Education, Cognitive Performance, and Investment Fees[1]

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Abstract

We study the association between human capital and rollovers into Individual Retirement Accounts (IRAs), using administrative records from the defined contribution savings plan for U.S. government employees: the Thrift Savings Plan (TSP). Employees who separate from government employment have the option to leave balances in the TSP, where fees are currently under 4 basis points. However, we estimate that more than a third of the TSP balances end up being rolled over into IRA accounts, which are very likely to have much higher fees. We find that educational attainment has a very small *positive* association with the propensity to roll balances *out* of the TSP (the extensive margin). Hence, when deciding whether to initiate a rollover, employees with higher levels of educational attainment choose higher fee investments. However, *conditional* on rolling money out of the TSP, we estimate a very small negative association between educational attainment and IRA fees measured as basis points (the intensive margin). Because the extensive and intensive associations have opposite signs and are each small to begin with, educational attainment has no economically meaningful association with retirement account fees paid by TSP participants. Similar small and/or null effects are observed for another human capital variable that we study in the TSP data: AFQT scores.

I. Introduction

Human capital includes all of the capabilities that make people more productive and more successful. Educational attainment is correlated with human capital because of two mechanisms. First, education directly creates human capital. Second, people who choose to obtain more years of education tend to be those who have already had the most success in school (e.g., higher grades and greater scholastic achievement).

Economic theory posits that human capital is correlated with more sophisticated decision-making, explaining why wages are correlated with human capital. Therefore, it is natural to hypothesize that educational attainment (a proxy for human capital) is correlated with better investment choices. We measure the strength of this protective effect in the domain of investment management fees.

Specifically, we study the association between education and rollovers from a large retirement savings plan, the federal government's Thrift Savings Plan (TSP) to Individual Retirement Accounts (IRAs). The TSP has extremely low asset management fees: all of the funds in the TSP have management fees that are less than 4 basis points. Because employees can leave their funds in the TSP, rollovers to IRAs, which almost all have much higher management fees, are economically puzzling. We estimate that in our data the average (dollar-weighted) IRA rollover pays fees that include expense ratios on mutual funds and advisory fees that are substantially higher than fees paid inside TSP. Nevertheless, we find that over a third of the TSP balances of those separating between ages 50 and 69 eventually rolls over to an IRA.

We study rollovers from the TSP during the 2016-2018 period. Somewhat surprisingly, we find that educational attainment has a very small *positive* association with the propensity to roll balances out of the TSP into an IRA. Controlling for balances, an extra year of education is associated with a 0.2 percentage point *higher* probability of rolling money out of the plan during this three-year period.

However, once we condition on only those employees who do roll money out of the plan, educational attainment has a very small negative association on the management fees paid at the institutions to which balances are rolled over. In our main specification (with controls), an extra year of education is associated with management fees that are one basis point lower.

Putting these two results together, in the TSP dataset we find that educational attainment does not have an economically meaningful association with retirement account fees. Two very small associations with *opposite* sign jointly amount to an

extremely small positive (statistically significant) association between educational attainment and retirement account fees. This result rules out the negative association predicted by most theories of human capital.

We are also able to study a direct measure of cognitive function: Armed Forces Qualification Test (AFQT) scores. These effects are roughly similar to those for educational attainment; the signs and effect sizes of the AFQT associations are usually the same as those for the educational attainment associations. Higher AFQT scores are associated with a slightly higher likelihood of rolling money out of the TSP. However, among those participants rolling out, higher AFQT scores are associated with the choice of an IRA provider that charges slightly lower total asset management fees. Putting these results together, in the TSP dataset, AFQT scores have an extremely small positive (statistically significant) association with retirement account fees. Once again, this result is at odds with the negative association predicted by most theories of human capital.

This paper contributes to four related literatures: (i) the behavioral finance literature that examines whether people make optimal investment decisions; (ii) a literature on advice given to TSP participants; (iii) the literature on cognitive ability and financial decision-making, and (iv) the literature on leakage out of the retirement system. First, this paper contributes to a broad body of work that seeks to explain why investors make suboptimal investment decisions.[2] Total fees in the TSP are low relative to outside options, but the TSP funds themselves are virtually identical to the mutual funds typically held in IRAs. Unless the rollovers out of TSP and into more expensive IRA accounts are based on other factors, such as greater flexibility regarding withdrawal options, our results suggest that people do not optimize their asset allocation. In particular, we replicate the finding that people fail to minimize mutual fund fees or fees in their portfolio even when expected returns (before fees) are equivalent (Elton et al., 2004; Hortaçsu and Syverson, 2004; Choi et al., 2010; Ayres and Curtis, 2015).[3]

This paper is also related to the literature on rollover advice that is given to TSP participants. Several studies have shown that financial advisers encourage TSP participants to roll over their accounts to IRAs. Turner, Klein, and Stein (2016) survey 15 advisers at financial institutions over the phone, and they find that 10 out of 15 advisers recommend rolling over balances out of the TSP and into an IRA. In making this recommendation, many advisers focused on the benefits of diversification and ignored

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[2] See Hirshleifer (2015) for a review of behavioral finance.
[3] We do observe the assets held in advisory accounts, so we cannot test the hypothesis that the assets are not identical but instead provide account services that warrant a higher price. Elton, Gruber, and Busse (2004) and Grinblatt et al. (2016) both control for service quality and still find evidence of price dispersion.

fees as a relevant factor. They also conduct an email survey of 15 advisers who are subject to a fiduciary standard by the National Association of Personal Financial Advisors (NAPFA), and they find that having a fiduciary standard does not make any economically meaningful difference in the quality of advice, as many advisers still recommend a rollover on conditional terms and miss fees as a relevant factor. A related study by the Government Accountability Office (2013) surveys 30 call center representatives and studies the extent to which they recommend callers to roll over their 401(k) balances into an IRA. Like Turner, Klein, and Stein, they find that representatives generally recommend callers to roll over their 401(k) balances into an IRA, citing the benefits of increased investment options and direct control. Considering that representatives gave this advice with minimal knowledge of callers' financial circumstances, we would expect TSP participants to receive similar recommendations as well.

Our paper also contributes to a growing body of work that examines the relationship between cognitive ability or financial literacy and financial decisions.[4] Grinblatt et al. (2016) examine the effects of cognitive ability on management fees. Using a sample of Finnish IQ records that are merged with information on mutual fund purchases and education, the authors find a small association between IQ and expense ratios. The authors find a modest negative association between cognitive ability and expense ratios; in their preferred specification, they find that a one standard deviation difference in IQ is associated with fees that are lower by two percent. They isolate two mechanisms: (i) high-IQ investors typically avoid expensive asset classes, like balanced funds, and (ii) holding the asset class and services provided by the fund constant, high-IQ investors avoid expensive firms. We cannot observe the assets that people choose in non-TSP retirement accounts (to test the first mechanism), so our paper studies the second mechanism alone.

Similarly, Choi et al. (2010) are unable to reject the hypothesis that educational attainment has no relationship with investment fees, but they do find that financial literacy is associated with choosing lower fees. For example, people who self-report as very knowledgeable investors choose a portfolio with average fee that is 97 basis points lower than people who self-report as not at all knowledgeable. Several other papers contest Choi et al. (2010)'s finding that financial literacy is associated with reducing fees. Müller and Weber (2010) link an online survey about mutual fund choices with a measure of financial literacy. They conduct an exam that tests people's literacy objectively. They find no association between management fees and financial literacy, but people who are financially literate have more precise estimates of their fees.

