
# IL Securities and Inflation Risk Management

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## Inflation-Hedging Properties of Real Assets and Implications for Asset-Liability Management Decisions

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# *Outline*

- Motives for inflation hedging
- Instruments for inflation hedging
- Inflation hedging without inflation-linked assets
- From short-term to long-term inflation hedging
- Implication for pension funds


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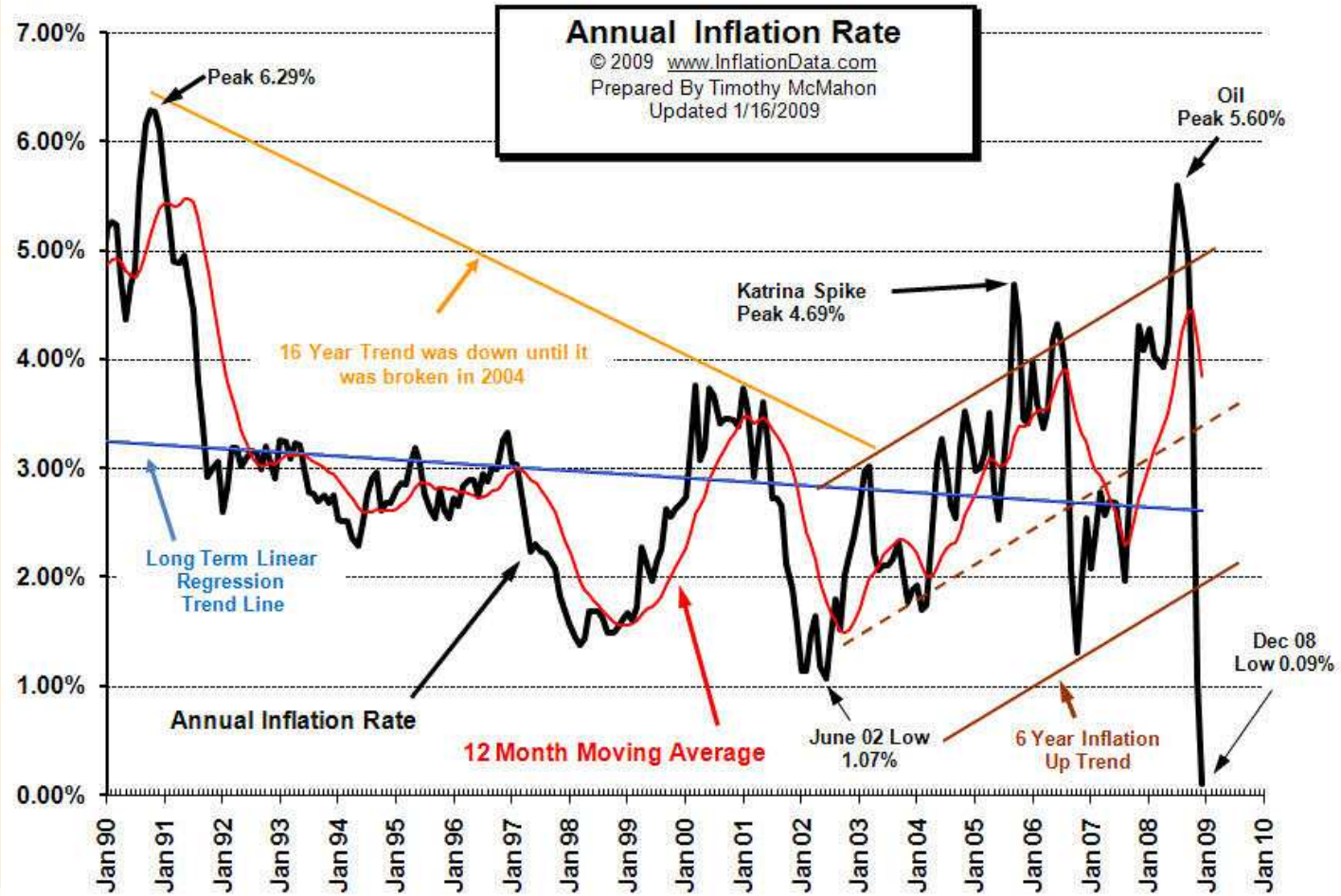
# *Inflation Hedging: Why?*

- Key insight of dynamic asset pricing theory is the introduction of dedicated *hedging demands* (in addition to standard *performance-seeking portfolio*), allowing investors to hedge away impact of unexpected changes in relevant state variables (Merton (1969, 1971)).

