Wealth, Portfolio Shares, and Risk Preference *

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Abstract

Using an administrative data set of Swedish lottery players that were randomly assigned 500M USD, we estimate the causal effect of wealth on the share of risky assets in a household's financial portfolio. We find that $150,000 causes a 9 percentage point decrease in the average household portfolio's equity share in their financial portfolio. The effect is immediate, not explained by passive investing, and negative in all subsamples considered. A decrease in risk taking could indicate increasing relative risk aversion. However, we show that a dynamic model with realistic income profile can replicate the estimated decrease in portfolio risk, and that caution should be used when inferring risk preference from portfolio shares.

1 Introduction

The relationship between financial risk taking and wealth has long been recognized as a fundamental economic relationship. Most economic theories predict that risk aversion either remains unchanged or decreases as wealth increases, and many studies have attempted to characterize the exact relationship between risk aversion and wealth. Early work by Samuelson (1969) and Merton (1971) showed that absent borrowing constraints, agents with CRRA utility choose a risky asset share independent of wealth. More recently, consumption habits (Sundaresan (1989); Abel (1990); Constantinides (1990); Campbell and Cochrane (1999)) have been shown to cause relative risk aversion to decrease, and thus risky portfolio shares to increase, as wealth increases. Similar behavior emerges in models with consumption commitments (Chetty and Szeidl (2004, 2010)), "keeping up with the Joneses" preferences that define utility of consumption relative to aggregate wealth (Gali (1994); Bakshi and Chen (1996);

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Chan and Kogan (2002)), precautionary risks insured through a "buffer stock" of wealth (Carroll (1997);Carroll (2000)), and luxury goods over which the utility function is less curved (Ait-Sahalia, Parker, and Yogo (2004); Wachter and Yogo (2010)). Furthermore, incorporating decreasing relative risk aversion driven by wealth fluctuations in macroeconomic models has been shown to be useful to account for empirically observed patterns in asset returns, interest rates, risk premia over business cycles (e.g., Boldrin, Christiano, and Fisher (2001); Jermann (1998); Buraschi and Jiltsov (2007); Chen and Ludvigson (2009); Verdelhan (2010); Santos and Veronesi (2010)).

Motivated by the proposed theoretical relationships between wealth and risk aversion, recent empirical studies have used panels of asset holdings to estimate the effect of wealth on risk taking as exhibited through the share of financial wealth allocated to equities. Brunnermeier and Nagel (2008) and Chiappori and Paiella (2011) estimate no statistically significant effect of changes in wealth on changes in portfolio allocations, and thus are unable to reject constant relative risk aversion. Using richer financial records that permit control of passive changes in portfolio allocation, Calvet, Campbell, and Sodini (2009) instead estimates that the share of financial wealth invested in risky assets increases with wealth, and Calvet and Sodini (2014) find similar results after using a panel of twins to control for unobserved heterogeneity. The relationship between wealth and financial risk taking is similarly ambiguous when looking beyond financial portfolios. Using alternative data sources, Guiso and Paiella (2008) find that relative risk aversion is increasing in wealth (survey instrument), Sahm (2013) finds no effect of wealth on relative risk aversion (survey instrument), and Paravisini, Rappoport, and Ravina (2015) estimate a positive effect of wealth on relative risk aversion (peer-to-peer lending portfolios).

This lack of consensus likely reflects the challenge of identifying the effect of wealth separately from the effect of other portfolio determinants. Changes in financial wealth often coincide with changes in future income expectations, macroeconomic fluctuations that affect beliefs, investment opportunities, family composition, and passive portfolio gains. Instrumental variables are often used to address concerns of endogeneity, but as discussed in Calvet, Campbell, and Sodini (2009) and Calvet and Sodini (2014), differing results in otherwise similar studies reflect a sensitivity to the choice of instrument.[1]

The current paper addresses this identification challenge by exploiting wealth randomly assigned to three Swedish samples of lottery players who have been matched to tax records of wealth holdings. A particular advantage of this sample is that we observe factors conditional on which lottery prizes are randomly assigned, and thus are able to estimate the causal effect of wealth on risky portfolio allocation without relying on instrumental variables. In addition, the prize pool is large, with over 500 million USD assigned to more than 300,000 households. Furthermore, because the data set is drawn from three distinct samples, we are able to analyze each sample separately to gauge how sample selection contributes to our results. Finally, because our lottery and wealth data are drawn from administrative records, measurement error and attrition are limited.

In our baseline estimates, we estimate that each 150K USD (1M SEK) received causes a 6.5 percentage point decrease in the average household's financial portfolio.[2] Among households that

[1]For example, Brunnermeier and Nagel (2008) instrument wealth changes with income growth and unexpected inheritance, Paravisini, Rappoport, and Ravina (2015) instrument with local house price changes, and Calvet, Campbell, and Sodini (2009) instrument with household portfolio returns.

[2]All monetary variables presented in this paper are reported in year-2010 prices. When converting to USD, we use

participated in equity markets prior to the lottery, each 150K USD (1M SEK) won causes a 9 percentage point decrease in the share of financial wealth allocated to equities. This effect is immediate, persistent up to 4 years after the lottery event, and appears to be driven by an active decision to allocate lottery winnings into assets offering safe returns. Furthermore, lottery wealth is estimated to cause decreases in risky asset share in all subpopulations considered, with larger decreases in risky asset share estimated for households that have pre-existing debt, that are not self-employed, that do not own a home, that win during a period of negative equity returns, and in which the winning household member is male.

This paper is the first that we are aware of that finds evidence that an increase in wealth causes a significant decrease in the share of financial wealth allocated to equities.[3] Interpreting risky asset share as a proxy for risk aversion would suggest, in contrast to most commonly assumed utility specifications, that increasing relative risk aversion.[4] However, in a simple model featuring an external consumption habit and non-tradeable future labor income, the effect of an increase in financial wealth on risky portfolio share may be positive or negative depending on the strength of the habit, distribution of income, and the correlation between income and equity returns. Furthermore, as shown in Polkovnichenko (2007), the interaction between a habit and non-tradeable income may give rise to a non-monotonic effect of wealth on risky portfolio share, further contributing to the theoretical ambiguity.

While the effect of an increase in financial wealth on risky portfolio share is theoretically unclear, if future income is non-tradeable, large relative to a consumption habit, and not too strongly correlated with equity returns, then our estimates have a simple structural interpretation. Under these conditions, households view income as similar to a non-tradeable bond when choosing the their risky portfolio share. To offset this position and reach the optimal equity share in total wealth, households allocate a larger share of their financial portfolio to equities. As financial wealth increases following a windfall gain, the non-tradeable income position becomes a lower share of total wealth, and the financial risky portfolio share decreases towards the optimal share of total wealth exposed to equities. The role of this channel in determining risky portfolio shares has been previously highlighted in structural life cycle models (Bodie, Merton, and Samuelson (1992); Jagannathan and Kocherlakota (1996); Viceira (2001); Polkovnichenko (2007)) and discussed in empirical studies (Calvet and Sodini (2014)), but empirical evidence of this channel affecting risky portfolio shares has been scarce. In addition to being consistent with our main empirical result, estimates of heterogeneity in the effects when stratified by pre-existing wealth, income, and by prize size are broadly consistent with this interpretation.

To provide quantitative interpretation of the causal estimates, we study a structural life-cycle portfolio choice model based on Gomes and Michaelides (2005) that includes Epstein-Zin preferences, an income process featuring permanent and transitory innovations, a risky and risk-free asset, a fixed cost of participation in equity markets, and stochastic mortality. Using a standard calibration with income and equity processes calibrated to Swedish estimates, we find that the model reasonably matches the estimated effect of windfall gains on risky portfolio share. After simulating windfall gains equivalent to those observed in the data, the model predicts that each 150K USD (1M SEK) won causes a twelve

the Dec. 31, 2010 exchange rate of 6.72 SEK/1 USD.

[3]Brunnermeier and Nagel (2008) estimate a negative effect in some specifications, but the effect is generally small and not statistically significantly different than zero.

[4]We do note that Guiso and Paiella (2008) estimate increasing relative risk aversion and argue that it is reasonable in the types of gamble posed in their key survey instrument.

percentage point decrease in the share of financial wealth allocated to equities, quite close to the nine percentage point decrease we estimate empirically. In addition, when changes in financial wealth are correlated with changes in the permanent component of income the model predicts that increases in financial wealth have no effect on the share of equities held in financial portfolios. Thus, the model is able to both account for our results and provide a possible explanation to sensitivity to the choice of instrument.

In summary, this paper makes a number of contributions. First, we present precise, credible quasi-experimental estimates of the causal effect of wealth on equity share in the financial portfolio, and are the first study to estimate that increases in wealth cause a significant decrease in risky portfolio share. Second, we show that accounting for non-tradeable income provides a plausible explanation of both our findings and the sensitivity of results in other studies to choice instrument. We thus provide a link between studies such as Bodie, Merton, and Samuelson (1992), Jagannathan and Kocherlakota (1996), and Viceira (2001) that have highlighted this channel and empirical work. Third, our structural analysis permits quantitative comparison of our quasi-experimental estimates to predictions of models used in an active structural literature (e.g., Gomes and Michaelides (2005); Cocco (2005); Alan (2006); Khorunzhina (2013); Wachter and Yogo (2010); Fagereng, Gottlieb, and Guiso (2015)). We show that quantitative predictions of these model generally align with empirical estimates and provide guidance for future modeling efforts.

The lottery sample that we use in this paper has been used in two related studies. First, Briggs, Cesarini, Lindqvist, and Östling (2015) examine the effect of windfall gains on stock market participation. This study finds that windfall gains cause a significant but relatively small increase in the probability of stock market participation among households that did not own equities prior to the lottery, but virtually no effect on households that owned equities prior to the lottery. Continued nonparticipation among large prize winners is puzzling and explaining it likely requires nonstandard preferences or beliefs that induce reluctance toward stock ownership, while the lack of effect on prior equity owners is consistent with inertia in equity ownership. In this paper we focus in greater detail on prior equity owners and study how wealth affects equity ownership on the intensive margin. Second, Cesarini, Lindqvist, Notowidigdo, and Ostling (2015) examine the effects of windfall gains on lifetime earnings, and find that wealth causes a significant but small decrease in lifetime earnings. In this paper we will treat labor income as exogenous, but accounting for this decrease would only buttress our main findings.

The remainder of the paper proceeds as follows. In Section 2 we present a simple model to highlight how labor income affects both optimal share of financial wealth allocated to equities and the interpretation of estimated effects of wealth. Section 3 describes our data, its key features, and identification strategy. Section 4 presents our main reduced form findings. Section 5 introduces a structural model and compares its quantitative predictions to our empirical estimates. Finally, Section 6 concludes.

