Precautionary Savings – A Panel Study

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Abstract

A large body of theoretical literature shows that income uncertainty boosts saving. Although the theory on this issue is well established, empirical work is incomplete. This paper tests for the precautionary motive for saving using panel data. Knowing the extent of the precautionary motive is important for gauging the responsiveness of saving to government programs that reduce income uncertainty. It is also important for tax and transfer policy to determine the strength of the precautionary saving motive relative to other motives, like bequests or saving for retirement. Most empirical studies that address issues related to precautionary saving use either aggregate time-series or cross-sectional data, but neither type of data can capture the effects of individual income uncertainty. I use measures of income uncertainty derived from panel data--the National Longitudinal Survey of Labor Market Experience--and find evidence of a strong precautionary motive for saving.

1. Introduction

Why might a Wall Street stockbroker's saving rate be higher than that of a tenured college professor? Could one motivation be precautionary: the stockbroker is worried his income may drop dramatically next year? Previous theoretical work has established that saving rates across individuals should differ depending upon the degree of uncertainty associated with their future income. Yet empirical evidence remains ambiguous because researchers use either inappropriate data or flawed proxies for income uncertainty. I find strong support for the existence of a precautionary motive using panel data and appropriate proxies for both income uncertainty and permanent income.

Empirical investigation of precautionary savings is relevant for both policy and theory. Knowing the extent of the precautionary motive is important for gauging the responsiveness of saving to government programs that reduce income uncertainty. Unemployment compensation, welfare, and advanced notice of plant closings may reduce personal saving by curbing income risk (Danziger et al. 1981). It is also important to determine the strength of the precautionary motive relative to other motives, like bequests or saving for retirement (Modigliani (1988) and Kotlikoff (1988)) because these motives respond differently to various tax and transfer policies. Bequests may partly be the accumulation of saving for that rainy day that never comes. Finally, utility functions with positive third derivatives are necessary to generate precautionary saving (Leland 1968). Empirical evidence of precautionary savings would support the possibility that consumers' tastes are represented by this type of preference ordering.

The theoretical literature has produced the consensus that income uncertainty boosts saving (e.g., Leland (1968), Sandmo (1970) Sibley (1975), and Skinner

(1988))[1], but empirical work is incomplete. Researchers use either inappropriate data (aggregate time series or cross section) which cannot capture the effects of individual income uncertainty or they use suitable panel data but create faulty uncertainty proxies.

Aggregate time series investigations of consumption and saving often contain proxies for uncertainty, such as the level and variability of inflation and unemployment.[2] Results from these studies are inconclusive, suggesting all possible scenarios: positive, negative, and zero effects of uncertainty on saving. Even if the time series results agreed, this research suffers from the use of proxies that do not necessarily measure income uncertainty for each individual. For example, increased inflation may represent income uncertainty for someone with substantial unearned income but not for someone with indexed wages. Also, the interpretation of results is problematic: consumers may increase saving in an inflationary environment to restore their eroded wealth rather than increase saving for precautionary purposes. For such reasons, aggregate time-series data are not ideal for exploring the precautionary motive for saving.

Using micro level cross-sectional data would seem to be a positive step since the theory models individuals' behavior. But the cross-sectional literature is plagued by unsatisfactory uncertainty proxies and has produced inconclusive results. Contrary to predictions, Skinner (1988) finds no evidence for the precautionary motive using the 1972-73 Consumer Expenditure Survey (CES). He cannot measure income movements over time so he proxies income uncertainty by occupation.[3] Even individuals within a narrow occupation category such as doctors experience varying degrees of income

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[1] This is the general result. One important variation is Sandmo's (1970) distinction between the effects of two different types of uncertainty--non–capital income risk and a risky yield on capital investment. While non–capital income risk induces precautionary saving, capital risk can cause people to consume more so that they have less to lose.

[2] E.g., Howrey and Hymans (1978), Boskin (1978), and Gylfason (1981). The primary concern of these papers is not the precautionary motive for saving. Gylfason's study provides a summary of these and other papers, highlighting the mixed results. Wachtel (1980) provides a survey of inflation's affect on saving.

[3] Fisher (1956) and Friedman (1957) also use cross–sectional data and methods similar to Skinner's to explore this issue. They find some evidence supporting the precautionary motive.

uncertainty. There may also be self-selection of risk-loving people into risky occupations. For example, sales people are expected to save more than government workers because their future income is more uncertain. But sales people may be more risk loving, and therefore expected to save less.