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[4] See Hastings, Madrian and Skimmyhorn (2013) for a review of the literature on financial literacy.

Other researchers have examined the effect of providing simplified information on fees; we think of these information treatments as providing education about some local context. Choi et al. (2010)'s study included one treatment arm that provided subjects with a simplified mutual fund prospectus in addition to an official prospectus. They find that the group with information provision had five percent lower fees than a control group that received the official prospectus alone. Hastings, Hortaçsu, and Syverson (2017) study Mexico's pension market using administrative data on mutual fund managers and workers. Of particular interest for this paper, they conduct a counterfactual simulation of the effect of reducing customers' cognitive cost of comprehending mutual funds; they calibrate their model using parameters from field- and natural-experimental studies of information campaigns to educate the financially illiterate. The authors find that such information campaigns would reduce fees by almost 35 percent.

Finally, this paper extends a smaller literature that studies the money that leaks out of retirement savings accounts. Munnell and Webb (2015) find evidence of moderate leakage out of retirement savings plans. The authors show that 0.5% of savings leak out of Vanguard plans via cashouts at separation annually; hardship withdrawals, age-based withdrawals, and loan defaults represent leakage of 0.3%, 0.2%, and 0.2% of plan assets respectively each year. The authors estimate that total leakages erode 25% of 401(k) wealth and 23% of IRA wealth by age 60. This work contrasts with earlier research by Poterba, Venti, and Wise (2001) that finds that cashouts at separation reduce retirement wealth by at most 5%. Argento, Bryant, and Sabelhaus (2015) study withdrawals during the 2008 financial crisis and find that people in the 5th income decile who experienced a negative income shock were more than twice as likely to take a net taxable withdrawal.

The rest of the paper is organized as follows. Section II discusses the TSP data and provides a description of the TSP plan. In Section III, we present the estimates of a Markov transition model that describes the flow of balances to different types of distributions, including IRA rollovers. In Section IV, we report our analysis of the relationship between human capital and rollovers, including separate analyses of the extensive margin (will separated employees choose to rollover their balances) and the intensive margin (among those employees who do roll over their TSP balances, what fee will their IRA charge them). Section V compares our results to those in the literature. We argue that our results are similar (in magnitude) to the results in other papers. Section VI concludes.

II. Data and institutional structure

A. TSP: Structure, Options, and Fees
a. Structure

The Federal Retirement Thrift Investment Board (FRTIB) administers the Thrift Savings Plan (TSP), a defined-contribution retirement savings plan for United States federal government employees. The TSP is the largest defined contribution plan in the world, with more than $500B in assets under management (Federal Retirement Thrift Investment Board 2018).[5] All TSP balances are invested in passively managed funds, with participants able to select from funds holding government bonds, corporate bonds, large capitalization U.S. stocks, small to medium capitalization U.S. stocks, international stocks, and (as of 2005) various lifecycle funds (Petrick 2015).[6] Table 1 lists the investment options available to participants.

Table 1: Investment Options in the TSP

Fund Name	Description of Investments	Objective of Fund	Expense Ratios	
			2016	2017
G Fund	Government securities (specially issued to the TSP)	Interest income without risk of loss of principal	0.038%	0.033%
F Fund	Government, corporate, and mortgage-backed bonds	To match the performance of the Bloomberg Barclays U.S. Aggregate Bond Index	0.038%	0.032%
C Fund	Stocks of large and medium-sized U.S. companies	To match the performance of the S&P 500 Index	0.038%	0.032%
S Fund	Stocks of small to medium-sizes U.S. companies	To match the performance of the Dow Jones U.S. Completion TSM Index	0.038%	0.032%
I Fund	International stocks of more than 20 developed countries	To match the performance of MSCI EAFE Index	0.039%	0.032%
L Funds	Invested in the G, F, C, S, and I Funds	To provide professional diversified portfolios based on various time horizons, using the G,F,C,S, and I Funds	0.038%	0.033%

Sources: Thrift Savings Plan, Fund Comparison Matrix. See https://www.tsp.gov/InvestmentFunds/FundsOverview/comparisonMatrix.html, https://www.tsp.gov/PDF/formspubs/high17b.pdf and https://www.tsp.gov/PDF/formspubs/high18b.pdf

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[5] Given the wider awareness of the TSP vs. the FRTIB, we refer to the data and organization throughout the paper as the TSP.

[6] The G Fund invests exclusively in special-issue non-marketable Treasury securities. The total return on these securities is equal to the interest yield (i.e. there are no capital gains or losses) which is set equal to the weighted average of the yield of all outstanding Treasury notes and bonds with 4 or more years to maturity. See https://www.tsp.gov/InvestmentFunds/FundOptions/fundPerformance_G.html

b. Fees

Table 1 also presents the current expense ratios for each of the investment options available in the TSP. Typical net expenses are less than 0.040%, i.e. 4 basis points. TSP's large assets under management and its exclusive reliance on passive management enables it to charge very low fees relative to funds available outside of TSP.

c. Withdrawal Options

While the TSP is currently implementing more flexible withdrawal options, the following choices were available to participants during our study period.[7] First, while still employed, individuals age 59 ½ and over can take a single "age-based in-service withdrawal", as a cash withdrawal, a rollover transfer to an IRA or another employer plan, or both.[8] Second, an employee that separates from government employment can initiate a partial withdrawal, i.e. a portion but not all of the TSP balance. Each separated employee who has not taken an age-based withdrawal is allowed to make at most one partial withdrawal, with a minimum amount of $1,000. This one-time payment can be allocated between a direct deposit to the participant (i.e. a cash withdrawal) and a rollover transfer. Finally, a separated employee can initiate a "full withdrawal" which can take the form of a cash withdrawal, a rollover transfer to an IRA or eligible employer plan, a stream of monthly payments (either a fixed dollar amount or an amount calculated by TSP based on life expectancy), an annuity purchase, or any combination of these options.[9] This full withdrawal must take place by April 1 of the year following the year the participant turns 70 ½.

The vast majority of rollovers are made to IRAs, which is the main focus of our analysis.

B. Participant data

We combine administrative data from the Department of the Army with account data from the TSP. Our sample includes all Department of the Army personnel (federal civilian employees and uniformed service members) who had a positive TSP balance at any point during the period Q1 2016 to Q1 2018.[10] Our Department of the Army

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[7] Legislative changes to TSP withdrawal options were recently made and are planned to go into effect in the fall of 2019. See https://www.tsp.gov/whatsnew/Content/index.html#withdrawaloptions, https://www.tsp.gov/PDF/formspubs/tspbk02.pdf, and https://www.tsp.gov/PDF/formspubs/tspfs10.pdf

[8] We do not include here one additional form of in-service withdrawal - the hardship withdrawal. See https://www.tsp.gov/PDF/formspubs/tspbk12.pdf.

[9] The rollover transfer can also occur via a stream of monthly payments, although this is rare. Only 0.6% of individuals rolling over initiate monthly rollover transfers.

[10] For civilian employees, the plan features a 1% automatic contribution by the employer, dollar for dollar matching for the first 3% of employee contributions, and fifty cents on the dollar matching for the next 2% of employee contributions. Since August of 2010 civilian employees have been subject to automatic

personnel administrative data include the level of educational attainment for each individual. Attainment categories include GED, associate degree, bachelor degree, and advanced degree, and there are also in-between categories indicating whether an individual dropped out from any of these programs. For military personnel and veteran civilians, we have scores on the Armed Forces Qualification Test (AFQT), which is used to determine whether an individual is qualified for enlistment. The AFQT evaluates individuals on vocabulary, reading comprehension, and mathematical skills, and researchers use AFQT scores as measures of cognitive ability (see, e.g. Griliches and Mason, 1972). Our data also include information on salary, employment separation dates, and demographic information on age, gender, race/ethnicity (i.e., Black non-Hispanic, Hispanic, White Non-Hispanic), military status (i.e., uniformed member or civilian employee), and military veteran status.

