

PRESSING ISSUES IN DEFINED BENEFIT PENSIONS

1. Definition and Current Situation

A pension plan is a retirement plan that requires an employer to make contributions into a pool of funds set aside for a worker's future benefit. The pool of funds is invested on the employee's behalf, and the earnings on the investments generate income to the worker upon retirement.¹ Most of these plans are tax exempted within certain restrictions in the tax codes, such as age, income level and other personal and financial considerations.

The issue of the state of retirement and pension funds is beginning to be widely acknowledged by federal and local governments, companies and the society in general, especially in the developed world. The roots of the issue dates back decades ago but we can safely say that fixes to the health of these retirement systems rely mostly in the willingness of governments, private employers, employees and the self-employed to sacrifice more present consumption for future one. However, beyond this realization we still encounter other larger, and even more profound structural economic, financial and demographical imbalances that can imperil any structural reformed aimed at achieving a higher savings rate.

Governments have implemented different retirement systems based on their society's needs, economic growth and prosperity, savings rate propensity, per capital income, poverty level and income inequality, demographical dynamics and other idiosyncratic cultural factors. The main types include private or public defined contributions plans, defined benefit plans, unfunded pension systems², sovereign wealth funds and individual retirement accounts (as in the case of the US).

Therefore in the design of any retirement plan, whether it be for an individual, employer or government entity or industry union, it is paramount to have a all-encompassing and realistic view of the internal and foreign economic environment in order to make sound assumptions that can withstand the test of markets, social and political changes, or at the very least be corrected with minimal short term financial implication to the beneficiaries or the solvency of the fund.

2. Pension Plans

Defined benefit plans (DB) have been in use for decades in the US and other countries as the preferred retirement system used by federal and local governments, unions, large and medium companies and institutions and private individuals. Large asset manager, funds and insurance companies manage about \$19Trillion dollars (or 52% of global pension assets in 2016) in DB retirement funds in the 22 major countries amounting to 62% of their GDP, with the US taking the highest percentage. Seven of these largest markets (Australia, Canada, Japan, Netherlands, Switzerland, UK and US), DCs take the highest share of assets in Japan at 96% and Australia the lowest at 13%. However, DC assets have grown at 2.6% annualized compounded return (CAGR) whereas defined contribution plans (DC) have been clipping a 5.6% CAGR.³

¹ Investopedia.com

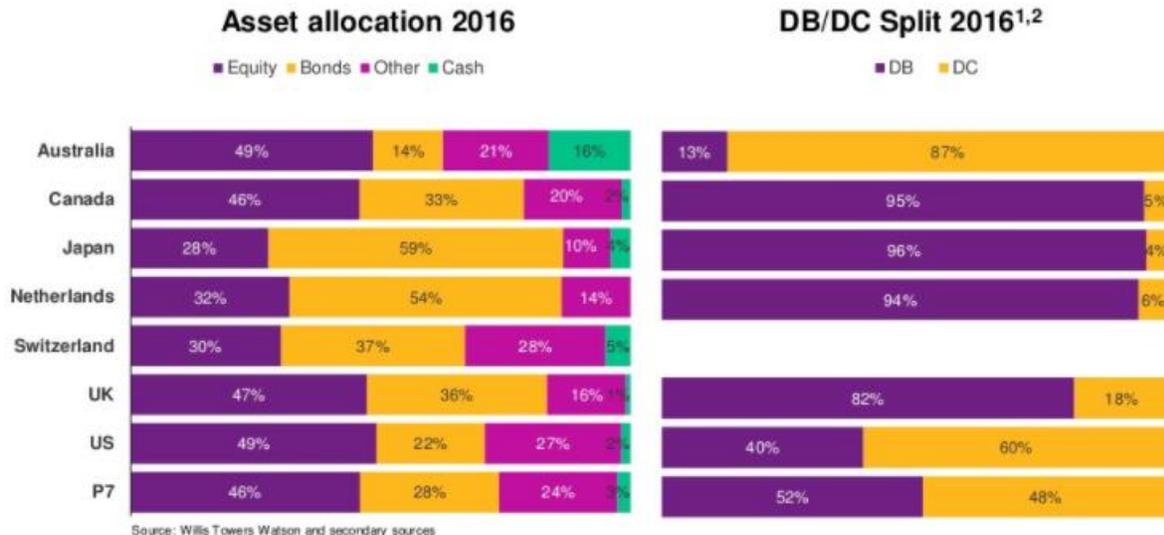
² Certain employers (including state governments) elect to fund the pension plan out of current earnings. This is a pay-as-you-go pension plan, and the future of such plans can often be put in danger by unexpected events.

