Investment Option Review

Federal Retirement Thrift Investment Board

Thrift Savings Plan

May 2017

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EXECUTIVE SUMMARY

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Background

The Federal Retirement Thrift Investment Board (FRTIB) asked Aon Hewitt Investment Consulting (AHIC) to review the line-up of options offered within the Thrift Savings Plan (TSP) to determine whether the line-up remains appropriate and to evaluate whether potential fund additions are warranted.

In this report, we:

- Review the circumstances of the TSP and compare its circumstances to that of peer plans
- Identify the key criteria to evaluate potential fund additions
- Apply the key criteria to a broad array of potential fund alternatives to identify those suitable for further consideration
- Review the appropriateness of including specific fund alternatives and provide our recommendations on whether a fund alternative should be included in the Plan line-up

Current Practices and Peer Comparisons

- As of December 31, 2016, the TSP had approximately 5.0 million participants who had approximately $473 billion invested among the underlying plan options. This translates to an average FERS participant balance of approximately $120,000.
- The TSP offers ten investment alternatives from which participants may choose. These include five core investment alternatives and five lifecycle or target retirement date funds.
- The table below lists the investment options currently offered within the Thrift Savings Plan

Investment Option Types	TSP Option	Market Values ($Billions) (As of 12/31/2016)*
Stable Value	G Fund	$169.2
Diversified Fixed Income	F Fund	$21.3
Lifecycle/Target date retirement funds	L Income L 2020 L 2030 L 2040 L 2050	$85.4
U.S. Stock	C Fund S Fund	$129.6 $47.7
Non-U.S. Stock	I Fund	$20.1

** The table shows that investments in the core funds are reduced by their representation in the L Funds in order to avoid double counting.*

Investment Structure

By investment structure, we refer to the number and types of options that are offered within a plan. We believe a plan's investment options should offer a sufficient range of choice to allow participants to form well-diversified portfolios, given a reasonable range of risk and return circumstances. As such, we believe that the TSP should have a structure that:

- Offers sufficient range of choice – with options that reasonably span the risk and return spectrum across major investable markets
- Allows participants to form well-diversified portfolios
- Is appropriately comparable with peers
- Meets broad participant demand

The investment option types offered to TSP participants match those that we recommend the TSP offer.

- U.S. stock
- Non-U.S. stock
- Diversified fixed income
- Cash equivalent/stable value
- Lifecycle/Target date retirement funds

Our recommendations regarding the TSP's investment structure are also influenced by our beliefs that:

- The majority of DC plan **participants don't form efficient portfolios over a lifetime** and are likely sacrificing financial outcomes at retirement.
- **Investment option structure** has a significant impact on participant behavior.
- **Simplicity** enhances the likelihood of an investment program's success.
- Investment decisions should be based on **accepted theoretical principles and sound empirical data**—not opinions, fads, or popular trends.
- Many participants are not saving enough. Funds and services that **automate the participant experience** can help employees better achieve their retirement goals.

And finally, **fees are important** as you can't control the markets, but you can control costs.

Review of the TSP's Investment Structure

- The five core investment alternatives span the risk/return spectrum and include what we would consider to be all of the core building blocks to build a diversified investment portfolio. With the exception of the G Fund, each of the core investment options is broadly diversified and provides comprehensive coverage of the asset class it represents. The G Fund, while not broadly diversified since it has exposure to a single issuer, the U.S. Treasury, is backed by the full faith and credit of the U.S. Government.
- The L Funds include an Income Fund and four target retirement date funds offered in 10-year increments commencing with a fund with a target retirement date of 2020. The L Funds allow participants to select an investment fund that is diversified among and within asset classes as the L Funds are constructed using the five core investment options. We have seen peer plans move their Lifecycle funds from 10-year increments to 5-year increments providing participants a more narrow window of time to match their intended retirement date with their asset allocation. We recommend the FRTIB consider expanding the L-Funds from 10-year increment asset allocation solutions to 5-year increment asset allocation solutions.
- While the number of options offered within the TSP is lower than that of peer plans, the TSP offers investment funds across the major categories that are found in a majority of participant directed plans and represent the investment options in peer plans. In addition, national data supports that the average participant only selects between 3 to 4 investment options; therefore participant behavior is not supporting a need for an abundance of investment options. Instead it is preferable to have access to broadly diversified and simple-to-select solutions.
- Moreover, the options offered within the TSP represent those that receive a large portion of the assets in peer participant directed plans.
- As noted earlier, we believe that the options offered also represent the core building blocks necessary to build a diversified investment portfolio.

One of the hallmarks of the TSP is its simplicity and efficiency. The TSP offers low-cost, broadly diversified options that provide coverage of the broad asset class segments that form the core building blocks of diversified portfolios. The core options allow participants to build portfolios that span the risk and return spectrum. Further, offering the L Funds is in line with contemporary best practices and allows participants who do not wish to make investment decisions pre-mixed portfolios that embrace the key tenets of investing (diversification, appropriate risk/return profile, and low cost).

We believe that the options offered represent the major categories found in peer plans and the options to which most participant assets are directed. In terms of broader industry trends, after years of offering an increasingly wide number of options from which participants can choose, we find that increasingly plan sponsors are seeking to streamline their plans and are focusing on simplicity and efficiency. This movement over the past five years has led to incremental reductions year-over-year in the average number of plan options offered across a broad range of participant directed defined contribution plans. AHIC's advice to our defined contribution clients is to maintain a simple efficient investment line-up that includes target retirement date funds, passive options that provide broad asset class coverage, and in some instances select, broadly-diversified active fund options. With the exception of active fund options, the TSP line-up is reflective of the broad advice we provide clients in structuring their defined contribution plan line-up.

We believe that the core of the TSP's line-up is well-structured and that there are no gaps in the fund line-up offered to participants.

Key Criteria for Evaluation of Investment Fund Alternatives

In evaluating the types of investment fund alternatives to offer in the TSP, we believe the following criteria (individually and collectively) are the most relevant to consider:

- Major diversified asset class/category not currently offered as an investment option
- Asset class/category is large enough for the TSP to invest in (consider asset classes/categories with a market capitalization or investment opportunity set of at least $1 trillion)
- Potential diversification benefit for TSP participant portfolios
- Asset class/category offers daily liquidity and daily valuation
- Ability to index
- Practices of peers

Review of Asset Classes/Categories Considered for Inclusion

The asset classes/categories we considered for review are listed in the table below.

Equities	Fixed Income	Alternatives/Other
U.S. Growth Stock	Non-U.S. Bonds	Private Real Estate
U.S. Value Stock	High Yield Bonds	Private Equity
Global REITs	TIPS	Commodities
Emerging Markets Stock	Emerging Market Debt	Hedge Funds
Non-U.S. Small-Cap Stock		Socially Responsible/ESG Funds
Frontier Markets		Infrastructure

Based on the application of the key criteria discussed above, we eliminated several categories from further consideration due to factors such as – small market size, illiquidity, lack of passive investment strategies, or concentrated strategies/purpose. The asset classes excluded for further consideration were:

- Frontier Market Equities
- High Yield Bonds
- TIPS
- Private Real Estate
- Private Equity
- Hedge Funds
- Socially Responsible/ESG Funds
- Infrastructure

Below we provide summary thoughts on the asset classes/categories that we reviewed in detail.

Value and Growth U.S. Stocks

Larger-capitalization growth and value funds are attractive alternatives from a market size, liquidity, sector and a security diversification standpoint. The diversification benefits from a portfolio standpoint, however, would not be material relative to the current investment funds already available. We do not believe it is necessary for the TSP to offer any additional U.S. stock funds as the C and S Funds provide exposure to the entire U.S. stock market. Offering a more limited number of U.S. stock funds without foregoing material improvement in portfolios would be consistent with avoiding investment choice overload. On balance, we do not find a compelling reason to add additional U.S. stock funds, as the TSP's current investment line-up provides broad exposure to the U.S. stock market via the C and S Funds. The same thinking also applies with value and growth stocks in non-U.S. developed markets.

Global REITs

While there appear to be compelling attributes supporting the inclusion of global REITs, we do not recommend their inclusion at this time. TSP participants attain exposure to REITs in market capitalization weights via the C, S and I Funds. REITs are a specific sector of the global equity market and exhibit a higher degree of volatility than the broad equity market. Adding REITs would make the plan line-up more complex. While the number of plans offering a REIT option did increase for a period of a few years. We feel it is important to note that the number of plans adding a REIT option have significantly slowed in recent periods, and in addition, utilization has remained low.

Emerging Markets Stock

Emerging markets are a large asset class, expected to experience secular growth, and provide a benefit to portfolios at the higher levels of risk. While emerging markets are an attractive asset class, we have concerns with the TSP (and DC plans in general) offering emerging markets as a standalone investment fund. The high risk associated with emerging markets has resulted in material losses over relatively short periods of time and is difficult for participants (or for any investor) to bear. Overall, we believe the negatives of offering an emerging markets investment fund outweigh the positives and recommend an emerging markets stock fund not be added as a standalone investment fund.

Non-U.S. Small Cap Stock

While non-U.S. small cap markets have grown to an adequate size and index products are now offered, we would prefer to take a more broadly diversified view of international stocks. More broadly defined investment options will make education easier and participation more likely. Non-U.S. small cap may rank second, next to emerging market equity, as one of the higher risk offerings and is not commonly offered, as a stand-alone investment option. The high risk associated with non-U.S. small cap stocks may result in material losses. We do not recommend non-U.S. small cap stock be included as a stand-alone investment fund.

Broad Non-U.S. Stock

Overall, we find value in expanding the coverage of the I Fund (e.g. Canada, emerging markets, and non-U.S. small cap stocks) to provide more of a complete coverage of the international equity opportunity set. Broader coverage of the international equity markets more fully captures global growth, and provides enhanced diversification of the international equity portfolio. Ultimately, broadening the coverage of the I Fund to encompass the full opportunity set will provide symmetry to TSP's equity investment line up as it would be providing access to both U.S. and non-U.S. large and small cap stocks. However, as we consider the appropriate market exposure for the I Fund, it is important to take into account the TSP's unique circumstances such as liquidity needs. Therefore, we recommend to consider expanding the mandate for the I Fund. This consideration will need further investigation to asses its feasibility. Given that the number of participants and level of assets will continue to grow compounded by the upcoming addition of military personnel to the TSP program through Blended Retirement, the liquidity analysis is especially important to ensure that the TSP's size and growth are adequately considered.

Non-U.S. Bonds

Non-U.S. bonds are a material portion of the world's market capitalization and investable opportunity set. However, the benefits of adding a non-U.S. bond option are minimal from an expected risk-return and portfolio diversification standpoint for TSP participants. Moreover, adding a non-U.S. bond fund would add complexity to a segment of the plan where we believe additional flexibility is not required and/or meaningful. As such, we recommend the FRTIB not add a non-U.S. bond fund as an investment fund alternative.

Emerging Market Debt

While correlations to traditional bonds are low, correlation to equities are fairly high, coupled with lower expected returns and high risk, this asset class is less appealing as a stand-alone option. Offering emerging market debt, as a stand-alone option, is not common practice (none of the top ten largest government plans offer this option). For these reasons we would not recommend emerging market debt be added as an investment fund alternative.

Commodities

Commodity futures offer a diversification benefit, as well as the potential to hedge against inflation. However, commodity prices are influenced by demand/supply considerations rather than the intrinsic value of a security, and future return expectations are uncertain. Most individual investors will have difficulty in determining an appropriate allocation to commodities. Commodity funds are also not a common investment option in defined contribution plans. We recommend that the FRTIB not offer commodities as an investment option in the TSP.

Conclusion

Based on our analysis, we think the current line-up G, F, C, S, and I Funds currently offered by the TSP remains in the best interest of the Plan's participants and beneficiaries. For that reason, we did not find any of the eight asset classes/categories that we evaluated in detail particularly compelling as a stand-alone investment fund addition to the TSP line-up with an exception to broadening the I Fund. The simplicity and efficiency of the existing line-up makes the TSP a very attractive offering to participants. With the exception of broadening the I Fund, we do not believe that the addition of any of these options evaluated would enhance the efficiency of the Plan without compromising materially on its simplicity. As such, we recommend that the FRTIB maintain the existing structure of its investment line-up while considering expanding the coverage of the I Fund as well as expanding the L-Funds to 5-year asset allocation solutions.

REVIEW OF CURRENT CIRCUMSTANCE AND COMPARISON TO PEERS

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The following section encapsulates the current circumstances of the TSP's investment structure and compares it to peer plans.

Overview

- Assets of approximately $473 billion as of December 31, 2016
- Over 5.0 million participants
- An average FERS participant balance of approximately $120,000
- 10 investment options are currently available to participants (5 core options and 5 lifecycle or target date funds):

Investment Option Types	TSP Option	Market Values ($Billions) (As of 12/31/2016)*
Stable Value	G Fund	$169.2
Diversified Fixed Income	F Fund	$21.3
Lifecycle/Target date retirement funds	L Income L 2020 L 2030 L 2040 L 2050	$85.4
U.S. Stock	C Fund S Fund	$129.6 $47.7
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** The table shows that investments in the core funds are reduced by their representation in the L Funds in order to avoid double counting.*

Key Characteristics of TSP

- The TSP offers participants the ability to invest in five diversified “core” investment alternatives (G, F, C, S, and I Funds) that reasonably span the risk and return spectrum, allowing participants to construct portfolios that range from low risk to moderate to higher risk. We note the G Fund is not “diversified” among securities, but is backed by the full faith and credit of the U.S. government.
- The L Funds allow participants to select an investment solution(s) that is diversified among and within asset classes, as the L Funds are constructed using the five underlying core investment funds. Importantly, the L Funds embrace the key principle of investing in that they are broadly diversified. The L Funds rebalance and evolve over time from growth-oriented portfolios to income and principal-preservation focused portfolios in order to adjust for participants’ time horizons.
- The net costs of administering the TSP’s total plan are well below industry average (under 5 basis points or 0.05%).

On the following pages, we compare the practices of the TSP to those of peer defined contribution plans. In order to compare the TSP to an appropriate sub-set of peers, we use information from two widely followed defined contribution surveys – Profit Sharing/401(k) Council of America (PSCA) which surveys private 401(k) plans and Vanguard which analyzes information on both public and private sector defined contribution plans. In addition, we compiled information on the offerings of the ten largest public sector (and quasi-public sector) defined contribution plans shown in the table below.

Top Ten Public Sector (Quasi Public Sector) Savings Plans by Assets as of 9/30/2016

Name of Fund	Market Value ($Billions)
University of California Retirement Systems	$20.8
New York State Deferred Compensation	$18.6
New York City Deferred Compensation	$16.8
Washington State	$15.6
Ohio Public Employees Deferred Compensation	$11.8
California State Savings Plan	$11.6
County of Los Angeles	$11.6
Teachers Retirement System of City of New York	$10.8
North Carolina Retirement Systems	$9.6
State Board of Administration Florida	$9.2

Public Peer Observations

From a practical standpoint, it is worth noting that while peer comparisons provide a good reference point, the large size of TSP's assets limit the options that can be offered to participants due to the size and liquidity attributes of a potential offering's market capitalization/opportunity set. Moreover, the TSP's governing statute and Board policies (such as offering passive options) limit the number of options that can be made available to participants.

The table below shows the types of investment options commonly offered to participants.

Investment Options Commonly Offered

Option Types	TSP	PSCA (5,000+ Participants)	Vanguard (5,000+ Participants)	Top 10 Public Sector Plans
Balanced Fund	No	44%	69%	60%
Bond Fund – Active	No	78%	75%	90%
Bond Fund – Passive	Yes	66%	91%	60%
International Bond	No	16%	17%	0%
TIPS*	Yes	29%	40%	50%
High Yield	No	N/A	19%	10%
Cash (CD/Money Market)*	Yes	36%	77%	50%
Company Stock	No	47%	37%	0%
US Equity – Active	No	83%	92%	70%
US Equity – Passive	Yes	88%	97%	80%
US Large Cap Value	No	N/A	83%	30%
US Large Cap Growth	No	N/A	83%	30%
US Mid Cap	No	N/A	85%	80%
US Small Cap	No	N/A	80%	90%
International Equity – Active	No	77%	85%	80%
International Equity – Passive	Yes	64%	74%	70%
Emerging Markets	No	40%	31%	30%
Target Date/Asset Allocation Fund	Yes	77%	99%	90%
Real Estate Fund	No	19%	23%	10%
Stable Value*	Yes	72%	58%	80%
Self-Directed (Brokerage/Mutual Fund)	No	34%	29%	70%
Socially Responsible	No	6%	18%	60%

Source: PSCA 59th Annual Survey of Profit Sharing and 401(k) Plans (2015 Plan Experience), Vanguard 2016, and Aon Hewitt
***For the purpose of this analysis, we classify the G Fund, offered within the TSP**, to represent three options – money market, stable value and TIPS – since it provides benefits and/or attributes associated with each of these categories. The G Fund adjusts almost immediately to changes in interest rates (without any principal volatility), which may be a result of rising inflation (TIPS), provides daily liquidity (money market), and provides higher yields than money market without risk of loss to principal (stable value).*

Overall Survey Observations

- The TSP offers investment options in the most widely provided categories.
- The areas where TSP does not offer options that are commonly utilized by peers include U.S. large cap growth/value, active equity and active bonds. Exposure to the market return (beta) that these active funds provide can be gained through passive domestic/international equity and passive bond funds (funds C, I, & F). On this issue, it is important to note the research that we and others in the industry have conducted shows that a vast majority of active funds fail to add value net of fees. As such, we do have a bias toward utilizing passive investments/funds, especially in defined contribution plans.

- Socially Responsible Investment (SRI) (or Environmental, Social, and Governance (ESG) funds) funds are offered by a majority of the largest public sector defined contribution plans, however, most of the exposure to stocks that such funds provide can be gained through the C, S, & I funds as SRI is a subsector of equities and not a distinct asset class.
- Balanced funds are offered by the majority of large defined contribution plans. However, over the past 10 years large defined contribution plans' assets in balanced funds have shrunk from 12% of total assets in 2006 to 6% of total plan assets in 2015. In addition, most of the exposure can be obtained by using the L Funds or a combination of C, S, I, F and G funds.

In the following tables, we show the participant asset allocation practices according to the three marketplace surveys mentioned earlier.

PSCA: Participant Asset Allocation as of December 2015

	Plans with 5,000+ Participants	**Allocations Excluding Company Stock**	**Average Number of Funds Offered**	**TSP** ***(As of December 2016)***
Cash (CD/Money Market)	2%	2%	0	--
Stable Value	12%	13%	1	36%
Bonds – Active	5%	5%	1	--
Bonds – Passive	2%	2%	1	4%
International Bonds	0%	0%	0	--
TIPS	0%	0%	0	--
Total Fixed Income	**21%**	**23%**	**3**	**40%**
Company Stock	7%	--	--	--
U.S. Equity – Active	21%	23%	4	--
U.S. Equity – Passive	14%	15%	2	37%
International Equity – Active	5%	5%	1	--
International Equity -- Passive	2%	2%	1	4%
Total Equity	**50%**	**45%**	**8**	**42%**
Balanced	7%	8%	1	--
SRI Funds	0%	0%	0	--
Sector Funds	0%	0%	0	--
Self-Directed	1%	1%	--	--
Target Date/Lifecycle	19%	21%	1	18%
Other	2%	2%	5	--
TOTAL	**100%**	**100%**	**18**	**100%**

Source: PSCA 59th Annual Survey of Profit Sharing and 401(k) Plans (2015 Plan Experience)

PSCA Survey Observations

- TSP participants have slightly less allocated to equities than their peer group.
- TSP participants have significantly higher allocations to fixed income, specifically with more in stable value than their peer group given the G Fund offering.
- TSP participants have a slightly lower allocation to target date/life cycle funds than their peer group when excluding company stock.

The table below shows the asset allocation practices according to the Vanguard 2016 survey.

