

# Conflicted Advice About Portfolio Diversification

## AUTHORS:

Sally Shen, *Global Risk Institute*

John A. Turner, *Pension Policy Center*



GLOBAL  
RISK  
INSTITUTE

## EXECUTIVE SUMMARY

---

Investors are often encouraged by financial advisors to “roll-over” their 401(k) into Individual Retirement Accounts (IRAs). This advice is based on the notion that IRAs, which offer a virtually unlimited number of investment options compared to 401(k) plans, provide improved diversification. This work investigates the soundness of this investment advice and empirically analyzes the diversification of a large 401(k)-type plans that offer five basic investment options.

The results of this study show that rolling over from Thrift Saving Plan (TSP), 401(k) or 403(k) plans with many investment options does not generally improve diversification. It follows that the common advice to roll-over is not valid and is often costly, with potential present-value losses in the thousands.

More generally, our results indicate that for participants in large 401(k) plans, which typically have lower fees than small plans and IRAs, it is in fact possible to achieve better diversification by rolling over. However, this advice ignores increased costs. Because the improvement in diversification is generally relatively small, the increase in costs from rolling over to an IRA outweighs the improvement in diversification. In other words, incomplete analysis has led to bad advice: the analysis focuses on only one aspect of the situation, in this case portfolio diversification, without adequately considering costs.

This study also shows that pension plans can be well diversified with a relatively small number of funds. For example, with its five basic investment options, the TSP is well diversified. Adding an additional four investment options results in slightly better Sharpe ratios using some investment strategies. It follows that defined contribution plans and other funds of funds, such as target date plans, can provide participants with the opportunity to have well diversified funds while maintaining simplicity of choice. This result is particularly relevant to litigations focused on the adequacy of the investment options offered by pension plans, where some plaintiffs have claimed imprudent management based on the small number of investment options being offered.

In addition, the results suggest that some financial advisers and some providers of financial products may use strategic complexity to impress naïve investors, recommending or providing complex investment portfolios when simpler portfolios may be superior, once fees are taken into account.

# Conflicted Advice About Portfolio Diversification

Sally Shen<sup>1</sup>

Global Risk Institute in Financial Services

John A. Turner

Pension Policy Center

November 2017

Sally Shen

[sallyshenmaastricht@gmail.com](mailto:sallyshenmaastricht@gmail.com)

Global Risk Institute in Financial Services

55 University Avenue, Suite 1801

Toronto, ON M5J 2H7, Canada

John A. Turner

[Jaturner49@aol.com](mailto:Jaturner49@aol.com)

3713 Chesapeake St. NW

Washington, DC 20016,

## Abstract

Due to pension rollovers, Individual Retirement Accounts (IRAs) have become the most important source of pension income in the United States. The argument generally supporting the campaign by the financial services industry to “roll over your ‘old’ 401(k)” is that 401(k)-type plans have a limited number of investment options, while IRAs have a virtually unlimited number of options. This paper investigates the validity of the implication that better diversification due to more options is a reason for rolling over to an IRA by empirically analyzing the diversification of a 401(k)-type plan with only five investment options—the Thrift Savings Plan for federal

---

<sup>1</sup> We express our appreciation to Kim Weaver of the TSP for providing us with rate of return data for the G Fund. We have received helpful comments from Louis Raes at the 2016 Canadian Economic Association meetings, from participants at the 2016 Behavioral Finance Working Group Conference at Queen Mary University in London, and from Jill Fisch.

government workers. The paper argues that some financial advisers may recommend complex portfolios to impress naïve clients while not weighing the cost of the portfolios.

**Keywords:** diversification, pension rollovers, financial advice

## Conflicted Advice About Portfolio Diversification

*“It is difficult to get a man to understand something, when his salary depends upon his not understanding it.”* —Upton Sinclair (1878-1968)

Due to pension rollovers, Individual Retirement Accounts (IRAs) have become the most important source of pension income in the United States. The argument generally made to support the campaign by the financial services industry to “roll over your ‘old’ 401(k)” is that 401(k)-type plans have a limited number of investment options, while IRAs have a virtually unlimited number of options. This paper investigates the validity of the advice that better diversification is a reason for rolling over to an IRA by empirically analyzing the diversification a 401(k)-type plan with only five investment options—the Thrift Savings Plan for federal government workers.

We argue in this paper, that conflicted advisers focus on the aspects that are favorable to the case they are making (e.g., “only five funds”), but do not consider whether pension participants need more choice in funds to improve diversification. In addition, they do not weigh the costs associated with their advice. We argue that it is psychologically less costly for advisers to make a true statement that is incomplete than to make a false statement. In addition, some advisers may simply follow the industry standard argument, without considering its merit. We argue that many participants are susceptible to this argument because of their naïve understanding of diversification, thinking that more options are always better, but not understanding the characteristics required of new options to improve diversification, and not considering costs.

This paper relates to the more general issue of how many diversified mutual funds are needed to form a diversified investment portfolio. For example, do target date funds need more than a dozen different investments in their portfolios, or would a smaller number possibly be better

in part because it would involve less costly funds. It can be argued that an investment that is a small share of the portfolio does not materially affect the risk-return characteristics of the portfolio and should not be included if it is a relatively expensive investment in terms of fees. Some financial advisers and financial products companies may engage in strategic complexity in their portfolios, providing complex portfolios to impress naïve clients.

The remainder of the paper is structured as follows. We first provide background information about roll overs to IRAs and why we focus on the Thrift Savings plan with its five basic options. Focusing on the TSP provides a test of the hypothesis that pension participants should roll over from their 401(k) plans to obtain greater portfolio diversification. We then review the relevant literature concerning portfolio diversification and pension rollovers. Following that, we discuss the investment options available in the Thrift Savings Plan. The main section of the paper follows, in which we analyze the effect of adding more investment options and investigate the validity of the advice to roll over from the TSP. Last, we offer our conclusions relating to the quality of the advice from conflicted financial advisers, the nature of the arguments conflicted financial advisers make, and the susceptibility of pension participants with low financial literacy to making decisions based on these arguments.

### **Rollovers to IRAs**

Individual Retirement Accounts (IRAs) are the largest type of pension plan in terms of assets in the United States, having overtaken 401(k) plans and defined benefit plans. Rollovers from 401(k)-type plans are the primary source of funding for IRAs, with relatively few people contributing to IRAs. IRAs had an estimated \$7.5 trillion in assets at the end of the second quarter of 2016 and represented 31 percent of total U.S. retirement market assets, compared to 18 percent

two decades earlier. In 2012, \$335 billion was rolled over from employer-provided plans to IRAs (Investment Company Institute 2016b).

The Council of Economic Advisers (CEA 2015), which advises the president on economic policy, recently surveyed the literature on the quality of financial advice provided in the United States. The CEA finds that advice concerning pension rollovers from employer-provided plans to Individual Retirement Accounts (IRAs), and stemming from this conflict of interest, costs U.S. pension participants \$17 billion a year in higher fees and lower rates of return. Supporting the conclusions of the Council of Economic Advisers, a study by Munnell, Aubrey and Crawford (2015) finds that IRAs tend to receive net rates of return that are about 1 percentage point less than do employer-provided defined contribution plans, such as 401(k) plans.

Advisers giving bad advice presumably make an argument to their clients as to why their advice is good advice. Typically, that argument in this context is that pension participants will have more investment options in IRAs than in 401(k)-type plans. That argument has become the industry standard for advice. The advice TIAA (2016) provides concerning roll overs is typical of the mutual fund industry. An advantage of rolling over to an IRA is that a pension participant has “a virtually unlimited array of investments.” Fidelity (2016) indicates a benefit of rolling over is that you have “a wide range of investment options”.

According to a survey of persons making pension rollovers, while improved diversification is not the only reason workers give for why they rolled over to an IRA, it is the most important reason for 21 percent of those making a rollover and one of the reasons for 61 percent of those making rollovers (Investment Company Institute 2016). This paper analyzes the validity of that argument as a reason to roll over.