³ Global Pension Assets Study 2017, by Willis Towers Watson as of January 2017.

August 31, 2017

Global Pension Assets Study 2017

Key findings – Figures



Source: Willis Towers Watson and secondary sources

¹ DC assets in Switzerland are cash balance plans where the plan sponsor shares the investment risk and all assets are pooled. There are no pure DC assets where members make an investment choice and receive market returns on their funds. Therefore, Switzerland is excluded from this analysis.

² In January 2017, the UK's Office for National Statistics stated that the figures previously disclosed for DC entitlements were significantly overestimated. As a result there is a significant decrease in UK DC pension assets this year when compared to the previous editions of this study. This change has a very limited impact on the P7 DC assets, in the order of a one percent reduction.

Source: Willis Towers Watson

Defined benefit plans achieved popularity and government support for over five decades. However, their growth and popularity have waned in the past decade, especially in the wake of the financial crisis as new economic growth patterns began to emerge as a long term forces.

Factors such as sluggish and persistent economic growth, low real yields, high deficits, low savings rate, low wage pressures, lower labor productivity, low inflation, technological disruption, trade globalization trends, higher life expectancy, and lower active labor force ratio are among the forces disrupting the assumptions set out some two decades ago and have been reluctant, resistant and slow to change.

From federal and local governments, large multinational companies and plan administrators (including asset management institutions and insurance companies) across the globe in charge of managing retirement pensions are becoming strained in keeping their funds solvent for their present and future pensioners and their beneficiaries in the distant and, in some cases, immediate future.

In order to better understand the long term effects of poor retirement planning, we designed a simple retirement fund for two sets of individuals with different savings patterns, financial markets, economic environments and demographics (Figure 1).

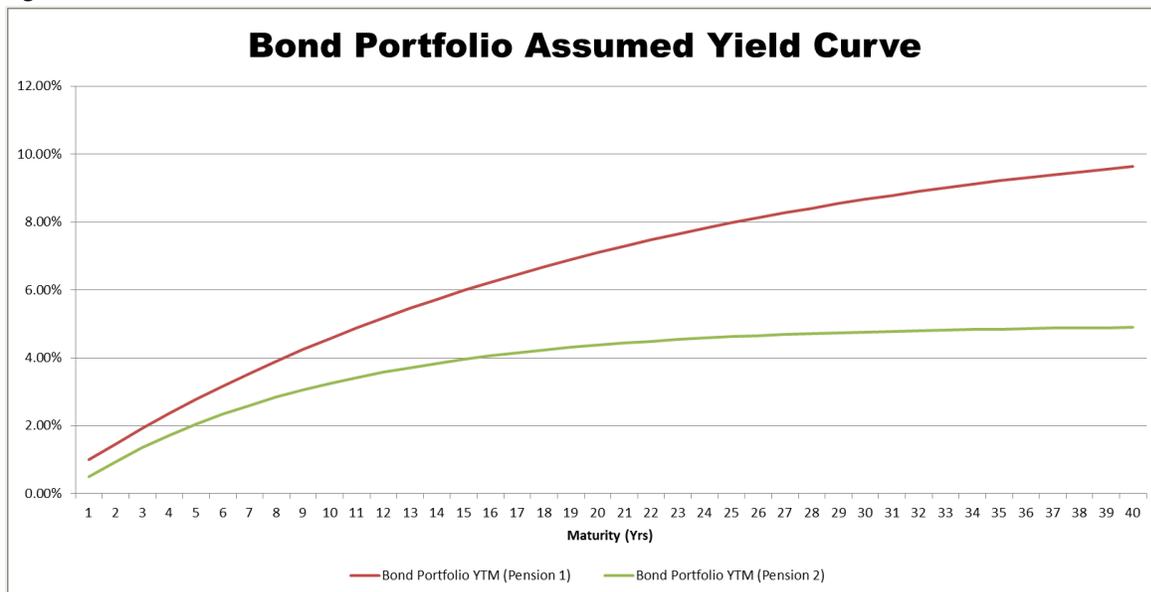
In the Pension 1, the fund is fully funded with a set of assumptions which could be thought as the economic and financial market environment existing before the financial crisis. In Pension 2, our assumptions have changed in terms of these factors, including a lower savings rate.

As such, one of the main factors affecting the outcome of the retirement system is the lower savings rate (reduced by half from around 25% to 12%) and a lower accumulation portfolio annualized return as well as the subsequent retirement bond portfolio yields. Other changes include a younger retirement age and an older mortality age.

