

REBALANCING 401(K) CORE MENUS TO MAKE THEM RETIREMENT READY

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Rebalancing 401(k) Core Menus to Make Them Retirement Ready

The role of the core menu in defined contribution (DC) plans has changed considerably over the last decade as default investments, target-date funds in particular, continue to capture participant attention and assets. This evolution requires plan sponsors and consultants to revisit key assumptions about optimal core menu design, especially as plan sponsors increasingly seek to retain retiree assets, which, in turn, necessitates that plans offer attractive solutions for older participants.

This paper uses data from 11,643 401(k) plans to better understand where asset class coverage gaps exist across core menus and quantifies the portfolio implications associated with the gaps. Two key potential improvements are noted.

First, core menus could potentially benefit from a "rebalance" to better accommodate the participants who are most likely to use them. Younger participants are much more likely to use default investments (e.g., target-date funds) while older participants, who tend to invest more conservatively, are much more likely to use the core menu. This is in direct contrast with common core menu design, where there are typically significantly more equity funds than fixed income funds (roughly three to one). The relatively high proportion of equity funds makes it not only difficult to build efficient conservative portfolios, but it may also lead to excess risk taking among participants (i.e., if the participant follows a naïve allocation strategy or chases returns).

Second, core menus are not currently designed to be "retirement ready." Efficient retirement portfolios look different than efficient accumulation portfolios given the more focused objective of generating an income stream, and unfortunately the key building blocks for efficient retirement portfolios are generally missing from DC core menus. The portfolio efficiency costs of these gaps can be staggering, exceeding roughly 100 bps on alpha-equivalent basis. The most notable gaps in asset class coverage include inflation-linked bonds, high yield bonds, commodities, and real estate, although adding other asset classes, such as long-term bonds, may be worth considering.

While some plan sponsors may hesitate to expand core menus given past research on the topic (e.g., research noting negative relationship between core menu size and plan participation¹) it's important to realize that a lot of existing research may be less applicable today, given the fact it took place before the broad adoption of automatic enrollment and prepackaged asset allocation solutions, such as target-date funds. Core menus don't necessarily need to be bigger, though, they just need to be smarter: it is possible to consolidate a few of the riskier (equity) options to make room for retirement-focused strategies.

Creating a truly optimal DC core menu requires a certain degree of art and science that will vary by plan. This research suggests, though, that most core menus today need to be revisited before they can truly be considered optimal for those most likely to use them.

¹ Iyengar, Jiang, and Huberman (2003).

The Changing Role of the Core Menu

The role of the core menu in DC plans has changed considerably over time. As the DC market evolved from a single-pooled portfolio to daily-valued individual accounts, the core menu took center stage. A growing body of research explored the potential impact of the core menu on participant decisions, such as those involving equity allocations and (Bernartzi and Thaler 2001) and even participation decisions (Iyengar, Jiang, and Huberman 2003).

The relevance of this early research on the core menu has likely declined significantly given the notable changes around the participation and investment decisions. For example, automatic enrollment has simplified the enrollment decision, and while prepackaged professionally managed multi-asset portfolios, such as target-date funds, were relatively uncommon (and unpopular) before the Pension Protection Act of 2006, today they are incredibly common. For example, in 2004 only 13% of plans recordkept at Vanguard (2021) offered target-date funds, versus 95% in 2020.

Exhibit 1 provides additional context on this effect, including statistics on the growth of target-date fund availability and usage for DC plans recordkept at Vanguard (2021) since 2010.



Exhibit I: Target-Date Fund Availability and Usage at Vanguard

Source: Vanguard 2021.

The growth in availability and usage of target-date funds is staggering. The growth of target-date funds has important implications for the core menu, since these products effectively transfer investment decision making from the participant to an investment professional (e.g., the target-date fund portfolio manager). While some professionally managed options leverage options offered by the core menu (e.g., retirement managed accounts), the participant is no longer directly driving the allocation decisions.

Utilization of target-date funds and professionally managed investment solutions is not random, and varies among attributes, such as age and income (Blanchett and Bruns 2019). The relation between age and target-date fund acceptance is especially important since age is the variable used to determine the risk level of a participant who is defaulted into a target-date fund (i.e., the respective vintage).

Exhibit 2 provides context as to how utilization of professionally managed investment solutions for 3.6 million participants in DC plans recordkept at Prudential varies by age as of March 31, 2021. The term professionally managed solutions includes target-date funds, as well as other strategies, such as managed accounts.

Age	% of all Participants	% of Total Assets	% Participants in a Professionally Managed Portfolios	% Assets in a Professionally Managed Portfolios	Average Participant Balance in Professionally Managed Solutions	Average Participant Balance Self-Directing
<25	3.51%	0.18%	82.59%	74.66%	\$3,498	\$5,631
25-34	19.43%	4.30%	76.18%	67.17%	\$14,587	\$22,804
35-44	22.33%	14.03%	69.61%	51.83%	\$35,011	\$74,527
45-54	23.34%	28.37%	60.02%	37.16%	\$56,286	\$142,887
55-64	21.32%	36.10%	52.72%	30.18%	\$72,525	\$187,096
>=65	10.07%	17.01%	36.43%	19.07%	\$66,131	\$160,804
All	n/a	n/a	62.16%	34.98%	\$42,093	\$128,531

Exhibit 2: Participant Utilization of Professionally Managed Solutions in 401(k) Plans by Age

Source: Prudential Retirement as of 3/31/21.

Roughly 62% of all participants captured in this data were using a professionally managed portfolio, which is effectively identical to the percentage noted by Vanguard (2020). While most participants may be using professionally managed portfolios, these participants represented only 35% of the assets. This difference can be attributed largely to the fact that participants who use a professionally managed portfolio are typically younger with lower balances. For example, participants younger than 25 had an average balance of \$3,869 and 83% usage of professionally managed portfolio. For additional context, while participants under the age of 45 comprise approximately half of total participants, they control less than 20% of total balances. Even older participants who used professionally managed options tended to have lower balances, on average, as well.

