OXFORD BULLETIN OF ECONOMICS AND STATISTICS, 75, 4 (2013) 0305-9049
doi: 10.1111/j.1468-0084.2012.00702.x

Precautionary and Entrepreneurial Savings: New Evidence from German Households*

Frank M. Fossen† and Davud Rostam-Afschar‡

†*School of Business & Economics, Freie Universität Berlin, Boltzmannstr. 20, 14195 Berlin, Germany, German Institute for Economic Research (DIW Berlin), and IZA (e-mail: frank.fossen@fu-berlin.de),*
‡*Freie Universität Berlin and DIW Berlin (e-mail: davud.rostam-afschar@fu-berlin.de)*

Abstract

Various studies interpret the positive correlation between income risk and wealth as evidence of significant precautionary savings. However, these high estimates emerge from pooling non-entrepreneurs and entrepreneurs, without controlling for heterogeneity. This article provides evidence for Germany based on representative panel data that includes private wealth balance sheets. Entrepreneurs, who face high income risk, hold more wealth than employees, but this tendency is not because of precautionary motives. Instead, they appear to save more for their old age, because they are usually not covered by statutory pension insurance. The analysis accounts for endogeneity in entrepreneurial choice and heterogeneous risk attitudes.

I. Introduction

Various studies suggest that a large share of the wealth of households can be explained by a precautionary saving motive. Quantity estimates of precautionary savings have important implications for policies that affect income risk, particularly with regard to labour market, social security, and taxation policy. If the precautionary saving motive is strong, policies that increase income risk will raise savings, which likely influences the growth rate of an economy (e.g. Femminis, 2001).[1]

A widely applied estimation approach uses the relationship between the income risk of households and their wealth holdings to quantify the fraction of wealth held as precaution against systematic uncertainty. If the stock of wealth relates positively to income variations, the relationship is interpreted as evidence for the existence of precautionary saving.

*The authors thank Johannes Geyer, Michal Myck, Viktor Steiner, the anonymous referees, the editor, and participants at the 2010 Warsaw International Economic Meeting, the 2010 Annual Conference of the German Economic Association in Kiel, and the joint Economic Policy Seminar of DIW Berlin and Freie Universität Berlin in 2009, for valuable comments and suggestions. Financial support from the German Research Foundation (DFG) for the project 'Tax Policy and Entrepreneurial Choice' (STE 681/7-1) is gratefully acknowledged. The usual disclaimer applies.
JEL Classification numbers: D91, D12, E21.

[1]Furthermore, as Pozzi (2003) has pointed out, Ricardian equivalence does not hold if a precautionary savings motive exists.

For example, with panel data from the United States, Kazarosian (1997) finds a strong precautionary saving motive, and Carroll and Samwick (1997, 1998) report that precautionary savings amount to almost half of US households' wealth. By analyzing data about the subjective assessments of risks, Lusardi (1997, 1998) casts doubt on these high estimates of precautionary saving though. Guariglia and Kim (2003) estimate that Muscovite households in 1996 saved significantly more if they faced a more variable consumption growth.[2]

Hurst *et al.* (2010) show that the precautionary saving motive is overestimated, because previous literature fails to account for heterogeneity between entrepreneurial and non-entrepreneurial households. Entrepreneurs hold more wealth, confront greater income risk, and differ in their saving motives compared with other, non-entrepreneurial households. By explicitly acknowledging the special role of entrepreneurial households, Hurst *et al.* (2010) estimate that precautionary wealth represents less than 10% of overall US wealth. They also show that the large estimates of precautionary savings reported in previous studies result from pooling of entrepreneurial and non-entrepreneurial households and vanish if the sample is split or the study controls for entrepreneurial households.

We add to this evolving literature by providing the first analysis of the existence and quantity of precautionary savings explicitly accounting for entrepreneurship in Germany. The findings reported by Hurst *et al.* (2010) for the United States turn out to be even more important in Germany: When the dependent variable is total net worth (with or without business wealth), rather than just financial wealth, and we use our preferred specifications to account for entrepreneurship, we find no statistically significant evidence of precautionary saving. Our analysis is based on the Socio-Economic Panel (SOEP), which offers the crucial advantages of providing information about both private wealth balance sheets and individual measures of risk aversion (for both partners in case of couple households).

By focusing on Germany, this study examines the importance of accounting for entrepreneurship when estimating precautionary savings in a country in which employees are covered by an extensive social security system, whereas entrepreneurs must save for their retirement and old age consumption. Therefore, saving behaviour may differ between entrepreneurs and non-entrepreneurs even more in Germany than in the United States.

Further, we investigate how income risk and entrepreneurial status affect the composition of households' asset portfolios. This analysis reveals that households shift their portfolios towards more liquid assets when they are confronted with higher income volatility, but they do not hold more wealth in total. Studies that find a positive effect of income risk on financial assets, which represent the most liquid component of a households wealth portfolio, should therefore be interpreted as evidence for portfolio decisions in favour of liquid assets rather than precautionary saving. For example, Fuchs-Schündeln and Schündeln (2005) and Bartzsch (2008) find that approximately one-fifth of household wealth in Germany represents precautionary savings, however their evidence is grounded on a positive effect of uncertainty on financial assets only. They employ the same data, the German SOEP, and use different strategies to control for risk aversion.

[2]Early empirical work on income variability and savings behaviour, including that of the self-employed, was pioneered by Fisher (1956). He relies on cross-sectional data, occupational classes and age as indicators for income variability, which triggered some discussion (Klein and Liviatan, 1957; Fisher, 1957).

Essig (2005) and Schunk (2009) instead use the German SAVE data set of the Mannheim Research Institute for the Economics of Aging (MEA) to relate saving behaviour to motives that they elicit using subjective importance measures. Essig (2005) notes a higher savings rate among the self-employed and, in line with our reasoning, expresses doubt that it can be attributed solely to uncertainty.

In comparison to previous research, particularly that by Hurst *et al.* (2010), the main methodological contribution of our study is the recognition of entrepreneurial status as endogenous with respect to wealth. Endogeneity may arise from the credit constraints faced by nascent entrepreneurs, which means that wealthy people are more likely to be able to enter entrepreneurship. Therefore, we estimate the wealth equations using instrumental variable (IV) estimators and an endogenous switching regression model. We account for the self-selection of less risk-averse people into riskier occupations by also controlling for individual risk attitudes, according to experimentally validated survey measures.

In section II, we present the empirical methodology employed to test the precautionary saving hypothesis. We discuss the specification of the wealth equation and outline some different strategies to account for entrepreneurship appropriately. This is followed by a description of the data and, in particular, the construction of measures of permanent income and income uncertainty. In section III, we present the results, and then discuss them in comparison with the literature in section IV. Section V analyzes the effects of income risk and entrepreneurship further by looking into the asset portfolios of households. Section VI concludes the analysis.

II. Methodology for wealth equations with entrepreneurship

Empirical specification

The estimation equation is motivated by the buffer-stock model developed by Deaton (1991) and Carroll (1992, 1997, 2004), particularly by its target wealth-to-income ratio that describes a positive relation between wealth W and permanent income P that consumers want to maintain. If wealth exceeds the target, consumption exceeds income, and wealth will fall. If wealth is below the target, income exceeds consumption, and wealth will accrue.[3] According to the model, the size of the wealth target depends on the degree of uncertainty ω that a consumer faces.[4] Target wealth also may be shifted by a vector of observed characteristics x and an unobserved error term u:

$$\frac{W}{P} = f(\omega, x, u). \tag{1}$$

Because wealth and income are highly unequally distributed, natural logarithms are chosen for the linearized empirical specification, and $\ln(P)$ is added to both sides of the equation:

[3]This model can explain why the saving rate increased in the United States after wealth balances shrank during the recent financial turmoil. From the beginning of 2005 to April 2008, the seasonally adjusted annual personal saving rate as provided by the Bureau of Economic Analysis of the US Department of Commerce remained quite stable, at an average of 1.8%. After May 2008, the point when the financial crisis hit the overall economy, savers reacted by accumulating at a 3.9% savings rate on average.

[4]In this general notation, ω is a vector, because in one specification we decompose income risk into permanent and transitory components (see section II).

$$\ln(W_{it}) = \alpha_0 + \gamma'\omega_{it} + \alpha_1 \ln(P_{it}) + \beta' x_{it} + u_{it}. \quad (2)$$

The equation refers to the household level because household members likely make saving decisions jointly and according to their pooled income. Thus, P denotes permanent net household income,[5] and we measure W as total net worth, that is, total assets of the household minus total debt. Unlike analyses of wealth components, such as financial assets, this approach avoids mixing savings with portfolio decisions, although we also consider wealth components to enable comparisons with prior literature.

The vector x reflects the characteristics of the household as control variables. For couple households, i.e. households with cohabiting adult partners, who may be married or unmarried, we include individual characteristics of both partners, for single adult households the sole household head's characteristics only. Specifically, we control for each partner's age, age squared, years of work experience and its square, years of unemployment experience and its square, German nationality, and disability. A dummy variable which equals one for couple households is also included. As further household characteristics, we include the number of children under 17 years in the household, region, and the year of observation. Moreover, we control for gender and marital status of the household head, who is defined as the earner with the highest gross monthly income in a given year. According to this definition, the household head may change between observation years. In section III, we assess the sensitivity of the results with respect to the definition of the household head.

To control for the risk attitudes of the household members, we use a method similar to Bartzsch (2008). In the 2004 and 2006 SOEP survey waves, respondents were asked to indicate their general willingness to take risks on an 11-point scale, from 0 to 10, where 0 means 'risk averse', and 10 means 'fully prepared to take risks'. We aggregate the 11 possible responses into three categories: low (responses 0–2), medium (3–7), and high willingness to take risks (8–10).[6] By including dummy variables for medium and high risk tolerance of both cohabiting partners or the single household head (with low risk tolerance as the base category), we control for the potential self-selection of less risk-averse people into occupations with higher income risk, which might otherwise create a downward selection bias in the coefficient of the income variance (Fuchs-Schündeln and Schündeln, 2005). In a field experiment with a representative sample of 450 subjects and with real money at stake, Dohmen *et al.* (2011) find that these measures of the willingness to take risks in the SOEP are good predictors of actual risk-taking behavior.[7]

For this specification, the buffer-stock model predicts $\alpha_1 > 0$; more specifically, $\alpha_1 = 1$ implies a fixed target wealth-to-permanent income ratio conditional on ω, x, and u. With respect to γ, the theoretical proposition is a positive value,[8] because the optimal reaction to greater uncertainty is to hold more wealth, that is, to demonstrate a precautionary saving

[5]We assume that households regard uncertainty in terms of the variation in their net rather than gross income, which is an important distinction, because one effect of progressive taxation is that variation in net income is smaller than in gross income.