Carroll (1989) combines cross-sectional and panel data from the 1960 CES and Panel Study of Income Dynamics (PSID) for measures of uncertainty and future income. He constructs five proxies for income uncertainty from the PSID: the variance and standard deviation of income, and three measures of the likelihood of large declines in income. These uncertainty proxies are assigned to each individual of the CES according to a vector of personal characteristics common to both data sets. Carroll's results support the precautionary saving hypothesis, with the income decline measures proving more significant than the variance-type measures in explaining consumption.

Ideally, one panel data set should be used for measuring both income uncertainty and expected future income. Proxies for these characteristics are never perfect. Yet to assume that they are interchangeable among people and across time, as Carroll does, compounds the errors in measurement.

Jianakoplos, et al. (1986) use the National Longitudinal Survey (NLS), a panel of data on men over a fifteen year period (1966-1981), to investigate the relation of precautionary savings to government income maintenance programs and find a strong precautionary motive. The proxy for uncertainty is the coefficient of variation around the time series average of the individual's discounted annual labor income. Since the authors do not account for an expected income trend, i.e., an age-income profile, the proxy may capture income growth in addition to uncertainty. For a given average level of income, any income growth (positive or negative), causes larger deviations from this mean.

The aim of this paper is to determine whether precautionary savings exists using panel data from the NLS. I expand the analysis of Jianakoplos, et al. by using panel econometric techniques to create improved proxies for income uncertainty and permanent income. Random effects estimation of a permanent income model (King and Dicks-Mireaux (1982)) allows me to isolate the permanent component of observed income. I proxy uncertainty using the standard deviation of the error of each individual's estimated log-income/age profile. This measure controls for the individual's income growth rate so that I proxy income uncertainty, rather than both predictable changes in human capital and income uncertainty. The empirical results are robust and support the hypothesis of precautionary saving. They also support the life-cycle prediction of the hump-shaped profile of asset accumulation.

The remainder of the paper is organized as follows. First, I present a two-period income model with uncertainty to demonstrate the precautionary motive. Second, I discuss the empirical implementation and the data giving special attention to construction of the two key variables--permanent income and income uncertainty. Third, I discuss the results and implications, and offer some concluding remarks.

2. The Precautionary Demand for Saving

This section illustrates the precautionary demand for saving via a two-period income model. It is a variant of Leland (1968) which highlights only the aggregate values of present and future consumption. Unlike multiperiod models, additive utility is not required for the precautionary saving result.[4] The degree of uncertainty associated with future expected income is an important predictor of saving behavior. Increased uncertainty is represented by an increase in the variance of future income holding its expected value constant.

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[4] Leland maximizes $E[U(C_1, C_2)]$ s.t $C_1=(1-k)I_1$, $C_2=I_2 + (1+r)kI_1$. Choosing k (the saving rate) yields $E(MU_1) = (1+r)E(MU_2)$, where $MU_1=\partial U/\partial C_1$, etc. I maximize $E[U(I_1, I_2)]$ with the same constraints (without (1+r) for simplicity) and the same choice variable. For simplicity I assume additivity.

The consumer maximizes the expected utility of income by choosing the saving rate that equalizes expected marginal utility of income across periods ($E(MU_1)=E(MU_2)$). If the uncertainty of second period income is increased, the consumer may increase precautionary saving. A risk averse utility function (e.g., quadratic utility) is not sufficient for the precautionary saving result. A utility function with a positive third derivative (convex marginal utility) is necessary and sufficient.

The intuition for this result is presented in Figure 1: The straight line in the figure represents marginal utility of a quadratic utility function with income in period two (I_2) as its sole argument. MU at points a, b and c correspond to low, mean, and high income values. Note that MU decreases at a constant rate since the third derivative of quadratic utility is zero. Assume $E(MU_1)$ is 10. If I_2 is known to equal its expected value $E(I_2)$, i.e., no uncertainty, $E(MU_2)$ is also 10 (point b). Expected marginal utility across periods is equalized and total utility is maximized.

Uncertainty is introduced in period two such that $E(I_2)$ remains unchanged. With I_L and I_H having equal probability, $E(MU_2)$ will be $(MU_L + MU_H)/2 = 10$. Increasing the spread between I_H and I_L in the quadratic case will not change $E(MU_2)$. Saving in period one need not be altered to equalize the marginal utilities. There is no precautionary saving.

