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# Returns, tax and volatility: Superannuation choice with a complete information set

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## Research question: How would leverage affect the distribution of the average worker's anticipated annuity stream in retirement?

- The rules governing acceptable superannuation investments that prohibit borrowing to fund an equity investment are not made in a portfolio context.
- Superannuation fund investments must conform to an investment strategy that explicitly considers risk and expected returns.
- However, S.67 of the Superannuation Industry Supervision Act 1993 prohibits them from borrowing except in limited circumstances.
- Why? Leverage is risky.
- But so are geared unit trusts, commercial property, instalment warrants and call options, all of which have embedded leverage.
- If the fund is sophisticated enough to devise an investment strategy with appropriate risk-return characteristics (as it is required to do), why is there a presumption that allowing leverage would result in an unreasonably volatile portfolio?
- Answer. The impact of leverage on the distribution of retirement outcomes has not been explicitly modelled.
- We explicitly model dividends, capital gains, interest rates and taxes in order to assess the incremental impact of leverage on the anticipated annuity stream in retirement.
- Retirement outcomes are enhanced for investors with low risk aversion.

The existing regulatory requirements of superannuation funds incorporates a selective treatment of leverage. This is the result of a focus on the risk of individual investment strategies rather than portfolio risk. Three specific anomalies are...

1. The requirement for a portfolio to conform to an investment management statement means that superannuation trustees are already required to estimate the risks and potential portfolio outcomes in retirement for their investors.
  - There seems to be no difference in principle between a fair risk assessment for a portfolio with leverage to one without it.
2. Superannuation funds are allowed to invest in geared unit trusts, instalment warrants and other derivatives as part of a portfolio which complies with the investment strategy.
  - Hence, the strategy must already account for the risk of an ungeared portfolio, the risks associated with embedded leverage and the ability of derivatives to reduce volatility.
  - There seems to be no reason why it cannot account for the relatively straightforward addition of leverage to the portfolio.
3. Leverage is prohibited because of its risk. To conclude that there are some investment strategies which are, by definition, "too risky" is to ignore 50 years of portfolio theory. The regulator therefore allows portfolios with above market volatility but disallows leveraged market portfolios with the same level of risk.
  - The fund is able to invest in an ungeared and less than fully-diversified portfolio with above-market risk, but cannot invest in a geared, fully-diversified market index. So believers in efficient markets have a volatility constraint, but active investors do not.
  - If the regulator is concerned about portfolio volatility, the prescription against leverage means that any portfolio with above-market risk would be equally unacceptable.

Method: In forming an asset allocation decision, the key metric for a representative investor is the distribution of their real terms anticipated annuity stream in retirement. Returns and volatility are an intermediate step in reaching this conclusion.

- Our representative investor is a full-time wage-earner who receives the compulsory 9% superannuation contribution. The investor has a hump-shaped earnings profile over a 45-year working life. Earnings are modelled from ABS data on average full-time and part-time earnings and the age distribution of earnings from the 2006 Census. Earnings expectations are:
 

–	Years 1 – 5	\$39,000
–	Years 6 – 15	\$55,000
–	Years 16 – 25	\$71,000
–	Years 26 – 35	\$62,000
–	Years 36 – 45	\$69,000
- Report terminal balances and anticipated annuity streams for 1000 simulated portfolios over 45 years for 6 investment strategies:
  1. Bonds
  2. Balanced (50/50 bonds and equities)
  3. Equities
  4. Leveraged equities (150% equities, -50% borrowings)
  5. Highly geared (200% equities, -100% borrowings)
  6. Decreasing leverage (move from strategies 1 – 5 every 9 years)
- Outcomes ranked according to a power utility function and reported as certainty-equivalent:

$$U(W) = \frac{W^{1-A}}{1-A}$$

- Does not imply that a financial adviser should model the investor's risk aversion coefficient. It is simply a means of ranking alternative investment strategies according to risk aversion.

Assumptions: Every superannuation fund makes an explicit or implicit assumption regarding equity returns, interest rates and tax. Without assumptions how would it be possible to write the investment management statement?

- Equity returns:
  - Capital gains: Uncorrelated across time and drawn from Australian historical distribution (mean = 8.4%; std dev 17.8%)
  - Dividend yield: Positive correlation with capital gains + random component (mean = 4.5%; std dev = 0.8%)

$$d_t = 0.0413 + 0.045g_t + 0.00156h_t \text{ where } h_t \sim N(0,1)$$

- Interest rates:
  - Real rate: Mean-reversion to long-term rate of 4% + random component

$$\Delta r_t = 0.01 - 0.25r_{t-1} + 0.25r_{t-1}h_t \text{ where } h_t \sim N(0,1)$$

- Inflation: Mean-reversion to long-term rate of 3%, inverse relationship with real rate + random component

$$\Delta \text{inf}_t = 0.0075 - 0.25\text{inf}_{t-1} - \Delta r + 0.25\text{inf}_{t-1}h_t \text{ where } h_t \sim N(0,1)$$