[6]The results are very similar if we include dummy variables for all the possible answers to the risk question instead of the aggregated category dummies.

[7]The 2002 and 2007 waves provide the wealth information for estimating the wealth equation. The individual risk attitude of the same respondent in 2004 provides a proxy for the risk attitude in 2002, and the risk attitude in 2006 is a proxy for 2007. See also Fossen (2011).

[8]Or, positive components of γ, for the decomposed measure of uncertainty.

motive. We describe the different uncertainty measures later; in the following section, we elaborate on the specification to account for the specific role of entrepreneurship.

Dealing with entrepreneurs

As we mention in the introduction, Carroll and Samwick's (1997) estimation results for the United States indicate that almost 50% of household total net worth stems from a precautionary motive. For their study, they used occupational categories, including self-employed managers, as instruments for measures of earnings risk and permanent income. This approach requires the strong assumption that entrepreneurship has no direct influence on wealth. The authors even identified the self-employed as crucial for their high estimate of precautionary savings: when they exclude farmers and the self-employed from the sample, their estimations offer almost no support for the existence of precautionary saving. However, they argue that these two groups provide variation in income and therefore should remain in the same sample (Carroll and Samwick, 1998, p. 415).

Yet as Hurst *et al.* (2010) argue, the correlation between wealth and income uncertainty in the pooled sample is not due to a precautionary motive rather than to differences between entrepreneurs and non-entrepreneurs, because entrepreneurs have both higher income variance and more wealth for reasons unrelated to precautionary saving. They argue that other incentives for entrepreneurs to save could explain the higher amounts of wealth among entrepreneurs, such as their need to save for their old-age provision to address a lack of pension. Entrepreneurial and non-entrepreneurial households also differ in their preferences, such that an entrepreneurial household could have a different bequest or housing motive or a distinct discount factor.

The evident heterogeneity between entrepreneurs and non-entrepreneurs demands consideration. We consider three potential strategies for doing so:

(i) Employ a dummy variable for entrepreneurial households in x.
(ii) Exclude entrepreneurial households from the sample.
(iii) Use a measure of wealth W that does not include business equity.

Hurst *et al.* (2010) show the effect of accounting for entrepreneurship using the Panel Study of Income Dynamics (PSID) for the United States. They demonstrate that the estimated amount of precautionary saving decreases from 50% without accounting for entrepreneurs to less than 10%. Yet, these authors do not consider the potential endogeneity of entrepreneurship.

Differences in the savings behaviour between entrepreneurs and non-entrepreneurs may be even greater in Germany because its social security system plays a more important role. Employees are covered by statutory pension insurance, but usually entrepreneurs are not. Entrepreneurs, therefore, must save for their old age consumption, by paying into life or private pension insurance policies, investing in property, or reinvesting in their own business, all of which adds to their total net worth, our dependent variable. The coefficient of an entrepreneurship dummy variable (strategy i) captures any additional saving due to the status as entrepreneur instead of their higher income variance. Because entrepreneurship is strongly correlated with more income variance, omitting the entrepreneurship dummy

in the pooled sample leads to an upward bias of the estimated coefficient of income risk and thus an overestimation of precautionary savings in the whole population.

Although it solves the omitted variable problem, including an entrepreneurship dummy in x may introduce another endogeneity problem. If credit constraints exist for nascent entrepreneurs, wealthier households may be more likely to enter entrepreneurship (e.g. Evans and Jovanovic, 1989; Blanchflower and Oswald, 1998; Hurst and Lusardi, 2004). Instead of capturing additional savings by entrepreneurs, the coefficient of the entrepreneurship dummy variable in the wealth equation may reflect the reverse causality of wealth on entrepreneurship, which would produce an upward bias. Endogeneity potentially biases all estimated coefficients, including the coefficient of income risk and thus the estimated degree of precautionary saving.

We employ an instrumental variables (IV) technique to deal with the endogeneity of the entrepreneurship dummy in the pooled regression. For the instruments, we use three dummy variables that indicate: (i) whether at least one of the partners in a couple household (or the single household head) had a self-employed father when he or she was 15 years old[9] and whether at least one of (ii) their fathers and (iii) their mothers earned the higher secondary school degree *Abitur*, which qualifies a student for university admission in Germany. A self-employed father strongly increases the probability of offspring being an entrepreneur (e.g. Dunn and Holtz-Eakin, 2000; Hout and Rosen, 2000; Fairlie and Robb, 2007). Parental education also should influence entrepreneurial choice, in that, as shown by the mentioned literature, family background is an important determinant of entrepreneurship (see Table 1 for descriptive evidence). The values of the instrumental variables all are fixed before the adults in the sample have chosen to be or not to be entrepreneurs and remain fixed over the observation period, which allays the potential reverse-causality concern. The instruments pass the test of overidentifying restrictions (see footnote 20).

The generalized method of moments (GMM) IV-estimation, based on the pooled sample, assumes that the coefficients are the same for entrepreneurs and non-entrepreneurs. Splitting the sample between them is less restrictive, because the coefficients may differ. The estimation of the non-entrepreneur sub-sample corresponds to strategy ii. For the same reasons that endogeneity emerges in the entrepreneurship dummy in the pooled regression though, splitting the sample between entrepreneurs and non-entrepreneurs may introduce a selectivity bias, because selection into entrepreneurship is non-random.

Instead of simply splitting the sample we thus employ an endogenous switching regression model in which entrepreneurs ($I = 1$) face a different regime than non-entrepreneurs (see Maddala, 1983; Lokshin and Sajaia, 2004):

$$I_{it} = 1 \quad \text{if } \delta z_{it} + v_{it} > 0.$$
$$I_{it} = 0 \quad \text{if } \delta z_{it} + v_{it} \leq 0.$$

$$\text{Regime 1: } \ln(W_{it}) = \alpha_{0,1} + \gamma_1' \omega_{it} + \alpha_{1,1} \ln(P_{it}) + \beta_1' x_{it} + u_{1,it} \quad \text{if } I_{it} = 1. \tag{3}$$

$$\text{Regime 2: } \ln(W_{it}) = \alpha_{0,2} + \gamma_2' \omega_{it} + \alpha_{1,2} \ln(P_{it}) + \beta_2' x_{it} + u_{2,it} \quad \text{if } I_{it} = 0. \tag{4}$$

[9] In Germany, self-employed mothers are rare in the generations of most respondents' parents, and this information is often missing, so only self-employed fathers are used.

TABLE 1

Weighted means of variables by households' entrepreneurial status

Variables	*Total*	*Non-entrepreneurs*	*Entrepreneurs*
Characteristics			
age	40.80	40.68	42.59
female	35.84	36.19	30.67
number of children	0.59	0.58	0.76
married	49.19	48.30	62.21
eastern Germany	16.87	16.88	16.70
German nationality	92.11	91.83	96.09
self-employed father*	10.71	10.18	18.30
father has Abitur**	16.30	15.66	25.62
mother has Abitur**	8.08	7.79	12.21
Willingness to take risks			
low	13.42	13.73	8.82
medium	74.17	74.52	68.99
high	12.41	11.75	22.19
Partner's willingness to take risks			
low	20.96	21.20	18.26
medium	70.29	70.39	69.06
high	8.75	8.41	12.68
Highest educational attainment			
apprenticeship	35.95	36.69	24.90
technical school or Abitur***	7.47	7.59	5.73
higher technical college or similar	21.77	21.63	23.74
university degree	26.47	25.57	39.86
Monetary variables (euro in 2002 prices)			
net worth	86,264	57,292	509,924
net financial wealth	7,451	5,914	29,927
wealth in enterprise	15,979	0	249,638
net value of owner-occupied housing	50,761	46,093	119,016
permanent income	32,121	31,889	35,579

Notes: All numbers are in percentages except for age, number of children, and the monetary variables. Individual characteristics refer to the current primary earner in the household, if not otherwise indicated. The means of partner's willingness to take risks is based on couple households only. We use survey weights provided by the SOEP and all observations available for each variable for these descriptives.
Source: Own calculations based on the SOEP. Statistics are shown for 2002 and 2007; the calculation of permanent income is based on the waves 1984–2007.
*Equals 1 if at least one of the partners' fathers in a couple household or the household head's father in a single household is/was self-employed, and zero otherwise.
Equals 1 if at least one of the partners' fathers/mothers in a couple household or the household head's father/mother in a single household has the higher secondary school degree Abitur*, and zero otherwise.
***Abitur refers to the higher secondary school degree that qualifies a student for university admission in Germany.

The explanatory variables z in the criterion function, which determines selection into entrepreneurship, include the variables in x and the dummy variables used as IVs. These additional variables thus serve as an exclusion restriction here. With the assumption that the error terms v, u_1, and u_2 follow a trivariate normal distribution, we can estimate the coefficients, which may differ between entrepreneurs and non-entrepreneurs, using the maximum likelihood method.

As an additional sensitivity check, we estimate a restricted version of the switching regression model in which the coefficients do not differ between the two regimes. Comparing the results from the restricted and the unrestricted model enables us to test for the significance of the difference between the regimes. The restricted model corresponds to a treatment effects model (Heckman, 1978), in which entrepreneurship represents the treatment.

Finally, as a robustness analysis, we check how excluding business equity from the wealth measure influences the estimate of precautionary savings (strategy iii).

