relationship between individual risk preferences and entrepreneurship.[7]

Our main independent variable is risk tolerance. In the SOEP questionnaire, respondents are asked how much risk they are willing to take in general on a scale from 0 to 10, where 0 means "completely unwilling" and 10 means "fully willing". Dohmen et al. (2011) compare this self-rated risk measure with an alternative measure of risk tolerance they obtain from an incentivized lottery experiment in the field and find that the self-rating predicts actual risk-taking behavior very well. Pinger (2017) also shows that the responses are a strong predictor of real life outcomes. In some of our specifications, we use dummy variables for ranges of risk tolerance. We define a range of 0-3 as low, 4-7 as medium, and 8-10 as high risk tolerance. Another potentially important determinant of entrepreneurship, which is related to risk preferences, is personality. The SOEP covers the Big Five personality traits openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Zhao et al., 2010). The short inventory elicits the traits by asking respondents how much they agree with 15 statements about themselves on a 7-point Likert scale. We standardize the variables of risk tolerance and the Big 5 traits to facilitate interpretation of the marginal effects.

[6]The self-employed may or may not employ others in their business and may or may not have other self-employed partners.

[7]The paper by Fossen (2011) is an exception, but the data used in this paper do not include a sufficient number of wealthy entrepreneurs to allow inference on their behavior.

We include several control variables in our analyses. In our setting, it is important to control for possibly nonlinear effects of wealth. Risk tolerance may change with the wealth level, and wealth may affect entrepreneurial choice for reasons other than risk tolerance, for example, due to credit constraints (e.g. Hurst and Lusardi, 2004). We also control for the Big Five personality traits listed above. These traits describe an individual's personality and are related to entrepreneurial decisions (e.g. Caliendo et al., 2014), which makes them potentially important control variables to isolate the effect of risk tolerance. Further, we account for variables that have been shown to be relevant for an individual's entrepreneurial choice (e.g. Parker, 2009): educational degrees, age and its square, gender, the number of children, marital status, migration background, disability, the self-employment status of mother and father when the respondent was 15 years old, region (in particular, residence in former East Germany), and the personal income tax rate.[8]

Population and Estimation Sample. The population of interest for our study is the active working population. For this reason, we use the full SOEP v36_beta, but we exclude all SOEP respondents younger than 19 and older than 65. The working sample contains 1,989 entrepreneurs and 18,679 non-entrepreneurs.

We define individuals with net worth greater than or equal to one million euro as "wealthy" and those with lower net worth as "non-wealthy". 913 respondents in our sample are wealthy, 78% of whom are entrepreneurs. 19,755 respondents are non-wealthy, 6% of whom are entrepreneurs.[9] This provides us with sufficient statistical power to analyze the very wealthy.

3 Methods

Our primary goal is to estimate the association of risk tolerance and entrepreneurial activity. We evaluate the association at the intensive margin (portfolio share invested in one's own business), conditional on being an entrepreneur, and at the extensive margin (being an entrepreneur, as measured by a strictly positive portfolio share, or not). We estimate the relationship separately for the wealthy and the non-wealthy.

Because the portfolio share of own business assets is bounded between zero and one and most individuals have zero business assets (non-entrepreneurs), we estimate a Tobit model. The

[8] The individual average effective tax rate is calculated as $1 - \frac{net-of-tax\ income}{gross\ income}$.

[9] Because of partial unit non-response, numbers of observations for analyses with more covariates can be smaller.

latent index model is,

$$share\_business_i^* = \alpha + \beta \times risk\_tolerance_i + X_i\gamma + \epsilon_i. \quad (1)$$

The explanatory variable of main interest, $risk\_tolerance$, is a continuous variable assumed to have a linear relationship with entrepreneurial activity in the most basic specification. We relax the linearity assumption in an additional specification where $risk\_tolerance$ is coded into a vector of dummy variables (see focal variables above). Based on the estimated Tobit model, we will provide average marginal effects (or average discrete effects in case of the dummy variable specification) both on the extensive and intensive margins.[10] The vector X_i includes the control variables described above. Finally, ϵ_i is the error term. We report standard errors robust to heteroskedasticity.

The Tobit model is restrictive in the sense that it implies that the effect of risk tolerance at the extensive margin (probability of being an entrepreneur) has the same sign as the effect at the intensive margin (portfolio share of own business assets conditional on being an entrepreneur). Therefore, in a robustness check, we estimate the relationship at the extensive margin separately by means of the Probit model,

$$P(entrepreneur_i = 1|risk\_tolerance_i, X_i) = \Phi\left(\tilde{\alpha_0} + \tilde{\beta} \times risk\_tolerance_i + X_i\tilde{\gamma}\right), \quad (2)$$

with the dependent variable being a dummy variable equal to one if an individual is an entrepreneur (with positive private business assets) and zero otherwise. Φ is the cumulative normal distribution. The independent variables are the same as in the Tobit model.