2 A Simple Model of Portfolio Choice

In this section, we study a static model of portfolio choice similar to that in Campbell and Viceira (2002a) that includes risky labor income and an exogenous consumption habit and show how these two features affect portfolio choice. Suppose an agent has wealth W, utility function U, external consumption habit X, non-negative stochastic labor income $\tilde{H} \sim G(\tilde{H})$. Suppose further the agent may invest in a risky asset paying stochastic return $1+\tilde{r} \sim F(\tilde{r})$ and a risk-free asset paying certain return r_f with $\mathbb{E}[\tilde{r}] > r_f$, and chooses risky asset share α to solve the following optimization problem:

$$\begin{aligned} V(W) &= \max_{\alpha} \mathbb{E}\left[U(C-X)\right] \\ s.t.\ \ C &= W\left[\alpha(\tilde{r}-r_f)+(1+r_f)\right]+\tilde{H} \end{aligned} \tag{1}$$

By assumption future labor income $\tilde{H}$ is non-tradeable. Defining surplus consumption $C^{\star} = C - X$, the problem is equivalent to solving Equation 2 with no habit and with adjusted budget constraint

$$C^{\star} = W\left[\alpha(\tilde{r}-r_f)+(1+r_f)\right]+\tilde{H}-\frac{X}{1+r_f} \tag{2}$$

An agent solves this problem by first investing $\frac{X}{1+r_f}$ in the risk-less asset to ensure wealth is positive next period. The agent then invests the remaining wealth $W - X/(1+r_f)$ exactly as if the habit was not present. If $\bar{\alpha}$ is the optimal share of wealth invested in risky assets when $X = 0$, then

$$\hat{\alpha} = \bar{\alpha}\left(1-\frac{X}{(1+r_f)W}\right) \tag{3}$$

Although a closed form solution for $\hat{\alpha}$ does not exist, if utility is CRRA with risk parameter γ and $\tilde{H}$ and $1+\tilde{r}$ are distributed multi-variate lognormal with covariance $\sigma_{h,r}$, Campbell and Viceira (2002b) show that $\hat{\alpha}$ may be approximated as

$$\begin{aligned} \bar{\alpha} &\approx \frac{1}{\rho}\left(\alpha^{\star}-\frac{\sigma_{h,r}}{\sigma_r^2}\right)+\frac{\sigma_{h,r}}{\sigma_r^2} \\ \frac{1}{\rho} &= 1+\frac{exp\{\mathbb{E}[log(\tilde{H})]\}}{exp\{\mathbb{E}\left[log(W)+log\left(\alpha(\tilde{r}-r_f)+(1+r_f)\right)\right)]\}} \\ \frac{1}{\rho} &\equiv 1+\overline{H/W} \end{aligned} \tag{4}$$

where $\alpha^{\star} = \frac{\mu_r+\sigma_r^2/2}{\gamma\sigma_r^2}$ is the optimal portfolio choice in the absence of labor income and $\overline{H/W}$ is the expected ratio of income to wealth. Plugging this expression back into Equation 3 yields

$$\hat{\alpha} = \left(1-\frac{X}{W(1+r_f)}+\frac{\overline{H}}{W}\right)\left(\alpha^{\star}-\frac{\sigma_{h,r}}{\sigma_r^2}\right)+\frac{\sigma_{h,r}}{\sigma_r^2}\left(1-\frac{X}{W(1+r_f)}\right) \tag{5}$$

as the optimal risky portfolio share.

Expression 5 shows that financial wealth W affects portfolio choice through two channels. First, an increase in W causes a decrease in the expected ratio of income to next period wealth, and the term

$(\overline{H/W})$ decreases. Second, an increase in W causes a decrease in the ratio of consumption habit to wealth and an increase in $\left(1 - \frac{X}{W(1+r_f)}\right)$. These terms reflect distortions induced by implicit wealth allocation due to non-tradeable income $\tilde{H}$ and a mandatory payments X that become less severe as the implicit allocations become a lower share of total wealth. However, these terms have opposite effects on risky asset share, and furthermore, the effect on optimal risky portfolio share depends critically on the correlation between income and risky asset returns $\sigma_{h,r}$. We thus analyze each channel separately to clarify the role of each before analyzing both simultaneously.

We begin by supposing that there is no labor income ($\tilde{H} = 0$) and analyze the effect of wealth on risky portfolio share in the presence of an exogenous habit. In this case the optimal share of financial wealth allocated to equities is given by Equation 3 with $\bar{\alpha} = \alpha^\star$ and we easily see that $\hat{\alpha}$ is increasing in W if X is constant. This argument is similar to that presented in Brunnermeier and Nagel (2008), and provides a plausible structural interpretation for a positive effect of wealth on risky portfolio share.

Next, we suppose that there is no habit ($X = 0$) and analyze the effect of wealth on risky portfolio share in the presence of stochastic labor income. In this case,

$$\begin{aligned}\hat{\alpha} &= (1 + \overline{H/W})\left(\alpha^\star - \frac{\sigma_{h,r}}{\sigma_r^2}\right) + \frac{\sigma_{h,r}}{\sigma_r^2} \\ &= (1 + \overline{H/W})\alpha^\star - (\overline{H/W})\frac{\sigma_{h,r}}{\sigma_r^2},\end{aligned} \tag{6}$$

showing there are two primary effects on risky portfolio share. The first term accounts for the effect of idiosyncratic, non-tradeable income which causes a larger share of wealth to be allocated to equities with the distortion is decreasing in W. The second term accounts for the hedging demand for equities, with the sign of the distortion opposite the sign of the correlation between income and risky asset returns. As we generally consider income and equity returns are generally assumed to have zero or positive correlation, the hedging demand generally lowers the share of financial wealth allocated to equities with the distortion decreasing in W. There are thus two countervailing effects of wealth on equity share, and the net effect depends on the sign of $\left(\alpha^\star - \frac{\sigma_{h,r}}{\sigma_r^2}\right)$. If $\left(\alpha^\star - \frac{\sigma_{h,r}}{\sigma_r^2}\right) > 0$, then the first term dominates and an increase in wealth causes a net decrease in risky portfolio share. If $\left(\alpha^\star - \frac{\sigma_{h,r}}{\sigma_r^2}\right) < 0$ then the hedging component of demand dominates and an increase in wealth causes an increase in risky portfolio share.

Determining the net effect of wealth on risky portfolio share becomes more intricate when both consumption habits and risky income are present. If $\sigma_{h,r} = 0$, Equation 5 shows the effect of wealth on risky portfolio share depends on whether $\left(1 - \frac{X}{(1+r_f)W} + \frac{\overline{H}}{W}\right)$ increases or decreases in wealth. Intuitively, if expected future income is large relative to the habit, increases in wealth cause decreases in the risky portfolio share, while if the consumption habit is large relative to expected income, increases in wealth cause decreases in the risky portfolio share. If $\sigma_{h,r} > 0$ then the hedging demand introduces an additional channel through which wealth might cause an increase in risky portfolio share, although the net effect is unclear given the ambiguity surrounding the effect implied by the first term.

As the above analysis makes clear, when utility exhibits CRRA an increase in wealth can cause an increase, decrease, or have no effect on risky portfolio share depending on the size of the consumption habit, the amount of income, and the correlation between labor income and equity returns. Furthermore, although closed form solutions generally do not exist, the same channels can cause similar patterns when utility does not exhibit CRRA. Thus, absent high quality measures of income, it's risk properties, and the habit formation process, little inference can be made regarding the curvature of a household's utility function by estimating the effect of wealth on risky portfolio share.

While little can be said about risk aversion, the above analysis does provide insight into how we might expect an increase in wealth to affect risky portfolio share. The sign of the effect rests critically on the size expected income to wealth ratio relative to the habit to wealth ratio. With regards to the size expected income/wealth ratio, it is well established that for most individuals, the presented discounted value of income is their primary source of wealth (Dublin and Lotka (1930); Weisbrod (1961); Becker (1975); Lillard (1977); Jorgenson and Fraumeni (1989)), and Baxter and Jermann (1995) argue that the value of human capital exceeds that of physical capital in most economies. Furthermore, even when valued using a stochastic discount factor the present value of labor income is generally several hundred thousand dollars (Benzoni, Collin-Dufresne, and Goldstein (2007); Huggett and Kaplan (2015)).[5] Thus, it is reasonable to expect the income/wealth ratio to be large.

The present discounted cost of habit maintenance is more difficult to quantify as it is unobserved. Campbell and Cochrane (1999) find that a habit to consumption ratio of close to one is able to match a variety of asset pricing phenomena. Calvet and Sodini (2014) estimate habits consistent with this assumption, first proxying internal (external) consumption habits in Sweden using average disposable income as 36K USD (25K USD), and later using their estimated risky share/wealth elasticity to calculate an implied habit of 23K USD. The latter implies a lifetime cost of maintenance of 770K USD. Thus, it is reasonable to expect that the habit to wealth ratio is large, and it is thus unclear whether the income to wealth or habit to wealth ratio should dominate.

Furthermore, the analysis above assumes that the lower bound on labor income and and equity return distributions were zero. As discussed in Polkovnichenko (2007) and Calvet and Sodini (2014), if either of these are positive, an additional constraint on the upper bound of risky asset share is determined by the worst-case realization of next period's wealth. This constraint becomes looser as wealth increases, providing an additional channel through which wealth might cause an increase in risky asset share. The full, dynamic model presented in Polkovnichenko (2007) shows that at low wealth levels this effect dominates, and at higher wealth levels the human capital channel dominates. Thus it is possible that the effect of wealth on risky asset share is non-monotonic, with risky asset share increasing in wealth at small to moderate wealth levels and decreasing in wealth at moderate to high wealth levels. By extension, it is reasonable to expect the effect on risky asset share to be non-monotonic in the size of the increase in wealth as well.

In short, the effect of wealth on portfolio share is ambiguous in this simple model framework. Nevertheless, the framework both aids in the interpretation of estimates in Section 4.4 and highlights the relevant portfolio determinants of the richer model in Section 5. Furthermore, this model provides a potential insight into the noted sensitivity of estimates to choice of instrument. It is rare to an

[5] Such studies also address the correlation between equity returns and income.Benzoni, Collin-Dufresne, and Goldstein (2007) estimating the equity component to be about 50 percent of human capital and Huggett and Kaplan (2015) estimating it to be positive but well below this level. As will be discussed in Section 5.2, in Sweden we estimate this correlation to be slightly negative but statistically indistinguishable from zero.

observe an increase in W that does not coincide with change in the distribution of $\tilde{H}$ or consumption habit X, and it is the effect on the ratios of these variables to wealth that determine portfolio share. If changes in W coincide with changes in $\tilde{H}$ or X in standard data, then the effect on the expected ratios that determine portfolio shares may be ambiguous. Thus, difficulty in controlling for all portfolio determinants provides a potential explanation for the sensitivity of previous studies to choice of instrument.

3 Data and Identification Strategy

This summary of the data is derived from Briggs, Cesarini, Lindqvist, and Östling (2015), which previously used the same data sets to study the extensive margin of equity ownership. Our analyses are conducted in a sample of lottery players who have been matched to administrative demographic and financial records using players' personal identification numbers (PINs).

3.1 Register Data

Our outcome variables are all derived from the Swedish Wealth Register, which contains high-quality information about the wealth portfolios of all Swedes. The register was discontinued when Sweden abolished its wealth tax, but has annual year-end financial information for 1999-2007. This information includes aggregate assets and debt, and relevant subcategories such as bank account balances[6], mutual funds, directly held stocks, bonds, money market funds, debt, residential and commercial real estate, and other financial and real assets. The data have proven valuable in household-finance research beginning with a landmark paper by Calvet, Campbell, and Sodini (2007). The quality of the Wealth Register compares favorably to other data sources, as it is not subject to attrition and included variables are likely measured with minimal error. Calvet, Campbell, and Sodini (2007) estimate that included variables account for approximately 86% of wealth in Sweden.