This argument supporting roll overs seemingly runs counter to the requirements of U.S. pension law. U.S. pension law (ERISA Section 404(c)) requires that 401(k) plans that allow participants the opportunity to make their own investment choices must provide investment options that permit adequate diversification. BrightScope and Investment Company Institute (2014) find that in 2012, 401(k) plans on average allowed participants 25 investment options.

### **Thrift Savings Plan**

The Thrift Savings Plan (TSP) is the 401(k)-type plan for U.S. federal government workers, members of Congress and the military. It is an individual account defined contribution plan. In terms of assets, it is the largest pension plan in the United States (Towers Watson 2014) and the largest defined contribution plan in the world (White 2011). It has more participants than the social security systems of more than 90 countries (World Bank 2014). We focus on the TSP because it only offers five basic investment options. It also charges extremely low fees— 3 basis points for all its funds, including its international equity fund and its target date funds, which tend to be higher fee funds. The average fee for target date funds outside the TSP is roughly 30 times higher than for the target date funds the TSP provides (Vanguard 2014).

A survey of TSP participants who made a withdrawal in 2013 found that an estimated 16,400 participants (about one-third of those making withdrawals) made a withdrawal of all or part of their TSP account because they were advised by their financial adviser to do so (AonHewitt 2014). Advisers frequently advise TSP participants to roll over from their low-fee account to an Individual Retirement Account (IRA) that the adviser would manage.

A survey of financial advisers finds that advisers who advise their clients to roll over their TSP accounts commonly use the argument that because the TSP only offers five funds (plus lifecycle funds based on those five funds), the client can obtain greater diversification outside of

the TSP (Turner, Klein, and Stein 2016). For example, Ric Edelman, who was three times named the top independent financial adviser in the United States by Barron's, has stated, "The downside to the Thrift Plan is the fact that you have only five investment choices. None of them are particularly exciting in terms of their performance relative to what's available elsewhere, so we are not terribly thrilled with the choices in the Thrift Plan although we do acknowledge it's really cheap" (Tergesen 2014).

## **Literature Review**

**Quality of Advice.** Because of the importance of the 401(k) rollover decision, many people seek financial advice. One survey finds that 61 percent of the people with rollover IRAs received advice from a financial adviser in connection to the rollover (Investment Company Institute 2015). Thus, rollovers are a financial decision where advice is particularly prevalent.

A small but growing literature focuses on the quality of investment advice that financial advisers provide their clients as being a factor leading to poor investment outcomes. Mullainathan, Noeth, and Schoar (2012) find that people who initially were invested in low-fee, diversified portfolios were advised to invest in higher-fee, less-well-diversified portfolios. Dvorak (2015) compares the 401(k) plan investment choices in the plans of financial advisory firms with the plans of the companies they advise. He finds that the investment options in the advisee firms' plans but not in the adviser firms' plans tend to be high-fee options. Christoffersen, Evans, and Musto (2013) find that brokers tend to sell higher-cost funds that give them higher compensation.

The fundamental explanation for bad advice is the conflict of interest that many advisers have. However, several theories go further to investigate why advisers act on that conflict of interest. Akerlof and Shiller (2015), two Nobel price laureates, in their book *Phishing for Phools*:



*The Economics of Manipulation & Deception*, argue that many financial advisers take advantage of the behavioral biases of their clients that lead to poor decision making.

A related strand of literature relates to psychological underpinnings of bad advice. Di Tella et al. (2015) analyze instances of self-serving biases, which occur when people take actions that benefit themselves but that harm other people. In such instances, the people taking the action negatively distort their views of the other person (think badly of the other person) to make it psychologically less costly to treat them poorly. Di Tella et al.'s main hypothesis is that "people manage their self image while trying to earn money." This purposeful bias in one's views of another person reduces the psychological cost of taking an action that is favorable to oneself but harmful to the other person.

In our paper, we make a slightly different argument. We argue that financial advisers exhibit self-serving biases in that they make true but incomplete statements to their clients because it is psychologically less costly to make those statements than it is to make false statements—i.e., to outright lie. Due to self-serving biases, the advisers may even believe that their advice concerning improved diversification is good advice, as suggested by the quotation at the beginning of this paper from Upton Sinclair, a social policy activist in the early and mid twentieth century. As Di Tella et al. (2015) note, "The possibility that beliefs exhibit a self-serving bias has been studied since the development of the theory of cognitive dissonance (e.g., Hastorf and Cantril [1954]; Festinger [1957])." Chen and Gesche (2016) in an experiment find that some people induced to provide bad advice through use of a cash incentive are likely to continue to provide that advice when the incentive is removed. They argue that the subjects continue to provide bad advice because the subjects have adopted a self-serving bias that justifies the objectively bad advice as actually being good advice.

**Diversification.** Relating to the issue of portfolio diversification, Fama (1976) analyzes the effect on the standard deviation of a portfolio of adding an additional stock. He finds a large decline in standard deviation up to 20 stocks, but relatively little further reduction when adding further stocks. Specifically, he finds that about 95 percent of the reduction in standard deviation in going from a portfolio of one stock to a portfolio with more stocks is achieved with a portfolio of 20 stocks.

According to Betterment (2016), an investment adviser, “Many investors know that they should be diversified, but don’t understand what that really means.” Lusardi and Mitchell (2011), in a survey of older Americans, find that only half of respondents know that holding stock in a single company is riskier than investing in a mutual fund. Benartzi and Thaler (2001) present experimental evidence suggesting the tendency of investors to engage in naïve diversification, splitting their investments evenly among the available options when a small number of options are provided. This approach is called the 1/n approach. Fisch and Wilkinson-Ryan (2014) present further experimental evidence that unsophisticated investors may be attracted to naïve diversification strategies, which may explain the appeal of the advice that they can have more investment options if they roll over their employer-sponsored defined contribution plan to an IRA. For example, in their experiment, 75 percent of those participants who invested in a low-fee equity index fund also invested in an identical high-fee fund.

Money Magazine (2015) identifies as a myth believed in by some investors that investing in a large number of different mutual funds guarantees diversification, writing “Breadth of holdings alone does not guarantee diversification.” That myth, presumably believed by many unsophisticated investors, directly relates to the success of the advice to roll over to have access to a larger number of investment options.

For some pension participants, having many options may make investment decisions more difficult. Behavioral economics does not support the idea that having unlimited choice by rolling over to an IRA is a good feature. “The paradox of choice” refers to the negative effects of having too many choices. Several studies have documented the problems that people have in making decisions when facing a large number of options (Iyengar and Lepper 2000; Carosa 2014). Despite the concept from traditional economics that more options are always better, research has documented that for psychological reasons of mental overload, above a minimum level, fewer choices are better for many people when the available options allow for a sufficient range of choice. Relating specifically to pension investment options, a study found that having many investment options in 401(k) plans lowered participation rates (Iyengar, Huberman, and Jiang 2004).

Another aspect of too much choice, in the context of IRAs, is the tradeoff between quantity of choice and quality of choice. A large number of choices that are not preselected by a financial expert with a fiduciary obligation, as in IRAs, will include more options that are of poor quality, are poorly diversified, have high fees and poor rates of return (Goldreich and Halaburda 2011).

A substantial literature demonstrates that the cognitive costs of greater choice can lead to worse savings and retirement investment choices (Ashraf, Karlan and Yin 2006; Madrian and Shea 2001; Choi et al. 2006, 2007; Hastings and Tajeda-Ashton 2008; Duarte and Hastings 2009).

### **Investment Options in the TSP**

The TSP uses passively managed index funds. The TSP offers a choice of 10 funds, five of which are lifecycle or target date funds, based on the participant’s expected date of retirement. In the empirical analysis, we focus on individual portfolios constructed from the five basic funds. The five basic funds are: 1) the Government Securities Investment Fund (G Fund, which is based

on medium-term and long-term government bond rates), 2) the Fixed Income Index Investment Fund (F Fund, which tracks the Barclays Capital U.S. Aggregate Bond Index), which includes Treasury Securities, Government-agency bonds, mortgage-backed bonds, corporate bonds and a small amount of foreign bonds traded in the United States, 3) the Common Stock Index Investment Fund (C Fund, which tracks the Standard & Poor's 500 Index), 4) the Small Capitalization Index Fund (S Fund, which tracks the Dow Jones U.S. Completion Total Stock Market Index, it represents all U.S. equities other than those in the Standard & Poor's 500 index), and 5) the International Stock Index Investment Fund (I Fund, which tracks the Morgan Stanley Capital International EAFE, which is the Europe, Australasia, and Far East Index) (Thrift Savings Plan 2015), which includes securities from more than 20 developed countries.