2016 Vanguard Survey: Participant Asset Allocation

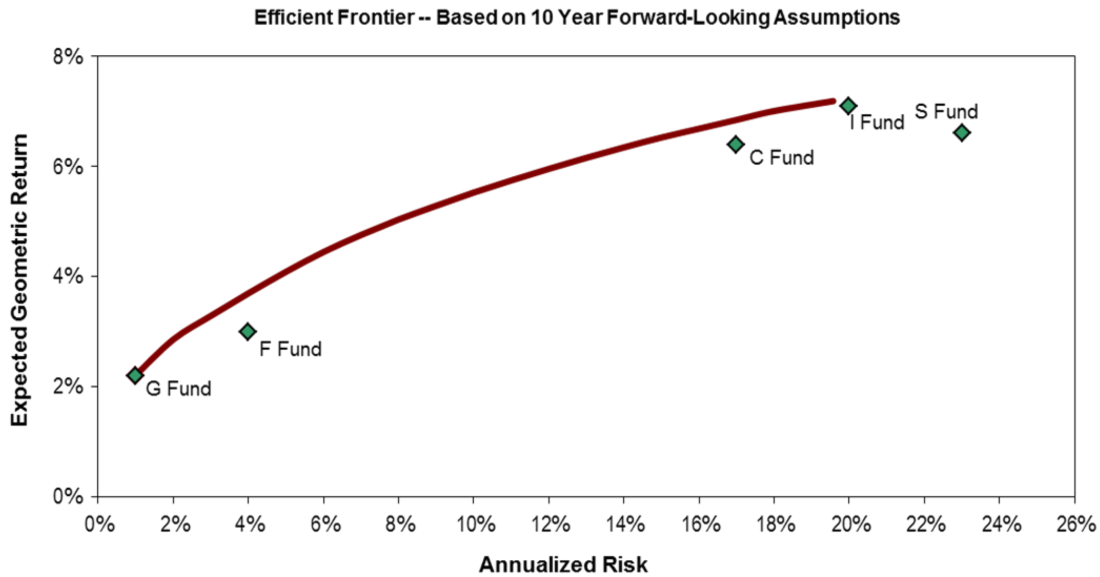
	Vanguard Plan Assets	**Allocations Excluding Company Stock**	**TSP** ***(As of December 2016)***
Cash Equivalents	11%	12%	36%
Bond	7%	8%	4%
Total Fixed Income	**18%**	**20%**	**40%**
Company Stock	7%	--	--
Diversified Stock	43%	46%	42%
Total Equity	**50%**	**46%**	**42%**
Balanced	6%	6%	--
Target Date/Lifecycle Funds	26%	28%	18%
TOTAL	**100%**	**100%**	**100%**

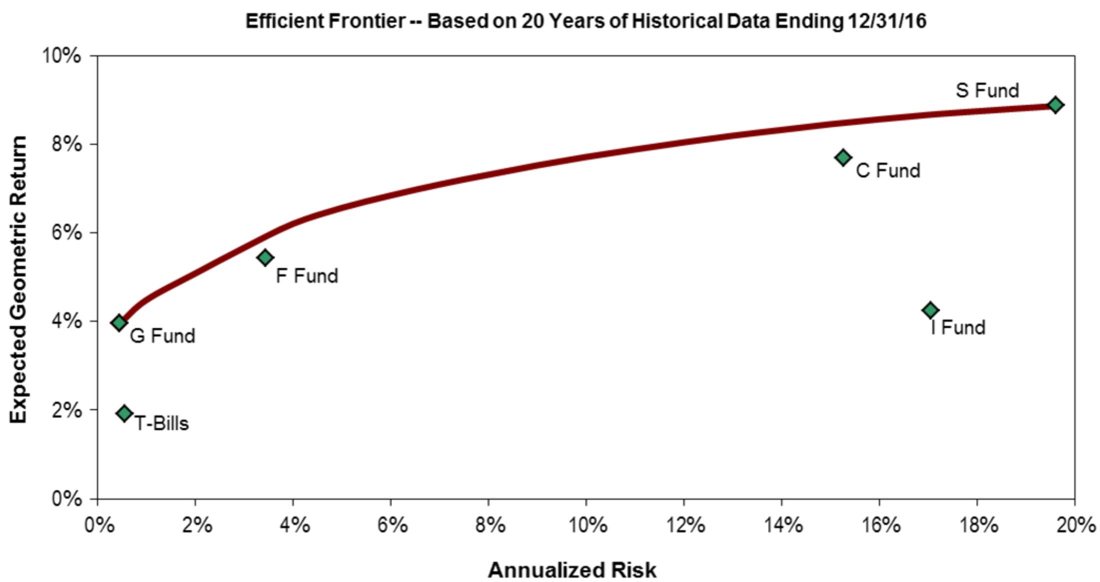
Source: Vanguard 2016

Vanguard Survey Observations

- TSP participants have slightly lower allocations to core fixed income (F Fund) and target date funds (L Fund) compared to Vanguard's 2016 survey of defined contribution plans.
- Even when excluding allocations to company stock, TSP participants still have slightly less exposure to equities when compared to its peers.
- TSP participants have the highest allocation to the lowest risk, stable value fund option given the G Fund offering.

The charts on the following page show the risk/return relationship characteristics of the TSP's current investment options on both a forward looking (Aon Hewitt Investment Consulting's 10 year assumptions) and historical (20 year) basis. Returns are shown on the Y-axis (annualized return) and risk (annualized standard deviation of return) is shown on the X-axis. The L Funds (target date funds) were introduced in August of 2005 and consist of varying proportions of the G, F, C, S, and I Funds. The historical risk/return characteristics of each L Fund are determined by the component weights for each fund. As shown, the investment funds currently offered to participants span the risk/return spectrum from conservative to more aggressive risk.





Summary

TSP participants are offered broad exposure to major asset classes within the five core investment options that span the risk spectrum. The L Funds deliver the choice of pre-mixed portfolios that offer participants well diversified portfolios with automatic rebalancing that provides a glide path to higher fixed income allocations (lower risk portfolios) as the participants' time horizon shortens. The investment options are provided through low-cost, passively managed funds.

Relative to peers, the TSP offers fewer choices; however, our review of the program leads us to the conclusion that there are no major gaps within the core investment options. There are areas within the broader equity universe that are not represented in the core options (e.g. Canada, emerging markets, and non-U.S. small cap stocks) that may provide better risk adjusted returns when included as part of the broader international equity exposure, which could occur through expanding the I Fund (e.g. from the EAFE to the ACWI ex U.S. or ACWI ex U.S. IMI). We do believe it to be prudent to review the inclusion of additional asset classes within the I Fund.

Knowing TSP's circumstances and how it compares to peers, we now review the factors that impact participant behavior and our thoughts on how to best implement an investment option structure from a "macro" perspective.

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INVESTMENT STRUCTURE

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INVESTMENT STRUCTURE

The investment structure of a participant directed defined contribution plan refers to the number and type of options offered to participants. This is the most important component of the investment program. It will not only determine the structure of investment options offered to participants, but will also:

- Shape how participants invest their assets
- Impact the participants' perceived value of the Plan

We believe a plan's investment options should offer a sufficient range of choice to allow participants to form well-diversified portfolios, given a reasonable range of risk and return circumstances. As such, we recommend that the TSP have a structure that:

- Offers sufficient range of choice – with options that reasonably span the risk and return spectrum across major investable markets
- Allows participants to form well-diversified portfolios
- Is appropriately comparable with peers
- Meets broad participant demand

We recommend that at a minimum the TSP offer the investment option types listed below. The investment option types provide representation of all major asset classes typically considered suitable for defined contribution plans, represent the major building blocks for a diversified portfolio, and allow for representation of different levels of risk:

- U.S. stock
- Non-U.S. stock
- Diversified fixed income
- Cash equivalent/stable value
- Lifecycle/Target date retirement funds

The TSP currently offers at least one broadly diversified "core" investment fund in each of these categories.

We generally recommend offering only a single option in the cash equivalent/stable value, diversified fixed income and international stock categories, as one option is all that is necessary to provide the asset class exposure required to diversify participant portfolios. However, we find that approximately 30% to 40% of plans provide two options for international stock (developed and emerging markets). In general, we would not recommend offering an emerging market equity fund on a standalone basis for most DC plans, but especially for a plan such as the TSP, given the higher volatility of the asset class. Instead, we would consider offering developed and emerging market equities in a single broadly diversified investment option.

The two categories where it is appropriate to consider multiple options are lifecycle and U.S. stock. It is appropriate to offer multiple lifecycle funds as a program must meet the needs of participants with materially different time horizons (e.g., 5 years vs. 35 years).

Offering multiple options in U.S. stock is appropriate for the following reasons:

- Participants' knowledge of U.S. stock investing has grown tremendously in recent years – resulting in increased demand for U.S. stock fund alternatives.
- U.S. stock is generally one of the largest components of a participant's portfolio; therefore, offering a large cap option and a small-mid cap option provides the participant choice but still in a simplified manner.
- Both the U.S. large cap and small-mid cap markets can stand on their own as investment options as they are well diversified, large, and liquid markets with each market representing over 500 stocks and greater than $3 trillion in market cap size.
- It represents contemporary practice, in part, due to the fact that small cap stocks have different risk and return attributes relative to large cap stocks.

The types of U.S. stock funds that are commonly offered across DC are:

- Core stock index fund
- Large-cap value
- Large-cap growth
- Mid/small-cap stock

The TSP does not offer separate large-cap growth and value fund options. We note, however, that participants have access to the entire U.S. stock market, including growth and value stocks, via the C and S Funds.

Actively managed U.S. and non-U.S. stock funds are offered in the majority of plans. The TSP has not offered actively managed stock funds as it has not been allowed to do so by statute. It is not necessary for the TSP to offer actively managed stock funds as the TSP has provided broad exposure to the U.S. and non-U.S. stock asset class via the C, S & I Funds.

Offering a single option in international stock is appropriate given that it represents contemporary practice. Typically, managers of non-U.S. investments have not focused on growth/value or large/small divisions when crafting investment products. A vast majority of defined contribution plans offer broad-based non-U.S. stock funds (inclusive of developed and emerging markets) as opposed to style or capitalization specific funds.

Guiding Principles

The guiding principles we recommend our clients generally employ in structuring their investment fund line-ups are listed below:

- The majority of DC plan **participants don’t form efficient portfolios over a lifetime** and are likely sacrificing financial outcomes at retirement.
- **Investment option structure** has a significant impact on participant behavior.
- **Simplicity** enhances the likelihood of an investment program’s success.
- Investment decisions should be based on **accepted theoretical principles and sound empirical data**—not opinions, fads, or popular trends.
- Many participants are not saving enough. Funds and services that **automate the participant experience** can help employees better achieve their retirement goals.

And finally, **fees are important** as you can’t control the markets, but you can control costs.

Number of options: Surveys and studies by providers such as, BlackRock, Fidelity and Vanguard, non-profit associations, PSCA, Employee Benefit Research Institute (EBRI), and Defined Contribution Institutional Investment Association (DCIIA), along with academics cite that the greater number of options offered, generally the lower a plan’s participation rate and/or the fewer number of investment funds utilized. The unintended consequence of offering too many funds to participants is that instead of selecting the appropriate fund(s) they become overwhelmed and delay their decision to participate. In many cases, they end up not participating at all, or make no investment decision and are mapped to the plan’s default fund.

Broadly Diversified Funds: We generally recommend our clients offer participants investment funds that are broadly diversified by security, sector, industry, etc. This assists in avoiding large losses due to an undue concentration in a sector, industry and/or security and assists participants in building broadly diversified portfolios.

Tiers of Investment Options: We recommend that clients communicate their lifecycle and asset class/category funds as different decision paths or “tiers”. The first path, or tier, is populated with lifecycle funds and is intended for participants uncomfortable in or not inclined to making investment decisions. Participants are able to then focus on the lifecycle fund that best suits their time horizon.

The second tier or “core” investment path is comprised of the asset class/category specific funds where participants are able to select and mix funds in order to build portfolios that best suit their needs.

Summary

For the most part, the TSP’s current practices are reflective of our general advice on how to best structure a participant-directed defined contribution plan. The investment options are well-diversified, the number of options offered in each category are sufficient to gain broad exposure, and participants have two “paths” or “tiers” to select from when making their investment decisions.

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KEY EVALUATION CRITERIA FOR INVESTMENT FUND ALTERNATIVES

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In this section of the report, we discuss the key criteria we use to evaluate whether or not an asset class or asset category should be considered as an investment fund for inclusion in the TSP. We use these criteria to narrow the asset classes/categories that we review in-depth as potential alternatives.

Evaluation Criteria

While there are numerous criteria to consider when evaluating the types of investment alternatives to offer in a participant directed defined contribution plan, we believe the following criteria (individually and collectively) are among the most relevant for the TSP to consider:

- Major diversified asset classes/categories not currently offered as an investment option
- Asset class/category is large enough for the TSP to invest in (consider asset classes/categories with a market capitalization or investment opportunity set of at least $1 trillion)
- Potential diversification benefit for TSP participant portfolios
- Asset class/category offers daily liquidity and daily valuation
- Ability to index
- Practices of peers

We discuss these criteria in more detail below.

Major Diversified Asset Classes/Categories Not Currently Offered to Participants

We believe it is worthwhile to consider the major diversified capital markets that are not currently offered to TSP participants. The TSP currently provides participants the ability to invest in three of the world's largest capital markets (U.S. stock, U.S. bonds and non-U.S. developed markets stock), but not all (e.g., non-dollar denominated debt or emerging markets stock). For the major diversified asset classes not currently offered to participants, we believe reviewing the rationale why such an asset class/category would or would not be an appropriate asset class/category to add as an investment option is prudent.

Our review takes into account the advantages and disadvantages of offering an asset class/category individually as well as how it could potentially allow participants to form improved portfolios.

Asset Class/Category is Large Enough for the TSP to Invest In

Given the extraordinary asset size of the TSP, any investment alternative offered should represent an asset class/category of such significance that the likelihood of the TSP becoming a disproportionately large investor and trader of the asset class/category is minimized. Several of the measures we evaluate are:

- Size of the asset class/category in terms of market capitalization
- Liquidity of the market/category
- Sector diversification within the asset class/category
- Number of securities that comprise the market /category

KEY EVALUATION CRITERIA FOR INVESTMENT FUND ALTERNATIVES

The criteria we will use within this category include:

Large Capital Market

We define a large capital market by its total market capitalization (the aggregate value of the securities that comprise the asset class/category). We believe the appropriate threshold to use for the TSP is a minimum market capitalization of $1 trillion. This is an important consideration as the extraordinary asset size of the TSP ($473 billion and growing) could cause it to own a large portion of a market that is less than $1 trillion in asset size if participants were to allocate just 10% of the Plan's assets to a smaller-sized asset class/category. Moreover, the fact that the TSP offers daily liquidity to its participants and participants have transferred substantial assets into and out of its options (e.g., $700 million in a single day and $1.5 billion in six consecutive business days) implies that TSP participants could trade an abnormally large amount of a small market in a single day and significantly impact prices. The market capitalization of each of the benchmarks for the TSP Funds exceeds $3.6 trillion.

	F Fund	C Fund	S Fund	I Fund
Fund benchmark	Bloomberg Barclays Aggregate Bond Index	S&P 500 Stock Index	Dow Jones Wilshire 4500 Index	Morgan Stanley Capital International (MSCI) Europe, Australasia, and Far East Stock (EAFE) Index
Market capitalization of benchmark	$19.1 trillion	$20.2 trillion	$3.6 trillion	$12.1 trillion
Number of securities	10,000+	505	3,000+	900+

Liquidity

We place significant emphasis on liquidity of a potential fund offering, given the need to ensure daily liquidity to participants and to ensure that all participant directed trading activity is met. For existing TSP fund options, liquidity is not a major issue given the large underlying market represented by each fund mandate's opportunity set.

Some markets/sectors may not be able to absorb large trades without impacting prices in a direction that is adverse to participants. If there is excessive demand to buy a stock relative to its supply, it will drive the price of the stock higher temporarily, and vice versa, resulting in a "buy high, sell low" outcome. Trades that constitute a large portion of the average daily volume (ADV) can be expensive; investment managers and traders typically avoid representing more than 10%, and at most 20% of the ADV in any security. While markets/sectors, per se, may be liquid, they may not be liquid enough for very large trades, such as those experienced by some of the TSP Funds. Liquidity of markets is more relevant and important to the TSP than to almost any other defined contribution plan. Based on an analysis of daily participant trading activity, we note that in times of market stress the TSP funds have significantly large cash flows resulting from participant trading activity both on a daily basis and in terms of the aggregate cash flows resulting from trading over consecutive days. Given the size of the TSP, these cash flows can represent a significant portion of the daily market liquidity, which could pose a challenge in meeting participant trading activity as needed and on a low-cost basis.

Sector/Security Diversification

As we discussed earlier, we believe it is important for defined contribution plans to offer broadly diversified investment options to participants to potentially limit the impact of large losses on their portfolios. One way to avoid overly concentrated portfolios is to offer options that are diversified by sector, industry and security. Asset classes/categories that are comprised of numerous sectors, industries and securities assist in minimizing large losses as the performance drivers of these sectors, industries and securities are different or diversified.

Index Fund Products are Available for TSP Use

We review the availability of index fund strategies that offer daily valuation within the asset class/category. This is a relevant criterion as the TSP has historically only offered index products and any product that the TSP may offer needs to offer daily liquidity so that it integrates easily with the plan administration. As discussed in this report, some asset classes/categories do not offer daily valued products or a very limited set of daily valued products, and/or no daily valued index product is currently available.

Diversification Benefit

We also review the potential “diversification benefit” that adding an asset class/category could offer participant portfolios. The diversification benefit is the risk reduction and/or return enhancement an asset class/category could provide by adding it to portfolios at various risk levels.

Asset classes/categories that benefit portfolios generally have low correlations relative to the investment funds currently offered and competitive historical and expected risk-return characteristics.

Practices of Peers

In making decisions about the number and type of investment options to offer in a participant directed defined contribution plan, it is worthwhile to be aware of contemporary practices. This serves as a guide as participants will likely compare the type of options offered in their plan to those of their spouse, friends, and neighbors.

This does not mean that the TSP should be compelled to offer funds just because peer plans offer certain fund types. Rather the types of options to consider should represent a diversified opportunity set that may provide participants exposures not currently available and allow them to form better portfolios.

As we discussed earlier in this report, the TSP offers the types of options that are found in the majority of defined contribution plans and the allocations of TSP’s participants to “core” investment options is comparable to that of peers.

KEY EVALUATION CRITERIA FOR INVESTMENT FUND ALTERNATIVES

Asset Classes/Asset Categories Under Consideration

Based on the criteria we've outlined, we segregate the asset classes/categories that we will review into:

- Broad asset classes/categories not currently offered to TSP participants
- Asset classes/categories that TSP participants have exposure to via the current investment options, but not as a separate fund option

The broad asset classes/categories currently not available to participants in any way that we will review are:

- Non-U.S. bonds
- TIPS
- High yield bonds
- Emerging markets stock
- Non-U.S. small-cap stock
- Real estate (private market)
- Private equity
- Commodities
- Emerging market debt
- Frontier market stock
- Hedge funds

The asset classes/categories that are not explicitly offered to TSP participants currently, but participants obtain some exposure to via the current investment options offered are:

- U.S. value stock
- U.S. growth stock
- Global REITs
- Infrastructure
- Socially Responsible Investment (SRI)/ ESG funds

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APPLICATION OF KEY CRITERIA TO INVESTMENT FUND ALTERNATIVES

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In this section of the report, we apply the criteria developed to the asset classes/categories identified in Section 4 of our report.