We supplement the portfolio data from the Wealth Register with basic demographic information available in the Statistics Sweden administered database LISA. Our analyses are conducted at the household level, with a household defined as the observed winner and, if present, his or her spouse. We choose this definition because the wealth of spouses of winning players increases by about 10% of the prize won following the lottery event, thus suggesting some joint control over assets. All our analyses are based on players aged 18 and above, and we restrict the sample to lottery draws conducted no later than 2007, the last year for which we have financial data. In addition, given that we consider a maximum horizon of 10 years and wealth data is only available starting in 1999, we restrict our sample to prize winners after 1989.

3.2 Lottery Data

Our basic identification strategy is to use the available data and knowledge about the institutional details of each of the lotteries to define cells within which the lottery wealth is randomly assigned.

[6]We thank Paolo Sodini for providing us with the imputed bank account balances for households whose balance fell below the required reporting threshold

We then control for these cell-fixed effects in our analyses, thus ensuring all identifying variation comes from players in the same cell. Because the exact construction of the cells varies across lotteries, we describe each lottery separately. For a detailed description of how the original lottery data were preprocessed and quality-controlled, we refer the reader to the Online Appendix of Cesarini, Lindqvist, Östling, and Wallace (2015).

Kombi – Kombi is a monthly subscription lottery whose proceeds are given to the Swedish Social Democratic Party, Sweden's main political party during the post-war era. Subscribers choose their desired number of subscription tickets and are billed monthly, usually by direct debit. Kombi provided us with a longitudinal data set with information about all draws conducted between 1998 and 2010. For each draw, the panel contains an entry per lottery participant, with information about the number of tickets held, any large prizes won, and the player's PIN.

The Kombi rules are simple. In a given draw, each prize is awarded by randomly selecting a unique ticket. Two individuals who purchased the same number of tickets are equally likely to win a large prize. To construct the cells, each winning player is matched to (up to) 100 non-winning players with the same number of tickets in the month of the draw. To improve precision, we choose controls similar to the winner on sex and age whenever more than 100 matches are available. This matching procedure leaves a sample of 349 large prize-winners, matched to a total of 34,852 controls.

Triss – The second sample is a scratch-ticket lottery run since 1986 by Svenska Spel, the Swedish government-owned gambling company. Since 1994, Triss lottery players can win the opportunity to participate in a TV show where they can win substantial prizes. In a typical month, 25 Triss winners appear on the show and draw a prize by selecting a ticket from a stack. The tickets are shuffled and look identical. The prizes are distributed according to a known prize plan with prizes varying from 50K SEK to 5M SEK. The prize plan is subject to occasional revision.

Svenska Spel supplied the basic demographic information (name, age, region of residence, and often also the names of close relatives) about all individuals who participated in the TV show between 1994 and 2010. With the help of Statistics Sweden, we were able to reliably identify the PINs of 99% of show participants. Svenska Spel also listed cases in which the player shared ownership of the ticket. Our analyses are based exclusively on the 90% of winners who did not indicate they shared ownership of the winning ticket. Our empirical strategy makes use of the fact that, conditional on the prize plan, the nominal prize amount is plausibly random. Thus, two players are assigned to the same cell if they won in the same year and under the same prize plan, providing a final sample of 3,416 winners.

PLS – PLS accounts are savings accounts whose owners participate in regular lotteries with monetary prizes paid on top of (or sometimes in lieu of) interest payments. Such accounts have existed in Sweden since 1949 and were originally subsidized by the government. When the subsidies ceased in 1985, the government authorized banks to continue to offer prize-linked-savings products. Two systems were put into place, one operated by savings banks and one by all other banks. The two systems were approximately equally popular and participation was widespread across broad strata of Swedish society; every other Swede owned an account.

Table 1: Overview of Identification Strategy.

Lottery	Period	Prize Type	Cells
PLS	1990-2003	Fixed Prize	Draw × # Fixed Prizes
PLS	1990-1994	Odds Prize	Draw × Balance
Kombi	1994-2007	Fixed Prize	Draw × # Tickets
Triss	1994-2007	Fixed Prize	Year × Prize Plan

The PLS sample was obtained by combining data from two sources of information about the PLS accounts maintained by the commercial banks and state bank. The first source is a set of printed lists with information about prizes won in the draws between 1986-2003. For each prize won in a draw, these sheets list the prize amount, type of prize won (described below), and the winning account number. The second source is a large number of microfiche images with information (account number, account owner's PIN, and number of tickets received) about all eligible accounts participating in the draws between December 1986 and December 1994 (the "fiche period"). Because the prize lists contain the winning account number, but not its owner PIN, the fiches are needed to identify winning players' PIN.

PLS account holders could win two types of prizes: odds prizes and fixed prizes. The probability of winning either type of prize was proportional to the number of tickets associated with an account: account holders assigned one lottery ticket per 100 SEK in account balance. Fixed prizes, which constitute the majority of prizes, were prizes whose magnitude did not depend on the balance of the winning account. Odds prizes, on the other hand, were awarded as a multiple of the balance of the prize-winning account.

For fixed-prize winners, our identification strategy exploits the fact that in the population of players who won exactly the same number of fixed prizes in a particular draw, the total sum of fixed prizes won is independent of the account balance. Previous studies of lottery players have used this identification strategy (Imbens, Rubin, and Sacerdote (2001); Hankins, Hoestra, and Skiba (2011)). Because the strategy does not require information about the number of tickets owned, it can be employed also during the post-fiche period, as long as the winning account was active during the fiche period so the account owner's PIN can be identified. We therefore assign two individuals to the same cell if they won an identical number of fixed prizes in that draw. Overall, we were able to reliably match 99% of the fixed-prize-winning accounts from the fiche era to a PIN.

To construct odds-prize cells, we match individuals who won exactly one odds-prize in a draw to individuals with a near-identical account balance who also won exactly one prize (odds or fixed) in the same draw. This matching procedure ensures that within a cell, the prize amount is independent of potential outcomes. After the fiche period, we do not observe account balances and therefore odds prizes are only included if won during the fiche period (1986-1994). In total, the sample includes 275,248 PLS prizes, of which 257 are larger than 1M SEK.

Table 2: Prize Distribution. Included are the all-year and post-1999 samples, and their respective lottery subsamples. Prize amounts are in year-2010 SEK and net of taxes.

	A. All-Year				B. Post-1999			
Prize Amount	**Pooled**	**PLS**	**Kombi**	**Triss**	**Pooled**	**PLS**	**Kombi**	**Triss**
$L_i \leq 10K$	293,470	258,618	34,852	0	71,211	42,223	28,988	0
$10K < L_i \leq 100K$	16,020	15,031	0	989	742	375	0	367
$100K < L_i \leq 500K$	3,348	1,267	0	2,081	1,240	0	0	1,240
$500K < L_i \leq 1M$	232	75	0	157	89	0	0	89
$1M < L_i \leq 2M$	605	222	333	50	298	2	274	22
$2M < L_i$	190	35	16	139	78	0	16	62

3.3 Identification

Table 1 summarizes the previous section's discussion of how we construct the cell fixed effects in each of the three lotteries. Normalizing the time of the lottery to $s = 0$, our main estimating equation is given by

$$Y_{i,s} = \beta_s \times L_{i,0} + \mathbf{X}_i \times \mathbf{M_s} + \mathbf{Z}_{i,-1} \times \boldsymbol{\gamma_s} + \eta_{i,s}, \tag{7}$$

where i indexes households, $L_{i,0}$ denotes the prize size (in million SEK), $\mathbf{X}_i$ is a vector of cell fixed effects, and $\mathbf{Z}_{i,-1}$ is a vector of controls. Controls are included to improve the precision of our estimates and are always measured in the year before the lottery. Standard errors are clustered at the level of the player. The key identifying assumption needed for β_s to have a causal interpretation is that the prize amount won is independent of $\eta_{i,s}$ conditional on the cell fixed effects.

In many of our analyses, we estimate Equation 7 in our pooled sample. We also conduct several analyses in the subsample of players who participated in draws conducted between 2000 and 2007. In what follows, we refer to these samples as the *all-year* and the *post-1999* samples. The post-1999 sample plays an important role in subsample analyses where we stratify players by their pre-lottery participation status, which is first observed in 1999. In the all-year sample regressions, we control for the following lagged baseline demographic characteristics: age, sex, marital status, retirement status, college completion, household size, disposable income, and self-employment. In the post-1999 sample regressions, we additionally control for the following lagged baseline financial characteristics: net wealth, gross debt, and indicators for real estate ownership and risky-asset share.

To get a better sense of the source of our identifying variation, Table 2 provides information about the distribution of prizes. The total value of the after-tax prize money disbursed to the winners in our samples is almost 3.5 billion SEK (about 500M USD), 67% of which is accounted for by prizes whose value is greater than the median annual Swedish household disposable income in 1999 (143K SEK (21K USD)). Thus, although small prizes account for a relatively large fraction of prizes won, most identifying variation comes from the larger prizes in all three lotteries. All lotteries contribute substantial identifying variation to the all-year sample, whereas Kombi and Triss prizes jointly account for most identifying variation to the post-1999 sample.

To test our key identifying assumption, we again normalize the time of lottery to $s = 0$ and run

Table 3: Testing for Random Assignment. Results are obtained by estimating Equation 8 in our all-year sample, in its lottery subsamples, and in the post-1999 sample.

	All-Year					**Post-1999**	
	Pooled		**PLS**	**Kombi**	**Triss**	**Pooled**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Fixed Effects	Cells	None	Cells	Cells	Cells	Cells	None
Demographic Controls							
F-stat	.69	11.54	.64	.92	1.37	.87	10.01
p	.74	<.001	.78	.51	.19	.56	<.001
Financial Controls							
F-stat	—	—	—	—	—	1.81	12.80
model p	—	—	—	—	—	.14	<.001
Demographic+Financial Controls							
F-stat	—	—	—	—	—	1.29	15.20
p	—	—	—	—	—	.22	<.001
N	313,865	313,865	275,248	35,201	3,416	73,658	73,658

the following regression:

$$L_{i,0} = \mathbf{X_i} \times \mathbf{\Gamma_0} + \mathbf{Z_{i,-1}} \times \boldsymbol{\rho_{-1}} + \epsilon_i. \tag{8}$$

Under the null hypothesis of conditional random assignment, the characteristics determined before the lottery ($\mathbf{Z_{i,-1}}$) should not predict the lottery outcome (L_i) conditional on the cell fixed ($\mathbf{X_i}$) effects. We run these quasi-randomization tests in the all-year sample, its lottery subsamples, and the post-1999 sample. As expected, Table 3 shows that the lagged characteristics have no statistically significant predictive power in the specifications that include cell fixed effects. If they are omitted however (columns 2 and 7), the null hypotheses of random assignment is rejected.

4 Estimating Causal Effects

Our primary outcome variable is the share of financial wealth invested in stocks or mutual funds. Figure 1 presents the estimated coefficients from equation 7 at horizons $s = -1, ..., 10$ estimated in the pooled lottery sample. Here we observe that each 1M SEK of lottery wealth causes an initial 7 percentage point decrease in the risky asset share the year of the lottery event. Although the negative effect diminishes in magnitude over time, the effect is still negative and significant even 7 years after the lottery event. The results are similar, but smaller, if we define risky asset share more narrowly to only include directly owned stocks (Appendix Table B.2, Panel B).