### **Empirical Analysis of the Advice to Roll Over from the TSP for Greater Diversification**

The TSP stock funds do not cover emerging markets, Canada, and international small capitalization stocks. The TSP's investment options also do not include real estate, commodity, and international bond funds. Copeland (2013) finds that, in aggregate, IRA participants invest 13.8 percent of their assets in the category "other," which refers to investments not in stocks, bonds, or target date funds. This finding suggests that IRA participants do hold a wider range of investments, since the TSP does not have any investment that would be in that category. The TSP does not offer actively managed funds.

We adopt the Bessler and Wolff (2015) method to test whether the optimal portfolio constructed by the basic five TSP funds is fully diversified. First, we investigate whether the TSP participants can benefit from greater diversification when extra investment options are available in addition to the five existing options. Second, we investigate the closely related question of whether rolling over from the TSP with its five basic investment options results in better

diversification. That analysis excludes the G fund, which is only available through the TSP, but replaces it in the portfolio with an investment in publicly available U.S. government bonds.

**Data.** TSP funds track the performance of various stock and bond indices, so we use those indices to run the diversification analysis. We collect monthly returns from January 1993 to April 2015. We use the Barclays Capital U.S. Aggregate Bond Index for the F Fund; Standard and Poor's (S&P) 500 Stock Index for the C Fund; the Dow Jones U.S. Completion Total Stock Market Index for the S Fund; and the MSCI EAFE Stock Index for the I Fund. Because the G Fund has different risk and return characteristics from publicly available U.S. government bonds, we use monthly-rate-of-return data provided to us by the Thrift Savings Board. We use three-month U.S Treasury discount bond yields as a proxy for the risk-free rate.

We consider four additional investment options. First, we include a real estate fund. We use the FTSE NAREIT U.S. Real Estate Index Series (REIT). Previous studies, such as Burns and Epley (1982), Ennis and Burik (1991), and Giliberto (1993), use REIT data to show that investing in real estate funds improves diversification for U.S investors. Second, we add an emerging market fund. Li, Sarkar, and Wang (2003) find substantial international diversification benefit for U.S equity investors. The data we use are from the MSCI Emerging Markets Index. Third, we consider the commodity market. Daskalaki and Skiadopoulos (2011) show that only non-mean-variance investors can benefit from commodity investment, and this result only holds in sample. We use the S&P Goldman Sachs Commodity Index to calculate the return from investing in the commodity market. Fourth, we add an international bonds fund. We use the Citi Non-USD Non-GBP world government bond index as a proxy.

[Table 1 here]

Table 1 shows summary statistics for the data. The upper panel presents the sample moments of the five TSP funds. The G Fund is almost risk free while providing an average annual return of 4.525 percent. 10-year government bonds are comparable to the G fund in terms of average return and volatility. Other TSP funds and additional funds all have higher annualized returns compared with the G fund and also higher levels of risk. The Sharpe ratios of all the additional funds are lower than the Sharpe ratios of most of the TSP funds, suggesting that the additional funds are not attractive as a stand-alone investment. The Jarque-Bara statistic of most funds is significant at the 5%-level besides the fixed income indices, rejecting the assumption of normal distribution of returns for all funds except bonds.

[Table 2 here]

Even if the additional funds do not appear to be attractive in terms of stand-alone investments, they may still improve the risk-return profile if the correlations with the TSP funds are low or negative. To gain insights in terms of potential diversification benefit, we present the pair-wise correlation matrix in Table 2. We find low but significantly positive correlation between the international bond index and most of the TSP funds. There is also a low but significant correlation between the real estate index and the F fund. The emerging market index is highly correlated with most of the TSP funds. Based on our correlation analysis, an international bond index fund might be able to bring additional diversification benefit to the TSP portfolio.

**In-sample and out-of-sample diversification performance.** We start the empirical analysis by examining the in-sample benefit of adding extra funds to the TSP portfolio. The results of the in-sample analysis are reported in Table 3. We compute the optimal mean-variance performance of TSP portfolios as well as extended portfolios that include one or all of the additional four options.

The first row is the benchmark case which only includes the current five TSP funds in the investment portfolio. Each of the next four rows include one additional fund added to the benchmark portfolio. The sixth row includes all four funds added to the TSP portfolio. The last row also includes all the investment vehicles but the investors are no longer TSP participants so the G fund is replaced with a publicly available government bond fund. The performance of optimal portfolios is presented in terms of their means, volatilities and Sharpe ratio after deducting the transaction cost which is 3 basis point for the TSP investors and 60 basis point for the non-TSP investors.

The performance of the standard mean-variance portfolio based on sample moment is generally disappointing. Hence, we also adopt two indexed-model based estimation approaches--CAPM and the Fama-French method and a Bayesian Shrinkage method recommended by Ledoit and Wolf (2003) to estimate the input parameters.

[Table 3 here]

Table 3 shows that adding all the extra funds to the TSP benchmark portfolio brings a small but significant improvement in the optimal in sample performance under the CAPM and Fama-French methods. Even for non-TSP investors, whose investment fee are 20 times higher, there is still a significant improvement on portfolio performance if all the nine indexed funds are included in the portfolio.

The in-sample test assumes a perfect forecast of all asset returns. This assumption does not reflect reality, as it is limited to the condition that future performance of the return series is known in advance. Therefore, we also analyze the out-of-sample benefit of having additional funds. We use the rolling estimation window method used by DeMiguel, Garlappi, and Uppal (2009), to compare the performance of various asset allocation strategies. It is not necessary to consider other

asset allocation strategies in the in-sample analysis since the Markowitz (1952) mean-variance strategy dominates any alternative strategies if investors only care about portfolio risk and return. The alternative asset allocation strategies we consider include the global minimum-variance strategy, risk parity strategy and  $1/N$  naïve strategy.

[Table 4 here]

Table 4 reports the out-of-sample analysis results. In general, the out-of-sample analysis has much lower returns and Shape ratios compared with the in-sample results. The minimum variance strategy performs the best out of sample, compared with other asset allocation strategies. The  $1/N$  strategy performs the worst. There is approximately a 2.5% increase in portfolio returns if TSP funds include the additional four instruments under both the CAPM and Fama-French estimation methods. The return improvement is not clear when using the risk parity and the  $1/N$  strategy, especially under the out-of-sample estimation methods. Despite the increases in returns and Sharpe ratios, including additional funds do not make volatilities of the portfolios smaller. This implicitly indicates that the TSP 5-fund portfolio is sufficiently diversified.

The take away from Table 3 and 4 is that both CAPM and Fama-French estimation methods are resilient against parameter misspecification for different investment strategies. Given the benchmark performance, there is almost no space for further diversification. However, investors can still benefit from higher returns when including more funds to their benchmark portfolio. Therefore, non-TSP investors can still benefit from investing in a larger number of indexed funds even with much higher fees.

[Table 5 here]

As a robustness check, in Table 5 we also present the out-of-sample analysis in three sub periods. Only during the subperiod 2001-2008 can a significant improvement in terms of higher



Sharpe ratios be found when adding extra investment vehicles to the TSP portfolio. This result indicates that a larger number of investment options does not always result in a better performance and the TSP benchmark is sufficiently diversified.

### **Policy Results**

The main result concerns the quality of advice that pension participants are receiving. The advice to roll over from the TSP for better diversification because the TSP has only five basic funds is not valid. Thus, we document that many participants in the TSP are receiving bad advice that is very costly. Not only do they have worse investment outcomes before fees, as we document here, but they also generally have substantially higher fees. The advice to roll over can result in present-value losses of thousands of dollars (Turner, Klein, and Stein 2016).

