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Misinformed and informed asset allocation decisions of self-directed retirement plan members

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Abstract

Most defined contribution pension plan members misunderstand asset allocation, but those with higher levels of wealth managing their own money are less likely to be confused. Younger, more-educated, higher-earning advice-receiving males with a planner mindset hold more equity. Notably, an understanding of asset allocation accentuates the impact of the key factors age, income and a planner mindset.

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1. Introduction

On February 6th, 2005, during his State of the Union speech, President Bush renewed his call for social security reform. One of his key proposals was to create personal retirement accounts whose returns would be a function of worker decisions. Unfortunately, the extant evidence suggests that future retirees often make potentially costly mistakes in managing their self-directed retirement accounts. Many do not begin saving till very late and

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do not save enough once they start (Mitchell & Utkus, 2004). Investment decisions are made though perceived to be suboptimal by the decision-makers (Benartzi & Thaler, 2002). Risk is not well understood: it is common to believe that an individual security is less risky than a market index (Benartzi, 2001). People become increasingly hesitant and even paralyzed when offered additional asset choices (Iyengar, Jiang, & Huberman, 2004). Ignoring the most basic lessons of diversification, future retirees put far too much money into company stock, and fall prey to recency and representativeness in chasing winners (Benartzi, 2001). And, despite all these shortcomings, plan members are all too sure that they are doing the right thing (Bhandari & Deaves, 2006).

One finding that has been particularly troubling is that many future retirees do not understand asset allocation. One way this has been demonstrated is when survey respondents are given several fund menus to choose from, they are often egregiously inconsistent in their equity exposure or risk-taking (Benartzi & Thaler, 2001). More specifically, they sometimes employ a "diversification" or "*1/n* heuristic," whereby all *n* funds on offer are given roughly equal allocations without regard for underlying risk. What makes this confusion potentially damaging is that it is often observed that the asset allocation decision is the most important one for an investor's long-term portfolio performance (e.g., Brinson, Hood, & Beebower, 1986 and Brinson, Singer, & Beebower, 1991).[1] The question of an investor's optimal allocation is complex and as yet unresolved. Nevertheless, most would agree that it is in large part driven by one's only noisily observed risk tolerance. Additionally, under reasonable conditions theory agrees with industry practice that risk-taking should decline with age and proximity to retirement (Bodie, Merton, & Samuelson, 1992). Financial planners typically recommend an equity share that not only conforms to an investor's risk attitudes, but also declines one for one (1%/year) as people approach retirement.

The purpose of the current paper is to conduct an analysis of the asset allocation knowledge and decisions made by individuals in self-directed retirement accounts. In doing so, we combine two strands in the asset allocation literature, that on confusion and that on demographic determinants. We make use of a survey of approximately 2000 Canadian defined contribution pension plan members. While surveys are commonplace, this one is unique in being consciously designed to investigate the extent to which plan members fall prey to certain investment knowledge gaps and behavioral pitfalls. One of the pitfalls investigated by the survey instrument was the extent of asset allocation confusion among participants.[2]

While this is old ground, unique to our paper, we then turn to the demographics of the problem. There has been some research on the demographics of investment knowledge inadequacy and behavioral biases. For example, gender and overconfidence appear to be associated, with men being more susceptible (Lundeberg, Fox, & Punccohar, 1994 and Barber & Odean, 2001). Further advances on who is most at risk might make it possible to direct educational offerings appropriately (MacFarland, Marconi, & Utkus, 2004).

We go on to explore how the stock-bond mix is impacted by demographic factors. Our dataset provides distinct advantages relative to previous work which looks at actual 401(k)

[1] Some argue that this view is overstated. See for example, Hensel, Ezra, and Ilkiw (1991).

[2] Aside from asset allocation confusion, the survey also investigated momentum-chasing and overconfidence. See Deaves (2005) for more details on the latter two issues.

or 403(b) behavior along four dimensions: ignorance, framing, inertia, and sample breadth.[3] First, and most importantly, others treat all individuals equally, though it is clear that some individuals are *ignorant* of asset allocation, while others *understand* it. Our paper is unique in being able to differentiate, and to observe how behavior differs between the groups. Second, the *1/n* heuristic indicates that for the ignorant the stock-bond mix will be a function of the *frame*, which in this context is the menu of choices available. This is particularly a problem for papers examining the revealed behavior of 401(k) or 403(b) investors, as member choices will be influenced by the frame. We obviate this problem as we are able to examine individuals who are consistent *regardless of the frame*. Third, member choices are sometimes not really choices at all, but rather inertia-induced defaults. In our sample, inertia is not an issue, as all must *express* their preferred allocations. Fourth, in most 401(k) or 403(b) studies members either come from a single company or a single pension provider, which raises questions about the extent to which findings can be generalized. On the other hand, our sample makes use of a broad range of plans.[4]

It should be noted that the use of surveys as opposed to large sample studies of actual investor decisions offers both advantages and disadvantages. On the negative side of the ledger is the suspicion that respondents, not being incentivized in any obvious fashion, are unlikely to respond with any care: that is, *salience* is lacking. While it is likely that the respondents are mature individuals who take their pensions quite seriously, beliefs are not the same as actions, and survey questions can be misunderstood. If the problem is noise creation, this is a weak criticism, since it just makes signal extraction all the more challenging. The problem of bias is not so easily countered, so any results must be scrutinized with this possibility in mind. Still Kühberger, Schulte-Mecklenbeck, and Perner (2002, p. 1164) argue that "the general consensus among psychologists seems to be that hypothetical choices give a reasonable, qualitatively correct picture of real choices." On the positive side of the ledger, a survey can allow for great flexibility. Graham and Harvey (2002, p. 189) point out in their study of a survey of CFOs that "large sample studies often have weaknesses related to variable specification and the inability to ask qualitative questions." Indeed, since one of the major goals of the present study is to observe differences in behavior between those who signal an understanding of asset allocation and those who do not, it would be difficult to broach this issue with naturally-occurring data.