The quarterly retirement account data from the TSP cover each quarter from Q1 2016 through Q1 2018, and include contributions, balances, fund allocations to the funds described above, and the amounts, timing, and form of partial and full withdrawals. Transaction amounts in each category are aggregated at the quarterly level. Our data also include a field listing the name of the financial institution receiving the rollover.

Table 2 describes the three samples that we use for our analysis, and Table 3 presents the corresponding sample sizes.   To take just one example, we are able to observe 10,270 individuals who rolled over from TSP to an IRA or employer plan during the period Q1 2016 to Q1 2018.

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enrollment at a 3% contribution rate. For the effects of this policy, see Beshears et al. (2018). During our period of study, uniformed service members receive no matching contributions and none were automatically enrolled. Civilian personnel were defaulted into the government securities (G) fund until September of 2015, when their default fund changed to the age-appropriate lifecycle (L) fund.

Table 2: Sample Definitions

Sample Name	Analysis	Definition
Middle-Age Separators	Fund Projections	Employees aged 50-69 at separation and had balances at some point during our sample period.[11] Only includes observations corresponding to the post-separation period. Excludes employees after all TSP funds have been withdrawn. Excludes fund flows during Q1 2016.
In-Sample Separators	Extensive Margin	Individuals employed as of Q1 2016 and who separated between Q2 2016-Q1 2018
In-Sample Rollovers	Intensive Margin	All separated employees with rollover transfers during Q1 2016-Q1 2018 to institutions for which we have fee data.[12]

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[11] Other age groups can be considered depending on the analyses. Employees in this sample could have separated at any time (both during and before our sample period). By focusing only on observations corresponding to periods of separation, we focus on the post-separation movement of TSP funds.

[12] Employees in this sample could have separated at any time. Fees for some institutions are imputed as outlined in section IV.

Table 3: Sample sizes and Summary Statistics[13]

| Sample Name	Middle-Age Separators		In-Sample Separators		In-Sample Rollovers	
Analysis	Fund Projections		Extensive Margin		Intensive Margin	
Subgroup	(Full)	(AFQT)	(Full)	(AFQT)	(Full)	(AFQT)
Years of Education	14.4 (2.7)	13.4 (2.4)	13.3 (2.6)	12.2 (1.9)	14.6 (2.7)	12.9 (2.2)
% with Rollover	8.2%	5.1%	5.9%	2.5%	100%	100%
Total Fees paid (bps) | Rollover					177 (64)	173 (51)
- Expense Ratios					56 (22)	55 (19)
- Advisory Fees					120 (56)	118 (46)
TSP Balances at Q1 2016	$155K ($180K)	$70K ($97K)	$52K ($112K)	$14K ($34K)	$124K ($163K)	$34K ($64K)
Age at Q1 2016	58.7 (4.9)	56.0 (4.9)	40.8 (13.7)	34.6 (10.2)	50.8 (13.6)	38.4 (11.3)
% Male	64.4%	84.2%	74.5%	83.0%	67.9%	80.1%
% Military	10.3%	36.7%	62.2%	86.9%	32.9%	79.3%
% White	57.4%	31.8%	46.8%	50.2%	57.7%	57.7%
% Black	9.3%	21.2%	17.3%	23.0%	8.5%	16.7%
% Hispanic	4.1%	5.9%	8.0%	10.8%	4.5%	7.5%
% Other	29.2%	41.2%	28.0%	16.0%	29.3%	18.1%
# of Employees	74,518	7,767	78,687	45,454	10,270	2,347
# of Observations Per Employee	[1,9] 6.29	[1,9] 5.24	1	1	1	1

[13] The table reports proportions or means with standard deviations in parenthesis

III. How Funds Leave the TSP

A. Methodology

When employees separate from employment, they can either leave their accumulated balances in the TSP or take an action to withdraw or transfer funds. As described above, under current rules, withdrawal and transfer options include: 1) transferring balances to another institution via a rollover to an IRA or eligible employer plan, 2) withdrawing balances as a single cash payment, 3) withdrawing balances as a series of monthly cash payments, 4) using funds to purchase a life annuity, or any combination of these.[14] Figure 1 summarizes these possible options, as well as subsequent allowable transitions.

Figure 1: Possible transitions of TSP balances
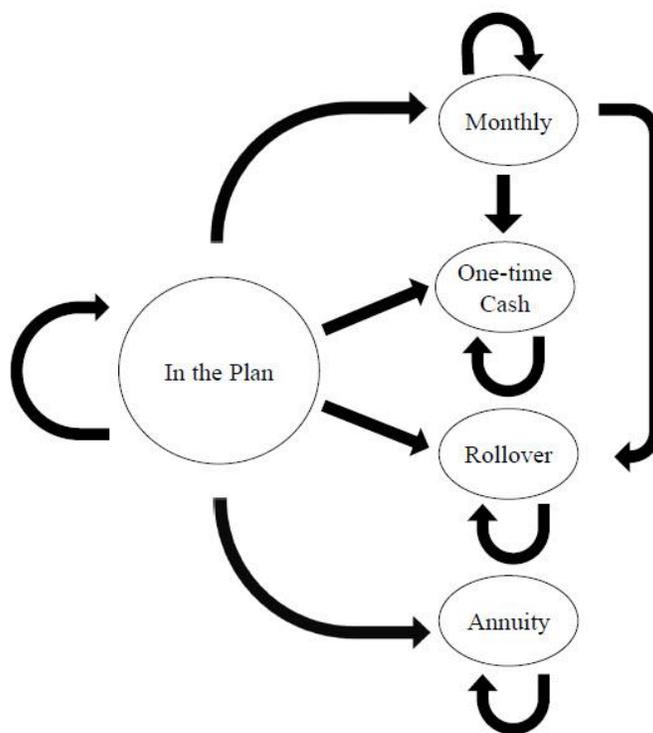
Once funds are allotted to monthly cash payments, they cannot be returned to the TSP. Such balances can be continued to be paid out on a monthly basis, or remaining portions can be converted to a final cash payment or rollover transfer. Balances must remain in their respective categories once they are allotted to single cash payments, rollover transfers, or annuities.

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[14] When the participant chooses to withdraw as a series of monthly payments, we include the entire balance into the monthly payments bucket, even though the bulk of the funds remain within TSP and only gradually leave. Once separated individuals turn age 70 ½ they are subject to Required Minimum Distribution rules (RMD), which can be satisfied by taking a full cash withdrawal, a series of monthly payments, or the purchase of an annuity. See https://www.tsp.gov/PDF/formspubs/tsp-776.pdf for details.

