A News-Utility Theory for Inattention and Rebalancing in Portfolio Choice*

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Job Market Paper

Abstract

Recent evidence suggests that investors are either inattentive to their portfolios or undertake puzzling rebalancing efforts. This paper develops a life-cycle portfolio-choice model in which the investor experiences loss-averse utility over news and can choose whether or not to look up his portfolio. I obtain three main predictions. First, the investor prefers to not look up and not rebalance his portfolio most of the time to avoid fluctuations in news utility. Such fluctuations cause a first-order decrease in expected utility because the investor dislikes bad news more than he likes good news. Consequently, the investor has a first-order willingness to pay a portfolio manager who rebalances actively for him. Second, if the investor looks up his portfolio himself, he rebalances extensively to enjoy or delay the realization of good or bad news. Third, the investor would like to commit to being inattentive even more often because it reduces overconsumption. Quantitatively, I structurally estimate the preference parameters by matching participation and stock shares over the life-cycle. My parameter estimates are in line with the micro literature, generate reasonable intervals of inattention, and simultaneously explain consumption and wealth accumulation over the life-cycle.

JEL Codes: G02, G11, D03, D14, D91.

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1 Introduction

Classic finance theory says that investors should rebalance their portfolios to bring their stock shares back in line with their target shares frequently because stock prices display large fluctuations. However, Bonaparte and Cooper (2009), Calvet et al. (2009a), Karlsson et al. (2009), Alvarez et al. (2012), and Brunnermeier and Nagel (2008) document that investors are either inattentive or undertake rebalancing efforts that do not seem to aim for well-defined target shares. Moreover, French (2008) and Hackethal et al. (2012) show that investors overpay for delegated portfolio management, Calvet et al. (2009b) and Meng (2010) document that investors have a tendency to sell winning stocks (the disposition effect), and Choi et al. (2009) and Thaler (1980) argue that investors mentally separate their accounts.

This paper offers an explanation for inattention that simultaneously speaks to delegated portfolio management, the disposition effect, and mental accounting by assuming that the investor experiences utility over news or changes in expectations about consumption. Such news-utility preferences were developed by Koszegi and Rabin (2006, 2007, 2009) to discipline the insights of prospect theory and have since shown to explain a broad range of micro evidence. The preferences' central idea is that bad news hurts more than good news pleases, which makes fluctuations in news utility painful in expectation and provides a micro foundation for inattention. This micro foundation has many behavior and welfare implications. If the investor has access to a brokerage and checking account, he chooses to not look up his portfolio in the brokerage account and finance consumption out of the checking account most of the time. Moreover, the investor has a first-order willingness to pay for a portfolio manager who rebalances his portfolio actively for him, as rebalancing reduces the portfolio's risk. Every so often, however, the investor has to rebalance his portfolio himself to smooth his consumption plans and then engages in behavior reminiscent of realization utility and the disposition effect. Moreover, the investor's desire to separate accounts, his consumption, and his self-control problems are reminiscent of mental accounting. Additionally, I present the preferences' implications for non-participation and stock shares in the presence of stochastic labor income to show that news utility simultaneously explains prevailing questions in life-cycle portfolio theory.

I first explain the preferences in greater detail. The agent's instantaneous utility in each period consists of the following components. First, "consumption utility" is determined by the agent's consumption as in the standard model. Second, "news utility" is determined by a comparison of the agent's updated expectations about consumption and his previous expectations about consumption. More specifically, the agent experiences "contemporaneous news utility" by comparing his present consumption with his expectations about consumption.

In this comparison, he experiences a sensation of good or bad news over each previously expected consumption outcome, by which bad news hurts more than good news pleases. Moreover, the agent experiences "prospective news utility" by comparing the updated expectations about future consumption with his previous expectations. In so doing, he experiences news utility over what he has learned about future consumption.

To build intuition for my results in the dynamic model, I first highlight two fundamental implications of news utility for portfolio choice in a static framework. First, as bad news hurts more than good news pleases, even small risks, resulting in good and bad news, cause a first-order decrease in expected utility. Consequently, the investor is first-order risk averse. Thus, he does not necessarily participate in the stock market and, when he does, he chooses a lower portfolio share of stocks than under standard preferences. Moreover, first-order risk aversion and non-participation are prevalent even in the presence of stochastic labor income.[1] Second, first-order risk aversion implies that the investor can diversify over time, i.e., his portfolio share is increasing in his investment horizon.[2] He considers the accumulated stock-market outcome of a longer investment horizon as less risky relative to its return because the expected first-order news disutility increases merely with the square root whereas the return increases linearly in his horizon.

These implications extend to a fully dynamic life-cycle model, in which the investor chooses how much to consume and how much to invest into a risk-free and a risky asset. To allow for inattention, I modify the standard life-cycle model by assuming that the investor adjusts his portfolio via a brokerage account, which he can choose to not look up.[3] If the investor plans to not look up his brokerage account, he uses a separate checking account to finance consumption in those inattentive periods.

The news-utility investor prefers to be inattentive for some periods if a period's length becomes sufficiently short. Looking up the portfolio implies fluctuations in good and bad news, which cause a first-order decrease in expected utility as explained above. Not looking

[1]The result about non-participation in the presence of background risk stands in contrast to earlier analysis, such as Barberis et al. (2006) and Koszegi and Rabin (2007, 2009). Nevertheless, labor income makes stock-market risk more bearable as news utility is proportional to consumption utility, such that fluctuations in good and bad news hurt less on the flatter part of the concave utility curve. Jointly, these implications generate increasing participation and portfolio shares in the beginning of life, consistent with empirical evidence.

[2]In the dynamic model, time diversification implies that the investor chooses a lower portfolio share toward the end of life. Empirically, participation and portfolio shares are hump-shaped over the life-cycle as shown in Section 6 and in Ameriks and Zeldes (2004). A lower portfolio share later in life is advised by financial planners; as a rule of thumb, it should equal 100 minus the investor's age. This advice is explained in the standard model via variation in the wealth-income ratio, variation in risk aversion due to changes in wealth, or mean reversion in stock prices.

[3]Beyond allowing for inattention, this model relaxes the degree of freedom associated with calibrating a period's length; this would otherwise crucially affect the results due to the possibility for time diversification.

up the portfolio implies that the investor cannot smooth consumption perfectly. However, imperfect consumption smoothing has only a second-order effect on expected utility because the investor deviates from an initially optimal path. Moreover, in inattentive periods, the investor cannot rebalance his portfolio. This increases the portfolio's risk and thus generates a first-order willingness to pay for a portfolio manager who rebalances the portfolio in accordance with neo-classical finance theory. Under plausible parameter values, these two effects have quantitative implications that are in line with the empirical evidence. In particular, the model matches the findings by Alvarez et al. (2012) and Bonaparte and Cooper (2009) that the typical investor rebalances his portfolio about once per year as well as the finding by French (2008) that the typical investor forgoes about 67 basis points of the market's annual return for portfolio management.

Every so often, the news-utility investor has to reconsider his consumption plans and rebalance his portfolio. I find that his optimal portfolio share is decreasing in the return realization whereas the standard investor's portfolio share is constant; thus, the news-utility investor rebalances extensively. Intuitively, in the event of a good return realization, the investor wants to realize the good news about future consumption and sells the risky asset. In the event of a bad return realization, however, the investor has to come to terms with bad news about future consumption. This bad news can be kept uncertain by increasing the portfolio share; in doing so, the investor delays the realization of bad news until the next period by which point his expectations have adjusted. Such behavior is reminiscent of the empirical evidence on the disposition and break-even effect but originates from news utility about future consumption rather than risk-lovingness in the loss domain.[4] However, extensive rebalancing implies that the investor holds on to rather than buys the risky asset after the market goes down. The reason is that the investor's end-of-period asset holdings may be increasing in the return realization because his consumption-wealth ratio is decreasing in the return realization. Intuitively, if an adverse return realizes, the investor consumes relatively more out of his wealth to delay the decrease in consumption until his expectations have decreased.

Beyond portfolio choice, this model makes predictions about consumption that are reminiscent of the concept of mental accounting.[5] In my model, the investor's two accounts

[4]The disposition effect (Odean (1998)) is an anomaly related to the tendency of investors to sell winners (stocks that have gone up in value) but keep losers (stocks that have gone down in value) to avoid the realization of losses. Odean (1998) argues in favor of the purchase price as a reference point, but Meng (2010) shows that expectations as a reference point seem to explain the data even better. The break-even effect refers to the observation that people become less risk averse in the loss domain. This effect is documented by Lee (2004) for professional poker players and Post et al. (2008) for Deal-or-No-Deal game show participants.

[5]Mental accounting (Thaler (1980)) describes the process whereby people mentally categorize financial

finance different types of consumption. The brokerage account finances future consumption whereas the checking account finances current consumption. Moreover, the accounts exhibit different marginal propensities to consume. An unexpected windfall gain in the brokerage account is integrated with existing stock-market risk and consumed partially while a windfall gain in the checking account is consumed entirely immediately.[6] However, with respect to expected gains, the investor's marginal propensity to consume is higher out of the brokerage account versus the checking account. The reason is that the investor overconsumes time inconsistently out of the brokerage account but consumes efficiently out of the checking account, which I explain next.[7]

The investor may behave time inconsistently because he takes his expectations as given when he thinks about increasing his consumption today. Yesterday, however, he took into account how such increases would have increased his expectations too. Thus, today, he is inclined to increase his consumption above expectations relative to the optimal precommitted plan that maximizes expected utility. As this time inconsistency depends on news utility, it depends on uncertainty. Because inattentive consumption is deterministic and restricted by the funds in the checking account, the investor consumes efficiently when he is inattentive. Intuitively, time-inconsistent overconsumption would result in good news about today's consumption but bad news about tomorrow's consumption. As the investor dislikes bad news more than he likes good news, he does not overconsume. As a result, the investor would like to precommit to looking up his portfolio less often, lowering attentive consumption, lowering his portfolio share, but rebalancing even more extensively. Exploring the investor's commitment problem for both consumption and portfolio choice allows me to conclude that inattention and separate accounts result in a first-order increase in welfare and less overconsumption, which are important results for normative household finance.

Even if people are deliberately inattentive, it seems unrealistic to assume that they do not receive any signals about what is happening in their brokerage account. Therefore, I extend the model such that the investor receives a signal about the value of his brokerage account and then decides if he will remain inattentive or not. I first argue that the model's implications are completely unaffected by the signal if its information content is low. In the presence of such signals, the investor chooses not to look up his portfolio independent of the realization of the signal. In that case, he does not increase his current consumption,

assets as belonging to different accounts and treat these accounts as non-fungible.

[6]This windfall result was first obtained by Koszegi and Rabin (2009). Moreover, this result relates to narrow framing, the phenomenon that people evaluate an offered gamble in isolation rather than mixing it with existing risk.

[7]This result may speak to the puzzle that people simultaneously borrow on their credit cards and hold liquid assets. The investor would happily pay additional interest to separate his wealth in order to not reconsider his consumption plans too frequently and overconsume less.

which is restricted by his funds in the checking account, because he would have to consume less in the next period. In turn, I outline the implications of signals that have large enough information content to affect the investor's attentiveness and thus consumption behavior using simulations. I find that, in the event of a adverse signal, the investor prefers not to look up his portfolio; thus, he behaves according to the Ostrich effect (Karlsson et al. (2009)).

To evaluate the model quantitatively, I structurally estimate the preference parameters by matching the average empirical life-cycle profile of participation and portfolio shares using household portfolio data from the Survey of Consumer Finances (SCF) from 1992 to 2007. I show that the estimated parameters are consistent with existing microeconomic estimates, generate reasonable attitudes towards small and large wealth bets, and generate reasonable intervals of inattention. In the data, I control for time and cohort effects by employing a technique that solves the identification problem associated with the joint presence of age, time, and cohort effects with minimal assumptions (Schulhofer-Wohl (2013)).[8] Moreover, the model's quantitative predictions about consumption and wealth accumulation are consistent with the empirical profiles as inferred from the Consumer Expenditure Survey (CEX).

I first review the literature in Section 2. In Section 3, I then explore news utility in a static portfolio setting to illustrate several fundamental results. I proceed to dynamic portfolio theory in Section 4. I first outline the model environment, preferences, and solution in Sections 4.1 to 4.3. In Section 5, I extend my previous results about inattention and time diversification to the dynamic setting and outline several more subtle comparative statics about inattention (Section 5.1), explain the investor's motives for rebalancing (Section 5.2), illustrate the model's welfare implications (Section 5.3), and explore a model extension in which the investor receives signals about his portfolio (Section 5.4). In Section 6, I empirically assess the quantitative performance of the model. Finally, I conclude the paper and discuss future research in Section 7.

2 Comparison to the Literature

Many papers study dynamic portfolio theory in discrete time under the assumption of reference-dependent preferences. Berkelaar et al. (2004) and Gomes (2003) among others assume prospect theory, Ang et al. (2005) assume disappointment aversion, and Gomes and Michaelides (2003) assume habit formation. Other papers investigate assumptions about the portfolio environment. Haliassos and Michaelides (2003) and Campanale et al. (2012)

[8]This technique is of special importance in this context because the life-cycle profiles of participation and shares are highly dependent on which assumptions the age-time-cohort identification is based on, as made clear by Ameriks and Zeldes (2004). Age profiles for participation and portfolio shares turn out to be hump-shaped over the life-cycle.

assume transaction costs, Gomes and Michaelides (2005) assume Epstein-Zin preferences, stock market entry costs, and heterogeneity in risk aversion, Lynch and Tan (2011) assume predictability of labor income growth at a business-cycle frequency and countercyclical variation in volatility, Gormley et al. (2010) and Ball (2008) assume disaster risk and participation costs, and Campanale (2009) assumes the existence of an underdiversified portfolio and participation costs. All of these papers focus on jointly explaining empirical observations about life-cycle consumption, participation, and portfolio shares.

Information aversion has recently been explored by Andries and Haddad (2013), Artstein-Avidan and Dillenberger (2011), and Dillenberger (2010) under the assumption of disappointment-aversion preferences, as formalized by Gul (1991). Several related papers study information and trading frictions in continuous-time portfolio-selection models.[9] Abel et al. (2013) assume that the agent faces information and transaction costs when transferring assets between accounts. Huang and Liu (2007) and Moscarini (2004) explore costly information acquisition, Ang et al. (fthc) assume illiquidity. Rational inattention also refers to a famous concept in macroeconomics introduced by Sims (2003), which postulates that people acquire and process information subject to a finite channel capacity. Luo (2010) explores how inattention affects consumption and investment in an infinite-horizon portfolio-choice model. A somewhat similar idea is pursued by Nieuwerburgh and Veldkamp (2013), who explore how precisely an investor wants to observe a signal about each asset's payoffs when he is constrained in the total amount of signal precision he can observe. Moreover, Mondria (2010) and Peng and Xiong (2006) study attention allocation of individual investors among multiple assets. Among many others, Mankiw and Reis (2002), Gabaix and Laibson (2001), and Chien et al. (2011) explore the aggregate implications of assuming that a fraction of agents are inattentive.

I combine these two literatures by exploring the implications of inattention for portfolio choice in a standard discrete-time framework, which simultaneously explains life-cycle consumption and wealth accumulation, participation, and shares.[10] Inattention and sporadic rebalancing have been documented empirically by Alvarez et al. (2012), Bonaparte and Cooper (2009), Calvet et al. (2009a,b), Karlsson et al. (2009), Brunnermeier and Nagel (2008), Bilias et al. (2010), Agnew et al. (2003), Dahlquist and Martinez (2012), and Mitchell

[9] An argument against information constraints is that there exist quite simple portfolio strategies that are consistent with the standard model, i.e., people could invest their entire wealth in an index fund.

[10] Hereby, I confirm the analysis in Pagel (2012a), which shows how news utility generates a realistic hump-shaped life-cycle consumption profile in addition to other life-cycle consumption phenomena. Moreover, Pagel (2012b) shows that news utility makes an additional step towards solving the equity premium puzzle by explaining asset prices and simultaneously generating reasonable attitudes over small and large wealth bets; an important point in favor of the prospect-theory asset-pricing literature that has been first emphasized by Barberis and Huang (2008, 2009).

et al. (2006). Moreover, Engelberg and Parsons (2013) show that after stock market declines hospital admissions for mental conditions in California increase. Lab and field evidence for myopic loss aversion is provided by Gneezy and Potters (1997), Gneezy et al. (2003), Haigh and List (2005), and Fellner and Sutter (2009). Relatedly, Anagol and Gamble (2011), Bellemare et al. (2005), and Zimmermann (2013) tests if subjects prefer information clumped or piecewise. The prediction of extensive rebalancing once the investor looks up his portfolio contradicts the intuitive idea that people sell stocks when the market is going down. The latter behavior would imply an increasing portfolio share as predicted by herding behavior or habit formation. Habit formation is tested in Brunnermeier and Nagel (2008), who, however, find evidence in favor of a constant or slightly decreasing portfolio share.[11] I briefly extend their analysis to provide suggestive evidence for a decreasing portfolio share, as predicted by news utility, using Panel Study of Income Dynamics (PSID) household portfolio data.

This paper analyzes a generally-applicable preference specification that has been used in various contexts to explain experimental and other microeconomic evidence.[12] The preferences' explanatory power in these other contexts is important because I put emphasis on the potentially normative question of how often people should look up and rebalance their portfolios. While most of the existing applications and evidence consider the static model of Koszegi and Rabin (2006, 2007), I incorporate the preferences into a fully dynamic and stochastic model. The inattention result has been anticipated by Koszegi and Rabin (2009) in a two-outcome model featuring consumption in the last period and signals in all prior periods. Several of my additional results extend and modify Koszegi and Rabin (2007), who analyze the preferences' implications for attitudes towards risk in a static setting.

[11]The tests run by Brunnermeier and Nagel (2008) are replicated in Calvet et al. (2009a). In the basic regression, Calvet et al. (2009a) confirm a slightly decreasing portfolio share. However, once the authors control for the realized return of the portfolio, the portfolio share becomes increasing. Calvet et al. (2009b) document that investors sell a greater amount of stocks that have outperformed the market relative to the amount of stocks that have underperformed, which corresponds to the prediction of extensive rebalancing.

[12]Heidhues and Koszegi (2008, 2010), Herweg and Mierendorff (2012), and Rosato (2012) explore the implications for consumer pricing, which are tested by Karle et al. (2011), Herweg et al. (2010) do so for principal-agent contracts, and Eisenhuth (2012) does so for mechanism design. An insufficient list of papers providing direct evidence for Koszegi and Rabin (2006, 2007) preferences is Sprenger (2010) on the implications of stochastic reference points, Abeler et al. (2012) on labor supply, Gill and Prowse (2012) on real-effort tournaments, Meng (2010) on the disposition effect, and Ericson and Fuster (2010) on the endowment effect (not confirmed by Heffetz and List (2011)). Barseghyan et al. (2010) structurally estimate a model of insurance-deductible choice. Suggestive evidence is provided by Crawford and Meng (2009) on labor supply, Pope and Schweitzer (2011) on golf players' performance, and Sydnor (2010) on deductible choice. Moreover, the numerous conflicting papers on the endowment effect can be reconciled with the notion of expectations determining the reference point. All of these papers consider the static preferences, but as the dynamic preferences of Koszegi and Rabin (2009) are a straightforward extension, the evidence is equally valid for the dynamic preferences. Moreover, the notion that people are loss averse with respect to news about future consumption is indirectly supported by all experiments, which use monetary payoffs because these concern future consumption.

3 News Utility in Static Portfolio Theory

I start with static portfolio theory to introduce the preferences and quickly illustrate several important predictions in a simple framework. I first outline the news-utility implications for participation and portfolio shares to then turn to time diversification and inattention. To make the exposition simple, I assume that the agent picks a share α of his wealth W to be invested in a risky asset with log return $log(R) = r \sim N(\mu - \frac{\sigma^2}{2}, \sigma^2)$ as opposed to a risk-free asset with log return $log(R^f) = r^f$ and that short sale and borrowing are prohibited, i.e., $0 \leq \alpha \leq 1$. Thus, the agent's consumption is given by $C = W(R^f + \alpha(R - R^f)) \sim F_C$. To further simplify the problem, I approximate the log portfolio return $log(R^f + \alpha(R - R^f))$ by $r^f + \alpha(r - r^f) + \alpha(1 - \alpha)\frac{\sigma^2}{2}$ as suggested in Campbell and Viceira (2002) and denote a standard normal variable by $s \sim N(0, 1)$.

3.1 Predictions about participation and shares

I now explain news-utility preferences in this static setting. Following Koszegi and Rabin (2006, 2007), I assume that the agent experiences "consumption utility" $u(c)$, which corresponds to the standard model of utility and is solely determined by consumption c. Additionally, he experiences "news utility," which corresponds to the prospect-theory model of utility determined by consumption c relative to the reference point r. The agent evaluates c relative to r using a piecewise linear value function $\mu(\cdot)$ with slope η and a coefficient of loss aversion λ, i.e., $\mu(x) = \eta x$ for $x > 0$ and $\mu(x) = \eta\lambda x$ for $x \leq 0$. The parameter $\eta > 0$ weights the news-utility component relative to the consumption-utility component and $\lambda > 1$ implies that bad news are weighed more heavily than good news. Moreover, Koszegi and Rabin (2006, 2007) allow for a stochastic reference point and make the central assumption that the distribution of the reference point equals the agent's fully probabilistic rational beliefs about consumption. In turn, in the static portfolio framework outlined above, expected utility is given by

$$EU = E[log(C) + \eta \int_{-\infty}^{C} (log(C) - log(c))dF_C(c) + \eta\lambda \int_{C}^{\infty} (log(C) - log(c))dF_C(c)]. \quad (1)$$

The first term in equation (1) is simply consumption utility, which I assume to correspond to log utility, i.e., $u(c) = log(c)$. The two additional terms in equation (1) correspond to good and bad news utility. First, the agent experiences a sensation of good news by evaluating each possible outcome C relative to all outcomes $c < C$ that would have had lower consumption weighted by their probabilities. Second, the agent experiences a sensation of bad news by evaluating each possible outcome C relative to all outcomes $c > C$ that

would have had higher consumption weighted by their probabilities. As expected good and bad news partly cancel, the second and third terms in equation (1) can be simplified to $E[\eta(\lambda-1)\int_C^\infty(log(C)-log(c))dF_C(c)]$ such that, in expectation, only the overweighted part of the bad news remains.