In the next section we provide a brief literature review of asset allocation confusion and decision-making. Section 3 describes the survey instrument and presents results on the extent of asset allocation confusion. The next section turns to the demographics of the issue. Section 5 moves on to exploring the determinants of equity exposure, with a focus on differentiating between the behavior of those who understand asset allocation and those who do not. The final section concludes.

[3] In particular, see Bodie and Crane (1997), Ameriks and Zeldes (2001) and Agnew, Balduzzi, and Sundén (2003). Our dataset is arguably deficient in two respects: salience and time dimension. Salience may be lacking because respondents are not putting dollars on the line in answering hypothetical questions. Still these are likely mature employees who take their pensions quite seriously. Time dimension is lacking since the current exercise is purely cross-sectional.

[4] Using Agnew et al. (2003) as an example, there were three equity funds and one bond fund, so equity preference was likely higher than it would have been had three of the four funds been bond funds (point 2); 48% of members were entirely in fixed-income defaults (point 3); and all members came from a single plan (point 4).

2. Literature review

2.1. Asset allocation confusion

The technique that has been used to ascertain whether people understand asset allocation is to see if they exhibit consistency in their choices when they are forced to make their opinions known. When individuals are unsure, they sometimes rely on *heuristics* or rules-of-thumb that allow them to make what to them seems a reasonable choice. While Simonson (1990) and Read and Loewenstein (1995) documented the *1/n* heuristic in non-financial realms, Benartzi and Thaler (2001) provided evidence that this heuristic also appears to come into play for decisions as important as asset allocation.[5] In a survey of University of California employees, when they were told to allocate their money among five funds, of which four were fixed-income and one was equity, they did so in a manner suggesting a 43% equity share. While there is nothing wrong with this in and of itself, in a second treatment employees were told to allocate their money among five other funds, of which, this time, four out of five were equity. This time the asset allocation suggested a much higher 68% equity share. The obvious inference is that confused respondents allowed the menu of options to have a major impact on their choice.

Actual allocations fall into line with the survey evidence. The same researchers also analyzed a database of the actual decisions made by 1.5 million members across 170 plans, concluding that there is solid evidence that the available choices affect allocations: when there are a lot of equity funds, people tend to put more of their money into equities. Huberman and Jiang (2006) provide contrary evidence, documenting that the *1/n* heuristic mostly applies for all funds *invested in* rather than all funds *offered for investment*. For the purpose of the present paper, this potential qualification is moot, since we are concerned with the use of *1/n* as a signal of ignorance, rather than what it implies about actual behavior.

2.2. Asset allocation decision-making

The two principal normative demographic factors are risk tolerance and age. First, highly risk-averse individuals, purely because of personal preferences, will naturally choose a higher fixed-income exposure in their portfolios. There is evidence that one proxy for risk attitude is gender, with women being more risk-averse than men (Barsky, Juster, Kimball, & Shapiro, 1997). Second, risk-taking naturally fluctuates as one moves through the stages of life. While this seems intuitive to most, Samuelson (1969) showed that age and retirement were irrelevant for portfolio decisions if investment opportunities are constant and human capital is tradable. The latter does not hold in reality though, as people must normally hold on to their human capital. As an individual ages and approaches retirement, her stock of relatively safe human capital declines, requiring a lower equity exposure to maintain a fairly stable risk stance (Bodie et al., 1992). Nevertheless, despite

[5] In certain cases, 1/*n* can be reasonable. For example, if one has to choose between 20 individual stocks, putting 5% of your money in each will provide significant diversification benefits. If, however, the latter is rephrased in terms of 20 equity funds, each of which is already well diversified, then very little additional diversification would result from investing in each fund.

these and other theoretical advances, it must be granted that careful thinkers still often wildly disagree.[6]

The empirical evidence is largely in line with theory. Ackert, Church, and Englis (2002) investigate a survey conducted by the *Stanford Research Institute*. Sundén and Surette (1998) and Faig and Shum (2004) explore the *Survey of Consumer Finances*. Bodie and Crane (1997), Ameriks and Zeldes (2001) and Agnew et al. (2003) perform clinical studies of actual asset allocation choices in 403(b)'s or 401(k)'s, with the first two papers focusing on *TIAA-CREF* plan participants and the latter on a company pension plan. As expected, younger, more risk-tolerant males hold more stock. Additionally, higher-earning people hold more equity. This is logical in that income should be correlated with one's stock of human capital. Married individuals also tilt towards stocks. One possible reason for this is that two-income families can afford to take on more risk because of their greater ability to diversify labor-market shocks. Those with high net worth lean towards equities. The causality is ambiguous: are people wealthier because they have in the past been risk-takers, or do they favor stocks because they can withstand adverse market movements? Finally, seniority (which is logically related to job security) is associated with risk-taking.