- Inflation is one key state variable that optimally commands an hedging demand for the following possible reasons:
  - Impact on wealth process (endowment and liability streams);
  - Impact on productivity of wealth (stochastic opportunity set);
  - Impact on utility of wealth (choice of a numeraire).

- Recent papers on inflation in dynamic asset allocation models: Brennan and Xia (2002), Campbell Chan and Viceira (2003), Sangvinatsos and Wachter (2005), Hoevenaars et al. (2008), Detemple and Rindisbacher (2008), Martellini and Milhau (2008), among others.

# Recent Increase in Inflation Volatility




# *Inflation: Dead but not Buried*

- Current credit crunch and related economic slowdown has eased the 2008 inflation scare for the next year, but inflation concern remains vivid for the medium- to long-term.
- The impact of the emerging economies on prices has unambiguously turned from being deflationary to inflationary, and this trend is bound to last.
- Need for governments to support weak economies with significant stimulus packages will remain, along with injection of liquidities in money markets.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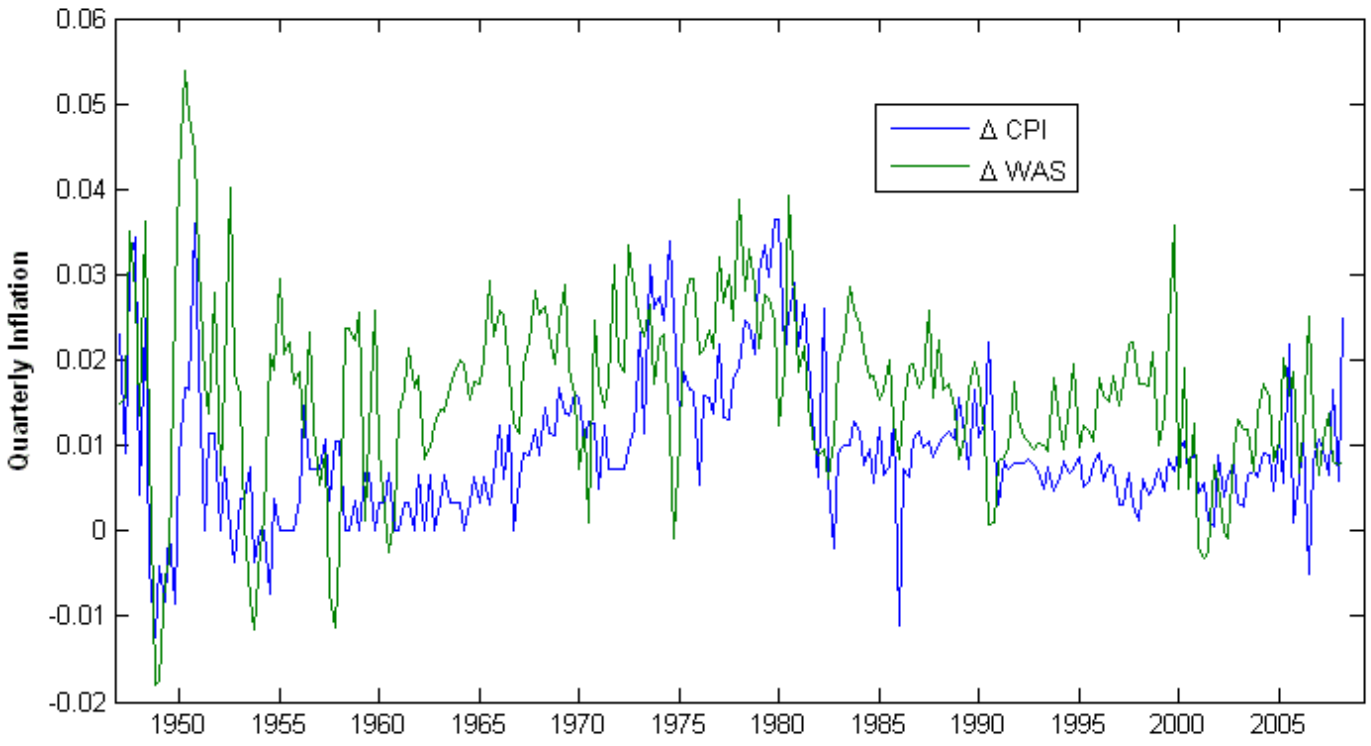
# *Inflation Hedging: How?*

- A key question from the empirical perspective in an incomplete market setting is the optimal composition of inflation-hedging portfolios.
- Inflation-linked securities, and most importantly inflation-linked bonds, are a priori the most natural hedge against inflation.
- Governments (and most corporations) are naturally hedged against inflation on the asset side, and find it optimal to issue a significant amount of IL bonds that allow them to benefit from inflation risk premium without increase in (ALM) risk (Martellini and Milhau (2008)).
- Inflation swaps are also used to customize inflation exposure.