We estimate a set of transition matrices between categories and use these matrices to forecast the proportion of TSP balances remaining in each category one to 40 quarters after separation. We allow these transition matrices to depend on the number of quarters since separation in an unrestricted way, but we assume that these matrices are stable across calendar time. When we perform our analysis on sub-samples based on age and other demographics, we estimate the transition matrices separately for those groups. Since our data cover only Q1 2016 to Q1 2018, we do not fully trace all separating employees for 40 subsequent quarters. However, we do observe the date of separation for each employee, allowing us to observe transfer activity for the set of employees who separated prior to Q1 2016 but retained some or all of their balances at TSP in or after Q1 2016. This allows us to estimate transition matrices beyond 8 quarters from separation. For example, if someone separated in Q1 2011 but had funds remaining in TSP in Q1 2016, we can use account activity in Q1 2016 to estimate the five year from separation transition probability matrix. We also use the data on pre Q1 2016 separators to help estimate one to eight quarter transition probabilities.[15] The sample of people who separate at ages 50-69 are referred to as "middle-age separators" (see above).

The projections are done using two types of weights: person-weights and dollar-weights. Person-weighted measures estimate the average proportion of individual balances that land in each category, while dollar-weighted measures estimate the proportion of all TSP balances in the system that land in the category.

B. Results

We begin by focusing on individuals who separate from employment between ages 60 and 69. Figure 2 shows the key person-weighted (left panel) and dollar-weighted (right panel) results. Our main findings are as follows.

First, in the years following separation, a substantial fraction of total balances of the group leave the plan via rollovers (see dollar-weighted results). Within 10 years of separation, 38% of initial balances are rolled over into IRAs at a financial institution. About half of this (18%) occurs in the first four quarters after separation from employment, and the other half occurs gradually over the subsequent 8 years. In Sections III and IV below, we examine these rollovers in more detail.

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[15] For instance, Q1 2016 corresponds to four quarters after separation for employees terminating in Q1 2015, and Q3 2017 also corresponds to four quarters after separation for employees terminating in Q3 2016. To estimate transition matrices at four quarters after separation, we incorporate transfers initiated by both of these employees. That is, we incorporate transfers from different calendar dates that occur after a fixed number of quarters after separation.

Second, about 14% of initial balances are removed from TSP via one-time lump-sum cash withdrawals within 10 years of separation. Combined with rollovers, this implies that just over half (52%) of all TSP balances are removed from the TSP via IRA rollovers and lump-sum withdrawals in the ten years after separation from employment. Note that the person-weighted percentage taking one time cash (37% over ten years) is substantially higher than the dollar-weighted, indicating that those with small balances are more likely to withdraw their balances as a single cash withdrawal.

Figure 2: Transition Results, Ages 60-69

Proportion in Each Bucket vs. Time
Ages 60-69 at Separation
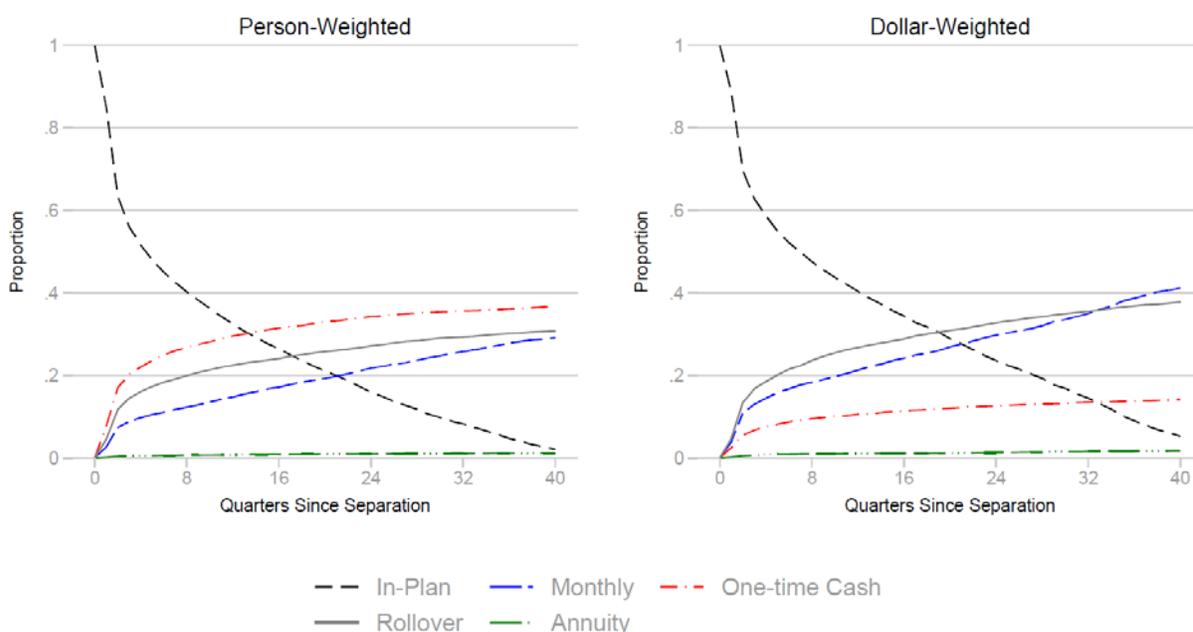

Quarterly transition matrices.
The exhibit displays flows alone and does not account for other factors like balances, income, employment duration, etc.

Third, we find that purchases of annuities are very infrequent. Only 1.8% of aggregate initial balances are used to purchase annuities during the entire 10 years after separation. We do not pursue in this paper the possible reasons for this low annuitization rate, but our finding is consistent with the large academic literature on the annuity puzzle. See, e.g. Benartzi, Previtero, and Thaler (2011) and Beshears, Choi, Laibson, Madrian, and Zeldes (2014).

Fourth, we find that by the end of 10 years about 41% of initial funds have been allocated to the monthly withdrawal option. This is in part due to RMD requirements

that minimum payments begin by or soon after age 70 ½.[16] To shed light on the effects of RMDs, Figure 3 shows the same patterns for the subset of individuals aged exactly 65 at separation. There are two bursts of activity around the monthly withdrawal option. One jump occurs initially, as about 19% of funds are allocated to the monthly withdrawal option within 4 quarters of separation. Another jump occurs between 16 and 24 quarters after separation, the times that these individuals become subject to RMDs.