More generally, our results indicate that for participants in large 401(k) plans, which typically have lower fees than small plans and than IRAs, the advice to roll over for better diversification is based on a true statement that it may be possible to obtain better diversification, but ignores the costs. Because the improvement in diversification is generally relatively small, the increase in costs from rolling over to an IRA outweighs the improvement in diversification. Thus, bad advice is supported by bad analysis. In particular, the analysis focuses on only one aspect of the situation, in this case portfolio diversification, without adequately taking into consideration costs.

The second main result is that pension plans can be well diversified with a relatively small number of funds. For example, with its five basic investment options, the TSP is well diversified. Adding an additional four investment options results in slightly better Sharpe ratios using some investment strategies. Thus, this result suggests that defined contribution plans and other funds of funds, such as target date plans, can provide their participants the opportunity to have well

diversified funds while still retaining the simple choice menu of a small number of funds that are themselves well diversified and that are selected to work well together in a portfolio that includes all five funds. This result has relevance for litigation as to the adequacy of the investment options offered by pension plans, where some plaintiffs have charged imprudent management based on a small number of investment options being offered (Fisch and Wilkinson-Ryan 2016).

In addition, the results here suggest that some financial advisers and some providers of financial products may use strategic complexity to impress naïve investors, recommending or providing complex investment portfolios when simpler portfolios may be superior, once fees are taken into account.

## **Conclusion**

Mounting evidence documents that financial advisers with conflicts of interest often provide advice that is costly to their clients. Nevertheless, these advisers presumably have arguments that they use to persuade their clients to follow their advice. We conclude that bad advice is sometimes supported by bad analysis. This paper analyzes one such argument. In doing so, it investigates the hypothesis that advisers with a conflict of interest, in communicating with their clients, focus on the benefits of their advice without weighing the marginal benefits against the marginal costs. We characterize this approach as telling a half-truth, in that the advisers are not divulging all of the relevant information, but are only divulging information that is favorable to the case they are making for a rollover. We argue that it is psychologically less costly to make a true statement that is incomplete than to make a false statement. Many advisers, however, may simply be following the industry standard advice. We present evidence against the industry standard advice concerning 401(k) plan rollovers in order to have greater investment options. A plan with as few as five well diversified investment options can provide adequate diversification,

while leaving an employer-provided plan and rolling over for more options will generally result in higher fees.

## References

- Akerlof, George A. and Robert J. Shiller (2015). *Phishing for Phools: The Economics of Manipulation & Deception*. Princeton, NJ: Princeton University Press.
- Aon Hewitt (2014). *2014 TSP Withdrawal Survey Results*. Lincolnshire, IL: Aon Hewitt.
- Ashraf, Nava, Dean Karlan and Wesley Yin (2006). "Tying Odysseus to the Mast; Evidence from a Commitment Savings Product in the Philippines." *Quarterly Journal of Economics*. 121(2): 635-672
- Benartzi, Shlomo, and Richard H. Thaler (2001). "Naive Diversification Strategies in Defined Contribution Saving Plans." *American Economic Review* 91(1): 79–98.
- Bessler, Wolfgang, and Dominik Wolff. "Do commodities add value in multi-asset portfolios? An out-of-sample analysis for different investment strategies." *Journal of Banking & Finance* 60 (2015): 1-20.
- BrightScope and Investment Company Institute (2014). *The BrightScope/ICI Defined Contribution Plan Profile: A Close Look at 401(k) Plans*. San Diego, CA: BrightScope and Washington, DC: Investment Company Institute (December).  
[www.ici.org/pdf/ppr\\_14\\_dcplan\\_profile\\_401k.pdf](http://www.ici.org/pdf/ppr_14_dcplan_profile_401k.pdf)
- Burns, William L., and Donald R. Epley (1982). "The Performance of Portfolios of REITs + Stocks." *Journal of Portfolio Management* 8(3): 37–42.
- Carosa, Christopher (2014). "Exclusive Interview: Quinn Curtis Reveals True Intent of the Curtis/Ayres 401k Fee Paper." *Fiduciary News*, March 18.  
<http://fiduciarynews.com/2014/03/exclusive-interview-quinn-curtis-reveals-true-intent-of-the-curtisayres-401k-fee-paper/>.

Chen, Zhuoqiong (Charlie) and Tobias Gesche (2016). "Persistent Bias in Advice-Giving." Paper presented at the 2016 Behavioural Finance Workshop, Queen Mary University, London.

Choi, James J., David Laibson and Brigitte C. Madrian (2006). "Why Does the Law of One Price Fail? An Experiment on Index Mutual Funds." NBER WP 12261.

\_\_\_\_\_ (2007). "\$100 Bills on the Sidewalk: Suboptimal Investment in 401(k) Plans." NBER WP 11554.

Christoffersen, Susan E. K., Richard Evans, and David K. Musto (2013). "What Do Consumers' Fund Flows Maximize? Evidence from Their Brokers' Incentives." *Journal of Finance* 68(1): 201–235. DOI: [10.2139/ssrn.1393289](https://doi.org/10.2139/ssrn.1393289).

[http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1393289](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1393289)

Copeland, Craig (2013). "IRA Asset Allocation, 2011." *EBRI Notes* 34(10): 8–22.

[http://www.ebri.org/pdf/notespdf/EBRI\\_Notes\\_10\\_Oct-13\\_RetSvgs-IRAs.pdf](http://www.ebri.org/pdf/notespdf/EBRI_Notes_10_Oct-13_RetSvgs-IRAs.pdf).

Council of Economic Advisers (2015). *The Effects of Conflicted Investment Advice on Retirement Savings*. Washington, DC: Executive Office of the President of the United States.

[http://www.whitehouse.gov/sites/default/files/docs/cea\\_coi\\_report\\_final.pdf](http://www.whitehouse.gov/sites/default/files/docs/cea_coi_report_final.pdf)

Daskalaki, Charoula, and George S. Skiadopoulos (2011). "Should Investors Include Commodities in Their Portfolios After All? New Evidence." *Journal of Banking and Finance* 35(10): 2606–2626.

DeMiguel, Victor, Lorenzo Garlappi, and Raman Uppal (2009). "Optimal versus Naive Diversification: How Inefficient is the 1/N Portfolio Strategy?" *Review of Financial Studies* 22(5): 1915–1953.

Di Tella, Rafael, Ricardo Perez-Truglia, Andres Babino, and Mariano Sigman (2015). “Conveniently Upset: Avoiding Altruism by Distorting Beliefs about Others’ Altruism.” *American Economic Review* (105)11: 3416–3442.

Duarte, Fabian and Justine Hastings (2009). “Fettered Consumers and Sophisticated Firms: Evidence from Mexico’s Privatized Social Security System.” Manuscript, Yale University Department of Economics.

Dvorak, Tomas (2015). “Do 401(k) Plan Advisors Take Their Own Advice?” *Journal of Pension Economics and Finance* 14(1): 55–75.

Ennis, Richard M. and Paul Burik (1991). “Pension Fund Real Estate Investment under a Simple Equilibrium Pricing Model.” *Financial Analysts Journal* 47(3): 20–30.

Fama, Eugene F. (1976). *Foundations of Finance: Portfolio Decisions and Securities Prices*. New York: Basic Books.

Festinger, Leon (1957). *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press.

Fidelity (2016). “Roll Over Your Old 401(k).” [https://www.fidelity.com/go/401k-rollover-hub/?imm\\_pid=700000001008509&immid=100063&imm\\_eid=e5548494616&gclid=CNG1jPj57s0CFUro6Qodb1AKjQ&gclsrc=ds](https://www.fidelity.com/go/401k-rollover-hub/?imm_pid=700000001008509&immid=100063&imm_eid=e5548494616&gclid=CNG1jPj57s0CFUro6Qodb1AKjQ&gclsrc=ds)

Fisch, Jill E. and Tess Wilkinson-Ryan (2014). “Why Do Retail Investors Make Costly Mistakes? An Experiment on Mutual Fund Choice.” *University of Pennsylvania Law Review*: 605-647. [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2086766](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2086766)

Giliberto, S. Michael (1993). "Measuring Real Estate Returns: The Hedged Reit Index." *Journal of Portfolio Management* 19(3): 94–99.