Figure 1

	PENSION 1	PENSION 2
Required_Income	\$ 100,000	\$ 100,000
Annual_Inflation	2.00%	2.00%
Contribution_Age	40	40
Retirement_Age	65	60
Mortality_Age	85	90
Tax_rate	20%	20%
Annual_Inflation_rate	2.00%	2.00%
Annual_Contribution	\$ 2,000	\$ 1,000
Portfolio_Return	7.12%	4.00%
Bond_Portfolio_Avg_Coupon	3.70%	2.82%
Bond_Portfolio_YTM	4.38%	3.48%
Portfolio_Duration	7.53	10.74
Retirement_Portfolio	\$ 1,553,412	\$ 358,348
Benefit_Payments (adj)	\$ 115,768	\$ 19,042
Liabilities_InflAdj	\$ (1,553,412)	\$ (2,371,597)
Future_Funding_Gap	\$ 0	\$ (2,013,249)
Assets	\$ 278,270	\$ 163,545
Liabilities	\$ (278,270)	\$ (1,082,366)
Funding_Gap	\$ 0	\$ (918,821)

Figure 2



As we could see in Figure 1 and 3, the funding gap and cash flow deficit in the retirement stage is significant. In the case of defined benefit plans including pensions, this deficit is ultimately borne by the sponsor, issuer or guarantor of the plan.

If they are companies, this off balance sheet liability can bring serious solvency issues, which can ultimately default on their pension obligation to their beneficiaries and forcing it to file for legal restructuring (Chapter 11 in the US), as we have learned recently from the Avaya Inc. chapter 11 case.

In the case of local governments, this situation can ultimately force large increases in local taxes, a surge in the municipal deficit with the deterioration in the local government credit ratings, a significant increase in borrowing and its associated financial cost. Eventually, this situation could force, in the long term, to

substantial increases in the active employees' contributions decreasing savings and consumption, or in the worst case large and painful cuts to retirees' pension benefits, as was the case with the city Detroit in 2014 and many other municipalities in the US currently facing major pension shortfalls. In the extreme case we are presenting, the required annualized benefit payment cuts can be extreme (Figure 4). But as mentioned above, this is not far from the fate suffered by the Detroit pensioners.