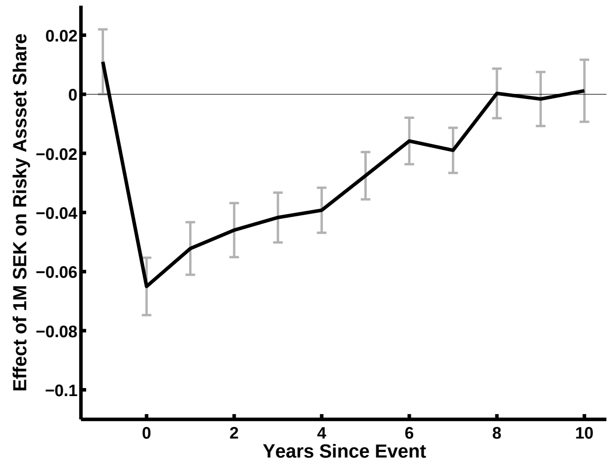


Figure 1: Effect of Wealth (1M SEK) on Risky Asset Share. Coefficients and 95% confidence intervals, are obtained by estimating Equation 7 in the all-year sample. See Appendix Table B.2 for the underlying estimates.

Households that did not participate in equity markets prior to the lottery can not decrease their risky portfolio share, and windfall gains effect their investment in equities primarily through the previously studied extensive margin participation decision. To understand how the effect on risky asset share differs for households that already owned equities, we re-estimate equation 7 in the post-1999 sample restricted to pre-lottery equity market participants. Figure 2 presents the resulting coefficient estimates for horizons $s = -1, ..., 4$. We estimate that 1M SEK (150K USD) causes a 9 percentage point decrease in the share of financial wealth invested in stocks or mutual funds the year following the lottery event that is persistent for four years after lottery event. Although there is some evidence that the effect is weaker (although less precisely estimated) at longer horizons, there is little evidence of the diminishing effect seen in Figure 1. The diminishing effect estimated in the pooled, all-year sample thus more likely reflects the entry and capital accumulation of non-participating households, and not portfolio inertia or delayed rebalancing. Results are again similar but weaker if we re-estimate this specification with risky asset share narrowly defined to only include directly owned stocks (Appendix Table B.3, Panel B).

Other studies (e.g., Brunnermeier and Nagel (2008), Calvet, Campbell, and Sodini (2009), Chiappori and Paiella (2011) and Calvet and Sodini (2014)) have interpreted risky asset share as a proxy for relative risk aversion. Interpreting our result in this way would suggest that relative risk aversion increases in wealth, contrary to most commonly assumed utility functions. However, as shown in Section 2, absent strong assumptions regarding the size of the consumption habit, the amount of labor income, and the correlation between labor income and equity returns, insights regarding risk aversion from risky portfolio share are tentative at best. Furthermore, the listed studies generally find either no or positive effects of wealth on risky asset share, and the significant negative effect of wealth on risky asset share we estimate is thus a novel finding. To better understand this result, we conduct several heterogeneity analyses to explore how the effect varies among subpopulations and with prize size.

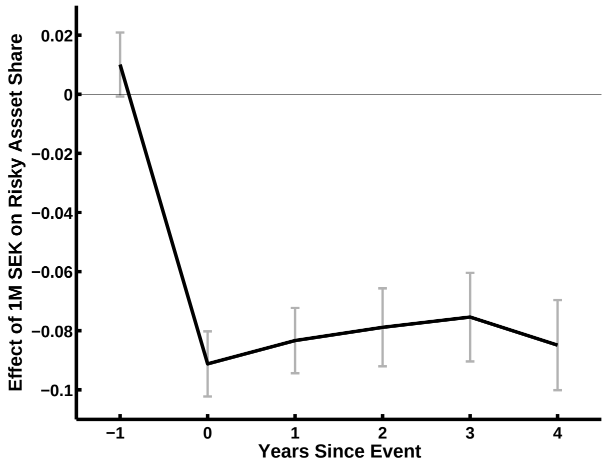


Figure 2: Effect of Wealth (1M SEK) on Risky Asset Share. Coefficients and 95% confidence intervals, are obtained by estimating Equation 7 in the Post-1999 sample. See Appendix Table B.3 for the underlying estimates.

4.1 Heterogeneity in Effects

Equation 2 implies that the effect of lottery wealth on risky portfolio share is potentially heterogeneous in both income and pre-existing wealth. Thus, as a first exercise we estimate equation 7 in the post-1999 subsample of pre-lottery equity market participants stratified by pre-existing income and wealth.[7] Specifically, we classify households as high wealth if their observed wealth holdings are above their age-specific median, and we classify households as high income if their average income the last 5 years is above their observed age-specific median. The results of these regressions are presented in Figure 3.

Figure 3 shows that there is significant heterogeneity in the effect of wealth on risky portfolio share in these subsamples, especially by pre-existing wealth. For households that are low wealth and low income, each 1M SEK (150K USD) won causes a 20 percentage point decrease in the share of stocks or mutual funds held in the financial portfolio the year of the lottery that is persistent for four years. Among households with low wealth and high income, each 1M SEK (150K USD) won causes a 12 percentage point decrease in risky asset share. In contrast, among households with high wealth each 1M SEK (150K USD) won causes a 7-8 percentage point decrease, with the effects not differing significantly between households with above and below age-specific median income. These results are subject to the important interpretational caveat that only lottery wealth is randomly assigned. The underlying correlation between pre-existing wealth and income and the endogenous selection into high and low income and wealth categories limits our ability to differentiate whether the estimated effects reflect differences due to wealth and income or other factors that are correlated with wealth and income. Figure 3 is however suggestive that the effect on risky asset share is strongest for households with low wealth.

[7] Procedurally, we run a single regression in which all regressors are interacted with an indicator variable for one of the subpopulations. The resulting coefficient estimates are identical to those obtained when Equation 7 is estimated separately in each subsample.

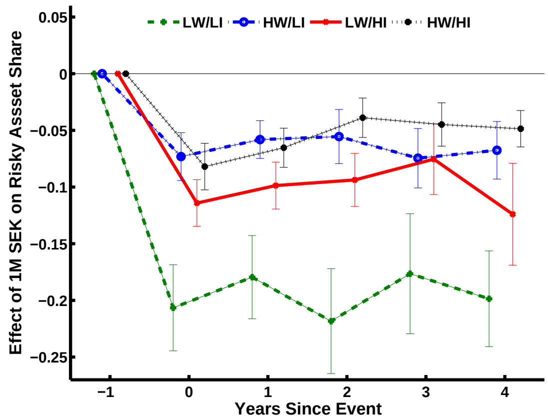


Figure 3: Effect of Wealth (1M SEK) on Risky Asset Share by $s = -1$ Income and Wealth. Coefficients and 95% confidence intervals, are obtained by estimating Equation 7 in the Post-1999 sample stratified by pre-lottery income and wealth. Households are classified as high wealth if their observed wealth at time $s = -1$ is greater than the median wealth among households of the same age, and as high income if the average of their income 5 years prior to the lottery event is greater than the median age-specific income. See Appendix Table B.4 for the underlying estimates.

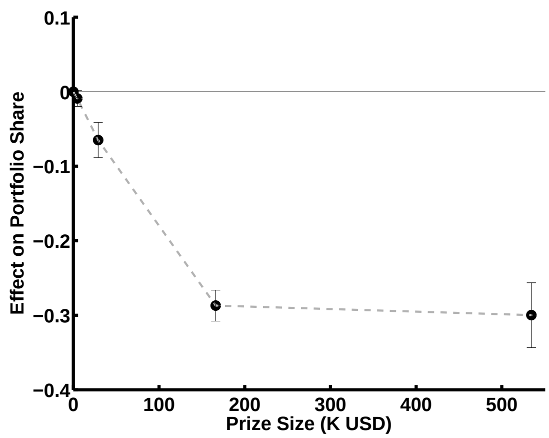


Figure 4: Effect of Wealth on Risky Asset Share by Prize Size. Coefficients are obtained by estimating Equation 7 in the post-1999 sample with the lottery wealth variable replaced by indicators for five mutually exclusive prize categories: 0 to 10K SEK (0 to 1.5K USD), 10K to 100K (1.5 to 15K), 100K to 1M (15 to 150K), 1M to 2M (150 to 300K), and 2M+ (300K+). Coefficient estimates and the 95% confidence bands are plotted at the mean prize in each category. See Appendix Table B.5 for the underlying estimates.

Equation 2 also suggests that the optimal risky portfolio share is nonlinear in wealth. The linear estimator specified in equation 7 gives an unbiased estimate of a weighted treatment-effect, but because large prizes account for most of our identifying variation, the estimator will assign most weight to the marginal effect of wealth at modest to large levels of wealth. To explore whether this masks significant non-linearity, we modify our basic estimating equation by replacing the lottery-wealth variable by indicator variables for prizes in five categories. We then run regressions in which the smallest prize

Table 4: Heterogeneous Effect of Wealth (1M SEK) on Risky Asset Share. Coefficients are obtained by estimating Equation 7 in the post-1999 sample of equity market participants at time $s = 0$. Hetero p obtained from an F-test of the null hypothesis that the two lottery-wealth coefficients are identical. Equity returns are based on the MSCI Sweden Index the calendar year prior to the lottery.

	Financial Characteristics							
	Gross Debt		**Home Owner**		**Income Risk**		**Equity Returns**	
	≤ 0	**> 0**	**Yes**	**No**	**High**	**Low**	**≤ 0**	**> 0**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Effect	-.111	-.118	-.103	-.190	-.102	-.134	-.149	-.101
SE	(.021)	(.016)	(.012)	(.040)	(.016)	(.021)	(.025)	(.015)
p	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Hetero p	.760		.038		.188		.097	
N	32,161	21,209	14,051	39,319	28,414	24,956	22,372	30,998
	Demographic Characteristics							
	Sex		**Age**		**College**		**Self-Employed**	
	Male	**Female**	**≤ 45**	**> 45**	**Yes**	**No**	**Yes**	**No**
	(9)	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
Effect	-.139	-.099	-.159	-.106	-.090	-.144	-.055	-.126
SE	(.020)	(.016)	(.035)	(.013)	(.015)	(.022)	(.031)	(.013)
p	<.001	<.001	<.001	<.001	<.001	<.001	.078	<.001
Hetero p	.114		.154		.037		.037	
N	26,163	27,207	6,571	46,799	30,531	22,839	50,036	3,334

category omitted in our post-1999 subsample of equity market participants.

Figure 4 presents the estimated coefficients for each of these categories at horizon $s = 0$, with coefficients marked at the mean prize size in each category. Relative to small prize winners (<10K SEK, 1.5K USD), a prize in the range 10K-100K SEK (1.5 to 15K USD) decreases the risky portfolio share by .009. The corresponding estimates for winners of prizes in the 100K-1M (15 to 150K), 1M-2M (150 to 300K), and 2M+ (300K+) are -.065, -.287, and -.300. Thus, the marginal effect is negative for all prize sizes, but diminishes with prize size.