Figure 3: Transition Results, Age 65

Proportion in Each Bucket vs. Time
#### Age 65 at Separation
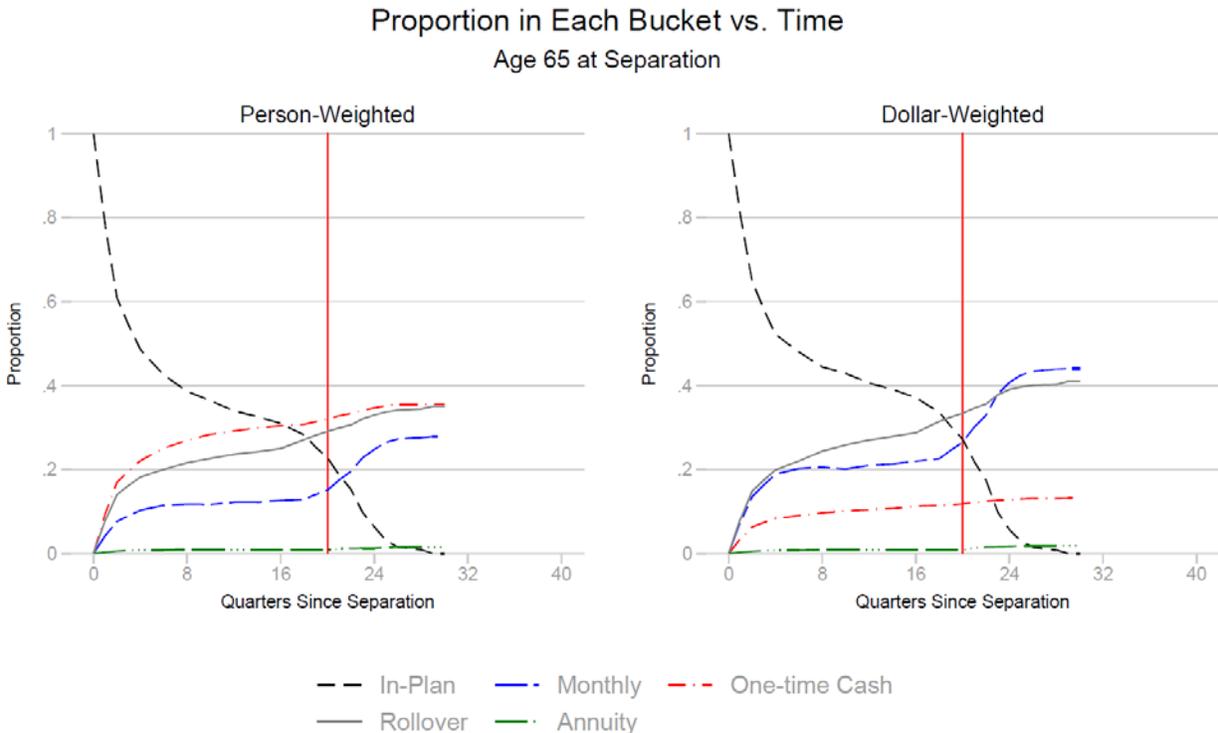
Each of the four patterns described above are present in the withdrawal patterns of other age groups, although to different degrees. Figures 4 and 5 show the same estimates for those who separate at ages 40-49 and 50-59 respectively. Relative to the 60-69 group, the fraction of balances taken as a one-time cash withdrawal is higher for younger separators, and the fraction that is rolled over is lower for younger separators.

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[16] The calendar year when a participant reaches age 70 ½ is referred to as the first distribution calendar year. If participants do not fully withdraw their balances by the end of the first distribution calendar year, they receive the required minimum distribution on March 1 of the following year. Remaining balances that are not withdrawn within a month of receiving the RMD are forfeited to the TSP.

Figure 4: Transition Results, Ages 40-49

Proportion in Each Bucket vs. Time
Ages 40-49 at Separation
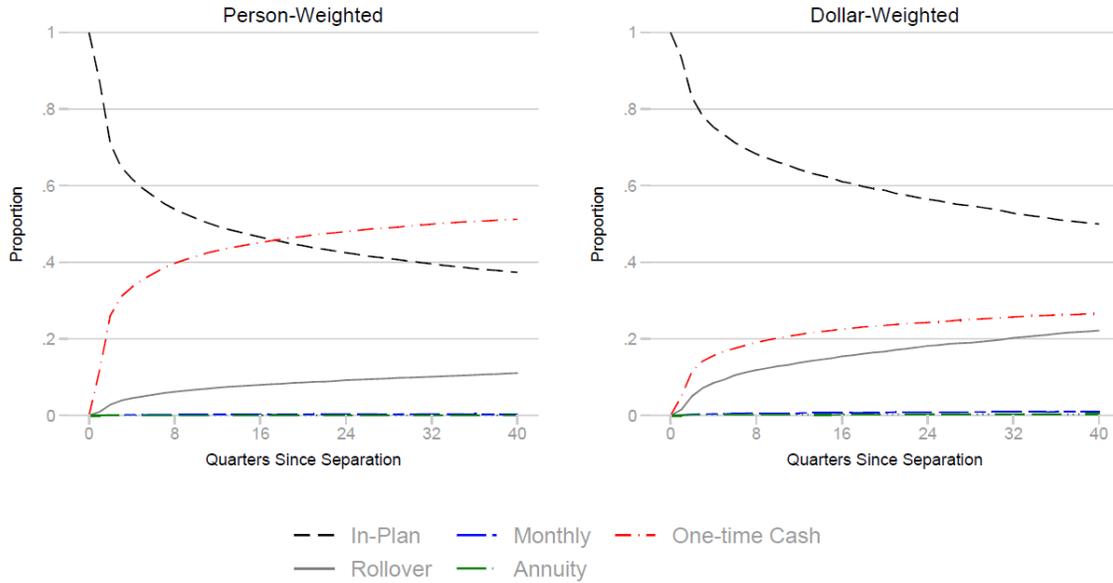
Quarterly transition matrices.
The exhibit displays flows alone and does not account for other factors like balances, income, employment duration, etc.
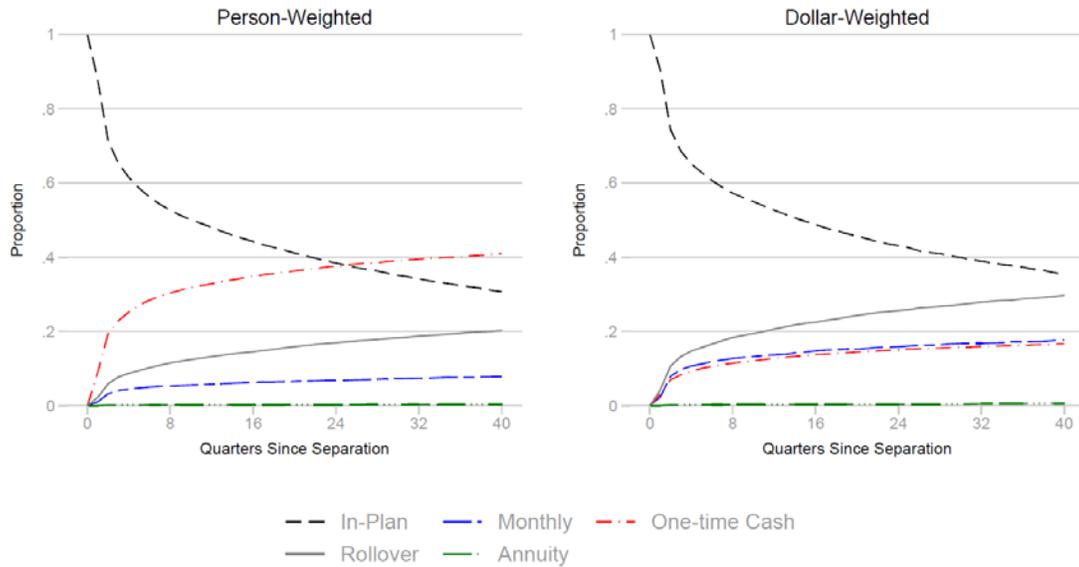
Figure 5: Transition Results, Ages 50-59

Proportion in Each Bucket vs. Time
Ages 50-59 at Separation

Quarterly transition matrices.
The exhibit displays flows alone and does not account for other factors like balances, income, employment duration, etc.

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In addition to varying with age, the decisions about whether and how to withdraw TSP balances correlates with other demographics. We perform the same transition analysis as above on a set of demographic subgroups, focusing on the sample that separated at ages 50-69. These results need to be interpreted with caution, since they do not control for factors such as balances, income, employment duration, etc. We focus on the dollar-weighted results after 10 years of transition, all calculated and presented as a percent of initial balances. We point out here only those results where economically meaningful differences arise. Our sub-group analysis includes the following findings. 1) We divide the sample into five education groups and find that one-time cash distributions are smaller as a percent of initial balances for sub-groups with higher levels of education. Percentages remaining in the plan are higher for those with higher levels of education. 2) Black non-Hispanics take greater one-time cash payments and take lower rollovers and monthly payments than white non-Hispanics. Hispanics fall in between these two groups in these dimensions. 3) Men tend to take greater amounts as monthly distributions than women. 4) Military personnel rollover less and take less as monthly distributions than civilians. 5) Veterans take slightly more as one-time cash payments than non-veterans. 6) We divide the sample into 3 balance groups, less than $25,000, $25,000 - $150,000, and greater than $150,000. Participants in the lowest balance category take out far more in one-time cash withdrawals, particularly in the first year after separation, than do those in the highest category, with those in the middle-balance category falling in between. Rollovers are much higher for the middle- and high-balance groups than for the low-balance group.