Figure 3

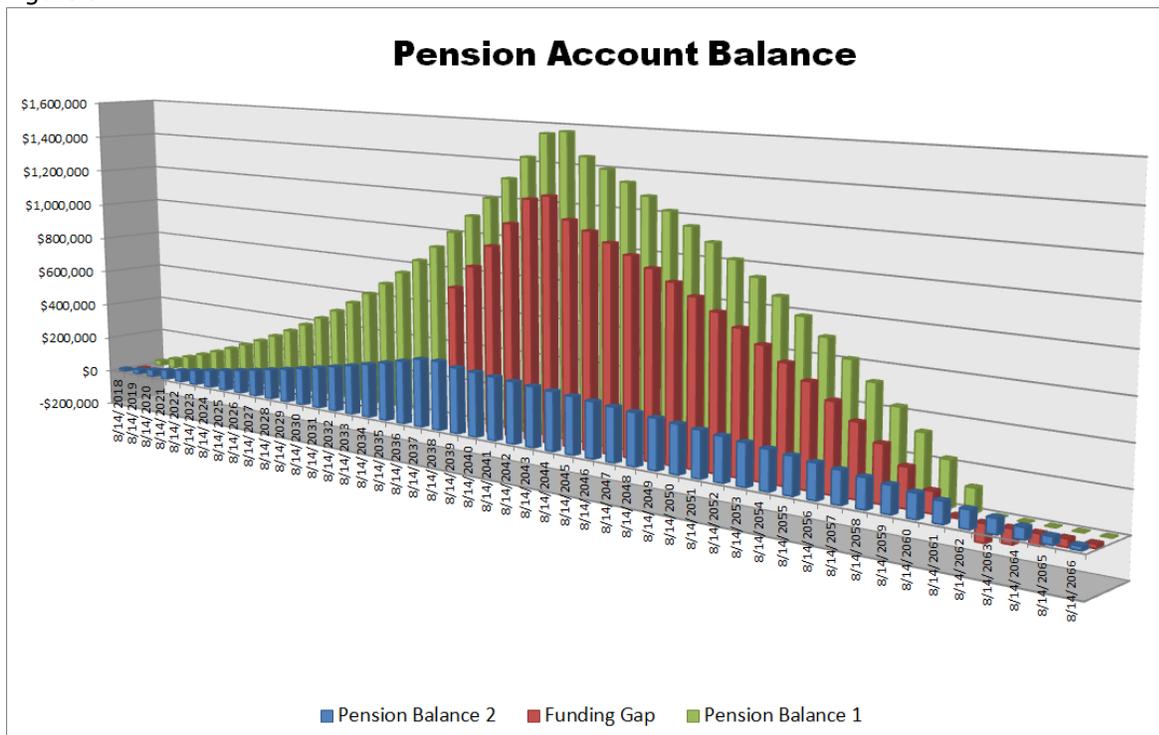
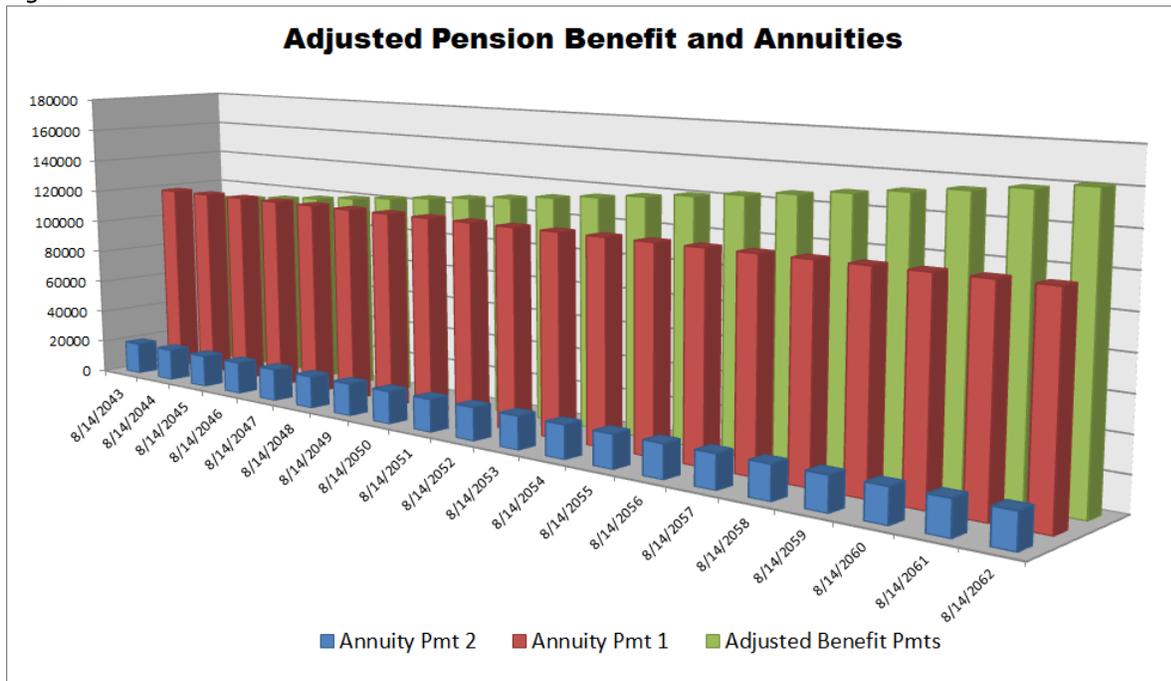


Figure 4



3. Crafting Your Own Retirement Plan

As part of this exercise, we designed an actual fixed income retirement portfolio with real bonds, with an investment grade rating matching the expected life of an individual retiring today. As we can see from figure 5 and 6, this portfolio of highly rated senior unsecured papers with semiannual coupons has a yield to maturity and duration that closely resembles the market conditions of the assumed Pension 2, with the exception of the average coupon which is 2% higher in the real portfolio.

Even though an annuity can be purchased from insurance companies, which have historically been active players in the retirement investment industry, they are very expensive as they incur all kinds of commissions and management fees, besides having onerous tax implications that make them less favorable for certain type of retirees. Without these associated costs and taxes, in theory one could replicate a payment annuity from the cash flows obtained from the proposed portfolio example below.⁴

⁴ By creating a cash excess/deficiency reserve account which reinvests these cash flows into the bond portfolio and redistributes into the annuity at a late stage.