If the utility function is cubic (positive third derivative) the introduction of uncertainty with respect to the second period income will influence saving. The curved line in Figure 1 represents the marginal utility of a cubic utility function. Marginal utility decreases at a decreasing rate. Again, in the initial situation where income is known to equal its expected value, $E(MU_2)$ is 10. Introducing uncertainty in period 2, again keeping $E(I_2)$ unchanged, will now yield an $E(MU_2)$ greater than 10. (See the dotted lines representing marginal utility of the cubic utility function at I_L and I_H.) Since $E(MU_1) = 10$, saving in period one must be increased to equalize the marginal utilities across periods. The higher the spread between I_H and I_L indicating more uncertainty, the higher will be $E(MU_2)$, and the greater will be the precautionary saving.

3. Empirical Implementation

My hypothesis is that people with more uncertain income hold more wealth as a proportion of their permanent income. The theory shows that more uncertainty about future income increases the saving rate if marginal utility is convex. This implies that an analysis of asset accumulation should incorporate a measure of income uncertainty.

I do the estimation in two stages. First I exploit the panel nature of the data to create proxies for permanent income and income uncertainty for each individual in the sample. Then I regress accumulated assets as a proportion of permanent income on these proxies and a vector of other personal characteristics.

Assets

The general form of the final wealth equation (the second stage of estimation) is

$$W_i/Y_i^P = f(U_i,\ Y_i^P,\ X_i) + e_i \qquad (1)$$

W_i is total net wealth in 1966 for person i, and includes housing assets, farm assets, business assets, investment real estate, deposits in financial institutions, personal loans made to others and unsecured personal debt. U_i is income uncertainty for person i, $\mathbf{X}_i$ is a vector of personal characteristics that is assumed to influence wealth, including a quadratic in age because I am interested in testing for the predicted hump shape of the W_i/Y_i^P vs. age profile. I scale wealth since saving and wealth will vary due to the variation in levels of permanent income for person i (Y_i^P). e_i is a normally distributed error term with mean zero. Before discussion of the estimation results, I present the model and estimation of permanent income and income uncertainty.

Permanent Income

Empirical analysis of precautionary savings requires a measure of permanent income. The key feature of the life-cycle model above is that the individual's saving behavior is based on expected total resources in both periods. It is therefore crucial to distinguish permanent income from observed income in an empirical exploration of asset accumulation. King and Dicks-Mireaux (1982) model permanent income and develop a method for estimating it using cross-sectional data. I adopt their model of permanent income and estimate it using panel data.

Following King and Dicks-Mireaux (1982) the model for permanent income is:

$$Y_i^P = \mathbf{Z}_i\beta + \delta_i. \qquad (2)$$

Y_i^P is determined by a vector of observable characteristics $\mathbf{Z}_i$, with β as the parameter vector. δ_i is an error term specific to each individual in the cross-section, and is constant over time. δ_i has a sample mean of zero and variance of σ_δ^2. Permanent income has no transitory component and is evaluated at the same age for each individual.

Observed income in any particular year in terms of permanent income is:

$$E_{it} = Y_i^P + g(A_{it}) + \mu_{it} \qquad (3)$$

E_{it} is income in year t for individual i, $g(A_{it})$ is the age-income profile, and μ_{it} is the transitory component of income. μ_{it} has a sample mean of zero, variance of σ_μ^2, and is assumed to be uncorrelated with δ_i. Substituting equation (2) into equation (3) yields:

$$E_{it} = \mathbf{Z}_i\beta + g(A_{it}) + \mu_{it} + \delta_i\,. \qquad (4)$$

This income equation highlights the components of observed income and its associated errors. Permanent income is the predicted income from equation (4) standardized for age, plus only that portion of the error that is due to the individual specific effect (δ_i).

μ_{it} and δ_i must be separated to identify permanent income from an estimate of this age-income profile. These two error components cannot be separated with the use of cross-sectional data alone because only one income observation defines the total error for each person.[5] If only cross-sectional data are available, the researcher must use information on the relative values of the error components from outside panel studies.

My use of panel data obtains a better estimate of permanent income than is possible with cross-sectional data. No outside panel estimates are needed to determine the error components of observed income. It is also possible to create a proxy of income uncertainty for each person from individual-specific income profiles estimated from the panel.