Application of Criteria

In determining the asset classes/categories that the TSP should consider as potential additions to its array of investment funds offered to participants, we first conduct a broad scope review of the possible additions. The purpose of the initial broad scope review is to determine which asset classes/categories are worthwhile to review in-depth and those asset classes/categories that should be eliminated early on in the process. Factors considered included whether:

- The asset class/category benefits participants' portfolios meaningfully
- The asset class/category has a small market capitalization
- The asset class/category is unduly concentrated
- Daily liquidity and daily-valued index products are not available
- It is a common investment option among peer plans

The asset classes/categories we initially review are:

Equities	Fixed Income	Alternatives/Other
U.S. Growth Stock	Non-U.S. Bonds	Private Real Estate
U.S. Value Stock	High Yield Bonds	Private Equity
Global REITs	TIPS	Commodities
Emerging Markets Stock	Emerging Market Debt	Hedge Funds
Non-U.S. Small-Cap Stock		Socially Responsible/ ESG Funds
Frontier Markets		Infrastructure

APPLICATION OF KEY CRITERIA TO INVESTMENT FUND ALTERNATIVES

Screening Criteria: U.S. Stock, Global REITs and Non-U.S. Stock*

Asset class/ asset category	Current Investment Fund provides exposure to:	Large market capitalization >$1 trillion	Diversified by sector, industry and/or securities	Liquid market	Meaningful portfolio diversifier: correlation of <0.5 relative to current TSP stock funds	Daily valued index product is available	Public Peer practice
U.S. Large Growth Stock	Yes	Yes ($11 trillion)	Yes	Yes	No	Yes	Yes
U.S. Large Value Stock	Yes	Yes ($11 trillion)	Yes	Yes	No	Yes	Yes
Public Real Estate/ Global REITs	Yes; 3% of C, 11% of S and 2% of I Funds	Yes ($1 trillion)	Yes – security Yes – industry No – sector	Yes; but may be an issue for TSP if cash flows exceed $100 million	No	Yes	No
Emerging Market Stock	No	Yes ($5 trillion)	Yes	Yes, but may be an issue for TSP if cash flows exceed $100 million in a day	No	Yes	No, it is not broadly offered as a standalone option
Non-U.S. Small-Cap Stock	No	Yes ($3 trillion)	Yes	Yes, but may be an issue for TSP if cash flows exceed $100 million in a day	No	Yes	No
Broad Non-U.S. Stock	Partial (No exposure to Canada, Emerging Markets, and Non-U.S. Small Cap)	Yes ($20 trillion)	Yes	Yes	No	Yes	Yes
Frontier Markets	No	No; Approx. $144 billion	No – security No – industry No – sector	No	No	No	No

*See appendix for complete correlation matrix and the indices used for the market capitalization size of each of the above markets. Market capitalization size is as of 12/31/2016.

APPLICATION OF KEY CRITERIA TO INVESTMENT FUND ALTERNATIVES

Screening Criteria: Fixed Income*

Asset class/asset category	Current Investment Fund provides exposure to	Large market capitalization >$1 trillion	Diversified by sector, industry and/or securities	Liquid market	Meaningful portfolio diversifier: correlation of <0.5 to current TSP bond funds	Daily valued index product is available	Peer practice
Non-U.S. Bonds	No	Yes ($24 trillion)	Yes	Yes	No	Yes	No
Emerging Market Debt**	No	Yes ($3 trillion)	Yes	Yes	Yes	Yes; 1 provider (Vanguard)	No
High Yield	No	Yes ($1 trillion)	Diversified, but has been concentrated in certain sectors and securities historically	Yes, but may be an issue for TSP if cash flows exceed $100 million in a day	Yes	Yes	No
TIPS	No	Yes ($1 trillion)	No; not a major issue as securities are backed by the full faith and credit of the U.S. government	Yes, but may be an issue for TSP if cash flows exceed $100 million in a day	No; high correlation to F Fund	Yes	Yes; nearly half of the top 10 government plans offer TIPs

*See appendix for complete correlation matrix and the indices used for the market capitalization size of each of the above markets. Market capitalization size is as of 12/31/2016.

**Market capitalization size of emerging market debt is based on the debt outstanding for the U.S. dollar hard currency segment. A subset of this market cap is represented in the JPM EMBI Global (Sovereign USD) and CEMBI Broad (Corporate USD) indices amounting to $1.6T. Correlation for emerging market debt was based on the JPM EMBI Global (Sovereign USD) Index.

APPLICATION OF KEY CRITERIA TO INVESTMENT FUND ALTERNATIVES

Screening Criteria: Real Estate, Private Equity and Alternatives/Other*

Asset class/asset category	Current Investment Fund provides exposure to	Large market capitalization: >$1 trillion	Diversified by sector, industry and/or securities	Liquid market	Portfolio diversifier: correlation to current funds is <0.5	Daily valued index product is available	Peer practice
Private Real Estate	No	Yes (>$11 trillion)	Yes – security Yes – industry No – sector	No	Yes; due to its appraisal based valuations	No	No
Private Equity	No	Yes ($2 trillion)	Yes	No	Not applicable; appraisal based valuations made	No	No
Commodities	No	Yes via futures instruments	Yes	Yes; most futures markets are liquid	Yes	Yes	No
Hedge Funds	No; active management strategy	Not applicable; not an asset class	Not applicable; not an asset class	No; most vehicles allow limited liquidity	Not applicable; not an asset class per se	No	No
SRI/ESG Funds	Yes; Within C, S, & I Funds	Yes ($9 trillion)	Yes	Yes	No	Yes	Yes; 6 of 10 large public plans
Publicly Traded Infrastructure (Equities)	Yes; Within C, S, & I Funds	Yes ($1 trillion)	Yes – Security No – Industry No – Sector	Yes	No; high correlation to C, S & I Funds	Yes; 1 provider (SSgA)	No

*See appendix for complete correlation matrix and the indices used for the market capitalization size of each of the above public markets. Market capitalization size is as of 12/31/2016 with an exception to private real estate and SRI, data is as of 2015.

While index funds are offered across some of the categories noted above, it is important to note that the size of passive offerings may not be sufficiently large and/or products/strategies may not be available from multiple providers. Those factors, in addition to others, may preclude the TSP from obtaining competitive bids from fund providers. Moreover, if the TSP were to offer an option to some of the categories listed, it is conceivable that the TSP's assets could easily represent more than 50% of the major index fund providers' assets under management in that category and in some cases could be as much as two times providers' assets under management.

APPLICATION OF KEY CRITERIA TO INVESTMENT FUND ALTERNATIVES

Below we discuss the information provided in the tables on the previous pages and provide our rationale for why we believe an asset class/category should or should not be further considered as an investment fund option. We also include comments where applicable if there are custodial hurdles to consider. Please note the following custody considerations apply to international strategies managed in separate accounts. Most of the world's largest custodians do not have custody operations in every country, requiring these organizations to contract with a local custodian that does have these local capabilities. Requiring global custody services introduces additional risks including:

- Failure or default of sub-custodian that could result in losses if proper segregation of securities and cash is not in place
- Lack of contingency planning and/or sufficient contractual protection by main custodian for adverse organizational events
- Settlement and other operational-related risks if the sub-custodian does not have strong controls & processes in place

We believe the above risks are generally mitigated across the world's largest custodians since the custodian is responsible for selecting the foreign custodian (sub-custodian), which is typically based on a very robust, in depth, and complex due diligence process. Custodians also monitor their sub-custodian relationships on an ongoing basis to ensure financial stability, monitor changes in personnel, and identify any changes to the business (technology, client service structure, etc.) that warrants a change.

In sections 6 to 13 of this report we provide an in-depth review of the asset classes/categories we believe are worthwhile to examine in detail.

U.S. Stock

We review investment fund alternatives in U.S. stock by style (value and growth).

We highlight our rationale for reviewing U.S. stock investment funds by valuation below:

- Larger-cap growth and value market segments are substantial with over $11 trillion market capitalizations in each segment
- The market segments are diversified by sector, industry, and securities
- Index products from the major index providers are available
- These market segments are liquid
- Peer practice: a majority of plans offer large-cap growth and value fund options to participants
- As the allocation to U.S. stocks is generally one of the largest components of a participant's portfolio, offering multiple U.S. equity investment options meets the needs of a subset of participants who are seeking more choice.
- Allows participants to better customize their TSP portfolio so that it complements their "total portfolio" – I.e., taxable investments, non-TSP retirement investments and spouse's assets – to better suit their circumstances.
- Securities lending is available in the U.S. large cap growth and value market segments

We do not review small cap value and growth funds. As each of these markets is relatively small (approximately $1 trillion in market capitalization), the TSP could face liquidity issues if cash flows exceed

$200 million in a day. Participants have access to these segments via the S Fund, and the amount of assets indexed in this category is modest.

We discuss the merits of offering large-cap growth and value funds in Section 6.

Global REITs

We review the merits of adding Global REITs as an investment option.

We review REITs as a potential investment fund alternative for the following reasons:

- REITs have grown substantially in market capitalization in recent years
- The major index providers offer REIT index funds
- Some investors argue that REITs are a hedge against inflation
- REITs are beginning to be offered as investment options in DC plans
- Securities lending is available in the Global REITs market segment.
- Country specific custodial documentation is required in order to trade in international markets. Additionally, custodians tend to use sub-custodians to custody international assets when the custodian does not have a local branch. Another consideration is custody costs for the safekeeping of international assets could potentially be higher than current fees given the exposure to less developed markets.

We address Global REITs in Section 7 of this report.

Non-U.S. Stock

We review the merits of offering an emerging markets stock fund.
We review the merits of offering a non-U.S. small-capitalization stock fund.
We review the merits of expanding the coverage of the existing I Fund.
We eliminate a frontier markets stock fund from further consideration.

As the I Fund is a large- to mid-cap diversified non-U.S. developed markets index fund, we review two potential additions to the TSP investment line-up, emerging markets stock and non-U.S. small-cap stock. Additionally, we review broadening the coverage of the I Fund.

Emerging Markets Stock

We believe it is appropriate to review the merits of an emerging markets stock fund for the following reasons:

- Large market with total capitalization of over $4.5 trillion (approximately 10% of world equity market capitalization)
- Emerging markets are diversified by country, sector, industry, and securities
- TSP participants do not currently have exposure to emerging markets
- Daily valued index products are available

- Expectations are that emerging markets will provide exposure to some of the world's most rapidly expanding economies. Emerging markets now account for 58% of world GDP.
- Securities lending is available in emerging market countries, but not all types of investors such as offshore investors can lend in these markets.
- Country specific custodial documentation is required in order to trade in international markets. Additionally, custodians tend to use sub-custodians to custody international assets when the custodian does not have a local branch. Another consideration is custody costs for the safekeeping of international assets could potentially be higher than current fees given the exposure to less developed markets.

There are a number of issues that warrant further discussion regarding the risks of offering an emerging markets stock fund, which include volatility of returns, market liquidity, political risk and that the majority of peer plans do not offer this fund type. We discuss the merits of adding an emerging markets stock fund in Section 8.

Non-U.S. Small-Cap Stock

We believe it is appropriate to further review the merits of adding a non-U.S. small-cap stock fund, for the following reasons:

- Market capitalization of nearly $3.0 trillion
- Daily valued non-U.S. small-cap stock index funds are offered by major index providers
- Modest diversification benefits
- Investors are realizing the importance of diversification through international equities and as a result, thinking should be consistent with the U.S. market options.
- Securities lending is available in the non-U.S. small cap market segment, but not all types of investors such as offshore investors can lend in these markets.
- Country specific custodial documentation is required in order to trade in international markets. Additionally, custodians tend to use sub-custodians to custody international assets when the custodian does not have a local branch. Another consideration is custody costs for the safekeeping of international assets could potentially be higher than current fees given the exposure to less developed markets.

We discuss the merits of offering a non-U.S. small cap option in Section 9 of this report.

Broad Non-U.S. Stock

We believe it is appropriate to further review the merits of expanding the coverage of the I Fund, for the following reasons:

- Large market with total capitalization of over $20.2 trillion (approximately 46% of world equity market capitalization)
- TSP participants do not currently have exposure to Canada, emerging markets, and non-U.S. small cap stocks

- Daily valued index products are available
- Securities lending is available in the broad non-U.S. market segment excluding some emerging market countries
- Country specific custodial documentation is required in order to trade in international markets. Additionally, custodians tend to use sub-custodians to custody international assets when the custodian does not have a local branch. Another consideration is custody costs for the safekeeping of international assets could potentially be higher than current fees given the exposure to less developed markets. Furthermore, the TSP may incur cost when transitioning the I Fund's benchmark from the MSCI EAFE Index to a broader non-U.S. equity benchmark.

We discuss the merits of offering a broad non-U.S. stock option in Section 10 of this report.

Frontier Markets Stock

We eliminate a frontier market stock fund from further consideration for the following reasons:

- Small market size of only $144 billion
- Concentrated exposures (stock, industry and sector)
- Frontier market stock funds are not common practice among peers

Non-U.S. Bonds

We believe it is appropriate to further review non-U.S. bonds for the following reasons:

- Large market: non-U.S. investment grade bonds represent approximately 27% of the world's market capitalization at nearly $24.4 trillion
- TSP participants do not currently have any exposure to this substantial asset class
- Non-U.S. bond market is well-diversified by country, maturity and issuers
- Non-U.S. bonds have a low correlation to stocks and the unhedged funds have relatively low correlations to traditional bonds
- Securities lending is available in the non-U.S. bond market segment excluding some emerging market countries
- Country specific custodial documentation is required in order to trade in international markets. Additionally, custodians tend to use sub-custodians to custody international assets when the custodian does not have a local branch. Another consideration is custody costs for the safekeeping of international assets are greater than the safekeeping of U.S. assets.

We discuss the merits of offering a non-U.S. bond fund in Section 11.

Emerging Market Debt

We believe it is appropriate to further consider emerging market debt for the following reasons:

- Large and rapidly growing market with current market capitalization of $2.7 trillion (U.S. dollar - hard Currency) and the market capitalization of the emerging market debt indices represent a subset of the total debt outstanding with market capitalization of $0.7 trillion for the sovereign U.S. dollar index

(JPM EMBI Global) and $0.9 trillion for the corporate U.S. Dollar index (JPM CEMBI Broad).Emerging markets have seen improvements relative to developed markets in recent years.

  – Higher GDP growth relative to developed markets
  – More stable financial condition from large currency reserves and lower public debt than developed countries
  – Improved credit ratings relative to developed market bonds
  – Higher yields relative to developed markets

- Diversification benefits with low correlation to traditional bond and equity markets
- Daily valued, index funds are available from major index providers.
- Securities lending is available in emerging market countries, but not all types of investors such as offshore investors can lend in these markets.
- Country specific custodial documentation is required in order to trade in international markets. Additionally, custodians tend to use sub-custodians to custody international assets when the custodian does not have a local branch. Another consideration is custody costs for the safekeeping of international assets could potentially be higher than current fees given the exposure to less developed markets.

We review the merits of offering an emerging market debt fund in Section 12 of this report.

TIPS

We do <u>not</u> believe TIPS warrant further consideration for the following reasons.

- The size of the market is $1.0 trillion.
- TIPS are an attractive asset class for investors who seek to hedge against inflation, but the TSP offers a fund (G Fund) that provides similar characteristics, over the long-term, without negative price volatility associated with a TIPS option.
- TIPS are a good hedge against inflation, if they are held to maturity. Over shorter periods, however, TIPS may not yield a return comparable with inflation since the prices at which the bonds may be traded may not perfectly sync with inflation over a given holding period.
- TIPS fund would provide limited diversification benefits to TSP participants and add complexity to the plan line-up in area where we do not believe additional flexibility is necessary given the G Fund offering.
- Not common practice among peers to offer TIPS funds.

High Yield Bonds

We do <u>not</u> believe high yield bonds warrant further consideration for the following reasons:

- While the high yield market is relatively large at $1 trillion, the market has been concentrated in certain industries over time (energy, metals and mining, and communication).

- Composition of market is driven by issuers – i.e., the high yield market's composition is not necessarily a result of demand by investors as the market's composition may result from sector/industry issuance and/or downgrading of former investment-grade issuers
- Replicating a broadly diversified high yield bond index is very difficult without incurring high tracking error. Only a highly liquid sub-set can be indexed successfully; however, that dilutes some of the diversification benefit
- High yield bond funds are not common practice among peers

Private Market Real Estate

We eliminate private market real estate from consideration.

While we generally advocate that our defined benefit plan clients invest in real estate, we eliminate private market real estate from further consideration. Daily valued direct real estate products are now being offered to defined contribution plans, usually as a sleeve of a multi-manager and/or target date retirement funds. These funds are typically invested in 1/3 REITs and cash and 2/3 direct real estate to provide daily liquidity. There is a movement in the industry to provide a single real estate investment option or a growth/return seeking investment option that provides exposure to both REITs and direct real estate investments. However, these funds are still fairly small and are limited to target date funds.

Private Equity

We eliminate private equity from further consideration.

Private equity is broadly defined as venture capital, leveraged buyouts, mezzanine financing, distressed debt and special situations. We eliminate private equity from further consideration for the following reasons:

- Private equity investment vehicles are illiquid, and the assets are valued infrequently - a major issue for TSP administration
- No daily valued index product currently exists
- Private equity investments cannot be passively managed
- Private equity represents a small proportion of the world's overall market capitalization
- Private equity is not a common investment type offered to participants

Hedge Funds

We eliminate hedge funds from further consideration.

While hedge funds have garnered billions of dollars in assets over the past several years, we recommend eliminating hedge funds from further consideration for the following reasons:

- The hedge fund category is not an asset class in and of itself; rather hedge funds represent a broad array of active management strategies
- No daily valued index fund of hedge funds exists
- The majority of hedge funds do not offer daily liquidity

APPLICATION OF KEY CRITERIA TO INVESTMENT FUND ALTERNATIVES

- Hedge funds are not a common investment offering in peer plans

Commodities

We evaluate the merits of offering commodities as an investment option.

We believe it is worthwhile to review commodities as a potential investment option for the following reasons:

- No explicit exposure via current TSP offerings
- Diversified among different types of commodities (e.g., oil, metals, grains)
- Commodities can be a strong portfolio diversifier
- Commodities have shown to be a strong hedge against inflation
- Large and liquid market
- Securities lending is available in the commodities market segment through equities or pooled vehicles (i.e. ETFs), but physical commodities or derivatives are not considered lendable assets.

We discuss the merits of adding a commodities fund in Section 13 of this report.

Socially Responsible/ESG Funds (Equities)

We eliminate socially responsible investment (SRI) stock funds from further consideration.

While SRI investing has gained in popularity over the years and several of the large public sector plans provide this option, we eliminated SRI from further consideration for the following reasons:

- SRI is a style of investing that can be implemented passively, but the selection of the SRI issue(s) is an active decision to exclude or include a security/company – an approach the TSP has not employed previously
- Identification of an issue(s) would likely draw attention from opposing parties of interest – i.e., difficult to find “perfect” common ground
- Exposure to equities found in socially responsible funds can be found in the C, S, & I Funds

While defined contribution plan participants often express an interest in an SRI fund option, our research and experience indicates that an SRI option is not widely offered across the broad spectrum of DC plans (including private sector DC plans). Where an SRI option is offered, we find participant utilization to be low.

One explanation of the discrepancy between the apparent participant demand and actual plan sponsor/participant practices is expressed in a study that was conducted by Hartford Financial Services Group in 2004. It notes that “91 percent of defined contribution plan participants would be interested in funds managed by a socially responsible firm as long as the funds boasted top historical performance.”

Some of the issues noted above were also reflected in a study conducted by the Government Accountability Office (GAO) titled “Thrift Savings Plan – Adding a Socially Responsible Index Fund Presents Challenges”.