Evidence has also been presented that risk-taking vs. age is a humped function (e.g., Ameriks & Zeldes, 2001). At first people increase risk-taking as they age, and, only later, after a maximum is achieved, does equity exposure begin to decline. This non-monotonicity is consistent with recent theoretical advancements. If one's income and stock returns are positively correlated to a sufficient degree, then risk-taking should *increase* with time because of reduced hedging demand (Jagannathan & Kocherlakota, 1996). Because of this, it is even possible that on retirement an individual could increase equity exposure (Viceira, 2001). Moreover, exposure to non-diversifiable entrepreneurial risk (Heaton & Lucas, 2000) is often more prevalent among the relatively young. The same is true of leveraged real estate purchases (Flavin & Yamashita, 2002) and personal illiquid projects such as private business start-ups (Faig & Shum, 2002).[7]

3. The survey instrument and the extent of asset allocation confusion

Early in 2004 a survey of Canadian defined contribution (*DC*) pension plan members was conducted.[8] Respondents, who had the choice of a web-based survey or one provided in hardcopy form, came from a broad spectrum of industries, geographical areas and socioeconomic groups, with 17 pension plans being represented.[9] The survey response rate

[6] Pension funds have historically opted for a 60/40 stock-bond mix, which can be viewed as a kind of average over their membership. Thaler and Williamson (1993) argue for a much higher equity share. Bodie and Clowes (2003) argue for a much higher fixed-income component for most investors.

[7] Bodie and Crane (1997) and Ackert et al. (2002) find *greater* risk-taking among home owners, but they suggest this may be due to the correlation between job security and home ownership.

[8] The survey, commissioned by *SEI Investments*, explored satisfaction with and attitudes about current pension plans as well as desire for changes. Additionally, a number of questions designed to ascertain knowledge levels and behavioral biases were included.

[9] Firms were from such industries as government, financial services, high-tech and resources. The identity of the actual companies is confidential.

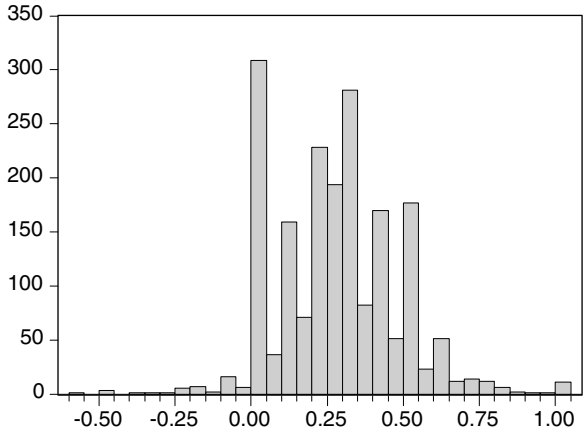

Fig. 1a. Frequency distribution showing the difference in equity share between the case where two funds are equity funds (case A) vs. the case where one fund is an equity fund (case B).

was 21%, and the sample size was 1992. In most important respects there is little difference between US and Canadian living standards, labor markets and pension arrangements.[10] The principle difference with respect to the latter is that Canada has been slower to adopt *DC*-type pension arrangements than has the US, but the trend in Canada has also been clearly towards decision- and risk-shifting to employees.[11] Two questions were designed to investigate asset allocation confusion and decisions. The first question asked respondents to allocate $100,000 among a "government bond fund," a "corporate bond fund," and a "stock fund." The second question was identical, except that the three choices were a "bond fund," a "growth stock fund," and a "value stock fund."[12]

If someone falls prey to the diversification heuristic, then his equity share on the first question should be about 33%, while the second question's share should be about 67%. When one/two out of three choices was/were an equity fund/equity funds, the mean equity share was 43.29%/69.06%.[13] The difference between the equity shares in the two questions is shown in Fig. 1, Panel A. The mean difference is 26.59% and is highly significant (with a *p*-value of 0.000). The primary and secondary modes are revealing. The former is at a 0–5% difference. Most of these people (15.93%) exhibit *perfect* consistency. Arguably, enlarging the choice of equity funds can lead an optimizing agent to ramp up equity exposure because of increased scope for manager diversification and style tilting. Still, according to Benartzi and Thaler (2001), this should seldom lead to a variation of more than 5%. Thus we would argue that respondents who are at least roughly consistent (a difference

[10] For example, see Osberg and Sharpe (2002).

[11] Pension assets in the US are now more than 50% in *DC* vs. *DB* (defined benefit). In Canada the figure is about 10%. For more on Canadian *DC* pensions, see Press (2002).

[12] The precise questions are available in Bhandari and Deaves (2007).

[13] Looking at Fig. 1, Panel B, it is apparent that there were significant concentrations at 0% or 100%, indicating that some respondents were quite risk-averse, while others were quite ready to bear significant market risk. Such substantial cross-sectional variation in risk-taking – even spikes at the endpoints – can reasonably result when some people are subject to loss- or disappointment-aversion (Ang, Bekaert, & Liu, 2005). It is also interesting to note that on average respondents comfortably lean towards equities despite the worldwide stock declines commencing in 2000. This attests to the rise of the "equity culture" discussed by Poterba (2001).

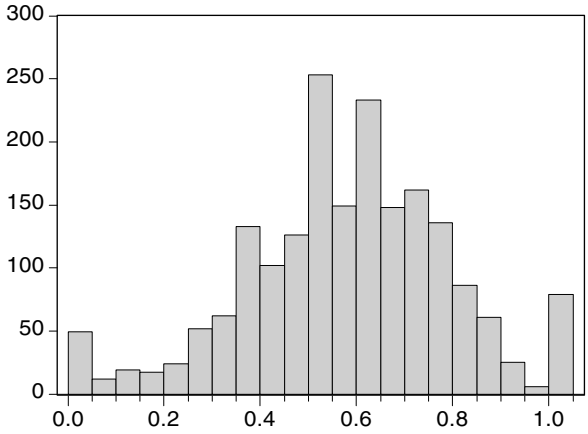

Fig. 1b. Frequency distribution showing the average equity share.

of 5% or less) are signaling an understanding of asset allocation.[14] These people we designate as belonging to the *AAC* (asset-allocation-consistent) group.

