Should Norway Change the 60% Equity portion of the GPFG fund?

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Overview

- Currently the Norvegian government targets a 60/40 allocation for the GPFG fund and 4% annual consumption.

Q? When is a 60/40 equity/bond allocation and fixed 4% consumption rule optimal?

- Investor has unit Elasticity of Intertemporal Substitution ($\sim$ log-utility).
- Returns are i.i.d.
- Risk-aversion is 4.
- Time preference $\beta = 4\%$

$\Rightarrow$ assuming $\mu - r = 6\%$ and $\sigma = 0.15$ gives a sharpe of $\frac{\mu - r}{\sigma} = 0.4$ and an optimal equity share of $\frac{\mu - r}{\gamma \sigma^2} = 0.66$ and $c = \beta W$.

$\Rightarrow$ Builds on seminal contribution of Merton-Samuelson from the 1970's.

- In addition, this rule implicitly assumes:
  - No endowment or income stream,
  - There are no trading costs,
  - The investor is a price taker (i.e., small).
- Let's discuss how relaxing these assumptions would change the allocation and discuss the implications for GPFG.

Portfolio Choice with a Random Endowment

Q? How should optimal consumption and asset allocation change if investor receives a random income over time (and stocks are i.i.d.)?

A! Merton-Samuelson theory still applies but to:

Total wealth=Financial wealth+ PV of future income:

$\Rightarrow$ Invest (and consume) a fixed fraction of total wealth (after synthetically 'selling off' all claims to future income).

- What does it imply for the target equity portion in the financial wealth portfolio?

$\Rightarrow$ Depends on whether future income is more Bond like or Stock-like

Portfolio Choice with a Random Endowment

- If income is bond like, then need to increase equity portion in the target fund.

$\Rightarrow$ In our example, if financial wealth is 50% of total wealth and income is risk-free, then financial wealth target allocation should be 120% so that the equity exposure as a function of total wealth is $50\% \times 120\% = 60\%$.
(Merton (1969), Viceira (2001) Cocco, Gomes, Maenhout (2005))

- If income is stock like, then need to decrease equity portion in the target fund.

$\Rightarrow$ In same example, if income is perfectly correlated with stock market dividends, then target financial wealth allocation should be 20% so that effective stock exposure as function of total wealth is $50\% \times 20\% + 50\% = 60\%$.

- If income is co-integrated with the stock market dividends, then the PV of income has both a bond-like component (in the short run) and a stock like component (in the long-run):

$\Rightarrow$ hump-shaped asset allocation over the horizon of the endowment stream.
Benzoni, Collin-Dufresne, Goldstein (2007)

Baseline and Sensitivity to Cointegration 'Strength'

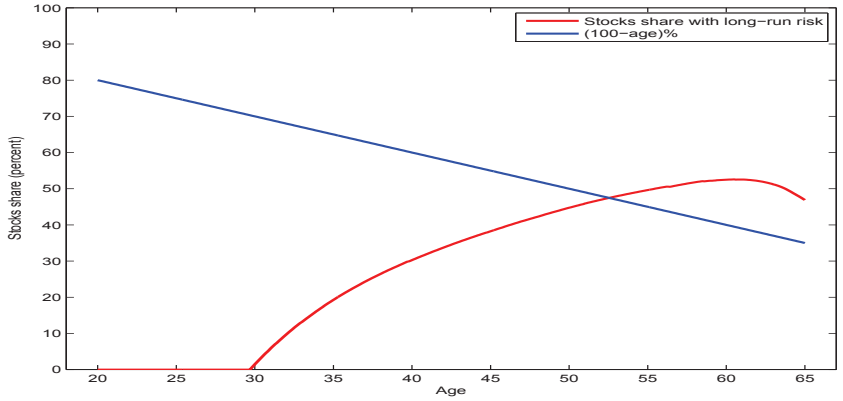

Figure 5: **Life-cycle stock holdings: Model predictions.** The red line shows the life-cycle stock holdings for a worker subject to long-run labor income risk. The blue line shows the life-cycle stock holdings for a strategy that invests (100−age)% of financial assets in stocks. Source: Benzoni et al. (2007), Figure 3, Panel B, page 2149.