Using a panel reduces the possibility of three measurement flaws: the direction and size of the individual specific effect, and the slopes of the profiles. In a cross section, equation (4) yields only as many profiles as there are groups defined by $\mathbf{Z}_i$. Differences in Y_i^P are determined by only one income observation so that someone whose observation is below the profile is assigned a negative δ_i. That income may have simply arisen from a bad year. If his other income observations (not observed in the cross section) are above the group profile, we should instead be adding to predicted income to obtain permanent income. This directional measurement flaw is less likely to occur in a panel because there are many income observations for each person and I estimate individual-specific profiles to determine the Y_i^P differences.

Even if the direction of the individual specific effect in a cross section is correct, its size is suspect. The δ_i value taken from outside sources could be a misrepresentation of the true δ_i specific to the cross-section being analyzed.

Finally, the slope of the income profile in a cross section is biased downward because each income observation is associated with a person from a different age cohort. The income observation (in real terms) of an old person is a downward misrepresentation of the actual future income of the younger person in the sample. This

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[5] Equation 4 is written without the time subscripts for a cross section.

vintage effect is reduced in a panel since there are many income observations for each individual.

Estimation

The permanent income model described above attempts to isolate the permanent component of observed income, accurately distinguish each individual from the group, and measure all people at the same point in their life cycle. The random effects (or error components) estimation model satisfies all purposes.

The panel estimation equation for age-income profiles is as follows:

$$\ln E_{it} = \sum_{k=1}^{10} \bar{\beta}_1 J_k + \sum_{k=1}^{10} \beta_{2k} J_k g(A_{it}) + \delta_i + \mu_{it} \quad (5)$$

The J_k variables are dummies that correspond to each occupation. $\ln E_{it}$ is the log of observed income for person i in year t and $g(A_{it})$ is a cubic in age.

Estimating equation (5) yields individual-specific age/log-income profiles. Each has a unique random intercept $\beta_{1i} = \bar{\beta}_1 + \delta_i$, while the slope is occupation-specific.[6] I isolate the individual-specific portion (δ_i) of the total error ($\delta_i + \mu_{it}$) using generalized least squares estimation of the random effects model (Judge, et. al (1982)). The $\mathbf{Z}_i$ vector from equation (4) need not be included in equation (5) since the profiles are already individual-specific.

Permanent income (Y_i^P) is the individual's position, at a standardized age (55), on his predicted income profile from equation (5). Each person has many income observations (5.6 on average) that define his profile's position. Each of these observations contains a transitory error. The predicted profile, however, does not.

I vary the slope only by occupation so there are sufficient observations to be confident predicting Y_i^P. Permanent income must be measured at a standardized age,

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[6] The assumption of the random effects model is that the $\bar{\beta}_{1i}$ are independent random variables with mean $\bar{\beta}_1$ and variance σ_δ^2.

and for many individuals this is a prediction beyond their observed data. Using all income observations within an occupation (an average of 307), rather than only the few from each individual, limits prediction error. Also, it is reasonable to assume that people within a certain occupation take note of others' income growth rates when forming their own expectations.

Summary statistics of Y_i^P from estimating equation (5) are presented in Table 1. I also present the means and standard deviations of the second stage's dependent variable W_i/Y_i^P in Table 1.

Uncertainty

A measure of income uncertainty is impossible unless there exists a measure of expected income. Without a plausible measure of this true expectation, any tracking of income variation could confound trend effects with variability effects. Since expected income changes over time, a trend line in the form of an age-income profile may be a better measure of the income that is truly expected each year. This idea motivates the estimation of the income profiles above. A corresponding measure of income uncertainty, due to both transitory and permanent shocks, is the deviation from the expected path each year. That is, income is more uncertain the more yearly income hovers around the expected age-income profile.

For example, consider an individual who expects steadily increasing income each year. The coefficient of variation about the time series mean of his observed income is an imperfect measure of uncertainty. Because the mean is not the true expectation of the person for any given year, the uncertainty measure is flawed--it is biased upward. The coefficient of variation in this example is a proxy for both income growth and uncertainty.

My income uncertainty proxy is the standard deviation of the error of each individual's profile from equation (5). This measure is smaller than the one described above. It reflects income uncertainty alone rather than both income growth and income uncertainty. This uncertainty proxy is in percentage terms since the dependent variable in equation (5) is the log of income.

4. Data

I use the Older Men cohort of the National Longitudinal Surveys of Labor Market Experience (NLS). The NLS is a panel of 5,020 men and their families, with information from eleven interviews from 1966 to 1981. The survey follows these men who are aged 45 to 59 at the time of the first interview (1966 for all) and are part of the civilian noninstitutionalized population. The NLS is designed primarily to analyze the sources of variation in the labor market behavior and experience of these men.[7] It is especially well-suited for my purpose because it contains information on both income and asset accumulation.

