ABN·AMRO Asset Management

# The Practice of Financial Optimization

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January 20, 2005

# Agenda

1. Optimization in asset management
2. Case study A: Modelling derivatives in strategic asset allocation
3. Case study B: Minimizing implementation costs
4. Conclusion

# Optimization in Asset Management

- Given investor's liabilities, how to allocate money to the various asset classes (stocks, bonds, property, etc)?
- Given a targeted investment in an asset class (e.g. stocks), what mix of asset managers to choose?
- Given a portfolio, how to select the securities (e.g. which stocks to buy)?

# The relevance of optimization to asset management

- Optimization issues arise at all decision levels in asset management
- But do decision makers often use optimization as a decision tool?

  **No, at least not explicitly**

- Optimization more regularly used at higher levels of decision making/consulting
  - asset allocation for pension funds
  - asset allocation for insurance companies

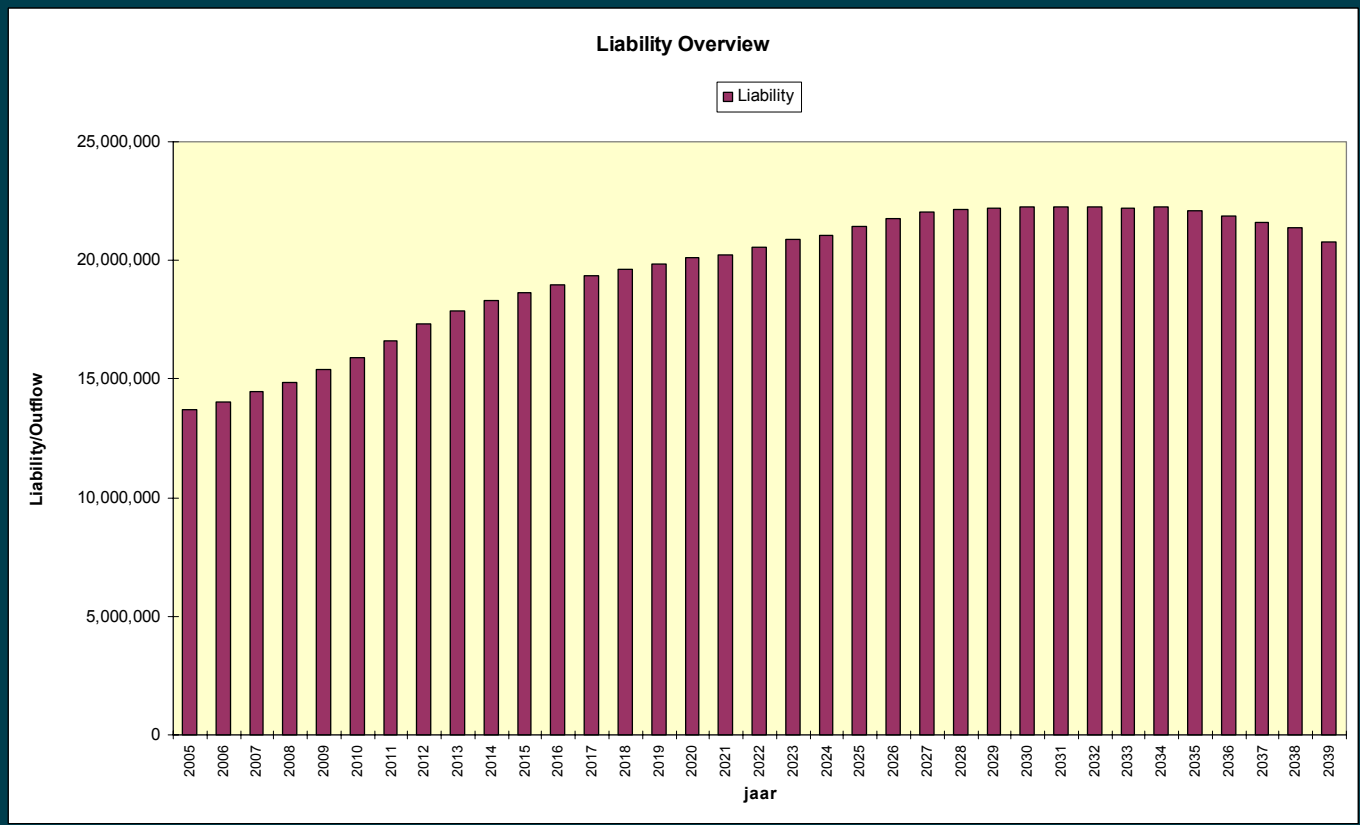
# Two cases on optimization

- First case: An area where optimization is frequently used, but may lead to undesirable outcomes

- Second case: An area where optimization is not frequently used (yet), but may be very beneficial

# Case Study: Modelling derivatives in Strategic Asset Allocation

A typical nominal liability profile of a pension fund ….