Finally, we conduct a number of additional heterogeneity analyses that stratify the post-1999 sample of participants by pre-lottery debt, home ownership, standard deviation of annual income changes, stock returns in the calendar year of win, self-employment, sex, age, and educational attainment. Results from these heterogeneity analyses for $s = 0$ are presented in Table 4.[8]

We find evidence of statistically significant differences in the effect of lottery wealth on risky portfolio share when stratifying by home ownership, prior equity returns, educational attainment, and self employment. In particular, our estimates suggest that lottery wealth causes larger decreases in risky portfolio share among home-owners, in years following negative equity returns in the MSCI

[8] Results for $s = 3$ are shown in Appendix Table B.7 and are broadly similar but less precisely estimated because the estimation sample size shrinks with time horizon.

Sweden Index, among non-college educated households, and among households that are not self-employed. Some of these findings are easy to reconcile with the findings of other studies. For example, households being less willing to invest in risky asset in years following poor equity returns is consistent with findings (e.g., Graham and Harvey (2001); Vissing-Jørgensen (2003); Greenwood and Shleifer (2014)) that beliefs of equity returns mirror recent return realizations. Similarly, we might expect for college educated household to be less sensitive to lottery wealth if households with college degrees rebalance portfolios faster (Calvet, Campbell, and Sodini (2009)), and if self-employed households hold less equities ex-ante the scope for reducing risky portfolio share might be smaller (Heaton and Lucas (2000); Viceira (2001)). The finding that homeowners reduce equity shares less is somewhat surprising, as several studies have argued that home-ownership makes households more risk averse (e.g., Grossman and Laroque (1990); Cocco (2005); Flavin and Yamashita (2011); Vestman (2013); Chetty and Szeidl (2010)). This finding thus might reflect differences in pre-lottery portfolio allocations or correlation with other unobserved portfolio determinants, and highlights the need for caution when interpreting heterogeneity analyses. Finally, we observe suggestive, but not statistically significant, evidence that the lottery winnings cause larger decreases in risky portfolio share for males, younger households, and households with less risky pre-lottery income profiles,[9] while there is no evidence of heterogeneity when stratified by whether a household had positive debt before the lottery.

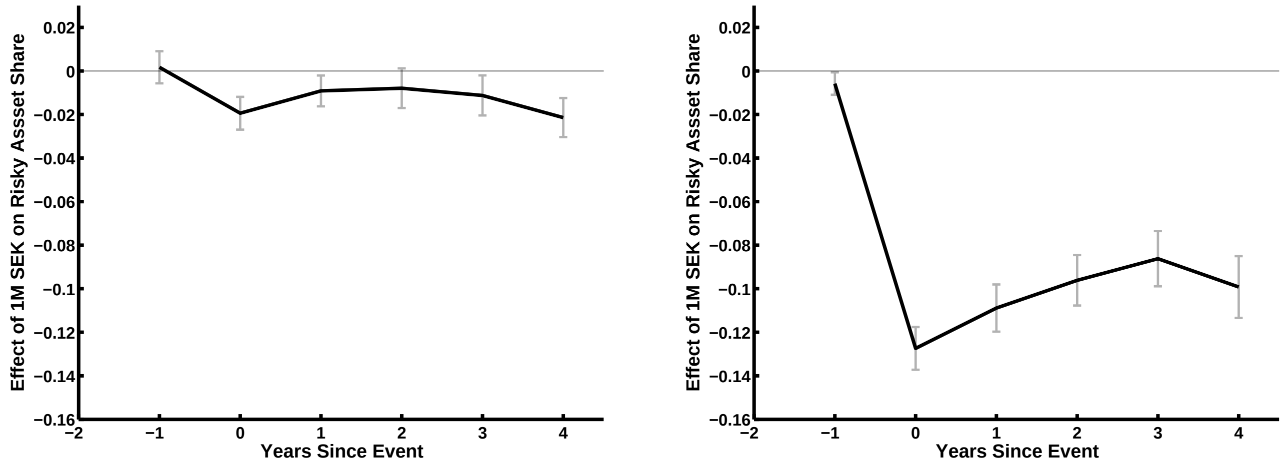
4.2 Other Risky Share Definitions and Robustness

The analysis above primarily defines risky share as the sum of stocks and mutual divided by total financial wealth, while Appendix Tables B.2 and B.3 show results are similar, albeit less pronounced, if the risky assets are more narrowly defined to include only stocks. To explore how results might vary if the risky asset share was defined differently, we consider two alternative specifications.

First, we consider the share of total wealth allocated to risky assets, where risky assets are still defined to include only stocks and mutual funds, and real estate holdings are notably counted as safe assets. The resulting estimates are presented in Panel A of Figure 5. We find that under this definition of risky share, wealth causes very small decreases in the risky portfolio share. This reflects that for most households real estate accounts for a large share of total wealth prior to the lottery event, and so the pre-lottery risky share is quite low, thus limiting any potential negative effect.

We find an opposite result when real estate is classified as a risky asset. In this case, the risky asset share is quite large prior to the lottery due to the dominance of real estate in the total wealth portfolio. However, as will be shown in Section 4.5, little of the lottery winnings are invested in real estate, and so the negative effect we estimated in our baseline specification is amplified. There is not sufficient investment of lottery winnings invested in real estate, equities, or mutual funds to match the large risky asset share of most households prior to the lottery event.

[9]Here, income risk refers to the standard deviation of annual changes in household income the 6 years prior to the lottery event



(a) Real Estate Safe **(b) Real Estate Risky**

Figure 5: Effect of Wealth (1M SEK) on Risky Asset Share, Alternative Definitions Coefficients and 95% confidence intervals, are obtained by estimating Equation 7 in the Post-1999 sample stratified by pre-lottery income and wealth. Both figures consider the share of total wealth allocated to risky assets. In Panel A, real estate is classified as a safe asset, while in Panel B real estate is considered risky. See Appendix Table B.6 for the underlying estimates.

4.3 Comparison of Estimates with Non-Experimental Estimates

Our study differs from previous studies both in its identification strategy and sample. While the sensitivity of result to choice of instrument has been noted in prior work (Calvet, Campbell, and Sodini (2009); Calvet and Sodini (2014)), it is unclear whether our differing results reflect a difference in identification strategy or sample composition. In addition, if results are dependent on identification strategy, understanding how risky portfolio shares change due to alternative sources of wealth variation in our sample might provide insight into the channels which generate our results. Thus, in this section we repeat the main analysis from Brunnermeier and Nagel (2008) in our sample of lottery winners to estimate how risky portfolio share changes due to non-quasi-experimental wealth variation.

In their baseline analysis, Brunnermeier and Nagel (2008) estimate the following equation

$$\Delta_k \alpha_t = \beta q_{t-k} + \gamma \Delta_k h_t + \rho \Delta_k w_t + \epsilon_t \tag{9}$$

where α_t is the share of stocks or mutual funds held in the financial portfolio, q_{t-k} is a vector of household characteristics (.e.g., age, gender, marital status, household composition, unemployment, log income, union employment, vehicle ownership, and inheritances), $\Delta_k h_t$ is a vector containing changes in family composition or asset ownership (e.g., changes in number of children, home ownership, business ownership, nonzero labor income), and $\Delta_k w_t$ is the change in wealth of interest. In addition, due to concerns regarding measurement error, Brunnermeier and Nagel (2008) use quantile dummies for income growth from $t-k$ to t and inheritance receipts as instruments and estimate equation 9 using two-stage least squares. We replicate this regression to the best of our abilities in the post-1999 sample of lottery participants.[10] In particular, we restrict analysis to households that won the lottery

[10] Because of differences in data sources, we are not able to exactly replicate this specification. In particular, our data

Table 5: Changes in the Proportion of Financial Wealth Invested in Risky Assets, Non-Experimental Variation. Coefficients are obtained by estimating Equation 9 in the post-1999 sample with a starting date at least six years prior to the lottery event. Regressions are estimated at a 2 year and 5 year horizon using both OLS and TSLS. This estimation closely replicates Table 4 of Brunnermeier and Nagel (2008).

	2 Year		5 Year	
	OLS (1)	TSLS (2)	OLS (3)	TSLS (4)
Full Sample				
$\Delta \log(W_t)$	-.014	-.025	.003	.045
SE	(.002)	(.069)	(.002)	(.083)
N	4,086	4,086	3,664	3,664
Subsample				
$\Delta \log(W_t)$	-.004	-.063	.006	.0001
SE	(.004)	(.068)	(.004)	(.098)
N	1,455	1,455	1,234	1,234
Comparison				
$\Delta \log(W_t)$	.023	-.136	-.013	-.012
SE	(.011)	(.076)	(.009)	(.058)
N	1,455	1,455	1,234	1,234

at least k years after 1999 to avoid contamination with lottery winnings, restricting our sample to winners in year 2001 or later and 2004 or later for horizon $k = 2$ and $k = 5$, respectively.

Estimates for full-sample, a random subsample the same size as that in Brunnermeier and Nagel (2008), and the corresponding estimates from Brunnermeier and Nagel (2008), Table 4 are presented in Table 5. Our results broadly confirm their main conclusion that changes in wealth do not cause changes in the share of risky assets in the financial portfolio. Although we do estimate negative effects of changes in wealth on risky portfolio share using both OLS and TSLS at the $k = 2$ year horizon, these estimates are either economically small or statistically indistinguishable from zero. Estimates are similarly small and indistinguishable from zero at the $k = 5$ year horizon, and in all specifications the sample-size matched estimates are statistically indistinguishable from those in Brunnermeier and Nagel (2008). These results provide evidence that our main estimates likely reflect differences in identification strategy and are not driven by differences in sample. Furthermore, they suggest that the source of wealth variation is important for determining the effect on portfolio composition.

Finally, we conducted a number of sensitivity checks to explore the robustness of our $s = 0$ results to lottery subsamples and household definition. The results from these analyses are summarized in Appendix Table B.1. Our main findings are robust to these alternative specifications and analyses, and in all cases we find that lottery wealth causes a significant decrease in risky portfolio share.

does not permit controls for vehicle ownership, inheritances, union coverage, and more than 5 years of lags for changes in wealth or income

4.4 Interpreting Emprical Results

Our empirical results documented several findings that may be interpreted using the simple model presented in Section 2. First, equation 2 shows that if labor income is not highly correlated with equity returns and the expected ratio of future labor income to financial wealth is large relative to the consumption habit, then the effect of wealth on risky portfolio share is negative. This provides a plausible explanation for our main result: increases in financial wealth cause a significant decrease in risky asset share.

Again, if labor income is not highly correlated with equity returns and the expected ratio of future labor income to financial wealth is large relative to the consumption habit, equation 2 predicts the effect of wealth on risky asset share should vary with pre-lottery wealth and income. Specifically, the effect of wealth on risky asset share should not only be negative, but more negative for households with lower pre-existing wealth and higher pre-existing income. The results in Figure 3 shows clear support for the former but not the latter prediction.

Finally, if the the correlation between labor income and equity returns is indeed low and present value of labor income is large relative to the consumption habit, then the marginal effect of wealth on risky portfolio share diminishes in wealth. Intuitively, because the the ratios of labor income and consumption habit to wealth determine risky portfolio shares, small increases in the denominators of these ratios have the biggest marginal effects. In Figure 4 we find clear evidence that the marginal effect diminishes in prize size.