As for the secondary mode (14.99% of respondents), these people have a between-question spread of 30–35%. Notably, following *1/n* implies a difference of 33%. Moreover a glance at the distribution indicates that many others are between 20% and 30%, suggesting they are *influenced* by this rule-of-thumb. On this basis, we conclude that many future retirees are either following or are influenced by *1/n*, suggesting asset allocation confusion. Thus they may be swayed by whatever fund menu is available to them.

4. Demographics of asset allocation confusion

We next consider what demographic characteristics are associated with consistency. The survey fortunately provides a wealth of demographic data. The full set of relevant variables is displayed in Table 1. Notice that there are three kinds of variables available: purely numerical variables, such as age; binary variables, such as marital status; and ordered categorical variables, such as income. In the case of income, for example, respondents could tick off one of four options: up to $25,000; $25,000–50,000; $50,000–100,000; and over $100,000.[15] All these variables are either sensible potential determinants of risk-taking based on previous theoretical or empirical work, or are closely related to such determinants.[16] There are two

[14] Using a "5% or less" criterion leads to an *AAC* group of 18.05% of the sample; going to 10% enlarges it to 27.04%. While all results presented below are in terms of the 5% definition, they are quite robust to moving to 0% or 10%.

[15] All dollar figures are Canadian. When the survey was conducted the Canadian/US dollar exchange rate was in the 1.30–1.35 Canadian/US territory.

[16] Years with the company (or *DC*) gets at seniority. Years to retirement (realistic or preferred) is another perspective on age. Children can be viewed as "personal illiquid projects." Education (like income) should be correlated with one's stock of human capital. *DC* size is another perspective on wealth. Since these variables logically could have an impact on optimal risk-taking, they may also have an impact on whether one educates oneself on investments in preparation for this risk-taking.

Table 1
Demographic variables

Variable	Variable type	Mean	SD
1. Age	Numerical	42.38	9.79
2. Years with company	Numerical	10.11	8.45
3. Years in *DC*	Numerical	7.22	6.60
4. Years to retirement	Numerical	18.43	9.94
5. Years to retirement by preference	Numerical	13.80	8.98
6. Self-investment? (makes own investment decisions = 1)	Indicator – two levels	0.42	0.49
7. Receives advice? (yes = 1)	Indicator – two levels	0.55	0.50
8. Gender (male = 1)	Indicator – two levels	0.62	0.49
9. Children (has = 1)	Indicator – two levels	0.69	0.46
10. Marital status (married = 1)	Indicator – two levels	0.77	0.42
11. Education (no college; some; graduated)	Ordered categorical	14.91	1.67
12. Income (0–25k; 25–50k; 50–100k; above 100k)	Ordered categorical	70.92	28.83
13. Wealth (0–50k; 50–100k; 100–200k; 200–300k; 300–500k; above 500k)	Ordered categorical	255.64	203.89
14. *DC* size (0–50k; 50–100k; 100–200k; 200–300k; 300–500k; above 500k)	Ordered categorical	77.74	90.07

These are the demographic variables used to potentially explain asset allocation consistency and equity share. The variable identity, type, means and SD are shown.

exceptions. The respondents were asked if they "receive any retirement planning recommendations or advice" and whether they "make [investment] decisions completely on [their] own." Indicator variables were constructed based on their dichotomous responses. Intuitively, one would expect that advisors would argue for a more substantial equity exposure than an unschooled investor would adopt on her own; and that the predisposition to make decisions on one's own might signal the acquisition of a pertinent investment knowledge base and a risk-taking demeanor, both of which would argue for a movement towards equity.

Preliminary analysis indicates that certain demographic characteristics are associated with the likelihood of being *AAC*.[17] For example, a higher percentage of males than females are *AAC*(19.61% vs. 15.96%). Age for the most part correlates with understanding: only 10.29% of those in the youngest group are consistent, while 26.47% in the oldest group are. Income also correlates with understanding, with 12.59% of those earning below $50,000 exhibiting consistency, while 28.70% of those earning above $100,000 are in the *AAC*group. Finally, education is also positively associated with consistency, with 20.30% of college graduates showing consistency vs. 14.23% for those without college degree (some college/just high school or less).[18]

[17] See Bhandari and Deaves (2007) for more details.

[18] The *p*-values testing the difference in *AAC* across gender, age, income, and education were 0.008, 0.000, 0.000, and 0.08 respectively.

Table 2
Probit regressions of asset allocation consistency on demographic variables

Variables	All variables			Vars significant at 10%		
	Eq. (1) (num.)	Eq. (2) (log Num.)	Eq. (3) (binary)	Eq. (4) (num.)	Eq. (5) (log num.)	Eq. (6) (binary)
Constant	−2.231 (0.001)	−4.316 (0.001)	−1.753 (0.001)	−1.999 (0.001)	−3.304 (0.001)	−1.431 (0.001)
Gender (male = 1)	−0.033 (0.716)	−0.047 (0.609)	−0.040 (0.663)			
Advice (yes = 1)	−0.049 (0.572)	−0.058 (0.508)	−0.037 (0.674)			
Age	0.002 (0.861)	0.003 (0.758)	0.005 (0.570)			
DC size	0.000 (0.746)	0.064 (0.449)	0.142 (0.161)			
Education	0.026 (0.360)	0.029 (0.303)	0.157 (**0.084**)	0.032 (0.163)	0.035 (0.135)	0.166 (**0.032**)
Income	0.004 (**0.039**)	0.262 (**0.032**)	0.214 (**0.052**)	0.003 (**0.070**)	0.173 (**0.079**)	0.130 (0.142)
Kids (yes = 1)	−0.056 (0.588)	−0.083 (0.423)	−0.086 (0.407)			
Mar. status (yes = 1)	0.016 (0.882)	0.021 (0.847)	0.057 (0.602)			
Self-inv. (yes = 1)	0.226 (**0.009**)	0.226 (**0.008**)	0.239 (**0.005**)	0.249 (**0.000**)	0.252 (**0.000**)	0.254 (**0.000**)
Wealth	0.002 (**0.000**)	0.264 (**0.000**)	0.410 (**0.000**)	0.001 (**0.000**)	0.196 (**0.000**)	0.369(**0.000**)
Years in co.	−0.004 (0.593)	−0.004 (0.561)	−0.005 (0.504)			
Years in *DC*	0.003 (0.718)	0.000 (0.967)	0.001 (0.897)			
Years to retirement	0.009 (0.307)	0.008 (0.397)	0.005 (0.617)			
Pref. yrs. to retirement	0.000 (0.988)	0.000 (0.978)	0.000 (1.000)			
McFadden R^2	0.062	0.053	0.047	0.045	0.038	0.034