# The challenge to pension funds

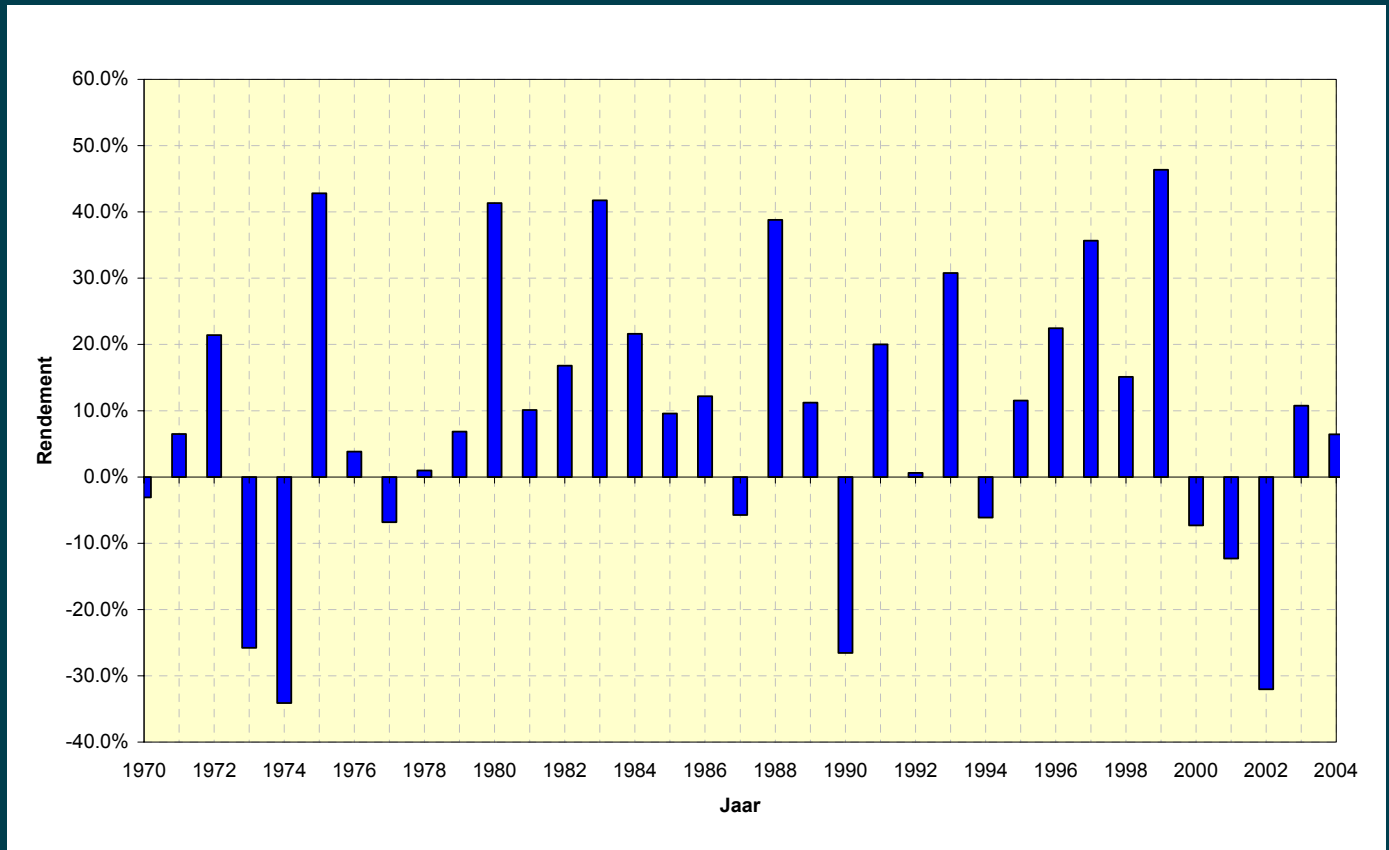
Choose an asset allocation such that

- The probability that pension payments can not be met, is kept at a minimum
- The likelihood that pension payments can be adjusted