Data

This analysis is based on data from the Socio-Economic Panel (SOEP), a representative annual household panel survey in Germany that started in 1984. Wagner *et al.* (2007) provide a detailed description of the data. We use all available waves (1984–2007) to estimate permanent income and income uncertainty measures. Because the 2002 and 2007 waves included a special module that collected information about private wealth our main analysis refers to these two periods. The surveys asked about the market value of personally owned real estate (owner-occupied housing, other property, mortgage debt), financial assets, tangible assets, private life and pension insurance, consumer credit, and private business equity (net market value; own share in case of a business partnership). The wealth balance sheets referred to the personal level, so in the case of jointly owned assets, the survey explicitly asked about each person's individually owned shares. For our analysis, we aggregate wealth and income data to the household level.

Fuchs-Schündeln and Schündeln (2005) also use SOEP data, but only up to 2000, so they do not include direct measures of wealth. Instead, they relied on flows of received amounts of interest and dividend payments to estimate financial wealth according to the yearly average interest and dividend yields in Germany. In addition to the poor precision, this method offers with regard to the amount of financial wealth, wealth components other than financial assets cannot be considered with the implications we discuss in section IV.

In a given year, we define an entrepreneurial household as one that currently owns a private business with a positive market value (see Hurst *et al.*, 2010). It is thus possible that a household is classified as entrepreneurial in one year and as not entrepreneurial in the other. We do not observe businesses with negative market values; respondents report a zero market value for such over indebted firms, and we classify these households as non-entrepreneurial.[10] To assess if this implies a misclassification, we repeat the estimations using self-employment (of at least one of the partners in a couple household, or the single household head) as an alternative indicator of entrepreneurship, which is independent of the positive or negative market value of the business (see section III).

We exclude observations where the household heads[11] are younger than 18 or older than 55 from the sample, because youth and people in the years immediately preceding their retirement likely do not engage in buffer-stock saving (see Carroll, 1997). For similar reason, households with heads who are pensioners, in education or vocational training,

[10]This state of over indebtedness can only occur temporarily, however, as it would otherwise result in bankruptcy.
[11]That is the current main earner; section III assesses sensitivity of results to alternative definitions.

interns, serving in the military or community service, unemployed, or not participating in the labor market, are excluded from the sample.[12] Therefore, 6,287 observations of household-years without missing values in the relevant variables remain in the 2002 and 2007 waves, 664 of which refer to entrepreneurial households.[13]

We provide in Table 1 the means of the variables by households' entrepreneurial status, using survey weights provided by the SOEP. At the bottom of the table, we also show the means of total net worth,[14] net financial wealth (financial assets minus debt from consumer credit), wealth held in private businesses, and the net value of owner-occupied housing. Private business equity equals zero for non-entrepreneurial households, by definition. All monetary variables are deflated using the consumer price index provided by the Federal Statistical Office.

Entrepreneurial households clearly differ from other households. Their total net worth is on average substantially greater than that of non-entrepreneurial households, although this comparison of assets exaggerates the wealth difference because it does not consider the statutory pension insurance entitlements of persons in dependent employment in Germany. Frick and Grabka (2010) estimate that the net present value of public pension entitlements of employees in Germany averages between 40,000 Euro (low-skilled workers) and 80,000 Euro (managers) per person. Thus, on average, employees have a lower total net worth than entrepreneurs do, even after we consider public pension wealth. Entrepreneurs also enjoy a higher level of permanent net income, in part because they do not pay social insurance contributions (we describe the construction of the permanent net income variable in the next section).

Another interesting observation involves the large share of private business equity in the total net worth of entrepreneurial households (see also Fossen, 2011). This finding highlights that total wealth holdings may correlate with entrepreneurship for reasons unrelated to precautionary savings.

As we expect, the fraction of entrepreneurial households connected to a self-employed father (18.3%) is much higher than that of non-entrepreneurial households (10.2%). Furthermore, in comparison to non-entrepreneurs, more entrepreneurs have parents with the higher secondary school degree *Abitur*. Thus, these variables suggest themselves as potential instruments for entrepreneurship. As expected, a larger portion of entrepreneurs are willing to take higher risks as indicated by the subjective risk measures in Table 1.

Construction of permanent income and income risk measures

Permanent income and the measures of income uncertainty are estimated on the basis of the household net income information contained in all SOEP waves. We assume that

[12]The results remain qualitatively similar if we use 50 or 65 years as the cut-off point for age and if unemployed household heads and non participants in the workforce appear in the sample (results available from the authors on request). We focus on labor income risk and therefore do not analyze the effect of unemployment risk on precautionary saving. For this investigation, see Engen and Gruber (2001).

[13]For the variables referring to both partners in a couple household, e.g. the instrumental variable indicating self-employment of at least one of the partners' fathers, we use information pertaining to only one partner in case the other partner's information is not available.

[14]Total net worth is the sum of housing and other property (minus mortgage debt), financial assets, the cash surrender value of private life and pension insurance policies, tangible assets, and the net market value of commercial enterprises, minus debt from consumer credit.

income depends on trends in demographic and human capital factors x_{it}^1 and a transitory component e_{it}, such that yearly net household income[15] y_{it} can be written as

$$\ln(y_{it}) = b' x_{it}^1 + e_{it}. \tag{5}$$

The x^1 vector contains the variables in x mentioned before and dummy variables indicating the household head's highest educational attainment.[16] To approximate permanent income, we predict $y_{it}^P := \hat{y}_{it}$ on the basis of an ordinary least squares (OLS) estimation of equation (5),[17] similar to Lusardi (1998).[18]

To estimate the wealth equation (2), we require a measure of income uncertainty. Because extant theory lacks an appropriate specification to capture the relationship between uncertainty and wealth, prior literature tends to use atheoretical measures of uncertainty. For this study, we construct several alternative measures to estimate the amount of precautionary wealth.

For the first measure of income variance, we estimate a heteroscedasticity function. By estimating equation (5), we can obtain the squared residuals $(\ln(y_{it}) - \ln(\hat{y}_{it}))^2 = \hat{\sigma}_{it}^2$. Then to estimate the heteroscedasticity function, we conduct an OLS regression of $\ln(\hat{\sigma}_{it}^2)$ on the x^1 variables and thereby gather the fitted values **lvarly I**. This measure contains the logarithm of the expected variance of log income, conditional on observed characteristics, and can be interpreted as a measure of income uncertainty. By applying the exponential function on lvarly I, we obtain **varly I** as an alternative measure.

Another approach to measure income uncertainty is to divide the sample into certain cells and to calculate the income variance in these sub-samples. We describe this in Appendix A and refer to this measure as **varly II** and to the logarithm of varly II as **lvarly II**. Carroll and Samwick (1997) and Hurst *et al.* (2010) both decompose the income variance into permanent and transitory components. In additional specifications, we adopt this method, as presented in Appendix B, to compare the results.

The sample means of the uncertainty measures varly I and varly II, we show in Table 2, clearly confirm that entrepreneurial households face higher income risk than do other households. The difference persists even when the estimated variance is normalized by the mean (variation coefficients reported in square brackets). When the variance is decomposed into permanent and transitory components, both components are greater for entrepreneurs.

[15]Yearly net household income is approximated by multiplying current monthly net household income by 12.

[16]We define four educational levels: Apprenticeship, technical school degree or Abitur, higher technical college degree or similar, and university degree. In the specifications that maintain the exogeneity assumption of entrepreneurship in wealth equation 2 used primarily to compare the results with extant literature, we include a dummy variable indicating entrepreneurial households in x^1 as well (results from this appear in Table 2). The estimation results of these specifications are presented in Table 3 as Pooled 1 and 2. The dummy gets dropped from x^1 in the preferred IV model with endogenous entrepreneurship, Pooled 3, and the endogenous switching model, to use exogenous variation in earnings risk and permanent income only. Furthermore, the dummy variables indicating the risk attitude are excluded from x^1, because they are available only for 2004 and 2006.

[17]To obtain consistent predictions of $\hat{y}_{it}$, the predicted values from the log model must be exponentiated and multiplied by the expected value of $exp(e_{it})$. A consistent estimator for the expected value of $exp(e_{it})$ is the estimated slope coefficient from a regression of y_{it} on the exponentiated predicted values from the log model through the origin. This procedure does not require normality of $\exp(e_{it})$.

[18]We obtain similar levels of permanent income if we use the method suggested by Fuchs-Schündeln and Schündeln (2005).

TABLE 2

Estimated income variance measures

	Total sample	*Non-entrepreneurs*	*Entrepreneurs*
varly I	0.1782	0.1630	0.3072
	(0.0967)	(0.0775)	(0.1384)
	[0.0396]	[0.0382]	[0.0510]
varly II	0.2513	0.2375	0.3681
	(0.0826)	(0.0635)	(0.1237)
	[0.0492]	[0.0480]	[0.0593]
permanent variance	0.0106	0.0105	0.0112
	(0.0687)	(0.0660)	(0.0881)
transitory variance	0.0421	0.0386	0.0720
	(0.1362)	(0.1280)	(0.1892)
Number of observations	6,287	5,623	664

Notes: The plain numbers are the means of the variance measures; their standard deviations are shown below in parentheses; mean coefficients of variation (SD/mean) appear in square brackets. The variance components do not add up to the total variance measures because only the detrended part of the total variance gets decomposed (see Appendix B). The number of observations is lower for the permanent and transitory variance because of missing information (4,670, 4,171, and 499, respectively).
Source: Own calculations based on the SOEP 1984–2007; statistics shown for 2002 and 2007.

Compared with Carroll and Samwick (1997), in the total sample, the average permanent variance is higher in the United States than in Germany, possibly because of Germany's labor legislation, that may reduce wage risk. The average transitory variance is almost the same though, so idiosyncratic shocks do not seem to differ much between the two countries.

The descriptive analysis reveals that entrepreneurial households possess a greater stock of wealth on average and more volatile labor income compared with other households, which emphasizes the importance of controlling for entrepreneurial status.

III. Empirical results accounting for entrepreneurship

Coefficients of income risk decrease

In Table 3, we provide the results from estimating equation (2) using the two alternative measures of income uncertainty, varly I (upper panel) and lvarly I (lower panel). The five columns refer to different specifications that we describe next. The dependent variable is the logarithm of total net worth.