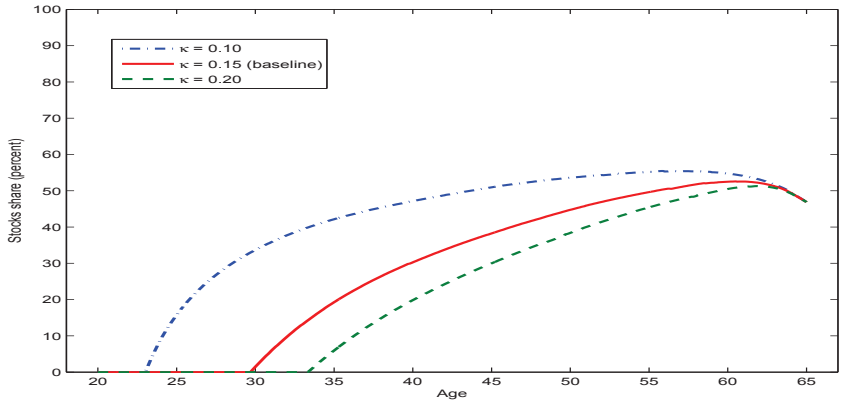

Figure 6: **Life-cycle stock holdings: Exposure to long-run risk.** The plots show life-cycle stock holdings for workers subject to different degrees of exposure to long-run labor income risk (measured by the model coefficient κ). Source: Benzoni et al. (2007), Figure 6, page 2154.

Sensitivity to Equity Premium and Risk-Aversion

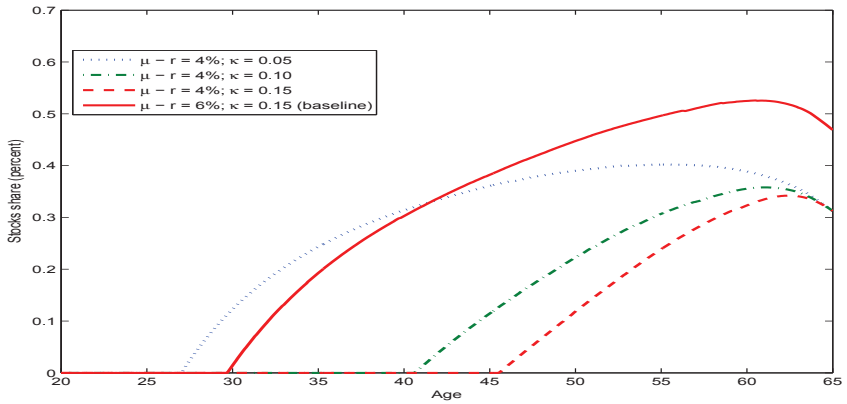

Figure 7: **Life-cycle stock holdings: Equity risk premium.** The plots show life-cycle stock holdings for different values of the equity risk premium (measured by the expected stock return minus the risk-free rate, $\mu - r$) and different degrees of exposure to long-run labor income risk (measured by the model coefficient κ). Source: Benzoni et al. (2007), Figure 7, page 2155.

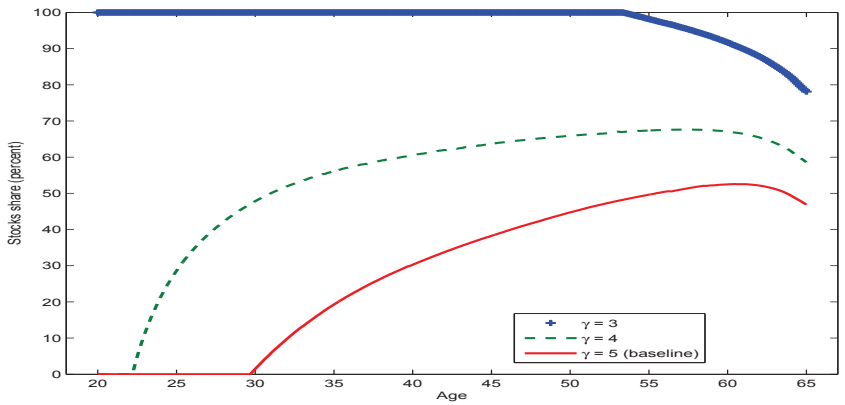

Figure 8: **Life-cycle stock holdings: Risk aversion.** The plots show life-cycle stock holdings for workers with different levels of risk tolerance. For most workers, the risk aversion measure γ is positive. Values of γ below 10 are considered to be common. Source: Benzoni et al. (2007), Figure 10, page 2158.