This interpretation of results suggests the importance of understanding the channel through which changes in wealth occur. If the change in wealth is driven by a positive innovation to current and future income, it is unclear how portfolio allocations will change. The resulting portfolio allocation depends critically on the relative size of the increases in financial wealth today and future wealth trajectories. When using lottery wealth as a source of identifying variation, we are uniquely confident that the increase in wealth is orthogonal to changes in all other relevant variables. When using non-quasi-experimental variation, it is quite likely that changes in income contribute to changes in wealth. Indeed, when we replicate the estimates of Brunnermeier and Nagel (2008) using income quantile changes as an instrument, we find results similar to other studies that conclude there is no significant effect of wealth on risky portfolio share.

Overall, the broad pattern of results are consistent with the simple portfolio decision problem when income and equity returns are not highly correlated and labor income is large relative to a consumption habit. Of the four predictions described above, only the effects stratified by above/below median age-specific labor income is not consistent with equation 2, and this result is subject to the noted intepretational caveat. Thus, although our results are somewhat surprising given the findings of previous studies, the bulk of evidence suggests this is a plausible interpretation of our findings.

In Section 5 we will use a realistically calibrated lifecycle portfolio choice model to revisit this interpretation and, determine how labor income and its correlation with equity returns interact to determine risky asset shares, and explore whether our quasi-experimental estimates align with the predictions of such a model.

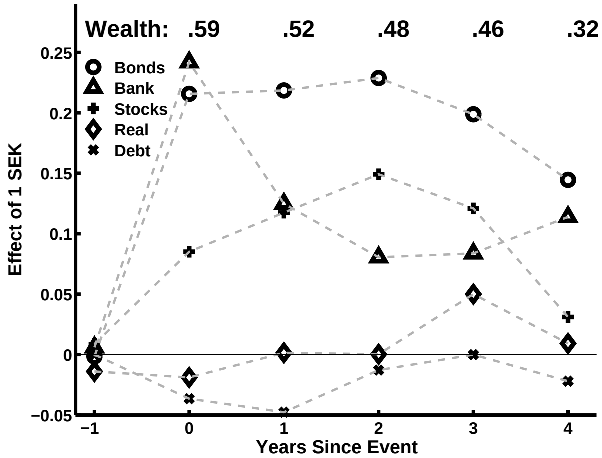


Figure 6: Effect of Wealth on Net Wealth, Bonds, Stocks, Bank Account Balances, Real Assets and Debt. Plotted are coefficients obtained from Equation 7 estimated in the post-1999 sample. For expositional clarity, the estimated effects on net wealth are displayed as numerical values. Bonds: interest rate funds, premium bonds and interest bonds. Stocks: directly and indirectly held stocks. Bank Acct: Bank Account Balances. Real Assets: property and land owned. Debt: gross debt. Net Wealth: financial and real assets minus debt. All outcome variables are valued at year-end market value. See Appendix Table B.8 for the underlying estimates.

4.5 Where does the money go?

Briggs, Cesarini, Lindqvist, and Östling (2015) estimated how lottery winnings are allocated across five wealth categories measured in the Swedish Wealth Register: bank account balances, stocks, bonds, debt and real assets. Figure 6 shows the results from these analyses (see the accompanying caption for details on variable definitions). All variables are measured at year-end market value and all analyses are run in the post-1999 sample or pre-lottery equity market participants. The coefficients plotted for each variable are scaled so an estimate of 0.10 means that the total market value of the outcome (e.g., risky assets owned) increases by .1 for each 1 SEK won. Shown at the top of the figure are the numerical values of the coefficient estimates from an analogous specification in which the dependent variable is net wealth.

There are several relevant points in this figure. First, roughly 60% of lottery winnings appear in household wealth holdings the year of win, with 28% of amount won appearing after four years. Thus, while some of the winnings are consumed, given away, or allocated to assets not included in the wealth registry, a substantial portion are saved and invested in documented asset classes. Second, there does appear an initial tendency to use the bank account as a default account, as roughly 20% of lottery winnings appear in the bank account the year of the win. However, this falls dramatically, with only 10% appearing in bank accounts after one year. Third, there appears to be little use of lottery winnings to invest in real assets (including real estate) or pay off debts. At all horizons, less than 5% of total amount won are estimated to appear in either of these categories, suggesting that real estate investment is not significantly affecting our results. Finally, households invest a substantial proportion of winnings in bonds and interest funds. Investment in this category overtakes bank accounts as the largest category after one year, and remains so at all subsequent horizons. Investment in these assets, which likely requires active investment decision, suggests that the decrease in risky portfolio share reflects a decision of households to allocate the majority of lottery winnings to safe assets.

5 A Structural Model

Patterns in our reduced form results suggest that estimates are consistent with a model in which non-tradeable labor income induces households to hold a larger share of their financial assets in equities than they would if income were tradeable, and that as financial wealth increases this distortion becomes smaller and the share of risky assets in the financial portfolio decreases. While plausible, it is unclear if the two conditions that are required for this interpretation, namely that equity returns and income innovations are not highly correlated and that the labor income distortion is large relative to that induced by a consumption habit, are satisfied. Furthermore, even if these conditions hold and our reduced form results can be accounted for qualitatively through the non-tradeable income channel, it is unclear whether the significant negative effects of wealth on risky portfolio share are quantitatively reasonable. To answer both of these questions, in this section we compare our casual estimates to the predictions of a life-cycle portfolio choice model calibrated to Swedish data.

The model we study is based on Gomes and Michaelides (2005) and Cocco, Gomes, and Maenhout (2005), and is similar in structure to other models of life-cycle portfolio choice including Cocco (2005), Alan (2006), Wachter and Yogo (2010), Khorunzhina (2013), and Fagereng, Gottlieb, and Guiso (2015). We briefly introduce the main model features and calibration before introducing the main results, and refer the reader to Appendix A for details of the model solution.

5.1 Model

Each period, an age t agent chooses how much to consume, save, and invest in equity markets, with returns realized at age $t+1$.

Demographics An agent has a maximum lifespan of $T = 113$, but prior to reaching age T, faces mortality risk with an exogenous probability of surviving from period t to $t+1$ denoted by s_t. The agent's age corresponds to the age of the lottery winner, and upon death the agent receives a payout of zero.

Preferences Households have Epstein-Zin utility functions (Epstein and Zin (1991)) defined over a consumption good. C_t and W_t denote respectively consumption and wealth at age t. The household's preferences over these objects are defined by

$$V_t = \left\{ (1-\beta s_t) C_t^{1-1/\psi} + \mathbb{E}\left[s_t V_{t+1}^{1-\rho} \right]^{\frac{1-1/\psi}{1-\rho}} \right\}^{\frac{1}{1-1/\psi}}$$

where ρ is the coefficient of relative risk aversion, ψ is the intertemporal elasticity of substitution, and β is the discount factor.

Income The labor income process $H_{i,t}$ has both a permanent component $P_{i,t}$ and a transitory component $U_{i,t}$. The log of the permanent component follows a random walk with a deterministic drift $f(t, Z_{i,t})$ and innovation $N_{i,t}$. All innovations are assumed to be lognormally distributed with mean zero. Formally, the labor income process before retirement is given by

$$H_{i,t} = P_{i,t}U_{i,t} \tag{10}$$

$$P_{i,t} = exp(f(t, Z_{i,t}))P_{i,t-1}N_{i,t}. \tag{11}$$

Included in variable set $f(t, Z_{i,t})$ is a polynomial of age and an indicator of marital status. At retirement age of $t = 65$, all future labor income becomes non-stochastic. For any age greater than 65, income is defined by a replacement rate λ of the age-65 permanent component of income. Formally, $H_{i,t} = \lambda P_{i,65}$ for all $t > 65$. The labor income process is thus summarized by parameters σ_U, σ_N, and the coefficients that define $f(t, Z_{i,t})$.

Assets Each period an agent has the option of investing in a risk free asset that pays out certain return r_f and a risky equity that pays stochastic return r_t^s, and chooses risky portfolio share $\alpha_{i,t}$. The equity returns are given by

$$r_t^s - r_f = \mu_s + \epsilon_{s,t}, \tag{12}$$

where $\epsilon_{s,t}$ is distributed normally with standard deviation σ_s. Innovations to excess returns are correlated with innovations to the permanent innovation to labor income, and we write the correlation coefficient as $cov(n_{i,t}, \epsilon_{s,t}) = \sigma_{n,s}$. Wealth thus accumulates according to the following expression:

$$W_{i,t+1} = (1 + r_f)(W_{i,t} - C_{i,t}) + \alpha_{i,t}(r_{s,t+1} - r_f)(W_{i,t} - C_{i,t}) + H_{i,t+1} \tag{13}$$

Note that because in our sample of interests all households already participate in equity markets, we do not require entry costs that are common in similar models.

Household Problem Combining the above expressions, we arrive at the following household decision problem:

$$\begin{aligned} V_t(W_t, P_t) = \max_{C_t,\alpha}\{(1 - \beta s_t)C_t^{1-1/\psi} + \beta\mathbb{E}\left[s_t V_{t+1}^{1-\rho}\right]^{\frac{1-1/\psi}{1-\rho}}\}^{\frac{1}{1-1/\psi}} \\ W_{t+1} = (1 + r_f)(W_t - C_t) + \alpha_t(r_{s,t+1} - r_f)(W_t - C_t) + H_{t+1}. \\ 0 \leq \alpha \leq 1 \end{aligned} \tag{14}$$

Of key interest for our purposes is the policy function for α, which characterizes the optimal allocation of financial wealth to risky assets.

Table 6: Baseline Calibration. This table presents the baseline calibration of all structural model parameters.

	Parameters		
Initial Age	$t_0 = 18$	**Death Age**	$T = 108$
Intertemporal Elast. of Sub.	$\psi = .2$	**Relative Risk Aversion**	$\rho = 5$
Transitory Risk	$\sigma_U = .23$	**Permanent Risk**	$\sigma_N = .09$
Income/Asset Covariance	$\sigma_{n,s} = -.04$	**Retirement Rep. Rate**	$\lambda = .60$
Discount Factor	$\beta = .96$	**Risk Free Return**	$r_f = .02$
Mean Excess Return	$\mu_s = .065$	**Return St. Dev.**	$\sigma_s = .21$

5.2 Calibration

We calibrate the model with standard preference paramters and update labor income and equity return processes to reflect historical Swedish data. The resulting calibration is presented in Table 6. Agents are assumed to die with certainty at age 108, and we solve for policy functions beginning at age 18, the minimum age in our sample. Additionally, we assume an annual discount rate of $\beta = .96$, relative risk aversion is set to $\rho = 5$, and the intertemporal elasticity of substitution is calibrated to .2. Risky equity returns are calibrated with $\mu_s = .065$ and $\sigma_s = .21$ to match historical Swedish equity market returns.