Goldreich, David and Hanna Halaburda (2011). "When Smaller Menus Are Better: Variability in Menu-Setting Ability." Harvard Business School Working Paper No. 11-086. Cambridge, MA: Harvard University. <http://www.hbs.edu/research/pdf/11-086.pdf>

Hastings, Justine and Lydia Tejada-Ashton (2008). "Financial Literacy, Information and Demand Elasticity: Survey and Experimental Evidence from Mexico. NBER WP 14538.

Hastorf, Albert H. and Hadley Cantril (1954). "They Saw a Game: A Case Study." *Journal of Abnormal and Social Psychology* 49(1): 129–134.

Investment Company Institute (2016a). "Retirement Assets Total \$24.5 Trillion in Second Quarter 2016." [https://ici.org/research/stats/retirement/ret\\_16\\_q2](https://ici.org/research/stats/retirement/ret_16_q2)

\_\_\_\_\_ (2016b). "The Role of IRAs in U.S. Households' Saving for Retirement, 2015" *ICI Research Perspective* 22(1): February. <https://www.ici.org/pdf/per22-01.pdf>

Iyengar, Sheena S., Gur Huberman, and Wei Jiang (2004). "How Much Choice Is Too Much? Contributions to 401(k) Retirement Plans." in *Pension Design and Structure: New Lessons from Behavioral Finance*, Olivia S. Mitchell and Stephen P. Utkus, eds. Oxford: Oxford University Press, pp. 83–95.

Iyengar, Sheena S. and Mark R. Lepper (2000). "When Choice Is Demotivating: Can One Desire Too Much of a Good Thing?" *Journal of Personality and Social Psychology* 79(6): 995–1006. <http://psycnet.apa.org/index.cfm?fa=buy.optionToBuy&id=2000-16701-012>

Ledoit, Olivier and Michael Wolf (2003). "Improved Estimation of the Covariance Matrix of Stock Returns with an Application to Portfolio Selection." *Journal of Empirical Finance* 10(5): 603–621.

Lusardi, Annamaria and Olivia S. Mitchell (2011). “Financial Literacy and Planning: Implications for Financial Wellbeing.” NBER WP 17078.

<file:///C:/Users/Owner/Downloads/FINANCIAL+LITERACY+AND+PLANNING-++IMPLICATIONS+FOR+RETIREMENT+WELLBEING.pdf>

Madrian, Brigitte C. and Dennis Shea (2001). “The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior.” *Quarterly Journal of Economics*, 116 (4): 1149 -1187.

Markowitz, Harry (1952). “Portfolio Selection.” *Journal of Finance* 7(1): 77–91.

Mullainathan, Sendhil, Markus Noeth, and Antoinette Schoar (2012). “The Market for Financial Advice: An Audit Study.” NBER WP 17929. Cambridge, MA: National Bureau of Economic Research. <http://www.nber.org/papers/w17929.pdf>

Munnell, Alicia H., Jean-Pierre Aubrey, and Caroline V. Crawford (2015). “Investment Returns: Defined Benefit vs. Defined Contribution Plans.” *Issue In Brief* No. 15-21, December.

[http://crr.bc.edu/wp-content/uploads/2015/12/IB\\_15-21.pdf](http://crr.bc.edu/wp-content/uploads/2015/12/IB_15-21.pdf)

Tergesen, Anne (2014). “Ditch a Super-Cheap 401(k) for an IRA? Sure IRA Sellers Say.” *The Wall Street Journal*, December 4. <http://blogs.wsj.com/totalreturn/2014/12/04/ditch-a-super-cheap-401k-for-an-ira-sure-ira-sellers-say/>

Thrift Savings Plan (2015). *Summary of the Thrift Savings Plan: Your Plan, Your Future*.

TIAA (2016). “IRA: Rollovers.” <https://www.tiaa.org/public/offer/products/iras/rollovers>

Turner, John A., Bruce W. Klein and Norman P. Stein (2016). “Financial Illiteracy Meets Conflicted Advice: The Case of Thrift Savings Plan Rollovers.” *Journal of Retirement* 3(4): 47-66.



White, A. (2011). "US Federal Employees' Plan Embarks on Giant Investment Tender." *Top 1000 Funds*, August 31. <http://www.top1000funds.com/profile/2011/08/31/us-federal-employees-plan-embarks-on-giant-investment-tender/>

World Bank (2014). "Pensions: Data."

<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSOCIALPROTECTION/EXTPENSIONS/0,,contentMDK:23231994~menuPK:8874064~pagePK:148956~piPK:216618~theSitePK:396253,00.html>

Vanguard. 2014 (*Vanguard Target Retirement Funds*). Malvern, PA: Vanguard Group.

<https://investor.vanguard.com/mutual-funds/target-retirement/#/>

**Table 1**

Descriptive statistics of asset returns (January 1993–April 2015).

	Mean (%)	Std. Dev. (%)	Skewness	Kurtosis	Sharpe	VaR (99%)	JB ( <i>p</i> -value %)	Observations
TSP G Fund	4.525	0.504	-0.190	1.940	0.000	0.643	0.084	268
TSP F Fund	5.686	3.595	-0.238	3.966	0.821	2.881	0.154	268
TSP C Fund	8.160	14.579	-0.711	4.300	0.372	8.966	0.000	268
TSP S Fund	10.090	18.567	-0.634	4.634	0.396	13.752	0.000	268
TSP I Fund	5.684	16.462	-0.659	4.351	0.179	9.816	0.000	268
10-Year Bond	4.508	0.449	-0.057	2.167	0.000	0.640	1.925	268
Real Estate	5.638	18.566	-0.881	10.418	0.156	12.265	0.000	268
Emerging	8.116	23.118	-0.710	5.071	0.233	14.854	0.000	268
Commodity	6.201	21.224	-0.269	4.603	0.163	14.943	0.000	268
Intern. Bond	5.203	8.300	0.223	3.897	0.297	6.510	0.368	268
3-Month T-bill	2.734	0.633	0.025	1.387	0.000	0.520	0.000	268

*Notes:* This table provides sample moments, Sharpe ratios, Value-at-risk and Jarque-Bera statistics of the five TSP-fund indices, the 10-year government bond, the four additional fund indices and the risk-free rate used in the empirical analysis. The evaluation period covers 268 months from January 1993 to April 2005. ‘Mean’ and ‘Std. Dev.’ represent annualized time-series mean and annualized standard deviation of monthly returns. ‘Skewness’ and ‘Kurtosis’ denote the third and the fourth moment of the return distribution. ‘Sharpe’ represents the annualized Sharpe ratios of the respective asset classes. We treat G fund index and 10-year government bond as riskless assets; therefore, their Sharpe ratios are zeros. VaR (99%) shows the non-parametric 99% value-at-risk of the monthly returns during the sample period. ‘JB (*p*-value)’ is the *p*-value of the Jarque-Bera statistics for testing normality of sample returns.

**Table 2**

Correlation matrix of asset returns (January 1993–April 2015).

Correlation	TSP Funds					Additional Funds				
	Gfund	Ffund	Cfund	Sfund	Ifund	10YearBond	RealEstate	Emerging	Commodity	Intern.Bond
Gfund	1.000	0.197**	-0.017	-0.048	-0.031	0.969**	-0.027	-0.066	-0.009	0.108*
Ffund	0.197**	1.000	0.039	-0.017	0.033	0.163**	0.176**	0.002	0.005	0.210**
Cfund	-0.017	0.039	1.000	0.851**	0.801**	-0.012	0.556**	0.718**	0.255**	0.002
Sfund	-0.048	-0.017	0.851**	1.000	0.753**	-0.045	0.581**	0.737**	0.308**	0.010
Ifund	-0.031	0.033	0.801**	0.753**	1.000	-0.019	0.527**	0.784**	0.380**	0.154*
10YearBond	0.969**	0.163**	-0.012	-0.045	-0.019	1.000	-0.034	-0.061	0.021	0.064
Real Estate	-0.027	0.176**	0.556**	0.581**	0.527**	-0.034	1.000	0.472**	0.163**	0.072
Emerging	-0.066	0.002	0.718**	0.737**	0.783**	-0.061	0.472**	1.000	0.361**	0.028
Commodity	-0.009	0.005	0.255**	0.308**	0.380**	0.021	0.163**	0.361**	1.000	0.074
Intern.Bond	0.108*	0.210**	0.002	0.010	0.154*	0.064	0.072	0.028	0.074	1.000

Note: The table displays the correlation matrix for the five TSP -fund indices, the 10-year government bond and the four additional fund indices used in the empirical analysis over the period from January 1993 to April 2015. \* and \*\* represent the correlation values significantly different from zero at the 5% and 1% level, respectively

**Table 3**

In sample performance of optimal mean-variance portfolio.