4 Results

4.1 Individual Characteristics and Assets of the Wealthy

Most wealthy individuals in Germany hold at least part of their wealth in own business assets. The observation numbers in Table 1 show that 78% of the wealthy individuals in the sample are entrepreneurs in the sense of being private business owners. The average monthly labor income of wealthy non-entrepreneurs is about 5,700 euro and of wealthy entrepreneurs almost 9,000

[10] As mentioned above, we use the portfolio share of own business assets to measure both the extensive margin of entrepreneurial activity (zero versus strictly positive share) and the intensive margin (share conditional on being strictly positive).

euro, as compared to roughly 2,200 euro and 5,000 euro, respectively among the non-wealthy. The wealthy are also older and on average and have higher educational attainment than the non-wealthy (see also Schröder et al., 2020).[11] The wealthy are male dominated, particularly in the group of entrepreneurs.

Table 1. Descriptive Statistics

	Wealthy			Non-wealthy		
Variable	Non-Entrp.	Entrp.	p-value	Non-Entrp.	Entrp.	p-value
Wealth Share of Own Business	0.00	0.52	0.00	0.00	0.29	0.00
Self-employment	0.29	0.75	0.00	0.04	0.68	0.00
Risk Tolerance	5.73	6.86	0.00	5.12	6.21	0.00
Low Risk Tolerance	0.21	0.07	0.00	0.28	0.15	0.00
Medium Risk Tolerance	0.53	0.49	0.32	0.55	0.52	0.06
High Risk Tolerance	0.26	0.44	0.00	0.17	0.33	0.00
Openness	4.75	5.01	0.01	4.54	4.86	0.00
Conscientiousness	2.10	2.01	0.11	2.15	2.03	0.00
Extraversion	2.06	2.20	0.02	2.14	2.19	0.06
Agreeableness	2.00	2.20	0.00	2.05	2.06	0.52
Neuroticism	1.03	1.06	0.70	1.33	1.18	0.00
Highschool	0.61	0.58	0.42	0.33	0.50	0.00
Apprenticeship	0.34	0.30	0.27	0.37	0.35	0.07
Technical College	0.18	0.25	0.04	0.21	0.27	0.00
University	0.51	0.45	0.16	0.23	0.38	0.00
Age	53	52	0.01	43	50	0.00
Female	0.39	0.19	0.00	0.56	0.35	0.00
Married	0.78	0.73	0.16	0.55	0.73	0.00
Migration Background	0.25	0.24	0.75	0.51	0.29	0.00
Disability Degree	3.59	1.53	0.02	5.06	2.29	0.00
East	0.07	0.17	0.00	0.19	0.23	0.00
South	0.42	0.33	0.01	0.26	0.25	0.30
North	0.11	0.10	0.67	0.14	0.10	0.00
Gross Income	5668	8976	0.00	2217	4978	0.00
Average Tax Rate	0.27	0.36	0.01	0.27	0.32	0.00
Observations	198	715		18481	1274	

Note: Own calculations based on SOEP v36_beta. The p-values refer to tests of equal means between non-entrepreneurs and entrepreneurs within the sample of the wealthy and non-wealthy. Big 5 personality items are non-standardized in this table. Results are unweighted.

The wealthy express a higher risk tolerance than the non-wealthy: Among wealthy entrepreneurs, general willingness to take risk is about 6.9 on average on the scale from 0 to 10 and significantly higher than that of wealthy non-entrepreneurs, which is only 5.7. For the

[11] The educational degrees are not mutually exclusive, because they can be accumulated; we do not code the highest educational degree.

non-wealthy, the respective numbers are significantly smaller, i.e. 6.2 and 5.1.[12] In both the samples of the wealthy and non-wealthy, entrepreneurs have a significantly higher willingness to take risk than non-entrepreneurs, as indicated by p-values below 0.01. The difference between entrepreneurs and non-entrepreneurs is consistent with what prior research shows for the general population (Caliendo et al., 2009, 2014).

Nicholson et al. (2005) report that the willingness to take risk is correlated with personality traits as described by the Big Five factors, combining high openness to experience and extraversion with low neuroticism, agreeableness, and conscientiousness. Consistent with this, entrepreneurs score higher than non-entrepreneurs in the traits openness to experience and extraversion (independent of wealth), and non-wealthy entrepreneurs also score lower than non-wealthy non-entrepreneurs in neuroticism and conscientiousness. However, agreeableness is larger for wealthy entrepreneurs than wealthy non-entrepreneurs.

Entrepreneurs hold their private wealth in remarkably undiversified portfolios. This was reported for Germany based on the SOEP without SOEP-P (Fossen, 2012; Fossen et al., 2020) and for the United States based on the Survey of Consumer Finances (Gentry and Hubbard, 2004). Table 2 shows portfolio composition of the wealthiest individuals in Germany and compares them to the non-wealthy, separately for non-entrepreneurs and entrepreneurs. The table provides the new insight that wealthy entrepreneurs diversify their investments even less than non-wealthy entrepreneurs: On average, wealthy entrepreneurs invest 52% of their wealth in their own business, whereas this share is only 29% among non-wealthy entrepreneurs.