IV. Education, Test Scores, and Fees: Evidence from Rollovers

In this section, we examine whether the tendency to rollover from TSP or the fees paid on rollovers are related to educational attainment and AFQT scores.

A. Rollover destinations and fee estimates
The vast majority of rollovers go to IRAs, which are managed by private financial institutions. Under current rules, IRAs offer substantially more flexibility than the TSP regarding both investment opportunities (including mutual funds, individual securities, and insurance products such as variable annuities) and withdrawal activity. IRAs also typically charge higher fees than the TSP. We focus on two types of fees paid in IRAs: expense ratios on mutual funds and advisory fees.

IRA account holders that hold mutual funds pay expense ratios on the mutual funds in their portfolios.[17] Since we do not observe mutual fund holdings of individual IRA accounts, we approximate the expense ratio paid by a typical account in each financial institution by taking the asset-weighted average expense ratio of all mutual fund products managed by that institution.[18] We obtain such average expense ratios using the CRSP Mutual Fund Database, which includes a history of open-ended mutual funds and information such as investment style, total net assets, and fee structure. Focusing on all mutual fund offerings excluding institutional funds and hybrid funds, we calculate the asset-weighted average expense ratios for 2016 and 2017, which cover 44 financial institutions.[19] Because CRSP lacks data on 2018 mutual fund offerings, we use firm-level average expense ratios for 2017 when merging with rollover transfers initiated in 2018.[20]

We collect data on advisory fees through wrap fee program brochures (Form ADV Part 2a brochures) that financial institutions fill out with the U.S. Securities and Exchange Commission (SEC).[21] These brochures summarize advisory services provided by the firm as well as program fees associated with these services. Program fees are presented as annual rates and vary according to investment size, with larger investments incurring lower fees. We focus on advisory fees charged for three different investment sizes: $250k, $500k, and $1 million.[22] Some firms report an explicit fee schedule based on the value of assets held in the account, while others provide a range of fee rates that they typically charge for advisory services. In the latter case, we take the midpoint of the reported range for our analysis. In this manner, we collected advisory fee rates for 33 financial institutions.

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[17] 47% of aggregate IRA assets are held in mutual funds. See ICI (2018).

[18] We make this assumption due to data limitations, but recognize that IRA balances are not necessarily invested in mutual funds managed by the same institution. For a future version of the paper, we hope to obtain and use data on individual holdings and fees on a sample of IRA holders. While these will not correspond to TSP rollovers, we believe this will give a better approximation to the average fees charged at each financial institution on IRA rollovers from the TSP.

[19] We first calibrate the database by constructing annual industry average expense ratios for the past years and comparing them to the corresponding statistics from an Investment Company Institute (ICI) report (ICI Report: The US Retirement Market, First Quarter 2018. https://www.ici.org/info/ret_18_q1_data.xls). While constructed averages align well with those from the ICI report for equity funds and fixed income funds, hybrid funds exhibit some systematic differences. We therefore drop hybrid funds when constructing average expense ratios for financial institutions.

[20] Rollovers in 2018 corresponds to 12% of the rollovers out of the TSP in our sample.

[21] These forms can be found on www.adviserinfo.sec.gov.

[22] Advisory fees are merged with rollover transfers from the TSP based on the financial institution and transfer amount. For the small number of individuals (<2%) initiating multiple transfers to the same financial institution, we determine the total transfer amount to that institution before merging with advisory fees.

Most fee brochures indicate that financial institutions have some discretion to raise or lower advisory fees for individual accounts. Also, at some institutions some accounts are advised and thus pay advisory fees and others are not advised and thus do not pay advisory fees. Because we do not have data on the percent of accounts at each institution that pay advisory fees, we assume that all IRA accounts at a financial institution pay the advisory fee. A limitation of our approach is therefore that the fees we use may not precisely reflect the actual fees that IRA account holders pay to their institutions. If educational attainment is associated with the choice or ability to not pay advisory fees either within or across institutions, our estimates will not capture this association.

Missing data: For financial institutions that provide advisory services but do not offer their own mutual funds, we take the average of firm-level expense ratios for available institutions, weighting them by the total amount of rollover dollars from the TSP. Similarly, for financial institutions that offer mutual fund products but not advisory services, we take the weighted average of firm-level advisory fees at available institutions.[23] We impute expense ratios and advisory fees in this manner for 14 and 25 institutions, respectively. Financial institutions that lack information on both fee components are excluded from our analysis. In total, we have expense ratios and advisory fees for 58 institutions that account for 77% of all individuals rolling out of the TSP and 82% of all rollover dollars.[24]

We estimate that in our data the average (dollar-weighted) IRA rollover pays an expense ratio on mutual funds equal to 57 basis points plus advisory fees equal to 119 basis points, for a total of 176 basis points. These fees are substantially higher than fees paid inside TSP.[25] Unless compensated with higher pre-fee returns, the high fees charged by IRAs relative to TSP imply that balances at withdrawal will be significantly lower. For example, if fees are 100 basis points higher in IRAs than in TSP and pre-fee returns are identical, money left in an IRA account for 25 years will have approximately 22% less money than if the money had been left in the TSP.[26] This raises the question

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[23] Some institutions offer advisory services, but we were unable to locate their SEC filings. The same procedure was applied for such cases.

[24] For the small number of individuals (<1%) rolling over to two financial institutions, we weight fees by the rollover amount to each institution. A smaller subset of those individuals (0.2%) rollover to one institution with fee data and to another institution without. In such cases, we use fees corresponding to the firm with valid measures.

[25] Fee estimates are almost identical using a person-weighted average, since there is little to no correlation between rollover size and fees paid on IRAs.

[26] Consider \$1 invested with and without fees. With an annual return equal to r and no fees, balances after 25 years will be $(1+r)^{25}$. Assuming the same pre-fee annual return r and fee rate f, balances after 25 years will be $[(1+r)(1-f)]^{25}$. The ratio of final balance with fees to that without fees is therefore $(1-f)^{25}$. For f=.01, this ratio equals .78, implying that balances with fees will be 22% less than balances without fees.

as to why participants rollover their funds from the TSP to other financial institutions (Alden 2017, Causey 2017, Caplinger 2015).[27]

B. Regression specification

We are interested in whether a participant's human capital is associated with (1) the decision to roll balances out of the TSP and (2) annual fees paid, conditional on taking a rollover. We describe the first choice as rollovers on the *extensive* margin, and the second choice as rollovers on the *intensive* margin. We run regressions of the following form to study these questions:

$$Y_i = \alpha + \beta H_i + \gamma X_i + \epsilon_i \qquad (1)$$

For extensive margin regressions, Y_i is a variable indicating whether a participant transferred any of their TSP balances into an IRA or employed-sponsored 401(k) plan.[28] For intensive margin regressions, the sample consists of all individuals who transferred some or all of their balances during the Q1 2016-Q1 2018 period to one or more of the 58 financial institutions mentioned above. For this specification, Y_i is the estimated annualized fee rate (in bps) charged to individual i by the financial institution to which funds are rolled over. We include expense ratios and advisory fees for our analysis.