These dynamics are important when thinking about the optimal design of the core menu. For example, while most participants use professionally managed portfolios (when considering all participants), it does not appear that most *older* participants are likely to use a professionally managed portfolio. In other words, older participants clearly have a different set of preferences compared to younger participants with respect to how they invest their balances in a DC plan.

While most of the funds in the core menu are typically equity funds (discussed in future sections), older participants invest in increasingly conservative portfolios. This particular effect is demonstrated in Exhibit 3, which includes the distribution of the equity allocations of participants self-directing their accounts by age, based on research by Blanchett (2020). The equity allocation for the Day One target-date series has been included for reference purposes.





4 Rebalancing 401(k) Core Menus to Make Them Retirement Ready

Overall, the analysis in this section suggests that a core menu built for the entire population of participants might not end up being truly optimal for those who end up actually using it (which is older participants). Therefore, plan sponsors should identify and fill in the gaps in asset class coverage. These topics will be discussed at length in the following sections.

Core Menu Dataset

To better understand plan sponsor decisions regarding core menu structure, we obtained data on 401(k) fund menus from Rightpond Intelligence (RPI) based on 2018 plan year filings. RPI is a provider of business intelligence data and analytics on defined contribution and defined benefit plans for financial services firms owned by Morningstar.

To be included in the test dataset, the DC plan had to meet a number of requirements, which include the plan being coded as a total participant directed 401(k) plan, with at least 10 funds, and with 95% of the plan funds and 95% of the plan fund weighted assets residing in identifiable Morningstar Categories (the classification approach for investment style). A total of 11,643 plans met the required filters.

Exhibit 4 includes information about the total number of 401(k) plans for the five different plan asset sizes considered for the analysis. While it would be possible to break down the plans into more granular levels (i.e., more than five groups) the goal with the plan size groups is to provide general context as to how things like asset class coverage vary by plan size, for which the five groups considered are more than adequate.

Exhibit 4: Number of 401(k) Plans by Total Plan Assets

Plan Size	Number
<\$1m	1,068
\$1m-\$10m	5,781
\$10m-\$100m	4,147
\$100m-\$250m	397
>=\$250m	250
Total	11,643

Source: RPI and Authors' Calculations. Data as of 2018 Plan Year Filings.

One notable gap in the analysis is the availability of larger 401(k) plans. For example, only 250 plans with assets exceeding \$250 million meet the required criteria to be included in the analysis. Larger plans are significantly more likely to use custom investments or collective trusts, and these are much more difficult for RPI to identify and categorize.

One additional limitation of this analysis is that it focuses on core menus from a single plan year (2018). Therefore, the analysis should be viewed as providing context as to the state of core menus at a particular point in time. It is worth noting that core menu sizes have been relatively unchanged over the last decade, especially if you control for target-date funds. This effect is demonstrated in Exhibit 5, which includes data on the average core menu size since 2006 based on research from Brightscope/ ICI (2020).



Exhibit 5: The Evolution of Core Menu Sizes Since 2006 for all 401(k) Plans

Source: Brightscope/ICI (2020). Data as of 2017 Plan Year Filings.

While the average total number of funds in core menus has increased since 2006, this effect is almost entirely due to adding target-date funds to the menu, since a target-date series can have ten (or more) separate funds, which are referred to as vintages. Once the target-date fund vintage effect is controlled for, core menus appear to have changed relatively little from a size perspective since 2006, and effect that is consistent across plan sizes.

Broad Asset Class Core Menu Coverage

This section provides some general perspective about broad asset class coverage for the five plan size asset groups considered. Investment styles are grouped into the following broad asset class groups, again where investment style is based on the fund's respective Morningstar Category:

- Domestic Equity: Large Growth, Large Blend, Large Value, Mid-Cap Growth, Mid-Cap Blend, Mid-Cap Value, Small Growth, Small Blend, Small Value
- *Foreign Equity:* Foreign Large Growth, Foreign Large Blend, Foreign Large Value, Foreign Small/Mid Growth, Foreign Small/Mid Blend, Foreign Small/Mid Growth, Emerging Markets, World Large Stock, World Small/Mid Stock
- Alternative Equity: Bear Market, China Region, Communications, Consumer Cyclical, Consumer Defensive, Diversified Pacific/Asia, Energy Limited Partnership, Equity Energy, Equity Precious Metals, Financial, Health, India Equity, Industrials, Infrastructure, Japan Stock, Latin America Stock, Long-Short Equity, Miscellaneous Region, Natural Resources, Pacific/Asia ex-Japan Stk, Technology, and Utilities
- Cash: Money Market, Stable Value, and Ultrashort bond
- *Domestic Bond:* Short-term Bond, Short Government Bond, Intermediate Core Bond, Intermediate Core-Plus Bond, Intermediate Government, Long-term Bond, Long-term Government, Bank Loan, Corporate Bond, High Yield Bond, Inflation-Protected Bond, Multisector Bond, Nontraditional Bond
- Foreign Bond: Emerging Markets Bond and World Bond
- Alternative: Commodities Broad Basket, Commodities Focused, Real Estate, Global Real Estate
- *Allocation (non-TDF):* Allocation—15% to 30% Equity, Allocation—30% to 50% Equity, Allocation—50% to 70% Equity, Allocation-70% to 85% Equity, Allocation—85%+ Equity, World Allocation
- *Target-Date Fund:* Target-Date 2000-2010, Target-Date 2015, Target-Date 2020, Target-Date 2025, Target-Date 2030, Target-Date 2035, Target-Date 2040, Target-Date 2045, Target-Date 2050, Target-Date 2055, Target-Date 2060, Target-Date Retirement
- Other: any asset class not included in the above classes

Exhibit 6 includes information about the percentage of plans within each plan size group offering at least one fund within the respective broad category. The slope of the relation between the five plan size groups (included as one through five) and the variable of interest is also provided to provide context about how the relation changes by plan size.