Figure 1 shows the relationship between willingness to take risk and entrepreneurial activity, both at the extensive margin (being an entrepreneur, i.e., a business owner) and the intensive margin (the portfolio share of own business assets conditional on being an entrepreneur). The unconditional portfolio share is also provided. Panel (a) displays the relationships among the non-wealthy and Panel (b) among the wealthy. Entrepreneurial activity is much larger among the wealthy than among the non-wealthy across all risk preferences. For example, for the risk tolerance level of 5, the probability of being an entrepreneur is about 78.7% for the wealthy and only about 5.6% for the non-wealthy, and the conditional portfolio share of own business assets is about 50% for the wealthy and 27% for the non-wealthy. For both the wealthy and the non-wealthy, the Figure shows that there are positive relationships between the willingness

[12] When pooling entrepreneurs and non-entrepreneurs, the average willingness to take risk of the wealthy is 6.6 and of the non-wealthy 5.2 (not shown in the table). The difference is significant at the 1% level.

Table 2. Portfolio Composition

	Wealthy			
	Non-Entrepreneurs		Entrepreneurs	
	Mean	Share	Mean	Share
Owner-occupied Housing	606822	0.34	415685	0.15
Rental Property	950689	0.40	976278	0.21
Financial Assets	437387	0.16	297288	0.06
Building Loan Contracts	13500	0.01	11043	0.00
Private Life & Pension Insur.	601198	0.05	158483	0.04
Own Business Assets	0	0.00	3161371	0.52
Vehicles	229076	0.03	40578	0.01
Tangible Assets	32536	0.02	23484	0.00
Gross Wealth	2871207	1.00	5084211	1.00
Owner-occ. Housing Debt	56823		49622	
Rental Property Debt	154767		278478	
Consumer Debt	9928		53083	
Education Debt	0		0	
Total Debt	221518	0.08	381183	0.08
Net Worth	2649689	0.92	4703027	0.92
Observations	198		715	

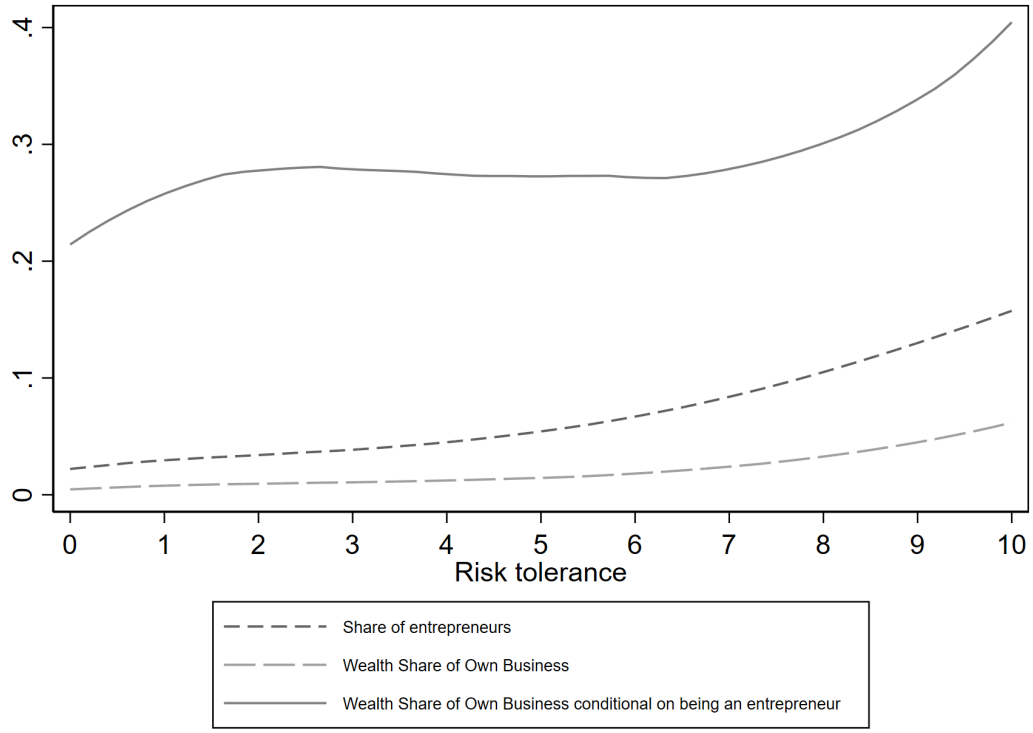
	Non-wealthy			
	Non-entrepreneurs		Entrepreneurs	
	Mean	Share	Mean	Share
Owner-occupied Housing	63868	0.59	143269	0.34
Rental Property	15239	0.14	77068	0.18
Financial Assets	10378	0.10	26052	0.06
Building Loan Contracts	3139	0.03	5595	0.01
Private Life & Pension Insur.	8900	0.08	33279	0.08
Own Business Assets	0	0.00	120789	0.29
Vehicles	5907	0.05	13739	0.03
Tangible Assets	561	0.01	1901	0.00
Gross Wealth	107991	1.00	421693	1.00
Owner-occ. Housing Debt	15513		32722	
Rental Property Debt	4094		25948	
Consumer Debt	3479		38657	
Education Debt	279		105	
Total Debt	23375	0.22	97432	0.23
Net Worth	84625	0.78	324260	0.77
Observations	18481		1274	