These regressions were estimated using probit. The dependent variable is an indicator which equals one if people are consistent in their asset allocation choices between the two questions (where variation up to 5% is allowed). The ordered categorical independent variables were operationalized in three ways: using numerical interpolation; using the latter but with income, wealth and *DC* size converted to logs; and converting to zero/one binary variables, where categories were combined in such a way as to equate (as closely as possible) the number of individuals in each grouped category. *P*-values are shown below coefficient estimates.

Since many of these factors are correlated, multivariate regression analysis is appropriate.[19] In Table 2, we report regressions of an asset allocation confusion indicator variable on the full set of demographic variables shown in Table 1. The dependent variable takes on a value of unity if a respondent is consistent with respect to equity share (continuing to use a 5% cutoff) between the two survey questions; and zero otherwise. Since the dependent variable is binary, probit regression is in order. Ordered categorical variables are treated in either of three ways. First, we convert them to numerical variables by interpolation.[20] Second, hypothesizing diminishing sensitivities for all variables with dollar magnitudes (income, wealth and pension size), we convert in these cases numerical magnitudes to logs. And, third, we transform ordered categorical variables to binary ones, where we choose as a breakpoint that which (as closely as possible) equates the number of respondents on each side of the boundary.[21] Note that we display regressions both on all demographic variables (Eqs. (1)–(3)) and on those which first pass a 10% significance cut for at least one of the three initial specifications (Eqs. (4)–(6)).

As Table 2 shows, the results using all of the three methods are broadly consistent.[22] Two variables come strongly through: those who have the highest wealth and those who invest on their own tend to have a better sense of asset allocation. Neither of these findings is surprising. People with self-investment experience have likely built up a good knowledge base and thus come up with more sensible answers. Moreover, people with greater wealth levels have more to gain by judicious investing and have consequently taken the time to acquire useful knowledge.[23] Note that we see the usefulness of a multivariate approach in being able to weed out spurious correlations: for example, while gender is negatively correlated with consistency, this is due to the fact that women in our sample have lower levels of wealth and self-invest to a lesser extent.[24]

5. Equity share preferences, demographics and asset allocation consistency

In this section we turn to preferences on risk-taking. Specifically, we examine the stock-bond mix (averaged over the two questions) of all respondents as a function of demo-

[19] Bhandari and Deaves (2007) provide a correlation matrix. For example, income and education have a correlation coefficient of 0.21.

[20] The way we operationalized the conversion to numerical variables was to take the midpoint where there was one; and to depart by 20% for a one-sided (open-ended) interval. For example, below $25,000 was converted to $20,000 and $25,000–50,000 was converted to $37,500. Results were robust to using different interpolation schemes.

[21] We also conducted our empirical work by creating binary variables based on that breakpoint which minimizes the *p*-value relative to the variable to be explained. One problem with this approach is that there could be some endogeneity in the regressor, biasing it in favor of being significant. In any case, our results were robust to the use of this approach.

[22] The same is true with future reported estimations. Therefore, for brevity, from this point on we just present regressions with raw values (as in Eqs. (1) and (4)).

[23] There is also evidence, albeit weaker, that higher levels of generic (as opposed to financial) education and higher levels of income are associated with an ability to understand asset allocation. Again, we should not be surprised to see such groups educating themselves appropriately.

[24] Men/women have average wealth of $284,000/$206,000; and self-invest 45%/37% of the time.

Table 3
Regressions of average equity share on demographic variables with *AAC* indicator

Dependent variables	Eq. (1)	Eq. (2)	
		Standard coefficients	Interactive coefficients
Constant	0.537 (**0.000**)	**0.549 (0.000)**	
AAC (yes = 1)	0.051 (**0.005**)	−0.108 (0.731)	
Gender (male = 1)	0.046 (**0.000**)	0.041 (**0.001**)	0.031 (0.487)
Advice (yes = 1)	0.049 (**0.000**)	0.042 (**0.000**)	0.060 (**0.096**)
Age	−0.006 (**0.000**)	−0.005 (**0.000**)	−0.006 (0.119)
Education	0.011 (**0.000**)	0.009 (**0.003**)	0.018 (0.184)
Income	0.001 (**0.000**)	0.001 (**0.000**)	0.001 (**0.051**)
Self-investment (yes = 1)	0.013 (0.204)	0.011 (0.256)	0.010 (0.780)
Years to retirement	−0.002 (**0.008**)	−0.002 (**0.006**)	0.001 (0.876)
Adjusted R^2	0.124	0.146	

These regressions were estimated using OLS. Standard errors are White's heteroscedastic-consistent standard errors. The dependent variable is the average equity share. *P*-values are shown below coefficient estimates. *DC* size, kids, marital status, wealth, years in company, years in *DC*, and preferred years to retirement were included in the first regression, but were dropped as they were not significant at 10%.

graphic factors.[25] In Table 3 we report *OLS* regressions of equity exposure on demographic factors.[26] As with Table 2, we proceed by first regressing equity share on *all* possible demographic variables (the same set as in Table 2), and then dropping those variables whose *p*-values are greater than 10%. For brevity, we now only report the 10% cut regressions. Additionally, an *AAC* indicator variable (taking on a value of one when one is *AAC* and zero otherwise) is included, resulting in Eq. (1). Eq. (2) further includes multiplicative effects, whereby whether or not one is *AAC* potentially impacts slopes as well as the intercept. Such an approach was suggested by preliminary data analysis.[27] For example, if one observes how risk-taking varies with age, the impact of the latter on equity exposure is much more pronounced among those who understand asset allocation. Indeed those lacking understanding (most of the sample) exhibit very little age sensitivity.