The following is the conclusion from that report:

Adoption of an SRI index fund would present challenges for TSP. Currently, the law limits the types of funds that TSP can offer, prohibits overlap among existing funds, and charges TSP to keep its costs low. First, TSP would have difficulty finding an SRI index fund that did not overlap with the existing TSP funds, limiting opportunities for additional portfolio diversification. However, officials at other DC plans, which do not face the same restrictions as TSP, said that a certain amount of overlap with SRI and other investment options was acceptable and the purpose of SRI was to provide an alternative investment choice. Second, TSP would have difficulty selecting SRI screening criteria that all participants and the Congress would find acceptable. While challenging, a number of plans have a long history of SRI in their plans. Finally, under TSP's current structure, the costs of adding a new fund would be distributed among all participants regardless of whether they participated in that fund. We note that the Board has the authority to open a mutual fund window for participants to invest in mutual funds managed outside TSP. With the Board's decision to allow the mutual fund window, participants seeking other forms of investment, including SRI, could invest in mutual funds and would bear the costs associated with this investment.

Publicly Traded Infrastructure Funds (Equities)

We eliminate publicly traded infrastructure funds from further consideration.

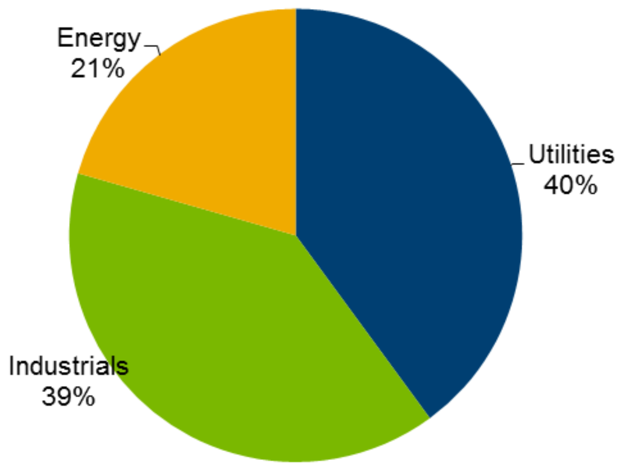
Background: The broad infrastructure includes publicly traded equities of infrastructure and infrastructure-related companies and private infrastructure investments. Private infrastructure investments include toll roads, airports, ports, etc. and are offered in fund vehicles similar to private equity investments.

We eliminate private infrastructure from further review because of the lack of a daily valued product/strategy in the space and the illiquid nature of this asset class.

Publicly-traded infrastructure comprises equity of companies that are directly or indirectly related to the infrastructure space. Most of these companies are concentrated in the industrials, utilities and energy sectors. These may include pipelines, airport services, highways, railroads, ports, electric, gas and water utilities.

The chart on the follow page shows the sector concentrations of the S&P Global Infrastructure Index. The S&P Global Infrastructure Index is the most commonly used liquid infrastructure index. It has exposures to 75 companies across 18 countries across the world. The Index provides exposure to three broad sectors – energy, industrials, and utilities – as shown in the chart below. The Index is constructed by selecting the largest 30 stocks each from the Utilities and Transportation Infrastructure segments and the largest 15 stocks from the Energy Infrastructure segment. S&P notes that up to 20% of the constituents within the

Index are emerging market stocks with a liquid developed market listing. The Index is somewhat concentrated in that the top ten stocks represent nearly 35% of the Index, as compared to the S&P 500 Index where the top ten stocks represent approximately 18% of the overall market capitalization.



- Concentrated exposure to utilities, energy and industrial sectors of the equity market
- Minimal diversification benefits relative the broader equity market
- Publicly traded infrastructure exposure is approximately 3% of the U.S. and international equity markets as of 3/31/2017 and, as a result, can be accessed through the C,S, & I Funds
- Infrastructure is not a commonly offered option to participants

Summary

We conduct an in-depth review of the following asset classes/categories in Sections 6 through 13.

- U.S. Stock
- Global REITs
- Emerging markets stock
- Non-U.S. small cap stock
- Broad non-U.S. stock
- Non-U.S. bonds
- Emerging market debt
- Commodities

APPLICATION OF KEY CRITERIA TO INVESTMENT FUND ALTERNATIVES

We eliminate the following asset classes/categories from further consideration:

- Frontier Market Equities
- High Yield Bonds
- TIPS
- Private Real Estate
- Private Equity
- Hedge Funds
- Socially Responsible/ESG Funds
- Infrastructure

U.S. STOCK

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Our rationale for reviewing the merits of offering additional broad-based U.S. stock investment funds include:

- Participants' knowledge of U.S. stock investing has grown tremendously in recent years – resulting in increased demand for U.S. stock fund alternatives.
- As the allocation to U.S. stocks is generally one of the largest components of a participant's portfolio, offering multiple U.S. equity investment options meets the needs of a subset of participants who are seeking more choice.
- Since the U.S. stock market is well diversified, liquid, and represents a large market capitalization, this allows for some segments of the U.S. equity market to have the breadth and size to be considered as standalone investment offerings.
- A subset of participants may desire to customize their defined contribution plan U.S. stock portfolios to account for personal (taxable and tax-exempt) investments, complement investment funds available in a spouse's plan and/or account for their own investment preferences/risk tolerance.
- It represents contemporary practice.

The types of U.S. stock funds that we generally recommend offering are:

- Core stock index fund
- Large-cap value
- Large-cap growth
- Mid-/small-cap stock

Depending upon a plan's circumstances, four to eight U.S. stock funds are typically offered to participants. The number of options offered is generally influenced by the number of active and passive funds offered and how finely each of the categories is defined. More recently, we have seen a trend across DC plans simplifying their U.S. stock line-up. Several of our clients today simply offer a broad based (all cap, broadly style neutral), active and passive option within their 401(k) plans. In addition, the average participant selects 3 to 4 investment options, therefore by adding additional U.S. stock funds it opens up the possibility of a participant selecting a redundant investment option to the C and S funds.

The TSP already offers access to large cap stocks and mid/small cap stocks via the C and S Funds, respectively. In this section of the report, we focus our attention on large cap value and growth options.

We do not review small cap value and growth funds. As each of these markets is relatively small (approximately $1 trillion in market capitalization), the TSP could face liquidity issues if cash flows exceed $200 million in a day. Participants have access to these segments via the S Fund, and the amount of assets indexed in this category is modest.

Growth stocks are generally thought of as those that have a high earnings growth rate, high price-to-book and high price-to-earnings ratios. Value stocks on the other hand are thought of as those that have a high dividend yield, low price-to-book and low price-to-earnings ratios. We show the historical returns, volatility (annualized standard deviation) and Sharpe Ratios for the Russell 1000 Growth and Value Indexes on the following page. We have used the Russell family of U.S. stock indexes as these are the most popularly followed style indexes. Russell utilizes two major factors in determining whether a stock is a value stock or a growth stock – price-to-book ratio, and the mean long-term growth rate obtained from analysts' estimates. Higher price-to-book ratios would denote growth characteristics.

Annualized Returns (As of December 31, 2016)

Trailing Years	Russell 1000 Growth Index	Russell 1000 Value Index	S&P 500 Index
1	7.1%	17.3%	12.0%
3	8.6%	8.6%	8.9%
5	14.5%	14.8%	14.7%
10	8.3%	5.7%	7.0%
15	6.4%	7.4%	6.7%
20	6.9%	8.3%	7.7%

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	Russell 1000 Growth Index	Russell 1000 Value Index	S&P 500 Index
5	10.9%	10.6%	10.4%
10	15.5%	16.1%	15.3%
15	14.8%	15.0%	14.4%
20	17.5%	15.2%	15.3%

Sharpe Ratio (As of December 31, 2016)

Trailing Years	Russell 1000 Growth Index	Russell 1000 Value Index	S&P 500 Index
5	1.29	1.35	1.37
10	0.54	0.38	0.46
15	0.40	0.47	0.43
20	0.34	0.45	0.41

We show the correlations of the various capitalization and valuation segments in the following table.

Correlations (20 years ending December 31, 2016)

	G Fund	F Fund	C Fund	S Fund	I Fund	Russell 1000 Growth	Russell 1000 Value
G Fund	1						
F Fund	0.18	1					
C Fund	-0.05	-0.05	1				
S Fund	-0.06	-0.06	0.86	1			
I Fund	-0.03	0.01	0.84	0.79	1		
Russell 1000 Growth	**-0.06**	**-0.05**	**0.95**	**0.89**	**0.80**	**1**	
Russell 1000 Value	**-0.04**	**-0.05**	**0.94**	**0.78**	**0.81**	**0.80**	**1**

Observations

The historical data suggests that approximately a 50/50 mix of growth and value oriented stocks produces risk/return characteristics very similar to that of the S&P 500 Index (C Fund). This is why we have used the S&P 500 Index as the proxy for this analysis.

Growth and value oriented stocks fall into and out of favor depending on the market cycle. Some have argued that a value premium exists, but other research indicates that value stocks carry asymmetric risks. Value stocks tend to decline more than growth stocks, during times of economic stress, as is evident in the three and five year returns.

The common practice in the marketplace for plans that offer style specific funds is to offer both value and growth funds so complementary styles are offered to participants and they have the flexibility to customize their portfolios. However, we believe incorporating style-specific funds can be more confusing for participants given the likelihood that they will be choosing among a greater number of options.

Index Investment Options

The table below shows the amount of assets indexed to large-cap value and growth style equities by the major institutional index fund managers, Blackrock, Mellon Capital, Northern Trust, State Street Global Advisors (SSgA), and Vanguard.

U.S. Equity Styles Index Fund Products (assets in millions) – All assets

	Blackrock	Mellon	Northern Trust	SSgA	Vanguard
Russell 1000 Growth Index	$54,336	$5,790	$17,733	$13,356	$2,945
Russell 1000 Value Index	$56,561	$5,678	$17,681	$14,046	$2,371

U.S. Equity Styles Index Fund Products (assets in millions) – Daily-valued DC assets

	Blackrock	Mellon	Northern Trust	SSgA	Vanguard
Russell 1000 Growth Index	$3,524	$223	$16,580	$8,747	$312
Russell 1000 Value Index	$2,885	$181	$15,893	$8,125	$422

The level of assets currently invested in index funds benchmarked to the Russell 1000 Value and Russell 1000 Growth Index is material at above $94 billion each.

Considerations

While the broad industry trend is moving in the direction of simplification of the U.S. equity line-up, it is still common practice for plans to offer growth- and value-oriented U.S. stock funds, with it being more common to offer larger-capitalization growth and value funds than smaller-capitalization growth and value funds. Larger-capitalization growth and value funds are attractive alternatives from a market size, liquidity, sector and security diversification, and contemporary practice standpoint. The diversification benefits, however, would not be material relative to the current investment funds already available. We do not believe it is necessary for the TSP to offer any additional U.S. stock funds as the C and S Funds provide exposure to the entire U.S. stock market. Offering a more limited number of U.S. stock funds without foregoing material improvement in portfolios would be consistent with avoiding investment choice overload.

Conclusion

On balance, we do <u>not</u> find a compelling reason to add additional U.S. stock funds, as the TSP's current investment line-up provides broad exposure to the U.S. stock market via the C and S Funds.

GLOBAL REITs

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GLOBAL REITs

We review the merits of offering a Global REIT index fund as an investment alternative for the following reasons:

- REITs have grown substantially in market capitalization in recent years
- The major index providers offer REIT index funds
- Some investors argue that REITs are a hedge against inflation
- REITs are beginning to be offered as investment options

Real Estate Investment Trusts, or REITs are specialized companies that own, and in most cases operate income generating real estate properties. REITs are listed on most major stock markets and can be traded just like shares in any other company. REITs allow smaller investors the ability to share in the ownership of large, income generating real estate such as apartments, offices, hotels, and shopping centers – essentially allowing smaller investors the ability to diversify their exposure to real estate investments through investing in a portfolio of properties rather than an investment in a single or few properties. REITs must distribute at least 90% of their taxable income to shareholders annually.

As REITs are publicly traded securities and listed on U.S. and international stock exchanges, REITs are included in the major stock market indexes as part of the finance sector, and as such, we consider REITs a sub-sector, similar to autos within consumer durables, pharmaceuticals within healthcare, or insurance within the finance sector. US REITs represent approximately 3% of the C Fund and 11% of the S Fund. International REITs represent approximately 2% of the I Fund.

The table below shows the composition of the FTSE EPRA/NAREIT Global Index. We use the FTSE EPRA/NAREIT Index as a proxy for Global REITs. The FTSE EPRA/NAREIT Global Index covers listed REITs in both developed and emerging markets. The index is free-float adjusted, screened for liquidity, size and revenue making it suitable for use as the basis for index investment products. REITs are diversified among many different types of real estate properties.

FTSE EPRA/NAREIT Global Index – Sector Breakdown

Sector	% Allocation
Retail	23.0%
Residential	14.7%
Office	10.9%
Diversified	29.1%
Lodging/Resorts	3.6%
Industrial	6.0%
Healthcare	6.9%
Self Storage	3.5%
Industrial/Office Mixed	2.5%

The table below shows the country breakdown of the FTSE EPRA/NAREIT Index. The U.S.REIT market represents approximately 50% of the overall market, as represented by the FTSE EPRA/NAREIT Index.

FTSE EPRA/NAREIT Global Index – Country Breakdown

Sector	% Allocation
U.S.	50%
Japan	10%
Hong Kong	6%
Australia	5%
UK	4%
China	4%
Germany	3%
Canada	3%
Singapore	2%
Netherlands	2%
Other*	10%
Total	**100.0%**

Note: Other is comprised of countries with an allocation of 1.5% or less.

Historical Performance

We show the historical returns, volatility and Sharpe Ratios for the FTSE EPRA/NAREIT Global Index compared to the C and S Funds below.

Annualized Returns (As of December 31, 2016)

Trailing Years	FTSE EPRA/NAREIT Global Index	C Fund	S Fund
1	5.0%	12.0%	16.4%
3	6.8%	8.9%	6.8%
5	10.3%	14.7%	14.8%
10	2.2%	7.0%	8.1%
15	9.8%	6.7%	9.4%
20	7.4%	7.7%	8.8%

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	FTSE EPRA/NAREIT Global Index	C Fund	S Fund
5	12.9%	10.4%	13.1%
10	21.5%	15.3%	18.7%
15	19.0%	14.4%	17.3%
20	18.4%	15.3%	19.6%

Sharpe Ratios (As of December 31, 2016)

Trailing Years	FTSE EPRA/NAREIT Global Index	C Fund	S Fund
5	0.82	1.37	1.12
10	0.18	0.47	0.47
15	0.52	0.43	0.53
20	0.36	0.41	0.42

As shown in the tables above, REITs have generally underperformed the C and S Funds over the last 20 years. REITs also tend to come with more volatility than the broader stock market, as there is no diversification benefit due to its exposure to a single sector of the equity market.

We show the historical correlations of REITs to those of the current TSP investment funds in the table below.

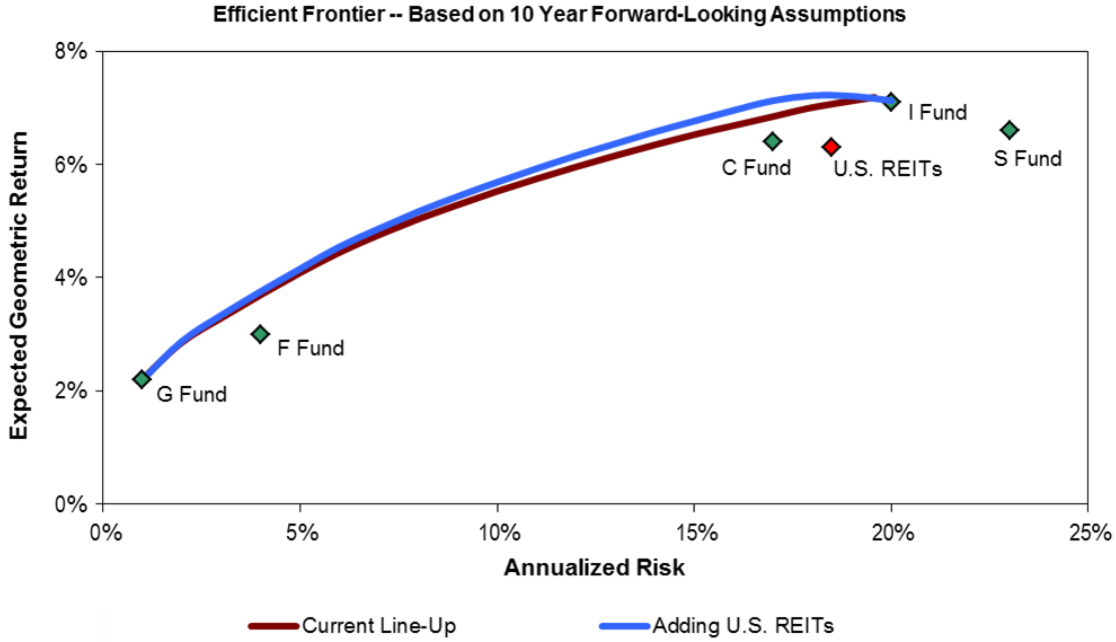
Correlations (20 years ending December 31, 2016)

	G Fund	F Fund	C Fund	S Fund	I Fund	FTSE EPRA/ NAREIT Global Index
G Fund	1					
F Fund	0.18	1				
C Fund	-0.05	-0.05	1			
S Fund	-0.06	-0.06	0.86	1		
I Fund	-0.03	0.01	0.84	0.79	1	
FTSE EPRA/NAREIT	**-0.05**	**0.18**	**0.71**	**0.70**	**0.79**	**1**

As shown in the table above, REITs have had a low correlation to the G and F Funds, but fairly high correlation to the C, S, and I Funds. Given that REITs are a sub-set of equities, it is no surprise that the correlation to the equity funds is fairly high.

On the following page, we show the efficient frontiers, based on AHIC’s 10-year forward looking capital market assumptions, using the current TSP Funds with and without U.S. REITs as an investment fund alternative. AHIC’s forward looking assumptions are only available for U.S. REITs. We believe U.S. REITs are a reasonable proxy to assess forward looking expectations for this market segment.

The efficient frontier is the mix of different funds that provides the highest expected return for a given level of risk or the asset mix with the lowest level of risk for a given return.



As shown, the efficient frontier that includes U.S. REITs does improve marginally compared to the efficient frontier with just the current investment fund line-up, indicating that the inclusion of REITs would slightly improve the risk return profile of the current line up.

We show the amount of assets indexed to Global REITs at Blackrock, Northern Trust and SSgA.

Global REITs Index Fund Products (assets in millions) – All assets

	Blackrock	Northern Trust	SSgA
Global REITs	$2,522	$6,136	$5,000

Global REITs Index Fund Products (assets in millions) – Daily-valued DC assets

	Blackrock	Northern Trust	SSgA
Global REITs	$1,608	$3,063	$1,055

The three leading institutional index fund providers listed above have in aggregate approximately $14 billion in assets indexed to the Global REIT indices.

Considerations

While REITs had gained in popularity for a few years due to their strong performance, low correlation of returns to many of the major capital markets, improved liquidity, and overall growth of the REIT market. Some studies have argued that REITs have inflation-protection properties. This has caused many investors to review whether or not they should have an explicit exposure to REITs. While TSP participants invest in REITs through their investments in the C and S Funds, a REIT option would allow participants to make a specific above-market allocation to the sector. The number of defined contribution plans offering a REIT option remained flat over the years, including one of the ten largest governmental sponsored defined contribution plans. Even though one in four plans now offers a REIT option, however participant utilization rates remain low.

Conclusion

While there appear to be compelling attributes supporting the inclusion of global REITs, we do not recommend their inclusion at this time. As noted, TSP participants attain exposure to REITs in market capitalization weights via the C, S and I Funds. One of the hallmarks of the TSP is its simplicity – i.e. streamlined option line-up, broadly diversified options that form the core building blocks for most portfolios. REITs are a specific sector of the global equity market and exhibit a higher degree of volatility than the broad equity market. Adding REITs would make the plan line-up more complex. While the number of plans offering a REIT option did increase for a period of a few years that trend has significantly slowed in recent periods, and in addition, participant utilization has remained low. According to the PSCA survey, 19% of DC plans with over 5,000 participants offered REIT funds, however only 0.2% of total plan asset were invested in REIT funds. Assets under management in Global REITs are among the smallest of all of the options we have reviewed and TSP cash flows could conceivably overwhelm the funds. Over time, we see this asset class evolving to include direct real estate investments, as part of daily valued index funds that are expected to provide exposure to assets that are not part of the overall equity market and as a result will be an even better diversifier. It may be worthwhile to revisit this asset class in the future as these developments play out, but, for the time being, we do not recommend consideration of a REIT option to the line-up.