Note: Own calculations based on SOEP v36_beta. Share is the average of the share of the wealth item related to gross wealth. We do not show the shares for debts because the shares may on an individual basis be larger than 1. Results are unweighted.

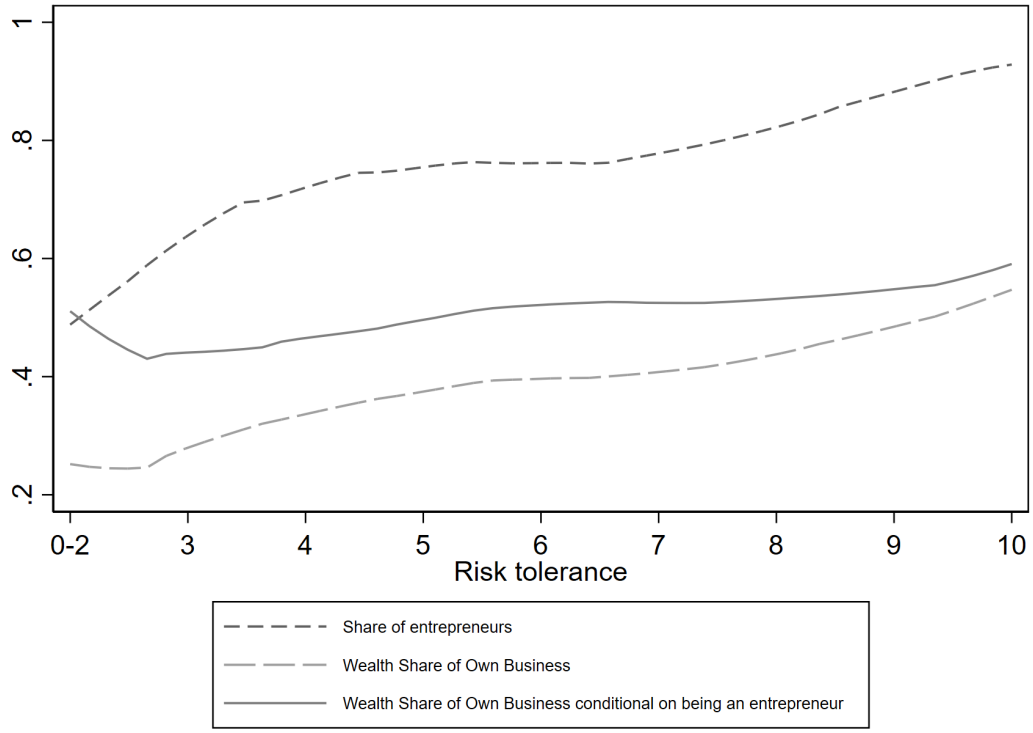
to take risk and the portfolio share of own business assets, both at the intensive and extensive margins. The positive association is plausible because investment in undiversified small business equity is very risky (Moskowitz and Vissing-Jørgensen, 2002). We provide the first evidence that this relationship also holds for the wealthy.

4.2 Risk Tolerance and Entrepreneurial Investment

This section presents the results from the Tobit estimation of the share of own private business assets in an individual's wealth portfolio. Table 3 shows the estimated Tobit coefficients from separate estimations for the non-wealthy (Columns 1 and 3) and the wealthy (Columns 2 and 4). In Columns 1 and 2, the willingness to take risk enters the model as a linear variable, whereas in Columns 3 and 4 we include dummy variables for medium and high risk tolerance (with low risk tolerance as omitted base category). All coefficients of the risk tolerance variables are positive and significant at the 1%-level, both for the wealthy and non-wealthy, indicating that individuals with a higher willingness to take risk invest a larger share of their wealth portfolio in own private businesses.



(a) Non-wealthy



(b) Wealthy

Note: Own calculations based on SOEP v36_beta. We show local quadratic polynomial smooths of the data. In the bottom panel we have collapsed categories 0, 1, and 2 of risk tolerance into one category because of a low number of observations. Results are unweighted.