Lemma 1. *The news-utility agent's optimal portfolio share can be approximated by*

$$\alpha^* = \frac{\mu - r^f + \sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF_s(\tilde{s}))]}{\sigma^2}. \tag{2}$$

Proof. I can rewrite the maximization problem as

$$r^f + \alpha(\mu - \frac{\sigma^2}{2} - r^f) + \alpha(1-\alpha)\frac{\sigma^2}{2} + \alpha\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF_s(\tilde{s}))]$$

which results in the optimal portfolio share stated in equation (2) if $0 \leq \alpha^* \leq 1$ and $\alpha^* = 0$ if the expression (2) is negative or $\alpha^* = 1$ if the expression (2) is larger than one. □

3.1.1 Samuelson's colleague, time diversification, and inattention

In order to illustrate the model's implications for time diversification, I define $\mu \triangleq h\mu_0$, $\sigma \triangleq \sqrt{h}\sigma_0$, and $r^f \triangleq hr_0^f$. The parameter h can be interpreted as the period's length, i.e., if μ_0 and σ_0 were originally calibrated to a monthly frequency, $h = 3$ would imply a quarterly frequency.[13] In the following proposition, I formalize that the news-utility investor prefers to not invest into the risky asset if a period's length is too short, can diversify over time, and gains from being inattentive.

Proposition 1. ***(Horizon effects on portfolio choice)***

1. *(Samuelson's colleague and time diversification) There exists some $\underline{h}$ such that the news-utility agent's portfolio share is zero for $h < \underline{h}$, whereas the standard agent's portfolio share is always positive. Moreover, the news-utility agent's portfolio share is increasing in h, whereas the standard agent's portfolio share is constant in h.*

2. *(Inattention) The news-utility agent's normalized expected utility, i.e., $\frac{EU}{h}$ with $W = 1$, is increasing in h, whereas the standard agent's normalized expected utility is constant in h.*

This and the following propositions' proofs can be found in Appendix D.

[13] Alternatively, h could be interpreted as the number of i.i.d. draws of an independent gamble of which the agent observes the overall outcome. Or h can be interpreted as a restriction on consumption smoothing.

To illustrate this proposition more formally, I plug the redefined terms into equation (2). As can be easily seen, the news-utility agent's portfolio share is positive if and only if h is high enough, i.e.,

$$\frac{\mu_0 - r_0^f}{\sigma_0} > -\frac{\sqrt{h}}{h} E[\eta(\lambda - 1) \int_s^\infty (s - \tilde{s}) dF_s(\tilde{s}))] > 0.$$

As the integral is always negative the news-utility agent requires a higher excess return to invest in the stock market if $\lambda > 1$ and $\eta > 0$, i.e., he is first-order risk averse.[14] Thus, he refuses to invest in the stock market if h is low, as $\frac{\sqrt{h}}{h}$ is high and increases the expected bad news of the investment relative to its expected return. Moreover, α^* is decreasing in h because the expected mean and variance of the investment increase by h while its expected sensation of bad news increases merely by $\sqrt{h}$. Thus, if h increases the investment's expected sensation of bad news increases by less than its expected return, which makes the investment more attractive. Thus, the news-utility agent can diversify over time. In contrast, the standard agent will invest some fraction of his wealth whenever $\mu > r^f$ and his portfolio share is independent of h as the expected mean of the investment increases in h proportional to its variance.

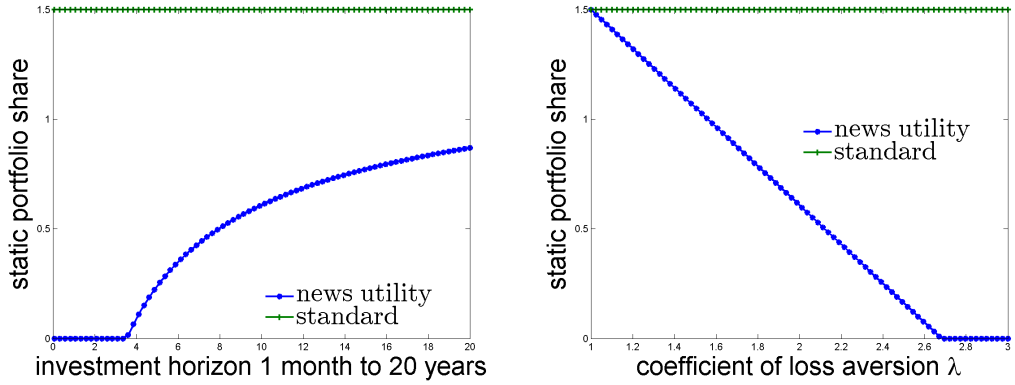

Figure 1: News-utility and standard agents' portfolio share as a function of the investment horizon h and the coefficient of loss aversion λ.

[14]The standard agent's portfolio share is positive whenever $\mu > r^f$ because he is approximately risk neutral for small risks, i.e., for small risks his concave utility function becomes approximately linear. The investment's risk becomes small if α is positive but small. A zero portfolio share for $\mu > r^f$ requires a kink in the utility function, which is introduced by news utility if $\eta > 0$ and $\lambda > 1$. An increase in σ is then associated with a first-order decrease in expected utility and the portfolio share. More formally, the terms of the agent's first-order condition that depend on σ, i.e., $-\alpha\sigma^2 + \sigma E[\eta(\lambda - 1) \int_r^\infty (s - \tilde{s}) dF_s(\tilde{s}))]$, can be approximated by a second-order Taylor expansion around $\sigma = 0$, i.e., $(E[\eta(\lambda - 1) \int_r^\infty (s - \tilde{s}) dF_s(\tilde{s}))])\sigma + (-2\alpha)\sigma^2$. In this second-order approximation, the news-utility term is proportional to σ while the standard agent's term is proportional to σ^2; thus, the former is a first-order and the latter is a second-order effect of uncertainty on the portfolio share and expected utility.

Figure 1 displays the static portfolio share of the news-utility and standard agents as a function of h and the coefficient of loss aversion λ for $h = 10$.[15]

I now give some background on these two results starting with the Samuelson's colleague story. In Samuelson's seminal paper, his colleague refuses to accept a 50/50 bet lose \$100 win \$200 but would accept 100 of such bets. In turn, Samuelson (1963) showed that, if one bet was rejected at all wealth levels, any number of such bets should be rejected under standard expected-utility theory. The reason is that the mean and variance of the sum of 100 bets increase by 100. The same logic applies to the investors who believe in diversification over time, i.e., who believe that stock-market risk is decreasing in the investment's horizon. Because the accumulated stock-market return over a given horizon is the sum of the individual outcomes in each time period, time diversification does not exist under standard assumptions, and investors' portfolio shares should be independent of their investment horizon.

To draw the connection to the welfare benefits of inattention, I consider the implications of h for expected utility per unit of time or investment, i.e., normalized by h, and $W = 1$. The news-utility agent's normalized expected utility, i.e.,

$$\frac{EU}{h} = r^f + \alpha(\mu - r^f) - \alpha^2\frac{\sigma^2}{2} + \frac{\sqrt{h}}{h}\alpha\sigma E[\eta(\lambda - 1)\int_s^\infty (s - \tilde{s})dF_s(\tilde{s}))]$$

is increasing in h. Again, the investment's expected return increases at a higher rate than the expected sensation of bad news. In contrast, the standard agent's normalized expected utility is constant in h. I now give some background on this result. Benartzi and Thaler (1995) explain the intuition of Samuelson's colleague by formally showing that people find individual gambles inherently less attractive than the accumulated outcome of several of them, if they are loss averse and myopically evaluate the outcome of each gamble. Myopically loss averse investors thus gain from evaluating their portfolio at long rather than short horizons and can diversify over time. Hereby, myopic loss aversion assumes that the accumulated outcome of the gamble is evaluated rather than each individual gamble to explain the behavior of Samuelson's colleague. In other words, Samuelson's colleague has to be inattentive to each individual gamble. Here, I show that the intuition generalizes to a setting in which the reference point is endogenous and stochastic. An increase in h implies that the agent integrates all risk, i.e., he does not look up and experience news utility over each realization of the independent gambles h represents; thus, he gains from being inattentive.

[15]The parameter values for the annual horizon are $\mu_0 = 8\%$, $r_0^f = 2\%$, and $\sigma_0 = 20\%$ and the preference parameters are $\eta = 1$ and $\lambda = 2$. These are standard parameters in the prospect-theory literature as I argue in Section 6.1.2 and generate realistic portfolio shares as can be seen in Figure 1.

3.1.2 Labor income and wealth accumulation

Before moving on to dynamic portfolio theory, I make a short digression to illustrate the implications of labor income and wealth accumulation in the static framework to briefly show that my theoretical results do not depend on the absence of labor income. I simply assume that the agent will receive riskless labor income $\bar{Y} \geq 0$ and risky labor income $Y = e^y \sim log - N(\mu_y, \sigma_y)$. The risky labor income may be correlated with the risky return with covariance $Cov(r, y) = \sigma_{ry}$. Lowercase letters denote logs.

Lemma 2. *In the presence of risky labor income, the news-utility agent's optimal portfolio share can be approximated by*

$$\alpha^* = \frac{1}{\rho}\frac{\mu - r^f + \sigma E[\eta(\lambda - 1)\int_s^\infty (s - \tilde{s})dF_s(\tilde{s}))]}{\sigma^2} - \frac{1-\rho}{\rho}\frac{\sigma_{ry}}{\sigma^2}. \tag{3}$$

The derivation of α^* and the consumption-function's log-linearization parameter ρ is delegated to Appendix B.[16] The portfolio share is potentially zero, decreasing in σ, η, and λ, increasing in riskless labor income, and decreasing in wealth. Riskless labor income simply transforms the portfolio share by $1 + \frac{\bar{Y}}{R^f W}$. This transformation does not affect participation because the news-utility agent refuses to invest in the stock market, if the expected excess return is not high enough, at any wealth level. Because the inverse of the consumption-function's log-linearization parameter $\frac{1}{\rho}$ is decreasing in age but $\frac{1-\rho}{\rho}$ decreases faster, labor income becomes relatively less important for older agents' portfolio shares. Nevertheless, in higher order approximations, additional wealth that enters in an additive manner buffers stock-market risk. Risk generates fluctuations in news utility, which are proportional to consumption utility. Accordingly, these fluctuations hurt less on a high part of the concave utility curve. Because labor income is increasing in the beginning of life, this consideration implies that both shares and participation are increasing in the beginning of life, consistent with empirical evidence.[17]

In this approximation, the presence of stochastic labor income does not affect the agent's participation constraint if $\sigma_{ry} \geq 0$, i.e., the agent's first-order risk aversion is preserved. Moreover, this result about first-order risk aversion in the presence of background risk does not depend on the approximation and can be illustrated via the agent's risk premium when stock market risk goes to zero, which I do in Appendix B. This result stands in contrast to earlier analyzes, such as Barberis et al. (2006) and Koszegi and Rabin (2007, 2009).

[16] See, e.g., Campbell and Viceira (2002).

[17] Refer to Fernandez-Villaverde and Krueger (2007) for an examination of hump-shaped income and consumption profiles and Ameriks and Zeldes (2004) for an analysis of portfolio share and participation profiles. Moreover, this paper's analysis of SCF data in Section 6 confirms these results.

Barberis et al. (2006) consider utility specifications that exhibit first-order risk aversion at one point. Background risk takes the agent away from this point and he becomes second-order risk averse with respect to additional risk. However, the reference point is stochastic in this paper's model, so that it exhibits first-order risk aversion over the entire support of background risk. Koszegi and Rabin (2007, 2009) consider situations in which background risk is large and utility potentially linear and find that, in the limit, the agent becomes second-order risk averse. However, labor income risk is not large relative to stock market risk in a life-cycle portfolio framework and the agent's utility function is unlikely to be linear in a model that is calibrated to realistic labor income and stock-market risk at an annual horizon.

4 News Utility in Dynamic Portfolio Theory

The previous results about time diversification illustrate that the model's implications are highly dependent on the length of one time period, which remains a worrisome degree of freedom in the application of news utility. In order to relax this degree of freedom and further elaborate on the interesting implications of the model's period length, I now introduce a life-cycle portfolio-choice model that deviates from other dynamic models in that it allows the agent to look up or refuse to look up his portfolio. I start with the model environment to then explain the dynamic preferences of Koszegi and Rabin (2009). Then, I extend my previous results to the dynamic setting, further describe the agent's preference for inattention, explain the agent's motives for rebalancing, and illustrate the agent's time inconsistency and its implications for inattention and rebalancing. Finally, I consider an extension to signals about the market to illustrate more refined results about information acquisition.

4.1 The life-cycle model environment

The agent lives for T periods indexed by $t \in \{1, ..., T\}$. In each period t, the agent consumes C_t and may invest a share α_t of his wealth W_t in a risk-free investment with deterministic return $log(R^f) = r^f$ or a risky investment with stochastic return $log(R_t) = r_t \sim N(\mu - \frac{\sigma^2}{2}, \sigma^2)$. I assume that short sale and borrowing are prohibited. In each period t, the agent may be inattentive and choose to not observe the realization of the risky asset r_t. If the agent invests a positive amount of wealth in the risky asset in period $t - i$, but is inattentive in periods $t - i + 1, ..., t$, he cannot observe the realization of his wealth W_t; therefore, his wealth for consumption in inattentive periods $C^{in}_{t-i+1}, ..., C^{in}_t$ has to be stored in a risk-free checking

account that pays interest $R^d = e^{r^d}$.[18] Thus, his budget constraint in any period t, when having observed the realization of his risky return in period $t-i$, is given by

$$W_t = (W_{t-i} - C_{t-i} - \sum_{k=1}^{i-1}(\frac{1}{R^d})^k C^{in}_{t-i+k})((R^f)^i + \alpha_{t-i}(\prod_{k=1}^{i} R_{t-i+k} - (R^f)^i)). \tag{4}$$

All the model's variables that are indexed by period t realize in period t. As preferences are defined over outcomes as well as beliefs, I explicitly define the agent's probabilistic "beliefs" about each of the model's period t variables from the perspective of any prior period. Throughout the paper, I assume rational expectations such that the agent's beliefs about any of the model's variables equal the objective probabilities determined by the economic environment.

Definition 1. Let I_t denote the agent's information set in some period $t \leq t+\tau$. Then, the agent's probabilistic beliefs about any model variable, call it $X_{t+\tau}$, conditional on period t information is denoted by $F^t_{X_{t+\tau}}(x) = Pr(X_{t+\tau} < x | I_t)$.

4.2 The dynamic preferences

In the dynamic model of Koszegi and Rabin (2009), the utility function consists of consumption utility, "contemporaneous" news utility about current consumption, and "prospective" news utility about the entire stream of future consumption. Thus, total instantaneous utility in period t is given by

$$U_t = u(C_t) + n(C_t, F^{t-1}_{C_t}) + \gamma \sum_{\tau=1}^{T-t} \beta^\tau \boldsymbol{n}(F^{t,t-1}_{C_{t+\tau}}). \tag{5}$$

The first term on the left-hand side of equation (5), $u(C_t)$, corresponds to consumption utility in period t. The first of the two remaining terms on the left-hand side of equation (5), $n(C_t, F^{t-1}_{C_t})$, corresponds to news utility over contemporaneous consumption; here, the agent compares his present consumption C_t with his beliefs $F^{t-1}_{C_t}$ about present consumption. According to Definition 1, the agent's beliefs $F^{t-1}_{C_t}$ correspond to the conditional distribution of consumption in period t given the information available in period $t-1$. Contemporaneous news utility is given by

[18] The separate checking account allows the agent to be inattentive and consume without risking zero or negative wealth, which is associated with infinitely negative utility and would thus prohibit inattentive behavior. Without the separate checking account, the agent would not consume more than $(1-\alpha_{t-i})W_{t-i}(R^f)^i$ in any inattentive period t, which might impose a binding restriction on his consumption maximization problem. To avoid such binding restrictions, the inattention model of Reis (2006) assumes exponential instead of power utility, which allows consumption to take negative values.

$$n(C_t, F_{C_t}^{t-1}) = \eta \int_{-\infty}^{C_t} (u(C_t) - u(c)) dF_{C_t}^{t-1}(c) + \eta\lambda \int_{C_t}^{\infty} (u(C_t) - u(c)) dF_{C_t}^{t-1}(c). \tag{6}$$

The third term on the left-hand side of equation (5), $\gamma \sum_{\tau=1}^{\infty} \beta^\tau \boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1})$, corresponds to prospective news utility, experienced in period t, over the entire stream of future consumption. Prospective news utility about period $t+\tau$ consumption depends on $F_{C_{t+\tau}}^{t-1}$, the agent's beliefs he entered the period with, and on $F_{C_{t+\tau}}^{t}$, the agent's updated beliefs about consumption in period $t+\tau$. The prior and updated beliefs about $C_{t+\tau}$, $F_{C_{t+\tau}}^{t-1}$ and $F_{C_{t+\tau}}^{t}$, are not independent distribution functions because future uncertainty $R_{t+1}, ..., R_{t+\tau}$ is contained in both. Thus, there exists a joint distribution, which I denote by $F_{C_{t+\tau}}^{t,t-1} \neq F_{C_{t+\tau}}^{t} F_{C_{t+\tau}}^{t-1}$.[19] Because the agent compares his newly formed beliefs with his prior beliefs, he experiences news utility about future consumption as follows

$$\boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1}) = \int_{-\infty}^{\infty} (\eta \int_{-\infty}^{c} (u(c) - u(r)) + \eta\lambda \int_{c}^{\infty} (u(c) - u(r))) dF_{C_{t+\tau}}^{t,t-1}(c, r). \tag{9}$$

The agent exponentially discounts prospective news utility by $\beta \in [0, 1]$. Moreover, he discounts prospective news utility relative to contemporaneous news utility by a factor $\gamma \in [0, 1]$. Thus, he puts the weight $\gamma\beta^\tau < 1$ on prospective news utility about $t+\tau$ consumption.

[19] Koszegi and Rabin (2006, 2007) allow for stochastic consumption, represented by the distribution function F_c, and a stochastic reference point, represented by the distribution function F_r. Then, the agent experiences news utility by evaluating each possible outcome relative to all other possible outcomes

$$n(c, F_r) = \int_{-\infty}^{\infty} (\eta \int_{-\infty}^{c} (u(c) - u(r)) dF_r(r) + \eta\lambda \int_{c}^{\infty} (u(c) - u(r)) dF_r(r)) dF_c(c). \tag{7}$$

I calculate prospective news utility $\boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1})$ by generalizing this "outcome-wise" comparison, equation (7), to account for the potential dependence of F_r and F_c, i.e.,

$$\boldsymbol{n}(F_{c,r}) = \int_{c=-\infty}^{c=\infty} (\eta \int_{r=-\infty}^{r=c} (u(c) - u(r)) + \eta\lambda \int_{r=c}^{r=\infty} (u(c) - u(r))) dF_{c,r}(c, r). \tag{8}$$

If F_r and F_c are independent, equation (8) reduces to equation (7). However, if F_r and F_c are non-independent, equation (8) and equation (7) yield different values. Suppose that F_r and F_c are perfectly correlated, as though no update in information occurs. Equation (7) would yield a negative value because the agent experiences news disutility over his previously expected uncertainty, which is unrealistic. In contrast, equation (8) would yield zero because the agent considers the dependence of prior and updated beliefs, which captures future uncertainty, thereby separating uncertainty that has been realized from uncertainty that has not been realized. Thus, I call this comparison the separated comparison. Koszegi and Rabin (2009) generalize the outcome-wise comparison slightly differently to a "percentile-wise" ordered comparison. The separated and ordered comparisons are equivalent for contemporaneous news utility. However, for prospective news utility, they are qualitatively similar but quantitatively slightly different. As a linear operator, the separated comparison is more tractable. Moreover, it simplifies the equilibrium-finding process because it preserves the outcome-wise nature of contemporaneous news utility.

4.3 The life-cycle model's solution

In order to obtain analytical results, I assume log utility $u(c) = log(c)$ and approximate the log portfolio return $log(R^f + \alpha(R_t - R^f))$ by $r^f + \alpha(r_t - r^f) + \alpha(1-\alpha)\frac{\sigma^2}{2}$. The agent's life-time utility in each period t is

$$u(C_t) + n(C_t, F_{C_t}^{t-1}) + \gamma \sum_{\tau=1}^{T-t} \beta^\tau \boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1}) + E_t[\sum_{\tau=1}^{T-t} \beta^\tau U_{t+\tau}], \tag{10}$$

with $\beta \in [0,1]$, $\eta \in (0,\infty)$, $\lambda \in (1,\infty)$, and $\gamma \in [0,1]$. I define the model's "monotone-personal" equilibrium solution concept in the spirit of the preferred-personal equilibrium solution concept as defined by Koszegi and Rabin (2009). In period t, the agent has looked up his portfolio in periods $t-i$ and $t-i-j_0$.

Definition 2. The attentive consumption function in any period t is admissible if it can be written as $C_t = g(W_t, T-t, r_t, ..., r_{t-i+1})$ and satisfies $\frac{\partial log(C_t)}{\partial(\sum_{j=1}^{i} r_{t-i+j})} > 0$. The inattentive consumption function in any period t is admissible if it can be written as $C_t^{in} = g^{in}(W_{t-i} - C_{t-i}, T-t)$ and satisfies $\frac{\partial log(C_t^{in})}{\partial(\sum_{j=1}^{j_0} r_{t-i-j_0+j})} > 0$. The portfolio function in any period t is admissible if it can be written as $\alpha_t = g_\alpha(T-t, j_1, r_t, ..., r_{t-i+1})$. $\{C_t^{in}, C_t, \alpha_t\}_{t\in\{1,...,T\}}$ is a monotone-personal equilibrium if, in all periods t, the admissible consumption and portfolio functions C_t^{in}, C_t, and α_t maximize (10) subject to (4) under the assumption that all future consumption and portfolio functions correspond to $C_{t+\tau}^{in}$, $C_{t+\tau}$, and $\alpha_{t+\tau}$. In each period t, the agent takes his prior beliefs about consumption $\{F_{C_{t+\tau}}^{t-1}\}_{\tau=0}^{T-t}$ as given in the maximization problem.

The monotone-personal equilibrium solution can be obtained by simple backward induction. The first-order condition is derived under the premise that the agent enters period t, takes his beliefs as given, optimizes over consumption, and expects to behave like this in the future. Thus, the equilibrium is time consistent in the sense that beliefs map into correct behavior and vice versa.[20] I now briefly state the equilibrium consumption and portfolio functions to convey a general idea of the model's solution. The derivation is explained in detail in Appendix C.

Proposition 2. *There exists a unique monotone-personal equilibrium if* $\sigma \geq \sigma_t^*$ *for all*

[20] If the consumption function obtained by backward induction falls into the class of admissible consumption functions, then the monotone-personal equilibrium corresponds to the preferred-personal equilibrium as defined by Koszegi and Rabin (2009).