# *Inflation Hedging: How?*

- Outstanding questions:
  - Can investors achieve perfect hedging?
  - Do investors really need hedging at each date?
- Incomplete markets:
  - Supply side: capacity of IL security market not sufficient to meet the collective demand of institutional investors.
  - Demand side: pension payments are often indexed with respect to wage, as opposed to price, inflation.
- Long-term investors:
  - Problem in ALM is not hedging inflation date by date, but instead hedging inflation at a typically long horizon.
  - Short-term hedging (when possible) can eventually prove unnecessarily costly.

# *From Price to Wage Inflation*




CPI is the “Consumer Price Index For All Urban Consumers” and WAS the index entitled “Compensation of Employees: Wages & Salary Accruals”. Both series are seasonal adjusted. Details on http://research.stlouisfed.org/fred2/.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# *Inflation Hedging Properties of Stocks*

- **Stocks**
  - On the one hand, equity investments appear as relatively poor inflation hedging vehicles from a short-term perspective.
  - Empirical evidence indeed suggests that there is a negative relationship between expected stock returns and expected inflation, consistent with the intuition that higher inflation leads to lower economic activity, thus depressing stock returns (e.g., Fama and Schwert (1977)).
  - On the other hand, higher future inflation leads to higher dividends and thus higher returns on stocks, and thus equity investments should offer significant inflation protection over longer horizons (Campbell and Shiller (1988)), a fact that has been confirmed by a number of recent empirical academic studies (e.g., Boudoukh and Richardson (1993)).


# *Inflation Hedging Properties of Bonds*

- **Bonds**
  - Bond yields may be decomposed into a real yield and an expected inflation components.
  - Since expected and realized inflation move together on the long-term (Schotman and Schweitzer (2000)), we expect a positive long-term correlation between bond returns and changes in inflation.
  - In the short-term, however, expected inflation may deviate from the actual realized inflation, leading to low or negative correlations (rigidities of the nominal yield due monetary policy may cause a retarded response).


# *Inflation Hedging Properties of Commodities*

- **Commodities**
  - Commodity prices generally are set in highly competitive auction markets and consequently tend to be more flexible than prices overall.
  - Beside, recent inflation is heavily driven by the increase in commodity prices, in particular in the domain of agriculture, minerals and energy.
  - Particularly well suited in the short run as idiosyncratic commodity price shocks induce inflation (natural catastrophes).
  - Gorton and Rouwenhorst (2006) find that, over the 1959-2004 period, commodity futures were positively correlated with inflation, unexpected inflation, and changes in expected inflation.


# *Inflation Hedging Properties of Real Estate*

- **Real estate**
  - Real estate income should reflect past and current inflation.
  - Real estate price level is part of the CPI basket inducing an endogenous link between real estate prices and CPI inflation.
  - However, rents and real estate prices exhibit some rigidities with respect to current inflation shocks.
  - Empirical evidence of inflation-hedging benefits of real estate investments can be found in Fama and Schwert (1977), Hartzell et al. (1987) or Rubens et al. (1989), Hoesli et al. (2007).


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# Econometric Methodology

- Evidence for return predictability (e.g. Kandel & Stambaugh (1996), Campbell & Viceira (1999)) based on vector-autoregressive (VAR) models capturing mean-reversion effects.
- Mean-reversion in stock returns is induced by positive relationship ($\beta_2>0$) with mean-reverting variable (DY).

$$\Delta p_t = \log(P_t) - \log(P_{t-1}) = \log\left(\frac{P_{t-1}}{P_t}\right) = \log(1+R_t) = r_t$$

$$\begin{bmatrix} r_t - rf \\ d_t - p_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} \alpha_1 & \beta_1 \\ \alpha_2 & \beta_2 \end{bmatrix} \begin{bmatrix} r_{t-1} - rf \\ d_{t-1} - p_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}$$

  - Price levels and their first differences enter the above model.