As a reminder, while filters were included to capture only 401(k) plans in which a majority of their core menu funds could be identified, there are going to be funds that were not identified (and therefore not captured for this analysis). This is more likely to affect certain broad asset classes than others, such as Cash, given the higher general usage of non-publicly traded funds within the group, in particular Stable Value funds. Therefore, these results should be viewed as being directionally useful, they are not going to perfectly capture the comprehensive set of funds in each 401(k) plan included.

Broad Asset Class	<\$Im	m \$1m-\$10m \$10m-\$100m \$10		\$100m-\$250m	>=\$250m	Slope
Domestic Equity	98.0	99.6	99.6 99.7		99.6	0.3
Foreign Equity	93.3	98.3 99.0		99.0	98.8	1.2
Alternative Equity	17.0	26.8	23.4	17.4	8.8	-2.6
Cash	69.7	76.4	77.1	89.2	91.2	5.6
Domestic Bond	91.2	97.9	99.3	99.0	98.8	1.6
Foreign Bond	23.1	31.3	30.8	23.4	16.8	-2.1
Alternatives	33.1	46.4	46.5	36.0	27.6	-2.1
Allocation (non-TDF)	64.2	70.4	67.7	66.2	60.4	-1.2
Target-Date Fund	91.7	89.6	88.2	91.4	96.8	1.2
Other	2.5	3.5	2.7	2.0	2.8	-0.1

Exhibit 6: % of Plans Offering at Least One Fund in Within a Broad Asset Class Group

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

Certain broad asset class groups are very well represented among 401(k) core menus, in particular domestic equity, foreign equity, domestic bond, and target-date funds. The high availability of target-date funds is not necessarily a surprise given the information in Exhibit 1. Brightscope/ICI (2020) further notes that the percentage of plans offering target-date funds has increased from 32% in 2006 to 82% in 2017.

Exhibit 7 provides context on the average number of funds across broad asset classes available in core menus by plan size groups. Again, the slope is included to provide context about how the relation for each broad asset class group varies by plan size.

Broad Asset Class <\$1m \$1m-\$10m \$10m-\$100m \$100m-\$250m >=\$250m Slope 6.50 8.09 8.36 7.80 0.1 Domestic Equity 7.11 2.71 3.04 2.97 2.66 2.53 -0.1 Foreign Equity Alternative Equity 0.32 0.58 0.49 0.34 0.17 -0.1Cash 0.79 0.87 1.03 1.48 1.66 0.2 Domestic Bond 2.44 3.03 3.00 2.69 2.54 0.0 0.0 Foreign Bond 0.24 0.35 0.34 0.25 0.18 Alternatives 0.39 0.55 0.56 0.41 0.31 0.01.27 Allocation (non-TDF) 1.52 1.29 1.05 0.88 -0.17.94 8.32 11.12 Target-Date Fund 9.02 10.29 0.8 Other 0.03 0.04 0.03 0.03 0.03 0.0Total 22.6 26.4 27.1 27.0 26.5 Total x TDF 14.7 18.1 18.1 16.7 15.4

Exhibit 7: Average Number of Funds Available

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

The largest average number of funds available across broad asset groups is target-date funds, with an average of approximately eight funds for plans with less than \$1 million in assets versus 11 for those with over \$250 million in assets. The high number of target-date funds is not a surprise, since target-date funds typically consist of a number of different vintages to reflect different expected ages of retirement (typically varying in five-year increments), as noted previously.

One of the more notable relationships is how significantly overrepresented equities are compared to fixed income funds. For example, there are roughly 2.7 times as many equity funds available as fixed income offerings. There is also a notable home bias with respect to funds, where domestic equity funds represent approximately 70% of total available equity funds and domestic fixed income funds represent approximately 93% of all available equity funds. Generally, the number of funds available suggests participants who are building more aggressive portfolios are likely to have more funds available, yet there may be gaps for more conservative investors, which is something we explore in the following section.

Exhibit 8 provides some perspective about the average total assets by broad asset class.

Broad Asset Class	<\$1m	\$1m \$1m-\$10m \$10m-\$10		\$100m-\$250m >=\$250m		n Slope	
Domestic Equity	23.1	30.5	35.5	35.2	34.2	2.7	
Foreign Equity	6.3	7.5	7.6	6.8	6.5	0.0	
Alternative Equity	0.6	1.0	0.8	0.8	0.2	-0.1	
Cash	3.6	4.2	5.3	7.7	7.9	1.2	
Domestic Bond	5.5	7.1	7.9	7.4	6.9	0.3	
Foreign Bond	0.4	0.5	0.4	0.2	0.1	-0.1	
Alternatives	0.5	0.7	0.8	0.5	0.3	-0.1	
Allocation (non-TDF)	6.7	7.1	5.8	4.7	4.8	-0.6	
Target-Date Fund	53.1	41.3	35.7	36.7	39.0	-3.3	
Other	0.1	0.1	0.0	0.0	0.1	0.0	
Total	100.0	100.0	100.0	100.0	100.0	_	
Total x TDF	46.9	58.7	64.3	63.3	61.0	_	

Exhibit 8: Average Total Assets by Broad Asset Class

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

Consistent with expectations, target-date funds have most of plan assets, followed by equity funds, in particular domestic equity funds. Target-date funds held approximately 40% of assets across plans, but the percentage of assets in target-date funds declined as the plan size increased. Overall assets in target-date funds have increased considerably, which is notable given that target-date funds captured only 3% of total 401(k) plan assets in 2006 based on data from Vanguard (2021).

Exhibit 9 provides some perspective about the average total assets per average fund by broad asset class. This provides context on how well utilized the average fund is within each broad asset class group.