We consider two main measures for human capital H_i: scores on the Armed Force Qualification Test (AFQT) and educational attainment. AFQT scores measure cognitive function, and this variable is standardized in the regression so that all coefficients indicate differences associated with a one standard deviation increase in AFQT scores. For educational attainment, we assign numerical years associated with attainment categories in the TSP data:[29]
   - 11 years for high school dropouts, high school graduates, and GED degrees
   - 13 years for dropouts from college or associate degree programs
   - 14 years for associate degree holders
   - 16 years for bachelor degree holders
   - 18 years for advanced degree holders.

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[27] The current research is conducted as part of a partnership between the Federal Retirement Thrift Investment Board and the U.S. Army Office of Economic and Manpower Analysis at West Point.

[28] This indicator equals 1 for individuals taking rollovers via partial withdrawals, full withdrawals, or both. Note that because our sample ends at a fixed point in time (Q1 2018), we observe individuals for a variable number of quarters after separation. Employees separating in Q1 2016 are observed for nine quarters after separation, but employees separating in Q4 2017 are only observed for 2 quarters after separation. This means that we observe any rollovers taking place within 9 quarters of separation for the former group, but we observe only rollovers occurring within 2 quarters for the latter group. This will not bias our estimates under the assumption that human capital measures are uncorrelated with the timing of rolling over.

[29] There are finer education categories available for civilians, but we group them into the aforementioned categories for consistency in assigning numerical years of education.

We use these numerical assignments for our main analysis, but our qualitative conclusions remain the same if we use a set of education indicator variables instead.

X_i is a set of control variables, which include age, gender, race, military status, and TSP balances. For individuals initiating rollover transfers, TSP balances are recorded prior to the first observed rollover. For individuals who never initiated such transfers, we record the last observed balance.

C. Choosing whether to roll balances out of the plan -- predicting the extensive margin

We first report regression results where Y_i is equal to 1 if the TSP participant ever rolled money into an IRA and 0 otherwise (Table 4). For the regressions in Table 4, each observation is at the account level (i.e., one observation for each TSP participant). TSP participants are included in this regression if they were employed as of Q1 2016 and separated at some point between Q2 2016 and Q1 2018. Intuitively, we are tracking the cohort of employees who were employed as of Q1 2016, which is when we are first able to observe rollover activity.[30]

The results in column (1) imply that an extra year of education is associated with a 1.06 percentage point greater likelihood of undertaking a rollover. Once controls are added in column (2), this effect falls in magnitude. Now an extra year of education is associated with a 0.21 percentage point greater likelihood of undertaking a rollover.

Table 4: Likelihood of taking a rollover

	(1) Proportions	(2) Proportions	(3) Proportions	(4) Proportions	(5) Proportions	(6) Proportions
Years of Education	0.0106***	0.00214***			0.00594***	0.00336***
	(0.000319)	(0.000454)			(0.000385)	(0.000586)
AFQT (standardized)			0.00356***	0.000120	0.00200**	-0.00120
			(0.000744)	(0.00110)	(0.000748)	(0.00112)
Constant	-0.0824***	0.0137	0.0255***	-0.0727***	-0.0471***	-0.0969***
	(0.00433)	(0.0122)	(0.000738)	(0.0132)	(0.00476)	(0.0139)
Controls	No	Yes	No	Yes	No	Yes
Observations	78687	59170	45454	32218	45454	32218

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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[30] In the appendix we also run a robustness check where we only study employees who separated in Q1 2016.

The association between AFQT and the existence of a rollover is even weaker than the association between educational attainment and rollovers. Without controls, one standard deviation of AFQT is associated with a 0.36 percentage point greater likelihood of undertaking a rollover (column 3). With controls, the relationship becomes smaller and statistically insignificant (column 4).

When both years of education and AFQT are included in the regression, both variables lose about half of their explanatory power (compare columns 1, 3 and 5). When both years of education and AFQT are included along with controls, years of education retains its explanatory power and AFQT continues to have no explanatory power (compare columns 2, 4, and 6).

In total, we consider these to be small effects in economic magnitude. In our data, the standard deviation of educational attainment is 1.5 years, so a one standard deviation change in educational attainment is associated with a 0.5 percentage point increase in the likelihood of a rollover (using the regression coefficient from column 6). AFQT appears to have no robust explanatory power at all.

Finally, we emphasize that the effects go in the wrong direction (when they are significant). In other words, higher levels of educational attainment are associated with a slightly greater likelihood of rolling money out of the TSP. The TSP has fees that are no greater than 4 basis points and the rollover IRAs have fees that are on average estimated to be many times higher.

D. Choosing among IRA providers -- predicting the intensive margin

We now report regression results that study choice among IRA providers -- the intensive (fee) margin. We study the sample of TSP participants who conducted a rollover to an IRA from Q1 2016 to Q1 2018. Now Y_i is equal to the estimated fee at the firm to which the IRA rollover was made and the results are reported in Table 5. Each observation is at the account level (i.e., one observation for each TSP participant).

The results in column (1) of Table 5 imply that an extra year of education is associated with a 1.2 basis point lower total annual IRA fee (across participants who executed a rollover). When controls are added in column (2), this association strengthens slightly. Now an extra year of education is associated with a 1.3 basis point lower total annual IRA fee.

Table 5: Total annual IRA fees (among participants who undertook an IRA rollover)

	(1) Total-bps	(2) Total-bps	(3) Total-bps	(4) Total-bps	(5) Total-bps	(6) Total-bps
Years of Education	-1.241***	-1.202***			-0.154	-0.684
	(0.231)	(0.251)			(0.471)	(0.524)
AFQT (standardized)			-2.304*	-1.147	-2.262*	-0.807
			(1.013)	(1.119)	(1.021)	(1.149)
Constant	194.9***	186.1***	173.3***	166.5***	175.2***	172.0***
	(3.444)	(9.184)	(1.070)	(13.96)	(6.148)	(14.57)
Controls	No	Yes	No	Yes	No	Yes
Observations	10270	9760	2347	2298	2347	2298

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The association between AFQT scores and total annual IRA fees is roughly commensurate to the association between educational attainment and total annual IRA fees. Without controls, one standard deviation of AFQT is associated with a 2.3 basis point lower total annual IRA fee (column 3). With controls, the relationship becomes smaller and statistically insignificant (column 4).

When both years of education and AFQT are included in the regression, years of education loses its explanatory power and AFQT retains its explanatory power (compare columns 1, 3 and 5). When both years of education and AFQT are included along with controls, neither variable has explanatory power (compare columns 2, 4, and 6).

Once again, we consider these to be small effects in economic magnitude. Even if we cherry pick the strongest results, the associations are small. For example, in column 3 a one standard deviation increase in AFQT is associated with a 2.3 basis point lower total annual IRA fee. However, unlike the previous section, at least these effects have the predicted sign. Higher human capital is associated with (slightly) lower fees.

E. Aggregate fees: combining the extensive and intensive margins

Finally, we combine the extensive and intensive margins and study total fees. To do this, we let the dependent variable be our estimate of the total annual fee for each participant, dollar weighting both within-plan assets and IRA rollovers. To calculate fees, we use end-of-sample asset allocations (e.g., Q1 2018). We include all individuals

that appear in our sample as employees during Q1 2016 and separate from federal government employment during the sample period (i.e., by the end of Q1 2018).[31]

Table 6 reports the results of this analysis. We find that the effects of the extensive margin (the decision to roll over assets) dominate the effects of the intensive margin (choice among IRA's). Accordingly, higher levels of human capital are consistently associated with higher fees. We find this relationship across all six specifications. All of the human capital coefficients are positive and all but one are significant ($p<0.001$).