In addition to the coefficients of each measure of earnings risk, we reveal the estimated coefficients of the logarithm of permanent income and the entrepreneurship dummy variable, if included, for each specification. The estimated coefficients of the control variables x appear in Appendix C, Table C.1, for the specification Pooled 3 (i.e. IV estimation based on the pooled sample, including an entrepreneurship dummy).[19]

The first column shows the estimates without controls for entrepreneurship on the basis of a pooled sample that includes both entrepreneurial and non-entrepreneurial households

[19]For the other specifications, the estimated coefficients of the control variables are available from the authors on request.

TABLE 3

Estimates of the effect of labor income risk on log net worth

				Endogenous switching model	
	Pooled 1	*Pooled 2*	*Pooled 3 (IV)*	*Non-entrepreneurs*	*Entrepreneurs*
varly I	4.6202***	1.6779**	−0.1732	−0.4000	3.9261
	(0.4250)	(0.7817)	(1.1402)	(0.9668)	(4.0245)
ln perm. income	1.5820***	1.2666***	1.0476***	1.1008***	1.0198*
	(0.1546)	(0.1624)	(0.1826)	(0.1520)	(0.5681)
entrepreneur		0.6973***	3.1108***		
		(0.1311)	(0.5961)		
lvarly I	1.2303***	−0.0066	0.0133	−0.0536	0.7494
	(0.0951)	(0.3634)	(0.3712)	(0.3864)	(1.2688)
ln perm. income	1.3463***	1.2448***	1.0486***	1.1045***	0.9466
	(0.1617)	(0.1624)	(0.1839)	(0.1531)	(0.5844)
entrepreneur		0.9724***	3.1049***		
		(0.2713)	(0.5954)		
observations	6,287	6,287	6,287	6,287	6,287

Notes: Robust standard errors are in parentheses. The Pooled 1 model does not control for entrepreneurship, Pooled 2 controls for entrepreneurship, and Pooled 3 employs an instrumented control variable for entrepreneurship. Right two columns: Endogenous switching model with distinct regimes for entrepreneurial and non-entrepreneurial households.
Source: Model estimations based on the SOEP 2002/2007; income variable estimations based on waves 1984–2007. Significant at ***1%, **5% level and *10% level.

(Pooled 1). Specification Pooled 2 is also based on the full sample but controls for entrepreneurial households using a dummy variable.

As discussed in section II, omitting the entrepreneurship dummy in the Pooled 1 specification may introduce omitted variable bias, and the entrepreneurship dummy in the Pooled 2 specification may be endogenous. Therefore the preferred specification is the IV model Pooled 3, which uses dummy variables indicating self-employed fathers and parental education as IVs for the entrepreneurship dummy.[20] The analysis by Carroll and Samwick (1998) suggests that the logarithm of the variance of log income has a nearly linear relationship with log wealth, so the preferred measure of income risk is lvarly I.

The last two columns report the estimation results from the endogenous switching regression model that is more flexible than the Pooled 3 specification because it allows the coefficients to differ between the two household types while also accounting appropriately for the endogeneity of entrepreneurship.[21] However, the analysis with this model suffers a disadvantage: The coefficients for the entrepreneurs' regime are imprecisely estimated because of the comparably small size of the sub-sample of entrepreneurs.

In Pooled 1, which does not control for entrepreneurship, the relationship between income variance and net worth, which might seemingly be attributed to precautionary

[20]The strength of these excluded instruments seems sufficient. An F-test indicates that they are jointly significant at the 1% level ($F = 16.56$ for varly I; $F = 16.59$ for lvarly I) in the first-stage regression of the entrepreneurship dummy variable on all instruments. The Hansen test of overidentifying restrictions also is not rejected ($P - \text{value} = 0.53$ both for varly I and lvarly I).

[21]The variables excluded from the criterion function, which are identical to the excluded instruments in the Pooled 3 specification, are jointly significant at the 5% level in the selection equation, which is jointly estimated with the regime equations.

saving, is significantly positive for both measures of income uncertainty. These results replicate findings in prior literature. The estimated coefficient for lvarly I of 1.23 implies that when income uncertainty (measured as the variance of log income) doubles, total net worth increases by 123%.

However, when we control for entrepreneurship the picture changes completely. Turning to the specifications other than Pooled 1 that account for entrepreneurship, the point estimates for the income variance coefficients become substantially smaller, and in some cases even negative, regardless of whether we use varly I or lvarly I. There is no longer a significant relationship between income uncertainty and total net worth; the only exception is the Pooled 2 specification using varly I, for which the point estimate is substantially smaller than that attained without controlling for entrepreneurship (i.e. 1.68 vs. 4.62), though still significant. As we argue, lvarly I is a preferable measure because of its better functional fit. Moreover, the coefficient in the Pooled 2 specification may be biased, because we control for the potential endogeneity of the entrepreneurship dummy variable only in the Pooled 3 specification and the endogenous switching models. The point estimate of the coefficient in the entrepreneurs' regime of the switching regression model using varly I (3.93) is the only one that does not become substantially smaller than the one in the Pooled 1 specification (4.62). This finding is not inconsistent with the general result though, because for this regime, the estimated coefficient has a large standard error and is not significantly different from zero. Overall the results clearly show that given the heterogeneity between entrepreneurial and non-entrepreneurial households, failing to control for entrepreneurship causes a spurious correlation between income uncertainty and wealth and leads to an upward bias of estimations of precautionary savings.

The point estimate of the coefficient of permanent income is not significantly different from one (except for the presumably biased Pooled 1 specification, which omits the entrepreneurship dummy). A value of one is consistent with a fixed target wealth-to-permanent income ratio, conditional on the other explanatory variables. The coefficient is positive and significantly different from zero across all specifications and income risk measures, except for the entrepreneurs' regime of the switching regression model using lvarly I, for which the coefficient is just insignificant because of the large standard error. Focusing on the Pooled 3 specification with the uncertainty measure lvarly I, the estimated coefficient of the log of permanent net income implies that doubling permanent net income increases total net worth by 105%.

The estimated positive and significant coefficient of the entrepreneurship dummy in all specifications reflects the higher average wealth stock held by entrepreneurial households, holding income risk and the other explanatory variables constant. The dummy variables indicating medium or high risk tolerance of each partner in a couple household or of the single household head (see Table C.1 in Appendix C) are jointly not significantly different from zero in the preferred specification Pooled 3. In Pooled 1 and Pooled 2, the risk dummies are jointly significant, but never individually significant.

The results remain similar when the coefficients (except for the intercept) in the endogenous switching model are restricted to be the same in the two regimes. As we mentioned in section II, this restricted model accounts for entrepreneurship by interpreting entrepreneurial status as a treatment in the sense of a treatment effects model (Heckman, 1978). As in the other models that account for entrepreneurship, the coefficient of the

earnings variance becomes small and insignificant, regardless of whether we use varly I or lvarly I.[22]

Last, but not least, the results are robust to the choice of alternative income risk measures, as demonstrated in Appendix A.

Share of precautionary savings in total net worth diminishes

To quantify the amount of precautionary savings based on the estimated parameters, we follow prior literature and compare the predicted net worth of households $\widehat{W}_i$ with the simulated net worth they would possess if they all faced the minimum income risk. The minimum income risk ω^* can be approximated by the minimum predicted risk in the sample. A prediction of $\widehat{W}_i$*, obtained by substituting households' income risk ω_i by ω*, can be interpreted as the amount that households would accumulate if they faced the minimum risk. The share of total net worth explained by precautionary saving in the sample thus is given by

$$\frac{\sum_{i=1}^{N} \widehat{W}_i - \sum_{i=1}^{N} \widehat{W}_i*}{\sum_{i=1}^{N} \widehat{W}_i}. \tag{6}$$

Table 4 contains the estimated share of precautionary savings in total net worth, according to the different specifications and measures of income risk. Without controlling for entrepreneurship (Pooled 1), the large estimated amount of precautionary savings replicates prior results (Carroll and Samwick, 1998). With preferred income risk measure lvarly I, it accounts for as much as 64.6% of total net worth. Including a dummy or applying the switching regression model to control for entrepreneurship substantially decreases the point estimates of the shares (they even become slightly negative in some specifications), except for the entrepreneurs' regime in the switching regression model.

Even in this regime though, the hypothesis that precautionary savings are 0 cannot be rejected, because the coefficients of the income variance are insignificant, as they are in almost all the specifications that account for entrepreneurship.[23] The specification controlling for entrepreneurship that yields a significant coefficient of the measure of income risk, Pooled 2 using varly I, produces a point estimate for the share of precautionary saving of 17.5%, which is much lower than that attained without controlling for entrepreneurship (37.1%). With the preferred measure lvarly I, the point estimate for the share is close to zero.

Results are robust

Here we assess the sensitivity of the results with respect to various modeling choices taken.[24] First, we consider the third potential strategy for dealing with entrepreneurial

[22]The results are available from the authors on request. We report the results of the more general endogenous switching model only, because the restrictions of equal coefficients in the two regimes are rejected by a likelihood ratio test ($\chi^2_{35} = 579.85$ using lvarly I). The treatment effects model is similar to the IV model Pooled 3, which we prefer, because it does not require the assumption of normally distributed error terms for consistency.

[23]This result holds when we decompose income variance into transitory and permantent components.

[24]We thank an anonymous referee and the editor for suggesting several of these robustness tests to us.

TABLE 4

Percentage of net worth explained by precautionary savings

				Endogenous Switching Model	
	Pooled 1	*Pooled 2*	*Pooled 3 (IV)*	*Non-entrepreneurs*	*Entrepreneurs*
varly I	37.05	17.48	−1.46*	−3.65*	28.84*
lvarly I	64.58	−0.64*	1.07*	−4.58*	45.75*
varly II	42.73	1.39*	5.74*		
lvarly II	36.74	0.79*	3.50*		

Notes: *Calculated on basis of insignificant coefficients.
Source: Model estimations based on the SOEP 2002/2007; income variable estimations based on waves 1984–2007.

households described in section II, i.e. we use total net worth minus the value of private businesses as the dependent variable, as we show in the two leftmost columns of Table C.2 in Appendix C. The effect of controlling for entrepreneurship does not change: When we plug the modified dependent variable into specification Pooled1 (first column), which does not include an entrepreneurship dummy variable, the estimated coefficients are positive and significant (3.00 for varly I and 0.75 for lvarly I), albeit smaller than those obtained when total net worth serves as the dependent variable in the same specification (4.62 and 1.23, respectively, see Table 3). Again, regardless of the measure of income risk used, the estimated coefficients of income risk are small and insignificant when we include an entrepreneurship indicator (second column). However, if the only channel for entrepreneurs' additional savings were investments in their own business, removing business wealth from the wealth measure would be sufficient to avoid the upward bias in the coefficient of earnings risk that results from not accounting for entrepreneurship. The results from this test show that this is not the case, at least in Germany, and invalidate the third potential strategy mentioned above. It is plausible that the additional savings of entrepreneurs, unrelated to a precautionary motive are not exclusively concentrated in their businesses, but also include other assets such as property; section V sheds more light on these portfolio choices.