Estimation Method	Sample Moments			CAPM			Fama French 3 Factor			Bayesian Shrinkage		
	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe
Benchmark TSP	32.14	19.93	1.59	20.23	15.77	1.26	19.84	15.61	1.25	25.81	17.84	1.43
+ Real estate	33.71	20.42	1.63	20.98	16.06	1.28	20.75	15.97	1.28	26.75	18.17	1.45
+ Emerging	32.14	19.93	1.59	20.69	15.94	1.27	20.17	15.74	1.26	25.73	17.81	1.42
+ Commodity	32.54	20.06	1.60	20.73	15.96	1.28	20.41	15.84	1.27	26.00	17.91	1.43
+ Intern.Bond	33.63	20.40	1.63	23.43	16.99	1.36	23.28	16.93	1.35	26.71	18.15	1.45
+ All	35.56	20.98	1.68	25.07	17.58	1.40**	24.98	17.55	1.40**	27.72	18.50	1.48
NonTSP	35.00	20.98	1.65	24.52	17.59	1.37*	24.43	17.55	1.37*	27.17	18.50	1.45

*Notes:* This table displays the in-sample optimal mean-variance portfolio performance net of administering cost for the full sample from January 1993 to April 2015. The first row is the benchmark TSP 5-fund portfolio and the next five rows show the TSP portfolios complemented with additional funds. The administrative expense for the TSP plan participants is 0.03% per year, which is applied to the first six rows. The last row shows the performance for the non TSP portfolio which consists of all the nine funds, but with G fund replaced to the 10-year government bond. For non TSP investors, the annual expense is assumed 20 times more expensive than the TSP participants. ‘Mean’ denotes the annualized monthly (in percentage) returns, ‘Std.dev’ represents the associated annualized standard deviation of portfolio returns. ‘Sharpe’ is the annualized Sharpe ratio. The mean and the covariance-matrix are estimated using four different methods. \* and \*\* indicate the significant higher values of Sharpe ratio in comparison to the value of the benchmark TSP portfolio at the 10% and 5% level, respectively.

**Table 4a**

Out-of-sample portfolio benefits of additional funds using mean-variance and minimum-variance asset allocation strategies.

Estimation Method	Sample Moments			CAPM			Fama French 3 Factor			Bayesian Shrinkage		
	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe
<i>Mean-variance asset allocation strategy</i>												
Benchmark TSP	9.88	21.29	0.35	10.60	16.06	0.51	9.52	15.85	0.45	8.75	18.72	0.32
+ Real estate	<b>11.76<sup>+</sup></b>	22.14	<b>0.41<sup>+</sup></b>	<b>11.25<sup>+</sup></b>	16.38	<b>0.54<sup>+</sup></b>	<b>10.33<sup>+</sup></b>	16.22	<b>0.48<sup>+</sup></b>	<b>10.07<sup>+</sup></b>	19.25	<b>0.38<sup>+</sup></b>
+ Emerging	<b>10.88<sup>+</sup></b>	22.24	<b>0.37<sup>+</sup></b>	<b>11.33<sup>+</sup></b>	16.19	<b>0.54<sup>+</sup></b>	<b>10.02<sup>+</sup></b>	15.93	<b>0.47<sup>+</sup></b>	<b>9.39<sup>+</sup></b>	19.35	<b>0.34<sup>+</sup></b>
+ Commodity	<b>9.93<sup>+</sup></b>	22.06	0.33	<b>11.02<sup>+</sup></b>	16.23	<b>0.52<sup>+</sup></b>	<b>10.04<sup>+</sup></b>	16.00	<b>0.46<sup>+</sup></b>	8.66	19.21	0.30
+ Intern.Bond	9.23	21.77	0.30	<b>11.56<sup>+</sup></b>	17.24	0.50	<b>10.52<sup>+</sup></b>	16.89	0.45	8.13	19.01	0.27
+ All	<b>13.19<sup>+</sup></b>	24.07	<b>0.43<sup>+</sup></b>	<b>13.40<sup>+</sup></b>	17.79	<b>0.57<sup>+</sup></b>	<b>12.50<sup>+</sup></b>	17.45	<b>0.51<sup>+</sup></b>	<b>10.76<sup>+</sup></b>	20.43	<b>0.38<sup>+</sup></b>
NonTSP	<b>11.83<sup>+</sup></b>	24.08	<b>0.37<sup>+</sup></b>	<b>12.42<sup>+</sup></b>	17.81	0.50	<b>11.62<sup>+</sup></b>	17.48	0.44	<b>9.66<sup>+</sup></b>	20.44	0.32
<i>Minimum-variance asset allocation strategy</i>												
Benchmark TSP	11.82	19.65	0.50	10.65	16.01	0.52	9.99	15.64	0.50	10.52	17.07	0.48
+ Real estate	<b>14.34<sup>+</sup></b>	20.46	<b>0.60<sup>+</sup></b>	<b>11.49<sup>+</sup></b>	16.30	<b>0.56<sup>+</sup></b>	<b>10.84<sup>+</sup></b>	15.96	<b>0.54<sup>+</sup></b>	<b>12.41<sup>+</sup></b>	17.60	<b>0.57<sup>+</sup></b>
+ Emerging	<b>12.42<sup>+</sup></b>	<b>19.32<sup>+</sup></b>	<b>0.55<sup>+</sup></b>	<b>11.61<sup>+</sup></b>	16.12	<b>0.57<sup>+</sup></b>	<b>10.87<sup>+</sup></b>	15.65	<b>0.55<sup>+</sup></b>	<b>10.79<sup>+</sup></b>	<b>16.44<sup>+</sup></b>	<b>0.52<sup>+</sup></b>
+ Commodity	<b>12.30<sup>+</sup></b>	20.24	0.50	<b>11.24<sup>+</sup></b>	16.17	<b>0.54<sup>+</sup></b>	<b>10.65<sup>+</sup></b>	15.75	<b>0.53<sup>+</sup></b>	<b>10.83<sup>+</sup></b>	17.43	0.48
+ Intern.Bond	11.26	20.08	0.44	<b>11.63<sup>+</sup></b>	17.19	0.51	<b>10.95<sup>+</sup></b>	16.68	0.50	9.96	17.37	0.43
+ All	<b>15.14<sup>+</sup></b>	21.07	<b>0.61<sup>+</sup></b>	<b>13.94<sup>+</sup></b>	17.70	<b>0.62<sup>+</sup></b>	<b>13.41<sup>+</sup></b>	17.13	<b>0.61<sup>+</sup></b>	<b>12.51<sup>+</sup></b>	17.56	<b>0.58<sup>+</sup></b>
NonTSP	<b>13.78<sup>+</sup></b>	21.09	<b>0.54<sup>+</sup></b>	<b>12.97<sup>+</sup></b>	17.72	<b>0.54<sup>+</sup></b>	<b>12.53<sup>+</sup></b>	17.15	<b>0.53<sup>+</sup></b>	<b>11.41<sup>+</sup></b>	17.58	<b>0.51<sup>+</sup></b>

Notes: This table displays the out-of-sample portfolio performance following mean variance and minimum variance asset allocation strategies for the TSP 5-fund portfolio and portfolios complemented with additional funds during the period from January 1993 to April 2015. The results are net of administration cost which is 0.03% for the TSP participants and 0.6% for the non-TSP investors. Parameters are estimated using four different methods. The estimation window length is 120 months and the testing window has the length of 168 months. Improvements in comparison to the TSP benchmark portfolio are bolded and highlighted with <sup>+</sup>.