- Tax
  - Dividends 70% franked and taxed at 15%.
  - Effective tax on capital gains of 7.3%, modelled as a function of an average 10-year holding period

Results metrics presented primarily in terms of the key metric for investors, the anticipated annuity stream in retirement

- Median annuity stream
  - Assuming present value of two years worth of cash flows in risk-free asset and remainder in balanced portfolio
- Certainty-equivalent annuity streams according to varying levels of risk aversion
  - How much expected annuity stream would the investor accept with certainty as a trade-off against the disperse outcomes from the asset allocation strategy
- Distribution of annuity stream at every 5<sup>th</sup> percentile
  - Probably the most reasonable set of metrics to present to an actual investor for comparison. The certainty-equivalent data is used for a more formal tanking mechanism.

Base case: At risk-aversion coefficients of 1 and 2, leverage enhances anticipated retirement outcomes by maximising the certainty-equivalent annuity stream. At coefficients of 3 – 9 the investor exhibits a preference for an equities or balanced strategy. At a coefficient of 10, the decreasing leverage strategy is preferred.

Strategy	Bonds	Balanced	Equities	Leveraged equities	Highly geared	Decreasing leverage	
Median	11	22	39	63	84	25	
Certainty-equivalent annuity stream according to risk-aversion coefficient:							
CEA A = 1	11 (6)	23 (5)	40 (3)	65 (2)	90 (1)	27 (4)	
CEA A = 2	11 (6)	21 (5)	31 (3)	36 (1)	32 (2)	22 (4)	
CEA A = 3	11 (6)	19 (4)	24 (1)	22 (2)	15 (5)	20 (3)	
CEA A = 5	10 (5)	17 (1)	16 (3)	11 (4)	6 (6)	16 (2)	
CEA A = 10	9 (3)	12 (2)	7 (4)	4 (5)	3 (6)	12 (1)	
Perc	5%	8	12	12	10	8	11
	10%	8	14	16	15	12	13
	15%	9	15	19	20	17	14
	20%	9	16	21	24	23	16
	25%	10	17	24	29	30	17
	50%	11	22	39	63	84	25
	75%	13	29	66	138	252	38

Sensitivity analysis: Expected equity returns  $\hat{a}2\%$  and interest rates  $\hat{a}1\%$  results in leverage only being attractive at risk-aversion coefficient of 1. At coefficients of 2 – 6 preference for equities or balanced portfolios. But at coefficients of 7 – 10, decreasing leverage is preferred.

Strategy	Bonds	Balanced	Equities	Leveraged equities	Highly geared	Decreasing leverage	
Median	12	19	24	27	27	19	
Certainty-equivalent annuity stream according to risk-aversion coefficient:							
CEA A = 1	13 (6)	19 (5)	25 (3)	29 (2)	29 (1)	20 (4)	
CEA A = 2	12 (6)	18 (2)	20 (1)	17 (4)	13 (5)	18 (3)	
CEA A = 3	12 (4)	16 (1)	16 (3)	11 (5)	7 (6)	16 (2)	
CEA A = 5	11 (3)	14 (1)	10 (4)	6 (5)	3 (6)	14 (2)	
CEA A = 10	9 (2)	8 (3)	4 (4)	2 (5)	1 (6)	10 (1)	
	5%	9	10	8	6	3	10
	10%	9	12	10	8	5	11
	15%	10	13	12	10	7	12
Perc	20%	10	14	13	11	9	13
	25%	11	15	15	14	10	14
	50%	12	19	24	27	27	19
	75%	15	25	40	57	72	27

# Concluding comments

- Despite five decades of modern portfolio theory, the regulation of acceptable superannuation investments has been made without explicit, detailed modeling of the likely outcomes for alternative investment strategies.
- Base case results show that the median anticipated annuity stream in retirement is \$39,000 for an equities strategy, compared to \$63,000 for a 50% leveraged investment. The standard deviation of outcomes increases five-fold, so whether this increased risk is acceptable to investors depends upon their risk-aversion.
- One option is to simply observe the distribution of outcomes and have an investor determine by inspection which best meets their objectives.
- A more formal ranking mechanism is to assume a utility function. Assuming a power utility function, expected utility is maximised with gearing for investors with a risk-aversion coefficient of 1 – 2; investors with coefficients of 3 – 4 prefer an all-equities strategy while more risk-averse investors prefer a balanced portfolio.
- A lower bound case in which equity returns were 2% below the historical mean and interest rates 1% above expectations – corresponding to a market risk premium of less than 4% - resulted in the balanced portfolio being preferred for investors with coefficient of risk aversion of 3 or more.
- **With explicit modeling of the annuity stream there is no need to categorise specific investments as “too risky”, such as borrowing to fund an equity investment.**