Exhibit 9: Average Total Assets per Average Number of Funds by Broad Asset Class

Broad Asset Class	<\$1m	\$1m-\$10m	\$10m-\$100m	\$100m-\$250m	>=\$250m	Slope
Domestic Equity	3.6	3.8	4.2	4.5	4.8	0.3
Foreign Equity	2.3	2.5	2.6	2.6	2.6	0.1
Alternative Equity	2.0	1.7	1.7	2.3	1.5	0.0
Cash	4.6	4.8	5.2	5.2	4.8	0.1
Domestic Bond	2.3	2.4	2.6	2.7	2.7	0.1
Foreign Bond	1.7	1.4	1.2	0.8	0.7	-0.3
Alternatives	1.3	1.3	1.4	1.1	1.1	0.0
Allocation (non-TDF)	5.3	4.7	4.5	4.5	5.4	0.0
Target-Date Fund	6.7	5.0	4.0	3.6	3.5	-0.8
Other	4.4	1.6	1.5	0.9	2.3	-0.5
Average	3.4	2.9	2.9	2.8	2.9	_

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

Funds in certain broad asset classes appear to capture more assets than others. For example, cash, allocation (non-TDF) and target-date fund broad asset classes tend to have a relatively high share of assets within a given plan.

Domestic equity tends to have a higher average level of total assets than domestic bond, this is despite the fact there are significantly more domestic equity funds than domestic bond funds. This effect can likely be attributed to the fact 401(k) investors are relatively aggressive (e.g., with an average equity allocation of approximately 75%).

Individual Asset Class Coverage

The previous section provided asset class coverage at the broad asset class level. In this section coverage at the more granular asset class level is reviewed. Asset classes are defined by their Morningstar category.

Exhibit 10 includes fixed income asset class coverage availability, based on the percentage of plans the asset class appears by plan size group. Note, even if a plan has multiple funds in an asset class it would only be included once for each plan.

Asset Class	<\$lm	\$1m-\$10m	\$10m-\$100m	\$100m-\$250m_	>=\$250m	Slope
Money Market	48	54	57	70	80	7.9
Stable Value	26	25	35	65	68	12.3
Ultrashort Bond	1	2	2	2	2	-0.1
Short-Term Bond	24	29	24	19	16	-2.6
Intermediate Core Bond	48	48	57	77	80	9.5
Intermediate Core-Plus Bond	44	58	63	62	66	4.8
Long-Term Bond	0	1	1	1	1	0.1
Short Government	4	6	6	6	4	-0.2
Intermediate Government	22	24	21	14	8	-3.9
Long Government	1	1	2	2	1	0.1
Inflation-Protected Bond	25	29	33	32	34	2.0
Multisector Bond	10	20	19	14	7	-1.2
Corporate Bond	6	7	6	4	6	-0.3
Nontraditional Bond	2	3	3	3	3	0.2
Bank Loan	2	4	3	1	1	-0.5
High Yield Bond	37	41	33	16	15	-6.9
World Bond	14	20	20	12	10	-1.6
World Bond-USD Hedged	7	10	10	11	6	-0.2
Emerging Markets Bond	1	2	2	2	1	-0.1
Emerging-Markets LC	1	1	0	0	0	-0.2

Exhibit 10: Fixed Income Asset Class Coverage Availability (% of All Plans in Plan Size Group)

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

These results are obviously similar to the broad asset class coverage exhibits but provide a more granular perspective. Coverage for the individual bond asset classes increases by plan sizes for most asset classes but at different rates. For example, while plans are more likely to have a money market fund (versus stable value), the rate of including stable value increases faster than the rate of including money market funds as the plan size increases. Larger 401(k) plans are much more likely to offer intermediate core bonds, but less likely to offer high yield bonds or intermediate term bonds.

There is relatively little availability of long bond funds (either core or government) in 401(k) plans. While this isn't entirely a surprise given relatively low bond yields, the incredibly low availability (roughly 1%) is a bit a shock given the notable literature on the important role long bonds can play as part of a retirement strategy. While long bonds maybe risky when viewed from an asset-only perspective, when viewed in the context of funding a retirement liability (or potentially purchasing an annuity) they can become significantly more efficient (Idzorek and Blanchett 2019).

Lack of short bond funds is not surprising given common bond maturity restrictions for plans offering stable value.

Exhibit 11 includes equity asset class coverage availability, based on the percentage of plans the asset class appears by plan size group.

Exhibit II: Equity Asset Class Coverage

Asset Class	<\$1m	\$10m-\$10m \$10m-\$100m		\$100m-\$250m	>=\$250m	Slope
Large Growth	82	90	92	92	89	1.5
Large Blend	89	95	98	100	98	2.3
Large Value	65	79	82	87	85	4.7
Mid-Cap Growth	39	59	63	58	49	1.9
Mid-Cap Blend	53	64	71	77	76	5.9
Mid-Cap Value	29	52	56	45	37	0.8
Small Growth	49	58	62	60	58	1.8
Small Blend	57	67	69	66	63	1.1
Small Value	44	53	56	53	39	-1.1
Foreign Large Growth	43	57	65	68	70	6.5
Foreign Large Blend	59	62	66	76	73	4.1
Foreign Large Value	15	18	19	22	25	2.5
Foreign Small/Mid Growth	6	6	7	6	7	0.2
Foreign Small/Mid Blend	3	4	5	3	4	0.1
Foreign Small/Mid Value	3	4	3	3	3	0.0
Diversified Emerging Mkts	55	60	56	41	34	-6.1
World Large Stock	32	37	29	14	12	-6.2
World Small/Mid Stock	16	12	8	3	3	-3.5
Commodities Broad Basket	3	4	5	4	3	-0.2
Real Estate	28	40	40	29	22	-2.3
Global Real Estate	6	9	7	7	6	-0.2

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

While the changes in fixed income asset class coverage were relatively significant by plan size, the changes in equity coverage by plan size is more muted. Overall, asset class coverage does tend to increase for most equity asset classes by plan size, though. When looking at groups of funds, coverage for domestic large cap is clearly the highest, followed by foreign large cap, while domestic mid cap and domestic small cap are roughly tied.

There is relatively little coverage of the more alternative-type asset classes, such as commodities and real estate (both domestic and global). Domestic real estate has the widest availability among the three considered.