for inflation, is as high as possible
- Contributions to the pension fund are kept at an acceptable level with preferably little variation

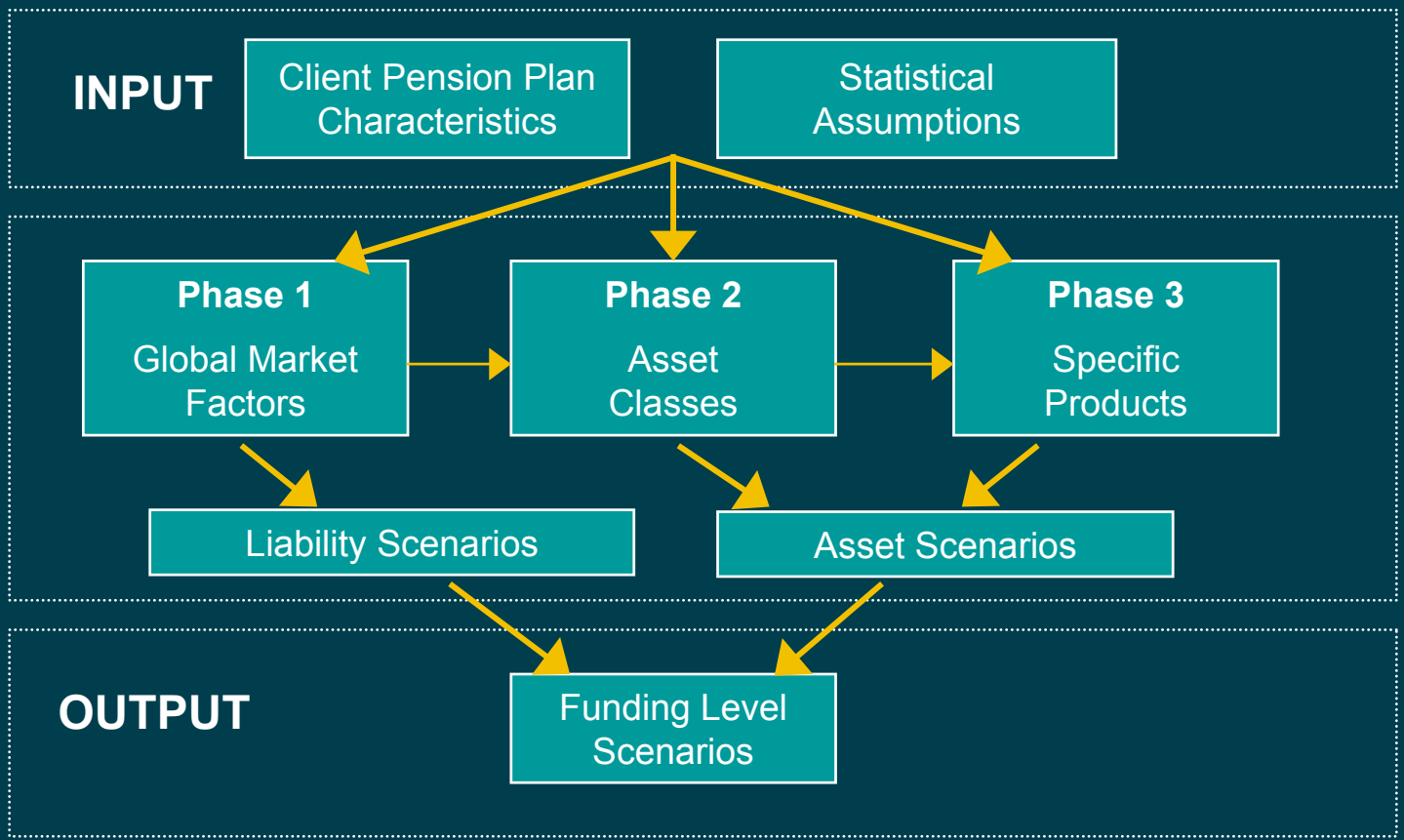
Just matching the nominal liabilities will not do the job!