I use family information for income and wealth and assume saving is based on their total resources. Income is measured before tax and is available for ten years between 1965 and 1980.[8] I use wealth in 1966 and convert all of the income and wealth values to 1976 dollars using the GNP deflator for personal consumption expenditures.

I delete the income observations of the entire sample in 1977 and 1979. The income questions in the telephone interviews for those two years are not as comprehensive as in other years. The number of non-missing observations and the mean income for the sample is unusually low in those years. I also delete income observations in years that the male of the household is over 65. Income earned when elderly may not be considered in precautionary behavior. Also, those observations do

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[7] Detailed information about the NLS is available in the NLS handbook (1990) from the Center for Human Resource Research at The Ohio State University.

[8] Taxes are not reported in the NLS.

not fit well in the cubic approximation of the age/log-income profile I estimate. Finally, I use only those families that have three or more income observations over time.

5. Results

Main Findings

I estimate the equation for individual income profiles (equation (5)) using the random effects model to impute permanent income and income uncertainty for each individual. I then estimate the wealth to permanent income ratio (equation (1)) using the permanent income and uncertainty proxies from the panel analysis as explanatory variables. Table 1 contains summary statistics of Y_i^P from equation (5) and W_i/Y_i^P for equation (1). Tables 2 and 3 contain results from two separate specifications of equation (1) and means for all variables including the uncertainty proxy.

The evidence supports a strong precautionary motive for saving. Recall that the theoretical model predicts that with convex marginal utility the saving rate will increase as uncertainty about expected income increases. The movement of the wealth to permanent income ratio with the uncertainty measure gives an indication of the precautionary motive.

What does an uncertainty level of .43 (the sample mean) represent? For a person with a mean permanent income $14,402 it represents an expected yearly income fluctuation of plus or minus $5,700.[9]

The positive impact of uncertainty on the wealth to permanent income ratio is highly significant and large (Table 2). A doubling of uncertainty increases W_i/Y_i^P by

[9] The .43 uncertainty represents less than 43% deviation because of n–1 degrees of freedom in calculating the standard deviation of the regression error. Also note, that because the incomes are in log values, a log–income increase (e.g 9.2 to 9.3) translates into a larger income increase ($1,041) than the translation of an equal sized log–income decrease (e.g. 9.2 to 9.1 represents a $941 decrease).

53 percent.[10] (See Skinner (1988), Caballero (1991), and Kimball (1990) for discussion on the size of the precautionary motive.)

Additional Findings

I interact self-employment and occupation with uncertainty (Table 3) to test for two potential biases. First, it is possible that there is a self selection of those less risk-averse into riskier situations (e.g. the self employed)[11]. Because we would expect these people to be less responsive to an increase in uncertainty (i.e. less prudent (Kimball 1990)), there is a potential downward bias in uncertainty effects. The negative point estimate on the interactive self-employed variable suggests that the self employed may have a weaker response to an increase in uncertainty than wage earners. The significantly positive coefficient on the non-interactive self-employed dummy (includes farmers) indicates that, all else equal, the self employed hold more wealth. One possible explanation is that the self employed (both farmers and non-farmers) need more wealth to operate a business, than a wage earner with the same permanent income. Also, in most cases the farmer owns the farmed land.

Second, since farmers have unusually high values for both W_i/Y_i^P and uncertainty it is possible that the precautionary result in Table 2 is driven by this particular occupation. Table 3 shows that this is not the case: precautionary behavior exists in all occupations. The uncertainty coefficients are positive for all occupations and seven of ten are statistically significant. The differences by occupation are most likely due to differences in risk preferences.

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[10] This response is due to both transitory and permanent shocks. Preliminary results from decomposing the components of the uncertainty measure (Carroll (1991)) indicates that about half of the uncertainty is due to permanent shocks. This result seems to have little variation when the transitory error is assumed to be i.i.d., MA(2) or MA(4). Carroll's results are similar.

[11] The self employed dummy that is interacted with uncertainty does not include farmers because farmers are generally born into the profession rather than having chosen it. Since I want to isolate those who choose the riskier profession (the less risk averse), I do not include farmers in this category.