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EMERGING MARKETS STOCKS

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We review the merits of offering an emerging markets stock fund as an investment alternative for the following reasons:

- Large market with total capitalization of over $4.5 trillion (approximately 10% of world equity market capitalization)
- Emerging markets are diversified by country, sector, industry, and securities
- TSP participants do not currently have exposure to emerging markets
- Daily valued index products are available
- Expectations are that emerging markets will provide exposure to some of the world's most rapidly expanding economies. Emerging markets now account for over 58% of world GDP.

While "emerging markets" are a commonly used term in today's investment world, there isn't a single concise definition for what constitutes an emerging market economy. In general, countries with developing economies that have low- to mid-per capita income levels and are experiencing positive structural changes to the characteristics of their economic systems can be thought of as emerging market economies. These changes include, but are not limited to, deregulation and privatization of industry, rationalization of monetary and fiscal policies, elimination of trade barriers, enhancement of property rights, etc. In other words, these economies can be thought of as transitional economies – ones that aren't yet perfectly integrated into the global financial system, but making strides to get there.

On the following pages we review the composition of the emerging markets stock index, its historical performance and the potential diversification benefits of adding an emerging markets stock fund.

We use the Morgan Stanley Capital International (MSCI) Emerging Markets (EM) Investable Market Index (IMI), the broadest emerging markets stock index, to review the characteristics and performance of emerging markets stocks. The following exhibits show that emerging markets are diversified by sector and country.

Emerging Market Characteristics (As of December 31, 2016)

Market Capitalization ($ in millions)	$4.5 trillion
Number of Securities	2,672
Average market capitalization	$1.7 billion

EMERGING MARKETS STOCK

The countries that comprise the MSCI Emerging Markets Stock IMI are shown in the table below.

Emerging Market Country Allocation (As of December 31, 2016)

Country/Region	% Allocation
China	26.0%
India	8.8%
Indonesia	2.6%
Korea	14.8%
Malaysia	2.6%
Philippines	1.2%
Taiwan	12.9%
Thailand	2.5%
Asia	**71.4%**
United Arab Emirates	0.9%
Czech Republic	0.2%
Egypt	0.2%
Hungary	0.3%
Poland	1.1%
Russia	4.0%
Turkey	1.1%
Greece	0.4%
Qatar	0.9%
Europe & Middle East	**9.0%**
Brazil	7.2%
Chile	1.2%
Colombia	0.4%
Mexico	3.5%
Peru	0.3%
Latin America	**12.7%**
South Africa	6.9%
Africa	**6.9%**
TOTAL	**100.0%**

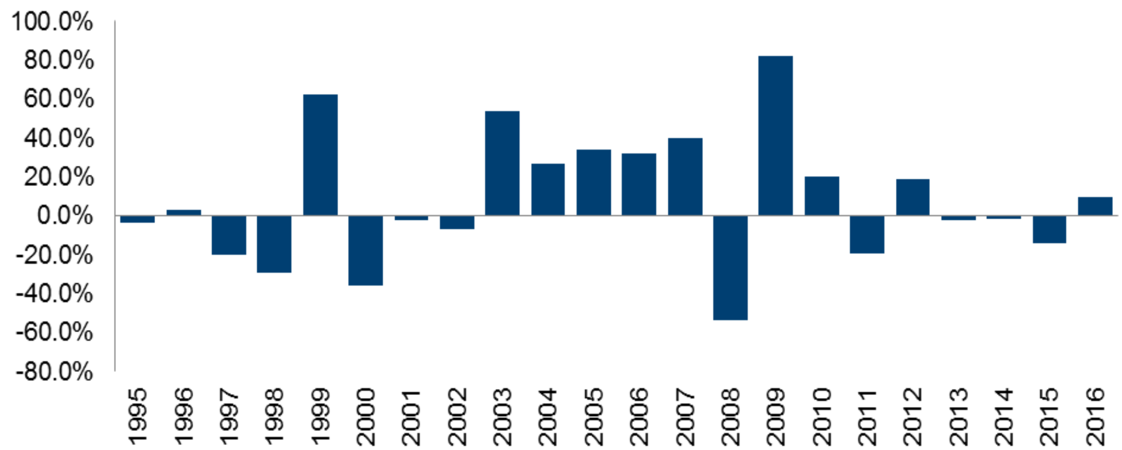
The sectors that comprise the MSCI Emerging Markets Stock IMI are shown in the table below.

Emerging Market Sector Allocation (As of December 31, 2016)

Sector	% Allocation
Energy	7.1%
Materials	7.9%
Industrials	7.0%
Consumer Discretionary	11.3%
Consumer Staples	7.2%
Health Care	3.4%
Financials	22.3%
Information Technology	22.3%
Telecommunication Services	5.2%
Utilities	3.0%
Real Estate	3.4%

Historical Performance

In the following chart, we show the annual returns of emerging markets over time. As seen in the chart, emerging market investments exhibit a very high degree of variability (volatility) from year to year.



EMERGING MARKETS STOCK

We show the annualized returns, volatility and Sharpe Ratios for the MSCI Emerging Markets IMI (MSCI EM IMI) in the following tables.

Annualized Returns (As of December 31, 2016)

Trailing Years	MSCI EM IMI	MSCI EAFE Index
1	9.9%	1.0%
3	-2.4%	-1.6%
5	1.5%	6.5%
10	2.1%	0.8%
15	9.6%	5.3%
20	4.2%	4.2%

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	MSCI EM IMI	MSCI EAFE Index
5	15.9%	13.5%
10	23.5%	18.6%
15	21.9%	17.1%
20	23.9%	16.9%

Sharpe Ratio (As of December 31, 2016)

Trailing Years	MSCI EM IMI	MSCI EAFE Index
5	0.17	0.53
10	0.17	0.09
15	0.47	0.31
20	0.20	0.19

The table below shows the historical correlations of the MSCI Emerging Markets IMI relative to the current TSP Funds.

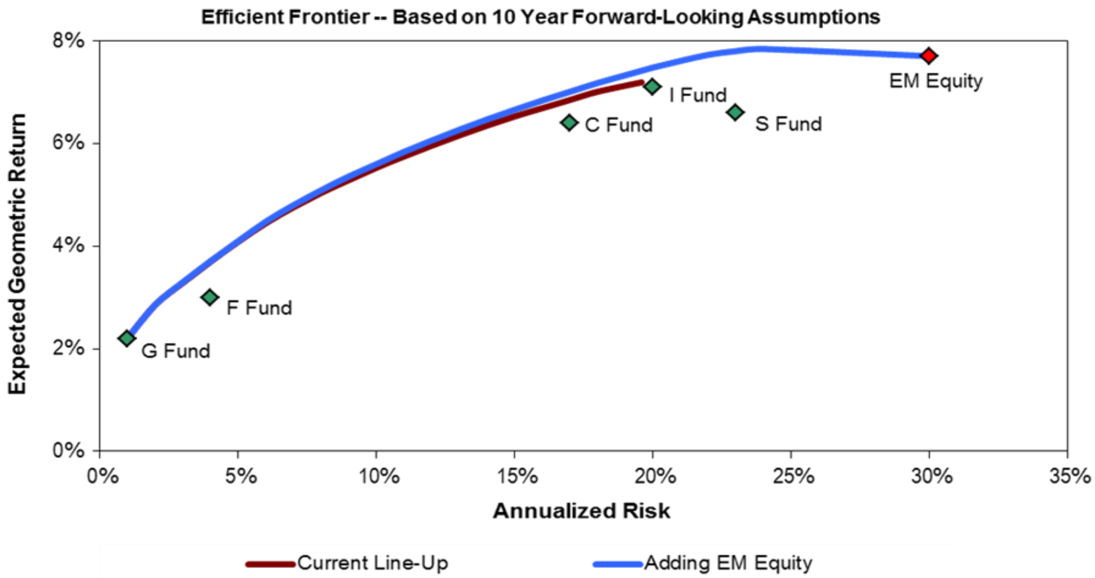
Correlations (20 years ending December 31, 2016)

	G Fund	F Fund	C Fund	S Fund	I Fund	MSCI EM IMI
G Fund	1					
F Fund	0.18	1				
C Fund	-0.05	-0.05	1			
S Fund	-0.06	-0.06	0.86	1		
I Fund	-0.03	0.01	0.84	0.79	1	
MSCI EM IMI	**-0.05**	**-0.02**	**0.73**	**0.75**	**0.81**	**1**

EMERGING MARKETS STOCK

Emerging market returns are relatively highly correlated to the C, S and I Funds, reflecting the globalized nature of the world economy and uncorrelated to the F and G Funds.

Below we show the efficient frontiers, based on AHIC's 10-year forward looking capital market assumptions, using the TSP Funds with and without emerging markets as an investment fund alternative.



As shown, the efficient frontier that includes emerging markets equity does improve marginally compared to the efficient frontier with just the current investment fund line-up, indicating that the inclusion of the asset class would slightly improve the risk return profile of the current line up.

The tables below show the amount of assets indexed to emerging market equities by the major institutional index fund mangers.

Emerging Markets Index Fund Products (assets in millions) – All assets

	Blackrock	Mellon	Northern Trust	SSgA	Vanguard
Broad Emerging Markets Index	$70,500	$4,497	$22,771	$44,121	$61,025

Emerging Markets Index Fund Products (assets in millions) – Daily-valued DC assets

	Blackrock	Mellon	Northern Trust	SSgA	Vanguard
Broad Emerging Markets Index	$2,499	$27	$9,318	$11,472	$1,986

The total assets indexed to emerging market stocks amongst the leading index fund providers are substantial at approximately $203 billion.

Considerations

Emerging markets continue to expand and represents approximately 10% of the world's equity market capitalization. Emerging markets generate over 58% of the world's GDP. Emerging markets have seen improvements in terms of stronger fiscal position and improving credit ratings of emerging market economies relative to developed markets. These developments coupled with higher expected growth rates make a compelling case for inclusion. These strong expectations, however, come with considerable risk in terms of volatility of returns and political risk that is not typically present in the developed markets. This causes us to pause when considering such an option for a defined contribution plan, where a participant could potentially put all of his/her assets in a single fund. Emerging market funds are not commonly found in peer plans as standalone investment options, but we are seeing the exposure provided through a broader international equity option. Liquidity would be another area of concern. Large cash flows of $300 to $400 million in a single day, which is not uncommon in the TSP funds, may be cause for concern from the standpoint of ensuring daily liquidity to meet all participant directed trading activity.

Conclusion

While emerging markets are a large asset class, expected to experience secular growth, and provide a benefit to portfolios at the highest levels of risk, we have concerns with the TSP offering emerging markets as a stand alone investment fund. The high risk associated with emerging markets has resulted in material losses over relatively short periods of time and is difficult for participants (or for any investor) to bear. Additionally, there are limited benefits to adding emerging market equities to well-diversified low to moderate risk portfolios.

Overall, we believe the negatives of offering an emerging markets investment fund outweigh the positives and recommend an emerging markets stock fund <u>not</u> be added as an investment fund alternative. However, we believe that exposure to this asset class could be considered as part of a broader allocation to international equities through the (I Fund). Several large government plans are offering emerging market exposure through broad market index funds that track the MSCI All Country World Index Ex -U.S. We would prefer to see emerging markets included, as part of a broader, international stock investment fund alternative invested in their respective market capitalization proportions as long as liquidity related concerns are evaluated.

NON-U.S. SMALL CAP STOCK

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NON-U.S. SMALL CAP STOCK

We reviewed the merits of offering a non-U.S. small cap fund as an investment alternative for the following reasons:

- Market capitalization of nearly $2.8 trillion
- Daily valued non-U.S. small-cap stock index funds are offered by major index providers
- Modest diversification benefits
- Not part of current investment options
- Consistent with the approach with respect to U.S. equities to broadly diversify stock exposure across the entire market capitalization spectrum, it is becoming a common institutional trend to diversify non-U.S. stock exposure into mid and small cap stocks.

Non-U.S. small cap stocks represent approximately 14% of the overall non-U.S. stock market. These companies tend to have market capitalization of $1 billion or less and may be located in both developed and emerging markets. Our focus will be on the broad non-U.S. small cap market as measured by the MSCI ACWI ex U.S. Small Cap Index. Non-U.S. small cap stocks are believed to have diversification benefits because smaller companies provide more pure exposure to foreign economies. Unlike large caps, small cap companies tend to draw most of their sales from their local countries and rely less on global trade. As a result, their success is less dependent on the global economy and more on local factors. Smaller companies also tend to have higher growth rates.

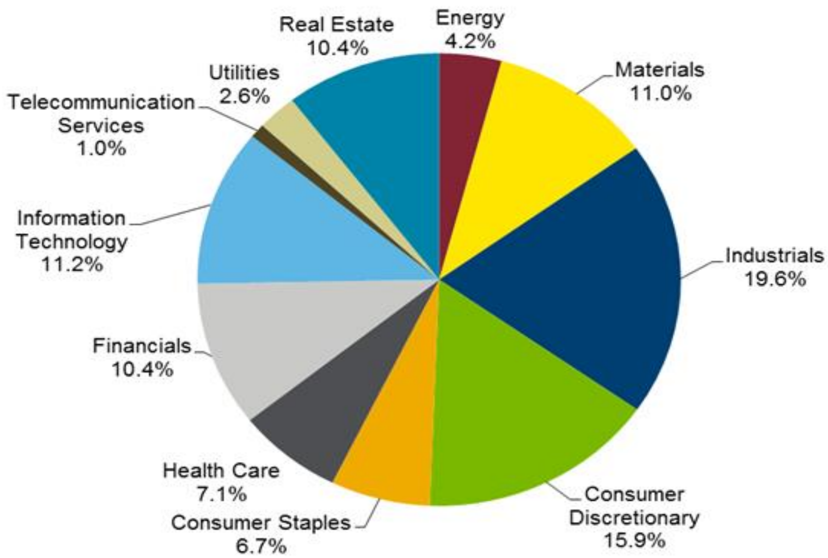
The I Fund is benchmarked to the MSCI EAFE Index which does not contain non-U.S. small cap stocks. The MSCI All Country World (ACW) ex U.S. Small Cap Index is well diversified by country and sector with over 4,000+ stocks.

MSCI ACWI ex U.S. Small Cap Index Characteristics (As of December 31, 2016)

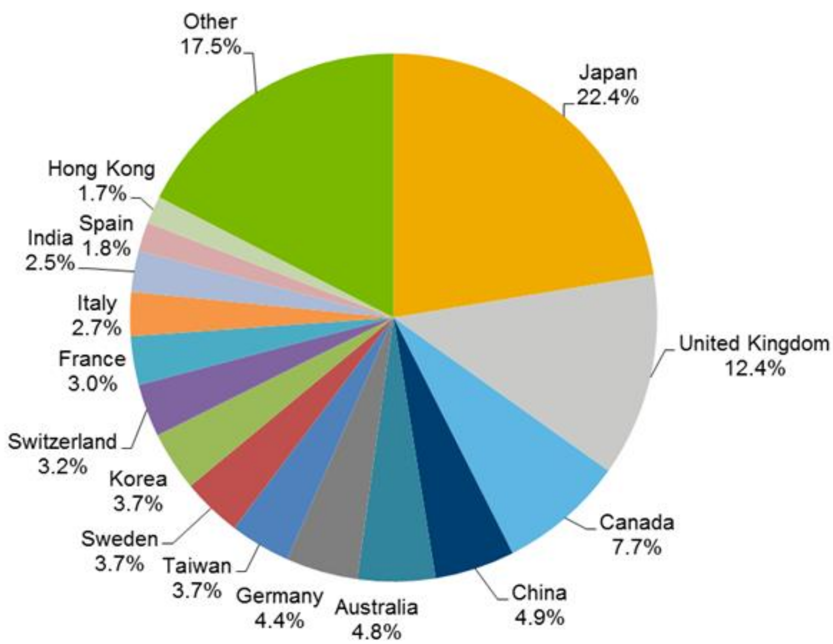
Market Capitalization ($ in millions)	$2.8 trillion
Number of Securities	4,294
Average market capitalization	$649 million

NON-U.S. SMALL CAP STOCK

The chart below shows the sector composition of the MSCI ACWI ex U.S. Small Cap Index.



The chart below shows the country exposure of the MSCI ACWI ex U.S. Small Cap Index.



Note: Other is comprised of countries with an allocation of 1.5% or less.

NON-U.S. SMALL CAP STOCK

We show the annualized returns, volatility and Sharpe Ratios for the MSCI ACWI ex U.S. Small Cap Index in the following tables. The MSCI ACWI ex U.S. Index was shown for comparative purposes.

Annualized Returns (As of December 31, 2016)

Trailing Years	MSCI ACWI ex U.S. Small Cap Index	MSCI ACWI ex U.S.
1	3.9%	4.5%
3	0.8%	-1.8%
5	7.7%	5.0%
10	2.9%	1.0%
15	9.6%	5.9%
20	5.9%	4.6%

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	MSCI ACWI ex U.S. Small Cap Index	MSCI ACWI ex U.S.
5	13.4%	13.4%
10	20.6%	19.1%
15	18.8%	17.6%
20	18.2%	17.4%

Sharpe Ratio (As of December 31, 2016)

Trailing Years	MSCI ACWI ex U.S. Small Cap Index	MSCI ACWI ex U.S.
5	0.6	0.4
10	0.2	0.1
15	0.5	0.3
20	0.3	0.2

As shown in the tables above, non-U.S. small cap stocks have outperformed their larger cap brethren over the majority of the trailing periods referenced above. Non-U.S. small cap stock volatility has been modestly higher, as expected, over the majority of time periods.

NON-U.S. SMALL CAP STOCK

The table below shows the historical correlations of the MSCI ACWI ex U.S. Small Cap Index relative to the current TSP funds.

Correlations (20 years ending December 31, 2016)

	G Fund	F Fund	C Fund	S Fund	I Fund	MSCI ACWI ex U.S.	MSCI ACWI ex U.S. Small Cap Index
G Fund	1						
F Fund	0.18	1					
C Fund	-0.05	-0.05	1				
S Fund	-0.06	-0.06	0.86	1			
I Fund	-0.03	0.01	0.84	0.79	1		
MSCI ACWI ex U.S.	-0.02	0.01	0.85	0.81	0.98	1	
MSCI ACWI ex U.S. Small Cap	**-0.07**	**0.02**	**0.74**	**0.76**	**0.91**	**0.94**	**1**

Non-U.S. small cap stocks have relatively high correlations to international developed equities (I Fund), but relatively lower correlation to U.S. equities (C and S Funds) and none to bonds & cash (G and F Funds).

Index Investment Options

The tables below show the amount of assets indexed to non-U.S. small cap stocks by the major institutional index fund managers.