The main results from further robustness checks appear in Table C.3 in Appendix C. Apart from specific changes described below, we use the preferred specification Pooled 3 with varly I (upper panel) and lvarly I (lower panel) as measures of income risk. Overall, the results confirm the findings from the baseline estimations: Income risk has no significant effect on household wealth once entrepreneurship is controlled for. Permanent income has a positive and in almost all cases significant relationship with wealth. Its coefficient is not significantly different from one, and entrepreneurship, treated as endogenous, is always positively and significantly related to wealth in these IV regressions.

Specifically, the first two columns assess alternative definitions of the household head. Instead of the household member with the highest income in the year of observation, column 1 defines the household member who was the main earner in 2002 as the household head both in 2002 and 2007, thus avoiding changing household heads. The second column uses the household head as defined in the SOEP, i.e. the person identified by the trained interviewers who is most likely to know about the overall situation of the household and who is at the same time likely to be able to answer the survey questions concerning the household every year.

The next three columns refer to alternative definitions of an entrepreneurial household. First, we define only those households as entrepreneurial households where both partners are entrepreneurs in the sense that both of them own personal shares in a private business. As this avoids classifying mixed households as entrepreneurial, this definition can be regarded as referring to households with a very strong entrepreneurial dimension. Here, the positive correlation between entrepreneurship and wealth is much larger than in the baseline specification. Second, we exclude mixed households from the sample altogether, i.e. we keep only couple households where both partners either indicate being or not being entrepreneurs, and single households. Third, we use self-employment instead of business ownership as our indicator of entrepreneurship. This includes self-employed persons whose business has zero or even a negative market value. The household is then classified as entrepreneurial if at least one of the partners in a couple household or the single household head reports self-employment as their primary occupation.

Finally, the last two columns deal with issues potentially arising from couple households where risk attitudes differ between partners. First, additionally to the dummy variables indicating medium or high willingness to take risks for each partner, we include two interaction terms, one indicating couple households where the household head (i.e. the current main earner) has high and the partner low risk tolerance, and one marking the opposite situation. The coefficient of the first interaction turns out to be positive and significant with a point estimate of 0.27, which suggests that such preference heterogeneity within households leads to increased savings. Whether this result reflects the outcome of bargaining within the household needs more detailed investigation and is left to future research. Second, we re-estimate the main wealth equation using single households only. As mentioned before, the results with respect to our conclusions are robust across all these specifications.

IV. Comparison to the literature

The results from this analysis are in line with findings described by Hurst *et al.* (2010), for the United States, in which they showed that estimates of precautionary savings decline dramatically once entrepreneurship is accounted for. They still find some evidence that precautionary savings exist in form of a small fraction of wealth, because the coefficient of income risk is positive and significant, albeit small, in some of their specifications. In contrast, our analysis of German data reveals no significant effects after controlling for entrepreneurship (except for one, less preferred specification). The insignificance of income risk cannot be attributed to the sample size because our German sample contains more observations than does the US sample used by Hurst *et al.* (2010). The failure to control for entrepreneurship in an estimation of precautionary savings yields high estimates in both countries, but it seems to produce estimated coefficients of earnings risk that are even more upward biased in Germany than in the United States. Thus, country differences could explain this distinction, as we argue in the conclusion.

Other estimations of precautionary savings in Germany rely on measures of financial wealth instead of total net worth as the dependent variable. Specifically, Fuchs-Schündeln and Schündeln (2005) and Bartzsch (2008) estimate precautionary savings of approximately 20% when they use different strategies to control for heterogeneity in risk aversion.

They excluded self-employed persons and thus, avoided the spurious correlation problem that arises from pooling non-entrepreneurial and entrepreneurial households without controlling for entrepreneurship. To allow for a comparison, in the three rightmost columns of Table C.2 in Appendix C, we provide the estimation results when we use net financial wealth as the dependent variable. The column labelled "non-entrepreneurs" excludes entrepreneurs, as in the two studies cited. Focusing on lvarly II as the measure of income risk, which it is very similar to one of the measures used in these two studies, we find that the coefficient of income risk is positive and significant (0.50). Positive and mostly significant results also emerge when we use the other measures of income risk, and also when we include entrepreneurial households in the sample and control for their status in specification Pooled 2 and the preferred IV specification, Pooled 3. The positive effect thus seems to arise when financial wealth is the dependent variable.

These findings show that households with higher income risk hold more of the assets that comprise financial wealth such as savings accounts, bonds, and stocks. Considering the fact that these assets are liquid relative to the other asset components of total wealth makes interpretation of these holdings as evidence of precautionary saving problematic. Our results from using total net worth as the dependent variable indicate that total net worth does not react significantly to changes in income risk, which implies that the changes in financial assets should rather be interpreted as portfolio decisions. The larger amount of financial assets that households hold when confronted with higher income risk must be offset by lesser amounts of other assets, such as property, whereas total net worth remains constant. It seems plausible that households with more volatile income keep a larger share of their wealth in liquid assets. In the light of the findings from this study though, this distribution of wealth does not mean that these households save more.

V. Income risk, self-employment, and portfolio choice

In section IV, we found that households with higher income risk hold a higher amount of financial assets without holding more net worth in total. Here, we further investigate the effects of income risk and entrepreneurial status on portfolio decisions of households. One of the aims is to find which other asset classes high risk households reduce in their portfolios to offset the higher amount of financial assets; another aim is to shed more light on differences between entrepreneurial and non-entrepreneurial households.

We consider six asset categories: financial assets, tangible assets, private life and pension insurance, private business equity, owner-occupied housing, and other property. For each asset class, we calculate the portfolio share in gross wealth, which is the sum of the six classes. Thus gross wealth is defined as wealth that is convertible into cash on the market, and does not include human capital or statutory pension insurance entitlements. Mortgage debt on owner-occupied housing and other property and consumer credits are not deducted, as we are interested in the portfolio split rather than the leverage decision. This ensures that the six portfolio shares calculated, which we will use as dependent variables, lie in the interval from 0 to 1 for all households.

The main explanatory variables are income risk, where we use our preferred measure lvarly I, and entrepreneurial status. Since business ownership as an indicator for entrepreneurship, as used in the main analysis, is directly connected to positive private business

equity by definition, we instead use a binary variable for self-employment as the primary occupation of at least one of the partners in a couple household or the single household head as our indicator for entrepreneurship. We employ the same control variables x as in the main analysis. In addition we control for total net worth, i.e. gross wealth minus mortgage debt and consumer credits, and its square.

As before, we consider entrepreneurship (i.e. self-employment here) as endogenous and use parental self-employment and parental education as excluded instruments (see section II). Since the dependent variable is always between 0 and 1, and many observations for some of the asset classes are zero, we estimate two-limit IV tobit models. We estimate the equations separately for each asset class using the Full Information Maximum Likelihood estimator.[25]

Table 5 shows the estimated tobit coefficients with heteroscedasticity robust standard errors.[26] Each column refers to the portfolio share of one of the six asset classes, roughly ordered from the most liquid (financial assets) to the least liquid (owner-occupied housing) as the dependent variable. The mean portfolio shares appear at the bottom of the table.

Income risk, as measured by lvarly I, has significant effects on the portfolio shares of two assets only. Higher income risk increases the share of financial assets (coeff. 0.39) in total gross wealth, which is consistent with our earlier result, and it decreases the share of owner-occupied housing (coeff. −0.42). Households with higher income risk thus shift their portfolio away from the most illiquid component towards the most liquid component.[27] A plausible interpretation is that the portfolio shift towards liquid assets allows households with higher income risk to smooth the fluctuations in their income while avoiding liquidity problems and high transaction costs. Together with the finding from the main analysis, namely that total net worth remains unchanged, this completes the picture: Income risk does not induce households to save more overall, but rather to hold their wealth in more liquid form.

Self-employment obviously increases the portfolio share of private business equity. Apart from that, households engaged in self-employment hold significantly larger shares of financial assets (such as stocks and bonds), tangible assets (such as gold, jewelry, and collections), and rental property, i.e. assets most households in Germany do not own at all or only in small quantities. Entrepreneurial households offset these larger portfolio shares by a significantly smaller share of owner-occupied housing. The absolute net value of owner-occupied housing is still larger for entrepreneurial households, however, because of their larger average wealth (see Table 1). The finding that unlike non-entrepreneurs,

[25]Our methodological approach is similar to Poterba and Samwick (2002), who use the tobit specification to estimate a portfolio choice model of various financial assets in the US (they also estimate the asset demand equations separately), and related to King and Leape (1998), who estimate the asset portfolio composition of US households. Both studies exclude private business equity. Fossen (2011) similarly uses the SOEP and focuses on the share of private business equity in individual persons' wealth portfolios.

[26]The coefficients of the control variables not displayed are available from the authors on request.

[27]Quantitatively, the marginal effects, evaluated at the sample means of the explanatory variables, indicate that when income uncertainty doubles, the portfolio share of financial assets, conditional on holding a positive amount, increases by 26 %-points, and the probability of having positive financial assets increases by 11 %-points. At the same time, the portfolio share of owner-occupied housing, conditional on a positive value, decreases by 6.9 %-points, and the probability of owning any such property decreases by 4.9 %-points. Households may also adjust other asset classes, but in smaller quantities, which are not significantly different from zero. The marginal effects of the other variables are available from the authors on request.