The relative permanent incomes across occupational categories is as expected: professionals, managers and sales people have the highest incomes while farmers, laborers and service people have the lowest (Table 1). Also, as expected, farmers, laborers and the self employed have the highest uncertainty in their income stream (Table 3, column 3).[12] Carroll (1989) and Jianakoplos, et al. (1986) both calculate the coefficient of variation (CV) around the individual's time series mean of income to measure uncertainty. Since this approach does not account for expected income growth, the measures are as expected, larger than my measure. Carroll's mean CV is .44 and Jianakoplos' is 1.02.[13] Finally, W_i/Y_i^P for my total sample agrees with a subset of the sample used in King and Dicks-Mireaux (1982) of males aged 45 to 59.

The estimates support the life-cycle prediction of the hump-shaped profile of asset accumulation and predict a wealth to permanent income ratio peak at 57 years old. The coefficients on age (positive) and age squared (negative) are jointly significant at the .01 level in both regressions. This result is contrary to many studies that do not support the life-cycle prediction (e.g., Atkinson and Harrison (1978) and Menchik and David (1983)). Kotlikoff (1988) provides a survey of studies addressing this issue.

The coefficient on permanent income is insignificant suggesting that Modigliani's (1954) homogeneity of utility assumption cannot be rejected: the marginal propensity to save is determined by tastes only and not by the size of a person's lifetime resources. King and Dicks-Mireaux (1982) also find evidence that homogeneity cannot be rejected in a model with log of the wealth to permanent income ratio as their dependent variable.

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[12] The mean uncertainty for the self–employed including farmers (n=520) is .63.

[13] I re–estimate the Table 2 specification using the individual's time series average income for permanent income, and the standard deviation of log–income for uncertainty, (analogous to CV). The uncertainty coefficient has a 1.18 elasticity compared to .53 from Table 2. This is expected since the sample average slope of the income profiles at age 55 is –.017. The slower the income growth rate the larger the wealth. But the slower the growth rate, the larger is the uncorrected uncertainty measure (CV). Both the uncertainty and growth effects are represented in the uncorrected uncertainty (CV) coefficient, thus the upward bias.

The small and insignificant coefficient on the bequest intent dummy casts some doubt on the bequest motive for saving. It may be that a portion of bequests are accidental, the savings truly intended for precautionary purposes.

Families save significantly less as the number of children increases. I expect this is due to the inability to save as the number of dependents grows. The need to care for children today may outweigh any impulse to increase saving for their care during a bad income shock. Also, children are a form of security which reduces income uncertainty during retirement and therefore reduces saving. Non-whites save significantly less than whites, possibly due to a lower expected lifespan. The coefficients on the health dummies indicate that those with poor health save the least. This is expected since health care is expensive. Perhaps saving for health care also has a precautionary element. Those with good and fair health save more than those with excellent health possibly because they have higher expectations of failing health. Finally, the more education, the more wealth.

Alternate Specifications

This section addresses possible objections to the above specifications. One possible alternative for creating the permanent income proxy is to use a fixed effects rather than a random effects model.[14] Second, it may be reasonable to create the uncertainty proxy from a specification of equation (5) which allows both the intercept and slope to vary by individual (separate mini-regressions).[15] Recall that in the random effects estimation, the slope varies only by occupation. Finally, since the dependent

[14] The null hypothesis that the random effects model is the correct specification can not be rejected at any reasonable level (Hausman (1978)). Judge et al. (1982) and Hsiao (1986) provide discussion and references on issues surrounding the choice of fixed effects vs. random effects models.

[15] In other words, I estimate a separate age/log–income profile (mini–regression) for each individual, using only his observations. In equation (5) the J_k are now dummies corresponding to each individual rather than each occupation, and the $g(A_{it})$ is now linear in age to save degrees of freedom. An *F*–test comparing the random effects model (restricted) to the model of individual mini–regressions (unrestricted) reveals that the individual–specific slopes are significant. Ideally, if we had enough income observations for each person, the mini–regression model would be used to both predict permanent income and measure uncertainty.

variable is a ratio, extreme values may raise questions regarding the validity of the precautionary result.

I supplement my findings by re-estimating equations (5) and (1) according to the following specifications. First I assume fixed effects for equation (5), i.e. β_{1i} is a fixed parameter estimated by a dummy variable for each person and its deviation from the mean $\overline{\beta}_1$ is interpreted as the individual specific effect. When I substitute permanent income and uncertainty from this model into the wealth regressions of Tables 2 and 3, I obtain the same qualitative results. The overall uncertainty elasticity, from the new Table 2 specification, more than doubles from .53 to 1.16.