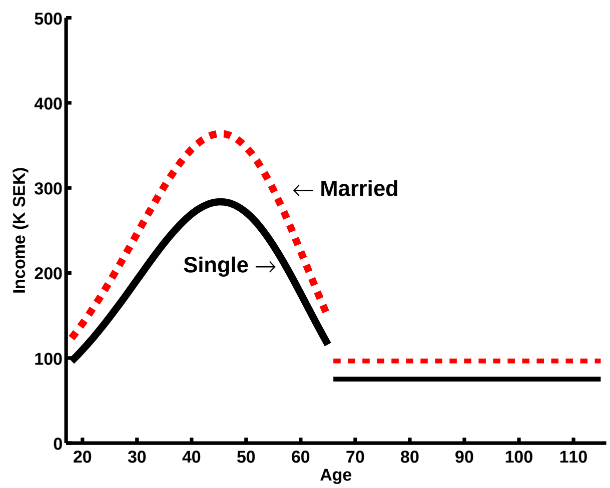


Figure 7: Estimated Income Processes. This figure presents the estimated income processes for married and single households. In each case, we present $H_{i,t}$ for the average household, determined by setting $U_{i,t} = N_{i,t} = 1$. See Appendix A.3 for the income process estimation procedure.

The labor income process described in equation 10 is estimated from pre-lottery labor income realizations from our sample of lottery winners. The estimation procedure follows that presented in Appendix B of Cocco, Gomes, and Maenhout (2005), and Appendix A.3 summarizes the exact procedure used to generate estimates of σ_U, σ_N, $\sigma_{n,s}$, and $f(t, Z_{i,t})$. Figure 7 presents the resulting estimates of $f(t, Z_{i,t})$ for both single and married households. In addition, we estimate that $\sigma_U = .23$, $\sigma_N = .09$. These numbers are comparable to values estimated in the United States by Carroll (1997), Gourinchas and Parker (2002), and Cocco, Gomes, and Maenhout (2005), although our estimate of σ_N is on the lower end of estimates. Importantly, we estimate that $\sigma_{n,s} = -.04$, although the point estimate is not statistically significantly different from zero. Thus, overall, our income estimates suggest that income is fairly safe and not correlated with equity market returns. Finally, we calibrate $\lambda = .6$ to reflect the median retirement income replacement rate during the period of study.

5.3 Results

Using the above calibration, we solve for optimal consumption, saving, and portfolio allocation decisions and explore how the model predicts windfall gains affect the share of financial wealth allocated to risky equities. Specifically, after solving the model we simulate portfolio decisions for a sample with characteristics identical to those in the data that receive lottery prizes identical to those in the data. We record the resulting portfolio allocations, and estimate Equation 7 on the simulated data set. This provides a set of model-implied coefficients $\tilde{\beta}$ comparable to the causal estimates presented in Section 4.

In solving for the optimal policy function, we observe that optimal risky asset share in the financial portfolio is increasing in permanent income, but decreasing in liquid wealth. Income is not positively correlated with equity returns and is non-tradeable and is thus more similar to a bond. Thus, as argued in Section 2 a household tilts their financial portfolio toward equities to offset this position. The degree to which households overweight equities is increasing in the ratio of income to financial wealth, causing the risky portfolio share to increase in income and decrease in financial wealth. Turning attention to the model-implied coefficients $\tilde{\beta}$ that replicate the causal estimates, we consider the effect of wealth on risky asset share for the sample of pre-lottery participants (Figure 2), the effect stratified by above and below median wealth and income (Figure 3), and the effect stratified by prize size (Figure 4) at the $s = 0$ horizon. In column 1 of Table 7 we present the causal estimates, and in column 2 we present the corresponding model-implied estimates under our baseline calibration.

The first striking feature of the model-implied effects is that the model overpredicts the negative effect of wealth on risky asset share. The model predicts that each 150K USD (1M SEK) received causes a 12.3 percentage point decrease in the risky asset share compared to an empirical estimate of 9.1 percentage points. Thus, the model suggests that the negative effects we estimate are not only theoretically plausible, but possibly less negative than expected. In addition, the model broadly matches the heterogeneity by prize size. For small prize winners the slightly overpredicts the effects and slightly underpredicts the effects of larger prize categories, but matches the diminishing marginal effect with prize size. The model does less well in matching heterogeneity by income and wealth, with the model suggesting substantial heterogeneity by pre-existing wealth with less heterogeneity by income. Overall, the qualitative patterns implied by the model are broadly consistent with empirical estimates, and modeling the full consumer decision problem provides quantitative support for our interpretation of the estimated negative effects of wealth on risky portfolio share.

We next undertake a series of exercises to explore how alternative calibrations and extensions might affect the model-implied estimates. First, we attempt to approximate an external consumption habit by imposing a mandatory consumption expense of 5% of total wealth each period (column 3). This

Table 7: Comparison of Model-Predicted Effects of 1M SEK Windfall Gain to Lottery-Based Estimates. This table compares the model-implied coefficients for the effect of wealth, the effect stratified by pre-lottery income and wealth, and the effect stratified by prize size under various calibration with the causal estimates (Column 1).

Effect		Estimate (1)	Baseline (2)	Habit (3)	$\sigma_{n,s} = .15$ (4)	$\rho = 8$ (5)	Lower Eq. Premium (6)
Participants		-.091	-.123	-.104	-.081	-.143	-.112
Income/Wealth	L/L	-.208	-.188	-.156	-.167	-.201	.181
	H/L	-.073	-.043	-.023	-.032	-.063	-.053
	L/H	-.114	-.192	-.190	-.156	-.215	-.171
	H/H	-.082	-.056	-.053	-.047	-.064	-.064
Prize Size	10K to 100K	-.009	-.024	-.018	-.016	-.034	-.013
	100K to 1M	-.065	-.102	-.087	-.081	-.114	-.088
	1M to 2M	-.287	-.244	-.223	-.124	-.253	-.237
	2M+ (300K+)	-.300	-.273	-.246	-.253	-.297	-.259

addition generates decreasing relative risk aversion, and thus results in less negative effects of wealth on risky portfolio share. Still, in all subgroups the model-implied effect of wealth on risky portfolio share is negative. In column 4 we allow for a positive correlation between income innovations and asset returns by setting $\sigma_{n,s} = .15$. We find that again this weakens the negative effect of wealth on risky portfolio share, but in all subpopulations considered the effect remains negative. In column 5 we explore sensitivity to risk aversion by increasing ρ to 8, and find that this causes the model to overstate the negative effect of wealth on portfolio share to an even greater degree. Finally, Calvet, Campbell, and Sodini (2007) show that the historical equity premium is larger than the return realized by most households. In column 6 we thus impose a 1.5% management fee and scale the expected equity premium in half, thus reducing the equity premium to 2%. This change reduces the level of the optimal portfolio share but has little effect on the wealth gradient, and we find little difference between this and our baseline calibration.

In short, under a wide range of calibrations and specifications the structural model suggests that the effect of a windfall gain on portfolio share is negative and quantitatively consistent with our empirical estimates. Importantly, we find that allowing for a realistic income process generates portfolio allocations that would seemingly imply increasing relative risk aversion despite relative risk aversion being constant. This analysis suggests that careful accounting for the income process and the full consumer decision problem is critical before observed portfolio shares may be used to inform risk preferences.

6 Conclusion

The relationship between wealth and risky asset share is an important question that remains unresolved despite being the focus of a number of recent studies (Brunnermeier and Nagel (2008); Guiso and Paiella (2008); Calvet, Campbell, and Sodini (2009); Calvet and Sodini (2014); Paravisini, Rappoport, and Ravina (2015)). This paper contributes to this literature by providing evidence that the effect of wealth on risky asset share is negative. A negative effect of the windfall gain induced by lottery winnings is present in all of specifications and subpopulations considered and is a robust finding that can not be explained easily by portfolio inertia. This finding does not appear to reflect differences in our sample, but rather differences in our identification strategy. When we estimate the main specification of Brunnermeier and Nagel (2008) in our sample of lottery winners, we obtain results similar to this prior study. Because of the high degree of confidence we have in the exogeneity of our wealth variation, this study presents estimates that are not subject to concerns of instrument sensitivity as noted in Calvet, Campbell, and Sodini (2009) and Calvet and Sodini (2014). Thus, estimating a negative effect of wealth on risky asset share is the first main contribution of this study.

While the estimated negative effect may be initially surprising, it is consistent with a properly specified decision problem. Importantly, when considering the portfolio choice problem with an external consumption habit and non-tradeable future income, the effect of wealth on risky portfolio share is negative provided that income and equity returns are not highly correlated and the present value of income is large relative to the consumption habit. We show that in a state-of-the-art lifecycle portfolio choice model calibrated to Swedish data, the effect of wealth on risky portfolio share is predicted to be similar to our empirical estimates. Thus, accounting for labor income in the portfolio choice problem, as proposed by Bodie, Merton, and Samuelson (1992), Jagannathan and Kocherlakota (1996), and Viceira (2001), provides a plausible interpretation of our main finding.

Finally, despite the finding of a negative effect of wealth on portfolio share, our results do not provide, as other studies have argued, insight into risk preferences. Depending on the strength of the habit, distribution of labor income, and the correlation between income and equity returns, the effect of wealth on risky portfolio share may be positive, negative, or none. Thus, the effect of wealth on risky asset share in a household's financial portfolio is unlikely to be informative of risk preferences without a careful treatment of labor income, habit formation process, source of wealth variation, and the full consumer decision problem.

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A Model Solution and Details

A.1 Model Solution and Simulation

The model solution algorithm utilizes a modified endogenous grid method algorithm. The endogenous grid is defined over the savings problem, while a grid search (100 grid points) is used to identify optimal portfolio choice (see Carroll (2006) and Barillas and Fernández-Villaverde (2007)) for more details. Model solution algorithm summary and model code are both available on request.

To simulate the model and generate model-implied coefficients $\tilde{\beta}$, we first solve the model under the baseline calibration and proceed in several steps:

1. From the time $s = -1$ data set sample for all lottery players all relevant variables, including observed wealth, and time invariant covariates.

2. From the time $s = 0$ data set, sample the amount won. For each sampled observation, draw a realization of equity return r_s.

3. Calculate for optimal portfolio decision rules.

4. Taking the time $s = -1$ data set as given, assign lottery wealth and calculate the optimal $s = 0$ portfolio choice.

5. Repeat reduced form estimation on the model simulated data set to obtain coefficients $\tilde{\beta}$.

A.2 Survival Probabilities

The survival probability is calculated using the observed survival probabilities from years 1999-2000. We select 100,000 individuals in year 1998 from the Swedish population, and define a binary indicator equal to one if the individual is observed alive in 1999. We then regress a quartic in age on this indicator. We do not permit time or cohort effects in our estimation, and do not allow survival probabilities to vary with wealth, income, or sex. Note that there is no attrition or selection concerns in this sample as it is drawn randomly from the entire population. Although simple, we view it as unlikely that allowing for richer survival probabilities would substantially affect our qualitative conclusions. The resulting estimates are presented in Figure 8.

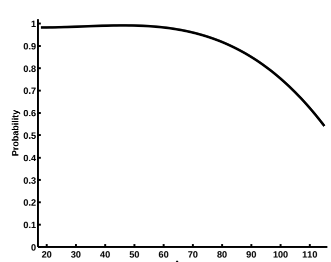

Figure 8: Survival Probabilities. This figure presents the estimated one year survival probability for each age.