# 100% in Global Equity (stocks)?

## MSCI World August 2000 – March 2003: -54%



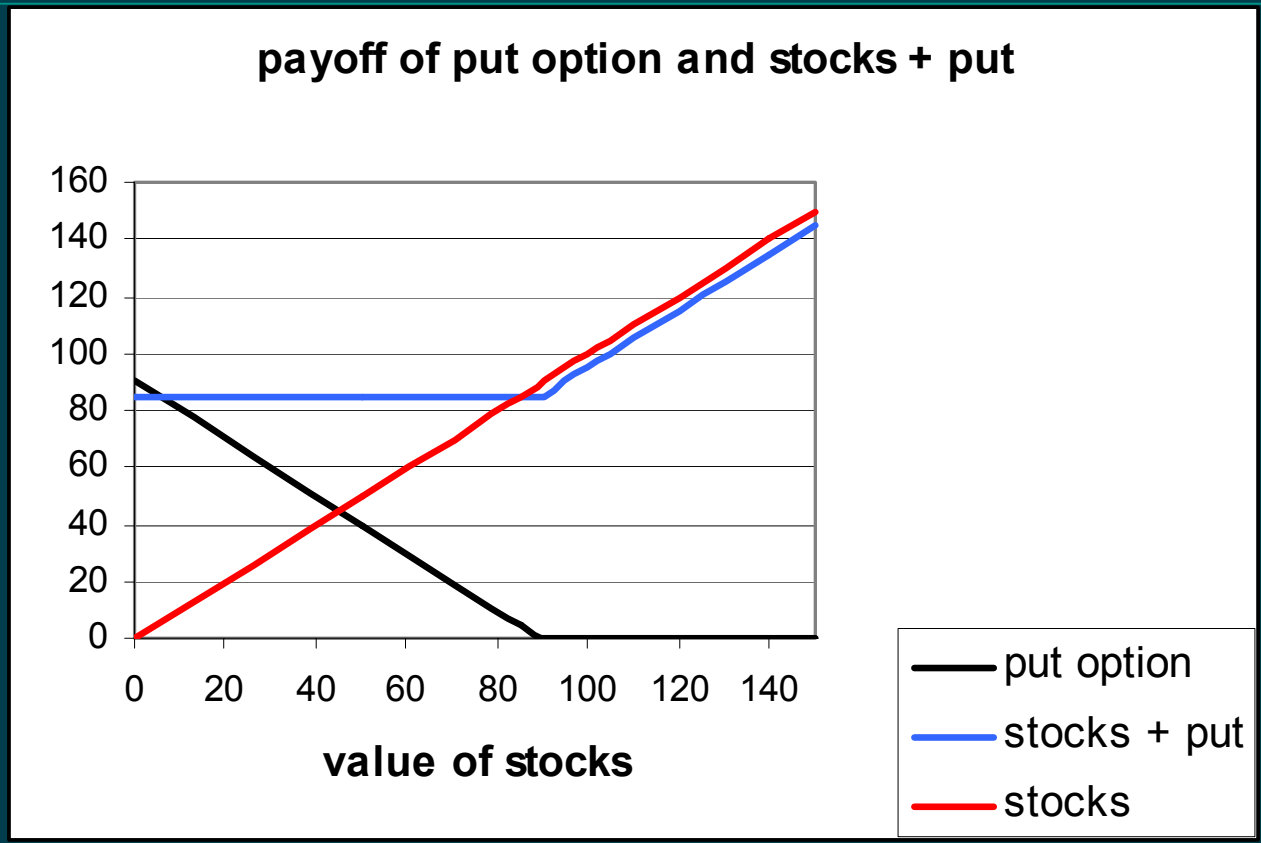
# The AAAM Advisory Model



# Pension funds: the case for derivatives

- A lot of pressure on short term funding risk from regulatory authorities
- Conventional asset allocation of just stocks and bonds often imply too much risk for a given expected return