TABLE 5

Portfolio shares of asset classes in total gross wealth: IV-tobit coefficients

	Financial assets	*Tangible assets*	*Life- & priv. pension ins.*	*Private business*	*Not owner-occ. property*	*Owner-occ. property*
lvarly I	0.3868**	−0.0299	−0.1186	−0.0414	0.3107	−0.4151**
	(0.1227)	(0.1444)	(0.1171)	(0.2572)	(0.2356)	(0.2001)
ln perm. income	0.2785***	0.1529**	−0.0549	0.0207	0.3571**	−0.1543
	(0.0573)	(0.0685)	(0.0506)	(0.1275)	(0.1124)	(0.1023)
self-employed	0.4582**	1.0513***	−0.1573	2.0769***	1.1912**	−1.6250***
	(0.2250)	(0.3121)	(0.1812)	(0.4435)	(0.3943)	(0.4476)
ln net worth	−0.0154***	−0.0106**	−0.0078**	0.0012	0.0128*	0.0357**
	(0.0047)	(0.0053)	(0.0037)	(0.0072)	(0.0071)	(0.0116)
squared ln net worth	0.0000***	0.0000**	0.0000**	0.0000	−0.0000**	−0.0001**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
further controls	✓	✓	✓	✓	✓	✓
mean portfolio shares	0.2099	0.0121	0.2427	0.0329	0.0730	0.4295
observations	6,287	6,287	6,287	6,287	6,287	6,287

Notes: Robust standard errors are in parentheses. Parental self-employment and parental education used as excluded instruments for the endogenous self-employment dummy variable.

Source: Model estimations based on the SOEP 2002/2007; income variable estimations based on waves 1984–2007.

Significant at ***1%, **5% and *10% level.

entrepreneurial households tend to diversify their assets must be explained by reasons other than entrepreneurs' higher average wealth and their lower risk aversion, as we are controlling for these factors; perhaps entrepreneurial experience induces the self-employed to invest in a broader set of assets than non-entrepreneurs. As there is no significant effect of self-employment on the value of private life- and pension insurance policies, the self-employed do not seem to substitute public pension insurance, which they lack, by private insurance, but rather invest in other assets to save for their old age, i.e. their own businesses, financial and tangible assets, and rental property.[28]

VI. Conclusion

Empirical estimates of significant precautionary savings disappear once the heterogeneity between entrepreneurial and non-entrepreneurial households is accounted for, as reported by Hurst *et al.* (2010) using data from the United States. We confirm their results in a different country and revise estimates of precautionary savings in Germany. Hurst *et al.* (2010) find some evidence that precautionary savings account for a small fraction of wealth in the United States; in contrast, when we use the preferred specifications, our results show that no significant estimates of precautionary savings remain in Germany after controlling for entrepreneurship.

Therefore, we assert that the failure to account for entrepreneurship in an estimation of precautionary savings is even more misleading in Germany than in the United States. The difference in the savings behaviour of entrepreneurial versus non-entrepreneurial house-

[28]The instruments seem to be sufficiently relevant, as the F-statistic of joint significance of the excluded instruments, obtained from the first stage regression of the endogenous self-employment dummy on all instruments, is 18.33.

holds may become especially pronounced in countries with an extensive social security system, such as Germany, where employees receive statutory pension insurance, but entrepreneurs have to save individually for their old age consumption. Extra savings by entrepreneurs likely reflect their exclusion from the public pension system. Pooling household types without controlling for entrepreneurship, therefore, misleadingly connects the higher savings of entrepreneurs to their higher income risk and leads to an upward bias in estimates of precautionary savings.

Prior studies that estimated precautionary savings in Germany, particularly Fuchs-Schündeln and Schündeln (2005) and Bartzsch (2008), analyze the effect of income risk on certain components of wealth, such as net financial wealth. They interpret their results as evidence of precautionary savings and although their results can be replicated, we demonstrate the lack of significant effects of income risk on total net worth. Instead, we show that higher income risk is associated with a portfolio shift from less liquid toward more liquid assets, but not with more saving.

Methodologically, the main innovation of our study involves our recognition of entrepreneurship as being endogenous with wealth, in line with substantive literature on the credit constraints faced by nascent entrepreneurs. This study employs IV estimators and an endogenous switching regression model, which acknowledges that entrepreneurial and non-entrepreneurial households face different regimes, to deal with this endogeneity. Moreover, we account for the self-selection of less risk-averse persons into occupations with higher income risk by controlling for new and experimentally validated measures of individual risk attitudes, separately for each partner in couple households.

Estimates of precautionary savings are important for policy design, especially for labor market, social insurance, and taxation policies, which directly affect variance in households' net income. Governments in Western welfare states have been tending to reduce the coverage of social insurance systems in recent decades. At the same time, collective labor agreements have lost importance in some countries such as Germany. Prior estimates of precautionary savings suggested that households would considerably increase their savings due to the rising income uncertainty. In contrast, the new findings we offer in this study, which account for the important role of entrepreneurship, imply that policy makers should expect no significant effects on the saving rate, but rather a shift of savings towards more liquid assets.

Final Manuscript Received: March 2012

References

Bartzsch, N. (2008). 'Precautionary saving and income uncertainty in Germany – new evidence from microdata', *Journal of Economics and Statistics*, Vol. 228, pp. 5–24.

Blanchflower, D. G. and Oswald, A. J., (1998). 'What Makes an Entrepreneur?', *Journal of Labor Economics*, Vol. 16, pp. 26–60.

Carroll, C. D. (1992). 'The buffer-stock theory of saving: some macroeconomic evidence', *Brookings Papers on Economic Activity*, Vol. 23, pp. 61–156.

Carroll, C. D. (1997). 'Buffer-stock saving and the life cycle/permanent income hypothesis', *Quarterly Journal of Economics*, Vol. 112, pp. 1–55.

Carroll, C. D. (2004). *Theoretical Foundations of Buffer Stock Saving*, Economics Working Paper Archive No. 517, Department of Economics, Johns Hopkins University.

Carroll, C. D. and Samwick, A. A. (1997). 'The nature of precautionary wealth', *Journal of Monetary Economics*, Vol. 40, pp. 41–71.
Carroll, C. D. and Samwick, A. A. (1998). 'How important is precautionary saving?', *Review of Economics and Statistics*, Vol. 80, pp. 410–419.
Deaton, A. (1991). 'Saving and liquidity constraints', *Econometrica*, Vol. 59, pp. 1221–1248.
Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011). 'Individual risk attitudes: measurement, determinants, and behavioral consequences', *Journal of the European Economic Association*, Vol. 9, pp. 522–550.
Dunn, T. and Holtz-Eakin, D. (2000). 'Financial capital human capital, and the transition to self-employment: evidence from intergenerational links', *Journal of Labor Economics*, Vol. 18, pp. 282–305.
Engen, E. M. and Gruber, J. (2001). 'Unemployment insurance and precautionary saving', *Journal of Monetary Economics*, Vol. 47, pp. 545–579.
Essig, L. (2005). *Precautionary Saving and Old-age Provisions: do subjective saving motive measure work?*, MEA discussion paper series No. 05084, Mannheim Research Institute for the Economics of Aging (MEA), University of Mannheim.
Evans, D. S. and Jovanovic, B. (1989). 'An estimated model of entrepreneurial choice under liquidity constraints', *Journal of Political Economy*, Vol. 97, pp. 808–827.
Fairlie, R. W. and Robb, A. (2007). 'Families, human capital, and small business: evidence from the characteristics of business owners survey', *Industrial and Labor Relations Review*, Vol. 60, pp. 225–245.
Femminis, G. (2001). 'Risk-sharing and growth: the role of precautionary savings in the "education" model', *Scandinavian Journal of Economics*, Vol. 103, pp. 63–77.
Fisher, M. R. (1956). 'Exploration in savings behaviour', *Bulletin of the Oxford University Institute of Economics & Statistics*, Vol. 18, pp. 201–277.
Fisher, M. R. (1957). 'A reply to the critics', *Bulletin of the Oxford University Institute of Economics & Statistics*, Vol. 19, pp. 179–199.
Fossen, F. M. (2011) 'The private equity premium puzzle revisited–new evidence on the role of heterogeneous risk attitudes', *Economica*, Vol. 78, pp. 656–675.
Frick, J. R. and Grabka, M. M. (2010). 'Old-age pension entitlements mitigate inequality: but concentration of wealth remains high', *DIW Weekly Report*, Vol. 6, pp. 55–64
Fuchs-Schündeln, N. and Schündeln, M. (2005). 'Precautionary savings and self-selection: evidence from the German reunification "experiment"', *Quarterly Journal of Economics*, Vol. 120, pp. 1085–1120.
Guariglia, A. and Kim, B. Y. (2003). 'The effects of consumption variability on saving: evidence from a panel of muscovite households', *Oxford Bulletin of Economics and Statistics*, Vol. 65, pp. 357–377.
Heckman, J. J. (1978). 'Dummy endogenous variables in a simultaneous equation system', *Econometrica*, Vol. 46, pp. 931–959.
Hout, M. and Rosen, H. (2000). 'Self-employment, family background, and race', *Journal of Human Resources*, Vol. 35, pp. 670–692
Hurst, E. and Lusardi, A. (2004). 'Liquidity constraints, household wealth, and entrepreneurship', *Journal of Political Economy*, Vol. 112, pp. 319–347.
Hurst, E., Lusardi, A., Kennickell, A. and Torralba, F. (2010). 'The importance of business owners in assessing the size of precautionary savings', *Review of Economics and Statistics*, Vol. 92, pp. 61–69.
Kazarosian, M. (1997). 'Precautionary savings – a panel study', *Review of Economics and Statistics*, Vol. 79, pp. 241–247.
King, M. A. and Leape, J. I. (1998). 'Wealth and portfolio composition: theory and evidence', *Journal of Public Economics*, Vol. 69, pp. 155–193.
Klein, L. R. and Liviatan, N. (1957). 'The significance of income variability on savings behaviour', *Bulletin of the Oxford University Institute of Economics & Statistics*, Vol. 19, pp. 151–160.
Lokshin, M. and Sajaia, Z. (2004). 'Maximum likelihood estimation of endogenous switching regression models', *Stata Journal*, Vol. 4, pp. 282–289.
Lusardi, A. (1997). 'Precautionary saving and subjective earnings variance', *Economics Letters*, Vol. 57, pp. 319–326.
Lusardi, A. (1998). 'On the importance of the precautionary saving motive', *American Economic Review*, Vol. 88, pp. 449–453.