Non-U.S. Small Cap Stock Index Fund Products (assets in millions) – All assets

	BlackRock	Northern Trust	SSgA	Vanguard
Non-U.S. Small Cap Index	$9,710	$1,554	$3,664	$3,399

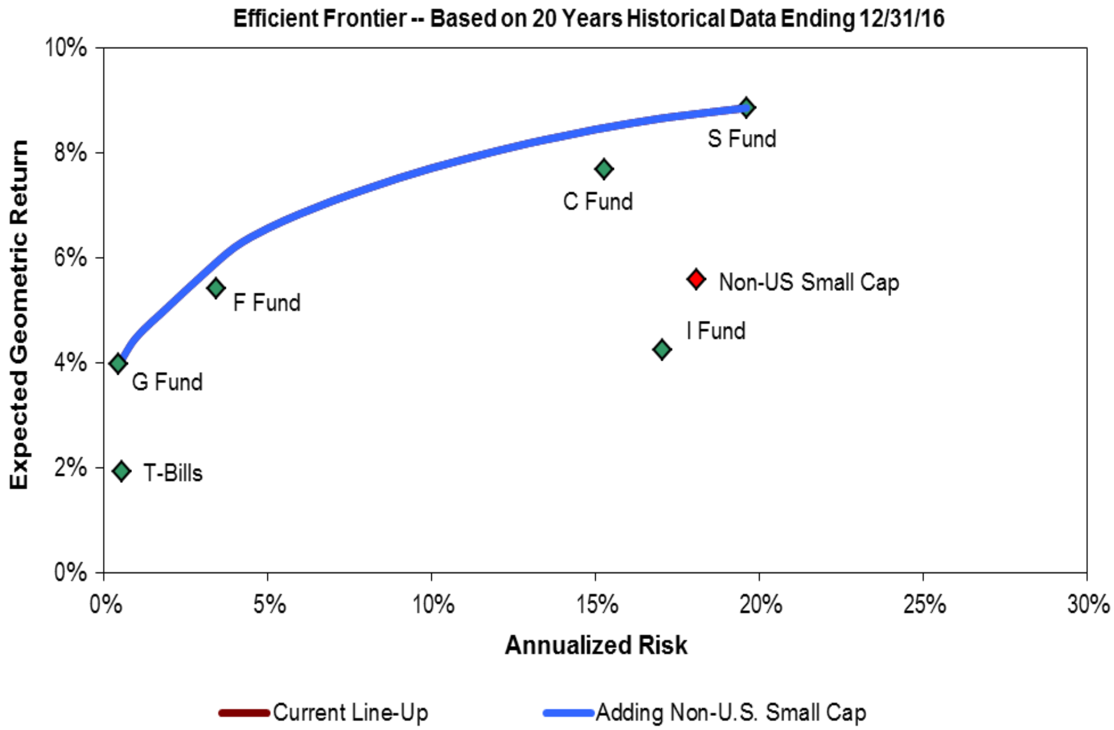
Non-U.S. Small Cap Stock Index Fund Products (assets in millions) – Daily-valued DC assets

	BlackRock	Northern Trust	SSgA	Vanguard
Non-U.S. Small Cap Index	$276	$1,219	$2,340	$13

Total assets indexed to non-U.S. small cap stocks amongst the leading index fund providers is approximately $18 billion.

NON-U.S. SMALL CAP STOCK

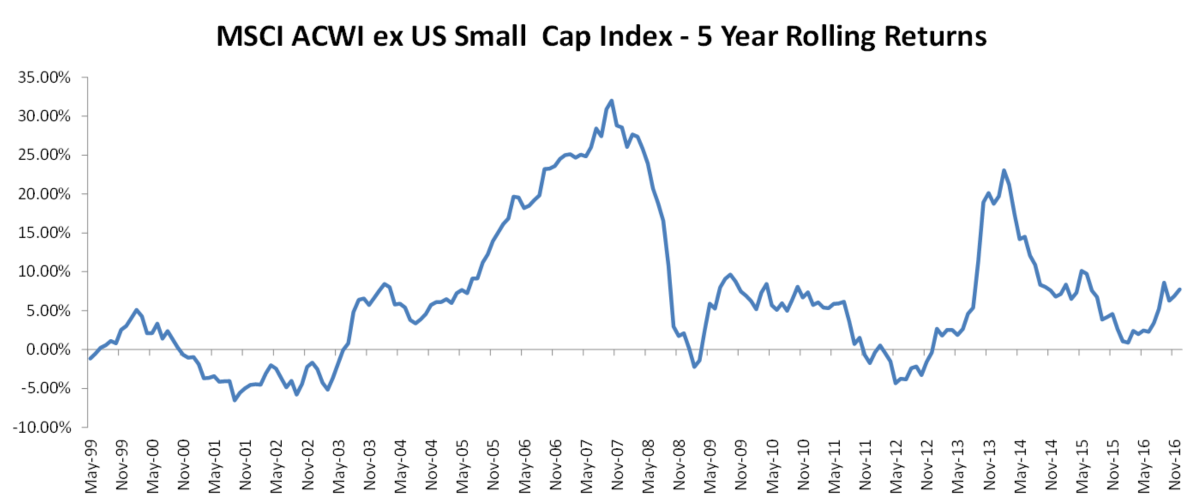
Below we show the efficient frontiers, based on historical data, using the TSP funds with and without non-U.S. small cap as an investment fund alternative. AHIC forward looking assumptions are not available for the non-U.S. small cap market.



Our optimization model does not recommend adding non-U.S. small cap to the existing line-up of TSP funds based on the last 20 years of historical data. The benefits of modest correlations to other TSP funds have been offset by low returns and high volatility. We must caution against using historical performance as the only consideration.

NON-U.S. SMALL CAP STOCK

Recent poor performance of the index has significantly lowered the trailing 20 years return which is an input into the optimization. Had this optimization been run ten years ago, non-U.S. small cap stock would have been shown to improve the risk/return trade-off of the TSP investment program. The chart below shows the five year rolling annualized returns of the MSCI ACWI ex-U.S. Small Cap Index. Recent returns are near historical lows, in contrast to ten years ago when they were near historical highs.



AHIC does not produce capital market assumptions (forward-looking) for this asset class. However, we believe a small cap premium (MSCI ACWI ex U.S. Small Cap outperforming MSCI ACWI ex U.S.), over the long-term, will most likely exist.

Considerations

Now that non-U.S. small cap stock market size has grown to approximately $3 trillion and several index products are now being offered, the same argument could be made for a stand-alone non-U.S. small cap as with U.S. small cap.

Non-U.S. small cap stocks have benefits of modest correlations to other equities, due to less dependence on global market forces and higher growth rates. However, these benefits also come with higher volatility. Very few plans offer non-U.S. small cap and none of the top ten largest public sector plans do.

We would prefer to view the international stock asset class from the broadest level, that is consider large and small cap along with emerging markets stock, as part of a single asset class or fund alternative. As noted previously, our guiding principles recommend the more broadly diversified an asset class, the better it will serve participants given that too many fund alternatives will make education more difficult and participation less likely.

Conclusion

We would prefer to take a more broad and diversified view when considering the optimal international stock fund. More broadly defined investment options will make education easier and participation more likely. Non-U.S. small cap may rank second, next to emerging market equity, as one of the higher risk offerings and are not commonly offered, as a stand-alone investment option. The high risk associated with non-U.S. small cap stocks may result in material losses.

We would prefer to see non-U.S. small cap included, as part of a broader, international stock investment fund alternative invested in their respective market capitalization proportions. For these reasons, we would not recommend non-U.S. small cap stock be included as a stand-alone investment fund alternative.

BROAD NON-U.S. STOCK

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BROAD NON-U.S. STOCK

We review the merits of expanding the I Fund (e.g. Canada, emerging markets, and non-U.S. small cap stocks) to provide more of a complete coverage of the international equity opportunity set.

- Large market with total capitalization of over $20.2 trillion (approximately 46% of world equity market capitalization)
- TSP participants do not currently have exposure to Canada, emerging markets, and non-U.S. small cap stocks
- Daily valued index products are available

Modern portfolio theory suggests that the “market portfolio” is the most efficient portfolio (in terms of risk/return trade-off) that an investor can hold. The “market portfolio” is a market-cap weighted sum of all available asset classes/regions/countries. Excluding segments of the market limits investors’ opportunities (return and/or diversification potential).

In general, we recommend constructing equity portfolios with the broadest possible market coverage. For instance, we recommend the DJ U.S. Total Stock Market Index, which provides complete coverage of large, mid, and small-cap stocks, as the benchmark for the broad U.S. equity market.

The C and S Funds’ recommended benchmarks, the S&P 500 Index and the DJ U.S. Completion Total Stock Market Index, respectively, when combined, provide coverage of the broad U.S. equity opportunity set that is very similar to the coverage provided by the DJ U.S. Total Stock Market Index.

The I Fund’s existing benchmark, the MSCI EAFE Index, excludes Canada and the emerging markets. As noted earlier, the Canadian equity market is the third-largest equity market outside of the U.S. Emerging markets represent nearly a fourth of the non-U.S. equity opportunity set. Moreover, emerging markets represent a significant and growing portion of global growth or GDP and an increasingly larger portion of the world equity market capitalization. Over the past two decades, emerging economies, such as Brazil, China, India, Russia and South Africa, have expanded at a much faster pace than developed countries.

Today, emerging markets contribute 58% of global GDP as compared to 27% in 1997.

Market participants broadly expect emerging economies to continue to grow at a faster pace than developed economies. Reasons include:

- Favorable demographics and a growing middle class
- Growth in local consumption demand
- Improving economic, legal and regulatory systems
- Disciplined fiscal and monetary policies

While the case for investing in emerging markets has become more compelling, emerging markets have experienced, and, in our opinion, will experience greater volatility than developed markets. Some of the risks in emerging markets include:

- Political risk (trade protectionism, rogue regimes, expropriation of assets, etc.)
- Slowing down or a reversal of favorable economic and monetary policies

- A higher willingness based on historical experience to default or devalue their currencies
- Growth that is heavily dependent on or tied to growth in developed markets (exports, commodities, etc.)

While several of these risks are not easily quantified, we do believe investors get compensated for these risks on a risk-adjusted basis. The volatility of emerging markets has been higher than developed markets over the last decade or two, but emerging markets have been able to outperform developed markets on a risk-adjusted basis.

The following table shows Aon Hewitt Investment Consulting's expected returns and risk (volatility) for developed and emerging markets over the long-term. These represent 10-year forward looking expectations.

Aon Hewitt Investment Consulting – Capital Market Expectations (Q1 2017)

	Expected Return	Expected Risk
Developed Markets	7.1%	20.0%
Emerging Markets	7.7%	30.0%

As shown, we expect emerging markets to perform favorably as compared to developed markets, but at a materially higher level of risk.

As for non-U.S. small cap stocks, because commonly used benchmarks for international equity, MSCI EAFE and MSCI ACWI ex-U.S. indices, do not contain small cap names, we believe that non-U.S. small cap stocks are under-invested relative to their U.S. small cap peers. Additionally, relative to larger peers, smaller companies in the index are covered by a smaller pool of sell-side analysts. This under-investment and lack of analyst coverage may lead to less market efficiency and a greater return potential.

Non-U.S. small cap stocks are also tied more to their local economies than to the global economy. The lack of connection from the global economy should provide lower correlations to the broader equity market. Consequently, we believe that adding non-U.S. small cap exposure will likely improve the Sharpe ratio of the overall non-U.S. equity portfolio.

Market Characteristics (As of December 31, 2016)

International Markets	MSCI ACWI ex U.S. IMI	MSCI ACWI ex U.S.	MSCI EAFE
Market Capitalization ($ in millions)	$20.2 trillion	$17.4 trillion	$12.2 trillion
Number of Securities	6,150	1,856	930
Average market capitalization	$3.3 billion	$9.4 billion	$13.1 billion

The above table illustrates the market coverage of each of the above indices. The table demonstrates that there is improvement in the number of stocks covered and market capitalization diversification within the MSCI ACWI ex U.S. indices. The inclusion of non-U.S. small cap stocks results in the MSCI ACWI ex U.S. IMI having the highest number of securities represented at 6,150 and the lowest average market capitalization providing a more complete coverage of the non-U.S. equity opportunity set than the other indices referenced.

The countries that comprise the broad international indices are shown in the table below.

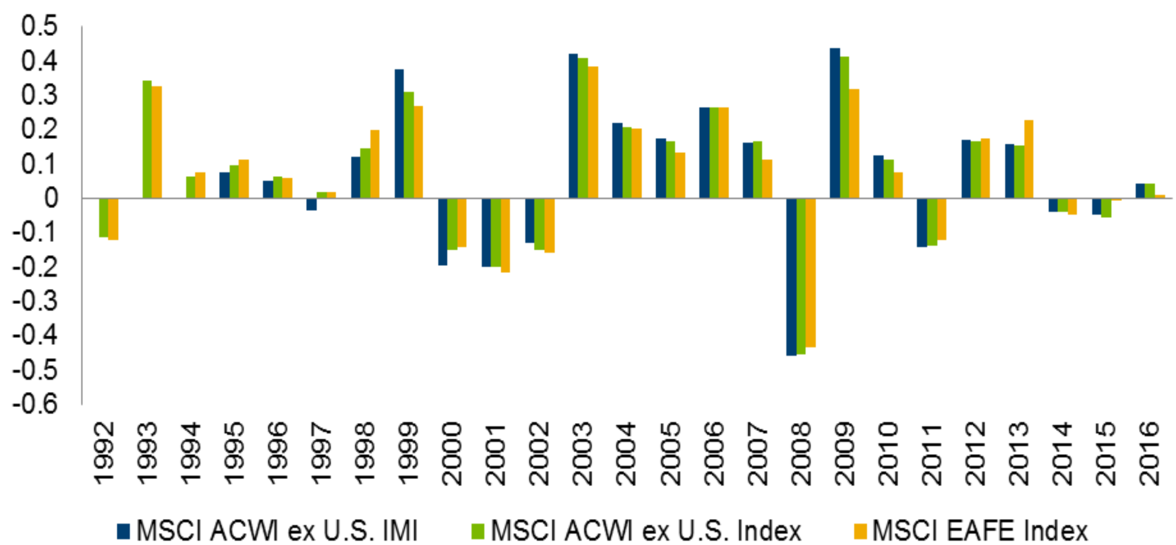
International Equity Markets - Country Allocation (As of December 31, 2016)

Country/Region	MSCI ACWI ex U.S. IMI	MSCI ACWI ex U.S.	MSCI EAFE
Australia	5.1%	5.2%	7.4%
China	5.9%	6.0%	
Hong Kong	2.2%	2.3%	3.3%
Indonesia	0.6%	0.6%	
India	2.0%	1.9%	
Japan	17.7%	17.0%	24.1%
Korea	3.3%	3.3%	
Malaysia	0.6%	0.6%	
New Zealand	0.2%	0.1%	0.2%
Philippines	0.3%	0.3%	
Singapore	0.9%	0.9%	1.2%
Thailand	0.6%	0.5%	
Taiwan	2.9%	2.8%	
Asia & Australia	**42.3%**	**41.3%**	**36.2%**
United Arab Emirates	0.2%	0.2%	
Austria	0.2%	0.1%	0.2%
Belgium	0.9%	0.8%	1.2%
Switzerland	5.7%	6.1%	8.7%
Germany	6.2%	6.5%	9.3%
Czech Republic	0.0%	0.0%	
Denmark	1.1%	1.2%	1.7%
Egypt	0.0%	0.0%	
Spain	2.1%	2.2%	3.1%
Finland	0.7%	0.7%	1.0%
France	6.6%	7.2%	10.2%
United Kingdom	12.8%	12.9%	18.3%
Greece	0.1%	0.1%	
Hungary	0.1%	0.1%	
Ireland	0.4%	0.3%	0.5%
Israel	0.5%	0.5%	0.7%
Italy	1.6%	1.5%	2.1%
Netherlands	2.2%	2.3%	3.3%
Norway	0.6%	0.5%	0.7%
Poland	0.3%	0.3%	
Portugal	0.1%	0.1%	0.2%
Qatar	0.2%	0.2%	
Russia	0.9%	1.0%	
Sweden	2.2%	2.0%	2.8%

Country/Region	MSCI ACWI ex U.S. IMI	MSCI ACWI ex U.S.	MSCI EAFE
Turkey	0.2%	0.2%	
Europe & Middle East	**46.2%**	**47.0%**	**63.8%**
Brazil	1.6%	1.7%	
Peru	0.1%	0.1%	
Canada	7.1%	7.1%	
Chile	0.3%	0.3%	
Colombia	0.1%	0.1%	
Mexico	0.8%	0.8%	
Americas	**10.0%**	**10.1%**	
South Africa	1.6%	1.6%	
Africa	**1.6%**	**1.6%**	
TOTAL	**100.0%**	**100.0%**	**100.0%**

Historical Performance

In the following chart, we show the annual returns of the broad non-U.S. stock indices along with the non-U.S. developed index over time.



We show annualized returns, volatility and Sharpe Ratios for the broad non-U.S. stock indices along with the non-U.S. developed index in the following tables.

Annualized Returns (As of December 31, 2016)

Trailing Years	MSCI ACWI ex U.S. IMI	MSCI ACWI ex U.S.	MSCI EAFE
1	4.4%	4.5%	1.0%
3	-1.4%	-1.8%	-1.6%
5	5.4%	5.0%	6.5%
10	1.2%	1.0%	0.8%
15	6.4%	5.9%	5.3%
20	4.6%	4.6%	4.2%

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	MSCI ACWI ex U.S. IMI	MSCI ACWI ex U.S.	MSCI EAFE
5	13.3%	13.4%	13.5%
10	19.2%	19.1%	18.6%
15	17.6%	17.6%	17.1%
20	17.4%	17.4%	16.9%

Sharpe Ratio (As of December 31, 2016)

Trailing Years	MSCI ACWI ex U.S. IMI	MSCI ACWI ex U.S.	MSCI EAFE
5	0.45	0.42	0.53
10	0.12	0.11	0.09
15	0.37	0.34	0.31
20	0.22	0.22	0.19

As shown in the tables above, the broad non-U.S. stock indices have outperformed the non-U.S. developed index over longer-time periods. Although the volatility levels of the broader indices are modestly higher, as expected, the risk/return profiles are still more favorable than the non-U.S. developed index over the longer-time periods.

The table below shows the historical correlations of the broad international equity indices relative to the current TSP Funds.

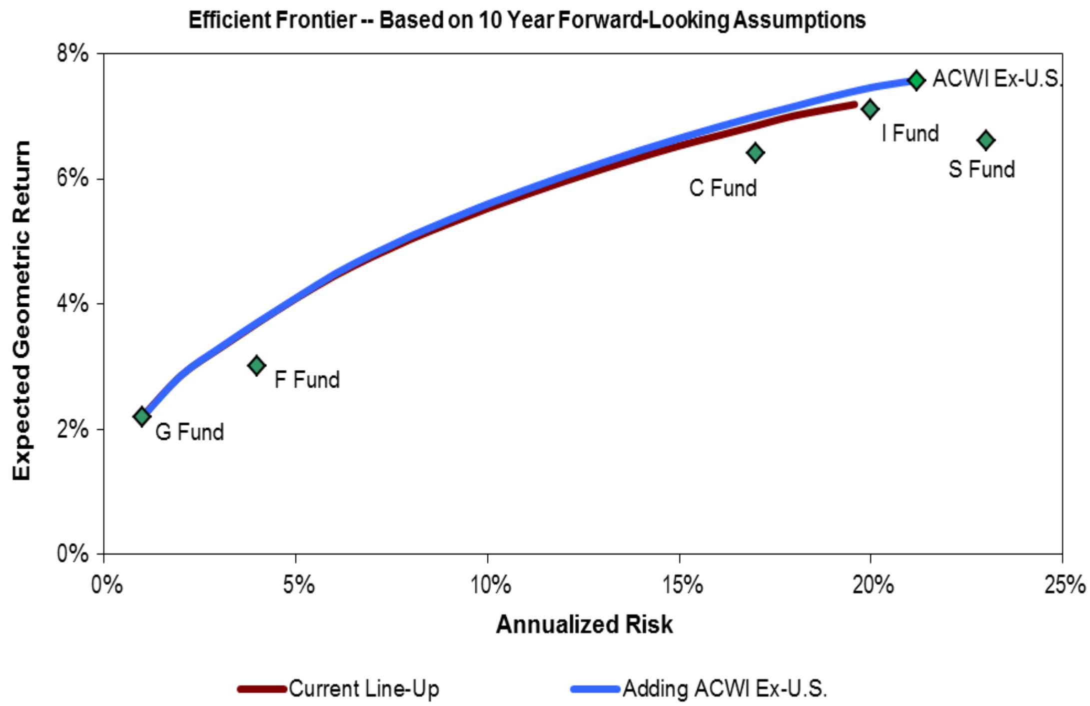
Correlations (20 years ending December 31, 2016)

	G Fund	F Fund	C Fund	S Fund	I Fund	MSCI ACWI ex U.S. IMI	MSCI ACWI ex U.S.
G Fund	1						
F Fund	0.18	1					
C Fund	-0.05	-0.05	1				
S Fund	-0.06	-0.06	0.86	1			
I Fund	-0.03	0.01	0.84	0.79	1		
MSCI ACWI Ex U.S. IMI	**-0.03**	**0.01**	**0.84**	**0.81**	**0.98**	**1**	
MSCI ACWI ex U.S.	**-0.02**	**0.01**	**0.85**	**0.81**	**0.98**	**1.00**	**1**

The returns of the broad non-U.S stock indices are relatively highly correlated to the C, S and I Funds, reflecting the globalized nature of the world economy and uncorrelated to the F and G Funds. On a forward looking basis, we expect the broad non-U.S. stock indices to be less correlated to the C and S Funds relative to the I Fund. Based on AHIC's 10-year capital market assumptions, emerging market equities are less correlated to the C and S Funds relative to the I Fund. Therefore, broader exposure to the international equity market is expected to improve the participant's portfolio diversification on a forward looking basis.