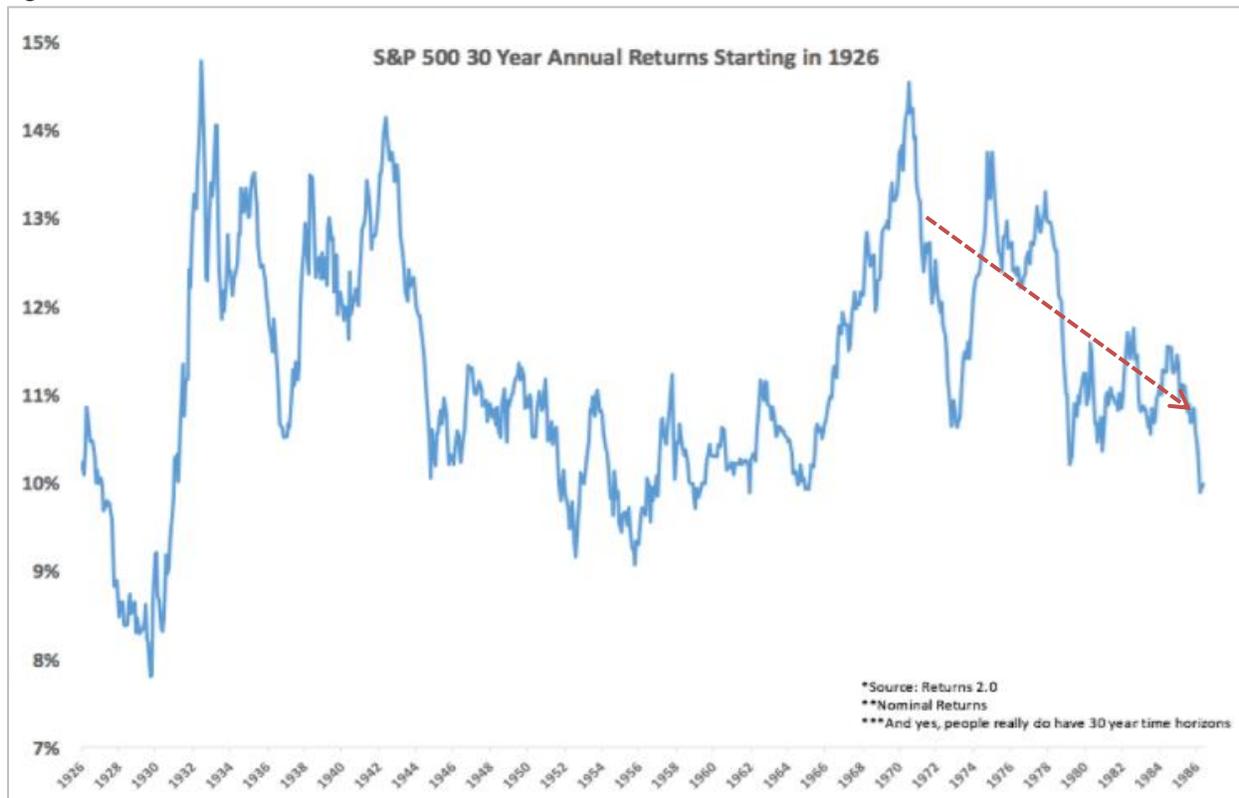
Figure 5 – Fixed Income Retirement Portfolio Holdings