Maddala, G. S. (1983). *Limited-Dependent and Qualitative Variables in Econometrics*, University Press, Cambridge, MA.
Poterba, J. M. and Samwick, A. A. (2002). 'Taxation and household portfolio composition: US evidence from the 1980s and 1990s', *Journal of Public Economics*, Vol. 87, pp. 5–38.
Pozzi, L. (2003). 'Tax discounting in a high-debt economy', *Oxford Bulletin of Economics and Statistics*, Vol. 65, pp. 261–282.
Schunk, D. (2009). 'What determines household saving behavior? An examination of saving motives and decisions', *Journal of Economics and Statistics*, Vol. 229, pp. 467–491.
Wagner, G. G., Frick, J. R. and Schupp, J. (2007). 'The German socio-economic panel study (SOEP): scope, evolution and enhancements', *Journal of Applied Social Science Studies*, Vol. 127, pp. 139–169.

Appendix A: Alternative measures of income risk

To construct the income risk measure **varly II**, we divide the sample into four occupational groups (civil servants, self-employed, white-collar workers, and blue-collar workers) and five categories of education (university, higher technical college or similar, technical school or Abitur, apprenticeship, and other), both referring to the household member with the highest current income. This way we construct 20 cells associated with a cell-specific income uncertainty, measured as the variance of the logarithm of income. Carroll and Samwick (1998) additionally consider industry sector groups. They demonstrate that the relationship between the logarithm of the variance of log income and the logarithm of the target wealth ratio, as predicted by the buffer stock-model, can be fitted well linearly. Fuchs-Schündeln and Schündeln (2005) also use the logarithm as a conventional risk measure.

Because varly II, lvarly II, and the decomposed variance components could entail substantial measurement errors, we employ, in line with prior literature, a GMM IV estimator in the wealth equations that rely on these measures and use dummy variables indicating the highest educational attainment of the household's current main earner as the excluded instruments.

The results from the IV estimations using these alternative measures of income uncertainty appear in Table A1. The findings confirm the preceding results that we obtained using the variance measures varly I and lvarly I. In Pooled 1, without accounting for entrepreneurship, the estimated coefficient of earnings risk is positive and significant both for varly II and lvarly II. When the variance is decomposed into permanent and transitory components (see Appendix B), the coefficients of both components are positive, but significant only for the transitory variance. For all the uncertainty measures, again the significance disappears and the point estimates become substantially smaller when we control for entrepreneurship by including an entrepreneurship dummy that is assumed to be exogenous (Pooled 2) or endogenous (Pooled 3, with the same additional instruments as before).

The Hansen test of overidentifying restrictions does not indicate any invalidity of the instrumental variables in the specifications that include the entrepreneurship indicator in the wealth equation, i.e. Pooled 2 and Pooled 3.[29] In specification Pooled 1, which imitates

[29]The *P*-value of this test is 0.43 (0.41) using varly II (lvarly II) and 0.28 for the decomposed variance measures in specification Pooled 3.

prior literature, the null hypothesis of the Hansen test is rejected. This again confirms that omitting the entrepreneurship dummy variable (and using it as an *excluded* instrument instead) leads to inconsistent results.

The instruments seem sufficiently strong for the income risk measures varly II and lvarly II, with Shea's partial R^2 of 0.16 and 0.21, respectively, in Pooled 3. For the entrepreneurship indicator, Shea's partial R^2 is only 0.016 for both variance measures. A likely reason for the higher correlation of the instruments with the variance measures is that the educational dummy IVs also define the cells to construct these variance measures, so the indicator may not be very informative. The strength of the instruments for the decomposed variance measure is unsatisfactory, as indicated by a partial R^2 of 0.0023 for the variance of permanent shocks and 0.0021 for the variance of transitory shocks. Hurst *et al.* (2010) report similar weak instrument problems. The results based on these variance measures therefore must be interpreted with caution; it is the main reason we prefer varly I and lvarly I, which are unaffected by these problems, over varly II, lvarly II, and decomposed variance as measures of income risk.

TABLE A1

IV estimates of the effect of labor income risk on log net worth

	Pooled 1	*Pooled 2*	*Pooled 3*
varly II	4.5642***	0.1134	0.3287
	(0.5588)	(0.7339)	(0.7421)
ln perm. income	1.3135***	1.2295***	1.0305***
	(0.1983)	(0.1913)	(0.2038)
entrepreneur		0.9574***	2.8175***
		(0.0971)	(0.5766)
observations	6,287	6,287	6,287
lvarly II	1.0942***	0.0179	0.0606
	(0.1628)	(0.1924)	(0.1952)
ln perm. income	1.5439***	1.2358***	1.0439***
	(0.1952)	(0.1901)	(0.2029)
entrepreneur		0.9631***	2.8399***
		(0.0863)	(0.5731)
observations	6,287	6,287	6,287
permanent variance	28.1237	−6.2705	−10.7988
	(23.7998)	(27.3712)	(13.0624)
transitory variance	29.3754***	5.1650	−1.3279
	(6.5946)	(16.5148)	(7.0955)
ln perm. income	0.6280	1.2504**	1.2744***
	(0.5223)	(0.5266)	(0.2674)
entrepreneur		0.7375	2.9917**
		(0.4879)	(1.2075)
observations	4,670	4,670	4,670

Notes: Significant at ***1%, **5% and *10% level. Robust standard errors are in parentheses. The Pooled 1 specification does not control for entrepreneurship, Pooled 2 uses controls for entrepreneurship, and Pooled 3 employs instrumented controls for entrepreneurship.

Source: Model estimations based on the SOEP 2002/2007; income variable estimations based on waves 1984–2007.

Appendix B: Construction of the variance of permanent and transitory income

By exploiting the panel structure of income observations contained in the SOEP data set, we can separate the variance of innovations to permanent income from transitory shocks to income. We follow the method proposed by Carroll and Samwick (1997) for comparability.

The income process is characterized by three components. Specifically,

$$\ln(y_t) = \ln(G_t) + \ln(y_t^P) + \epsilon_t, \tag{7}$$

where $\ln(G_t)$ represents demographic and human capital factors, $\ln(y_t^P)$ is a permanent component, and ϵ_t refers to a transitory white noise component of income with variance σ_ϵ^2. Permanent income is modeled as a random walk:

$$\ln(y_t^P) = \ln(y_{t-1}^P) + \eta_t, \tag{8}$$

where the variance of a shock to permanent income is σ_η^2. The shocks η_t and ϵ_t are assumed to be uncorrelated in all periods.

To estimate σ_η^2 and σ_ϵ^2, we first remove the trend $\ln(G_t)$ by a cross-sectional OLS regression of $\ln(y_t)$ on the variables included in x^1, which yields as residuals the detrended income $\hat{y}_t$. The next step is to calculate the d-year differences of detrended income: $r_d = \hat{y}_{t+d} - \hat{y}_t$, which can be written using equations (7) and (8), after the trend has been removed, as

$$r_d = \sum_{s=1}^{d} \eta_{t+s} + \epsilon_{t+d} - \epsilon_t. \tag{9}$$

TABLE B1

Observations used to estimate household variances

$d=3$	$d=4$	$\cdots$	$d=23$
1987−1984	1988−1984	$\cdots$	2007−1984
1988−1985	1989−1985		
$\vdots$	$\vdots$		
2006−2003	2007−2003		
2007−2004			
20	19	$\cdots$	1

Now we can estimate the variance $r_d^2 = d\sigma_\eta^2 + 2\sigma_\epsilon^2$. To extract all information available, we conduct household-by-household OLS regressions of r_d^2 on d and a constant using all possible differences at least three years apart (see Table B1). Thus, each household's permanent and transitory variance components can be estimated using up to 210 observations, in contrast with only 9 observations in Carroll and Samwick (1997) and Hurst *et al.* (2010). Households for which 3 or fewer observations are available are not considered.

Appendix C: Additional estimation results

TABLE C1

Complete estimation results using Pooled 3 (dep. variable: log net worth)