BROAD NON-U.S. STOCK

Below we show the efficient frontiers, based on AHIC's 10-year forward looking capital market assumptions, using the TSP Funds with and without broad non-U.S. stock as an investment fund alternative.



As shown, the efficient frontier that includes the broader international equity exposure does improve marginally compared to the efficient frontier with just the current investment fund line-up, indicating that the inclusion of the asset class would improve the risk return profile of the current line-up.

The tables below show the amount of assets indexed to broad international equities by the major institutional index fund managers.

Broad International Equity Fund Products (assets in millions) – All assets

	Blackrock	Mellon	Northern Trust	SSgA	Vanguard
MSCI ACWI ex U.S.	$35,630	$7,975	$17,113	$45,602	$231,928
MSCI ACWI ex U.S. IMI	$27,730	$467	$12,513	$23,079	--

Broad International Equity Fund Products (assets in millions) – Daily-valued DC assets

	Blackrock	Mellon	Northern Trust	SSgA	Vanguard
MSCI ACWI ex U.S.	$6,564	$1,274	$12,573	$20,822	$18,979
MSCI ACWI ex U.S. IMI	$6,247	$342	$9,368	$18,704	--

The total assets indexed to broad international indices amongst the leading index fund providers are substantial at approximately $402 billion.

Considerations

Overall, we favor the I Fund expanding its exposure to Canada, emerging markets, and non-U.S. small cap stocks as it provides broader coverage of the international equity markets, more fully captures global growth, and provides enhanced diversification of the international equity portfolio. From a theoretical standpoint, we recommend that clients utilize the MSCI ACWI ex U.S. or MSCI ACWI ex U.S. IMI as these indices provide complete coverage of the non-U.S. equity opportunity set, however a detailed benchmark study will determine the appropriate benchmark for the TSP.

The broad non-U.S. equity market is of significant market size and index assets under management are large. The broad non-U.S. equity market provides diversification across country, sector, and market capitalization. By broadening the exposure of the I Fund, the stock coverage increases by almost 930 stocks in the case of the MSCI ACWI ex U.S. Index and 5,220 stocks in the case of the MSCI ACWI ex U.S. IMI. Additionally, as illustrated in this report, expanding the exposure of the I Fund is expected to improve participants' risk adjusted returns by delivering stronger returns at a modestly higher level of risk on a forward looking basis. On a historical basis, both broad market indices (ACWI ex U.S. or ACWI ex U.S. IMI) have delivered stronger risk adjusted performance relative to the non-U.S. developed index (EAFE) over longer-time periods, Although emerging markets and non-U.S. small cap exhibit greater volatility than the non-U.S. developed index (EAFE) over the past 10-, 15-, and 20-year periods, both markets have outperformed the non-U.S. developed index (EAFE) and have delivered stronger performance per unit of risk.

As we review the I Fund's current benchmark, the MSCI EAFE Index, the case to include Canada is very compelling and obvious given that it is the third-largest equity market outside the U.S. and a country with which participants should have familiarity.

The case for the inclusion of emerging markets and non-U.S. small cap stocks, while compelling, needs further investigation. The foremost consideration in expanding the I Fund benchmark to include emerging markets and non-U.S. small cap stocks is the need to provide daily liquidity. A sufficient level of cash must be maintained in the fund to meet participant withdrawal needs. As an example, BlackRock, the existing manager of the I Fund, has a cash buffer in order to meet routine liquidity needs. The cash is equitized to the markets using futures contracts. While the use of futures contracts minimizes the cash drag on the portfolio, the futures contracts may not always track the benchmark precisely (if multiple country futures contracts are used to track a benchmark) or may not have adequate levels of liquidity. These could be potential sources of tracking error. Additionally, while the liquidity in emerging markets and non-U.S. small cap has improved, we typically see a flight to quality from emerging markets and non-U.S. small cap stocks in times of market stress. Liquidity can be adversely impacted in times of market stress. A liquidity analysis assessing TSP I Fund's daily cash flow activity during stressed market environments should be conducted to affirm that daily liquidity can be met without impacting the price of securities and tracking error is reasonable. Given that the number of participants and level of assets will continue to grow compounded by the upcoming addition of military personnel to the TSP program through

Blended Retirement, the liquidity analysis is especially important to ensure that the TSP’s size and growth are adequately considered.

Conclusion

We recommend considering broadening the market coverage of the I Fund to Canada, emerging markets, and non-U.S. small cap stocks. Ultimately, broadening the coverage of the I Fund to encompass the full opportunity set will provide symmetry to TSP’s equity investment line up as it would be providing access to both U.S. and non-U.S. large and small cap stocks. The expansion of coverage into these markets will primarily be contingent on the broader analysis suggested above.

NON-U.S. BONDS

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We review the merits of offering a non-U.S. bond fund as an investment fund alternative. The primary rationale for reviewing non-U.S. bonds includes the significance of non-U.S. bonds in terms of size and the fact that it is diversified by security and issuer. We review the asset class in greater detail and provide our recommendation as to whether the FRTIB should offer a non-U.S. bond fund.

Market Size

Non-U.S. investment grade bonds comprise over 27% of the world markets (stocks and bonds) with approximately $24 trillion in assets. As one of the world's largest capital markets, it is appropriate to review whether or not the TSP should offer this asset class as a stand alone investment fund. Below we discuss the relevant factors to consider in making this decision, such as historical risk-return characteristics, potential diversification benefits and index product availability. Earlier in our report we noted that non-U.S. bond portfolios were <u>not</u> commonly offered in peer plans.

Historical Performance

In the table below, we show the historical returns of currency unhedged and currency hedged non-U.S. bonds. We show the returns of the Bloomberg Barclays Global Aggregate ex U.S. Index (Global Aggregate ex U.S.) as this index provides broad coverage to non-U.S. investment grade bonds. We also show the returns of the Bloomberg Barclays Aggregate Bond Index (benchmark for the F Fund) for comparative purposes.

Annualized Returns (As of December 31, 2016)

Trailing Years	Bloomberg Barclays Global Aggregate ex U.S. Index (Unhedged)	Bloomberg Barclays Global Aggregate ex U.S. Index (Hedged)	Bloomberg Barclays Aggregate Bond Index
1	1.5%	4.9%	2.7%
3	-2.6%	5.0%	3.0%
5	-1.4%	4.5%	2.2%
10	2.4%	4.4%	4.3%
15	5.0%	4.5%	4.6%
20	3.5%	5.4%	5.3%

The fluctuations in returns between the unhedged Global Aggregate ex U.S. Index and the hedged index are a result of the performance of the U.S. dollar relative to foreign currencies. The decline in yields over the past few years have been greater outside of the U.S., which has helped hedged Global Aggregate ex U.S. Index to outperform the Bloomberg Barclays Aggregate Bond Index.

NON-U.S. BONDS

The table below shows the volatility (annual standard deviation) of the indices over several trailing periods.

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	Bloomberg Barclays Global Aggregate ex U.S. Index (Unhedged)	Bloomberg Barclays Global Aggregate ex U.S. Index Index (Hedged)	Bloomberg Barclays Aggregate Bond Index
5	6.8%	2.6%	2.9%
10	8.4%	2.6%	3.3%
15	8.4%	2.5%	3.5%
20	8.3%	2.5%	3.4%

The higher level of volatility of the Global Aggregate ex U.S. Unhedged Index is due to foreign currency performance relative to the U.S. dollar.

Sharpe Ratio (As of December 31, 2016)

Trailing Years	Bloomberg Barclays Global Aggregate ex U.S. Index (Unhedged)	Bloomberg Barclays Global Aggregate ex U.S. Index (Hedged)	Bloomberg Barclays Aggregate Bond Index
5	-0.19	1.65	0.73
10	0.23	1.34	1.06
15	0.46	1.21	0.92
20	0.18	1.19	0.87

NON-U.S. BONDS

We show the correlations of the unhedged and hedged Global Aggregate ex U.S. indices returns relative to the returns of the TSP's current investment funds in the table below. Correlation coefficients can range from +1 to -1. A correlation of +1 between two indexes implies that the returns of the two indexes move in the same direction and in the same proportion, while a correlation of -1 means that the returns move in opposite directions but in the same proportion. Low to negative correlations generally imply a risk diversification benefit.

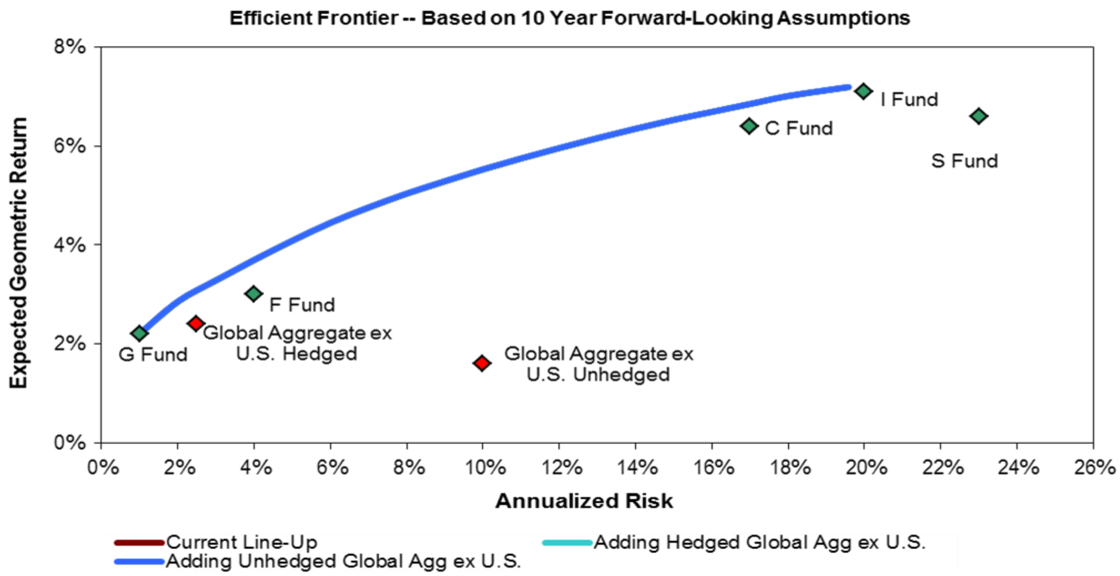
Correlations (20 years ending December 31, 2016)

	G Fund	**F Fund**	**C Fund**	**S Fund**	**I Fund**	**Global Aggregate ex U.S. Unhedged**	**Global Aggregate ex U.S. Hedged**
G Fund	1						
F Fund	0.18	1					
C Fund	-0.05	-0.05	1				
S Fund	-0.06	-0.06	0.86	1			
I Fund	-0.03	0.01	0.84	0.79	1		
Global Aggregate ex U.S. Unhedged	0.06	0.52	0.15	0.15	0.38	1	
Global Aggregate ex U.S. Hedged	0.19	0.77	-0.09	-0.15	-0.10	0.39	1

The overall low correlations of the hedged and unhedged Global Aggregate ex U.S. indices to the C, S and I Funds seem appealing at first. However, the F Fund also has low correlations to the C, S and I Funds. Additionally, the hedged and unhedged Global Aggregate ex U.S. indices have a reasonably high correlation to the F Fund.

NON-U.S. BONDS

In the following chart, we show the 10-year forward looking efficient frontier for TSP participants using the current TSP investment options and the efficient frontier if the hedged and unhedged Global Aggregate ex U.S. indices were part of the investment line-up.



There is little difference in the forward looking efficient frontiers for the TSP's current investment fund line-up and the frontier that includes the unhedged or hedged Global Aggregate ex U.S. indices. On a forward looking basis, the unhedged Global Aggregate ex U.S. Index has a less favorable risk/return profile relative to the hedged Global Aggregate ex U.S. Index and the F Fund given the lower expected return and higher expected risk level driven by currency volatility.

The tables below shows the amount of assets indexed to non-U.S. bonds by three of the major institutional index fund managers.

Non-U.S. Bond Index Fund Products (assets in millions) – All assets

	Blackrock	SSgA	Vanguard
Global Aggregate Bonds	$853	$8,044	--
Non-U.S. Aggregate/ Developed Bonds	$796	$601	$68,204

Non-U.S. Bond Index Fund Products (assets in millions) – Daily-valued DC assets

	Blackrock	SSgA	Vanguard
Global Aggregate Bonds	--	--	--
Non-U.S. Aggregate Bonds/ Developed Bonds	--	$80	$354

Considerations

We generally advocate that our clients offer only one investment fund alternative in the diversified fixed income/bond fund category. We advocate simplicity in the bond category as participants generally do not allocate significant assets to bond funds and do not obtain material benefits from specialized bond funds if they have a broadly diversified portfolio. Additionally, it can be difficult to educate participants regarding the drivers of a specialized bond fund's performance (interest rate sensitivity, credit spreads, currency fluctuations, etc.).

Non-U.S. bond funds are not common practice in peer plans and the addition of non-U.S. bond funds has not shown to add material diversification benefits.

Conclusion

While non-U.S. bonds are a material portion of the world's market capitalization, indexed assets under management are small and could be overwhelmed by cash flows from the TSP. The benefits of adding a non-U.S. bond option are minimal from an expected risk-return and portfolio diversification standpoint for TSP participants. Moreover, adding a non-U.S. bond fund would add complexity to a segment of the plan where we believe additional flexibility is not required and/or meaningful. As such, we recommend the FRTIB not add a non-U.S. bond fund as an investment fund alternative.

EMERGING MARKET DEBT

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EMERGING MARKET DEBT

We review the merits of offering an emerging market debt fund as an investment alternative for the following reasons:

- Large and rapidly growing market with current market capitalization of $2.7 trillion of total debt outstanding (U.S. dollar - hard currency) and $1.6 trillion is represented in the main broad emerging market debt indices (U.S. dollar sovereign and corporate bonds). Emerging markets have seen improvements relative to developed markets in recent years
  - Higher GDP growth relative to developed markets
  - More stable financial condition from large currency reserves and lower public debt than developed countries
  - Improved credit ratings relative to developed market bonds
  - Higher yields relative to developed markets
- Diversification benefits with low correlation to traditional bond and equity markets
- Daily valued, index funds are available from major index providers; however the maximum tradable dollar amount per day is estimated at only $250-500 million with transaction costs of 25 to 50 basis points.

Emerging market debt are bonds issued by emerging market countries' governments and corporations. These may be denominated in U.S. dollars (hard currency) or local currencies. The market cap of emerging market debt outstanding is $16 trillion; $2.5 trillion of the market cap is represented in the broad emerging market debt indices (local and hard currency). We focus our analysis on the U.S. dollar (hard currency) part of the market which amounts to approximately $2.7 trillion of total debt outstanding and $1.6 trillion represented in the broad emerging market debt indices. Hard currency emerging market debt tends to be less volatile because there is no currency risk associated with these bonds, while most of the risk associated with local currency denominated bonds is as a result of the currency fluctuations. The most commonly used benchmark for the hard currency part of the market is the J.P. Morgan EMBI Global Index. This index consists of sovereign and quasi-sovereign bonds. There are no corporate bonds in this index.

There has been growing interest in emerging market debt for several reasons. First, emerging market bonds still command higher yields than comparable U.S. bonds, though the differential is currently low by historical standards. Second, emerging market countries have experienced improving fundamentals such as rapid GDP growth rates with emerging markets share of global GDP around 58%, lower government debt, more investor protections and higher credit quality. Third, emerging market debt has low correlations to stocks and traditional fixed income which will provide diversification benefits.

There are still many risks associated with emerging market debt. The chief concern is always the possibility of political instability. Another is that emerging market countries are still very dependent on the export of commodities and any slowdown in demand can hurt economic prospects.

Historical Performance

In the table below, we show the historical returns of emerging market debt. We show the returns of the J.P. Morgan EMBI Global Index as this is the most widely used emerging market debt index for hard currency emerging debt. We also show the returns of the Bloomberg Barclays Aggregate Bond Index (benchmark for the F Fund) for comparative purposes.

Annualized Returns (As of December 31, 2016)

Trailing Years	J.P. Morgan EMBI Global Index	Bloomberg Barclays Aggregate Bond Index
1	10.2%	2.7%
3	5.6%	3.0%
5	5.4%	2.2%
10	6.8%	4.3%
15	9.2%	4.6%
20	8.7%	5.3%

The performance of the J.P. Morgan EMBI Global Index has been very strong relative to traditional bonds over both short and longer time periods.

The table below shows the volatility (annualized standard deviation) of the indexes over several trailing periods.

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	J.P. Morgan EMBI Global Index	Bloomberg Barclays Aggregate Bond Index
5	7.2%	2.9%
10	8.9%	3.3%
15	8.9%	3.5%
20	11.6%	3.4%

J.P. Morgan EMBI Global Index has had significantly more volatility than traditional bonds, but it has come with significantly higher returns.

EMERGING MARKET DEBT

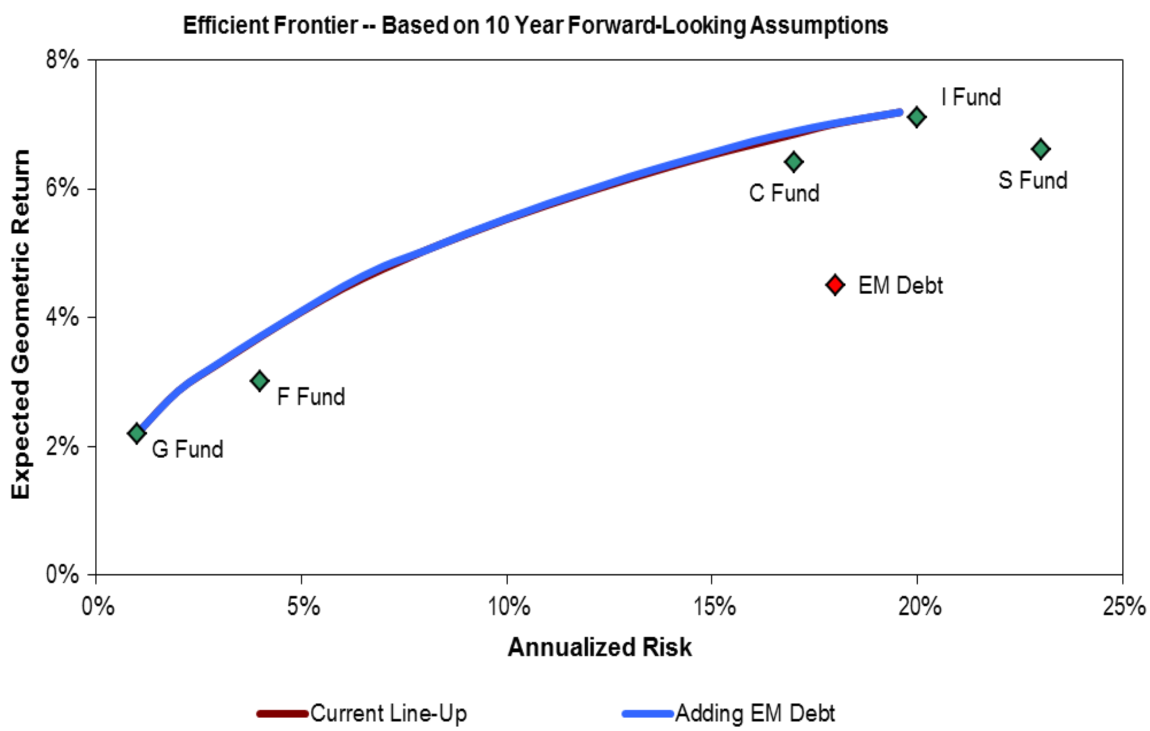
We show the correlations of J.P. Morgan EMBI Global Index relative to the returns of TSP's current investment funds in the table below.