Figure 1. Entrepreneurship and Risk Tolerance

Table 3. Wealth Share of Own Business: Tobit Coefficients

	(1) Non-wealthy	(2) Wealthy	(3) Non-wealthy	(4) Wealthy
Risk Tolerance	0.044***	0.030***		
	(0.005)	(0.007)		
Medium Risk Tolerance			0.088***	0.181***
			(0.024)	(0.051)
High Risk Tolerance			0.274***	0.217***
			(0.029)	(0.053)
Openness	0.195***	-0.022	0.200***	-0.012
	(0.031)	(0.040)	(0.031)	(0.040)
Conscientiousness	-0.226***	-0.114*	-0.228***	-0.107
	(0.051)	(0.069)	(0.051)	(0.069)
Extraversion	0.058	0.066	0.063	0.067
	(0.044)	(0.066)	(0.044)	(0.066)
Agreeableness	0.008	0.113**	0.009	0.118**
	(0.045)	(0.057)	(0.045)	(0.057)
Neuroticism	0.023	0.077	0.019	0.071
	(0.035)	(0.052)	(0.035)	(0.052)
Wealth in Thsd.	0.092***	0.002***	0.092***	0.003***
	(0.004)	(0.000)	(0.004)	(0.000)
Wealth in Thsd. Squared	0.001***	-0.000***	0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Gross Income in Thsd.	0.031***	0.008***	0.032***	0.007***
	(0.003)	(0.002)	(0.003)	(0.002)
Tax Rate	0.011	0.071**	0.010	0.069**
	(0.034)	(0.028)	(0.033)	(0.027)
Highschool	0.029	-0.015	0.032	-0.014
	(0.023)	(0.032)	(0.023)	(0.032)
Apprenticeship	-0.003	0.003	-0.001	0.003
	(0.024)	(0.034)	(0.024)	(0.034)
Higher Tech. College	0.064**	-0.003	0.068***	-0.004
	(0.026)	(0.038)	(0.026)	(0.038)
University	-0.038	-0.024	-0.034	-0.024
	(0.026)	(0.032)	(0.026)	(0.032)
Female	-0.126***	-0.078**	-0.132***	-0.083**
	(0.020)	(0.035)	(0.020)	(0.035)
Number of Children	-0.015	-0.027*	-0.014	-0.028*
	(0.010)	(0.015)	(0.010)	(0.016)
Married	0.019	0.063**	0.018	0.068**
	(0.022)	(0.031)	(0.022)	(0.031)
Age	-0.037*	0.025	-0.038*	0.027
	(0.022)	(0.032)	(0.022)	(0.032)
Age Squared	-0.003***	-0.002	-0.003***	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Migration Background	0.065***	-0.036**	0.064***	-0.034**
	(0.007)	(0.016)	(0.007)	(0.016)
Disability Degree	-0.001***	0.000	-0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Father Self-employed	0.234***	0.052*	0.233***	0.047
	(0.028)	(0.029)	(0.027)	(0.029)
Mother Self-employed	0.091**	-0.091**	0.097**	-0.090**
	(0.039)	(0.045)	(0.039)	(0.044)
East	0.091***	0.133***	0.092***	0.125***
	(0.024)	(0.039)	(0.024)	(0.039)
South	-0.097***	-0.002	-0.098***	-0.003
	(0.024)	(0.031)	(0.024)	(0.031)
North	-0.093***	-0.036	-0.091***	-0.035
	(0.030)	(0.048)	(0.030)	(0.048)
Constant	-2.825***	1.162***	-2.686***	1.137***
	(0.169)	(0.399)	(0.165)	(0.408)
Observations	19186	907	19186	907

Note: Own calculations using SOEP v36_beta. Results are unweighted. Standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4 presents the average marginal and discrete effects of the focal independent variables, i.e. risk tolerance and the Big Five personality traits, based on the estimated Tobit models. An individual whose level of risk tolerance is one standard deviation higher than another individual's risk tolerance has a 1.1 percentage points larger probability of being an entrepreneur if they are wealthy and an 0.7 percentage points larger probability if they are not. Conditional on being an entrepreneur, a one standard deviation higher risk tolerance increases the share invested in one's own business by 1.3 percentage points for the wealthy and 0.5 percentage points for the non-wealthy.