Second, I calculate a new uncertainty variable based on the individual profiles obtained from the mini-regressions rather than either the random effects or fixed effects models. I use this uncertainty value again re-estimating the wealth regressions of Tables 2 and 3. The results still indicate a positive and highly significant precautionary motive. The overall uncertainty elasticity, from the Table 2 specification using the mini-regression uncertainty measure is .41. One notable difference is that the interactive self-employed × uncertainty coefficient becomes significantly negative, further supporting the hypothesis that those traditionally considered less risk averse (the self employed), have a weaker response to increased uncertainty.

Finally, I deleted extreme values (absolute values ≥ 30) of the dependent variable in the original wealth regressions (n=3049 in these regressions). The coefficients on uncertainty remain positive and highly significant with an elasticity of .32, and again the interactive self-employed × uncertainty coefficient is significantly negative. Another notable difference is that the bequest coefficient is significantly positive in these regressions. When I delete uncertainty and the self employed dummy, the coefficient on the bequest dummy increases. This lends support to the hypothesis that bequeathed wealth may be partly accidental--composed of some unused precautionary savings.

6. Conclusion

My estimates show that there is a strong precautionary motive for saving. Income uncertainty has a positive affect on the wealth to permanent income ratio. This precautionary motive varies in size depending upon the occupation of the consumer. Furthermore, my results suggest that risk preference is an important factor in the strength of the precautionary motive, as predicted. In all occupations, those less risk averse (the self employed) have a weaker response to uncertainty increases than their more risk averse counterparts.

The findings are important because they indicate that government income maintenance programs that reduce income uncertainty may reduce personal saving. The results are also relevant to the controversy about the size of the bequest motive. Precautionary savings not specified in saving studies may upwardly bias bequest coefficients. Finally, my results suggest that the expected marginal utility of future income is convex.

I improve on previous studies of precautionary savings because I construct individual-specific measures of income uncertainty and permanent income using panel data while controlling for changes in human capital. Previous researchers used broad measures of income uncertainty such as occupational categories or inflation rates and had no permanent income measure.

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Table 1

Panel Results--Random Effects Income Regression
Table of Means

Occupation	Sample size	Permanent income (Y_i^P) Mean	Permanent income (Y_i^P) Standard Deviation	Wealth/Permanent Income (W_i/Y_i^P) Mean	Wealth/Permanent Income (W_i/Y_i^P) Standard Deviation
Total sample	3,072	14,402	9,204	2.73	8.1
Prof./technical	249	24,558	10,528	2.72	5.4
Managerial	363	21,309	13,467	5.16	13.1
Clerical	159	16,467	5,722	1.65	2.5
Sales	112	21,604	9,900	2.51	3.3
Craftsperson	668	14,881	6,167	1.72	2.5
Operative	648	11,839	4,914	1.67	9.0
Services	243	11,194	6,984	1.34	3.2
Farmers	215	8,320	6,056	10.97	14.9
Farm laborers	112	4,928	2,896	0.93	2.6
Laborers	303	8,852	4,316	0.87	1.5
Self-employed Non-Farmers	310	15,576	10,740	5.49	13.73

These results are from the subset of 3,072 families used in the wealth regressions (second stage of estimation). They are generated by the random effects regression (eqaution (5)) on 23,167 income observations (total family income before tax, in 1976 dollars) from a sample of 4,140 families. W_i is wealth in 1966 (in 1976 dollars) and permanent income is at age 55.

Table 2

Least Squares Regression Results--Specification 1--Overall Response to Uncertainty

Dependent variable: Total Net Family Wealth in 1966 Divided by Permanent Income (W_i/Y_i^P)

Variable	Estimated Coefficient	t-value	Variable mean
Constant	−39.780	−1.82	1.00
Uncertainty	3.392	12.32	.43
Uncertainty × Self-Employed Non-Farmer	−0.494	−0.91	.57
Age (1966)	1.470	1.73	51.22
Age squared	−0.013	−1.58	2641.06
Permanent Income (At age 55)	-0.620×10^{-5}	−0.32	14,402.15
Bequest Dummy (1 if intend to leave bequest)	0.006	0.02	0.67
Self Employed Dummy (1 if self-employed)	5.256	13.01	0.17
Race Dummy (1 if non-white)	−1.480	−4.64	0.31
Married Dummy (1 if married)	0.656	1.46	0.89
Number of Children	−0.148	−2.62	2.86
Health Dummies			
Excellent Health	1.333	2.12	0.35
Good Health	1.457	2.38	0.42
Fair Health	1.452	2.23	0.17
Education Dummies			
Elementary Education	−2.334	−2.91	0.47
Some High School Education	−1.590	−1.96	0.19
High School Education	−1.226	−1.55	0.21
Some College Education	−0.951	−1.07	0.06
College Education	−0.263	−0.27	0.04
Adjusted R-squared		.1473	
F-statistic		30.466	
Observations		3072	
Dependent variable mean		2.73	

The reference categories for the dummy variables are as follows: Health--poor; Education--graduate school. The variable mean for the interactive variable is calculated for a dummy value of 1, representing the self-employed non-farmers.