# *Econometric Methodology*

- Vector Error Correction Model (VECM): add information on long-term price equilibrium relationships in addition to pure return modelling allows one us to explicitly distinguish between short-run and long-run dynamics (with mean-reversion towards long-term price relationship $\beta$).

$$\Delta y_{t+1} = c + \alpha\beta' y_t + \Gamma \Delta y_t + \varepsilon_{t+1}$$

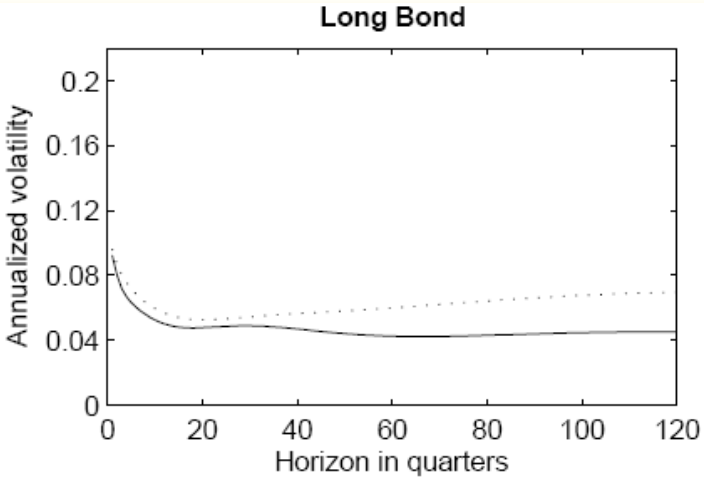
- The model involves instantaneous shocks to the system if it deviates from the long-term equilibrium $\alpha\beta'$.

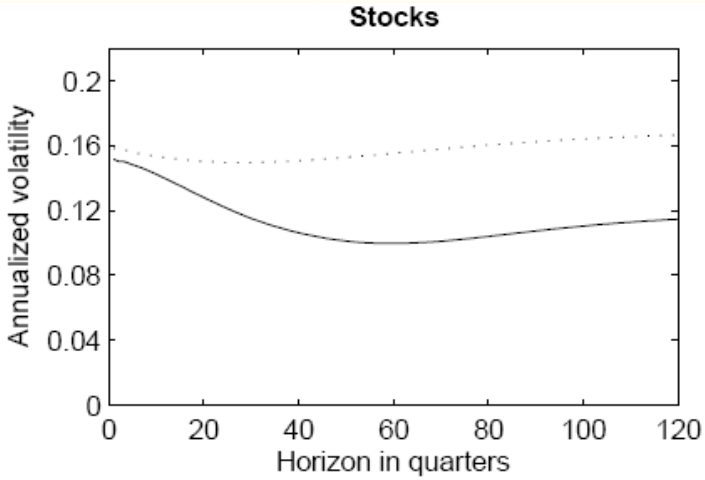
- VAR and VEC models deliver model-implied forward-looking term structures of risk and return parameters via the process of innovations $\varepsilon$.