$t \in \{1, ..., T\}$. *The agent's optimal level of attentive consumption is* $C_t = W_t \rho_t$ *with*

$$\rho_t = \frac{1}{1 + \sum_{\tau=1}^{T-t} \beta^\tau \frac{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}{1+\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1}))}}. \tag{11}$$

If the agent is attentive, his optimal portfolio share is

$$\alpha_t = \frac{\mu - r^f + \frac{\frac{1+\gamma \sum_{\tau=1}^{T-t-j_1} \beta^\tau}{\sum_{\tau=0}^{T-t-j_1} \beta^\tau} \frac{\sqrt{j_1}}{j_1} \sigma E[\eta(\lambda-1) \int_s^\infty (s-\tilde{s}) dF(\tilde{s}))]}{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}}{\sigma^2}. \tag{12}$$

if he plans to look up his portfolio next time in periods $t + j_1$ *and has looked up his portfolio in periods* $t - i$ *and* $t - i - j_0$. *Moreover, the agent's optimal level of inattentive consumption is* $C_t^{in} = (W_{t-i} - C_{t-i})(R^d)^i \rho_t^{in}$ *with* ρ_{t-i+k}^{in} *for* $k = 1, ..., j_1 - 1$ *determined by the following recursion*

$$\rho_t^{in} = \frac{1}{1 + \beta^{j_1} \sum_{\tau=0}^{T-t-j_1} \beta^\tau} (1 - \sum_{k=1}^{i-1} \rho_{t-i+k}^{in} - \sum_{k=1}^{j_1-1} \rho_{t+k}^{in}). \tag{13}$$

Here, $0 \leq \alpha_t \leq 1$ and $\alpha_t = 0$ if the expression (12) is negative or $\alpha_t = 1$ if the expression (12) is larger than one, as I assume that short sale and borrowing are prohibited. Moreover, note that j_1, i.e., the number of periods the agent is inattentive after he looked up his brokerage account in period t, depends on $T - t$ and α_t and is not determined in closed form. All of the following propositions are derived within this model environment under the first-order approximation for the portfolio return and hold in any monotone-personal equilibrium if one exists.[21]

4.4 Comparison of the news-utility and standard policy functions

I now highlight three observations about the news-utility agent's policy functions in comparison to the standard agent's ones. The standard agent is attentive in every period t, his optimal consumption function is $C_t^s = W_t^s \frac{1}{1+\sum_{\tau=1}^{T-t} \beta^\tau}$, and his portfolio share is $\alpha^s = \frac{\mu - r^f}{\sigma^2}$. First, the news-utility agent overconsumes relative to the standard agent in attentive periods, as the standard agent's consumption-wealth ratio is lower than the news-utility agent's consumption-wealth ratio ρ_t, i.e., equation (11). This overconsumption results from news utility as determined by the history of returns $F_r(r_t)...F_r(r_{t-i+1})$ and $\gamma < 1$, i.e., the agent cares more about contemporaneous than prospective news, in combination with a time incon-

[21] Most of my results can be easily extended to a model with a CRRA utility function and without the approximation for the portfolio return. Moreover, I can confirm my results by solving the more complicated model numerically. Finally, my main proposition is derived for h small and the portfolio approximation becomes accurate for $h \to 0$.

sistency that I explain in Section 5.3. Second, the news-utility agent does not overconsume in inattentive periods. In inattentive periods, the agent does not experience news utility over inattentive consumption and γ is irrelevant, as can be seen in equation (13). The agent does not overconsume in inattentive periods because the good news in present consumption would be outweighed by the bad news in future consumption.[22] Absent overconsumption, I can assume that the agent's optimal level of inattentive consumption has been stored in the checking account previously. Third, the news-utility agent's portfolio share, equation (12), is reminiscent of the static model's portfolio share. However, in the dynamic model it depends on the agent's horizon $T-t$, the amount of periods the agent will remain inattentive j_1, and the history of returns $F_r(r_t)...F_r(r_{t-i+1})$. I now explain all these implications in greater detail. Hereby, I assume that $\gamma < 1$, however, all the results that depend on $\gamma < 1$ hold for $\gamma = 1$ too, if, instead of log utility, I assume power utility with the relative coefficient of risk aversion larger than one.

5 Theoretical Predictions

I first extend the static model's implications to the dynamic environment. Then, I explain the model's predictions about inattention and rebalancing as well as the agent's time inconsistency in more detail to finally consider signals about the market.

5.1 Predictions about inattention

5.1.1 Samuelson's colleague, time diversification, and inattention

To extend the model's predictions for the Samuelson's colleague story, time diversification, and inattention to the dynamic environment, I define $\mu \triangleq h\mu_0$, $\sigma \triangleq \sqrt{h}\sigma_0$, $r^f \triangleq hr_0^f$, and $\beta \triangleq \beta_0^h$.

Corollary 1. ***(Horizon effects on portfolio choice)*** *For $\beta \in (1-\Delta, 1)$ with Δ small and assuming that the agent has to look up his portfolio every period.*

1. *(Samuelson's colleague and time diversification) There exists some $\underline{h}$ such that the news-utility agent's portfolio share is zero for $h < \underline{h}$, whereas the standard agent's*

[22] In inattentive periods, the agent does not experience news utility in equilibrium because no uncertainty resolves and he cannot fool himself. Therefore, he is not going to deviate from his inattentive consumption path in periods $t-i+1$ to $t-1$ so long as $u'(C^{in}_{t-i+1})(1+\eta) < (\beta R^d)^{i-1}u'(C^{in}_{t-1})(1+\gamma\eta\lambda)$. As $u'(C^{in}_{t-i+1}) \approx (\beta R^d)^{i-1}u'(C^{in}_{t-1})$, this condition boils down to $\gamma\lambda > 1$. In the derivation, I assume that this condition holds, such that, in inattentive periods, the agent does not deviate from his consumption path and overconsumes time inconsistently.

portfolio share is always positive. The news-utility agent's portfolio share is increasing in h, whereas the standard agent's portfolio share is constant in h. Moreover, if $\gamma < 1$ the news-utility agent's portfolio share is increasing in the agent's horizon $T-t$, whereas the standard agent's portfolio share is constant in $T-t$.

2. *(Inattention) The news-utility agent's normalized expected utility, i.e., $\frac{E_{t-1}[U_t]}{h}$ with $E_{t-1}[log(W_t\rho_t)] = 0$, is increasing in h, whereas the standard agent's normalized expected utility is constant in h.*

The intuitions presented in Section 3.1 carry over to the dynamic model directly. I now proceed to the main proposition in the dynamic model.

Proposition 3. *For T large, there exist some $\bar{h}$ and some $\underline{h}$ with $\bar{h} > \underline{h}$ such that if $h > \bar{h}$ the news-utility agent will be attentive in all periods and if $h < \underline{h}$ the news-utility agent will be inattentive in at least one period. The standard agent will be attentive in all periods independent of h.*

The basic intuition for this proposition is that the agent will look up his portfolio in every period, if a period's length is very long, say ten years. However, if a period's length is very short, say one day, the agent will find it optimal to be inattentive for a positive number of periods. The agent trades off the benefits from consumption smoothing and the costs from experiencing news utility. The benefits from consumption smoothing are proportional to the length of a period h and second-order because the agent deviates from his optimal consumption path. The costs from experiencing news utility are proportional to $\sqrt{h}$ and first-order. Thus, as h becomes small the benefits from consumption smoothing decrease relative to the costs of news utility. Moreover, inattention has the additional benefit that the agent overconsumes less.[23] To facilitate understanding of the model's implications when the agent can choose to look up his portfolio, I will explain the agent's decision-making problem in four periods in his end of life, i.e., periods T, $T-1$, $T-2$, and $T-3$. Let me start with the agent's portfolio share in period $T-1$ assuming that he has looked up his portfolio in period $T-2$, i.e.,

$$\alpha_{T-1} = \frac{\mu_0 - r_0^f + \frac{\sqrt{h}}{h}\frac{\sigma_0 E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]}{1+\gamma(\eta F_r(r_{T-1})+\eta\lambda(1-F_r(r_{T-1})))}}{\sigma_0^2}.$$

For now, I ignore the term containing $F_r(r_{T-1})$, which I explain in Section 5.2, and focus on the terms that are known from the static model. As can be seen, there exists a lower bound

[23] Thus, avoiding overconsumption and news utility are two forces that drive inattention. Which of these forces dominates cannot be inferred from the proof of Proposition 3. However, for the parameter ranges I consider in the quantitative section, the avoidance of news utility is the more important force.

for $\underline{h}$ such that the agent's portfolio share in period $T-1$ is zero for any realization of r_{T-1}; i.e., he behaves consistent with Samuelson's colleague. I now assume that $h = \underline{h}$ and ask if the agent would look up his portfolio in period $T-1$ or be inattentive. Abstracting from the difference in consumption utility terms, he will look up his portfolio iff

$$\alpha_{T-2}(1+\gamma\beta)\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))] > \alpha_{T-2}\sqrt{2}\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]].$$

Contemporaneous and prospective news utility today is proportional to $1+\gamma\beta$ while news utility tomorrow over the realization of returns today and tomorrow is proportional to $\beta\sqrt{2}$. Because $1+\gamma\beta > \beta\sqrt{2}$ is a reasonable parameter combination and the agent consumes more if he looks up his portfolio $E_{T-2}[log(C_{T-1})] > log(C_{T-1}^{in})$, as can be seen in equations (11) and (13), I conclude that he is not unlikely to look up his portfolio. Let me simply suppose he does so and move on to the optimal portfolio share in period $T-2$, which differs from the one in period $T-1$ in that the expected sensation of bad news, i.e., $\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]$, is multiplied by $\frac{1+\gamma\beta}{1+\beta} < 1$. As I picked $h = \underline{h}$, the portfolio share in period $T-2$ has to be positive for some realizations of r_{T-2}; thus, the agent chooses a higher portfolio share early in life because he can diversify over time. Now, again omitting differences in consumption utilities, the agent will find it optimal to look up his portfolio in period $T-2$ iff

$$(\alpha_{T-3}(1+\gamma(\beta+\beta^2)) + \beta\alpha_{T-2}(1+\gamma\beta))\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]$$

$$> \beta\alpha_{T-3}\sqrt{2}(1+\gamma\beta)\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))].$$

This consistency constraint is much less likely to hold than the previous one because α_{T-2} is positive whereas α_{T-1} is zero. Thus, the agent experiences news utility, which is painful in expectation, in period $T-2$ and $T-1$ as opposed to period $T-1$ only. Thus, being inattentive in period $T-2$ causes a first-order increase in expected utility that is proportional to $\sigma = \sqrt{h}\sigma_0$. To not smooth consumption perfectly in period $T-2$, however, causes a decrease in expected utility that is proportional to his consumption level and thus proportional to the portfolio return, which is proportional to $\mu = h\mu_0$. Finally, let me suppose that the condition does not hold, i.e., the agent remains inattentive in period $T-2$, and move on to his portfolio share in period $T-3$, if he has looked up his portfolio in period $T-4$. The mere difference of his portfolio share in period $T-3$ relative to the one in period $T-1$ is that the expected sensation of bad news is multiplied by $\frac{1+\gamma\beta}{1+\beta}\frac{\sqrt{2}}{2} < 1$. Thus, the mere difference to his portfolio share in period $T-2$ is that the expected sensation of bad news is multiplied by $\frac{\sqrt{2}}{2} < 1$. Accordingly, the agent chooses a higher portfolio share if he will

be inattentive in period $T-2$ because the expected return of two periods is 2μ while the expected sensation of bad news increases by $\sqrt{2}$.

5.1.2 Comparative statics about inattention

The agent trades off the benefits from smoothing consumption perfectly with the costs of experiencing more news utility. Moreover, his portfolio share is higher if j_1 is high, i.e., if he plans to be inattentive for a while. j_1, in turn, is determined by the agent's decision of whether or not to look up his portfolio. But what affects the agent's consideration whether or not he should look up his portfolio? I now illustrate several comparative statics about the cost and benefit from inattention. Suppose the agent plans to look up his portfolio in period $t+j_1$ and has looked up his portfolio in period $t-i$. When the agent decides whether or not to look up his portfolio in period t, he considers that he would experience news utility if he looks up his portfolio but also that he would consume more. Thus, he compares the "benefit of delaying news utility" in period t given by

$$-\sqrt{i}\alpha_{t-i}(1+\gamma\sum_{\tau=1}^{T-t}\beta^{\tau})\sigma E[\eta(\lambda-1)\int_{s}^{\infty}(s-\tilde{s})dF(\tilde{s}))],$$

with the "cost of less consumption utility" in period t, i.e., $log(\rho_t^{in})-E[log(\rho_t)]$. However, he also considers that he will experience more news utility in period $t+j_1$. The "cost of delayed news utility" in period $t+j_1$ is given by

$$-(\sqrt{j_1}E[\alpha_t]-\alpha_{t-i}\sqrt{i+j_1})(1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^{\tau}))\sigma E[\eta(\lambda-1)\int_{s}^{\infty}(s-\tilde{s})dF(\tilde{s}))].$$

Thus, in terms of news utility, the "benefit of inattention" is the "benefit of delaying news utility" plus the "cost of delayed news utility". I first formalize the implications in the following proposition to then explain each in detail.

Corollary 2. *In the beginning of life, if t is small, the expected benefit of inattention is positive. Toward the end of life, if t is large, the expected benefit of inattention is decreasing. Moreover, the benefit of inattention is decreasing in $r_{t-i}+...+r_{t-i-j_0+1}$.*

In the beginning of life the optimal portfolio share has converged such that $E[\alpha_{t-i}]=E[\alpha_t]$ and the expected benefit of inattention is necessarily positive. As $\sqrt{i}+\sqrt{j_1}>\sqrt{i+j_1}$ the agent prefers to not look up his portfolio in order to reduce his overall expected disutility from fluctuations in news. Toward the end of life the expected benefit of inattention is decreasing, as $E[\alpha_{t-i}]>E[\alpha_t]$. The optimal portfolio share converges if the agent's horizon

becomes large and thus decreases rapidly toward the end of life. Therefore, i and j_1 are small toward the end of life, which itself results in more frequent readjustments as the benefit of inattention, which is proportional to $\sqrt{i} + \sqrt{j_1} > \sqrt{j_1 + i}$, is decreasing. Thus, looking up the portfolio more often itself results in a reduction of the portfolio share as the agent cannot benefit from inattention as much. Last, if the agent experienced an adverse return realization in period $t - i$ such that $\alpha_{t-i} > E[\alpha_t]$, which I will explain in the next section, the benefit of inattention is reduced and the agent looks up his portfolio again earlier. For illustration, Figure 2 displays the optimal level of j_1, which is increasing in the agent's horizon and the history of returns $r_{t-i} + ... + r_{t-i-j_0+1}$. Note that, the agent is attentive every period if his portfolio share is zero in the end of life as $R^f > R^d$. However, the portfolio share is not necessarily zero in the last ten years of life, which depends on the realization of returns. If it is nonzero the average interval of inattention will be eight or nine months respectively. Moreover, Figure 3 displays the news-utility and standard agents portfolio shares at different points in their life-cycle and indicates how long the news-utility agent is planning to be inattentive.[24]

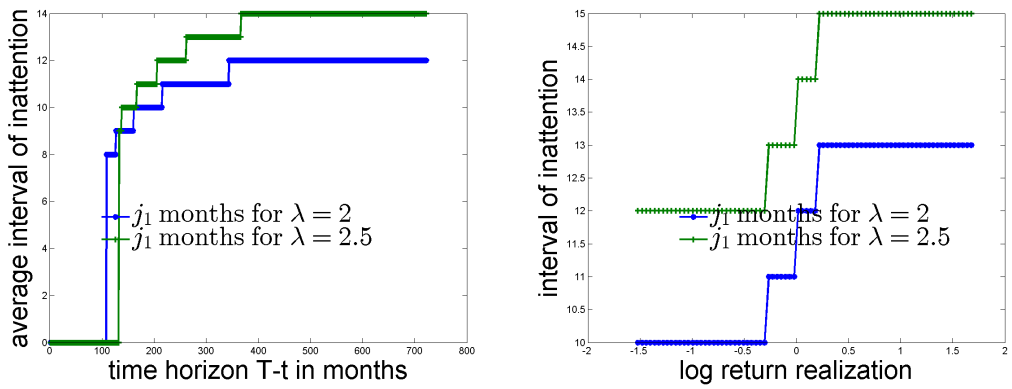

Figure 2: Optimal intervals of inattention at different points over the life-cycle and for different histories of returns.

[24]The parameter values are $12\mu = 8\%$, $12r^f = 2\%$, and $\sqrt{12}\sigma_r = 20\%$ and the preference parameters are $\beta = 0.99 \approx 0.96^{\frac{1}{12}}$, $\eta = 1$, $\lambda = 2$ versus $\lambda = 2.5$, and $\gamma = 0.8$.

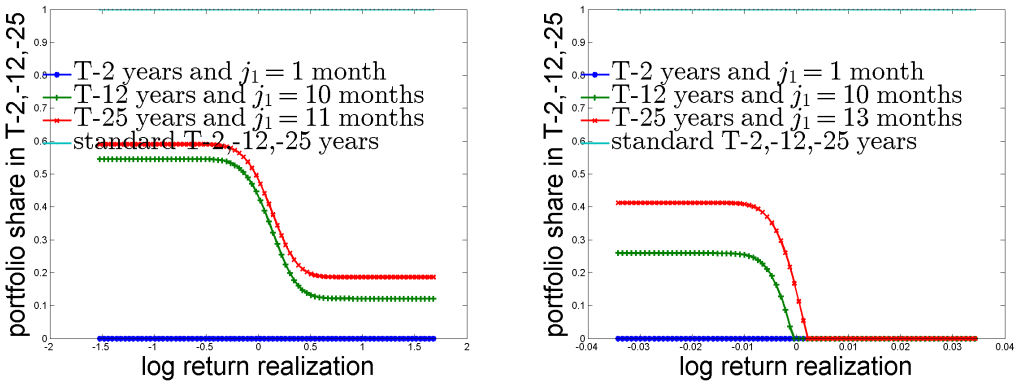

Figure 3: News-utility and standard agents' portfolio shares at different points over the life-cycle with $\lambda = 2$ and $\lambda = 2.5$.

It can be seen that the news-utility agent's portfolio share is not only increasing in his horizon but also decreasing in the return realization, which I explain next.

5.2 Predictions about rebalancing

If the agent stays inattentive, he does not rebalance his portfolio as the return on his wealth is given by $((R^f)^i + \alpha_{t-i}(\prod_{k=1}^{i} R_{t-i+k} - (R^f)^i))$. However, if he looks up his portfolio, he has a motive for extensive rebalancing or buy-low-sell-high investing because his portfolio share is decreasing in the return realization. However, the agent does not necessarily buy the risky asset in bad times, rather, his end-of-period asset holdings may increase in the market return by more than implied by a constant portfolio share.

5.2.1 Extensive rebalancing in life-cycle portfolio theory

I refer to extensive rebalancing as a buy-low-sell-high investment strategy, i.e., the portfolio share is decreasing rather than constant in the return realization.

Definition 3. The agent rebalances extensively if $\frac{\partial \alpha_t}{\partial (r_t + ... + r_{t-i+1})} < 0$.

Proposition 4. *If he looks up his portfolio, the news-utility agent rebalances extensively. Moreover, iff $\gamma < 1$, the degree of extensive rebalancing is decreasing in the agent's horizon.*

The basic intuition for extensive rebalancing is that, upon a favorable return realization, the agent wants to realize the good news about consumption and liquidates his risky asset holdings. In contrast, upon an adverse return realization, the agent prefers to not realize all of the bad news associated with future consumption. Rather, he wants to keep the bad news

in future consumption more uncertain and thus increases his portfolio share. This allows him to effectively delay the realization of bad news until the next period by which point his expectations will have decreased.

To illustrate this result, I now explain the derivation of the optimal portfolio share in period $T-1$ assuming that the agent has looked up his portfolio in period $T-2$. The first derivative of the agent's continuation value is explained in the static portfolio choice application (Section 3.1) and as above given by $\beta(\mu - r^f - \alpha_{T-1}\sigma^2 + E[\eta(\lambda-1)\int_r^\infty (r_T - \tilde{r})dF_r(\tilde{r}))])$. Moreover, the portfolio share affects prospective news utility, as $log(C_T) = log(W_{T-1} - C_{T-1}) + r^f + \alpha_{T-1}(r_T - r^f) + \alpha_{T-1}(1-\alpha_{T-1})\frac{\sigma^2}{2}$. Note that, $W_{T-1} - C_{T-1}$ and α_{T-1} are stochastic from the perspective of period $T-2$ but deterministic from the perspective of period $T-1$, whereas the realization of r_T is stochastic from the perspective of period $T-2$ and $T-1$. Because the agent takes his prior beliefs $F^{T-2}_{W_{T-1}-C_{T-1}}$ and $F^{T-2}_{\alpha_{T-1}}$ as given and $log(C_T)$ is increasing in r_{T-1}, the first derivative of prospective news utility with respect to the portfolio share is

$$\frac{\partial \gamma\beta \boldsymbol{n}(F^{T-1,T-2}_{C_T})}{\partial \alpha_{T-1}} = \gamma\beta(\mu - r^f + \alpha_{T-1}\sigma^2)(\eta F_r(r_{T-1}) + \eta\lambda(1 - F_r(r_{T-1}))).$$

This term implies that α_{T-1} is decreasing in the realization of r_{T-1}. If $F_r(r_{T-1})$ is high, then the agent experiences relatively good news about future consumption and α_{T-1} is relatively low. Or, if $F_r(r_{T-1})$ is low then the agent experiences relatively bad news about future consumption and α_{T-1} is relatively high.[25]

5.2.2 End-of-period asset holdings in life-cycle portfolio theory

Extensive rebalancing, however, does not necessarily imply that the agent buys the risky asset in the event of a bad return realization. Rather, he might leave his risky wealth untouched or decrease his risky asset holdings. In fact, his end-of-period risky asset holdings, i.e., $W_t(1-\rho_t)\alpha_t$, may increase more with the market return than a constant portfolio and consumption share, as displayed by the standard agent, would imply.

[25] Additionally, a decreasing portfolio share implies that the news-utility agent portfolio holdings are predictable by past shocks. The standard agent's risky asset holdings in the end of period t are given by $(W_t - C_t)\alpha^s = ((W_{t-1} - C_{t-1})R^p_t - C_t)\alpha^s$ and thus linearly increasing in the standard agent's portfolio return in period t. In contrast, the news-utility agent's risky asset holdings in the end of period t, assuming he has looked up his portfolio in period $t-1$, are given by $(W_t - C_t)\alpha_t = ((W_{t-1} - C_{t-1})R^p_t - C_t)\alpha_t$ and are thus increasing in the portfolio return. However, they are not increasing linearly but less than linearly in the neighborhood of the return's mean, as $\frac{\partial \alpha_t}{\partial r_t} < 0$. Moreover, the period $t+1$ change in risky asset holdings is given by $(R^f + \alpha_t(R_{t+1} - R^f)(1-\rho_{t+1})\alpha_{t+1} - \alpha_t$ and thus predictable by the period's t return realization, whereas it only depends on the period $t+1$ return realization in the standard model. Therefore, news-utility risky asset holdings are more smooth than the standard agent's risky asset holdings.