Exhibit 12 includes allocation asset class coverage availability, based on the percentage of plans in which the asset class appears by plan size group.

Exhibit 12: Allocation Asset Class Coverage

Asset Class	<\$1m	\$1m-\$10m	\$10m-\$100m	\$100m-\$250m	>=\$250m	Slope
Allocation—15% to 30% Equity	4	6	4	3	2	-0.7
Allocation—30% to 50% Equity	15	23	21	21	18	0.3
Allocation—50% to 70% Equity	49	53	52	52	46	-0.7
Allocation-70% to 85% Equity	21	22	15	8	6	-4.4
Allocation—85%+ Equity	3	4	3	1	1	-0.7
World Allocation	17	20	14	7	6	-3.6
Target-Date 2000-2010	22	27	31	26	27	0.9
Target-Date 2015	39	52	63	78	88	12.5
Target-Date 2020	72	79	83	89	95	5.6
Target-Date 2025	76	77	80	86	92	4.2
Target-Date 2030	81	83	84	90	95	3.5
Target-Date 2035	78	79	80	86	92	3.5
Target-Date 2040	82	83	84	89	95	3.2
Target-Date 2045	79	78	80	86	92	3.3
Target-Date 2050	81	81	83	89	95	3.7
Target-Date 2055	75	73	77	84	90	4.2
Target-Date 2060+	54	55	66	81	92	10.1
Target-Date Retirement	32	40	51	67	72	10.6

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

While the availability of static allocation portfolios (e.g., a portfolio targeting 50% equity and 50% fixed income) tend to decline for larger plans, there is a clear increase in the availability of target-date funds, especially for the vintages for younger investors (e.g., the 2055 vintage). Among the static options, balanced portfolios, with approximately a 60% equity and 40% fixed income exposure, tend to be the most common.

The Economic Cost of Coverage Gaps

The previous analysis suggests that coverage of asset classes is likely to vary significantly by plan. In theory, a plan with more asset class coverage allows for participants (and their financial advisors) to potentially develop more efficient portfolios; however, it's not clear what the potential economic costs of lower availability (i.e., coverage) would be. In this section we attempt to quantify that gap.

For this analysis, four different sets of "corner" efficient portfolios are constructed given the available asset classes in the plan. The portfolios are focused entirely on the general asset class exposures, which is defined by Morningstar category, not the actual underlying quality or respective betas of the underlying funds.

The four corner portfolios constructed are designed to span the risk and lifecycle spectrum: a safe accumulation portfolio, a risky accumulation portfolio, a safe retirement portfolio, and a risky retirement portfolio. The accumulation portfolios are effectively those with the highest return per unit of risk (i.e., are optimized in an asset-only space). The retirement portfolios are optimized by factoring in the retirement liability (i.e., a form of surplus optimization.)

Two different sets of portfolios are created to reflect the fact that the definition of risk changes when it comes to investing across the lifecycle. Younger investors should be primarily concerned with accumulating wealth. As an individual ages, the portfolio starts to focus more on generating income during retirement. This creates a different perspective on risk, since the goal of the portfolio is no longer to just maximize return, but rather maximize the probability that the investor will be able achieve a target consumption level in retirement.

Unlike past research that assumes the liability is a more traditional investment asset class (e.g., TIPS) or something like inflation, we develop a model to estimate how the actual cost of income has evolved historically and build risk metrics based off of that to determine the efficient retirement portfolios.

Using historical mortality tables from the Social Security Administration², historical bond Treasury yields from the Federal Reserve³, and historical implied inflation estimates from Cleveland Federal Reserve⁴ we estimate⁵ the respective cost of retirement income on a monthly basis since January 1982. This model does a relatively good job tracking actual nominal historical annuity payouts available from CANNEX over the period. The historical cost of \$1 of real income is included in Exhibit 13.

Exhibit 13: The Historical Cost of \$1 of Real Income



Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

The underlying risk and correlation associated with the real income liability are based on the average change in the monthly values for males and females.

² https://www.ssa.gov/oact/NOTES/as120/LifeTables_Body.html

³ https://www.federalreserve.gov/releases/h15/data.htm

⁴ https://www.clevelandfed.org/en/our-research/indicators-and-data/inflation-expectations.aspx

⁵ For informational purposes only. There can be no assurance that these forecasts will be achieved.

The opportunity set for the assumed safe (i.e., fixed income) and risky (i.e., equity) portfolios, along with the underlying capital market assumptions, are included in Exhibit 14. We intentionally use a reduced opportunity set (e.g., exclude Growth and Value dimensions) in our analysis to limit overly precise estimates from our optimizations. The base capital market assumptions for the respective asset classes are based primarily on PGIM Quantitative Solutions 2021 Capital Market Assumptions (CMAs)⁶ but are supplemented with additional information if necessary. Returns are assumed to follow a multivariate normal distribution.

Exhibit 14: Capital Market Assumptions

Fixed Income CMAs	Correlations												
Asset Class	Ret	Vol	1	2	3	4	5	6	7	8	9	10	11
Real Income	2.30	5.00	1.00	0.12	0.57	0.68	0.75	0.42	0.69	0.70	0.80	0.10	0.20
Money Market	0.46	0.44	0.12	1.00	0.63	0.41	0.17	0.43	0.33	0.14	0.06	-0.02	0.08
Short Government	0.78	1.81	0.57	0.63	1.00	0.93	0.66	0.70	0.85	0.54	0.49	0.04	0.41
Intermediate Government	1.94	4.56	0.68	0.41	0.93	1.00	0.85	0.65	0.94	0.68	0.64	0.04	0.46
Long Government	1.88	11.33	0.75	0.17	0.66	0.85	1.00	0.45	0.88	0.77	0.61	0.03	0.34
Short-Term Bond	1.08	2.84	0.42	0.43	0.70	0.65	0.45	1.00	0.75	0.73	0.59	0.53	0.44
Intermediate Core Bond	2.54	5.64	0.69	0.33	0.85	0.94	0.88	0.75	1.00	0.86	0.77	0.29	0.50
Long-Term Bond	2.66	10.11	0.70	0.14	0.54	0.68	0.77	0.73	0.86	1.00	0.68	0.52	0.46
Inflation-Protected Bond	2.18	5.53	0.80	0.06	0.49	0.64	0.61	0.59	0.77	0.68	1.00	0.29	0.54
High Yield Bond	3.82	8.53	0.10	-0.02	0.04	0.04	0.03	0.53	0.29	0.52	0.29	1.00	0.20
World Bond	1.55	5.44	0.20	0.08	0.41	0.46	0.34	0.44	0.50	0.46	0.54	0.20	1.00