Implications for GPFG

- GPFG has inflows that are highly correlated with oil prices
- Oil prices and stock market performance are correlated and there is also some evidence of long-term cointegration.
- Going forward there is also substantial technological risk driving the joint dynamics of stock and oil prices.

$\Rightarrow$ Should affect the equity allocation:

- Equity allocation in the financial portfolio needs to reflect desired exposure in the total wealth portfolio
- Benchmark should be adjusted for oil exposure, indirect equity exposure, and potentially technological risk (e.g., overweight renewable energy sector).

- Substantial (parameter) uncertainty in the precise relation between oil and stock markets and in estimate of future endowment flows (and of course in technological risk).

$\Rightarrow$ However, ignoring this relation if it is there is likely to be much more costly than trading on it if it is not (CD, Lochstoer (2013)).

Portfolio Choice with Consumption Commitments

Q? How should optimal consumption and asset allocation change if investor has a constraint on its future planned consumption in dollar (or NOK) terms?

A! Investor should split total wealth into an unconstrained investment portfolio and a liability management portfolio of put options written on the investment portfolio with strikes equal to the planned consumption stream.
(Grossman and Vila (1989), El Karoui and Jeanblanc (1998))

- Suppose that planned consumption is fixed in dollar terms, then effectively should hold a risk-free bond portfolio that matches the planned consumption annuity and invest the rest in a portfolio of Call options.

$\Rightarrow$ The investor becomes more risk-averse and lowers the equity portion of its allocation when the total wealth falls towards the PV of planned consumption.

$\Rightarrow$ This intuition also applies if investor develops a consumption habit (Sundaresan (1989), Campbell and Cochrane (1999), Lindset and Mork (2016)).

Implications for GPFG

- It might be useful to forecast desired consumption level at some horizon (e.g., 10 or 30 years) focusing especially on long-term commitments (e.g., infrastructure projects, pension liabilities. . .)
- These consumption commitments should be targeted by a specific liability management portfolio (e.g., mostly fixed income)
- The remaining component of the portfolio should be invested in an unconstrained portfolio, but where the desired level of risk (i.e., the equity share) would be reduced by the investment committee when its value drops to levels close to the PV of the consumption commitment (ALM management).

$\Rightarrow$ Important to clearly define the objective function for GPFG (e.g., maximize long term performance, or utilty of consumption with or without habit/commitment. . .).

Portfolio Choice when Returns are Predictable

Q? How should optimal asset allocation of a long term investor change if returns are predictable?

A! Investor deviates from unconditional fixed allocation to exploit predictability tilting towards higher Sharpe ratio assets

$\Rightarrow$ Time-varying equity target allocation driven by varying estimates of expected returns and volatilities.

A! Long term investors have hedging demand, which differentiates them from short term investors.

$\Rightarrow$ Long-term investor should take larger equity exposure than short-term investors if risk-premia are countercyclical
(e.g., mean-reversion makes stocks less risky in the long-run, since expected returns increases after negative return shock).

Are Returns Predictable?

- Harvey, Liu, and Zhu (2014) list more than 100 anomalies with high Sharpe ratios
- Goyal Welch (2008) find poor performance of out of sample trading on predictability
- Many anomalies disappear after they have been identified by researchers (Engelberg, McLean, and Pontiff (2015)).
- Many anomalies require trading small and illiquid stocks.
- Evidence that actively managed mutual funds outperform properly diversified index funds on average is not strong (especially after fees).

$\Rightarrow$ Important to distinguish predictability due to risk-premia from predictability due to inefficiencies (true asymptotic arbitrage).

- "Dog does not bark" argument of Cochrane (2011) suggests that there *must be* predictability.
- However, this predictability is not very strong and associated with a lot of (parameter) uncertainty

Portfolio Choice in the presence of trading costs

Q? How do trading costs affect the optimal trading strategy?