Corollary 3. *Iff $\gamma < \bar{\gamma}$, the news-utility agent's end-of-period asset holdings increase with the market return by more than a constant portfolio share would imply*

$$\frac{\partial(((R^f)^i + \alpha_{t-i}(R_t...R_{t-i+1} - (R^f)^i))(1-\rho_t)\alpha_t)}{\partial(R_t...R_{t-i+1})} > \alpha_{t-i}(1-\rho_t)\alpha_t.$$

In any period t, the agent's end-of-period risky asset holdings are given by $W_t(1-\rho_t)\alpha_t$ whereas the beginning-of-period asset holdings are given by $W_{t-1}(1-\rho_{t-1})\alpha_{t-1}R_t$. I have shown that α_t is decreasing in the return realization. But, $1-\rho_t$, i.e., one minus the agent's consumption-wealth ratio, is increasing in the return realization as can be easily seen in equation (11). If $1-\rho_t$ is increasing in the return realization then optimal end-of-period asset holdings in the event of a favorable shock are relatively high. Intuitively, the consumption-wealth ratio ρ_t is increasing in the return realization because, in the event of an adverse shock, the agent wishes to delay the reduction in consumption until his expectations have decreased.[26] This increase may dominate the desire for extensive rebalancing, if γ is small. For illustration, suppose $\gamma = 0$, in which case α_t is constant but $1-\rho_t$ is increasing in the return realization; in this case, the agent engages in insufficient rebalancing.[27]

5.2.3 The net effect on the agent's asset holdings

Now, I want to assess the net effect of the two motives, i.e., does the news-utility agent move money in or out of his risky account in the event of favorable or adverse shocks? I start with the standard agent, whose change in risky asset holdings is proportional to $(R^f + \alpha^s(R_t - R^f))(1-\rho_t^s)\alpha^s - \alpha^s R_t$. Both terms are negative whenever the portfolio share is not larger than one, i.e., $\alpha^s < 1$, and the return realization is not too low, such that the standard agent will typically move money out of the risky account and the amount of the money transfer is monotonically increasing in the return realization.

The news-utility agent's change in risky asset holdings is proportional to $(R^f + \alpha_{t-1}(R_t - R^f))(1-\rho_t)\alpha_t - \alpha_t R_t$. Again, both terms are likely to be negative as $\alpha_{t-1} < 1$, however, as both α_t and ρ_t are decreasing in the realization of R_t the overall response becomes ambiguous instead of uniformly decreasing as the case for the standard agent. Figure 4 illustrates that the news-utility variation in α_t and ρ_t may simultaneously lead to the change in his risky asset holdings being biased towards zero for each t, as in the first scenario, or induce the news-utility agent to sell stocks when the market is going down because γ is low, as in the

[26] This result about delaying consumption adjustments is analyzed in Pagel (2012a), as it brings about excess smoothness in consumption, and Pagel (2012b), as it brings about predictability in stock returns.

[27] In a general-equilibrium asset-pricing model, in which consumption is exogenous and returns are endogenous, the latter motive drives strongly countercyclical expected returns as shown by Pagel (2012a).

second scenario.[28]

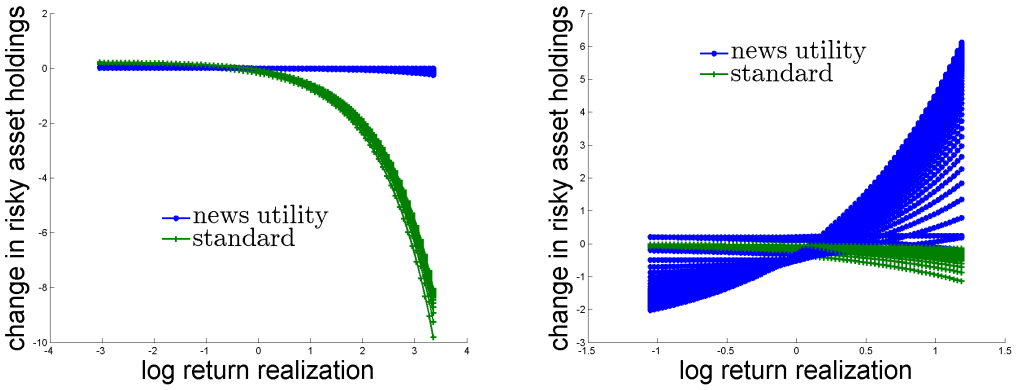

Figure 4: News-utility and standard agents' change in risky asset holdings for each $t \in \{1, ..., T\}$.

5.3 Commitment and welfare implications

The monotone-personal equilibrium is different from the one the agent would like to precommit to, thus he is subject to a commitment or time inconsistency problem. The agent behaves time inconsistently because he enjoys the pleasant surprise of increasing his consumption or portfolio share above expectations today, whereas yesterday he also considered that such an increase in his consumption and portfolio share would have increased his expectations. Thus, today's self thinks inherently differently about today's consumption and portfolio share than yesterday's self. And moreover, today's self wants to consume and enjoy the good news of potentially higher future consumption before his expectations catch up. In the next proposition, I formalize that the agent would like to precommit to consume less, invest less, look up his portfolio less often, but if he does, rebalance more extensively.

Proposition 5. ***(Comparison to the monotone-precommitted equilibrium)***

1. *The monotone-precommitted consumption share does not correspond to the monotone-personal consumption share, if the agent is attentive and $\gamma < 1$. In the monotone-precommitted equilibrium, the agent chooses a lower consumption share and the gap increases in good states, i.e., $\rho_t > \rho_t^c$ and $\frac{\partial(\rho_t - \rho_t^c)}{\partial(r_t + ... + r_{t-i+1})} > 0$. If the agent is inattentive, he chooses the same consumption share, i.e., $\rho_t^{in} > \rho_t^{cin}$.*

[28]The parameter values for the annual horizon are $\mu = 8\%$, $r^f = 2\%$, and $\sigma_r = 20\%$ and the preference parameters are $\eta = 1$, $\lambda = 2$, and $\gamma = 0.8$ versus $\gamma = 0.2$.

2. *The monotone-precommitted portfolio share does not correspond to the monotone-personal portfolio share. In the monotone-precommitted equilibrium, the agent chooses a lower portfolio share and the gap increases in good states, i.e.,* $\alpha_t > \alpha_t^c$ *and* $\frac{\partial(\alpha_t - \alpha_t^c)}{\partial(r_t + ... + r_{t-i+1})} > 0$.

3. *The cost of less consumption utility from not looking up the portfolio are lower on the precommitted path.*

4. *Extensive rebalancing is more pronounced on the precommitted path.*

I first explain the precommitted equilibrium in greater detail. The monotone-precommitted equilibrium maximizes expected utility and is derived under the premise that the agent can precommit to an optimal history-dependent consumption path for each possible future contingency and thus jointly optimizes over consumption and beliefs. In contrast, the monotone-personal equilibrium is derived under the premise that the agent takes his beliefs as given, which is why he would deviate from the optimal precommitted path. I define the model's "monotone-precommitted" equilibrium in the spirit of the choice-acclimating equilibrium concept in Koszegi and Rabin (2007) as follows.

Definition 4. $\{C_t^{in}, C_t, \alpha_t\}_{t\in\{1,...,T\}}$ is a monotone-precommitted equilibrium if, in all periods t, the admissible consumption and portfolio functions C_t^{in}, C_t, and α_t maximize (10) subject to (4) under the assumption that all future consumption and portfolio functions correspond to $C_{t+\tau}^{in}$, $C_{t+\tau}$, and $\alpha_{t+\tau}$. In each period t, the agent's maximization problem determines both the agent's fully probabilistic rational beliefs $\{F_{C_{t+\tau}}^{t-1}\}_{\tau=0}^{T-t}$ as well as consumption $\{C_{t+\tau}^{in}, C_{t+\tau}\}_{\tau=0}^{T-t}$.

The monotone-precommitted equilibrium is derived in Appendix C.2. Suppose that the agent can precommit to an optimal consumption path for each possible future contingency. In his optimization problem, the agent's marginal news utility is no longer solely composed of the sensation of increasing consumption in that contingency; additionally, the agent considers that he will experience fewer sensations of good news and more bad news in all other contingencies. Thus, marginal news utility has a second component, $-u'(C_{T-1})(\eta(1 - F_{C_t}^{t-1}(C_t)) + \eta\lambda F_{C_t}^{t-1}(C_t))$, which is negative such that the precommitted agent consumes and invests less than the non-precommitted agent, as can be easily seen in equations (11) and (12). The additional negative component dominates if the consumption realization is above the median, i.e., $F_{C_t}^{t-1}(C_t) > 0.5$. Thus, in the event of good return realizations, precommitted marginal news utility is negative. In contrast, non-precommitted marginal news utility is always positive because the agent enjoys the sensation of increasing consumption in any contingency. Thus, the additional negative component in marginal news utility implies that the precommitted agent does not overconsume even if $\gamma < 1$. Moreover, the difference between the precommitted and non-precommitted consumption paths is less

large in the event of adverse return realizations because increasing risky asset holdings is the optimal response even on the precommitted path. Thus, the degree of the agent's time inconsistency is reference dependent, which also implies that the motive for extensive rebalancing is more pronounced on the precommitted path. However, in inattentive periods, the agent does not overconsume so long as $\gamma > \frac{1}{\lambda}$, as explained in Section 4.3. Therefore, the difference between inattentive and attentive consumption is less large for the precommitted agent, which decreases the benefits from looking up his portfolio.

A simple calculation reveals the quantitative magnitude of the welfare implications of inattention. Suppose a period's length is one month. If the news-utility agent has to look up his portfolio every period, his portfolio share would be zero. If he can be inattentive, however, his wealth would achieve a return of around four percent per year which accumulates over time. Thus, he would be willing to give up a considerable share of his initial wealth or the return to his wealth to separate his accounts. Moreover, he has a first-order willingness to pay for a portfolio manager who rebalances actively. The simple reason is that his log portfolio return is given by $log((R^f)^i + \alpha_{t-i}(\prod_{k=1}^{i} R_{t-i+k} - (R^f)^i))$ while his return under active rebalancing would be given by $log(\prod_{k=1}^{i}(R^f + \alpha_{t-i}(R_{t-i+k} - R^f)))$. The variance of the former is strictly higher than the variance of the latter and the news-utility agent cares about risk to a first-order extent. This effect matches the empirical evidence provided by French (2008), who finds that the typical investor forgoes about 67 basis points of the market's annual return for active investing.[29] Furthermore, the news-utility agent would pay a portfolio manager who commits him to be inattentive more often, as it prevents overconsumption. More generally, as the separate accounts help the agent to exercise self control, my welfare results relate to the idea of mental accounting (Thaler (1980)).

5.4 Extension to signals about the market

Even if people are deliberately inattentive, it seems unrealistic to assume that they do not receive any news about what is happening in their brokerage account. Therefore, I extend the model such that, in each period, the agent receives a signal about the value of his asset holdings in the brokerage account and then decides if he stays inattentive or not. In Section 5.4.1, I first argue that the equilibrium under consideration will be completely unaffected by the signal if its information content is low. In Section 5.4.2, I then outline the implications of signals that have large information content such that they would affect

[29] As a back-of-the-envelope calculation, suppose the agent's portfolio share is 0.4. Monthly as opposed to yearly rebalancing will result in a reduction of risk given by 0.3% and an increase in the expected return of around 0.04%. Thus, the agent would be willing to give up $(-0.3E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s})] - 0.04)\frac{1}{0.4}\%$ of the annual stock-market return, which matches the empirical evidence for $\eta = 1$ and $\lambda \approx 2.6$.

the agent's attentiveness and thus consumption behavior. Nevertheless, I argue that the signal's effect on consumption and attentiveness is modest and confirm my conjectures using simulations. While the signals seem to not affect the agent's attentiveness and consumption behavior, they do affect his rebalancing once he looks up his portfolio. If the agent rebalances extensively or not does not depend on the overall market any more but depends on how his portfolio compares to the signals he received.

5.4.1 Signals with low information content

In the following, I consider signals about the market that have low information content and show that the agent's attentiveness and thus consumption behavior are completely unaffected. The basic idea is that the potential good news from looking up the portfolio even if the signal happens to be particularly favorable are outweighed by the expected disutility from looking up the portfolio. If the presence of the signal does not affect the agent's plans to look up his portfolio, they do not affect his consumption out of the checking account either. The agent does not want to consume more in the event of a favorable signal because such an increase in current consumption would imply a decrease in future consumption, if the agent does not plan to change the date of when to look up his brokerage account. Since the bad news about the decrease in future consumption outweigh the good news of overconsumption, the agent sticks to his original consumption plan independent of the signal. Thus, the agent experiences news utility merely over his consumption in the future after he has looked up his brokerage account.

5.4.2 Signals with high information content and the Ostrich effect

In the following, I will outline what happens if the signal's information content is so large that it does affect the agent's plans to look up his portfolio. I assume that the agent has looked up his portfolio in period $t-i$, plans to look up his portfolio in period $t+j_1$, and receives a signal $\hat{r}_t = r_t + \epsilon_t$ with $\epsilon_t \sim N(0, \sigma_\epsilon^2)$ about r_t in period t. In this section, I will show that the agent's willingness to look up his portfolio increases in the realization of the signal. This allows me to conjecture how the equilibrium looks like given my previous findings.

In period t, the agent will look up his portfolio after receiving a particularly favorable signal, will not react to signals in some middle range, and will want to refuse to look up his portfolio for particularly bad signals. If he does not look up his portfolio, he does not consume time-inconsistently because he does not experience news utility over inattentive consumption but merely over future consumption after having looked up the portfolio. Absent time-

inconsistent overconsumption, his previous selves have no reason to restrict the funds in the checking account. However, his previous selves may want to affect his decision whether or not to look up his portfolio in period t. But, his previous selves cannot affect his period t decision to look up his portfolio. Although his previous selves can force his period t self to look up his portfolio, namely, when his period t self runs out of funds in the checking account. However, his previous selves will never want to make him look up his portfolio earlier than his period t self wants as the precommitted path features looking up the portfolio fewer times than the non-precommitted path. Because there is no time inconsistency associated with inattentive consumption, I can assume that the previous selves stored sufficient funds in the checking account to allow the investor to remain inattentive longer, in the event of adverse signals, until he would look up his portfolio on the precommitted path.

Now, I show that the agent is more likely to look up his portfolio after a favorable realization of the signal; a behavior that has been termed the Ostrich effect. If the agent looks up his portfolio, he will experience news utility over the actual realization of his portfolio. If he does not look up his portfolio, he will experience news utility over the signal. The expectation of contemporaneous and prospective news utility in period t is assessed conditional on the signal. In particular, the agent expects contemporaneous and prospective news from looking up his return as follows

$$\alpha_{t-i}(1+\gamma\sum_{\tau=1}^{T-t}\beta^{\tau})\int_{-\infty}^{\infty}\eta(\lambda-1)\int_{r}^{\infty}(r-\tilde{r})dF_{r_t+\ldots+r_{t-i+1}|\hat{r}_{t-1},\ldots,\hat{r}_{t-i+1}}(\tilde{r})dF_{r_t+\ldots+r_{t-i+1}|\hat{r}_t,\hat{r}_{t-1},\ldots,\hat{r}_{t-i+1}}(r).$$

If $\hat{r}_t$ is high then r_t is more likely to be high and the agent is likely to experience positive news utility. If the agent decides to not look up his portfolio, he will experience prospective news utility over the signal. In that case, prospective news utility in period t is

$$\sum_{j=1}^{j_1}\beta^j p_{t+j}\alpha_{t-i}(1+\gamma\sum_{\tau=1}^{T-t-j}\beta^{\tau})\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\eta(\lambda-1)\mu(r-\tilde{r})dF^{t+j,t+j-1}_{r_{t+j}+\ldots+r_{t-i+1}}(r,\tilde{r}).$$

Here, p_{t+j} denotes the probability of looking up the portfolio in period $t+j$ conditional on period t information, such that $\sum_{j=1}^{j_1} p_j = 1$, i.e., the investor knows he cannot delay to look up his portfolio beyond period $t+j_1$. For a simplified comparison, suppose the agent will look up his portfolio in period $t+1$, i.e., $j_1 = 1$ and $p_{j_1} = 1$. In expectation, it is more painful to look up the true return than merely experiencing prospective news utility simply because more uncertainty will be resolved. But, the difference between the two is smaller when the agent received a more favorable signal. The reason is that expected marginal news utility from resolution of ϵ_t is less if $\hat{r}_t$ is high because the agent considers news fluctuations

high up on the utility curve. Accordingly, after having received a favorable signal, the agent is more likely to look up his portfolio. This behavior is commonly known as the "Ostrich effect" and supported by empirical evidence (Karlsson et al. (2009)).

Nevertheless, this example also suggests that it is not unlikely that the agent will choose to ignore the signal and not adjust his attentiveness and thus consumption. After all, in the event of a favorable signal, he experiences news utility over the signal or news utility over the actual realization. Thus, the sole reason that he is more likely to look up the realization is that the expected costs of receiving more information are lower conditional on a favorable signal. A simple simulation confirms this conclusion quantitatively. Figure 5 compares the news utility experienced over the signal to the expected news utility conditional on the signal. It can be seen that the quantitative difference is decreasing in the realization of the signal, but is very small in comparison to the overall variation in news utility.[30] More details can be found in Appendix 5.4.

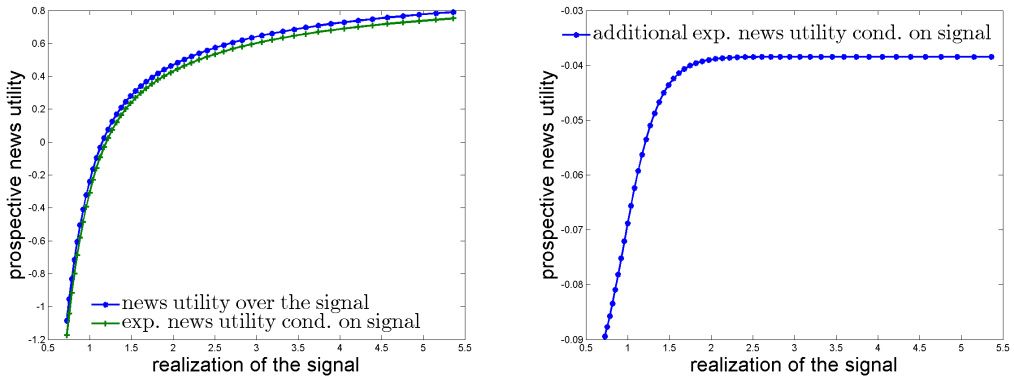

Figure 5: Comparison of experienced news utility over the signal and expected news utility conditional on the signal.

However, this comparison does not take into account that the agent cares more about contemporaneous than prospective news, i.e., the expected news utility is weighted by $1 + \gamma \sum_{\tau=1}^{T-t} \beta^\tau$ while prospective news utility is weighted by $\sum_{j=1}^{j_1} \beta^j p_{t+j}(1 + \gamma \sum_{\tau=1}^{T-t-j} \beta^\tau)$. But, if the agent's horizon is long and a period is short the difference between the two are small. Moreover, if a period is short the contemporaneous realization of the return has very small quantitative implications for immediate consumption. Additionally, if a period's length

[30] I choose a quantitative example that should produce a larger difference in experienced and expected news utility than the model under consideration. I choose an annual horizon as a period's length such that the signal has large information content and choose a variance of the signal that is equally variable as the stock-market variance because more noisy signals increase this difference in news utility. The parameter values are $\mu = 8\%$, $r^f = 2\%$, and $\sigma_r = \sigma_\epsilon = 20\%$ and the preference parameters are $\eta = 1$ and $\lambda = 2.5$.

is small the agent compares experiencing news utility over a one-period realization of the signal to experiencing news utility over the multi-period uncertainty left. I confirm these conjectures by introducing a signal into the model simulation and find that for a period's length of one month relatively accurate signals with a standard deviation of $\sigma_\epsilon = \frac{\sigma_r}{2}$ slightly change the intervals of inattention in equilibrium.

Overconfidence and extrapolative expectations. Now, I ask how the agent's behavior is perceived by an outsider. The outsider acquires all available information because he does not experience any news utility over the agent's portfolio or consumption. Will the outsider perceive the agent's behavior as overconfident or extrapolative? After all, whenever the agent decides to not look up his portfolio, his behavior, as reflected in his portfolio share, is based on a different information set than the outsider's one. The agent's information set in each period t is denoted by I_t and might contain today's return r_t and all past returns or only the returns past r_{t-i}. Even though the agent receives the signals $\hat{r}_{t-i+1}, ..., \hat{r}_t$, his behavior, as reflected in his portfolio share will be based on the returns past r_{t-i} only. This portfolio share is denoted by $f^\alpha(I_t)$. In contrast, the outsider's information is denoted by I_t^o and contains r_t and all past r_{t-i}.

I say that if $f^\alpha(I_t) > f^\alpha(I_t^o)$ the agent is perceived to be overconfident by an outsider. Whenever the agent does not look up his portfolio because the return realization is likely to be bad, he will have chosen a higher portfolio share as if he expects high returns. Thus, an outsider would perceive his behavior as overconfident.

I say that if $f^\alpha(I_t) = \rho f^\alpha(I_t^o) + (1-\rho) f^\alpha(I_{t-i}^o)$ the agent is perceived to have extrapolative expectations by an outsider. Whenever the agent decides to not look up his portfolio, but the outsider acquires all information, then the agent's behavior, as reflected in his portfolio share, is based on an outdated information set; thus, he looks extrapolative. Overconfidence and extrapolative expectations are two descriptive theories for beliefs that have been assumed in a variety of behavioral-finance papers to explain stock prices, e.g., Scheinkman and Xiong (2003), Malmendier and Tate (2005, 2008), Choi (2006), Hirshleifer and Yu (2011), and Barberis et al. (2013).

6 Quantitative Implications for Life-Cycle Consumption and Portfolio Choice and Empirical Evidence

In Section 6.1, I assess the quantitative performance of the model with a structural estimation exercise using household portfolio data on participation and shares. I first choose

an empirically plausible parametrization of the environmental parameters and the period's length to then estimate the preference parameters. For the parametrization, I explore how often the investor chooses to look up his portfolio given a plausible calibration of the environmental and preference parameters. I then use the implied average length of inattention as the period's length in a standard life-cycle model. This standard model assumes power utility $u(c) = \frac{c^{1-\theta}}{1-\theta}$ with a coefficient of risk aversion θ instead of relying on log utility and is outlined in Appendix C.4. Section 6.1.1 quickly describes the household portfolio data, Section 6.1.2 presents results for different calibrations of the period's length, Section 6.1.3 provides details on the identification, and Section 6.1.4 describes the estimation procedure and compares the estimates with the existing literature. Finally, in Section 6.2, I provide some suggestive empirical evidence for extensive rebalancing in portfolio choice using PSID household portfolio data.

6.1 Structural estimation

To validate the model quantitatively, I structurally estimate the preference parameters by matching the average empirical life-cycle profile of participation and portfolio shares using household portfolio data of the Survey of Consumer Finances (SCF) from 1992 to 2007.