Equity CMAs	Correlations										
Asset Class	Ret	Vol	1	2	3	4	5	6	7	8	9
Real Income	2.30	5.00	1.00	0.15	0.07	0.03	-0.05	-0.06	-0.13	0.10	0.30
Large Cap	6.97	15.14	0.15	1.00	0.96	0.86	0.69	0.68	0.82	0.35	0.69
Mid Cap	7.52	17.01	0.07	0.96	1.00	0.94	0.68	0.70	0.85	0.40	0.73
Small Cap	8.26	19.67	0.03	0.86	0.94	1.00	0.62	0.66	0.79	0.35	0.66
Foreign Large	8.39	16.04	-0.05	0.69	0.68	0.62	1.00	0.71	0.94	0.45	0.78
Emerging Markets	9.60	23.63	-0.06	0.68	0.70	0.66	0.71	1.00	0.85	0.45	0.70
Foreign Small	8.89	20.57	-0.13	0.82	0.85	0.79	0.94	0.85	1.00	0.55	0.81
Commodities	2.38	14.55	0.10	0.35	0.40	0.35	0.45	0.45	0.55	1.00	0.41
Real Estate	7.54	17.42	0.30	0.69	0.73	0.66	0.78	0.70	0.81	0.41	1.00

Source: Morningstar, PGIM Quantitative Solutions, and Authors' Calculations. Data as of June 30, 2021.

Optimal portfolios are determined using a resampled optimization approach where the goal is to maximize the certainty equivalent utility for some potential weights to the respective opportunity set based on a constant relative-risk aversion (CRRA) utility function. For those readers not familiar with utility functions, they are commonly used to quantify outcomes and preferences. A key component of utility (in particular, CRRA) is the concept of diminishing marginal utility, which means the first unit of consumption of a good or service yields more utility than the second and subsequent units. The level of risk aversion (Y) describes the "penalty" associated with a bad outcome; higher levels of risk aversion increasingly penalize bad incomes (i.e., negative returns).

A utility approach is used since it allows for a more precise calibration of risk aversion with respective to "bad" outcomes versus compared to other metrics (e.g., standard deviation). Additionally, it easily allows for comparing the risk-adjusted differences in the respective portfolios by comparing the certainty equivalent wealth values within each simulation. The certainty equivalent wealth is effectively the utility-adjusted wealth from the respective portfolio and provides a relatively straightforward metric to quantify the differences in the efficiency of different portfolios via an alpha-equivalent metric.

The "optimal" allocations for each of the four corner portfolios are defined based on the average weights to the opportunity set across the 10 separate (resampled) optimizations, each consisting of 100 years. A series of 10 resampled optimizations are performed, versus a single optimization, to reduce estimation error.

⁶ https://www.pgimquantitativesolutions.com/outlook/2021-q2-capital-market-assumptions

Exhibit 15 includes the optimal allocations for the four corner portfolios, along with insights as to the differences between the respective retirement and accumulation portfolios.

Exhibit 15: Corner Portfolio Allocations

Panel A					Panel B	Panel B	Panel B
Asset Class	Accum	Retire	Diff		Asset Class	Asset Class Accum	Asset Class Accum Retire
Money Market	32.80%	1.60%	-31.20%		Large Cap	Large Cap 2.00%	Large Cap 2.00% 22.00%
Short Govt	0.00%	0.00%	0.00%		Mid Cap	Mid Cap 0.00%	Mid Cap 0.00% 0.00%
Intermediate Govt	27.60%	35.20%	7.60%		Small Cap	Small Cap 12.30%	Small Cap 12.30% 1.20%
Long Govt	0.00%	8.20%	8.20%		Equation Lance	Ecretary Large (2.00%)	Equation Large (2.000/ 3/4.200/
Short Bond	0.00%	0.00%	0.00%		Foreign Large	Foreign Large 45.90%	Foreign Large 45.90% 54.30%
Intermediate Bond	4.00%	1.70%	-2.30%		Foreign Small	Foreign Small 0.00%	Foreign Small 0.00% 0.00%
Long Bond	0.00%	0.00%	0.00%		Emerging Markets	Emerging Markets 12.20%	Emerging Markets 12.20% 0.60%
Inflation-Linked Bond	3.30%	33.10%	29.80%		Commodities	Commodities 0.00%	Commodities 0.00% 10.70%
High Yield	30.40%	20.20%	-10.20%		Real Estate	Real Estate 29.60%	Real Estate 29.60% 31.20%
World Bond	2.00%	0.00%	-2.00%		Real Estate		Real Estate 27.00 /0 51.20 /0
Total	100.00%	100.00%	_	,	Total	Total 100.00%	Total 100.00% 100.00%

Source: Authors' Calculations. Data as of June 30, 2021.

There are significant differences in the efficient portfolios depending on whether the portfolio is built for someone in accumulation versus retirement even when using the same asset class opportunity set. For example, the safe retirement portfolios have significantly longer duration, higher allocations to inflation-linked bonds, and lower high yield and world bond exposures than the safe accumulation portfolios. While long bonds are often described as the optimal retiree asset, they are relatively unattractive based on the CMAs used for the optimizations, despite their attractive hedging aspects for liability portfolio. This suggests that there are likely tactical (or at least dynamic) considerations that should be addressed when determining an efficient retirement income portfolio.