Table 6: Fees among all participants (including those who stay inside the TSP and those who roll over their balances)

	(1) Total-bps	(2) Total-bps	(3) Total-bps	(4) Total-bps	(5) Total-bps	(6) Total-bps
Years of Education	1.562***	0.362***			0.789***	0.417***
	(0.0535)	(0.0774)			(0.0621)	(0.0954)
AFQT (standardized)			0.438***	-0.0485	0.231	-0.213
			(0.120)	(0.178)	(0.121)	(0.182)
Constant	-9.385***	7.119***	6.705***	-8.146***	-2.931***	-11.17***
	(0.727)	(2.085)	(0.119)	(2.155)	(0.768)	(2.263)
Controls	No	Yes	No	Yes	No	Yes
Observations	77718	58201	45221	31985	45221	31985

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

However, the effects are extremely small as one would anticipate, because we are combining extensive and intensive margin effects that are small to begin with and opposite in direction. Cherry picking the largest effects in Table 6, we see that even these effects are not economically meaningful. For example, in column 3 a one standard deviation increase in the AFQT score is associated with 0.4 basis points in higher annual fees, and in column 1 each additional year of education is associated with 1.6 basis points higher in annual fees.

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[31] We use TSP expense ratios for in-sample separators who never took a rollover. We exclude in-sample separators who rolled over to institutions without fee data: the fee variable is undefined for this group of individuals (1% of in-sample separators).

V. Comparison to other papers in the household finance literature

We now compare the effect sizes in our analysis to effect sizes generated by two other related studies. We find that our results are broadly consistent with results in other papers.

First, we discuss the analysis of Grinblatt et al (2016), which uses Finnish mutual fund data that is merged with The Finnish Armed Forces (FAF) test for intellectual ability. The FAF test is given to Finnish males at draft age, which is typically 19 or 20. The test includes a battery of 120 questions. Grinblatt et al show that high-IQ investors avoid funds with high management fees. Their effect size is very close in magnitude to ours. Formally, they estimate a logistic regression relating IQ to ln(management fee). Their marginal effect (Table 4), implies that a one standard-deviation change in measured IQ (two IQ stanines) is associated with a 0.34% reduction in management fees. Because the average management fee in their study is 112.6 basis points (Table 2, panel B), a one standard deviation increase in IQ is associated with a 0.38 basis point reduction in management fees.

Our analogous result is in Table 5, column 6, where we report that a one-standard deviation increase in the AFQT (the US equivalent of the Finnish armed forces IQ exam) is associated with a 0.70 basis point reduction in management fees. A *t*-test can't reject the null hypothesis that the two effects are identical.

We can also compare our estimates to those in Choi et al (2010). In this paper, different populations of experimental participants -- Harvard staff, Harvard undergraduates, and Wharton MBA students -- are asked to allocate $10,000 across four essentially identical S&P500 funds. This money is real in the sense that experimental participants are allowed to keep any appreciation on this investment net of fees. So experimental participants get the upside (but aren't asked to pay if their investment loses money). The only real difference among these mutual funds are the fees of the funds. For the Harvard staff, Choi et al record variation in educational attainment and relate this to the average fee that is paid by each experimental participant. To maximize comparability, we re-analyzed the Choi et al data set and regressed the average asset management fee paid by each experimental participant (in basis points) on educational attainment. The estimated coefficient is positive and statistically insignificant: an extra year of education is associated with 1.5 *more* basis points in fees (standard error = 2.7 basis points). We do not make anything of the sign of this effect (because the coefficient is smaller than the standard error), but we do emphasize that the effect is likely to be small whatever its sign.

Choi et al also have data on SAT scores for the Harvard undergraduates and Wharton MBA students who participated in the study. For the Harvard undergraduates, a one standard deviation increase in SAT scores is associated with 4.0 *more* basis points in fees, with a standard error of 9.9 basis points. For the Wharton MBA students, a one standard deviation increase in SAT scores is associated with 2.4 *fewer* basis points in fees, with a standard error of 9.0 basis points. Once again there appears to be no large, robust relationship between cognitive function and fees.

VI. Conclusion

We have reported four basic findings. First, even though the TSP has very low asset management fees (all of the funds on the platform have fees under 4 basis points), at least a third of the balances in the TSP roll out to IRA's after employees separate from federal government employment. Second, the propensity to roll over balances from the low-cost TSP to relatively high-cost IRA's is positively associated with both educational attainment and AFQT scores. Third, conditional on rolling balances out of the TSP, asset management fees at the institutions that receive rollovers are negatively associated with both educational attainment and AFQT scores. Finally, when we analyze total asset management fees, including *both* balances that stay inside the TSP and balances rolled over to IRA's, we find that fees are positively associated with our two proxies for human capital. However, these (statistically significant) associations are not economically meaningful. For example, a one standard deviation increase in AFQT score is associated with at most 0.2 basis points of greater total fees.

In summary, we find that proxies for human capital have very little predictive power for fees, and, if anything, are on average statistically significantly *positively* associated with total fees. Accordingly, for DC balances originally accumulated in the TSP, we can reject the hypothesis that proxies for human capital are negatively associated with asset management fees.

On the contrary, we expected to find that households with greater human capital would be better investors as judged by the normative benchmarks embraced by academic economists. Specifically, the TSP is widely viewed as an outstanding investment platform because of its extremely low asset management fees (and fiduciary protections). If the low fees on the TSP platform are a paramount consideration, then investors *should* leave their retirement balances inside the TSP when they are no longer employed by the federal government (e.g., see Turner et al 2016). Moreover, we predicted that relatively sophisticated investors – e.g., those with the most human

capital – would be the most prone to leave their retirement balances inside the TSP. Our evidence is not consistent with these predictions.

Our results may be explained by two alternative interpretations. First, "sophisticated" and "knowledgeable" investors may be the most prone to actively adjust their investment allocations because they perceive that they "know what they are doing." The perception that you are a capable investor can become a disadvantage when your retirement balance starts out in a low fee, well-diversified investment platform with strong fiduciary protections. Being sophisticated may put you at greater risk of rejecting the set of options on the TSP platform, which would lead the investor to initiate an IRA rollover.

Alternatively, high human capital investors may be leaving the TSP for economically sound reasons. Maybe they are frustrated by the limited withdrawal options currently offered within the TSP. Perhaps they are optimally seeking other investment vehicles that are not available on the TSP website. They may rationally believe that the passive strategies that are available on the TSP menu are not optimal. They may rationally believe that other asset classes – e.g., hedge funds and absolute return funds, smart beta, infrastructure investment pools, etc. – are superior to the plain vanilla stocks and bonds on the TSP menu. Finally, they may truly benefit from the investment advice that can be obtained by holding their assets in a high-fee asset management account. Whatever the explanation for our results, it is important to emphasize that educational attainment and AFQT scores are not strongly predictive of investment decisions. All of the associations with human capital that we report are very small in economic magnitude. Participant balances are rapidly flowing out of the low-cost TSP system and the existence and ultimate destination of those flows has little relationship with general measures of human capital, like educational attainment and AFQT scores. In light of our results, we suspect that other factors, like marketing campaigns and person-to-person sales tactics (see Turner et al 2016), may play a much more important explanatory role than the personal characteristics of the TSP participants.

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