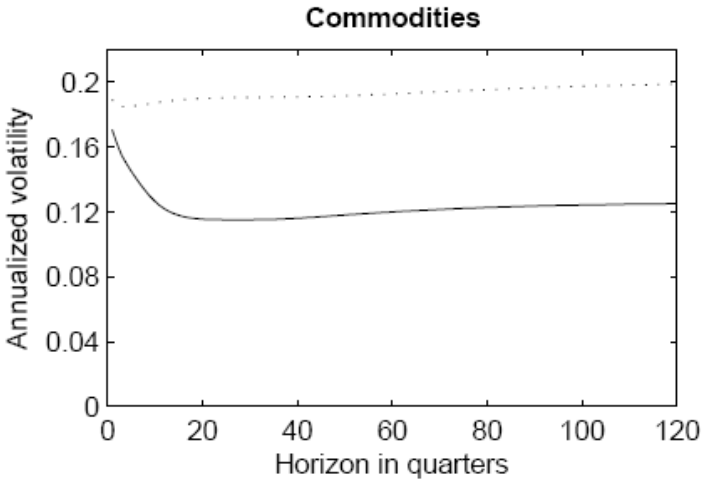

# *Econometric Methodology*

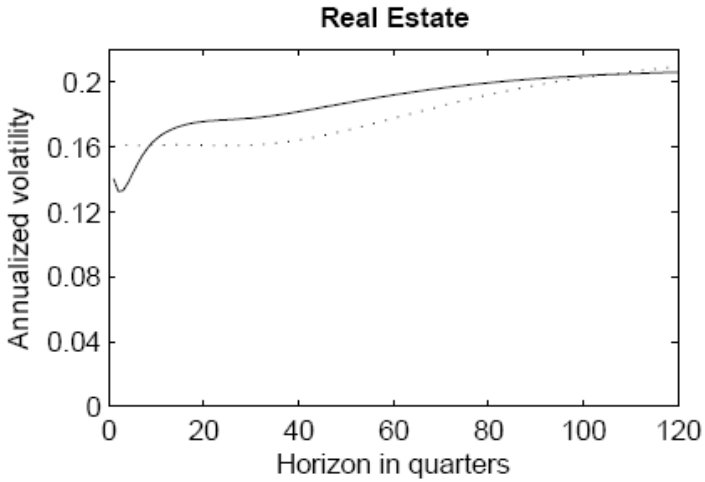
- Traditional assets:
  - Stocks: CRSP vw index of NYSE and AMEX listed stocks
  - Bonds: Lehman US Treasury Aggregate
  - T-Bill: 1 month treasury bills from CRSP
- Alternative assets:
  - Commodities: Goldman Sachs Commodity Index (GSCI)
  - Real estate: FTSE NAREIT real estate index
- Economic variables:
  - CPI index
  - Credit spread: difference of Baa and Aaa Corporate Bond yields
  - Term spread: difference between 10Y and 3M Treasury yield
  - Dividend yield from CRSP
- Data from Q1 1978 through Q4 2007.