The risky retirement portfolios have higher large cap US equity exposure, commodities, and real estate exposures and a lower US small cap equity exposure, foreign large equity, and emerging market equities.

For each core menu, we determine whether a fund is available that covers the respective asset class that is included in the opportunity set. For example, a plan with either Small Growth, Small Blend, and Small Value would be assumed to have a Small Cap equity fund. Appendix 1 provides some perspective about the coverage levels by fund.

It is assumed, at a minimum, that all plans have at least a Money Market, Intermediate Bond, and Large Cap fund for our analysis. In reality, most plans also typically have a Mid Cap, Small Cap, and Foreign Large, although these asset classes do differ slightly by plan.

For each plan we perform ten sets of resampled optimizations based on the asset classes available in that plan. The average asset classes' weights based on that plan's menu are compared to the average asset class weights for the full opportunity set (i.e., assuming all asset classes are available). Differences in the efficiency of the portfolios is determined using a certainty-equivalent wealth metric.

For readers not familiar with certainty-equivalence, it provides context as the guaranteed return (i.e., alpha) someone would take versus uncertain return. By subtracting the ending certainty-equivalent wealth for the optimal portfolios built using the plan line-up from the certainty-equivalent wealth for the portfolio using the entire opportunity, set it becomes possible to estimate the "alpha-equivalent cost" associated with not having access to the complete set of asset classes.

These alpha-equivalent values are explored more fully in the following section.

Alpha-Equivalent Metrics

When building a portfolio, there is a cost of "simplification" in that it may not be possible to build a truly efficient portfolio, depending on asset classes that are not available. This investor could be a participant (e.g., with the help of a financial advisor) or a retirement managed accounts provider who builds portfolios based on the core menu.

For each plan menu, and the respective optimal portfolios, we have an alpha-equivalent metric that can be used to compare the relative efficiency of the portfolios (i.e., the certainty equivalent wealth). This is the metric we focus on since it is risk-adjusted (i.e., it incorporates both return and risk into the calculation, versus focusing on either dimension individually). However, it is also worth providing context around the excess returns and excess risk (i.e., standard deviation) of the different potential core menu combinations for the four corner portfolios. The excess return is the return of the optimal portfolio determined using the entire opportunity set minus the return of the plan-level optimal portfolio (higher is better) while the excess risk is the standard deviation of the optimal portfolio determined using the entire opportunity set minus the standard deviation of the plan-level optimal portfolio (lower is better)

Exhibit 16 includes these values for each of the four corner portfolios for each of the plan asset class combinations considered.



Exhibit 16: Distribution of Excess Returns and Excess Standard Deviations for Different Possible Core Menus

Source: Authors' Calculations. Data as of June 30, 2021.

There are no plan-level portfolios with higher returns and lower risk compared to the entire opportunity set (i.e., positive excess risk and negative excess return); however, there are combinations of portfolios that have higher returns and higher risk and some with lower returns and lower risk, for example. Only those portfolios with lower returns and higher risk could be less efficient; the other portfolios require some type of risk-adjustment to normalize the respective risk and returns levels.

When comparing the different excess plots in Exhibit 16, it is clear that the retirement portfolios (Panels B and D) are more disperse than the accumulation portfolios (Panels A and C), and the risky portfolios (Panels C and D) and more disperse than the retirement portfolios (Panels A and B). However, the fact the risky portfolios have more disperse excess risk levels shouldn't necessarily be a surprise, since they have higher standard deviations by definition.

Next, we focus on the certainty-equivalent alpha differences, since this metric more explicitly controls for excess return and excess risk (i.e., it effectively weights the dimensions accordingly). Exhibit 17 provides context around the distribution of the alpha-equivalent values across all plans included in the analysis for the four corner portfolios.



Exhibit 17: Distribution of Alpha-Equivalent Costs Across All Plans

Source: Authors' Calculations. Data as of June 30, 2021.

The portfolio efficiency costs for not having certain asset classes can be relatively significant, exceeding 100 bps for certain plans, a level which is relatively staggering.

The alpha-equivalent costs for the retirement portfolios are generally higher than the accumulation portfolios. This can largely be attributed to the unique nature of the retirement liability and the assets required to build efficient retirement portfolios, which are missing to a much higher degree than the asset classes required to build efficient accumulation portfolios. In other words, the portfolio efficiency gaps for accumulation investors appear to the relatively small, in contrast the portfolio efficiency gaps for retirement-focused investors appear to the be relatively significant.

Exhibit 18 provides context on how the average (Panel A) and median (Panel B) alpha-equivalent costs differ by plan size.

Exhibit 18: Alpha-Equivalent Cost of Lack of Diversification by Plan Size (i	in bps	3)
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Average					Median				
Plan Size	Safe/Accum	Safe/Retire	Risky/Accum	Risky/Retire	Plan Size	Safe/Accum	Safe/Retire	Risky/Accum	Risky/
<\$1m	0.31	0.92	0.38	1.88	<\$1m	0.43	1.13	0.40	2.
\$1m-\$10m	0.29	0.88	0.25	1.46	\$1m-\$10m	0.42	1.12	0.40	2.
\$10m-\$100m	0.32	0.88	0.24	1.46	\$10m-\$100m	0.43	1.12	0.40	2.
\$100m-\$250m	0.39	0.93	0.28	1.72	\$100m-\$250m	0.45	1.22	0.40	2.
>=\$250m	0.40	0.94	0.31	1.93	>=\$250m	0.45	1.22	0.40	2.
Average	0.34	0.91	0.29	1.69	Average	0.43	1.15	0.40	2.
Slope	0.029	0.008	-0.012	0.035	Slope	0.005	0.027	0.000	0.0

Source: Authors' Calculations. Data as of June 30, 2021.

The results in Exhibit 18 suggest the alpha-equivalent costs do not vary significantly by plan size. While the slopes are generally positive, suggesting the economic costs are higher for larger plans, the slopes aren't necessarily all that economically significant. In other words, the analysis suggests the gaps prevalent in core menus are not isolated to just smaller or larger plans, rather it is relatively common through 401(k) plans today.