Issuer	Coupon	Maturity	Moody's®	S&P	Last	Chg	Chg%	Yield
BANK AMER CORP	4	8/15/2037	Baa1	BBB+	98.752	-0.743	-0.75	4.092
BARCLAYS PLC	5.25	8/17/2045	Baa2		113.07	-0.784	-0.69	4.431
BANK MONTREAL	1.9	8/27/2021	A1		98.754	0	0	2.225
ROYAL BK SCOTLAND PLC	5.625	8/24/2020	A3		109.2	0	0	2.445
KRAFT FOODS GROUP INC	6.125	8/23/2018	Baa3	BBB-	104.31	-0.017	-0.02	1.814
CITIGROUP INC	2.5	7/29/2019	Baa1	BBB+	101.08	0	0	1.933
CITIGROUP	3.4	8/15/2036	Baa1	BBB+	96	-2	-2.04	3.691
COLGATE-PALMOLIVE	3.7	8/1/2047	Aa3	AA-	98.854	-0.16	-0.16	3.764
CREDIT SUISSE	3.8	6/9/2023	Baa2		104.17	-0.282	-0.27	3.012
DISCOVER FINL	4.15	8/15/2029	BBB-		99.875	0	0	4.163
FORD MOTOR CO	4.134	8/4/2025	Baa2	BBB	103.57	1.906	1.87	3.614
GE CAPITAL	4.418	11/15/2035	A1	AA-	107.81	0.301	0.28	3.819
International Paper Company	4.35	8/15/2048	BBB		99.123	0.1	0.1	4.402
BANK ONE CAP	8.75	9/1/2030	BBB-		146.02	-0.128	-0.09	4.149
COASTAL CORP	6.95	6/1/2028	Baa3		111.21	-1.39	-1.23	5.579
EL PASO ENERGY CORP	7.8	8/1/2031	Baa3	BBB-	127.39	-0.295	-0.23	
KINDER MORGAN ENERGY PARTNERS LP	7.3	8/15/2033	Baa3	BBB-	123.5	0	0	5.129
MAY DEPT STORES CO	6.7	7/15/2034	Baa3	BBB-	102.05	-1	-0.97	
ALTRIA GROUP INC	4.25	8/9/2042	A3	A-	101.4	0.1	0.1	4.159
ALTRIA GROUP INC	4.5	5/2/2043	A3	A-	101.38	-0.2	-0.2	4.409
PHILIP MORRIS INTL INC	4.375	11/15/2041	A2	A	104.7	-0.08	-0.08	4.068
PHILIP MORRIS INTL INC	2.5	8/22/2022	A2	A	101.05	0.05	0.05	2.277
PHILIP MORRIS INTL INC	4.25	11/10/2044	A2	A	102.84	-0.468	-0.45	4.076
PROSPECT CAP CORP	5.75	11/15/2032	BBB-		99.954	-0.1	-0.1	5.754
PROSPECT CAP CORP	6.5	8/15/2038	BBB-		99.531	0	0	6.54
ROYAL BANK OF CANADA	2.9	10/30/2024	NR		99.1	0.85	0.87	3.039
SUMITOMO MITSUI FINL GROUP INC	3.01	10/19/2026	A1		98.605	-0.135	-0.14	3.186
SUMITOMO MITSUI FINL GROUP INC	3.364	7/12/2027	A1		101.42	0.146	0.14	3.195
VERIZON COMMUNICATIONS INC	4.125	8/15/2046	Baa1	BBB+	88.028	-0.084	-0.1	4.903
VERIZON COMMUNICATIONS INC	4.812	3/15/2039	BBB+		99.569	0.059	0.06	4.844
WAL-MART STORES INC	4.875	7/8/2040	Aa2	AA	117.06	-0.878	-0.74	3.757

Figure 6 - Fixed Income Retirement Portfolio Profile

Avrg Coupon	4.71%
Avrg YTM	3.88%
Duration (yrs)	10.6
Life (yrs)	30

Figure 7



Source: “Deconstructing 30 Year Stock Market Returns” by Ben Carlson, May 2016

Even though annualized returns for the S&P500 of the past 30 years have been 10.46% with a standard deviation of 16.82%⁵, we can also observe from figure 7 that the trend is definitely negative suggesting that in a few years the markets could drive this annualized return into the levels assumed in our Pension 2 scenario.

There are many retirement and target date funds in the market place, with Blackrock and Vanguard as the two colossal leaders taking over the industry for these managed funds and plan administrators, at increasingly lower fees in exchange for a more automatic, algorithm driven investment planning, portfolio construction and robo advisory. However, the need for dynamic rebalancing coupled with human analysis of the markets, economic environment and financial circumstances of the retirees make it necessary for companies, institutions and individuals to hire experienced advisors to navigate troubled markets.

Finally, for those investors looking for a starting point in their retirement accumulation fund, we present three different portfolios, depending on the risk bucket the individuals or group belongs to, which in turn is set by their current life stage, financial and wealth condition and tax circumstances. The unrealized returns since inception in November 2016 for these simulated portfolios are also presented.

⁵ Moneychimp.com
August 31, 2017

Figure 8

AGGRESSIVE FUND (>20yrr Horizon)

Ticker	Sector	Description	Unrealized P&L	Allocation
BIB	Biotech	ProShares Trust - ProShares Ultra Nasdaq Biotechnology	29.15%	10%
CEMB	EM_Bond	iShares J.P. Morgan EM Corporate Bond ETF	1.58%	10%
DBC	Commodities	PowerShares DB Commodity Tracking ETF	-1.72%	10%
FAS	Financial	Direxion Daily Financial Bull 3X ETF	79.89%	10%
HYG	HY_Bonds	iShares iBoxx \$ High Yield Corp Bd ETF	2.63%	10%
IJS	Small_Cap_Value	iShares Trust - iShares S&P Small-Cap 600 Value ETF	11.85%	10%
IJT	Small_Cap_Growth	iShares Trust - iShares S&P Small-Cap 600 Growth ETF	16.46%	10%
LEMB	EM_Bond_Local_Ccy	iShares JP Morgan EM Local Ccy Bd ETF]	6.81%	10%
SSO	S&P_500	ProShares Ultra S&P500	36.41%	10%
TECL	Techonlogy	Direxion Shares ETF Trust - Direxion Daily Technology Bull 3X Shares	81.93%	10%
Cash	Cash	Cash	0.00%	0%
Total Fund PnL (Unrealized)			20.83%	