- Derivatives may be used to adjust the return distribution of stock returns or decrease interest rate risk
- Let us look at a simplified strategy: adding put options to control downside risk of stocks

# Payoff profile of stocks and put option

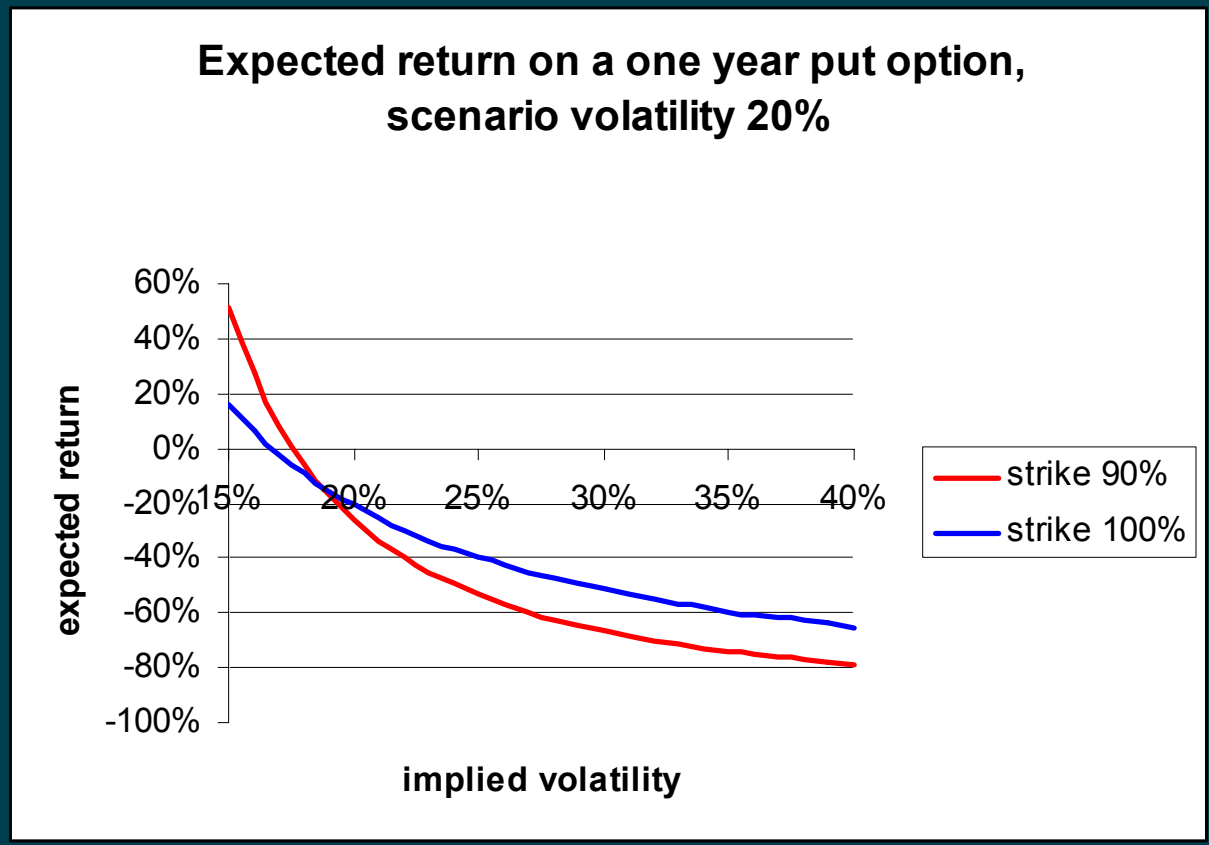



Put options become more valuable if probability of large fluctuations in value of stocks is high