Finally, Exhibit 19 provides some context around the average alpha-equivalent cost when a given asset is missing for each of the four corner portfolios. This provides additional context on the relative impact of not having a given asset class available.

Exhibit 19: Averages Alpha-Equivalent Cost When an Asset Class is Missing

Panel A			Panel B				
	ļ	Ipha-Equivalent Cost			Alpha-Equivalent Cos		
Asset Class	Accumulation	Retirement	Diff	Asset Class	Accumulation	Retirement	
Short Government	0.00	0.00	0.00	Mid-Cap Blend	0.01	0.01	
Intermediate Government	0.04	0.33	0.29	Small Blend	0.00	0.00	
Long Government	0.00	0.15	0.15	Foreign Large Blend	0.86	1.04	
Short-Term Bond	0.01	0.00	-0.01	Diversified Emersing Mirts	0.07	0.07	
Long-Term Bond	0.00	0.02	0.02		0.07	-0.07	
Inflation-Protected Bond	0.01	0.56	0.55	World Small/Mid Stock	0.06	-0.11	
High Yield Bond	0.40	0.19	-0.20	Commodities Broad Basket	-0.03	0.68	
World Bond	0.01	0.00	-0.01	Real Estate	0.55	2.64	

Source: Authors' Calculations. Data as of June 30, 2021.

The economic costs associated with "gaps" in asset class coverage varies considerably by asset class and is notably different across accumulation and retirement portfolios. For example, when focusing on the safe portfolios, there is relatively little "cost" associated with not including short or long bonds. While there is a notable cost of not having Intermediate Government and Inflation-Protected Bond in the retirement portfolios, the cost is relatively small in accumulation portfolios. High yield bond was relatively important for both sets of portfolios. The most notable gaps in these results in current line-ups is high yield bond (only in 36% of plans) and inflation protected bonds (only in 30% of plans).

From a risky portfolio perspective, having Commodities and Real Estate is clearly significantly more important in the Retirement portfolios than in the Accumulation portfolios (although Real Estate was important for both). These asset classes are perhaps most notable since they are the biggest gaps that currently exist in 401(k) plan line-ups, with only around 4% and 40% offering these asset classes, respectively. While Foreign Large Cap was clearly important, over 90% of plan sponsors offer some kind of Foreign Large Cap; therefore, the asset class exposure is relatively well represented.

Among the four asset classes that were both important from an alpha-equivalent cost perspective and had notable gaps (Inflation-Protected Bond, High Yield Bond, Commodities Broad Basket, and Real Estate) three are commonly included in "Real Asset" strategies. Therefore, a plan sponsor could theoretically add a single (multi-asset) fund to capture a good share of the benefits associated with the exposures versus individual funds for each asset class. A problem with a single fund is that it would not necessarily allow the participant to finely calibrate the risk exposure but it would obviously be easier than adding multiple funds.

Conclusions

There is an increasing emphasis among plan sponsors to keep participants in the DC plan post-retirement. There are a number of potential benefits associated with staying in-plan, such as fiduciary oversight, economies of scale, access to institutionally priced investments, etc. that can make the decision a smart one for participants. However, for a participant to want to stay in a DC plan (versus roll-out) the plan itself must be "retirement ready." A retirement ready DC plan needs to have a variety of features, one of which is access to a robust set of funds that enable participants to build diversified portfolios from the core menu who choose to do so.

This research suggests that while many DC plans offer a relatively diverse set of asset class exposures there are notable gaps, given the overweight of equity funds versus bond funds and the lack of availability of asset classes essential to building efficient retirement portfolios, such as inflation-linked bonds, high yield bonds, commodities, and real estate, as well as potentially long-term bonds. Three of these asset classes are typically used in "Real Asset" strategies, so adding a single multi-asset fund could be an approach, although this won't necessarily allow a participant to more finely calibrate risk levels, especially if a participant is looking for specific risk exposures within the DC plan (i.e., given non-DC holdings).

While some plan sponsors may be hesitant to add more funds to the menu, reducing existing overlap and focusing on breadth of coverage, versus depth, may be a smart strategy. For example, using a single fund to represent large cap and adding a real estate and an inflation-protected bond fund could potentially enable participants more diversification than having each of the nine common "style box" asset classes covered.

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Appendices

Appendix I: Asset Class Coverage by Plan Size for Analysis

Asset Class	<\$1m	\$1m-\$10m	\$10m-\$100m	\$100m-\$250m	>=\$250m	Slope
Money Market	70	76	77	89	92	5.6
Short Govt	4	6	6	6	4	-0.2
Intermediate Govt	22	24	21	14	8	-3.9
Long Govt	1	1	2	2	1	0.1
Short Bond	23	29	24	19	16	-2.4
Intermediate Bond	81	92	96	96	97	3.6
Long Bond	0	1	1	1	1	0.1
Inflation-Linked Bond	25	29	33	32	34	2.0
High Yield	38	41	33	16	15	-7.0
World Bond	23	31	31	23	17	-2.1
Large Cap	98	100	100	100	100	0.4
Mid Cap	71	87	93	92	92	4.7
Small Cap	74	88	94	95	93	4.5
Foreign Large	90	97	98	98	99	2.0
Emerging Markets	56	60	56	42	35	-6.1
Foreign Small	26	23	21	14	16	-3.1
Commodities	10	16	13	7	2	-2.5
Real Estate	33	46	46	35	27	-2.2

Source: Morningstar, RPI, and Authors' Calculations. Data as of 2018 Plan Year Filings.

All mentions of defined contribution (DC) plans and DC plan participants refer to qualified US retirement plans and account holders in US defined contribution plans, respectively. Target date funds (TDFs) are predominantly a US investment vehicle and are not readily available outside of the United States. PGIM Quantitative Solutions does not establish or operate Pension plans.

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