# Term Structure of Volatilities

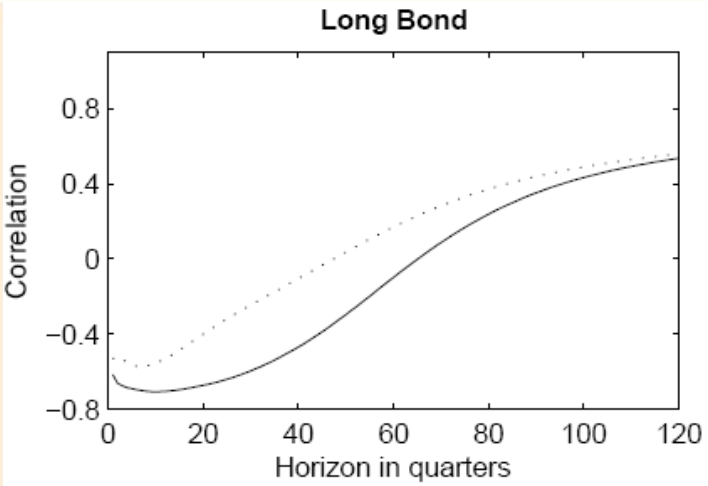


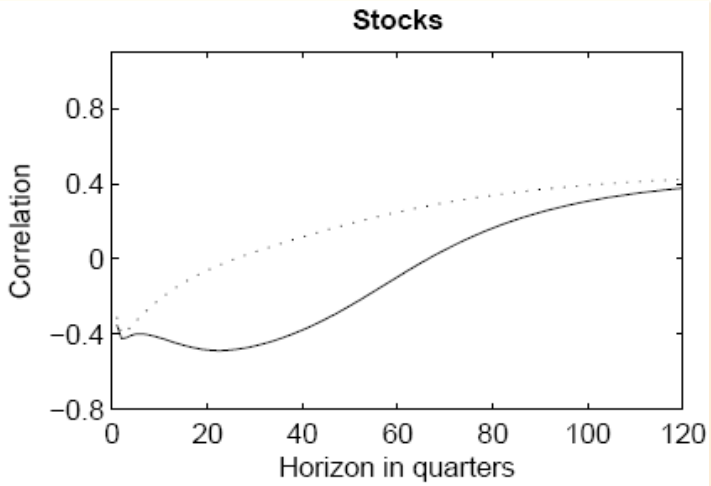



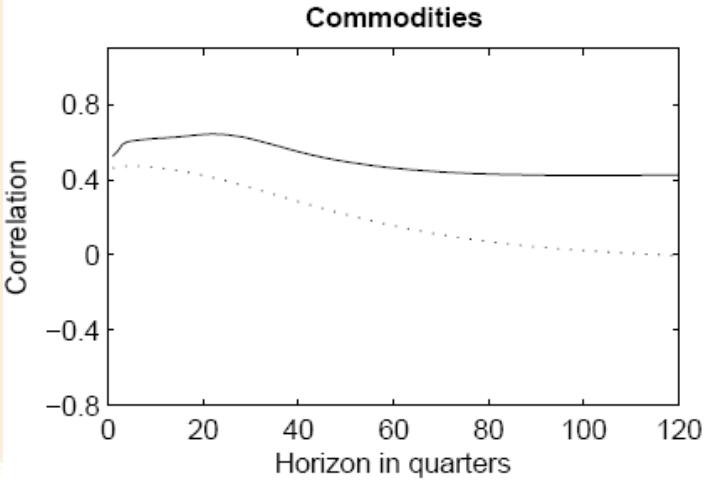



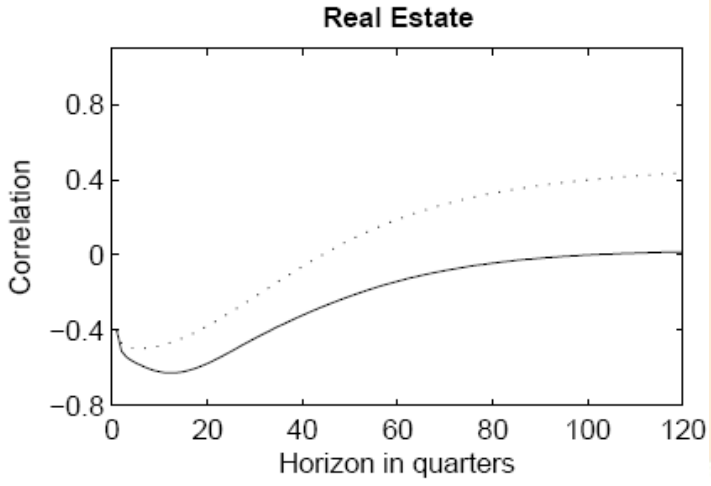



# TS of Correlations w.r.t. to Liabilities

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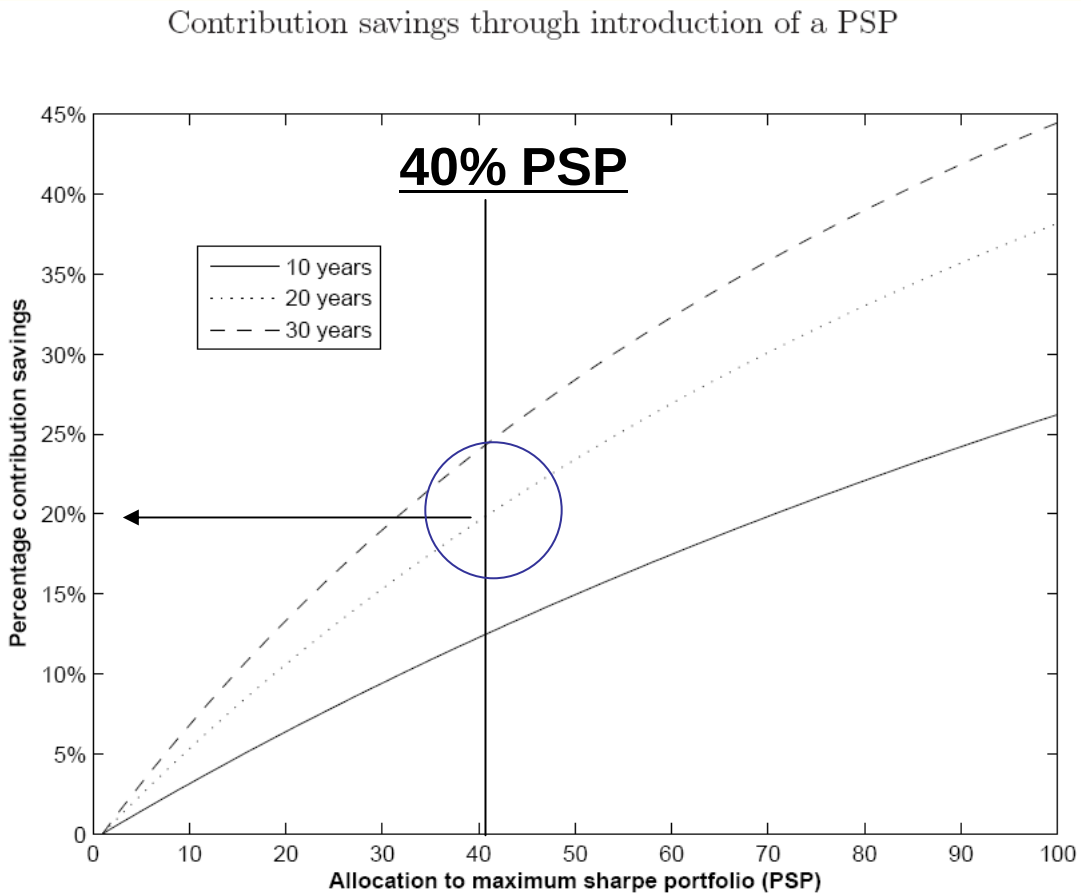
# *Risk Budgeting in ALM*