**Table 4.b**

Out-of-sample portfolio benefits of additional funds using risk parity and 1/N naïve asset allocation rules.

Estimation Method	Sample Moments			CAPM			Fama French 3 Factor			Bayesian Shrinkage		
	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe	Mean	Std.dev.	Sharpe
<i>Risk parity asset allocation strategy</i>												
Benchmark TSP	6.89	10.57	0.42	10.01	11.75	0.66	9.00	10.48	0.65	6.50	9.67	0.41
+ Real estate	6.24	<b>9.83<sup>+</sup></b>	0.40	10.01	<b>11.59<sup>+</sup></b>	<b>0.68<sup>+</sup></b>	<b>9.13<sup>+</sup></b>	<b>10.44<sup>+</sup></b>	0.66 <sup>+</sup>	5.95	<b>9.04<sup>+</sup></b>	0.39
+ Emerging	6.36	<b>9.54<sup>+</sup></b>	<b>0.44<sup>+</sup></b>	<b>11.00<sup>+</sup></b>	<b>11.22<sup>+</sup></b>	<b>0.75<sup>+</sup></b>	<b>9.85<sup>+</sup></b>	<b>9.71<sup>+</sup></b>	0.73 <sup>+</sup>	6.05	<b>8.77<sup>+</sup></b>	<b>0.43<sup>+</sup></b>
+ Commodity	<b>6.94<sup>+</sup></b>	11.18	<b>0.43<sup>+</sup></b>	<b>10.20<sup>+</sup></b>	<b>11.46<sup>+</sup></b>	<b>0.67<sup>+</sup></b>	<b>9.39<sup>+</sup></b>	<b>10.19<sup>+</sup></b>	0.66 <sup>+</sup>	<b>6.57<sup>+</sup></b>	10.21	<b>0.42<sup>+</sup></b>
+ Intern.Bond	<b>7.70<sup>+</sup></b>	12.04	<b>0.43<sup>+</sup></b>	<b>10.92<sup>+</sup></b>	13.31	0.64	<b>9.96<sup>+</sup></b>	11.91	0.62	<b>7.25<sup>+</sup></b>	11.07	<b>0.42<sup>+</sup></b>
+ All	6.72	10.83	<b>0.44<sup>+</sup></b>	<b>12.33<sup>+</sup></b>	12.65	<b>0.76<sup>+</sup></b>	<b>11.80<sup>+</sup></b>	11.16	0.75 <sup>+</sup>	6.47	10.01	<b>0.43<sup>+</sup></b>
NonTSP	6.15	10.85	0.37	<b>11.69<sup>+</sup></b>	12.67	<b>0.68<sup>+</sup></b>	<b>11.27<sup>+</sup></b>	11.18	0.65	5.92	10.02	0.36
<i>1/N naïve asset allocation strategy</i>												
Benchmark TSP	4.99	5.79	0.37	6.67	6.39	0.59	5.94	4.98	0.59	4.94	5.66	0.35
+ Real estate	4.70	5.83	0.35	6.58	6.66	0.58	<b>6.03<sup>+</sup></b>	5.39	0.57	4.67	5.68	0.34
+ Emerging	4.52	<b>5.69<sup>+</sup></b>	<b>0.39<sup>+</sup></b>	<b>7.26<sup>+</sup></b>	<b>6.06<sup>+</sup></b>	<b>0.69<sup>+</sup></b>	<b>6.43<sup>+</sup></b>	<b>4.48<sup>+</sup></b>	<b>0.68<sup>+</sup></b>	4.49	<b>5.53<sup>+</sup></b>	<b>0.39<sup>+</sup></b>
+ Commodity	4.92	7.15	<b>0.38<sup>+</sup></b>	<b>6.93<sup>+</sup></b>	6.48	0.58	<b>6.46<sup>+</sup></b>	5.16	0.58	4.89	6.90	<b>0.37<sup>+</sup></b>
+ Intern.Bond	<b>5.44<sup>+</sup></b>	7.02	<b>0.38<sup>+</sup></b>	<b>7.44<sup>+</sup></b>	7.85	<b>0.60<sup>+</sup></b>	<b>6.66<sup>+</sup></b>	6.33	0.58	<b>5.39<sup>+</sup></b>	6.84	<b>0.38<sup>+</sup></b>
+ All	4.73	7.36	<b>0.41<sup>+</sup></b>	<b>8.66<sup>+</sup></b>	7.70	<b>0.71<sup>+</sup></b>	<b>8.35<sup>+</sup></b>	6.19	<b>0.71<sup>+</sup></b>	4.77	7.06	<b>0.41<sup>+</sup></b>
NonTSP	4.24	7.37	0.31	<b>8.17<sup>+</sup></b>	7.71	<b>0.61<sup>+</sup></b>	<b>7.91<sup>+</sup></b>	6.20	<b>0.63<sup>+</sup></b>	4.28	7.07	0.31

Notes: This table continues Table 4.a, reporting the out-of-sample portfolio performance for another two different asset allocation strategies: risk parity and 1/N naïve rules, net of administration cost. ‘Mean’ denotes the annualized average monthly returns (in percentage) for each portfolio during the last 168 months (the length of testing window), ‘Std.dev’ represents the associated annualized standard deviation (in percentage). ‘Sharpe’ is the annualized Sharpe ratio. Improvements in comparison to the TSP benchmark portfolio are bolded and highlighted with <sup>+</sup>.

**Table 5.a**

Out-of-sample analysis for sub-period from January 1993 to January 2001.

	<i>Mean-variance asset allocation strategy</i>				<i>Minimum-variance asset allocation strategy</i>			
	Sample Moments	CAPM	Fama French	Bayesian Shrink	Sample Moments	CAPM	Fama French	Bayesian Shrink
Benchmark TSP	0.671	0.773	0.621	0.603	-0.448	0.756	0.674	- 0.564
+ Real estate	0.653	0.764	0.565	0.534	<b>-0.418<sup>+</sup></b>	0.743	0.633	- 0.593
+ Emerging	<b>1.300<sup>+</sup></b>	0.661	0.598	<b>1.091<sup>+</sup></b>	-0.795	0.604	0.554	- 0.982
+ Commodity	0.542	0.620	0.315	0.513	<b>-0.280<sup>+</sup></b>	0.669	0.585	<b>- 0.364<sup>+</sup></b>
+ Intern.Bond	0.523	0.571	0.412	0.458	<b>-0.424<sup>+</sup></b>	0.545	0.518	<b>- 0.515<sup>+</sup></b>
+ All	<b>1.391<sup>+</sup></b>	0.359	0.095	<b>1.017<sup>+</sup></b>	-0.663	0.349	0.300	- 0.977
NonTSP	<b>1.413<sup>+</sup></b>	0.421	0.152	<b>1.019<sup>+</sup></b>	-0.618	0.412	0.358	- 0.988
	<i>Risk parity asset allocation strategy</i>				<i>1/N naive asset allocation strategy</i>			
	Sample Moments	CAPM	Fama French	Bayesian Shrink	Sample Moments	CAPM	Fama French	Bayesian Shrink
Benchmark TSP	0.549	0.833	0.778	0.483	0.485	0.754	0.706	0.447
+ Real estate	0.433	0.683	0.608	0.368	0.371	0.613	0.541	0.331
+ Emerging	0.281	0.466	0.416	0.244	0.117	0.194	0.173	0.127
+ Commodity	0.443	0.693	0.645	0.396	0.356	0.577	0.521	0.347
+ Intern.Bond	0.315	0.472	0.463	0.275	0.298	0.471	0.460	0.279
+ All	0.013	0.062	0.007	- 0.007	- 0.078	- 0.088	- 0.144	- 0.022
NonTSP	0.012	0.102	0.039	- 0.017	0.033	- 0.083	- 0.151	- 1.034

*Notes:* This table displays the out-of-sample portfolio Sharpe ratios for different asset allocation strategies and different parameter estimation methods for the TSP 5-fund portfolio and portfolios complemented with additional funds during the sub period from January 1993 to January 2001. The results are net of administration cost. The length of the estimation window is 30 months. Improvements in comparison to the TSP benchmark portfolio are bolded and highlighted with <sup>+</sup>.