Beginning with equation 1 and first abstracting from *AAC*, the results are largely in line with previous research. Males prefer equity, holding 4.6% more. Higher education and income (both reflecting more relatively safe human capital) induce greater equity exposure. Older people move away from equity as they age. Interestingly, there is both an age and a years-to-retirement effect. The years-to-retirement effect suggests that individuals *increase* equity exposure as they approach retirement. This seems in conflict with the age effect. A possible interpretation is that, holding age constant, the *ability* to retire sooner (which is proxied by fewer years to retirement) may signal greater investment success, which could

[25] See Fig. 1, *Panel B* for this frequency distribution. Results were robust to just using the first or second question as the independent variable. Notably though fits were higher using the first question. We conjecture that this was because the second question (naturally following the first) may have suffered from a framing bias. Ideally, if we had been able to run the survey, a preferred approach would have been to randomize the order of the two questions.

[26] Since it was always the case that heteroscedasticity could not be rejected, standard errors and *p*-values are based on White's heteroscedasticity-consistent standard errors. Estimation was done by *OLS*. Nevertheless, because of the concentration of observations at 0% and 100% equity (i.e., the endpoints), censored regressions were also run. The results were robust to the use of this methodology. (The same was true for Table 4.)

[27] See Bhandari and Deaves (2007) for more details.

be correlated with past risk-taking. The advice indicator also matters as one would expect: those who receive investment advice also prefer equity by an amount that is statistically and economically significant.[28] As for the impact of AAC, clearly investment knowledge leads to greater risk-taking, with the equity share increasing by a statistically significant 5.1%. One can infer from this that educational effort (whether self-administered or accessed within a plan) will likely lead to greater risk-taking and, if done judiciously, greater retirement preparedness.[29]

In order to more carefully consider whether factor sensitivities vary depending on the ability of respondents to understand asset allocation, we turn to Eq. (2). The column on the left shows standard coefficients, and the column on the right shows multiplicative interactive coefficients. Since interactive variables are the variables in question times the AAC indicator, the column on the left is relevant for those who do not understand asset allocation, and the column on the right is the *incremental* impact for those who do understand.[30] As we saw with Eq. (1), gender, advice-taking, age, education, income and years to retirement all significantly matter (at 1% or better) in the expected direction. Notably, the AAC indicator is no longer significant as its impact is captured by the interactive terms. In all but one case (years to retirement, where it is in any case insignificant) the demographic impact is *enhanced* for the AAC group. That is to say, those who are AAC have higher sensitivities to normative factors. For advice-giving and income, the incremental impact is both economically meaningful – the sensitivity is at least doubled – and statistically significant at 10% or better.

With Table 4, we pursue several refinements. The age non-linearity and non-monotonicity detected in previous research are tested for by including as additional regressors an age-squared term and its interactive counterpart. Moreover we aim for a more "optimized" regression model by performing a sequential variable-dropping procedure that leads to only significant variables being retained. Finally, we consider whether "money personality" has explanatory power.

The first equation, which includes all variables (both standard and interactive) regardless of significance, shows that, with age and age-squared both now included along with their interactive terms, because of high multicollinearity we are not close to statistical significance for any of these four variables individually. Next we pursue the following optimizing approach. Beginning with Eq. (1) we sequentially drop one variable at a time, choosing that variable with the highest p-value. This is continued till all variables pass a 10% p-value test. Eqs. (2) and (3) are the last two runs using this approach. Focusing on Eq. (2) (since the last variable dropped is just above 10% in significance, and the adjusted R^2 is higher than for 3), gender, advice, age (in its squared form), education, income and years to retirement all have the anticipated sign. Note that while there is clear evidence in favor of age-non-linearity, we are unable to reject monotonicity: in other

[28] Faig and Shum (2004) find that taking advice leads to a higher probability of holding equities but not a higher equity share.

[29] Wealth and self-investment, the two main determinants of asset allocation consistency, while insignificant in this regression, are significant in an (unreported) regression that does not include an AAC indicator (Bhandari & Deaves, 2007). Further, there is evidence that an understanding of asset allocation is correlated with a wider understanding of investments (Deaves, 2005).

[30] One could also estimate separate regressions for the AAC and non-AAC groups. Taking Eq. (2) of Table 3 as an example, the intercept for the non-AAC/AAC group is $0.549/(0.549 - 0.108)$; the gender coefficient is $0.041/(0.041 + 0.031)$; the advice coefficient is $0.042/(0.042 + 0.60)$; and so on.