Correlations (20 years ending December 31, 2016)

	G Fund	F Fund	C Fund	S Fund	I Fund	JPM-EMBI
G Fund	1					
F Fund	0.18	1				
C Fund	-0.05	-0.05	1			
S Fund	-0.06	-0.06	0.86	1		
I Fund	-0.03	0.01	0.84	0.79	1	
JPM-EMBI	**0.02**	**0.33**	**0.55**	**0.55**	**0.57**	**1**

Emerging market debt is modestly correlated to the C, S, & I Funds and has low correlations to the G and F Funds.

Below we show the efficient frontiers, based on AHIC's 10-year forward looking capital market assumptions, using the TSP funds with and without emerging market debt as an investment fund alternative.



As shown, the efficient frontier with emerging market debt as an investment fund alternative does not change the efficient frontier position from its current line-ups risk/return trade-off. On a forward looking basis, emerging market debt is viewed less favorable as it is expected to have a similar risk level to equities while achieving lower returns.

Index Investment Options

The table below shows the amount of assets indexed to emerging market debt indexes by the major institutional index fund managers.

Emerging Market Debt Index Fund Products (Hard Currency) (assets in millions) – All assets

	Blackrock	SSgA	Vanguard
Emerging Market Debt Hard Currency	$792	$477	$1,107

Emerging Market Debt Index Fund Products (assets in millions) – Daily-valued DC assets

	Blackrock	SSgA	Vanguard
Emerging Market Debt Hard Currency	--	--	$2

Approximately, $2 billion in assets are managed to emerging market U.S. dollar (hard currency) indexes, by the leading institutional index providers.

Considerations

Emerging market debt has seen an explosion of interest in recent years by many institutional investors looking for higher yields from an asset class that has low correlation to traditional bonds. Investors have also taken comfort in improving fundamentals with regard to government debts, credit ratings and robust growth rates relative to their developed counterparts. Larger and more liquid markets have enabled large institutional index providers to create index products that track various emerging market indexes.

However, we have to be cautious when evaluating the merits of this asset class based on only historical information. While recent performance has been strong, we believe future returns will not likely be as strong. There are still significant risks associated with this asset class with regard to political risk and the reliance on commodity driven economies.

Liquidity and cost are also of concern as it is estimated that only a maximum of $250-500 million of daily transaction volume can be executed at costs of 25 to 50 basis points.

Conclusions

While correlations to traditional bonds are low, correlation to equities are modestly higher coupled with lower expected returns and high risk making this asset class less appealing as a stand-alone option. Offering emerging market debt, as a stand-alone option, is not common practice (none of the top ten largest public plans offer this option). For these reasons we would not recommend emerging market debt be added as an investment fund alternative.

COMMODITIES

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Over the last decade, investing in commodities has caught the attention of institutional investors. Steep declines in equity markets coupled with strong returns from commodities and fears of higher inflation, due to large budget deficits, have contributed to this phenomenon.

Commodities include energy (crude oil, natural gas, etc.), precious metals (gold, silver, etc.), base metals (copper, aluminum, etc.), and agricultural products (cattle, soybeans, etc.). Commodities provide a strong diversification benefit, as they tend to have low or even negative correlations with other asset classes. Investing in commodities is typically achieved using futures contracts, as investing in physical commodities is generally not feasible. Most investors don't have the ability to buy and store crude oil or grains.

Futures contracts can be bought by placing a margin deposit with the futures broker. The margin is typically a small fraction of the value of the futures contract and is adjusted (marked-to-market) on a daily basis depending on the change in the value of the contract. In order to gain exposure to the underlying commodity / financial instrument, the investor need only place a fraction of the value of the exposure desired in the margin account, implying that purchasing futures contracts on margin essentially results in the use of leverage. In order to maintain an un-levered exposure to the underlying commodity, an investor can buy the necessary futures contract on margin and place the remaining investments in cash or a cash-like instrument.

As a result, the returns from a long-only un-levered investment in futures contracts can be decomposed as follows:

Spot Return – Return attributable to the change in the price level of the underlying commodity represented by the futures contract

Roll Return – Return associated with "rolling" the futures contract at each contract maturity date. Futures contracts have a finite life. In order to maintain continuous exposure to the underlying assets, investors need to sell near-dated futures contracts at expiration and buy longer-dated contracts. The process of trading the futures to maintain exposure to the underlying commodity is referred to as rolling the futures. The roll process can result in either a profit or a loss.

Collateral Return – The yield on the cash or government bond instrument held as collateral against the futures investment.

The chart below shows the sector breakdown of the Goldman Sachs Commodities Index (GSCI) and Bloomberg Commodity Index, which are the most widely tracked commodities indexes.

Sectors	Bloomberg Commodity	GSCI
Energy	34.9%	62.8%
Agriculture	27.5%	16.8%
Industrial Metals	21.1%	9.3%
Precious Metals	11.2%	3.9%
Livestock	5.3%	7.1%

Historical Performance

We show the historical performance of the Goldman Sachs Commodities Index (GSCI) and Bloomberg Commodity Index, the most widely tracked commodity indexes, below.

Annualized Returns (As of December 31, 2016)

Trailing Years	Bloomberg Commodity	GSCI
1	11.7%	11.4%
3	-11.3%	-20.6%
5	-9.0%	-13.1%
10	-5.6%	-8.1%
15	1.2%	-1.0%
20	0.5%	-1.9%

Annualized Standard Deviation (As of December 31, 2016)

Trailing Years	Bloomberg Commodity	GSCI
5	13.4%	19.0%
10	18.0%	23.6%
15	16.9%	23.4%
20	16.4%	22.9%

Sharpe Ratios (As of December 31, 2016)

Trailing Years	Bloomberg Commodity	GSCI
5	-0.64	-0.65
10	-0.27	-0.27
15	0.08	0.02
20	-0.03	-0.07

The Bloomberg Commodity Index has been significantly less volatile than the GSCI Index because it has lower concentration in the energy sector. Commodities in general have had fairly low Sharpe ratios, due to modest returns and high volatility. Given, the high volatility and concentrated nature of the GSCI Index, we will eliminate it from further analysis, in the remainder of this section.

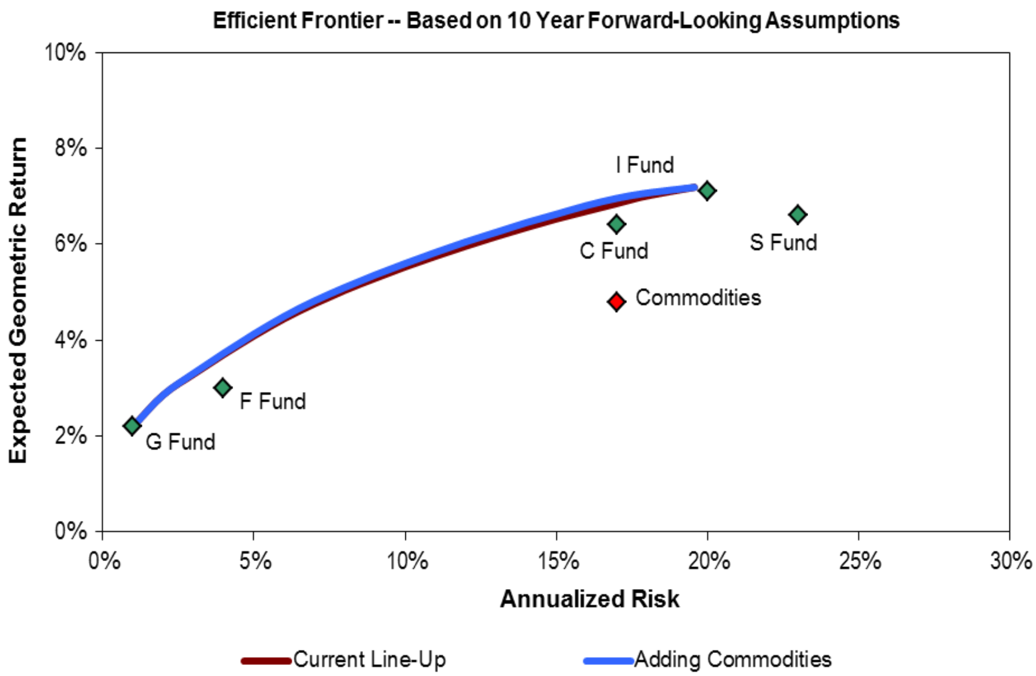
COMMODITIES

Correlations (20 years ending December 31, 2016)

	G Fund	F Fund	C Fund	S Fund	I Fund	Bloomberg Commodity
G Fund	1					
F Fund	0.18	1				
C Fund	-0.05	-0.05	1			
S Fund	-0.06	-0.06	0.86	1		
I Fund	-0.03	0.01	0.84	0.79	1	
Bloomberg Commodity	**0.09**	**0.06**	**0.31**	**0.34**	**0.44**	**1**

As shown in the table above, commodities have had low correlation of returns relative to the TSP's current investment funds.

Below we show the efficient frontiers, based on AHIC's 10-year forward looking capital market assumptions, using the current TSP Funds with and without Commodities as an investment fund alternative.



On a forward-looking basis, the addition of commodities has very minimal improvement on the efficient frontier, over using only the current TSP options. Despite low correlations to other assets, the low expected return and high risk offsets those benefits.

Below we show the amount of assets indexed to commodities with the leading index fund providers.

Commodities Index Fund Products (assets in millions) – All assets

	Blackrock	SSgA
Bloomberg Commodity	$1,367	$2,699
GSCI	$1,036	$511

Commodities Index Fund Products (assets in millions) – Daily-valued DC assets

	Blackrock	SSgA
Bloomberg Commodity	$848	$1,888
GSCI	--	--

Over $6 billion is indexed to the major commodities indexes by two major index providers of commodities.

Considerations

Commodities futures offer a diversification benefit, relative to equities and a potential hedge against inflation. We note that spot commodities have actually underperformed both cash and inflation over the long term; commodity futures have outperformed because of the roll return and collateral yield. Unlike other capital assets such as equities or fixed income securities, commodities do not represent the capitalization of a stream of future cash flows. Commodity prices and consequently returns are driven by current and expected supply/demand; we have no means to expect the roll returns of the past to continue in the future. To complicate matters, many commodities are trading in contango which is where the spot price is cheaper than those expiring in the future. This is important because it will have the effect of producing negative roll yield, as more expensive futures are purchased to replace expiring ones, in order to maintain exposure. Historically, most commodities traded in backwardation which produced positive roll yield. Studies have indicated that the increase in speculation versus hedging may have some influence on the increased incidence of contango in commodity futures markets.

Participants' general knowledge of the intricacies of the working of commodity futures is likely to be minimal, which could result in inappropriate allocations to such an investment fund in the program. We also note that it is not a commonly offered investment option in defined contribution programs.

Conclusion

Commodity futures offer a diversification benefit, as well as the potential to hedge against inflation. However, commodity prices are influenced by demand/supply considerations rather than the intrinsic value of a security, and future return expectations are uncertain. Most individual investors will have difficulty in determining an appropriate allocation to commodities. Commodity funds are also not a common investment option in defined contribution plans. We recommend that the FRTIB <u>not</u> offer commodities as an investment option in the TSP.

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APPENDIX

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Annual Returns (1997 – 2016)

Year	C Fund	S Fund*	I Fund*	F Fund	G Fund	MSCI ACWI Ex U.S. Index IMI	MSCI ACWI Ex U.S. Small Cap Index
1997	33.2			9.6	6.8	-3.3	-18.7
1998	28.4			8.7	5.7	12.0	5.0
1999	21.0			-0.9	6.0	37.7	32.7
2000	-9.1			11.7	6.4	-19.4	-18.1
2001	-11.9			8.6	5.4	-19.8	-14.6
2002	-22.1	-18.1	-16.0	10.3	5.0	-12.9	-5.7
2003	28.5	42.9	37.9	4.1	4.1	42.3	57.6
2004	10.8	18.0	20.0	4.3	4.3	21.9	29.3
2005	5.0	10.5	13.6	2.4	4.5	17.7	22.6
2006	15.8	15.3	26.3	4.4	4.9	26.5	26.9
2007	5.5	5.5	11.4	7.1	4.9	16.1	10.8
2008	-37.0	-38.3	-42.4	5.5	3.8	-46.0	-50.2
2009	26.7	34.9	30.0	6.0	3.0	43.6	62.9
2010	15.1	29.1	7.9	6.7	2.8	12.7	25.2
2011	2.1	-3.4	-11.8	7.9	2.5	-14.3	-18.5
2012	16.1	18.6	18.6	4.3	1.5	17.0	18.5
2013	32.5	38.4	22.1	-1.7	1.9	15.8	19.7
2014	13.8	7.8	-5.3	6.7	2.3	-3.9	-4.0
2015	1.5	-2.9	-0.5	0.9	2.0	-4.6	2.6
2016	12.0	16.4	2.1	2.9	1.8	4.4	3.9

*The benchmark returns of the S and I Funds were used prior to 2002 in this report where longer-time series of returns were needed.

Annual Returns (1997 – 2016)

Year	Bloomberg Barclays U.S. High Yield	Bloomberg Barclays Global Aggregate ex U.S. Index (Unhedged)	Bloomberg Barclays Global Aggregate ex U.S Index (Hedged)	Russell 1000 Growth Index	Russell 1000 Value Index	MSCI Emerging Markets Index IMI
1997	12.8	-4.0	10.9	30.5	35.2	-19.8
1998	1.9	18.4	12.1	38.7	15.6	-29.6
1999	2.4	-8.8	2.1	33.2	7.3	62.7
2000	-5.9	-3.9	9.1	-22.4	7.0	-35.7
2001	5.3	-3.7	6.3	-20.4	-5.6	-2.0
2002	-1.4	22.4	6.8	-27.9	-15.5	-6.6
2003	29.0	19.4	2.4	29.7	30.0	53.8
2004	11.1	12.5	5.3	6.3	16.5	26.5
2005	2.7	-8.7	5.4	5.3	7.1	33.9
2006	11.9	8.2	3.2	9.1	22.2	31.8
2007	1.9	11.0	4.3	11.8	-0.2	39.8
2008	-26.2	4.4	5.7	-38.4	-36.8	-53.8
2009	58.2	7.5	4.4	37.2	19.7	82.4
2010	15.1	4.9	3.3	16.7	15.5	19.9
2011	5.0	4.4	3.9	2.6	0.4	-19.5
2012	15.8	4.1	6.5	15.3	17.5	18.7
2013	7.4	-3.1	1.2	33.5	32.5	-2.2
2014	2.5	-3.1	8.8	13.1	13.5	-1.8
2015	-4.5	-6.0	1.4	5.7	-3.8	-13.9
2016	17.1	1.5	4.9	7.1	17.3	9.9

Annual Returns (1997 – 2016)

Year	FTSE EPRA Global REIT	Bloomberg Barclays Inflation Linked Index	Bloomberg Commodity Index	JPM EMBI Global	S&P Global Infrastructure Index
1997	-7.4		-3.4	12.0	
1998	-8.2	3.9	-27.0	-11.5	
1999	8.9	2.4	24.3	24.2	
2000	13.8	13.2	31.8	14.4	
2001	-3.8	7.9	-19.5	1.4	
2002	2.8	16.6	25.9	13.1	-2.0
2003	40.7	8.4	23.9	25.7	40.2
2004	38.0	8.5	9.1	11.7	30.7
2005	15.4	2.8	21.4	10.7	15.0
2006	42.4	0.5	2.1	9.9	39.5
2007	-7.0	11.6	16.2	6.3	23.2
2008	-47.7	-2.4	-35.6	-10.9	-39.0
2009	38.3	11.4	18.9	28.2	25.3
2010	20.4	6.3	16.8	12.1	5.8
2011	-5.8	13.6	-13.3	8.5	-0.4
2012	28.7	7.0	-1.1	18.5	11.9
2013	4.4	-8.6	-9.5	-6.6	15.0
2014	15.9	3.6	-17.0	5.5	13.0
2015	0.1	-1.4	-24.7	1.2	-11.5
2016	5.0	4.7	11.7	10.2	12.4

Correlations (Based on 20-years of data ending December 30, 2016)*

	G Fund	F Fund	C Fund	S Fund	I Fund
G Fund	1				
F Fund	0.18	1			
C Fund	-0.05	-0.05	1		
S Fund	-0.06	-0.06	0.86	1	
I Fund	-0.03	0.01	0.84	0.79	1
MSCI ACWI ex U.S. Small Cap Index	-0.07	0.02	0.74	0.76	0.91
MSCI ACWI ex U.S. IMI	-0.03	0.01	0.84	0.81	0.98
Bloomberg Barclays U.S. High Yield	-0.12	0.17	0.62	0.65	0.65
Russell 1000 Growth Index	-0.06	-0.05	0.95	0.89	0.80
Russell 1000 Value Index	-0.04	-0.05	0.94	0.78	0.81
MSCI Emerging Markets IMI	-0.05	-0.02	0.73	0.75	0.81
FTSE EPRA Global REIT	-0.05	0.18	0.71	0.70	0.79
JPM EMBI Global	0.02	0.33	0.55	0.55	0.57
S&P Global Infrastructure[1]	0.07	0.23	0.78	0.75	0.90
Barclays TIPS Index[2]	0.12	0.76	0.02	0.01	0.10
Bloomberg Commodity	0.09	0.06	0.31	0.34	0.44
MSCI Frontier Markets IMI[3]	-0.18	-0.21	0.56	0.48	0.60
Global Aggregate ex U.S. Index (Unhedged)	0.06	0.52	0.15	0.15	0.38
Global Aggregate ex U.S. Index (Hedged)	0.19	0.77	-0.09	-0.15	-0.10

*For indexes with less than 20 years history, we used the longest common period (see below).

1) S&P Global Infrastructure 12/01

2) Barclays TIPS Index 3/97

3) MSCI Frontier Markets IMI 12/10

APPENDIX

AHIC Capital Market Assumptions as of 1Q – 2017 10 Years

Asset Class	Proxies	Expected Return	Expected Risk
US Large Cap Equity	C Fund	6.4%	17.0%
US Small Cap Equity	S Fund	6.6	23.0
International Equity (Developed)	I Fund	7.1	20.0
Emerging Market Equity		7.7	30.0
U.S. REITs		6.3	18.5
Cash	G Fund	2.2	1.0
Core Fixed Income	F Fund	3.0	4.0
High Yield Bonds		4.3	12.0
Emerging Market Debt		4.5	13.0
Non-U.S. Developed Bonds (Unhedged)		1.6	10.0
Non-U.S. Developed Bonds (Hedged)		2.4	2.5
Commodities		4.8	17.0
TIPS		2.9	4.5

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