Table 4. Wealth Share of Own Business and Entrepreneurship: Tobit Marginal Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Probability of Being an Entrepreneur				Cond. Wealth Share of Own Business			
	Non-wealthy	Wealthy	Non-wealthy	Wealthy	Non-wealthy	Wealthy	Non-wealthy	Wealthy
Risk Tolerance	0.007***	0.011***			0.005***	0.013***		
	(0.001)	(0.003)			(0.001)	(0.003)		
Medium Risk Tol.			0.011***	0.134***			0.010***	0.077***
			(0.003)	(0.051)			(0.003)	(0.022)
High Risk Tol.			0.035***	0.160***			0.031***	0.092***
			(0.003)	(0.055)			(0.003)	(0.023)
Openness	0.031***	-0.008	0.025***	-0.009	0.022***	-0.009	0.023***	-0.005
	(0.005)	(0.015)	(0.004)	(0.030)	(0.003)	(0.017)	(0.003)	(0.017)
Conscientiousness	-0.036***	-0.042	-0.029***	-0.079	-0.026***	-0.048*	-0.026***	-0.045
	(0.008)	(0.026)	(0.007)	(0.052)	(0.006)	(0.029)	(0.006)	(0.029)
Extraversion	0.009	0.024	0.008	0.049	0.007	0.028	0.007	0.028
	(0.007)	(0.024)	(0.006)	(0.049)	(0.005)	(0.028)	(0.005)	(0.028)
Agreeableness	0.001	0.042**	0.001	0.087**	0.001	0.048**	0.001	0.050**
	(0.007)	(0.021)	(0.006)	(0.043)	(0.005)	(0.024)	(0.005)	(0.024)
Neuroticism	0.004	0.028	0.002	0.053	0.003	0.032	0.002	0.030
	(0.006)	(0.019)	(0.004)	(0.039)	(0.004)	(0.022)	(0.004)	(0.022)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19186	907	19186	907	19186	907	19186	907

Note: Own calculations based on SOEP v36_beta. We show average marginal effects. Results are unweighted. Standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

To capture potential non-linearities in the relationship between risk tolerance and entrepreneurial portfolio choice, an alternative specification includes dummy variables for medium and high risk tolerance. The predictions obtained from this and the linear specification are similar, as shown in Figure 2, which presents predictions at the mean values of the control variables.[13] The interpretation of the estimates is clearest in the dummy variables model (Table 4): Wealthy individuals with a medium level of risk tolerance are 13 percentage points more likely to be an entrepreneur than those with a low level of risk tolerance. If they have a high level of risk tolerance, the likelihood is even 16 percentage points larger. Conditional on being an entrepreneur, wealthy persons with a medium risk tolerance invest about 8 percentage points more of their wealth in their own business than those with a low risk tolerance, and those with a high risk tolerance level even 9 percentage points more. These associations, both at the extensive and intensive margins, are much larger for the wealthy than for the non-wealthy, although they are also significantly different from zero at the 1%-level for the non-wealthy. The difference between the associations for the wealthy and non-wealthy is statistically significant at the 1%-level as well.[14] In sum, both the linear and the dummy variables specifications indicate that risk preferences play an even larger role in entrepreneurial decisions among the wealthy than among the non-wealthy.

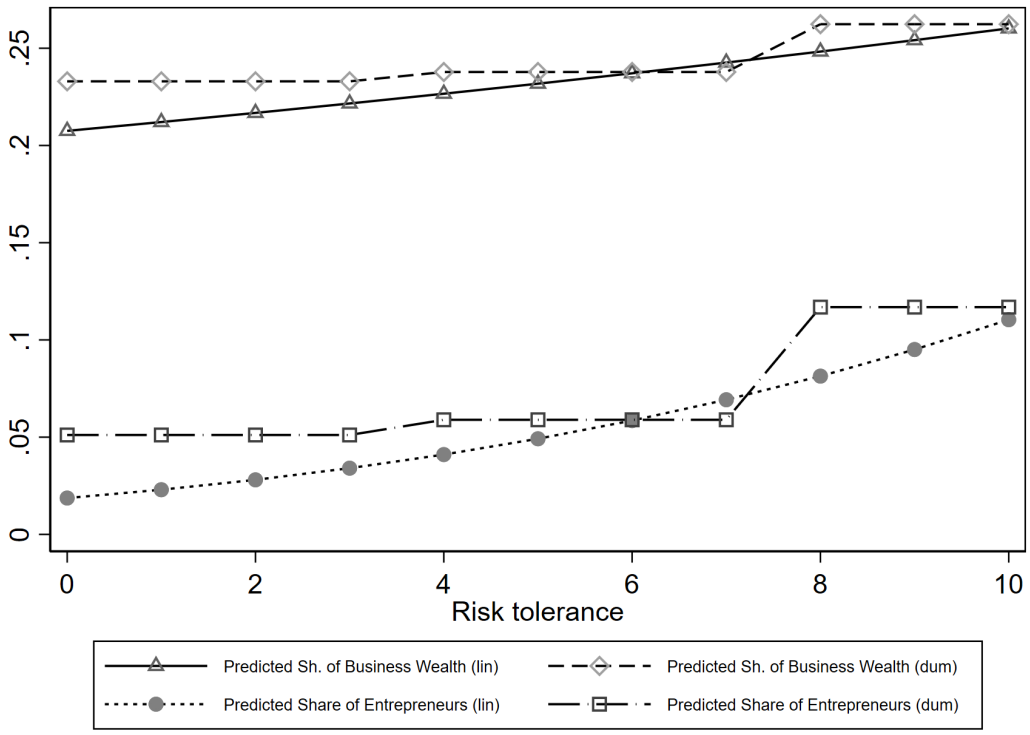
Our analysis also reveals interesting differences between the wealthy and non-wealthy with regard to the association of the Big 5 personality traits with entrepreneurial investment (Table 4). Controlling for other individual characteristics, openness to experience has a positive association with entrepreneurial investment only for the non-wealthy, whereas agreeableness exhibits a significantly positive association only for the wealthy.[15] Conscientiousness is negatively related to entrepreneurial investment, but the negative point estimates of the marginal effects lack statistical significance for the wealthy except for column 6, where it is significant at the 10% level.