Table 4
Regressions of average equity share on demographic variables with *AAC* interactive effects (and age non-linearity and non-monotonicity, a planner indicator, and sequential variable elimination)

Variables	Eq. (1) non-/interactive coefficients		Eq. (2) non-/interactive coefficients		Eq. (3) non-/interactive coefficients		Eq. (4) non-/interactive coefficients	
Constant	0.4465 (0.000)		0.4032 (0.000)		0.4011 (0.000)		0.3855 (0.000)	
AAC (yes = 1)	−0.3755 (0.510)							
Gender (male = 1)	0.0381 (**0.001**)	0.0284 (0.541)	0.0472 (**0.000**)		0.0474 (**0.000**)		0.0409 (**0.000**)	
Advice (yes = 1)	0.0458 (**0.001**)	0.0254 (0.527)	0.0473 (**0.000**)		0.0462 (**0.000**)		0.0308 (**0.002**)	
Age	0.0000 (0.942)	0.0181 (0.410)						
Age^2**/100**	−0.0047 (0.308)	−0.0303 (0.204)	−0.0048 (**0.000**)	−0.0088 (**0.000**)	−0.0050 (**0.000**)	−0.0070 (**0.000**)	−0.0044 (**0.000**)	−0.0083 (**0.000**)
DC size	0.0000 (0.865)	0.0000 (0.647)						
Education	0.0087 (**0.009**)	0.0140 (0.372)	0.0105 (**0.001**)	0.0067 (0.110)	0.0115 (**0.000**)		0.0101 (**0.001**)	0.0034 (0.427)
Income	0.0008 (**0.001**)	0.0008 (0.391)	0.0009 (**0.000**)	0.0016 (**0.009**)	0.0007 (**0.000**)	0.0024 (**0.000**)	0.0008 (**0.000**)	0.0017 (**0.007**)
Kids (yes = 1)	0.0017 (0.898)	−0.0321 (0.525)						
Mar. status (yes = 1)	0.0088 (0.478)	−0.0491 (0.341)						
Self-inv. (yes = 1)	0.0223 (**0.039**)	−0.0025 (0.946)						
Wealth	0.0000 (0.279)	0.0000 (0.938)						
Years in co.	−0.0006 (0.590)	−0.0005 (0.895)						
Years in *DC*	−0.0010 (0.593)	0.0020 (0.649)						
Years to retirement	−0.0020 (**0.031**)	−0.0008 (0.869)	−0.0018 (**0.048**)		−0.0017 (**0.061**)		−0.0013 (0.149)	
Pref. yrs. to retire.	0.000 (0.860)	0.001 (0.905)						
Planner (yes = 1)							0.0383 **(0.000)**	0.0928 **(0.025)**
Adjusted R^2	0.143		0.147		0.146		0.163	

These regressions were estimated using OLS. For each regression equation, the left column provides non-interactive coefficients and the right column provides interactive (*AAC* times the variable in question) coefficients. Standard errors are White's heteroscedastic-consistent standard errors. The dependent variable is the average equity share. *P*-values are shown below coefficient estimates.

words, the hump disappears in a multivariate context.[31] While in our data a hump *does* exist when we condition on age alone, this arises from the fact that younger workers usually have lower income and are more likely to be female (both of which tilt things towards reduced risk-taking at early ages).[32] Age-squared, education and income have at least marginally significant interactive terms. Note that in all three cases the *incremental* impact implies an enhanced impact for the variables in question when a respondent signals an understanding of asset allocation.

There has been recent interest in whether money personality can explain investor behavior over and above pure demographics. For example, research conducted by *Vanguard* uses a statistical technique known as cluster analysis to assign plan members to attitudinal segments based on measurable attributes (Marconi & Utkus, 2002). While this work identifies five groups, their key distinction is between "planners" and "avoiders." Planners are motivated and comfortable with retirement and pension concepts. Avoiders are not comfortable at all: they may not have the time, they may not have the inclination, or they may not have the capacity to become planners. Based on this approach, survey respondents were assigned to either the planner or avoider camps.[33] To investigate the impact of money personality, we ran a regression (Eq. (4) of Table 4) which is identical to Eq. (2), except that a planner indicator and its interactive counterpart are included as additional explanatory variables.[34] This indicator takes on a value of one when an individual falls into the planner camp; and zero otherwise.[35] It is apparent that further risk-taking predictability can be gleaned from attitudinal segmentation. Being a planner leads one in the direction of increased equity exposure. It is likely that planners are people who are more likely to have attended retirement planning seminars and to have thought carefully about the consequences of their investing. Additionally, planners who understand asset allocation bear even more risk.[36] Finally, note that years to retirement and the interaction of education and AAC are now rendered insignificant.

[31] Note that, even if we re-introduce age and its interactive component at the stage of Eq. (2), the signs of the coefficients are inconsistent with the existence of an extremum.

[32] 54% of those under 30 are female. The under-30 income level ($48,430) is substantially below the other age categories. Running a stripped-down regression of equity share on age and age^2/100, we arrive at:

$$\text{Equity share} = 0.415 + 0.100^{*}\text{age} - 0.015^{*}\text{age}^2/100$$

$$\text{Adjusted } R^2 = 0.02, n = 1845, \text{Coefficient } p\text{-values} = \{0.000, 0.111, 0.052\}$$

Since the coefficient on age is close to being significant at 10%, there is weak evidence of a hump. Differentiating the above equation and solving for the maximum equity share, we find that this occurs at a value (with rounding) of 34 years.

[33] SEI Investments (2004), using data from the survey under study, slotted respondents into five groups. Three of their groups corresponded quite closely to various shades of the planner mentality, while the remaining two groups fit the avoider mold.

[34] Ackert et al. (2002) find that generic (as opposed to money) personality-types have some explanatory power in explaining risk-taking. Statman and Wood (2004) also investigate generic personality types.

[35] We also ran a regression using four indicators (since there were five attitudinal segments). The coefficients were such that it was clear that the risk-taking of the planner/avoider sub-groups differed little.

[36] For additional evidence on planners and financial decision-making, see Deaves, Veit, Bhandari, and Cheney (2007).