BALANCED FUND (5yr - 10yr Horizon)

Ticker	Sector	Description	Unrealized P&L	Allocation
AGG	IG_Bonds	iShares Core US Aggregate Bond ETF	-0.89%	30%
EEM	EM_Equities	iShares MSCI Emerging Markets ETF	19.92%	10%
HYG	HY_Bonds	iShares iBoxx \$ High Yield Corp Bd ETF	2.92%	10%
IYW	Technology	iShares US Technology ETF	25.02%	10%
XLE	Energy	The Select Sector SPDR Trust - The Energy Select Sector SPDR Fund	-7.77%	10%
XLF	Financial	The Select Sector SPDR Trust - The Financial Select Sector SPDR Fund	26.61%	10%
XLY	Consumer Disc	Consumer Discret Sel Sect SPDR ETF	15.35%	10%
Cash	Cash	Cash	0.00%	10%
Total Fund PnL (Unrealized)			6.69%	

CONSERVATIVE FUND (<5yr Horizon)

Ticker	Sector	Description	Unrealized P&L	Allocation
AGG	IG_Bonds	iShares Core US Aggregate Bond ETF	-1.04%	30%
EMB	EM_Bonds	iShares Trust - iShares J.P. Morgan USD Emerging Markets Bond ETF	1.25%	10%
GE	Industrial	General Electric Company	-11.10%	10%
GLD	Commodities	SPDR Gold Trust	-1.09%	5%
GOOG	Technology	Alphabet Inc.	19.34%	5%
SPY	Equity_Mkts	SPDR S&P 500 ETF	16.47%	10%
TLT	Gvrmt_Bonds	iShares Trust - iShares 20+ Year Treasury Bond ETF	-3.17%	20%
Cash	Cash	Cash	0.00%	10%
Total Fund PnL (Unrealized)			0.06%	

4. Constant Proportion Portfolio Insurance (CPPI)

CPPIs have been around for some time now, especially in the insurance industry as a portfolio allocation method and trading strategy to maintain exposure to a risky asset (like equities) in a portfolio while at the same time protecting its principal, or providing a capital guarantee at maturity, resembling in way a “bonds plus call option” strategy generally as a wrapper in equity linked structured notes and deposits sold by major wall street firms in the last 15 years to retail and institutional investors.

We think is important to mention this strategy because of its usefulness as an alternative to growing and protecting a long term retirement accumulation fund. The aim here is to understand by way of an example on how we could build such a strategy as well as the factors affecting its future outcome.

In order to guarantee the capital invested, the seller of portfolio insurance maintains a position in a treasury bonds or liquid monetary instruments, together with a leveraged position in a "risky asset", usually a market index. While in the case of a bond+call, the client would only get the remaining proceeds (or initial cushion) invested in an option, bought once and for all, the CPPI provides leverage through a multiplier. This multiplier is set to 100 divided by the crash size (as a percentage) that is being insured against.⁶

Let's assume an investor has a \$100k retirement portfolio that we would like to grow but protect its principal once it reaches a stated maturity (say 10 years). The writer of this strategy will determine the value of a bond floor, say \$90K with a face value of \$100K, and a multiplier of 3 (guaranteeing a drop in the risky asset of 33% at most before rebalancing the portfolio). On day one, the writer will allocate an initial cushion of \$30k (3x\$10k) to the risky asset and the remainder \$70k to the risk free asset (the bond). After that, the exposure to the risky asset will be changed dynamically in order to maintain the original gap (ie. the proportion of the equity part compared to cushion) and thereby the corresponding leverage, as the whole CPPI portfolio changes.

This dynamic rebalancing takes place whenever the gap ends outside a lower or upper bounds. In the case, this gap ends above the upper bounds the strategy triggers a releveraging on the risky asset. In the opposite case, it will deleverage from the risky asset, in order to place the gap inside the stated band. This rule is aimed at avoiding high turnover costs but can also incur significant costs in cases where prices have already moved considerably against it (effectively buying high or selling low). Such sudden moves in prices may make it impossible for the writer to reallocate from the risky asset to the bond asset, rendering the strategy useless as it fails to guarantee the principal at maturity. As such, this is effectively like writing a put to the investor, mandating (by contract) the writer to cover the difference of the guaranteed principal. In order to assume this rebalancing volatility risk, the CPPI issuing institutions charge a gap fee which depends on the leverage assumed by the underlying strategy.