The Tobit coefficients of the other control variables seem plausible (Table 3). For example, wealthier individuals invest a larger share of their wealth in an own business, and women invest

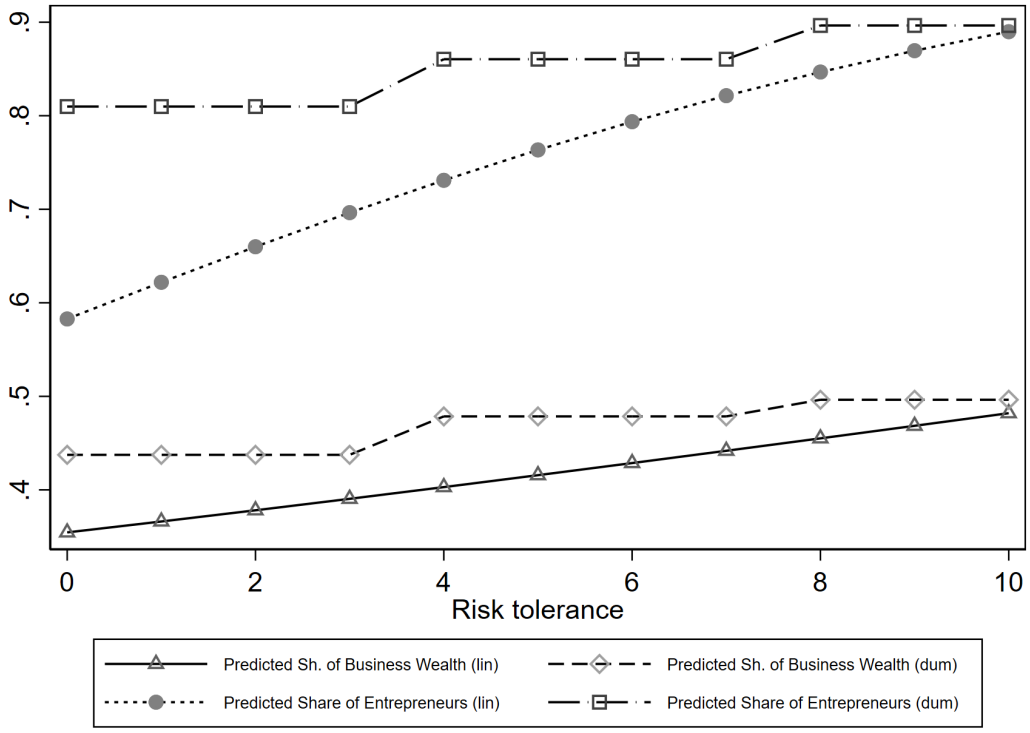
[13] Table 4 shows average marginal effects instead.

[14] To conduct this test, we estimate the model based on the pooled sample of the wealthy and non-wealthy and interact all independent variables with a dummy variable indicating the wealthy, thus, mimicking the separate estimations reported above. We then test whether the coefficients of the interaction terms of the two dummy variables capturing risk tolerance with the dummy for the wealthy are jointly significantly different from zero.

[15] Caliendo et al. (2014) report a positive relationship between openness to experience and the probability of self-employment, which is consistent with the association of this trait with the probability of being an entrepreneur (defined as a business owner) among the non-wealthy reported here. Our results for the wealthy as well as the relationships of the Big 5 traits with entrepreneurial investment are novel results not previously reported in the literature.



(a) Non-wealthy



(b) Wealthy

Note: Own calculations based on SOEP v36_beta. Results are unweighted. The figure shows the predicted ownership probability and conditional portfolio share of private business assets as a function of risk tolerance at average values of the control variables in the estimation samples. The predictions are based on the estimated Tobit coefficients in Table 3. The models including risk tolerance as a linear model are denoted lin and the models including risk tolerance as dummy variables are denoted dum.

Figure 2. Predicted Responses to Risk Tolerance

less in own ventures. Individuals whose fathers were self-employed when they were 15 years old invest more in their own businesses. Interestingly, self-employed mothers also have a (weaker) positive association with own entrepreneurial investment among the non-wealthy, but a negative association among the wealthy.