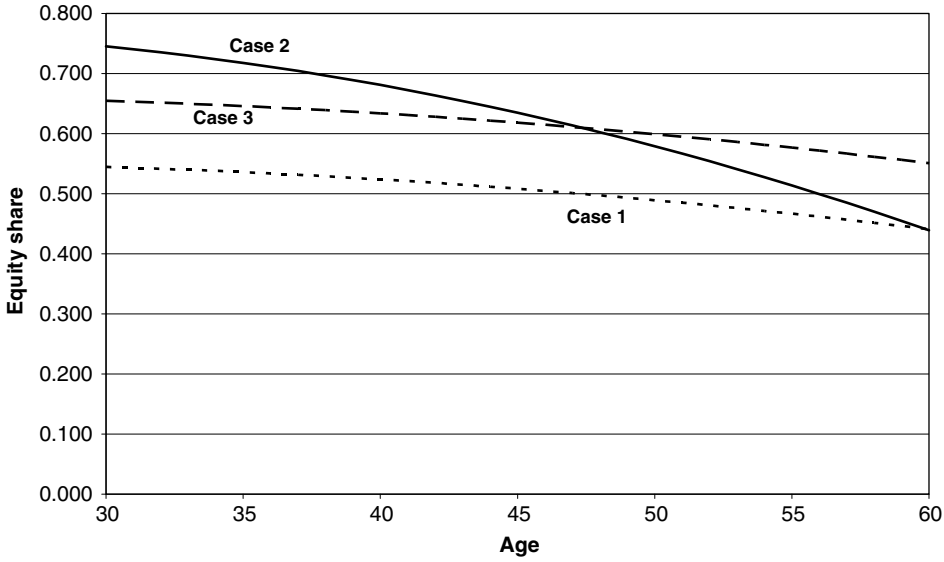

Fig. 2. Equity exposure as a function of age: This figure shows equity exposure over a 30-year career based on three scenarios. In all cases, the individual has average education (14.9 years). The income profile is based on fitted values from a regression of average income on age. Case 1 is for a non-planner, non-advice-receiving female who does not understand asset allocation. Case 2 is for a planner, advice-receiving male who does understand asset allocation. Case 3 is identical to Case 2 except the individual does not understand asset allocation. In all three cases, the coefficients of Eq. (4) of Table 4 are utilized.

Fig. 2 allows us to get a sense of the collective impact of all these determinants on behavior. Take an individual with average education and average income.[37] As a base case (Case 1), suppose the individual in question is female, does not receive advice, is not *AAC*, and falls into the avoider camp. Consider her equity exposure over a 30-year career beginning at the age of 30. It is shown by the dotted lower curve: beginning at 54.5%, it declines to 44.1% at 60. Now consider an alternative case (Case 2): male, receiving advice, *AAC*, and in the planner camp. The solid line shows the evolution of risk-taking over the same career: 20% higher than Case 1 at 30, virtually converging at 60. Finally the broken line illustrates Case 3, which is Case 2 with one alteration, namely that the individual in question is not *AAC*. It is apparent that at 30 roughly half (11%) of the difference between the alternative case and the base case (Case 1) is due to the member being an advice-taking, male planner; and the other half (9%) is due to one signaling an understanding of asset allocation. There is a further salient point: as one ages, that part of the gap which is explained by being *AAC* diminishes, eventually becoming negative. The upshot of this is that being *AAC* causes one's risk-taking to exhibit a higher *sensitivity* to aging: in fact, if one is *AAC*, equity exposure declines by roughly 1% per year – exactly the decline recommended by many financial planners.

[37] We used the average education level of 14.9 years, average age-specific income levels, and Eq. (4) (of Table 4) coefficient estimates.

6. Concluding remarks

The existence of asset allocation confusion among self-directed retirement account members is documented using a dataset of Canadian DC plan members. Consistent with Benartzi and Thaler (2001), confusion is widespread. Further, those with higher levels of wealth who actively manage their own portfolios have a clearer sense of asset allocation and are less likely to err.

Consistent with previous work, the stock-bond mix is impacted by gender, age and income: younger, higher-earning males hold more equities. A reasonable inference seems to be that no strong bias arises from the use of hypothetical survey data rather than actual portfolios. Moreover, we produce some new insights. Those with higher levels of education, receiving advice and having a planner mindset take on more risk. Additionally, those who understand asset allocation are more likely to be risk-takers. This comes through in the enhanced sensitivity of several key factors for those who are AAC. For example, while those who are ignorant do decrease their equity share a little with age, the decrease is greater for the AAC group.

Some care is called for. Can we definitively conclude that those who understand asset allocation are closer to optimal behavior than those who do not? It is impossible to be certain. The reason is that most theoretical models are not precise enough. For example, while models do call for a positive relationship between income and equity share, they do not specify what the partial derivative should be. So it is always possible that those who are consistent overshoot. This issue awaits further research.

This caveat notwithstanding, the evidence here seems to reinforce the importance of education to increase the likelihood that individuals will conform to normative precepts. Bernheim and Garrett (2003) and Lusardi (2004) document that workplace financial education increases saving. Admittedly though some are not likely to access or be swayed by education. In such cases, judicious defaults are arguably best. In this regard, it has been demonstrated that automatic enrolment is helpful in getting people to save (Madrian & Shea, 2001), and that a program whereby people lock themselves into future scheduled deferral increases is effective in inducing people to save more (Thaler & Benartzi, 2004). In the context of asset allocation, defaults into age-based asset allocation funds, or, even better, the increasingly popular lifecycle-type funds designed to dynamically adjust asset allocation as individuals approach retirement (Holden & VanDerhei, 2005), are sensible.

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