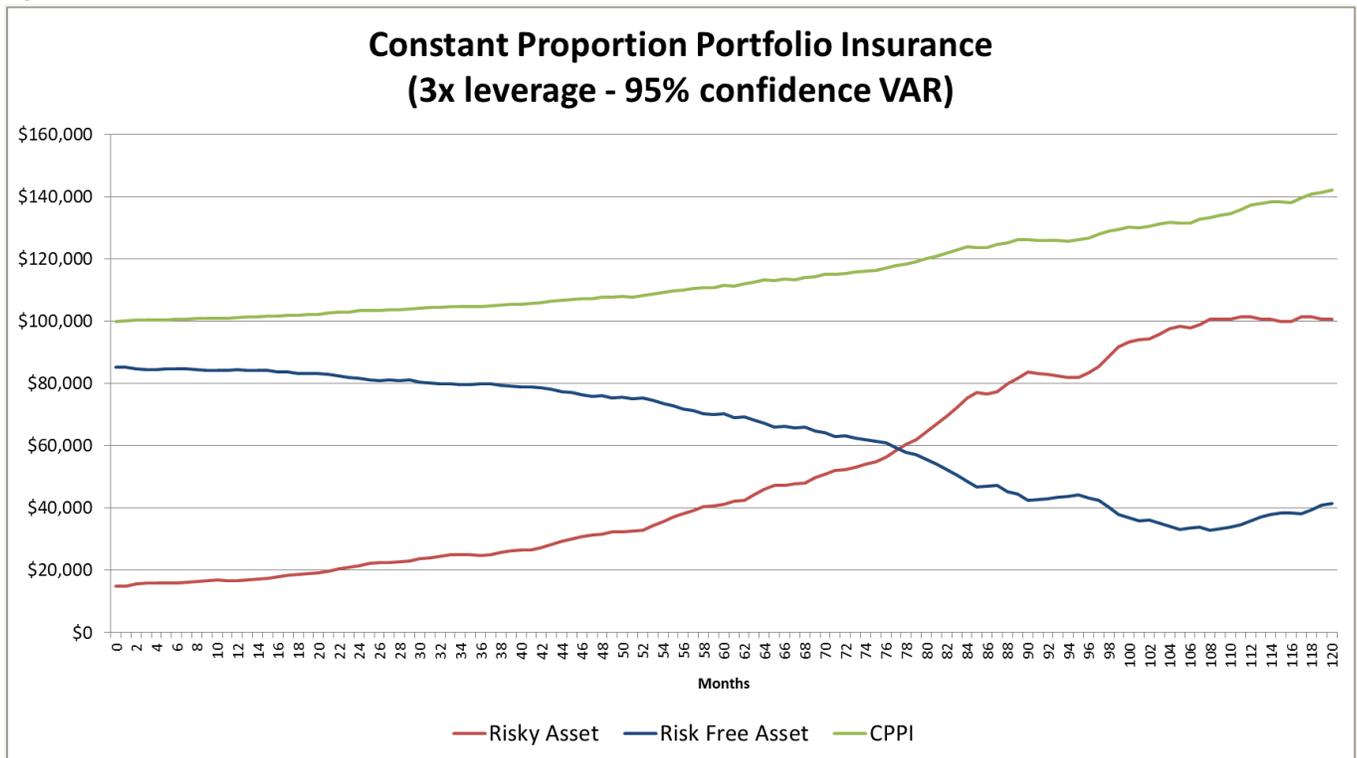
In the following example, we have assumed the future retiree investor, who will retire in 10 years, has \$100k and is considering investing in a CPPI structured product. As mentioned above, he could synthetically recreate this product by buying a balanced portfolio (risky asset) and a zero coupon US Treasury bond (Stripped TNote). Additional assumptions are given in figure 9; where Return_{ra} = risky asset annualized return, Return_{fra} = free risk asset annualized return, and Confidence = Value-at-Risk confidence level (to determine the expected loss in a given period for the risky asset).

⁶ Form Wikipedia

Figure 9 – CPPI assumptions

Principal	100,000
Years	10
Return_fra	0.50%
Return_ra	7.00%
Volatility_ra	32.86%
Leverage_x	3
Confidence	95%

Figure 10



After running a stochastic volatility simulation on the returns of the risky asset, the results are shown in figure 10. As we can see, during the 10 year horizon, the balanced fund allocation has grown more than 5 fold, reducing the Treasury bond to less than half. After continuous dynamic rebalancing, the CPPI portfolio has increased more than 40%. Other important consideration, such as the frequency and transaction cost of the turnover, where not accounted for, but can be nonetheless crucially important in determining the overall net return of the strategy. If this strategy was wrapped up in a note or long term over-the-counter deposit form, we would need to add the gap/protection fee as well as any structuring and distribution fee.

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