6.1.1 Data

The SCF data is a statistical survey of the balance sheet, pension, income and other demographic characteristics of families in the United States sponsored by the Federal Reserve Board in cooperation with the Treasury Department. The SCF is conducted of six survey waves from 1992 to 2007 but does not survey households consecutively. I follow the risk-free and risky-asset definitions of Flavin and Nakagawa (2008) and construct a pseudo-panel by averaging participation and shares of all households at each age.

In addition to the age effects of interest, the data is contaminated by potential time and cohort effects, which constitutes an identification problem as time minus age equals cohort. In the portfolio-choice literature, it is standard to solve the identification problem by acknowledging age and time effects, as tradable and nontradable wealth varies with age and contemporaneous stock-market happenings are likely to affect participation and shares, but omitting cohort effects (Campbell and Viceira (2002)). In contrast, it is standard to omit time effects but acknowledge cohort effects (Gourinchas and Parker (2002)), in the consumption literature. I employ a new method, recently invented by Schulhofer-Wohl (2013), that solves the age-time-and-cohort identification problem with minimal assumptions. In particular, the method merely assumes that age, time, and cohort effects are linearly related. I first estimate

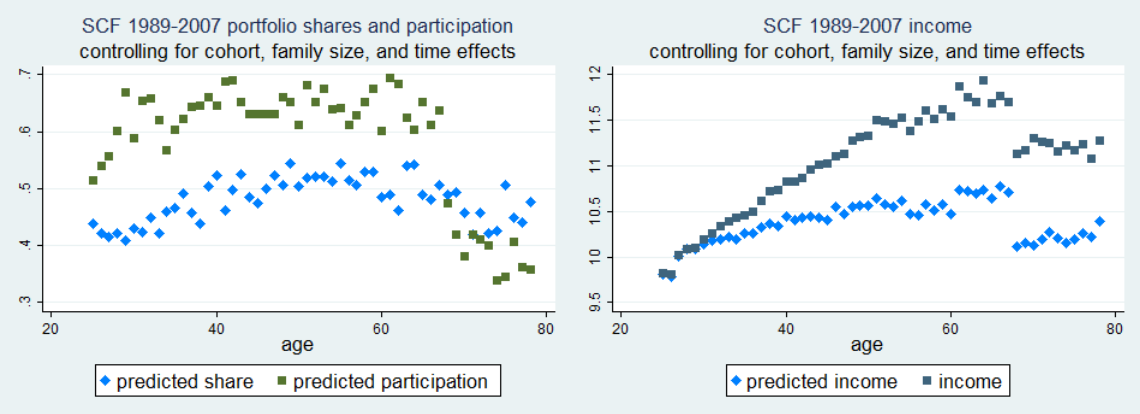

Figure 6: Participation, portfolio shares, and labor income over the life-cycle.

a pooled OLS model, whereby I jointly control for age, time, and cohort effects and identify the model with a random assumption about its trend. Then, I estimate this arbitrary trend together with the structural parameters, which results in consistent estimates using data that is uncontaminated by time and cohort effects. This application of Schulhofer-Wohl (2013) to household portfolio data is an important contribution, as portfolio profiles are highly dependent on which assumptions the identification is based on, as made clear by Ameriks and Zeldes (2004).

Figure 6 displays the uncontaminated empirical profiles for participation and portfolio shares as well as labor income. Both participation and portfolio shares are hump shaped over the life-cycle. The predicted income profile is lower than the profile containing the disturbances because the SCF oversamples rich households but provides weights to adjust the regressions.

Moreover, the model's quantitative predictions about consumption and wealth accumulation are compared to the empirical profiles as inferred from the Consumer Expenditure Survey (CEX). The CEX is a survey of the consumption expenditures, income, balance sheet, and other demographic characteristics of families in the United States sponsored by the Bureau of Labor Statistics.

6.1.2 Calibrating the period's length

I estimate a standard life-cycle model in which the investor looks up his portfolio each period. As can be inferred from the theoretical analysis, an important calibrational degree of freedom constitutes the model's period length, which I determine first. As a first step, I will calibrate the risky and risk-free return moments, i.e., $h\mu_0$, $\sqrt{h}\sigma_0$, and hr_0^f, to a monthly investment horizon if $h = 1$. Then, $h = 12$ would recalibrate the model to an annual horizon.

The literature suggests fairly tight ranges for the parameters of the log-normal return, i.e., $12\mu_0 = 8\%$, $\sqrt{12}\sigma_0 = 20\%$, and the log risk-free rate, i.e., $12r_0^f = 2\%$. Additionally, I choose the agent's horizon $T = 60$ years (720 months) and his retirement period $R = 10$ years (120 months), in accordance with the life-cycle literature. Moreover, I set $\eta = 1$, $\lambda = 2.5$, and $\gamma = 0.8$, which are reasonable preference parameter choices given the literature on prospect theory and reference dependence, as I will discuss in Section 6.1.4.

Under this calibration, I find that the agent looks up his portfolio approximately once a year early in life and chooses a zero portfolio share after the start of retirement. Figure 3 in Section 5.1.2 displays the news-utility and standard agents' optimal portfolio shares. As can be seen, the news-utility agent's share is increasing in the agent's horizon and decreasing in the return realization. In contrast, the standard agent's share is constant in the horizon and return realizations. Not surprisingly, the standard agent accumulates wealth more rapidly, as his portfolio share is one. Beyond these implications for portfolio choice, the news-utility agent's consumption profile is hump shaped whereas the standard agent's consumption profile is increasing throughout. Figure 7 displays the theoretical and empirical consumption profiles estimated from CEX data.[31]

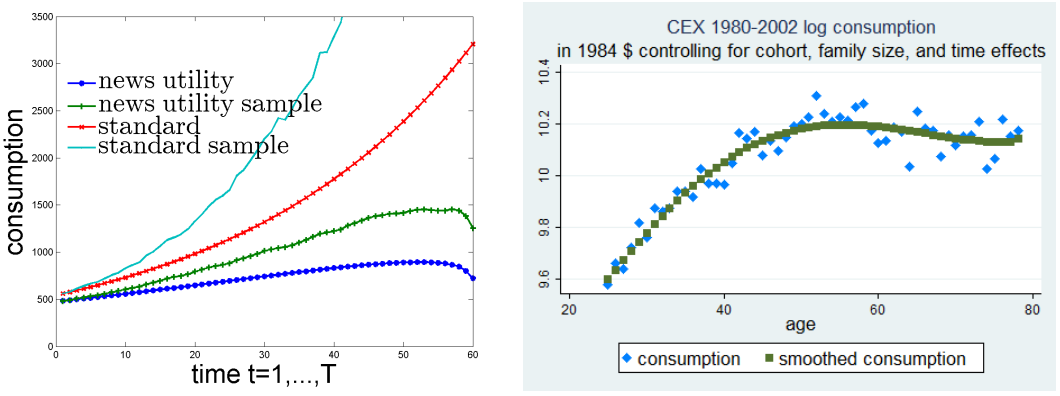

Figure 7: News-utility and standard agents' consumption over the life-cycle and empirical consumption profile.

I conclude that a yearly investment horizon seems a reasonable calibrational choice that has also been assumed in similar contexts (Benartzi and Thaler (1995) and Barberis et al. (2001)).

[31] Note that this empirical profile implicitly assumes that households do not retire, which is why consumption is not decreasing too much toward the end of life. I consider this comparison to be more adequate, as the model I use in this section abstracts from labor income.

6.1.3 Identification

Are the empirical life-cycle participation and portfolio shares profiles able to identify the preference parameters? I am interested in five preference parameters, namely β, θ, η, λ, γ. As shown in Appendix C.4, both participation and the portfolio share are determined by the following first-order condition $\gamma\frac{\partial\Phi_t}{\partial\alpha_t}(\eta F_{A_t}^{t-1}(A_t)+\eta\lambda(1-F_{A_t}^{t-1}(A_t)))+\frac{\partial\Psi_t}{\partial\alpha_t}=0$ of which I observe the average of all households. $\frac{\partial\Phi_t}{\partial\alpha_t}$ represents future marginal consumption utility, as in the standard model, and is determined by β and θ, which can be separately identified in a finite-horizon model. $\frac{\partial\psi_t}{\partial\alpha_t}$ represents future marginal consumption and news utility and is thus determined by something akin of $\eta(\lambda-1)$. $\eta F_{A_t}^{t-1}(A_t)+\eta\lambda(1-F_{A_t}^{t-1}(A_t))$ represents the weighted sum of the cumulative distribution function of savings, A_t, of which merely the average determined by $\eta 0.5(1+\lambda)$ is observed. Thus, I have two equations in two unknowns and can separately identify η and λ. Furthermore, participation is determined by the value of $F_{A_t}(A_t)$ at which the average portfolio share becomes zero, which provides additional variation identifying η and λ separately. Finally, γ enters the first-order condition distinctly from all other parameters, and I conclude that the model is identified which can also be verified by deriving the Jacobian that has full rank.

6.1.4 Estimation

Methods of simulated moments procedure. At an annual horizon, the literature suggests fairly tight ranges for the parameters of the log-normal return, i.e., $\mu = 8\%$, $\sigma = 20\%$, and the log risk-free rate, i.e., $r^f = 2\%$. Moreover, the life-cycle consumption literature suggests fairly tight ranges for the parameters determining stochastic labor income, i.e., labor income is log-normal, characterized by shocks with variance $\sigma_Y \approx 0.1$, and a trend G. I estimate σ_Y and G from the SCF data. After having calibrated the structural parameters governing the environment $\Xi = (\mu, \sigma, \sigma_Y, G, r^f, R, T)$, I now estimate the preference parameters $\boldsymbol{\theta} = (\eta, \lambda, \gamma, \beta, \theta)$ by matching the simulated and empirical life-cycle profiles for participation and shares. The empirical profiles are the average participation and shares at each age $a \in [1, T]$ across all household observations i. More precisely, it is $\bar{\alpha}_a = \frac{1}{n_a}\sum_{i=1}^{n_a}\bar{\alpha}_{i,a}$ with $\bar{\alpha}_{i,a}$ being the household i's portfolio share at age a of which n_a are observed. The theoretical population analogue to $\bar{\alpha}_a$ is denoted by $\alpha_a(\theta, \Xi)$ and the simulated approximation is denoted by $\hat{\alpha}_a(\boldsymbol{\theta}, \Xi)$. Similarly, I define the empirical percentage of participating households at each age as $\bar{p}_a$ and its theoretical population analogue is denoted by $p_a(\theta, \Xi)$ and the simulated approximation is denoted by $\hat{p}_a(\boldsymbol{\theta}, \Xi)$. Moreover, I define

$$\hat{g}(\boldsymbol{\theta}, \Xi) = \begin{pmatrix} \hat{\alpha}_a(\boldsymbol{\theta}, \Xi) - \bar{\alpha}_a \\ \hat{p}_a(\boldsymbol{\theta}, \Xi) - \bar{p}_a \end{pmatrix}.$$

Calibration and Estimation Results

μ	σ	$\hat{\sigma}_Y$	$\hat{G}_t$	$\hat{\beta}$	r^f	$\hat{\theta}$	$\hat{\eta}$	$\hat{\lambda}$	$\hat{\gamma}$
8%	20%	0.12	$e^{Y_{t+1}-Y_t}$	0.97	2%	1.15	1.21	2.67	0.81
		(0.067)	$(\hat{\Omega}_{\hat{G}})$	(0.008)		(0.054)	(0.052)	(0.083)	(0.103)

Table 1: This table displays the calibrated and estimated parameters as well as the standard errors of the estimated parameters (in parentheses).

In turn, if $\boldsymbol{\theta}_0$ and Ξ_0 are the true parameter vectors, the procedure's moment conditions imply that $E[g(\theta_0, \Xi_0)] = 0$. In turn, let W denote a positive definite weighting matrix then

$$q(\boldsymbol{\theta}, \Xi) = \hat{g}(\boldsymbol{\theta}, \Xi) W^{-1} \hat{g}(\boldsymbol{\theta}, \Xi)'$$

is the weighted sum of squared deviations of the simulated from their corresponding empirical moments. I assume that W is a robust weighting matrix rather than the optimal weighting matrix to avoid small-sample bias. More precisely, I assume that W corresponds to the inverse of the variance-covariance matrix of each point of $\bar{\alpha}_a$ and $\bar{p}_a$, which I denote by Ω_g^{-1} and consistently estimate from the sample data. Taking $\hat{\Xi}$ as given, I minimize $q(\boldsymbol{\theta}, \hat{\Xi})$ with respect to $\boldsymbol{\theta}$ to obtain $\hat{\boldsymbol{\theta}}$ the consistent estimator of $\boldsymbol{\theta}$ that is asymptotically normally distributed with standard errors

$$\Omega_\theta = (G_\theta' W G_\theta)^{-1} G_\theta' W [\Omega_g + \Omega_g^s + G_\Xi \Omega_\Xi G_\Xi'] W G_\theta (G_\theta' W G_\theta)^{-1}.$$

Here, G_θ and G_Ξ denote the derivatives of the moment functions $\frac{\partial g(\boldsymbol{\theta}_0, \Xi_0)}{\partial \boldsymbol{\theta}}$ and $\frac{\partial g(\boldsymbol{\theta}_0, \Xi_0)}{\partial \Xi}$, Ω_g denotes the variance-covariance matrix of the second-stage moments as above that corresponds to $E[g(\boldsymbol{\theta}_0, \Xi_0) g(\boldsymbol{\theta}_0, \Xi_0)']$, and $\Omega_g^s = \frac{n_a}{n_s} \Omega_g$ denotes the sample correction with n_s being the number of simulated observations at each age a. As Ω_g, I can estimate Ω_Ξ directly and consistently from sample data. For the minimization, I employ a Nelder-Mead algorithm. For the standard errors, I numerically estimate the gradient of the moment function at its optimum. If I omit the first-stage correction and simulation correction the expression becomes $\Omega_\theta = (G_\theta' \Omega_g^{-1} G_\theta)^{-1}$. Finally, I can test for overidentification by comparing $\hat{g}(\hat{\boldsymbol{\theta}}, \hat{\Xi})$ to a chi-squared distribution with $T - 5$ degrees of freedom. The calibration and estimated parameters can be found in Table 1.

Discussion of estimation results. I refer to the literature regarding the standard estimates for β and θ, but discuss the plausibility of the news-utility parameter values, i.e., η, λ, and γ, in more detail. In the following, I demonstrate that my estimates are consistent with existing micro evidence on risk and time preferences. In Table 2 in Appendix A, I illus-

trate the risk preferences over gambles with various stakes of the news-utility and standard agents. In particular, I calculate the required gain G for a range of losses L to make each agent indifferent between accepting or rejecting a 50-50 win G or lose L gamble at a wealth level of 300,000 in the spirit of Rabin (2001) and Chetty and Szeidl (2007).[32]

First, I want to match risk attitudes towards bets regarding immediate consumption, which are determined solely by η and λ because it can be reasonably assumed that utility over immediate consumption is linear. Thus, $\eta \approx 1$ and $\lambda \approx 2.5$ are suggested by the laboratory evidence on loss aversion over immediate consumption, i.e., the endowment effect literature.[33] In Table 2, it can be seen that the news-utility agent's contemporaneous news utility generates reasonable attitudes towards small and large gambles over immediate consumption. In contrast, when I assume linear utility over immediate consumption, the standard agent is risk neutral. Second, I elicit the agents' risk attitudes by assuming that each of them is presented the gamble after all consumption in that period has taken place. The news-utility agent will only experience prospective news utility over the gamble's outcome that is determined by γ. Empirical estimates for the quasi-hyperbolic parameter β in the $\beta\delta-$model typically range between 0.7 and 0.8 (e.g., Laibson et al. (2012)). Thus, the experimental and field evidence on peoples' attitudes towards intertemporal consumption trade-offs makes $b = \gamma \approx 0.8$ when $\beta \approx 1$ a plausible estimate. In Table 2, it can be seen that the news-utility agent's risk attitudes take reasonable values for small, medium, and large stakes. The standard agent is risk neutral for small and medium stakes and reasonable risk averse for large stakes only. Moreover, my estimates match the parameter values obtained by a structural estimation of a life-cycle consumption model in Pagel (2012a).

Beyond matching micro estimates, the implied life-cycle profiles of shares and participation fit the hump-shaped empirical profiles. The profiles are decreasing in the end of life because risk is not as well diversified across time and expected labor income is decumulat-

[32]In a canonical asset-pricing model, Pagel (2012b) demonstrates that news-utility preferences constitute an additional step towards resolving the equity-premium puzzle, as they match the historical level and the variation of the equity premium while simultaneously implying plausible attitudes towards small and large wealth bets.

[33]For illustration, I borrow a concrete example from Kahneman et al. (1990), in which the authors distribute a good (mugs or pens) to half of their subjects and ask those who received the good about their willingness to accept (WTA) and those who did not receive it about their willingness to pay (WTP) if they traded the good. The median WTA is \$5.25, whereas the median WTP is \$2.75. Accordingly, I infer $(1+\eta)u(mug) = (1+\eta\lambda)2.25$ and $(1+\eta\lambda)u(mug) = (1+\eta)5.25$, which implies that $\lambda \approx 3$ when $\eta \approx 1$. I obtain a similar result for the pen experiment. Unfortunately, thus far, I can only jointly identify η and λ. If the news-utility agent were only to exhibit news utility, I would obtain $\eta\lambda 2.25 \approx 5.25$ and $\eta 2.25 \approx 2.25$, i.e., $\lambda \approx 2.3$ and $\eta \approx 1$ both identified. Alternatively, if I assume that the market price for mugs (or pens), which is \$6 in the experiment (or \$3.75), equals $(1+\eta)u(mug)$ (or $(1+\eta)u(pen)$), then I can estimate $\eta = 0.74$ and $\lambda = 2.03$ for the mug experiment and $\eta = 1.09$ and $\lambda = 2.1$ for the pen experiment. These latter assumptions are reasonable given the induced-market experiments of Kahneman et al. (1990). $\eta \approx 1$ and $\lambda \approx 2.5$ thus appear to be reasonable estimates that are typically used in the literature concerning the static preferences.

ing. The profiles are increasing in the beginning of life because high expected labor income makes labor-income and stock-market risk more bearable as news utility is proportional to consumption utility, such that fluctuations in good and bad news hurt less on the flatter part of the concave utility curve. In the beginning of life, however, the implied profiles tend to be slightly too high and not as steeply increasing relative to what I find in the SCF data. The implied life-cycle consumption profiles display a hump similar to what I find in the CEX data.

6.2 Testing the model's implications using household portfolio data

In the following, I provide some suggestive empirical evidence for extensive rebalancing in portfolio choice. I use the same data set as Brunnermeier and Nagel (2008) from the PSID, which contains household characteristics, wealth, income, stock market holdings, business equity, and home equity. Brunnermeier and Nagel (2008) aim to test if portfolio shares are increasing in wealth as would be predicted by a habit-formation model and other asset-pricing models that rely on increasing risk aversion to explain countercyclical equity premia. The authors find that, if anything, the risky asset share is slightly decreasing in wealth. In the following, I show that the risky asset share seems to be decreasing in the innovation to wealth for the group of households that adjust their risky asset holdings, as predicted by the news-utility model. Nevertheless, in an asset-pricing model, news utility predicts countercyclical equity premia as shown in Pagel (2012b).

I follow the methodology of Brunnermeier and Nagel (2008). However, instead of the risky asset share's response to changes in wealth, I am interested in its response to innovations or unexpected changes in wealth. The unexpected change in wealth, $\tilde{\Delta} w_t$, corresponds to the residual of a predictive regression of the change in wealth on all other variables used by Brunnermeier and Nagel (2008) including last period's change and level in wealth, i.e.,

$$\Delta w_t = \beta q_{t-2} + \gamma \Delta h_t + \tilde{\Delta} w_t.$$

q_{t-2} consists of a vector of ones and constant or lagged variables that are known at date t, such as age, education, gender, marital status, employment, inheritances, etc.[34] Δh_t is a

[34]Following Brunnermeier and Nagel (2008), I include age and age^2; indicators for completed high school and college education, respectively, and their interaction with age and age^2; dummy variables for gender and their interaction with age and age^2, marital status, health status; the number of children in the household, the number of people in the household; dummy variables for any unemployment in the two years leading up to and including year $t-2$, and for coverage of the household heads job by a union contract. In addition, I include the log of the equity in vehicles owned by the household, log family income at $t-2-2$, two-year growth in log family income at $t-2$ and $t-4$, and a variable for inheritances received in the two years leading up to and including year $t-2$. Moreover, I include time fixed effects to control for aggregate wealth

vector of variables that captures major changes in family composition or asset ownership, such as changes in family size, house ownership, etc.[35] Moreover, I restrict the regression to those households who did change their risky asset holdings, as the model predicts that some people are inattentive. Furthermore, Brunnermeier and Nagel (2008) analyze the change in the risky asset share, whereas I use the level of the risky asset share as the dependent variable and the lagged risky asset share as an additional independent variable. I restrict myself to the second subsample that contains the PSID waves of 1999, 2001, and 2003, as the first subsample has a five year difference, which is likely to be too long for analyzing an expectations-based reference point. I run a pooled regression of the form

$$\alpha_t = b\alpha_{t-2} + \beta q_{t-2} + \gamma \Delta h_t + \rho \tilde{\Delta} w_t + \epsilon_t$$

with α_{t-2} denoting the lagged risky asset share.[36] Consistent with the results of Brunnermeier and Nagel (2008), the coefficient on the unexpected change in wealth for those households who did change their risky asset holdings in that period is negative but relatively small. I obtain a coefficient of approximately -.13 with a t-statistic of 3.34 which implies that an unexpected decrease in wealth of 20% leads to an increase in the risky asset share by 2.6%. The coefficient is more negative and significant if I restrict the sample to households that changed their risky asset holdings, consistent with the model. However, the model predicts that an innovation in wealth by σ_r, i.e., $e^{\mu_r+\sigma_r} - e^{\mu_r} \approx 20\%$, yields to a reduction in the risky asset share by roundabout 10% when I omit the variation in $1 - \rho_t$. Alternatively, I run a 2SLS regression in which I instrument the unexpected change in wealth by the unexpected change in labor income using the same methodology as Brunnermeier and Nagel (2008) obtaining similar results.

changes, region fixed effects to control for local wealth changes, and an interaction of each of them.

[35]Following Brunnermeier and Nagel (2008), I include changes in some household characteristics between $t-2$ and t: changes in family size, changes in the number of children, and a sets of dummies for house ownership, business ownership, and non-zero labor income at t and $t-2$.

[36]Following Brunnermeier and Nagel (2008), I define liquid assets as the sum of holdings of stocks and mutual funds plus riskless assets, where riskless assets are defined as the sum of cash-like assets and holdings of bonds. Subtracting other debts, which comprises non-mortgage debt such as credit card debt and consumer loans, from liquid assets yields liquid wealth. I denote the sum of liquid wealth, equity in a private business, and home equity as financial wealth. I then calculate the risky asset share as the sum of stocks and mutual funds, home equity, and equity in a private business, divided by financial wealth. Alternatively, I could exclude home equity and equity in a private business.