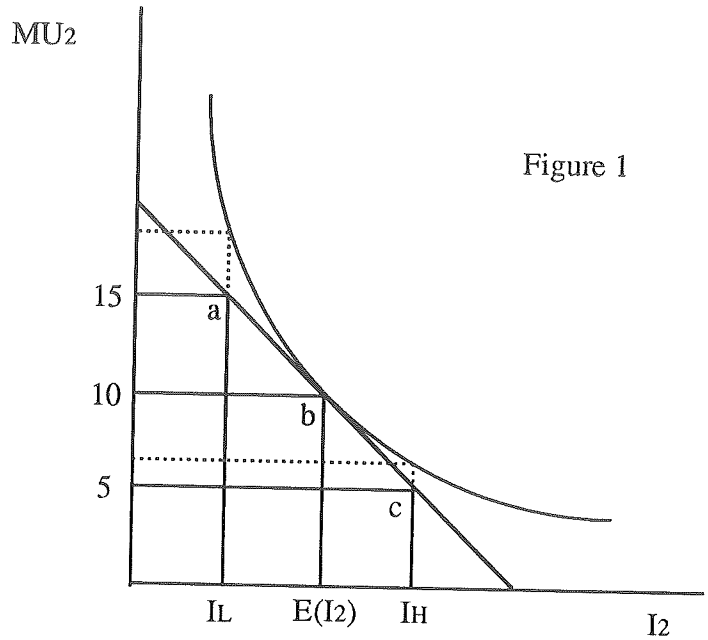
Table 3

Least Squares Regression Results--Specification 2--Response to Uncertainty by Occupation

Dependent variable: Total Net Family Wealth in 1966 Divided by Permanent Income (W_i/Y_i^P)

Variable	Estimated Coefficient	*t*-value	Variable mean
Constant	−38.006	−1.77	1.00
Uncertainty × Professional/Technical	1.757	2.40	0.37
Uncertainty × Manager	7.336	11.25	0.44
Uncertainty × Clerical	2.894	2.65	0.34
Uncertainty × Sales	1.789	1.12	0.36
Uncertainty × Craftsman	1.426	2.71	0.38
Uncertainty × Operative	3.599	7.28	0.40
Uncertainty × Services	1.787	2.46	0.43
Uncertainty × Farmers	6.754	12.31	0.72
Uncertainty × Farm Laborers	0.857	1.06	0.62
Uncertainty × Laborers	0.785	1.37	0.48
Uncertainty × Self-Employed Non-Farmers	−0.386	−0.59	0.57
Age (1966)	1.480	1.77	51.21
Age squared	−0.013	−1.65	2641.06
Permanent Income (At age 55)	-0.189×10^{-4}	−0.97	14,402.15
Bequest Dummy (1 if intend to leave bequest)	−0.028	−0.10	0.67
Self Employed Dummy (1 if self-employed)	3.525	7.67	0.17
Race Dummy (1 if non-white)	−1.299	−4.12	0.31
Married Dummy (1 if married)	0.498	1.13	0.89
Number of Children	−0.180	−3.24	2.86
<u>Health Dummies</u>			
Excellent Health	1.155	1.88	0.35
Good Health	1.291	2.15	0.42
Fair Health	1.220	1.91	0.17
<u>Education Dummies</u>			
Elementary Education	−2.782	−3.41	0.47
Some High School Education	−2.196	−2.66	0.19
High School Education	−1.813	−2.26	0.21
Some College Education	−1.487	−1.67	0.06
College Education	−0.785	−0.80	0.04
Adjusted R-squared		.1838	
F-statistic		26.617	
Observations		3072	
Dependent variable mean		2.73	

The reference categories for the dummy variables are as follows: Health--poor; Education--Graduate school. The variable means for all interactive dummies are calculated for dummy values of 1.


MU2
Figure 1
15
10
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a
b
c
IL
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I2