4.3 Robustness Checks

As mentioned in Section 3, the Tobit model is restrictive in the sense that the signs of the relationships of risk tolerance with entrepreneurial activity must be the same at the extensive and intensive margins. Therefore, in the first robustness check, we separately re-estimate the probability of being an entrepreneur, i.e., the probability of holding private business assets, using a probit model. We focus on the more flexible specification where risk tolerance enters the model as a set of dummy variables. Table 5, Columns 1 and 2, present the estimated marginal effects of medium and high risk tolerance (in comparison to low risk tolerance) and of the Big Five personality traits.[16]

[16] We also include all other control variables, but omit the results for brevity. They are available from the authors on request.

Table 5. Entrepreneurship or Self-Employment: Probit Marginal Effects

	(1) Entrep. Non-wealthy	(2) Entrep. Wealthy	(3) Selfemp. Non-wealthy	(4) Selfemp. Wealthy
Medium risk tol.	0.012***	0.132**	0.018***	0.049
	(0.003)	(0.056)	(0.003)	(0.054)
High risk tol.	0.043***	0.207***	0.050***	0.098*
	(0.003)	(0.064)	(0.003)	(0.059)
Openness	0.024***	0.027	0.058***	0.080*
	(0.005)	(0.049)	(0.006)	(0.048)
Conscientiousness	-0.038***	-0.185**	-0.032***	-0.125
	(0.007)	(0.087)	(0.008)	(0.085)
Extraversion	0.009	0.099	0.009	0.157**
	(0.006)	(0.081)	(0.007)	(0.078)
Agreeableness	0.000	0.205***	-0.007	0.115*
	(0.006)	(0.075)	(0.007)	(0.069)
Neuroticism	0.004	0.017	-0.003	-0.090
	(0.005)	(0.067)	(0.005)	(0.061)
Control variables	Yes	Yes	Yes	Yes
Observations	19197	907	19197	907

Note: Own calculations based on SOEP v36_beta. Results are unweighted. Standard errors in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The point estimates of the marginal effect of medium and high risk tolerance on being an entrepreneur are similar to those obtained from the Tobit model in Table 4, both for the wealthy and the non-wealthy; the confidence intervals from the two estimators overlap. Openness to experience has a somewhat larger positive association with entrepreneurship for the non-wealthy when using the Probit model.

In the second robustness check, we estimate the probability of being self-employed instead of the probability of being a business owner. Table 1 shows that 68% of the non-wealthy private business owners also report self-employment as their primary occupation, and even 75% among the wealthy business owners. A possible explanation for the different shares is that among the non-wealthy, more business owners have sideline businesses, but are employees in different companies as their main jobs because their own businesses do not generate sufficient income. According to the estimation results for the non-wealthy in Table 5, the marginal effects of medium and high risk tolerance are even larger when using self-employment instead of business ownership as a measure of entrepreneurship at the extensive margin. For the wealthy, the point estimates are still positive and larger for high than for medium risk tolerance, but only the marginal effect of high risk tolerance is significant at the 10%-level. Among the wealthy, self-reported self-employment may be a much noisier measure of entrepreneurship than private business ownership. It is plausible that some wealthy owner-managers of big private businesses with a large number of employees may not self-classify as self-employed in a survey, so private business ownership is the preferred measure of entrepreneurship among the wealthy.

5 Conclusion

We provide first evidence that individuals at the top of the wealth distribution are more likely to be entrepreneurs and invest a larger share of their wealth in their own businesses when they have a stronger taste for risk-taking. These associations are even stronger among the wealthy than among less wealthy individuals. In addition, we show that the wealthy are on average more risk tolerant than the non-wealthy. Thus, risk preferences play an even more important role for portfolio investment decisions of very wealthy potential entrepreneurs than for the general population that prior empirical research was based on.

The results have important implications for debates on policies affecting the income distribution and income risk because they shed light on how such policies influence entrepreneurial

risk-taking of the very wealthy. For example, progressive taxation and loss offset provisions, implemented for distributional purposes, also affect the riskiness of after-tax income, and this insurance effect has been shown to affect entrepreneurship in general (Cullen and Gordon, 2007; Fossen, 2009; Wen and Gordon, 2014). This paper shows that wealthy entrepreneurs are not only more risk tolerant on average than the full population of entrepreneurs, but their risky investment in their own businesses is also more strongly shaped by their individual level of risk tolerance. Thus, taking into account heterogeneity in risk preferences when evaluating the effects of policies influencing risk is even more important when considering the wealthy. Theories assuming homogeneous risk preferences among the wealthy and across the wealth distribution will lead to misguided conclusions. This insight needs to be taken into account for any prediction of the influence of policies affecting risk on aggregate entrepreneurial investment: Since individuals at the top of the wealth distribution dominate aggregate private investment, the reactions of the very wealthy to policies shape the effects on aggregate private risky investment. Understanding these relationships is crucial due to the importance of entrepreneurial risk-taking for innovation and economic growth. Future research should investigate the effects of specific policies influencing risk, such as tax policy and bankruptcy law, on entrepreneurial choices of the wealthy, taking into account the pronounced heterogeneity in risk preferences.

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