7 Discussion and Conclusion

This paper provides a comprehensive analysis of the portfolio implications of news utility, a recent theoretical advance in behavioral economics, which successfully explains micro evidence in a broad range of domains. The preferences' robust explanatory power in other domains is of special importance because I put emphasis on a potentially normative issue. In particular, I ask how often people should look up and rebalance their portfolios. Several of my results are applicable to financial advice. First, the preferences predict that people prefer to stay inattentive and can diversify over time. Therefore, people should look up their portfolios only once in a while and choose lower portfolio shares toward the end of life. Moreover, people should delegate the management of their portfolios to an agent who encourages inattention and rebalances actively. Furthermore, the preferences make specific predictions about how investors should rebalance their portfolios if they look it up. Most importantly, people should choose a lower portfolio share after the market goes up and thus follow a buy-low-sell-high investment strategy.

The intuitions behind my results are immediately appealing. If the investor cares more about bad news than good news, then fluctuations in expectations about future consumption hurt on average. Thus, the investor prefers to be inattentive most of the time and does not rebalance his portfolio. Once in a while, however, the investor has to look up his portfolio and then rebalances extensively. After the market goes down, the investor finds it optimal to increase his portfolio share temporarily to not realize all the bad news associated with future consumption. Hereby, the investor effectively delays the realization of bad news until the next period by which point his expectations will have decreased. On the other hand, after the market goes up, the investor finds it optimal to play safe and wants to realize the good news by liquidating his asset holdings. The investor may not look up his portfolio because he has access to two different accounts, a brokerage account, through which he can invest a share of his wealth into the stock market, and a checking account, which finances inattentive consumption. These two accounts relate to the notion of mental accounting because the accounts finance different types of consumption, they feature different marginal propensities to consume, they allow less overconsumption or to exercise self control, and the investor treats windfall gains in each differently.

Theoretically, I obtain analytical results to explain these phenomena under the assumption of log utility and the Campbell and Viceira (2002) approximation of log portfolio returns. Quantitatively, I structurally estimate the preference parameters and show that the model's predictions match the empirical life-cycle evidence on participation, portfolio shares, consumption, and wealth accumulation and provide some suggestive evidence for extensive

rebalancing. In the future, I would like to further explore cross-sectional asset pricing, as the theory predicts that more newsy investments should carry higher risk premia.

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A Attitudes over Wealth Bets

Table 2:
Risk Attitudes over Small and Large Wealth Bets

	standard	news-utility	
Loss (L)		contemp.	prospective
10	10	16	18
200	200	328	366
1000	1000	1645	1836
5000	5000	83947	9387
50000	61802	108860	124220
100000	161350	317490	375050

For each loss L, the table's entries show the required gain G to make each agent indifferent between accepting and rejecting a 50-50 gamble win G or lose L at a wealth level of 300,000.

B Derivations of the portfolio share approximation in the presence of labor income

I first derive the news-utility agent's optimal portfolio share in greater detail. To obtain a closed-form portfolio solution, I assume log utility $u(c) = log(c)$. The news-utility agent wants to maximize

$$E[log(W)+(log(R^f+\alpha(R-R^f))+\eta(\lambda-1)\int_R^\infty (log(R^f+\alpha(R-R^f))-log(R^f+\alpha(\tilde{R}-R^f)))dF_R(\tilde{R}))]$$

$$\Rightarrow E[(r^f+\alpha(r-r^f)+\alpha(1-\alpha)\frac{\sigma^2}{2})+\eta(\lambda-1)\int_r^\infty (r^f+\alpha(r-r^f)+\alpha(1-\alpha)\frac{\sigma^2}{2}-(r^f+\alpha(\tilde{r}-r^f)+\alpha(1-\alpha)\frac{\sigma^2}{2}))dF_r(\tilde{r}))]$$

$$E[(r^f+\alpha(r-r^f)+\alpha(1-\alpha)\frac{\sigma^2}{2})+\alpha\eta(\lambda-1)\int_r^\infty (r-\tilde{r})dF_r(\tilde{r}))]$$

$$(r^f + \alpha(\mu - \frac{\sigma^2}{2} - r^f) + \alpha(1-\alpha)\frac{\sigma^2}{2}) + \alpha E[\eta(\lambda - 1)\int_r^\infty (r - \tilde{r})dF_r(\tilde{r}))]$$

$$\mu - r^f - \alpha\sigma^2 + E[\eta(\lambda - 1)\int_r^\infty (r - \tilde{r})dF_r(\tilde{r}))] = 0$$

$$\alpha^* = \frac{\mu - r^f + E[\eta(\lambda - 1)\int_r^\infty (r - \tilde{r})dF_r(\tilde{r}))]}{\sigma^2}.$$

I now consider the case in which labor income is riskless, i.e., $Y > 0$ and F_Y degenerate. In this case, I can simply transform the problem to the one above by noting that Y dollars of labor income is equivalent to $\frac{1}{R^f}Y$ dollars invested in the risk-free asset. Thus, the agent wants to invest the fraction α^* out of his transformed wealth $W + \frac{1}{R^f}Y$ in the risky asset; accordingly, his actual share invested into the risky asset is

$$\alpha^*_{Y>0} = \frac{\alpha^*(W + \frac{1}{R^f}Y)}{W} = \alpha^*(1 + \frac{Y}{R^f W}).$$

Now, I move on to stochastic labor income. Stochastic income makes the model considerably more complicated, as its solution requires numerical techniques. In order to provide analytical insights into the model's mechanisms, I will continue to follow Campbell and Viceira (2002) and employ an approximation strategy for the log portfolio return, the consumption function, and the agent's first-order condition. Logs are denoted by lower case letters. More specifically, the log portfolio return r^p is approximated by $r^f + \alpha(r - r^f) + \alpha(1-\alpha)\frac{\sigma^2}{2}$ and the log of the consumption function $C = g^C(r, y) = W(e^{r^f} + \alpha(e^r - e^{r^f})) + e^y$ can be approximated by

$$log(C) - log(Y) = c - y = log(e^{r^p + w - y} + 1) \Rightarrow c \approx k + \rho(w + r^p) + (1-\rho)y$$

with ρ being the log-linearization parameter, i.e., $\rho = \frac{e^{r^p + \bar{w} - y}}{1 + e^{r^p + \bar{w} - y}}$. The agent's first-order condition is given by

$$E[e^{-c}(e^r - e^{r^f}) + \eta(\lambda - 1)\int_y^\infty \int_r^\infty (e^{-c}(e^r - e^{r^f}) - e^{-log(g^C(\tilde{r},\tilde{y}))}(e^{\tilde{r}} - e^{r^f}))dF_r(\tilde{r})dF_y(\tilde{y})] = 0.$$

The first part of this equation can be approximated by

$$E[e^{-c}(e^r - e^{r^f})] = 0 \Rightarrow E[e^{-(\rho\alpha r + (1-\rho)y) + r}] - E[e^{-(\rho\alpha r + (1-\rho)y) + r^f}] = 0$$

$$\Rightarrow E[e^{(1-\rho\alpha)r - (1-\rho)y}] - E[e^{-\rho\alpha r - (1-\rho)y + r^f}] = 0$$

$$e^{(1-\rho\alpha)(\mu - \frac{1}{2}\sigma^2) - (1-\rho)\mu_y + 0.5(1-\rho\alpha)^2\sigma^2 + 0.5(1-\rho)^2\sigma_y^2 - (1-\rho\alpha)(1-\rho)\sigma_{ry}^2}$$

$$-e^{-\rho\alpha(\mu - \frac{1}{2}\sigma^2) - (1-\rho)\mu_y + 0.5\rho^2\alpha^2\sigma^2 + 0.5(1-\rho)^2\sigma_y^2 + \rho\alpha(1-\rho)\sigma_{ry}^2 + r^f} = 0$$

$$e^{\mu - \rho\alpha\sigma^2 - (1-\rho)\sigma_{ry} - r^f} = 1 \Rightarrow \mu - r^f - \rho\alpha\sigma^2 - (1-\rho)\sigma_{ry} = 0$$

therefore, the news-utility first-order condition can be approximated by

$$e^{\mu - \rho\alpha\sigma^2 - (1-\rho)\sigma_{ry} - r^f} - 1 + e^{\rho\alpha(\mu - \frac{1}{2}\sigma^2) + (1-\rho)\mu_y - 0.5\rho^2\alpha^2\sigma^2 - 0.5(1-\rho)^2\sigma_y^2 - \rho\alpha(1-\rho)\sigma_{ry}^2 - r^f}$$

$$\eta(\lambda-1)E[\int_r^\infty \int_y^\infty (e^{-\rho\alpha r-(1-\rho)y}(e^r-1)-e^{-\rho\alpha\tilde{r}-(1-\rho)\tilde{y}}(e^{\tilde{r}}-1))dF_r(\tilde{r})dF_y(\tilde{y})]=0.$$

which can be rewritten as

$$e^{\mu-\rho\alpha\sigma^2-(1-\rho)\sigma_{ry}-r^f}-1+e^{-0.5\rho^2\alpha^2\sigma^2-0.5(1-\rho)^2\sigma_y^2-\rho\alpha(1-\rho)\sigma_{ry}^2-r^f}$$

$$\eta(\lambda-1)E[\int_z^\infty \int_s^\infty (e^{-\rho\alpha\sigma s-(1-\rho)\sigma_y z}(e^{\sigma s}-1)-e^{-\rho\alpha\sigma\tilde{s}-(1-\rho)\sigma_y\tilde{z}}(e^{\sigma\tilde{s}}-1))dF_s(\tilde{s})dF_s(\tilde{z})]=0$$

$$e^{\mu-\rho\alpha\sigma^2-(1-\rho)\sigma_{ry}-r^f}-1+e^{-0.5\rho^2\alpha^2\sigma^2-0.5(1-\rho)^2\sigma_y^2-\rho\alpha(1-\rho)\sigma_{ry}^2-r^f}$$

$$\eta(\lambda-1)E[\int_z^\infty \int_s^\infty (e^{(1-\rho\alpha\sigma)s-(1-\rho)\sigma_y z}-e^{-\rho\alpha\sigma s-(1-\rho)\sigma_y z}-e^{(1-\rho\alpha\sigma)\tilde{s}-(1-\rho)\sigma_y\tilde{z}}+e^{-\rho\alpha\sigma\tilde{s}-(1-\rho)\sigma_y\tilde{z}})dF_s(\tilde{s})dF_s(\tilde{z})]=0$$

and if I approximate $e^x \approx 1+x$ for x small (to approximate $e^{(1-\rho\alpha\sigma)s-(1-\rho)\sigma_y z}$ is more accurate than $e^{-\rho\alpha\sigma s-(1-\rho)\sigma_y z}(e^{\sigma s}-1)$ if $1-\rho\alpha\sigma<1$ (note that $\rho<1$ and $\alpha<1$), to approximate $e^{(1-\rho\alpha\sigma)s-(1-\rho)\sigma_y z}$ is more accurate than $e^{(1-\rho\alpha\sigma)s}$ and $e^{-(1-\rho)\sigma_y z}$ if r and y are positively correlated (although the result is not affected by this choice), and the term $e^{-0.5\rho^2\alpha^2\sigma^2-0.5(1-\rho)^2\sigma_y^2-\rho\alpha(1-\rho)\sigma_{ry}^2-r^f}$ is taken into the integral before the approximation) I end up with

$$\mu-\rho\alpha\sigma^2-(1-\rho)\sigma_{ry}-r^f+\eta(\lambda-1)E[\int_s^\infty (s-\tilde{s})dF_s(\tilde{s})]=0.$$

This first-order condition results in the portfolio share in the text.

I now illustrate the agent's first-order risk aversion in the presence of background risk without relying on the approximation above. To simplify the exposition, suppose the agent's consumption is $\alpha r+y$ with $r\sim F_r$ and $y\sim F_y$ independently distributed, his risk premium for investing into the risky return r is then given by

$$\pi=log(\alpha E[r]+y)+E[\eta(\lambda-1)\int_y^\infty (log(\alpha E[r]+y)-log(\alpha E[r]+\tilde{y}))dF_y(\tilde{y})]$$

$$-E[log(\alpha r+y)+\eta(\lambda-1)\int_r^\infty \int_y^\infty (log(\alpha r+y)-log(\alpha\tilde{r}+\tilde{y}))dF_y(\tilde{y})dF_r(\tilde{r})]$$

and it's marginal value for an additional increment of risk is

$$\frac{\partial\pi}{\partial\alpha}=E[\frac{E[r]}{\alpha E[r]+y}+\eta(\lambda-1)\int_y^\infty (\frac{E[r]}{\alpha E[r]+y}-\frac{E[r]}{\alpha E[r]+\tilde{y}})dF_y(\tilde{y}))]$$

$$-E[\frac{r}{\alpha r+y}+\eta(\lambda-1)\int_r^\infty \int_y^\infty (\frac{r}{\alpha r+y}-\frac{\tilde{r}}{\alpha\tilde{r}+\tilde{y}})dF_y(\tilde{y})dF_r(\tilde{r}))].$$

Now, what happens if return risk becomes small, i.e., $\alpha \to 0$

$$\frac{\partial \pi}{\partial \alpha}|_{\alpha=0} = \underbrace{\eta(\lambda-1)E[\int_y^\infty (\frac{E[r]}{y} - \frac{E[r]}{\tilde{y}})dF_y(\tilde{y}))]}_{>0} - E[\eta(\lambda-1)\int_r^\infty \int_y^\infty (\frac{r}{y} - \frac{\tilde{r}}{\tilde{y}})dF_y(\tilde{y})dF_x(\tilde{x}))].$$

For the standard agent $\frac{\partial \pi}{\partial \alpha}|_{\alpha=0} = 0$, which implies that he is second-order risk averse. For the news-utility agent, the first integral is necessarily positive and dominates the second integral that can be negative or positive as in the second integral the positive effect of r enters on top of the negative effect of y.

C Derivation of the Inattentive Life-Cycle Portfolio Choice Model

C.1 The monotone-personal equilibrium

The agent adjusts his portfolio share and consumes a fraction ρ_t out of his wealth if he looks up his portfolio and a fraction ρ_t^{in} out of his wealth if he stays inattentive. I follow a guess and verify solution procedure. Suppose he last looked up his portfolio in $t-i$, i.e., he knows W_{t-i}. And suppose he will look up his portfolio in period $t+j_1$. Suppose he is inattentive in period t, then his inattentive consumption in periods $t-i+1$ to $t+j_1-1$ is given by (for $k = 0, ..., i+j_1-1$)

$$C_{t-i+k}^{in} = (W_{t-i} - C_{t-i})(R^d)^k \rho_{t-i+k}^{in}$$

and his consumption when he looks up his portfolio in period $t+j_1$ is given by

$$C_{t+j_1} = W_{t+j_1}\rho_{t+j_1} = (W_{t-i} - C_{t-i} - \sum_{k=1}^{i+j_1-1} \frac{C_{t-i+k}^{in}}{(R^d)^k})((R^f)^{i+j_1} + \alpha_{t-i}(\prod_{j=1}^{i+j_1} R_{t-i+j} - (R^f)^{i+j_1}))\rho_{t+j_1}$$

$$= W_{t-i}(1-\rho_{t-i})(1 - \sum_{j=1}^{i+j_1-1} \rho_{t-i+j}^{in})((R^f)^{i+j_1} + \alpha_{t-i}(\prod_{j=1}^{i+j_1} R_{t-i+j} - (R^f)^{i+j_1}))\rho_{t+j_1}.$$

Now, suppose the agent looks up his portfolio in period t and then chooses C_t and α_t knowing that he will look up his portfolio in period $t+j_1$ next time. I first explain the optimal choice of C_t. First, the agent considers marginal consumption and contemporaneous marginal news utility given by

$$u'(C_t)(1 + \eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1 - F_r(r_t)...F_r(r_{t-i+1}))).$$

To understand these terms note that the agent takes his beliefs as given, his admissible consumption function C_t is increasing in $r_t + ... + r_{t-i+1}$ such that $F_{C_t}^{t-i}(C_t) = F_r(r_t)...F_r(r_{t-i+1})$,

and

$$\frac{\partial(\eta\int_{-\infty}^{C_t}(u(C_t)-u(x))dF_{C_t}^{t-i}(x)+\eta\lambda\int_{C_t}^{\infty}(u(C_t)-u(x))dF_{C_t}^{t-i}(x))}{\partial C_t}=u'(C_t)(\eta F_{C_t}^{t-i}(C_t)+\eta\lambda(1-F_{C_t}^{t-i}(C_t))).$$

Second, the agent takes into account that he will experience prospective news utility over all consumption in periods $t+1,...,T$. Inattentive consumption in periods $t+1$ to $t+j_1-1$ is as above given by (for $k=1,...,j_1-1$)

$$C_{t+k}^{in}=(W_t-C_t)(R^d)^k\rho_{t+k}^{in}$$

and thus proportional to W_t-C_t. Attentive consumption in period $t+j_1$ is given by

$$C_{t+j_1}=W_{t+j_1}\rho_{t+j_1}=(W_t-C_t-\sum_{k=1}^{j_1-1}\frac{C_{t+k}^{in}}{(R^d)^k})((R^f)^{j_1}+\alpha_t(\prod_{j=1}^{j_1}R_{t+j}-(R^f)^{j_1}))\rho_{t+j_1}$$

$$=(W_t-C_t)(1-\sum_{j=1}^{j_1-1}\rho_{t+j}^{in})((R^f)^{j_1}+\alpha_t(\prod_{j=1}^{j_1}R_{t+j}-(R^f)^{j_1}))\rho_{t+j_1}$$

and thus proportional to W_t-C_t. As in the derivation in Section 5.2, prospective marginal news utility is

$$\frac{\partial(\gamma\sum_{k=1}^{j_1-1}\beta^k\boldsymbol{n}(F^{t,t-i}_{(W_t-C_t)(R^d)^k\rho_{t+k}^{in}})+\gamma\sum_{j=j_1}^{T-t-j_1}\beta^j\boldsymbol{n}(F^{t,t-i}_{C_{t+j}}))}{\partial C_t}$$

$$=\frac{\partial log(W_t-C_t)}{\partial C_t}\gamma\sum_{j=1}^{T-t}\beta^j(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1}))).$$

To understand this derivation note that the agent takes his beliefs as given, future consumption is increasing in today's return realization, and the only terms that realize and thus do not cancel out of the news-utility terms are W_t-C_t such that $F^{t-i}_{W_t-C_t}(W_t-C_t)=F_r(r_t)...F_r(r_{t-i+1})$. As an example consider the derivative of prospective news-utility in period $t+1$

$$\frac{\partial\gamma\beta\boldsymbol{n}(F^{t,t-i}_{(W_t-C_t)R^d\rho_{t+1}^{in}})}{\partial C_t}=\frac{\partial\gamma\beta\int_{-\infty}^{\infty}\mu(u((W_t-C_t)R^d\rho_{t+1}^{in})-u(x))dF^{t-i}_{(W_t-C_t)R^d\rho_{t+1}^{in}}(x)}{\partial C_t}$$

$$=-u'(W_t-C_t)\gamma\beta(\eta F^{t-i}_{W_t-C_t}(W_t-C_t)+\eta\lambda(1-F^{t-i}_{W_t-C_t}(W_t-C_t))).$$

Third, thanks to log utility, the agent's continuation utility is not affected by expected news utility as $log(W_t-C_t)$ cancels out of these terms. However, expected consumption utility matters. Consumption utility beyond period $t+j_1$ can be iterated back to $t+j_1$ wealth which can be iterated back to W_t as $log(W_t-C_t-\sum_{k=1}^{j_1-1}\frac{C_{t+k}^{in}}{(R^d)^k})=log((W_t-C_t)(1-\sum_{k=1}^{j_1-1}\rho_{t+k}^{in}))$

such that

$$\frac{\partial \sum_{j=1}^{T-t} \beta^j E_t[log(C_{t+j})]}{\partial C_t} = -u'(W_t - C_t) \sum_{\tau=1}^{T-t} \beta^\tau$$

Putting the three pieces together, optimal consumption if the agent looks up his portfolio in period t is determined by the following first-order condition

$$u'(C_t)(1 + \eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1 - F_r(r_t)...F_r(r_{t-i+1})))$$

$$-\gamma u'(W_t - C_t) \sum_{j=1}^{T-t} \beta^j (\eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1 - F_r(r_t)...F_r(r_{t-i+1}))) - u'(W_t - C_t) \sum_{\tau=1}^{T-t} \beta^\tau = 0.$$

In turn, the solution guess can be verified

$$\frac{C_t}{W_t} = \rho_t = \frac{1}{1 + \sum_{\tau=1}^{T-t} \beta^\tau \frac{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1 - F_r(r_t)...F_r(r_{t-i+1})))}{1+\eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1 - F_r(r_t)...F_r(r_{t-i+1}))}}.$$

The optimal portfolio share depends on prospective news utility in period t for all the consumption levels in periods $t+j_1$ to T that are all proportional to W_{t+j_1} (that is determined by α_t). Moreover, the agent's consumption and news utility in period $t + j_1$ matters. However, consumption in inattentive periods t to $t + j_1 - 1$ depends only on $W_t - C_t$, which is not affected by α_t. Thus, the relevant terms in the maximization problem for the portfolio share are given by

$$\gamma\beta^{j_1} \sum_{\tau=0}^{T-t-j_1} \beta^\tau \boldsymbol{n}(F^{t,t-i}_{C_{t+j_1+\tau}}) + \beta^{j_1} E_t[n(C_{t+j_1}, F^{t+j_1,t}_{C_{t+j_1}}) + \gamma \sum_{\tau=1}^{T-t-j_1} \beta^\tau \boldsymbol{n}(F^{t+j_1,t}_{C_{t+j_1+\tau}})] + \beta^{j_1} \sum_{\tau=0}^{T-t-j_1} \beta^\tau log(C_{t+j_1+\tau})$$

The derivative of the first term is

$$\frac{\partial \gamma\beta^{j_1} \sum_{\tau=0}^{T-t-j_1} \beta^\tau \boldsymbol{n}(F^{t,t-i}_{C_{t+j_1+\tau}})}{\partial \alpha_t} = j_1(\mu - r^f - \alpha_t\sigma^2)\gamma\beta^{j_1} \sum_{\tau=0}^{T-t-j_1} \beta^\tau (\eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1 - F_r(r_t)...F_r(r_{t-i+1}))).$$

To illustrate where the derivative comes from

$$log(C_{t+j_1}) = log(W_{t+j_1}\rho_{t+j_1}) = log((W_t - C_t)(1 - \sum_{j=1}^{j_1-1} \rho^{in}_{t+j})((R^f)^{j_1} + \alpha_t(\prod_{j=1}^{j_1} R_{t+j} - (R^f)^{j_1}))\rho_{t+j_1})$$

thus the only term determined by α_t is $log((R^f)^{j_1} + \alpha_t(\prod_{j=1}^{j_1} R_{t+j} - (R^f)^{j_1}))$ and the only terms that are different from the agent's prior beliefs are $(W_t - C_t)$ (and the agent takes his beliefs as given and future consumption is increasing in today's return as in the derivation of the consumption share above). Moreover,

$$C^{in}_{t+j_1+1} = (W_t - C_t)(1 - \sum_{j=1}^{j_1-1} \rho^{in}_{t+j})((R^f)^{j_1} + \alpha_t(\prod_{j=1}^{j_1} R_{t+j} - (R^f)^{j_1}))(1 - \rho_{t+j_1})R^d\rho^{in}_{t+j_1+1}$$

thus the only term determined by α_t are $log((R^f)^{j_1} + \alpha_t(\prod_{j=1}^{j_1} R_{t+j} - (R^f)^{j_1}))$ and the only terms that are different from the agent's prior beliefs are $(W_t - C_t)$. Thus, in the derivation the term $j_1(\mu - r^f - \alpha_t\sigma^2)$ is left as the agent does not consider his beliefs in the optimization and the integrals are determined by $F^{t-1}_{W_t - C_t}(W_t - C_t)$.