**Table 5.b**

Out-of-sample analysis for sub-period from February 2001 to February 2008.

	<i>Mean-variance asset allocation strategy</i>				<i>Minimum-variance asset allocation strategy</i>			
	Sample Moments	CAPM	Fama French	Bayesian Shrink	Sample Moments	CAPM	Fama French	Bayesian Shrink
Benchmark TSP	0.537	0.499	0.279	0.464	0.217	0.508	0.530	0.156
+ Real estate	0.368	0.468	0.098	0.334	0.026	<b>0.520<sup>+</sup></b>	0.530	0.028
+ Emerging	<b>0.712<sup>+</sup></b>	<b>0.655<sup>+</sup></b>	<b>0.320<sup>+</sup></b>	<b>0.627<sup>+</sup></b>	- 0.037	<b>0.691<sup>+</sup></b>	<b>0.676<sup>+</sup></b>	- 0.156
+ Commodity	<b>0.593<sup>+</sup></b>	<b>0.614<sup>+</sup></b>	<b>0.364<sup>+</sup></b>	<b>0.510<sup>+</sup></b>	<b>0.328<sup>+</sup></b>	<b>0.626<sup>+</sup></b>	<b>0.631<sup>+</sup></b>	<b>0.249<sup>+</sup></b>
+ Intern.Bond	<b>0.853<sup>+</sup></b>	<b>0.678<sup>+</sup></b>	<b>0.425<sup>+</sup></b>	<b>0.713<sup>+</sup></b>	<b>0.444<sup>+</sup></b>	<b>0.674<sup>+</sup></b>	<b>0.700<sup>+</sup></b>	<b>0.331<sup>+</sup></b>
+ All	<b>0.738<sup>+</sup></b>	<b>0.902<sup>+</sup></b>	<b>0.394<sup>+</sup></b>	<b>0.677<sup>+</sup></b>	0.018	<b>0.943<sup>+</sup></b>	<b>0.894<sup>+</sup></b>	- 0.080
NonTSP	<b>0.748<sup>+</sup></b>	<b>0.908<sup>+</sup></b>	<b>0.400<sup>+</sup></b>	<b>0.675<sup>+</sup></b>	0.025	<b>0.949<sup>+</sup></b>	<b>0.898<sup>+</sup></b>	- 0.097
	<i>Risk parity asset allocation strategy</i>				<i>1/N naive asset allocation strategy</i>			
	Sample Moments	CAPM	Fama French	Bayesian Shrink	Sample Moments	CAPM	Fama French	Bayesian Shrink
Benchmark TSP	0.505	0.692	0.681	0.484	0.460	0.686	0.655	0.439
+ Real estate	0.469	0.669	0.663	0.453	0.402	0.615	0.601	0.394
+ Emerging	<b>0.726<sup>+</sup></b>	<b>1.150<sup>+</sup></b>	<b>1.112<sup>+</sup></b>	<b>0.678<sup>+</sup></b>	<b>0.788<sup>+</sup></b>	<b>1.335<sup>+</sup></b>	<b>1.273<sup>+</sup></b>	<b>0.748<sup>+</sup></b>
+ Commodity	<b>0.816<sup>+</sup></b>	<b>1.022<sup>+</sup></b>	<b>1.005<sup>+</sup></b>	<b>0.761<sup>+</sup></b>	<b>0.931<sup>+</sup></b>	<b>1.150<sup>+</sup></b>	<b>1.130<sup>+</sup></b>	<b>0.876<sup>+</sup></b>
+ Intern.Bond	<b>0.622<sup>+</sup></b>	<b>0.852<sup>+</sup></b>	<b>0.851<sup>+</sup></b>	<b>0.595<sup>+</sup></b>	<b>0.507<sup>+</sup></b>	<b>0.781<sup>+</sup></b>	<b>0.765<sup>+</sup></b>	<b>0.503<sup>+</sup></b>
+ All	<b>0.927<sup>+</sup></b>	<b>1.421<sup>+</sup></b>	<b>1.397<sup>+</sup></b>	<b>0.860<sup>+</sup></b>	<b>1.023<sup>+</sup></b>	<b>1.537<sup>+</sup></b>	<b>1.485<sup>+</sup></b>	<b>0.950<sup>+</sup></b>
NonTSP	<b>0.918<sup>+</sup></b>	<b>1.409<sup>+</sup></b>	<b>1.344<sup>+</sup></b>	<b>0.844<sup>+</sup></b>	<b>1.001<sup>+</sup></b>	<b>1.488<sup>+</sup></b>	<b>1.796<sup>+</sup></b>	<b>0.922<sup>+</sup></b>

Notes: This table continues Table 5.a, showing the out-of-sample portfolio Sharpe ratios for different asset allocation strategies and different parameter estimation methods during the sub period from February 2001 to February 2008. Improvements in comparison to the TSP benchmark portfolio are bolded and highlighted with <sup>+</sup>.



**Table 5.c**

Out-of-sample analysis for sub-period from March 2008 to April 2015.

	<i>Mean-variance asset allocation strategy</i>				<i>Minimum-variance asset allocation strategy</i>			
	Sample Moments	CAPM	Fama French	Bayesian Shrink	Sample Moments	CAPM	Fama French	Bayesian Shrink
Benchmark TSP	1.107	0.479	0.456	0.833	0.992	0.702	0.700	0.706
+ Real estate	<b>1.223<sup>+</sup></b>	0.304	0.326	<b>0.893<sup>+</sup></b>	<b>1.196<sup>+</sup></b>	<b>0.719<sup>+</sup></b>	<b>0.702<sup>+</sup></b>	<b>0.882<sup>+</sup></b>
+ Emerging	<b>1.343<sup>+</sup></b>	<b>0.531<sup>+</sup></b>	<b>0.668<sup>+</sup></b>	<b>0.951<sup>+</sup></b>	<b>1.326<sup>+</sup></b>	0.678	0.656	<b>0.915<sup>+</sup></b>
+ Commodity	<b>1.425<sup>+</sup></b>	0.453	0.331	<b>1.091<sup>+</sup></b>	0.772	0.588	0.514	0.458
+ Intern.Bond	1.047	-0.025	-0.055	0.790	0.744	0.428	0.422	0.477
+ All	<b>1.919<sup>+</sup></b>	-0.131	0.136	<b>1.250<sup>+</sup></b>	<b>1.734<sup>+</sup></b>	0.318	0.247	<b>1.044<sup>+</sup></b>
NonTSP	<b>1.760<sup>+</sup></b>	-0.292	0.003	<b>1.138<sup>+</sup></b>	<b>1.543<sup>+</sup></b>	0.086	-0.029	<b>0.887<sup>+</sup></b>
	<i>Risk parity asset allocation strategy</i>				<i>1/N naive asset allocation strategy</i>			
	Sample Moments	CAPM	Fama French	Bayesian Shrink	Sample Moments	CAPM	Fama French	Bayesian Shrink
Benchmark TSP	0.809	1.130	1.111	0.760	0.686	1.039	1.005	0.683
+ Real estate	0.724	1.134 <sup>+</sup>	1.095	0.688	0.647	1.012	0.982	0.610
+ Emerging	0.610	0.974	0.938	0.589	0.472	0.797	0.741	0.487
+ Commodity	0.497	0.802	0.753	0.477	0.333	0.574	0.530	0.365
+ Intern.Bond	0.620	0.841	0.804	0.579	0.596	0.903	0.867	0.600
+ All	0.299	0.559	0.512	0.294	0.221	0.442	0.422	0.222
NonTSP	0.189	0.426	0.702	0.184	-0.046	0.193	0.452	-0.798

Notes: This table continues Table 5.a and 5.b, reporting the out-of-sample portfolio performance net of administration cost during the sub period from March 2008 to April 2015. for different asset allocation strategies and different parameter estimation methods. Improvements in comparison to the TSP benchmark portfolio are bolded and highlighted with <sup>+</sup>.