	varly I	*lvarly I*	*varly II (IV)*	*lvarly II (IV)*	*decomp IV*
d2007	−0.1142**	−0.1062	−0.1112**	−0.1111**	−0.0281
	(0.0557)	(0.0806)	(0.0413)	(0.0413)	(0.0553)
female	−0.1905**	−0.1968**	−0.2035***	−0.2024***	−0.0795
	(0.0635)	(0.0754)	(0.0578)	(0.0589)	(0.1067)
Region (Base: West)					
east	−0.1942**	−0.1928**	−0.1949**	−0.1928**	−0.1286
	(0.0654)	(0.0653)	(0.0658)	(0.0657)	(0.0843)
south	0.2353***	0.2371***	0.2381***	0.2374***	0.2262**
	(0.0506)	(0.0521)	(0.0496)	(0.0496)	(0.0987)
north	0.0226	0.0252	0.0255	0.0252	0.0243
	(0.0697)	(0.0713)	(0.0680)	(0.0680)	(0.0952)
age	−0.0224	−0.0172	−0.0190	−0.0184	−0.0458
	(0.0468)	(0.0520)	(0.0385)	(0.0385)	(0.0876)
age sq.	0.0006	0.0006	0.0006	0.0006	0.0007
	(0.0006)	(0.0007)	(0.0005)	(0.0005)	(0.0010)
work exp. (10 yrs)	0.4453**	0.4518**	0.4619**	0.4558**	0.2253
	(0.1594)	(0.1714)	(0.1611)	(0.1612)	(0.3554)
work exp. sq. (100 yrs)	−0.0913**	−0.0909**	−0.0946**	−0.0935**	−0.0120
	(0.0393)	(0.0392)	(0.0396)	(0.0396)	(0.0923)
unemployment exp.	−0.1707**	−0.1699**	−0.1732**	−0.1724**	−0.1275
	(0.0542)	(0.0540)	(0.0530)	(0.0530)	(0.0942)
unemployment exp. sq.	0.0065	0.0064	0.0071	0.0070	0.0035
	(0.0083)	(0.0083)	(0.0081)	(0.0081)	(0.0110)
disabled	0.1045	0.1070	0.1018	0.1011	0.0233
	(0.0915)	(0.0940)	(0.0893)	(0.0893)	(0.1345)
German	0.2967**	0.3029**	0.3087**	0.3063**	0.3708**
	(0.1219)	(0.1298)	(0.1170)	(0.1168)	(0.1534)
Number of children (Base: no child)					
one child	0.0885	0.0940	0.0952*	0.0954*	0.0350
	(0.0618)	(0.0745)	(0.0569)	(0.0570)	(0.0774)
two children	0.2411**	0.2495**	0.2501***	0.2499***	0.2147*
	(0.0754)	(0.1102)	(0.0662)	(0.0662)	(0.1142)
three or more	0.3957***	0.4051**	0.4147***	0.4142***	0.3317*
	(0.1039)	(0.1367)	(0.0953)	(0.0954)	(0.1724)
Marital status (Base: Single)					
married	−0.0616	−0.0285	−0.0360	−0.0400	−0.2161
	(0.1805)	(0.2854)	(0.0886)	(0.0884)	(0.2022)
divorced	−0.3794***	−0.3713***	−0.3672***	−0.3668***	−0.3594**
	(0.0983)	(0.1015)	(0.0898)	(0.0898)	(0.1492)
separated	−0.4134**	−0.3948*	−0.3907**	−0.3894**	−0.3197
	(0.1824)	(0.2032)	(0.1557)	(0.1557)	(0.2878)
Willingness to take risks (Base: lowrisk–risk averse)					
medrisk	−0.0989	−0.0989	−0.0908	−0.0906	−0.1593
	(0.0675)	(0.0674)	(0.0663)	(0.0663)	(0.1039)
highrisk	−0.0887	−0.0885	−0.0680	−0.0662	−0.0485
	(0.1058)	(0.1057)	(0.1028)	(0.1027)	(0.1340)

TABLE C1

(Continued)

	varly I	*lvarly I*	*varly II (IV)*	*lvarly II (IV)*	*decomp IV*
Partner's characteristics					
cohabiting partner	−1.3287*	−1.3154*	−1.3958**	−1.3894**	−2.1902**
	(0.7249)	(0.7152)	(0.7031)	(0.7036)	(1.0019)
age	0.0302	0.0295	0.0332	0.0329	0.0645
	(0.0369)	(0.0364)	(0.0358)	(0.0358)	(0.0523)
age sq.	−0.0002	−0.0002	−0.0002	−0.0002	−0.0005
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0006)
work exp. (10 yrs)	0.3487**	0.3498**	0.3559**	0.3565**	0.3897**
	(0.1245)	(0.1245)	(0.1225)	(0.1225)	(0.1800)
work exp. sq. (100 yrs)	−0.0856**	−0.0858**	−0.0874**	−0.0874**	−0.1000**
	(0.0349)	(0.0349)	(0.0344)	(0.0344)	(0.0475)
unemployment exp.	−0.1313***	−0.1313***	−0.1298***	−0.1301***	−0.1332**
	(0.0352)	(0.0352)	(0.0348)	(0.0348)	(0.0456)
unemployment exp. sq.	0.0040	0.0040	0.0036	0.0037	0.0059
	(0.0043)	(0.0043)	(0.0043)	(0.0043)	(0.0053)
disabled	0.0675	0.0677	0.0589	0.0591	0.0978
	(0.1094)	(0.1094)	(0.1074)	(0.1074)	(0.1774)
German	0.4055**	0.4050**	0.3985**	0.3983**	0.4182**
	(0.1271)	(0.1270)	(0.1242)	(0.1243)	(0.1684)
Partner's willingness to take risks (Base: lowrisk–risk averse)					
medrisk	−0.0298	−0.0296	−0.0257	−0.0260	−0.0468
	(0.0615)	(0.0614)	(0.0602)	(0.0603)	(0.0753)
highrisk	0.0333	0.0338	0.0457	0.0449	0.1268
	(0.1030)	(0.1029)	(0.1004)	(0.1004)	(0.1289)
entrepreneur	3.1108***	3.1049***	2.8175***	2.8399***	2.9917**
	(0.5961)	(0.5954)	(0.5766)	(0.5731)	(1.2075)
ln perm. income	1.0476***	1.0486***	1.0305***	1.0439***	1.2744***
	(0.1826)	(0.1839)	(0.2038)	(0.2029)	(0.2674)
Measures of income uncertainty					
varly I	−0.1732				
	(1.1402)				
lvarly I		0.0133			
		(0.3712)			
varly II			0.3287		
			(0.7421)		
lvarly II				0.0606	
				(0.1952)	
permanent variance					−10.7988
					(13.0624)
transitory variance					−1.3279
					(7.0955)
constant	−1.0727	−1.1999	−1.0991	−1.0748	−2.1688
	(2.1150)	(2.0149)	(2.1011)	(2.3192)	(2.6452)
observations	6,287	6,287	6,287	6,287	4,670

Notes: Significant at ***1%, **5% *10% level. Robust standard errors are in parentheses. The Pooled 3 specification uses instrumented controls for entrepreneurship.

Source: Model estimations based on the SOEP 2002/2007; income variable estimations based on waves 1984–2007.

TABLE C2

Estimates of the effect of labor income risk on log non-business net worth (NBNW) and log net financial wealth (NFW)

Dependent var.	*Pooled 1 NBNW*	*Pooled 3 (IV) NBNW*	*Non-entrepreneurs NFW*	*Pooled 2 NFW*	*Pooled 3 (IV) NFW*
varly I	3.0012***	−0.4276	1.8453	1.2524	1.7534
	(0.4374)	(1.1244)	(1.1530)	(0.8278)	(1.3356)
ln perm. income	1.3680***	0.9977***	1.6670***	1.7205***	1.3800***
	(0.1537)	(0.1834)	(0.1651)	(0.1564)	(0.2472)
entrepreneur		2.5378***		−0.0514	4.9327***
		(0.6465)		(0.1444)	(1.2191)
lvarly I	0.7486***	−0.0250	0.9333**	0.9682**	0.7227
	(0.0954)	(0.3703)	(0.3437)	(0.3319)	(0.4597)
ln perm. income	1.2600***	1.0020***	1.6479***	1.7124***	1.3445***
	(0.1608)	(0.1846)	(0.1644)	(0.1559)	(0.2455)
entrepreneur		2.5301***		−0.5537**	4.8892***
		(0.6450)		(0.2540)	(1.2179)
varly II	2.6302***	0.1648	1.9395**	2.0152**	2.0697**
	(0.5471)	(0.7395)	(0.6823)	(0.6710)	(0.8138)
ln perm. income	1.2648***	1.0054***	1.4207***	1.4411***	1.1879***
	(0.1922)	(0.2035)	(0.1803)	(0.1789)	(0.2286)
entrepreneur		2.2792***		−0.0489	3.4713***
		(0.6154)		(0.1036)	(0.9658)
lvarly II	0.6147***	0.0249	0.5000**	0.5301**	0.5118**
	(0.1601)	(0.1942)	(0.1778)	(0.1770)	(0.2168)
ln perm. income	1.4026***	1.0145***	1.4095***	1.4460***	1.2075***
	(0.1902)	(0.2029)	(0.1820)	(0.1778)	(0.2285)
entrepreneur		2.2931***		0.0037	3.5594***
		(0.6126)		(0.0932)	(0.9645)

Notes: Significant at ***1%, **5% and *10% level. Robust standard errors are in parentheses. Non-entrepreneurs refers to a sub-sample restricted to households which are not engaged in a private business. The Pooled 1 specification does not control for entrepreneurship, Pooled 2 controls for entrepreneurship, and Pooled 3 employs an instrumented control variable for entrepreneurship.

Source: Model estimations based on the SOEP 2002/2007; income variable estimations based on waves 1984–2007.

TABLE C3

Estimates of the effect of labour income risk on log net worth: further robustness checks

	Household head 2002	*SOEP household-head*	*Both partners are entrepreneurs*	*Excluding mixed households*	*Self-employment indicator*	*Interacted risk dummies*	*Singles only*
varly I	1.0190	−0.4077	−0.3258	−0.0876	−0.8994	−0.0863	−0.2502
	(1.1416)	(1.1769)	(1.7026)	(1.2931)	(1.2017)	(1.1403)	(1.8302)
ln perm. income	0.9296***	1.0824***	0.5410	0.8881***	1.0577***	1.0384***	1.0787**
	(0.2016)	(0.1994)	(0.3604)	(0.2521)	(0.1974)	(0.1827)	(0.3610)
entrepreneur/	2.9987***	2.8499***	12.3879**	6.6974**	2.8316***	3.1212***	4.4090***
self-employed	(0.6255)	(0.6109)	(3.8720)	(2.2646)	(0.6103)	(0.5965)	(1.0857)
lvarly I	−0.0271	0.0742	−0.1130	0.0059	−0.0859	0.0243	−0.4432
	(0.4351)	(0.3319)	(0.5132)	(0.4093)	(0.3991)	(0.3701)	(0.6218)
ln perm. income	0.9717***	1.0501***	0.5466	0.8887***	1.0672***	1.0384***	1.0789**
	(0.2281)	(0.2099)	(0.3634)	(0.2535)	(0.1984)	(0.1839)	(0.3626)
entrepreneur	3.0047***	2.8332***	12.4043**	6.6934**	2.8234***	3.1157***	4.4403***
self-employed	(0.6252)	(0.6129)	(3.8770)	(2.2694)	(0.6084)	(0.5958)	(1.0919)
observations	5,437	5,513	6,287	5,801	6,287	6,287	2,018

Notes: Significant at *** 1%, **5% and *10% level. Robust standard errors are in parentheses. The estimated models are variants of the preferred Pooled 3 specification with an endogenous entrepreneurship (or self-employment) dummy variable.

Source: Model estimations based on the SOEP 2002/2007; income variable estimations based on waves 1984–2007.