# How to incorporate options in the model?

- Market prices for put options reflect what the consensus is regarding the standard deviation of future stock returns
- Models usually rely on historical data to set standard deviations of stock returns and return correlations
- Usually, the market implied standard deviation and the model standard deviation do not coincide
- How does this affect the outcome of the optimization process?

# The expected return of a put option




Realistically, return on put anywhere in between -50% and +50% depending on today's price and assumptions!!

# How to deal with this issue?

- Just ignore it (arbitrage?)
- Base the standard deviation of stock return scenarios on market consensus (*implied volatility*)
- Reprice the option according to the empirical standard deviation of return
- Derive the entire probability distribution of returns from option prices (but still OK time series characteristics?)
- Let scenarios be based on the option's pricing model + change of measure adjustment (but still OK time series characteristics?)
- In case of option strategies starting in the future: modelling stochastic volatility

# How to deal with this issue (cont.)?

- choice of strategy depends on objectives:
  - tactical use of derivatives: use current price and empirically based scenarios
  - strategic use of derivatives: use uniform methodology to generate return scenarios and price options/derivatives
- optimization may lead to maximization of spurious profits
- at least make sure that scenario structure is arbitrage-free
- uniform, theoretically appealing solution an open issue (?)

# Case Study: Minimizing Implementation Costs

Conventional portfolio management:

- fundamental analysis of companies in the benchmark
- tracking error relative to a benchmark (e.g. MSCI Europe, World)
- stocks in the portfolio for the longer term excess return
- portfolio turnover usually not too large (100%)
- limits on country and sector deviations
- often some valuation model for the various companies in universe
- otherwise a qualitative approach

Many traditional money managers fit into this framework

# Quantitative approach

Framework for quantitative portfolio management:

- based on statistical approach
- statistical model used to estimate which factors determine market prices of stocks: pricing model
  - past return based factors (e.g. last month return)
  - valuation factors
  - earnings estimations by analysts

Future return = a * Factor1 + b * Factor2 + …. + error

# Quantitative approach (cont.)

- Error distribution yields probability distribution of excess return
- pricing model sets a ranking based on predicted excess returns (possibly risk-adjusted)
- buy the top x% percentile of your list
- run your model on a regular basis (e.g. monthly)
- result: a lot of turnover (>>100%)

# Implementation costs

- Implementation costs include:
  - brokerage fees
  - market impact (“moving the market” as you trade)
  - delay costs
- Assume that you replace 50% of your portfolio on a monthly basis
- Assume implementation costs equal 0.6% (assuming sizeable portfolio)
- Annual implementation costs estimated at 3.6%
- Given realistic risk levels, targeted outperformance in range of 5% to 10% already quite an achievement
- Hence, implementation costs take out a very large chunk of potential outperformance!

# Potential optimization framework

- Do not always hold top x% percentile of your list, but also account for costs of getting to new portfolio
- For each stock, take prob. distribution of excess return into account and estimate implementation costs
- Account for the various portfolio constraints (e.g.sector/country weights, deviations from benchmark)
- Optimize expected excess return of portfolio
- Rely on theoretical framework, not too much on empirical data
- Model ideally used to update portfolio on a daily basis or to determine optimal holding period for each stock

# The optimization challenge

- Probably a linear problem
- Stochastic coefficients
- Multi-period framework

Common practice is to use rules of thumb.

- Prove (sub)optimality of rules of thumb

# Concluding remarks

- Optimization relevant to all levels of decision making in finance, but infrequently used in practice
- Optimization and data: a bad relationship
- Fixing the data issue in finance: use finance theory
- Potential applications that have not been addressed yet