In the continuation value, the only term affected by today's portfolio share are the future consumption terms in periods $t + j_1, ..., T$ as in all news-utility terms (except period $t + j_1$) the portfolio share of period t will cancel and the portfolio share does not matter for all inattentive consumption up until period $t + j_1$. Thus, the derivative of the continuation value is

$$\frac{\beta^{j_1} E_t[n(C_{t+j_1}, F^{t+j_1,t}_{C_{t+j_1}}) + \gamma \sum_{\tau=1}^{T-t-j_1} \beta^\tau \boldsymbol{n}(F^{t+j_1,t}_{C_{t+j_1+\tau}})] + \beta^{j_1} \sum_{\tau=0}^{T-t-j_1} \beta^\tau log(C_{t+j_1+\tau})}{\partial \alpha_t}$$

$$= \beta^{j_1}(1 + \gamma \sum_{\tau=1}^{T-t-j_1} \beta^\tau)\sqrt{j_1}\sigma E[\eta(\lambda - 1)\int_s^\infty (s - \tilde{s})dF(\tilde{s}))] + \beta^{j_1} \sum_{\tau=0}^{T-t-j_1} \beta^\tau j_1(\mu - r^f - \alpha_t\sigma^2).$$

Altogether, the optimal portfolio share is given by

$$\alpha_t = \frac{\mu - r^f + \frac{\frac{\beta^{j_1}(1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau)}{\beta^{j_1}\sum_{\tau=0}^{T-t-j_1}\beta^\tau}\frac{\sqrt{j_1}}{j_1}\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]}{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}}{\sigma^2}.$$

If the agent does not look up his portfolio in period t, his consumption is determined by the following first-order condition

$$u'(C^{in}_t) - \sum_{\tau=0}^{T-t-j_1} \beta^{j_1+\tau} u'(W_{t-i} - C_{t-i} - \sum_{k=1}^{i+j_1-1} \frac{C^{in}_{t-i+k}}{(R^d)^k})\frac{1}{(R^d)^i} = 0.$$

The term concerning consumption in period t is self-explanatory. The terms concerning consumption from periods $t - i$ to $t + j_1 - 1$ drop out as they are determined by the solution guess $C^{in}_t = (W_{t-i} - C_{t-i})(R^d)^i\rho^{in}_t$. The terms concerning consumption from period $t + j_1$ on are all proportional to $log(W_{t+j_1})$ which equals $log(W_{t-i} - C_{t-i} - \sum_{k=1}^{i+j_1-1} \frac{C^{in}_{t-i+k}}{(R^d)^k})$ plus the log returns from period $t - i + 1$ to period $t + j_1$, which, however, drop out by taking the derivative with respect to C^{in}_t. Accordingly,

$$\frac{1}{C^{in}_t} - \sum_{\tau=0}^{T-t-j_1} \beta^{j_1+\tau} \frac{1}{W_{t-i} - C_{t-i} - \sum_{k=1}^{i+j_1-1} \frac{C^{in}_{t-i+k}}{(R^d)^k}} \frac{1}{(R^d)^i} = 0 \Rightarrow \frac{1}{\rho^{in}_t} = \sum_{\tau=0}^{T-t-j_1} \beta^{j_1+\tau} \frac{1}{1 - \sum_{k=1}^{i+j_1-1} \rho^{in}_{t-i+k}}$$

$$\rho^{in}_t = \frac{1}{1 + \sum_{\tau=0}^{T-t-j_1} \beta^{j_1+\tau}}(1 - \sum_{k=1}^{i-1} \rho^{in}_{t-i+k} - \sum_{k=1}^{j_1-1} \rho^{in}_{t+k}).$$

And the solution guess ($C_t^{in} = (W_{t-i} - C_{t-i})(R^d)^i \rho_t^{in}$) can be verified. The agent is not going to deviate from his inattentive consumption path in period $t-i+j$ for $j = 1, ..., i-1$ so long as $u'(C_{t-i+j}^{in})(1+\eta) < (\beta R^d)^{i-j} u'(C_{t-1}^{in})(1+\gamma\eta\lambda)$. As $u'(C_{t-i+j}^{in}) \approx (\beta R^d)^{i-j} u'(C_{t-1}^{in})$, this condition is roughly equivalent to $\gamma\lambda > 1$.

C.2 The monotone-precommitted equilibrium

Suppose the agent has the ability to pick an optimal history-dependent consumption path for each possible future contingency in period zero when he does not experience any news utility. Thus, in period zero the agent chooses optimal consumption in period t in each possible contingency jointly with his beliefs, which of course coincide with the agent's optimal state-contingent plan. For instance, consider the joint optimization over consumption and beliefs for $C(Y^*)$ when income Y^* has been realized

$$\frac{\partial}{\partial C(Y^*)}\{\int\int \mu(u(C(Y)) - u(C(Y')))dF_Y(Y')dF_Y(Y)\}$$

$$= \frac{\partial}{\partial C(Y^*)} \int \eta \int_{-\infty}^{Y} \{(u(C(Y)) - u(C(Y')))dF_Y(Y') + \eta\lambda \int_{Y}^{\infty} (u(C(Y)) - u(C(Y')))dF_Y(Y')\}dF_Y(Y)$$

$$= u'(C(Y^*))(\eta F_Y(Y^*) + \eta\lambda(1 - F_Y(Y^*))) - u'(C(Y^*))(\eta(1 - F_Y(Y^*)) + \eta\lambda F_Y(Y^*))$$

$$= u'(C(Y^*))\eta(\lambda - 1)(1 - 2F_Y(Y^*)) \text{ with } \eta(\lambda-1)(1-2F_Y(Y^*)) > 0 \text{ for } F_Y(Y^*) < 0.5.$$

From the above consideration it can be easily inferred that the optimal precommitted portfolio function, if the agent would look up his portfolio his share will be

$$\alpha_t^c = \frac{\mu - r^f + \frac{\frac{\beta^{j_1}(1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau)}{\beta^{j_1}\sum_{\tau=0}^{T-t-j_1}\beta^\tau}\frac{\sqrt{j_1}}{j_1}\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]}{1+\gamma\eta(\lambda-1)(2F_r(r_t)...F_r(r_{t-i+1})-1)}}{\sigma^2}.$$

Moreover, the optimal precommitted attentive and inattentive consumption shares are

$$\rho_t^c = \frac{1}{1+\sum_{\tau=1}^{T-t}\beta^\tau \frac{1+\gamma\eta(\lambda-1)(2F_r(r_t)...F_r(r_{t-i+1})-1)}{1+\eta(\lambda-1)(2F_r(r_t)...F_r(r_{t-i+1})-1)}} \text{ and } \rho_t^{cin} = \frac{1}{1+\sum_{\tau=0}^{T-t-j_1}\beta^{j_1+\tau}}(1 - \sum_{k=1}^{i-1}\rho_{t-i+k}^{cin} - \sum_{k=1}^{j_1-1}\rho_{t-i+k}^{cin}).$$

Thus, the optimal precommitted portfolio share is always lower and the gap increases in good states.

C.3 Signals about the market

Instantaneous utility is either prospective news utility over the realization of R or prospective news utility over the signal $\tilde{R}$. Prospective news utility over the signal is given by

$$\gamma\beta \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \mu(u(e^{log(\tilde{R})-y}) - u(e^{x-y}))dF_{r+\epsilon}(x)dF_\epsilon(y),$$

because the agent separates uncertainty that has been realized in period one, represented by $\tilde{R}$ and $F_{r+\epsilon}(x)$, from uncertainty that has not been realized, represented by $F_\epsilon(y)$. The agent's expected news utility from looking up the return conditional on the signal $\tilde{R}$ is given by

$$\gamma\beta \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \mu(u(e^{log(\tilde{R})-y}) - u(e^x)) dF_r(x) dF_\epsilon(y).$$

Thus, the agent expects more favorable news utility over the return when having received a favorable signal. As can be easily seen, expected news utility from checking the return is always less than news utility from knowing merely the signal. The reason is simple, the agent expects to experience news utility, which is negative on average, over both the signal $\tilde{R}$ and the error ϵ. Thus, he always prefers to not look up his return when prospective news utility in period one is concerned. But, the difference between the two is smaller when the agent received a more favorable signal. The reason is that the expected news disutility from ϵ is less high up on the utility curve, i.e., when $\tilde{R}$ is high.

C.4 Derivation of the Standard Portfolio-Choice Model

The agent lives for $t = \{1, ..., T\}$ periods and is endowed with initial wealth W_1. Each period the agent optimally decides how much to consume C_t out of his wealth X_t and how to invest $A_t = X_t - C_t$. The agent has access to a risk-free investment with return R^f and a risky investment with i.i.d. return R_t. The risky investment's share is denoted by α_t such that the portfolio return in period t is given by $R_t^p = R^f + \alpha_{t-1}(R_t - R^f)$. Additionally, the agent receives labor income in each period t up until retirement in period $T - R$ given by $Y_t = P_t N_t^T = P_{t-1} G_t e^{s_t^P}$ with $s_t^P \sim N(0, \sigma_Y^2)$. Accordingly, the agent's maximization problem in each period t is given by

$$max_{C_t}\{u(C_t) + n(C_t, F_{C_t}^{t-1}) + \gamma \sum_{\tau=1}^{T-t} \beta^\tau \boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1}) + E_t[\sum_{\tau=1}^{T-t} \beta^\tau U_{t+\tau}]\}$$

subject to the budget constraint

$$X_t = (X_{t-1} - C_{t-1}) R_t^p + Y_t = A_{t-1}(R^f + \alpha_{t-1}(R_t - R^f)) + P_{t-1} G_t e^{s_t^P}.$$

I solve the model by numerical backward induction. The maximization problem in any period t is characterized by the following first-order condition

$$u'(C_t) = \frac{\Psi_t' + \gamma \Phi_t'(\eta F_{C_t}^{t-1}(C_t) + \eta\lambda(1 - F_{C_t}^{t-1}(C_t)))}{1 + \eta F_{A_t}^{t-1}(A_t) + \eta\lambda(1 - F_{A_t}^{t-1}(A_t))}$$

with

$$\Phi_t^{'} = \beta E_t[R_{t+1}^p \frac{\partial C_{t+1}}{\partial X_{t+1}} u'(C_{t+1}) + R_{t+1}^p (1 - \frac{\partial C_{t+1}}{\partial X_{t+1}}) \Phi_{t+1}^{'}]$$

and

$$\Psi_t^{'} = \beta E_t[R_{t+1}^p \frac{\partial C_{t+1}}{\partial X_{t+1}} u'(C_{t+1}) + \eta(\lambda - 1) \int_{C_{t+1}}^{\infty} (R_{t+1}^p \frac{\partial C_{t+1}}{\partial X_{t+1}} u'(C_{t+1}) - c) dF^t_{R_{t+1}^p \frac{\partial C_{t+1}}{\partial X_{t+1}} u'(C_{t+1})}(c)$$

$$+\gamma\eta(\lambda - 1) \int_{A_{t+1}}^{\infty} (R_{t+1}^p \frac{\partial A_{t+1}}{\partial X_{t+1}} \Phi_{t+1}^{'} - x) dF^t_{R_{t+1}^p \frac{\partial A_{t+1}}{\partial X_{t+1}} \Phi_{t+1}^{'}}(x) + R_{t+1}^p (1 - \frac{\partial C_{t+1}}{\partial X_{t+1}}) \Psi_{t+1}^{'}]$$

Note that, I denote $\Psi_t = \beta E_t[\sum_{\tau=0}^{T-t} \beta^\tau U_{t+1+\tau}]$, $\Phi_t = \beta E_t[\sum_{\tau=0}^{T-t} \beta^\tau u(C_{t+1+\tau})]$, $\Psi_t^{'} = \frac{\partial \Psi_t}{\partial A_{t+1}}$, and $\Phi_t^{'} = \frac{\partial \Phi_t}{\partial A_{t+1}}$. In turn, the optimal portfolio share can be determined by the following first-order condition

$$\gamma \frac{\partial \Phi_t}{\partial \alpha_t} (\eta F_{A_t}^{t-1}(A_t) + \eta\lambda(1 - F_{A_t}^{t-1}(A_t))) + \frac{\partial \Psi_t}{\partial \alpha_t} = 0$$

or equivalently by maximizing $\gamma \sum_{\tau=1}^{T-t} \beta^\tau \boldsymbol{n}(F_{C_{t+\tau}}^{t,t-1}) + \Psi_t$ (maximizing the transformed function $u^{-1}(\cdot)$ yields more robust results). More details on the numerical backward induction solution of a news-utility life-cycle model is provided in Pagel (2012a).

D Proofs

D.1 Proof of Proposition 1

The news-utility agent's optimal portfolio share is

$$\alpha = \frac{\mu - r^f + E[\eta(\lambda - 1) \int_r^{\infty} (r - \tilde{r}) dF_r(\tilde{r}))]}{\sigma^2}$$

and the second-order condition is

$$-\alpha\sigma^2 < 0.$$

It can be easily seen that $\frac{\partial \alpha}{\partial \eta} < 0$ and $\frac{\partial \alpha}{\partial \lambda} < 0$. As $E[\eta(\lambda - 1) \int_s^{\infty} (s - \tilde{s}) dF_s(\tilde{s})] < 0$ even for $\sigma = 0$ (note that $s \sim N(0, 1)$), the portfolio share is first-order decreasing in σ (the second-order approximation can be found in the text). Now, let me redefine $\mu \triangleq h\mu$, $\sigma \triangleq \sqrt{h}\sigma$, and $r^f \triangleq hr^f$. The optimal portfolio share is given by

$$\alpha = \frac{\mu - r^f + \frac{\sqrt{h}}{h} \sigma E[\eta(\lambda - 1) \int_s^{\infty} (s - \tilde{s}) dF_s(\tilde{s}))]}{\sigma^2}.$$

1. Samuelson's colleague and time diversification: As can be easily seen, as $lim \frac{\sqrt{h}}{h} \to \infty$

as $h \to 0$, there exists some $\underline{h}$ such that $\mu - r^f > -\frac{\sqrt{h}}{h}\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF_s(\tilde{s}))]$ and thus $\alpha = 0$. As $\alpha > 0$ only if

$$\frac{\mu - r^f}{\sigma} > -E[\eta(\lambda-1)\underbrace{\int_s^\infty (s-\tilde{s})dF_s(\tilde{s})]}_{<0} > 0.$$

In contrast, $\alpha^s > 0$ whenever $\mu > r^f$. On the other hand, $\alpha > 0$ for some h as if $h \to \infty$ then $lim\frac{\sqrt{h}}{h} \to 0$ and $\alpha \to \alpha^s$. Furthermore, it can be easily seen that $\frac{\partial \alpha}{\partial h} > 0$.

2. Inattention: Normalized expected utility is $\frac{EU}{h} = (r^f + \alpha(\mu - \frac{\sigma^2}{2} - r^f) + \alpha(1-\alpha)\frac{\sigma^2}{2}) + \frac{\sqrt{h}}{h}\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF_s(\tilde{s}))]$ which is increasing in h whereas it is constant for the standard agent.

D.2 Proof of Lemma 2

This proof can be immediately inferred from the derivation of the approximate portfolio share found in Appendix B. The comparative statics hold strictly if $\alpha^* \in (0,1)$.

D.3 Proof of Proposition 2

If the consumption function derived in Appendix C is admissible then the equilibrium exists and is unique as the equilibrium solution is obtained by maximizing the agent's objective function, which is globally concave, and there is a finite period that uniquely determines the equilibrium. As the consumption share in inattentive periods is constant consumption, C_t^{in} is necessarily increasing in $W_{t-i} - C_{t-i}$ and thus $r_{t-i} + ... + r_{t-i-j_0+1}$ (as $\frac{\partial \rho_{t-i}}{\partial(r_{t-i}+...+r_{t-i-j_0+1})} < 0$ which is shown below). For attentive periods, σ_t^* is implicitly defined by the log monotone consumption function restriction $\frac{\partial log(C_t)}{\partial(r_t+...+r_{t-i})} > 0$ as

$$log(C_t) = log(W_t) + log(\rho_t)$$

$$= log(W_{t-i} - C_{t-i} - \sum_{k=1}^{i-1} \frac{C_{t-i+k}^{in}}{(R^d)^k}) + log(R_t^p) + log(\frac{1}{1 + \sum_{\tau=1}^{T-t} \beta^\tau \frac{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}{1+\eta F_r(r_t)...F_r(r_{t-i+1}) + \eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1}))}})$$

as $\frac{\partial log(R_t^p)}{\partial(r_t+...+r_{t-i})} = \frac{\partial log((R^f)^i + \alpha_{t-i}(R_t...R_{t-i+1} - (R^f)^i))}{\partial(R_t...R_{t-i+1})} \frac{\partial(R_t...R_{t-i+1})}{\partial(r_t+...+r_{t-i+1})} \approx \alpha_{t-i}\frac{\partial R_t...R_{t-i+1}}{\partial(r_t+...+r_{t-i+1})}$ the restrictions are equivalent to $\frac{\partial \rho_t}{\partial(r_t+...+r_{t-i+1})} > -\alpha_{t-i}\frac{\partial R_t...R_{t-i+1}}{\partial(r_t+...r_{t-i+1})}$ then σ_{T-i}^* is implicitly defined by the restriction

$$\frac{\partial \rho_t}{\partial(F_r(r_t)...F_r(r_{t-i+1}))}\frac{\partial(F_r(r_t)...F_r(r_{t-i+1}))}{\partial(r_t + ... + r_{t-i+1})} > -\alpha_{t-i}\frac{\partial R_t...R_{t-i+1}}{\partial(r_t + ...r_{t-i+1})}$$

with

$$\frac{\partial \rho_t}{\partial(F_r(r_t)...F_r(r_{t-i+1}))} = -\frac{\frac{(1-\gamma)\eta(\lambda-1)\sum_{\tau=1}^{T-t}\beta^\tau}{(1+\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))^2}}{(1+\sum_{\tau=1}^{T-t}\beta^\tau\frac{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}{1+\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1}))})^2} < 0.$$

Increasing σ unambiguously decreases $\frac{\partial(F_r(r_t)...F_r(r_{t-i+1}))}{\partial(r_t+...+r_{t-i+1})} > 0$. Thus, there exists a condition $\sigma \geq \sigma_t^*$ for all t which ensures that an admissible consumption function exists. If $\sigma < \sigma_t^*$ for some t the agent would optimally choose a flat section that spans the part his consumption function is decreasing. In that situation, the admissible consumption function requirement is weakly satisfied and the model's equilibrium is not affected qualitatively or quantitatively.

D.4 Proof of Corollary 1

The proof of Corollary 1 in the dynamic model is very similar to the proof of Proposition 1 in the static model. Please refer to Appendix C for the derivation of the dynamic portfolio share; redefining $\mu \triangleq h\mu$, $\sigma \triangleq \sqrt{h}\sigma$, $r^f \triangleq hr^f$, and $\beta \triangleq \beta^h$, the optimal portfolio share (in any period t as the agent has to look up his portfolio every period) if $0 \leq \alpha_t \leq 1$ can be rewritten as

$$\alpha_t = \frac{\mu - r^f + \frac{\sqrt{h}}{h}\sigma\frac{\frac{1+\gamma\sum_{\tau=1}^{T-t-1}\beta^{\tau h}}{\sum_{\tau=0}^{T-t-1}\beta^{\tau h}}E_t[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]}{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}}{\sigma^2}.$$

- Samuelson's colleague and time diversification: As can be easily seen, as $lim\frac{\sqrt{h}}{h} \to \infty$ as $h \to 0$ whereas $lim\frac{1+\gamma\sum_{\tau=1}^{T-t-1}\beta^{\tau h}}{\sum_{\tau=0}^{T-t-1}\beta^{\tau h}} \to \frac{1+\gamma(T-t-1)}{T-t}$, there exists some $\underline{h}$ such that $\mu - r^f > -\frac{\sqrt{h}}{h}\sigma\frac{\frac{1+\gamma\sum_{\tau=1}^{T-t-1}\beta^{\tau h}}{\sum_{\tau=0}^{T-t-1}\beta^{\tau h}}E_t[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]}{1+\gamma(\eta F(s_t)+\eta\lambda(1-F(s_t)))}$ and thus $\alpha_t = 0$ for any t. In contrast, $\alpha^s > 0$ whenever $\mu > r^f$. On the other hand, $\alpha_t > 0$ for some h as if $h \to \infty$ then $lim\frac{\sqrt{h}}{h} \to 0$ and $\alpha_t \to \alpha^s$. Furthermore, it can be seen that $\frac{\partial \alpha_t}{\partial h} > 0$ since

$$\frac{\partial}{\partial h}\frac{\sqrt{h}}{h}\frac{1+\gamma\sum_{\tau=1}^{T-t-1}\beta^{\tau h}}{\sum_{\tau=0}^{T-t-1}\beta^{\tau h}} = \frac{\frac{1}{2\sqrt{h}}h-\sqrt{h}}{h^2}\frac{1+\gamma\sum_{\tau=1}^{T-t-1}\beta^{\tau h}}{\sum_{\tau=0}^{T-t-1}\beta^{\tau h}}$$

$$+\frac{\sqrt{h}}{h}\frac{\gamma\sum_{k=1}^{T-t-1}log(\beta)k\beta^{kh}\sum_{\tau=0}^{T-t-1}\beta^{\tau h}-\sum_{\tau=0}^{T-t-1}log(\beta)\tau\beta^{\tau h}(1+\gamma\sum_{k=1}^{T-t-1}\beta^{kh})}{(\sum_{\tau=0}^{T-t-1}\beta^{\tau h})^2} < 0$$

if $\beta \approx 1$. The first term is necessarily negative as $\frac{\frac{1}{2\sqrt{h}}h-\sqrt{h}}{h^2} < 0 \Rightarrow \frac{1}{2\sqrt{h}}h - \sqrt{h} < 0 \Rightarrow \frac{1}{2}h < h$ which is multiplied by $\frac{1+\gamma\sum_{\tau=1}^{T-t-1}\beta^{\tau h}}{\sum_{\tau=0}^{T-t-1}\beta^{\tau h}} > 0$. The second term is positive though as $\frac{\sqrt{h}}{h} > 0$ and the denominator of the fraction is positive while the numerator equals $(\gamma-1)\sum_{k=1}^{T-t-1}log(\beta)k\beta^{kh}$, which is positive if $\beta < 1$. However, if $\beta \approx 1$ the first negative term will necessarily dominate the second positive term as its numerator is

$(\gamma-1)\sum_{\tau=1}^{T-t-1} log(\beta)\tau\beta^{\tau h} \approx 0$. Moreover, $\frac{1+\gamma\sum_{\tau=1}^{T-t-1}\beta^{\tau h}}{\sum_{\tau=0}^{T-t-1}\beta^{\tau h}}$ is decreasing in $T-t$ if $\gamma<1$ such that α_t is decreasing in $T-t$.