A.3 Labor Income Process Estimation

We estimate the labor income process parameters following the procedure described in Appendix B of Cocco, Gomes, and Maenhout (2005), which is based on Carroll and Samwick (1997). This estimation procedure proceeds in seveal steps:

1. Regress log of household income on cubic polynomial in age and marital status to obtain an estimate of function $f(t, Z_{i,t})$.
2. Define residuals $\epsilon^H_{i,t} = log(H_{i,t}) - \hat{f}(t, Z_{i,t})$.
3. Define $r_{i,d} = \epsilon^H_{i,t+d} - \epsilon^H_{i,t}$, $d \in \{1, 2, ..., 6\}$
4. Given that $Var(r_{i,d}) = d \times \sigma^2_U + 2 \times \sigma^2_N$, we can obtain estimates of σ^2_U and σ^2_N by running an OLS regression on d and a constant term.
5. Define $\bar{r^s_1} = \sum r_{i,1}$ $\forall$ with a pre-lottery income observation in year s. Then estimating via OLS the following

$$\bar{r^s_1} = \sigma_{n,s}(r^s - r_f - \mu_s) + \zeta_s \tag{15}$$

provides an estimate of the covariance between asset and income innovations.

B Supplemental Tables

Table B.1: Effect of Wealth (1M SEK) on Risky Asset Share, Robustness Checks. This table presents the estimated effects of wealth at time $s = 0$ for various lottery subsamples and when the household definition is restricted to individual winners. For each case, the coefficient from the pooled regression estimated in the all-year sample and the coefficient for pre-lottery equity market participants estimated in the post-1999 sample are presented.

	Kombi		**Triss**	
	Pooled	**Post-1999**	**Pooled**	**Post-1999**
Effect	-.081	- .141	-.073	-.129
SE	(.018)	(.019)	(.022)	(.038)
N	31,903	21,306	1,969	1,070
	PLS		**Individual Analysis**	
	Pooled	**Post-1999**	**Pooled**	**Post-1999**
Effect	-.043	-.073	-.063	-.102
SE	(.024)	(.033)	(.021)	(.028)
N	45,905	30,994	79,777	49,012

Table B.2: Effect of Wealth (1M SEK) on Risky Asset Share. This table presents coefficients, standard errors, sample size, and mean predicted share of risky assets in the financial portfolio when lottery wealth is zero ($\hat{y}|L_i = 0$) from estimating Equation 7 in the all-year sample. Columns 5 through 8 show analogous estimates with participation defined more narrowly to only include directly owned stocks.

Horizon	**A. Stock or Mutual Fund**				**B. Stock Only**			
(s)	β_s	**SE**	N	$\hat{y}_{\|L_i=0}$	β_s	**SE**	N	$\hat{y}_{\|L_i=0}$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
0	-.065	.010	71,225	.401	-.018	.005	71,225	.095
1	-.052	.009	87,051	.402	-.008	.006	87,051	.101
2	-.046	.009	10,9185	.412	-.005	.006	109,185	.109
3	-.042	.008	137,779	.415	-.005	.006	137,779	.112
4	-.039	.008	147,279	.407	-.006	.005	147,279	.109
5	-.028	.008	153,034	.396	-.007	.005	153,034	.108
6	-.016	.008	168,753	.400	-.002	.005	168,753	.112
7	-.019	.008	184,375	.418	-.001	.005	184,375	.112
8	.0001	.008	201,593	.421	.001	.005	201,593	.123
9	-.001	.009	194,240	.405	.007	.005	194,240	.118
10	.001	.011	172,925	.381	-.0067	.006	172,925	.114

Table B.3: Effect of Wealth (1M SEK) on on Risky Asset Share Among $s = -1$ Equity Market Participants. This table presents coefficients, standard errors, sample size, and mean predicted participation probability when lottery wealth is zero ($\hat{y}|L_i = 0$) from estimating Equation 7 in the post-1999 sample. Columns 5 through 8 show analogous estimates with participation defined more narrowly to only include directly owned stocks.

	A. Stock or Mutual Fund				**B. Stock Only**			
(s)	β_s	**SE**	N	$\hat{y}_{\vert L_i=0}$	β_s	**SE**	N	$\hat{y}_{\vert L_i=0}$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
0	-.091	.013	53,370	.489	-.046	.009	31,181	.297
1	-.083	.012	50,354	.767	-.038	.010	29,424	.325
2	-.078	.014	46,455	.752	-.027	.013	27,199	.317
3	-.075	.017	43,069	.742	-.024	.014	25,304	.308
4	-.085	.027	39,822	.695	-.033	.012	23,474	.292

Table B.4: Effect of Wealth (1M SEK) on Risky Asset Share by $s = -1$ Income and Wealth. Coefficients and 95% confidence intervals, are obtained by estimating Equation 7 in the Post-1999 sample stratified by pre-lottery income and wealth. Households are classifed as high wealth if their observed wealth at time $s = -1$ is greater than the median wealth among households of the same age, and as high income if the average of their income 5 years prior to the lottery event is greater than the median age-specific income.

	Obervation at $s = -1$ (Wealth/Income)											
	A. Low/Low			**A. High /Low**			**A. Low/High**			**A. High/High**		
(s)	β_s	**SE**	N	β_s	**SE**	N	β_s	**SE**	N	β_s	**SE**	N
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
0	-.208	.038	15,371	-.073	.021	11,692	-.114	.021	11,412	-.082	.021	14,895
1	-.180	.037	14,597	-.058	.017	11,149	-.099	.021	10,651	-.065	.017	13,957
2	-.218	.046	13,466	-.055	.024	10,467	-.094	.023	9,596	-.039	.017	12,926
3	-.176	.053	12,324	-.074	.026	9,771	-.075	.031	8,818	-.044	.019	12,156
4	-.199	.042	11,211	-.068	.025	9,202	-.124	.045	7,942	-.049	.016	11,467

Table B.5: Effect of Wealth on Risky Asset Share by Prize Size. Coefficients are obtained by estimating Equation 7 in the post-1999 sample with the lottery wealth variable replaced by indicators for five mutually exclusive prize categories: 0 to 10K SEK (0 to 1.5K USD), 10K to 100K (1.5 to 15K), 100K to 1M (15 to 150K), 1M to 2M (150 to 300K), and 2M+ (300K+). Marginal effects are calculated by dividing the effect-size estimate by the mean prize in each category. In Triss, all prizes exceed 1.5K, so the omitted category is prizes below 15K USD.

		A. Pooled Sample		
	$10K < L_i \leq 100K$	$100K < L_i \leq 1M$	$1M < L_i \leq 2M$	$2M < L_i$
Estimate	-.009	-.065	-.287	-.300
SE	(.009)	(.024)	(.021)	(.044)
ME	-.297	-.334	-.257 2	-.084
N	485	804	204	50
		B.Kombi		
	$10K < L_i \leq 100K$	$100K < L_i \leq 1M$	$1M < L_i \leq 2M$	$2M < L_i$
Estimate			-.290	-.351
SE			(.020)	(.074)
ME			-.260	-.120
N			190	10
		C. Triss		
		$15K < L_i \leq 150K$	$1M < L_i \leq 2M$	$2M < L_i$
Estimate		-.058	-.194	-.267
SE		(.020)	(.012)	(.045)
ME		-.299	-.176	-.071
N		804	12	40
		D. PLS		
	$10K < L_i \leq 100K$	$100K < L_i \leq 1M$	$1M < L_i \leq 2M$	$2M < L_i$
Estimate	-.006		.023	
SE	(.009)		(.017)	
ME	-.566		.020	
N	271		2	

Table B.6: Effect of Wealth (1M SEK) on Risky Portfolio Share, Alternative Definitions. This table presents coefficients, standard errors, sample size, and mean predicted participation probability when lottery wealth is zero ($\hat{y}|L_i = 0$) from estimating Equation 7 in the post-1999 sample. Columns 1-4 present results when risky share is defined as the share of total wealth allocated to stocks and mutual funds, while columns 5-8 consider the share of total wealth allocated to stocks, mutual funds, and real estate.

	A. Real Estate Safe				**B. Real Estate Risky**			
(s)	β_s	**SE**	N	$\hat{y}_{\vert L_i=0}$	β_s	**SE**	N	$\hat{y}_{\vert L_i=0}$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
0	-.019	.008	53,370	.228	-.127	.009	53246	.760
1	-.009	.007	50,354	.231	-.109	.011	53,370	.881
2	-.008	.009	46,455	.210	-.096	.012	46,455	.872
3	-.011	.009	43,069	.292	-.086	.013	43,069	.868
4	-.021	.009	39,822	.250	-.099	.014	39,822	.847

Table B.7: Heterogeneous Effect of Wealth (1M SEK) on Risky Asset Share. Coefficients are obtained by estimating Equation 7 in the post-1999 sample of equity market participants at time $s = 3$. Hetero p obtained from an F-test of the null hypothesis that the two lottery-wealth coefficients are identical. Equity returns are based on the MSCI Sweden Index the calendar year prior to the lottery.

	Financial Characteristics							
	Debt		**Home Owner**		**Income Risk**		**Equity Returns**	
	$\leq$ **0**	$>$ **0**	**Yes**	**No**	**High**	**Low**	$\leq$ **0**	$>$ **0**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Effect	-.111	-.080	-.077	-.133	-.073	-.105	-.132	-.033
SE	(.034)	(.019)	(.018)	(.039)	(.022)	(.023)	(.023)	(.019)
p	.001	<.001	<.001	.001	.001	<.001	<.001	.095
Hetero p	.417		.181		.317		.001	
N	25,211	17,858	11,441	31,628	23,080	19,989	13,015	30,054
	Demographic Characteristics							
	Sex		**Age**		**College**		**Self-Employed**	
	Male	**Female**	$\leq$ **45**	$>$ **45**	**Yes**	**No**	**Yes**	**No**
	(9)	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
Effect	-.109	-.069	-.102	-.082	-.059	-.114	-.012	-.097
SE	(.022)	(.022)	(.049)	(.017)	(.021)	(.026)	(.029)	(.018)
p	.002	<.001	<.001	.029	.005	<.001	.689	<.001
Hetero p	.177		.677		.093		.010	
N	21,864	21,205	5,978	37,091	24,312	18,757	40,621	2,448

Table B.8: Effect of Wealth on Net Wealth, Bonds, Stocks, Bank Account Balances, Real Assets and Debt. This table presents results from estimating Equation 7 in the post-1999 sample of pre-lottery equity market participants. Lottery wealth and financial variables are measured in SEK.

	Total Wealth	**Real Assets**	**Financial Assets**			**Debt**
			Risky	**Safe**	**Bank**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$s = 0$	.572	-.020	.085	.215	.241	-.037
N=53,370	(.035)	(.011)	(.022)	(.021)	(.019)	(.011)
$s = 1$	.517	.001	.103	.225	.130	-.049
N=50,354	(.046)	(.039)	(.027)	(.037)	(.029)	(.015)
$s = 2$	.483	.001	.149	.228	.080	-.013
N=46,455	(.064)	(.058)	(.057)	(.044)	(.025)	(.030)
$s = 3$	.317	.013	.015	.149	.120	-.023
N=43,069	(.070)	(.054)	(.028)	(.029)	(.046)	(.018)
$s = 4$	.319	.009	.031	.144	.113	-.023
N=39,822	(.069)	(.054)	(.030)	(.027)	(.046)	(.017)