A! When returns are not predictable, then it is optimal to only rebalance towards the target weight portfolio outside of a no-trade region determined to trade-off rebalancing costs and diversification
(Constantinides (1986), Davis and Norman (1990))

A! When returns are predictable, then it is optimal to rebalance towards a moving target portfolio computed by shrinking the expected returns of factors that are less persistent (Garleanu-Pedersen (2011))

- Additional considerations related to trading costs:
  - Price impact: permanent or transitory.
  - Predatory trading.

$\Rightarrow$ Large trader should not impose too small tracking error to publicly known benchmark with predictable rebalancing rules (Yiqun Mou (2013))

$\Rightarrow$ Large trader should focus on more persistent sources of predictability.

Implications for GPFG

- Probably a good idea to modulate risk-exposure to stocks as function of slow-moving predictors (PE ratio, dividend yield, term structure slope. . .)
  - How often should the target exposure be changed? $\Rightarrow$ Not often (Ahn, Ang, Collin-Dufresne (2014)).
  - How should this be operationalized? $\Rightarrow$ Rules better than Discretion.
- Avoid trading on anomalies that are not robust, involve small and illiquid stocks, and have high turnover.
- Other anomalies (momentum, reversal, value, profitability, etc...) can be useful for trade execution (i.e., designing t-cost model).
- Give higher tracking error to fund managers so they can trade other risk factors (volatility, currency carry, term premium, credit risk. . .)
- Regular meetings with fund manager to discuss strategies which should be fully transparent and whose performance should be analyzed relative to the benchmark portfolio set by the government.
- Incentive fee structure for the manager that rewards long-term risk-adjusted outperformance ('claw-back incentive fee').

Mean-reversion, structural breaks, and rebalancing: GE Considerations

Q? Should large long-horizon investor with deep-pockets:

- Follow a contrarian strategy?
- Exploit market dislocations?
- Increase stock exposure because of 'new-normal' low fixed-income yield regime?

A! Depends crucially on who other investors are in the market

- If there is only one (type of) investor in the market, then cannot rebalance.
- Instead prices adjust to reflect new risks!

- CD and Lochstoer (2016) analyze GE framework with Long Horizon (LH) and SH investors where mean-reversion can be due to fundamental risk, or SH risk-tolerance fluctuations, or possible structural breaks:
  - LH investors take higher risk exposure if shock is driven by lower SH risk-bearing capacity, but not if shock is due to an increase in persistent fundamental risk.
  - LH investors reduce risk exposure in periods of higher structural uncertainty, because they are more sensitive to long-run risks than SH investors.

Implications for GPFG

- GPFG should seek to change risk-allocation and be contrarian:
  - if the change in valuation ratios is due to a change in market risk-bearing capacity or illiquidity premium
  - but not necessarily if change in valuation ratios is due to (priced-in) fundamental shock or regime shift,
- How to distinguish both?
  - Follow market proxies for market optimism, illiquidity premium, Financial Institutions Leverage, ...
- Easier said than done.

Conclusion

- Existing approach which defines a fixed tradable diversified benchmark is soundly based in theory (good!).
- Benefit to rules over discretion when specifying counter-cyclical rebalancing rule: transparency, ex-post justification, avoids behavioral bias...
- There are likely benefits to changing the tactical asset allocation over time given the evidence that returns are predictable.
- It would be desirable to propose a transparent tradable benchmark index with rules specifying the change in target allocation as a function of low frequency well-understood predictors.
- Size of GPFG makes 'general equilibrium considerations' relevant as rebalancing has price/market impact.
- Changing the tactical equity exposure when valuation ratios change to act counter-cyclically is desirable, especially if valuation ratios are driven by changes in market sentiment/risk-bearing capacity or illiquidity, but less if due to fundamental shifts in risk.

Conclusion

- GPFG should avoid targeting anomalies or factors with high turnover and small capacity.
- GPFG should relax the tracking error to allow fund to better manage transaction costs and price impact considerations, and possibly seek exposure to well-known factor premia (volatility, carry, ...), but add incentive fee structure based (regularly measured and advertised) long-term risk-adjusted performance relative to the benchmark set by the government.
- Oil exposure (cointegration) risk of the fund endowment should affect the target allocation in the financial wealth component of the fund and/or benchmark design to remove oil and commodity exposure and potentially hedge technological risk.
- It would be useful to define more explicitly the objective function for the fund for example by taking into account planned long-term consumption commitments (infrastructure and pension liabilities) and manage these with an ALM perspective.