- Inattention: Expected utility for any period t, i.e., $E_{t-1}[U_t]$, is given by

$$E_{t-1}[U_t] = E_{t-1}[log(W_t\rho_t) + \alpha_{t-1}(1+\gamma\sum_{j=1}^{T-t}\beta^{hj})\sqrt{h}\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))].$$

If $\beta \approx 1$, the change in the h terms in β^h will be close to zero (as shown in the previous proof), in which case $\frac{E_{t-1}[U_t]}{h}$ with $E_{t-1}[log(W_t\rho_t)]=0$ is given by

$$\frac{E_{t-1}[U_t]}{h} = E_{t-1}[i\alpha_{t-1}(1+\gamma\sum_{j=1}^{T-t}\beta^{hj})\frac{\sqrt{h}}{h}\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]$$

which is increasing in h while the standard agent's normalized expected utility is constant in h.

D.5 Proof of Proposition 3

I start with proving that there exists some $\bar{h}$ such that, if $h>\bar{h}$, the news-utility agent will be attentive in every period. I pick t such that $T-t$ is large and I can simplify the exposition by replacing $\sum_{k=1}^{T-t}\beta^k$ with $\frac{\beta}{1-\beta}$. If the agent is attentive every period, his value function is given by

$$\beta E_{t-1}[V_t(W_t)] = E_{t-1}[\frac{\beta}{1-\beta}log(W_t) + \psi_t^{t-1}(\alpha_{t-1})]$$

$$\psi_t^{t-1}(\alpha_{t-1}) = \beta E_{t-1}[log(\rho_t) + \alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]$$

$$+\frac{\beta}{1-\beta}log(1-\rho_t) + \frac{\beta}{1-\beta}(r^f + \alpha_t(r_{t+1}-r^f) + \alpha_t(1-\alpha_t)\frac{\sigma^2}{2}) + \psi_{t+1}^t(\alpha_t)].$$

Now, the agent compares the expected utility from being inattentive to the expected utility from being attentive

$$E_{t-1}[log(C_t^{in}) + \frac{\beta}{1-\beta}log(W_{t+1}) + \psi_{t+1}^{t-1}(\alpha_{t-1})] = E_{t-1}[log(W_{t-1}-C_{t-1}) + log(R^d) + log(\rho_t^{in})$$

$$+\frac{\beta}{1-\beta}log(W_{t-1}-C_{t-1}-\frac{C_t^{in}}{R^d}) + \frac{\beta}{1-\beta}(2r^f + \alpha_{t-1}(r_t+r_{t+1}-2r^f) + \alpha_{t-1}(1-\alpha_{t-1})\sigma^2) + \psi_{t+1}^{t-1}(\alpha_{t-1})]$$

$$> E_{t-1}[log(C_t)+\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]+\frac{\beta}{1-\beta}log(W_{t+1})+\psi_{t+1}^t(\alpha_t)]$$

$$= E_{t-1}[log(W_{t-1}-C_{t-1})+r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2}+log(\rho_t)$$

$$+\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]+\frac{\beta}{1-\beta}log(W_{t+1})+\psi_{t+1}^t(\alpha_t)]$$

$$\Rightarrow E_{t-1}[r^d+log(\rho_t^{in})+\frac{\beta}{1-\beta}log(W_{t-1}-C_{t-1})+\frac{\beta}{1-\beta}log(1-\rho_t^{in})$$

$$+\frac{\beta}{1-\beta}(2r^f+\alpha_{t-1}(r_t+r_{t+1}-2r^f)+\alpha_{t-1}(1-\alpha_{t-1})\sigma^2)+\psi_{t+1}^{t-1}(\alpha_{t-1})]$$

$$> E_{t-1}[r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2}+log(\rho_t)+\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]$$

$$+\frac{\beta}{1-\beta}log(W_{t-1}-C_{t-1})+\frac{\beta}{1-\beta}(r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2})$$

$$+\frac{\beta}{1-\beta}log(1-\rho_t)+\frac{\beta}{1-\beta}(r^f+\alpha_t(r_{t+1}-r^f)+\alpha_t(1-\alpha_t)\frac{\sigma^2}{2})+\psi_{t+1}^t(\alpha_t)]$$

$$\Rightarrow E_{t-1}[r^d+log(\rho_t^{in})+\frac{\beta}{1-\beta}log(1-\rho_t^{in})+\frac{\beta}{1-\beta}(2r^f+\alpha_{t-1}(r_t+r_{t+1}-2r^f)+\alpha_{t-1}(1-\alpha_{t-1})\sigma^2)+\psi_{t+1}^{t-1}(\alpha_{t-1})]$$

$$> E_{t-1}[r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2}+log(\rho_t)+\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]$$

$$+\frac{\beta}{1-\beta}(r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2})+\frac{\beta}{1-\beta}log(1-\rho_t)+\frac{\beta}{1-\beta}(r^f+\alpha_t(r_{t+1}-r^f)+\alpha_t(1-\alpha_t)\frac{\sigma^2}{2})+\psi_{t+1}^t(\alpha_t)].$$

As $T-t$ is large, for an average period $t-1$ it holds that $E_{t-1}[\alpha_t]\approx\alpha_{t-1}$ such that

$$E_{t-1}[r^d+log(\rho_t^{in})+\frac{\beta}{1-\beta}log(1-\rho_t^{in})+\psi_{t+1}^{t-1}(\alpha_{t-1})] > E_{t-1}[r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2}$$

$$+log(\rho_t)+\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]+\frac{\beta}{1-\beta}log(1-\rho_t)+\psi_{t+1}^t(\alpha_t)].$$

The agent's continuation utilities are given by

$$\psi_{t+1}^{t-1}(\alpha_{t-1})=\beta E_{t-1}[log(\rho_{t+1})+\sqrt{2}\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]$$

$$+\frac{\beta}{1-\beta}log(1-\rho_{t+1})+\frac{\beta}{1-\beta}(r^f+\alpha_{t+1}(r_{t+2}-r^f)+\alpha_{t+1}(1-\alpha_{t+1})\frac{\sigma^2}{2})+\psi_{t+2}^{t+1}(\alpha_{t+1})]$$

$$\psi_{t+1}^t(\alpha_t)=\beta E_t[log(\rho_{t+1})+\alpha_t(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))]$$

$$+\frac{\beta}{1-\beta}log(1-\rho_{t+1})+\frac{\beta}{1-\beta}(r^f+\alpha_{t+1}(r_{t+2}-r^f)+\alpha_{t+1}(1-\alpha_{t+1})\frac{\sigma^2}{2})+\psi_{t+2}^{t+1}(\alpha_{t+1})].$$

The agent's behavior from period $t+2$ on is not going to be affected by his period t (in)attentiveness (as his period $t+1$ self can be forced to look up the portfolio by his period t self). Moreover, as $T-t$ is large, for an average period $t-1$ it holds that $E_{t-1}[\alpha_t] \approx \alpha_{t-1}$ such that

$$E_{t-1}[\psi_{t+1}^{t-1}(\alpha_{t-1})-\psi_{t+1}^{t}(\alpha_t)] = E_{t-1}[(\sqrt{2}-1)\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]]$$

$$\Rightarrow E_{t-1}[r^d+log(\rho_t^{in})+\frac{\beta}{1-\beta}log(1-\rho_t^{in})+(\sqrt{2}-2)\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]]$$

$$> E_{t-1}[r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2}+log(\rho_t)+\frac{\beta}{1-\beta}log(1-\rho_t)],$$

which finally results in the following comparison

$$E_{t-1}[log(\rho_t^{in})+\frac{\beta}{1-\beta}log(1-\rho_t^{in})] > E_{t-1}[\underbrace{r^f+\alpha_{t-1}(r_t-r^f)+\alpha_{t-1}(1-\alpha_{t-1})\frac{\sigma^2}{2}-r^d}_{>0 \text{ in expectation and increasing with } h}$$

$$+log(\rho_t)+\frac{\beta}{1-\beta}log(1-\rho_t)+\underbrace{(2-\sqrt{2})\alpha_{t-1}(1+\gamma\frac{\beta}{1-\beta})\sigma E[\eta(\lambda-1)\int_s^\infty (s-\tilde{s})dF(\tilde{s}))]}_{<0 \text{ and increasing with } \sqrt{h}}].$$

In turn, if I increase h, I increase the positive return part, which becomes quantitatively relatively more important than the negative news-utility part. Increasing h implies that the difference between the positive return part and the negative news-utility part will at some point exceed the difference in consumption utilities $E_{t-1}[log(\rho_t^{in})+\frac{\beta}{1-\beta}log(1-\rho_t^{in})]-E_{t-1}[log(\rho_t)+\frac{\beta}{1-\beta}log(1-\rho_t)]$, which is positive because $log(\rho_t^{in})+\frac{\beta}{1-\beta}log(1-\rho_t^{in})$ is maximized for $\rho_t^{in}=\frac{1}{1+\frac{\beta}{1-\beta}}$, which corresponds the standard agent's portfolio share (plus given that $E_{t-1}[log(\rho_t)] < log(E_{t-1}[\rho_t])$ as $log(\cdot)$ is a concave function). The consumption utilities are given by ($\rho_t=\frac{1}{1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}} > \rho_t^{in}=\frac{1}{1+\frac{\beta}{1-\beta}}$ (with $\tilde{\eta}\in(\eta,\eta\lambda)$ and as the agent is inattentive for just one period $\rho_t^{in}=\frac{1}{1+\frac{\beta}{1-\beta}}$))

$$log(\rho_t^{in})+\frac{\beta}{1-\beta}log(1-\rho_t^{in}) = log(\frac{1}{1+\frac{\beta}{1-\beta}})+\frac{\beta}{1-\beta}log(\frac{\frac{\beta}{1-\beta}}{1+\frac{\beta}{1-\beta}}) = \frac{\beta}{1-\beta}log(\frac{\beta}{1-\beta})-(1+\frac{\beta}{1-\beta})log(1+\frac{\beta}{1-\beta})$$

and

$$E_{t-1}[log(\rho_t) + \frac{\beta}{1-\beta}log(1-\rho_t)] = E_{t-1}[log(\frac{1}{1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}}) + \frac{\beta}{1-\beta}log(\frac{\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}}{1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}})]$$

$$= E_{t-1}[\frac{\beta}{1-\beta}log(\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}) - (1+\frac{\beta}{1-\beta})log(1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}})].$$

And their difference is given by

$$-(1+\frac{\beta}{1-\beta})log(1+\frac{\beta}{1-\beta}) - E_{t-1}[\frac{\beta}{1-\beta}log(\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}) - (1+\frac{\beta}{1-\beta})log(1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}})],$$

which is decreasing in $\frac{\beta}{1-\beta}$, i.e., $\frac{\partial(\cdot)}{\partial\frac{\beta}{1-\beta}} < 0$, unless γ is too small, in which case it is increasing, i.e., $\frac{\partial(\cdot)}{\partial\frac{\beta}{1-\beta}} > 0$, because

$$\frac{\partial(\cdot)}{\partial\frac{\beta}{1-\beta}} = -log(1+\frac{\beta}{1-\beta}) - 1 \underbrace{-E_{t-1}[log(\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}})]}_{>0} \underbrace{- log(1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}})}_{<log(1+\frac{\beta}{1-\beta})} \underbrace{- (1+\frac{\beta}{1-\beta})\frac{\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}}{1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}}]}_{<1}$$

and note that

$$\frac{\partial(log(1+\frac{\beta}{1-\beta}) - log(1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}))}{\partial\frac{\beta}{1-\beta}} = \frac{1}{1+\frac{\beta}{1-\beta}} - \frac{1}{\frac{1+\tilde{\eta}}{1+\gamma\tilde{\eta}}+\frac{\beta}{1-\beta}} > 0$$

$$\frac{\partial(\frac{1-\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}}{1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}})}{\partial\frac{\beta}{1-\beta}} = \frac{(1-\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}})\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}}}{(1+\frac{\beta}{1-\beta}\frac{1+\gamma\tilde{\eta}}{1+\tilde{\eta}})^2} > 0.$$

Thus, an increase in h decreases $\frac{\beta}{1-\beta}$ which increases the difference in consumption utilities (unless γ is small such that $\frac{\partial(\cdot)}{\partial\frac{\beta}{1-\beta}} > 0$). If $\frac{\partial(\cdot)}{\partial\frac{\beta}{1-\beta}} < 0$, however, the increase in the difference in consumption utilities due to the increase in h will be less than the rate at which the difference between the return and news-utility part increases if h becomes large. The reason is that an increase in h will result in a decrease in $\frac{\beta}{1-\beta}$ given by $\frac{\beta^h log(\beta)}{(1-\beta^h)^2}$, which goes to zero as $h \to \infty$. Thus, I conclude that the agent will find it optimal to be attentive in every period for $h > \bar{h}$.

In turn, I can prove that the agent will be inattentive for at least one period if $h < \underline{h}$. If I decrease h, I decrease the positive return part, which becomes quantitatively less important (as it is proportional to h) relative to the negative news-utility part (as it is proportional to $\sqrt{h}$). Moreover, the difference in consumption utilities speaks towards not looking up the

portfolio too, i.e., $E_{t-1}[log(\rho_t^{in}) + \frac{\beta}{1-\beta} log(1-\rho_t^{in})] - E_{t-1}[log(\rho_t) + \frac{\beta}{1-\beta} log(1-\rho_t)] > 0$ as shown above. The intuition for this additional reason to not look up the portfolio is that inattentive consumption is not subject to a self-control problem while attentive consumption is. Furthermore, h affects the prospective news utility term via $1 + \gamma \frac{\beta}{1-\beta}$. However, as $\frac{\beta}{1-\beta}$ increases if h decreases this will only make the agent more likely to be inattentive. Thus, I conclude that the agent will find it optimal to be inattentive for at least one period if $h < \underline{h}$. It cannot be argued that the agent would behave differently than what is assumed from period $t+1$ on unless he finds it optimal to do so from the perspective of period t because the agent can restrict the funds in the checking account and determine whether or not his period $t+1$ self is attentive.

D.6 Proof of Corollary 2

Please refer to Appendix C for the derivation of the dynamic portfolio share. The expected benefit of inattention (as defined in the text) is given by

$$-(\sqrt{i}E[\alpha_{t-i}](1+\gamma\sum_{\tau=1}^{T-t}\beta^\tau)+(\sqrt{j_1}E[\alpha_t]-E[\alpha_{t-i}]\sqrt{j_1+i})(1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau))\sigma E[\eta(\lambda-1)\int_s^\infty(s-\tilde{s})dF(\tilde{s}))].$$

and is always positive if $E[\alpha_{t-i}] \approx E[\alpha_t]$ (i.e., if $T-t$ is large). As can be easily inferred $\frac{1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau}{\sum_{\tau=0}^{T-t-j_1}\beta^\tau}$ is converging as $T-t$ becomes large and thus increases quickly if $T-t$ is small. Therefore, α_t is decreasing more quickly, i.e., $\frac{\partial(\alpha_{t-i}-E_{t-1}[\alpha_t])}{\partial(T-t)} < 0$, and the expected benefit of inattention is lower if $E[\alpha_{t-i}] > E[\alpha_t]$ (toward the end of life). The benefit of inattention is lower if $\alpha_{t-i} > E[\alpha_t]$ and (as I will show in the proof of Proposition 4) $\frac{\partial\alpha_t}{\partial r_t+...+r_{t-i+1}} > 0$. Thus, the benefit of inattention is low if $r_{t-i} + ... + r_{t-i-j_0+1}$ is low.

D.7 Proof of Proposition 4

The agent's optimal portfolio share is given by

$$\alpha_t = \frac{\mu - r^f + \frac{\frac{1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau}{\sum_{\tau=0}^{T-t-j_1}\beta^\tau}E[\eta(\lambda-1)\int_{r_{t+1}}^\infty(r_{t+1}-\tilde{r})dF_r(\tilde{r}))]}{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}}{\sigma^2}.$$

As can be easily seen

$$\frac{\partial\alpha_t}{\partial F_r(r_t)...F_r(r_{t-i+1})}\frac{\partial F_r(r_t)...F_r(r_{t-i+1})}{\partial(r_t+...+r_{t-i+1})}$$

$$= \frac{\frac{\frac{1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau}{\sum_{\tau=0}^{T-t-j_1}\beta^\tau}E[\eta(\lambda-1)\int_{r_{t+1}}^\infty(r_{t+1}-\tilde{r})dF_r(\tilde{r}))]}{(1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1}))))^2}\gamma\eta(\lambda-1)}{\sigma^2}\frac{\partial F_r(r_t)...F_r(r_{t-i+1})}{\partial(r_t+...+r_{t-i+1})} < 0.$$

And $\frac{1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau}{\sum_{\tau=0}^{T-t-j_1}\beta^\tau}$ is decreasing in $T-t$ iff $\gamma<1$. And $\frac{\partial\alpha_t}{\partial r_t...r_{t-i+1}}$ is more negative if $\frac{1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau}{\sum_{\tau=0}^{T-t-j_1}\beta^\tau}$ is high thus the degree of extensive rebalancing is higher late in life.

D.8 Proof of Corollary 3

The agent's optimal consumption share is given by

$$\rho_t=\frac{1}{1+\sum_{\tau=1}^{T-t}\beta^\tau\frac{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}{1+\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}}.$$

As can be easily seen, $\frac{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}{1+\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}$ is increasing in $F_r(r_t)...F_r(r_{t-i+1})$ such that ρ_t is decreasing in $F_r(r_t)...F_r(r_{t-i+1})$, i.e.,

$$\frac{\partial\rho_t}{\partial F_r(r_t)...F_r(r_{t-i+1})}=-\frac{\frac{(1-\gamma)\eta(\lambda-1)\sum_{\tau=1}^{T-t}\beta^\tau}{(1+\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))^2}}{(1+\sum_{\tau=1}^{T-t}\beta^\tau\frac{1+\gamma(\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))}{1+\eta F_r(r_t)...F_r(r_{t-i+1})+\eta\lambda(1-F_r(r_t)...F_r(r_{t-i+1})))})^2}<0 \text{ if } \gamma<1.$$

If $\frac{\partial\rho_t}{\partial F_r(r_t)...F_r(r_{t-i+1})}<0$, it follows that $\frac{\partial\rho_t}{\partial R_t...R_{t-i+1}}<0$ such that if $\gamma=0$ (in which case $\frac{\partial\alpha_t}{\partial R_t...R_{t-i+1}}=0$) and $\frac{\partial(((R^f)^i+\alpha_{t-i}(R_t...R_{t-i+1}-(R^f)^i))(1-\rho_t)\alpha_t)}{\partial R_t...R_{t-i+1}}=\alpha_{t-i}(1-\rho_t)\alpha_t-(((R^f)^i+\alpha_{t-i}(R_t...R_{t-i+1}-(R^f)^i))\frac{\partial\rho_t}{\partial R_t...R_{t-i+1}}\alpha_t>\alpha_{t-i}(1-\rho_t)\alpha_t$. If $\gamma>0$, then there exist some threshold $\bar\gamma$ such that the increasing variation in $1-\rho_t$ outweighs the decreasing variation in α_t.

D.9 Proof of Proposition 5

Comparing the precommitted-monotone and personal-monotone portfolio share it can be easily seen that they are not the same for any period $t\in\{1,...,T-1\}$.

1. The precommitted consumption share for attentive consumption is

$$\rho_t^c=\frac{1}{1+\sum_{\tau=1}^{T-t}\beta^\tau\frac{(1+\gamma\eta(\lambda-1)(2F_r(r_t)...F_r(r_{t-i+1})-1))}{1+\eta(\lambda-1)(2F_r(r_t)...F_r(r_{t-i+1})-1))}}$$

   which is lower than the personal-monotone share if $\gamma<1$ as $\eta(\lambda-1)(2F_r(r_t)-1)<\eta F_r(r_t)+\eta\lambda(1-F_r(r_t)))$ and the difference increases if $F_r(r_t)...F_r(r_{t-i+1})$ increases.

2. The precommitted portfolio share is

$$\alpha_t^c=\frac{\mu-r^f+\frac{\frac{1+\gamma\sum_{\tau=1}^{T-t-j_1}\beta^\tau}{\sum_{\tau=0}^{T-t-j_1}\beta^\tau}E[\eta(\lambda-1)\int_r^\infty(r_T-\tilde r)dF_r(\tilde r))]}{1+\gamma\eta(\lambda-1)(2F_r(r_t)...F_r(r_{t-i+1})-1)}}{\sigma^2}$$

   which is lower than the personal-monotone share as $\eta(\lambda-1)(2F_r(r_t)-1)<\eta F_r(r_t)+\eta\lambda(1-F_r(r_t)))$ and the difference increases if $F_r(r_t)...F_r(r_{t-i+1})$ increases.

3. γ does not necessarily imply an increase in ρ_t^c because $\eta(\lambda-1)(2F_r(r_t)...F_r(r_{t-i+1})-1)$ can be negative. Thus, attentive consumption is higher only due to the differences

in returns and not due to the time inconsistency any more. Thus, the cost of less consumption utility in period t, is (as defined in the text)

$$E[log(\rho_t^{cin})] - E[log(\rho_t^c)]$$

is lower as $\rho_t^{cin} = \rho_t^{in}$ but $E[log(\rho_t^c)] < E[log(\rho_t)]$.

4. As precommitted marginal news utility is always lower and the gap increases in good states there is larger variation in it, i.e., it varies from $\{-\eta(\lambda-1), \eta(\lambda-1)\}$ which is larger than the variation in non-precommitted marginal news $\{\eta, \eta\lambda\}$, as $2\eta(\lambda-1) > \eta(\lambda-1)$. Thus, the variation in α_t (extensive rebalancing) is more pronounced on the pre-committed path. More formally it can be easily seen that

$$\frac{\partial \alpha_t^c}{\partial F_r(r_t)...F_r(r_{t-i+1})} < \frac{\partial \alpha_t}{\partial F_r(r_t)...F_r(r_{t-i+1})} < 0.$$