- In terms of risk budgets, the implementation of ALM/LDI solutions critically depends on the attitude towards risk.
  - High risk aversion levels leads to a predominant investment in the LHP, which in turn implies low extreme funding risk, low expected performance and high necessary contributions.
  - On the other hand, low risk aversion levels lead to a predominant investment in the PSP, which implies high funding risk, higher expected performance, and lower contributions.

- Compare the initial contribution needed to generate a 100% funding ratio at the horizon when the investor's portfolio is fully invested in TIPS (the perfect LHP) versus the initial contribution needed to generate an average 100% funding ratio at the horizon when stock-bond PSP is introduced.

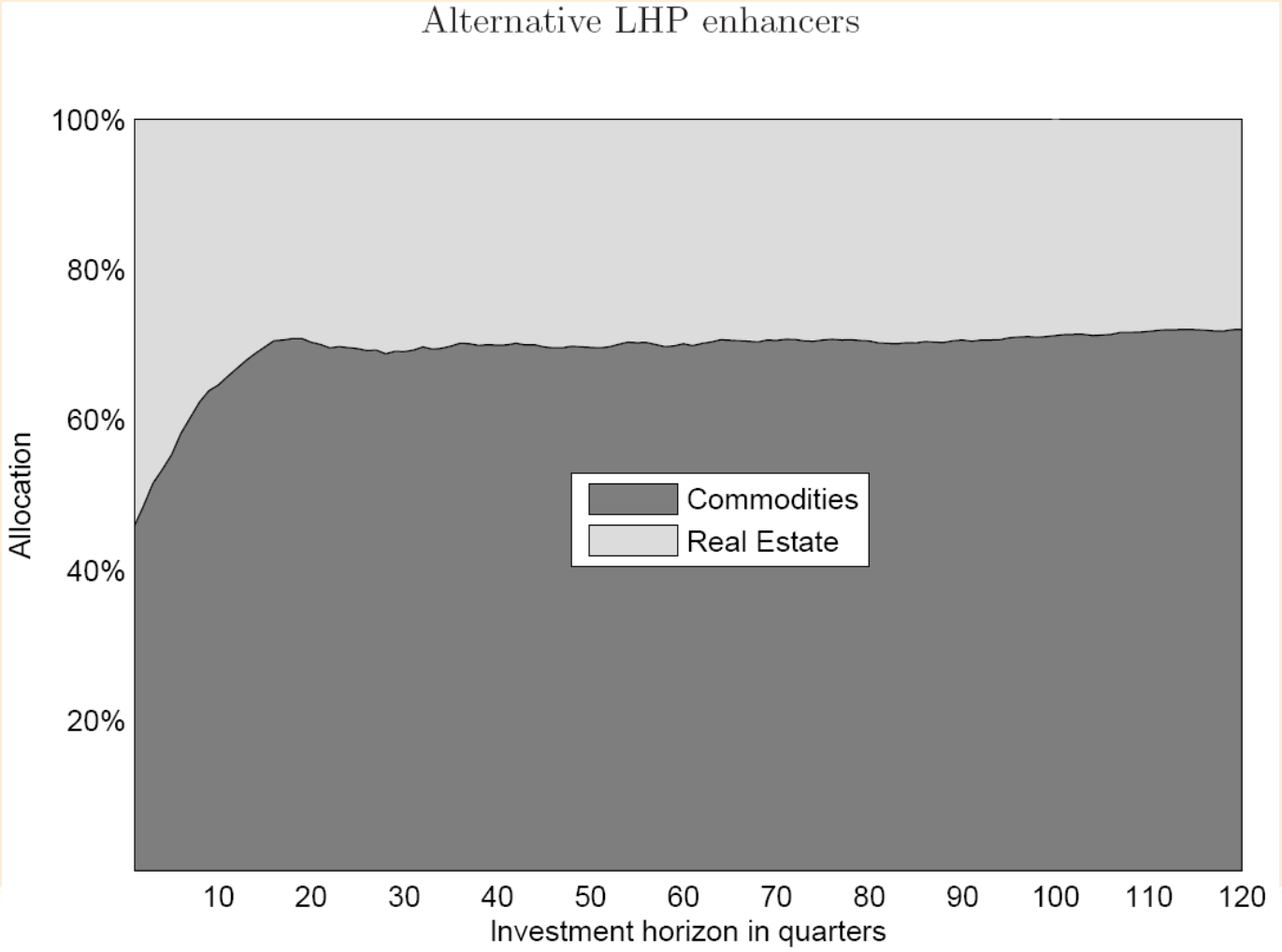
# *Introducing a PSP*

If horizon = 20 years, an allocation of 40% to the PSP => reduction of the initial contribution by almost 20%; of course, this comes at the cost of introducing funding risk.



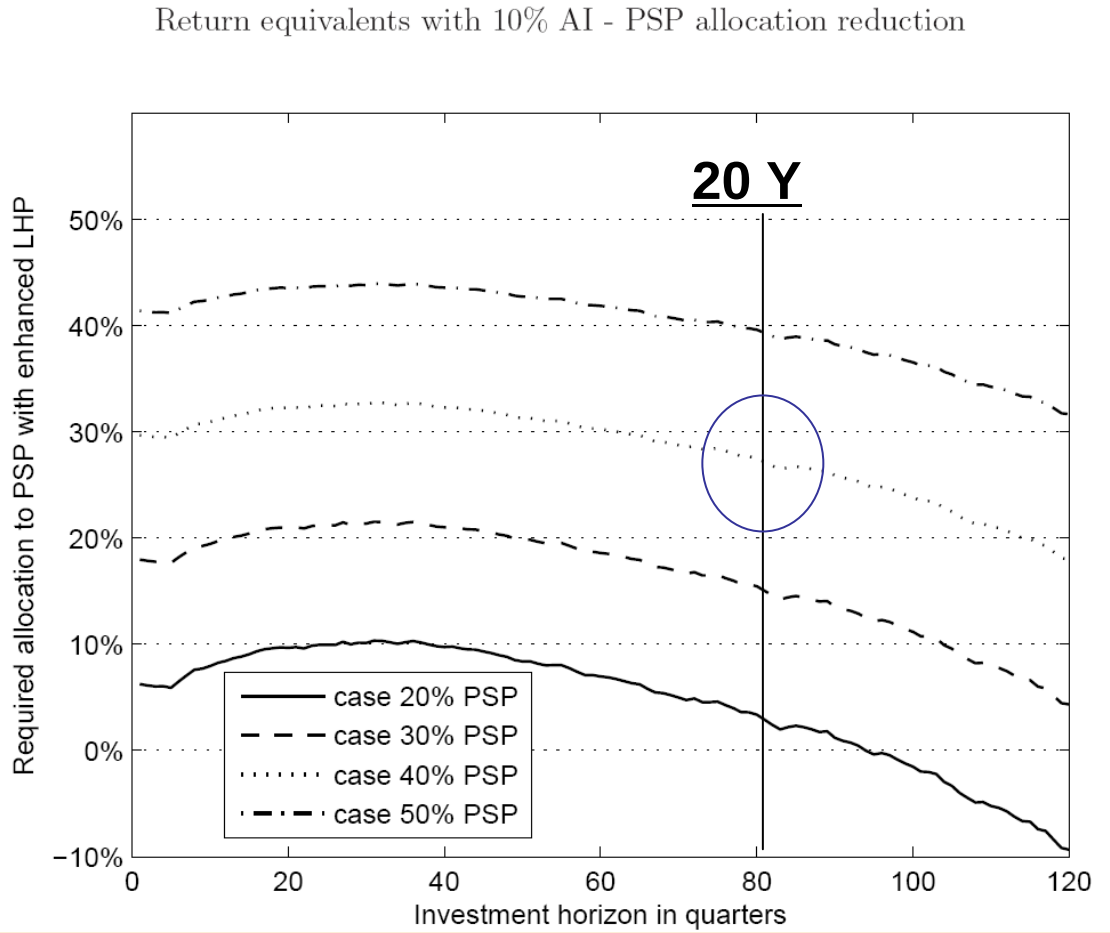

Contribution savings defined as the reduction of initial investment when introducing a PSP so that, on average, the pension plan is fully funded. PSP contains stocks and bonds in proportions that depend on horizon.

# Enhancing the LHP

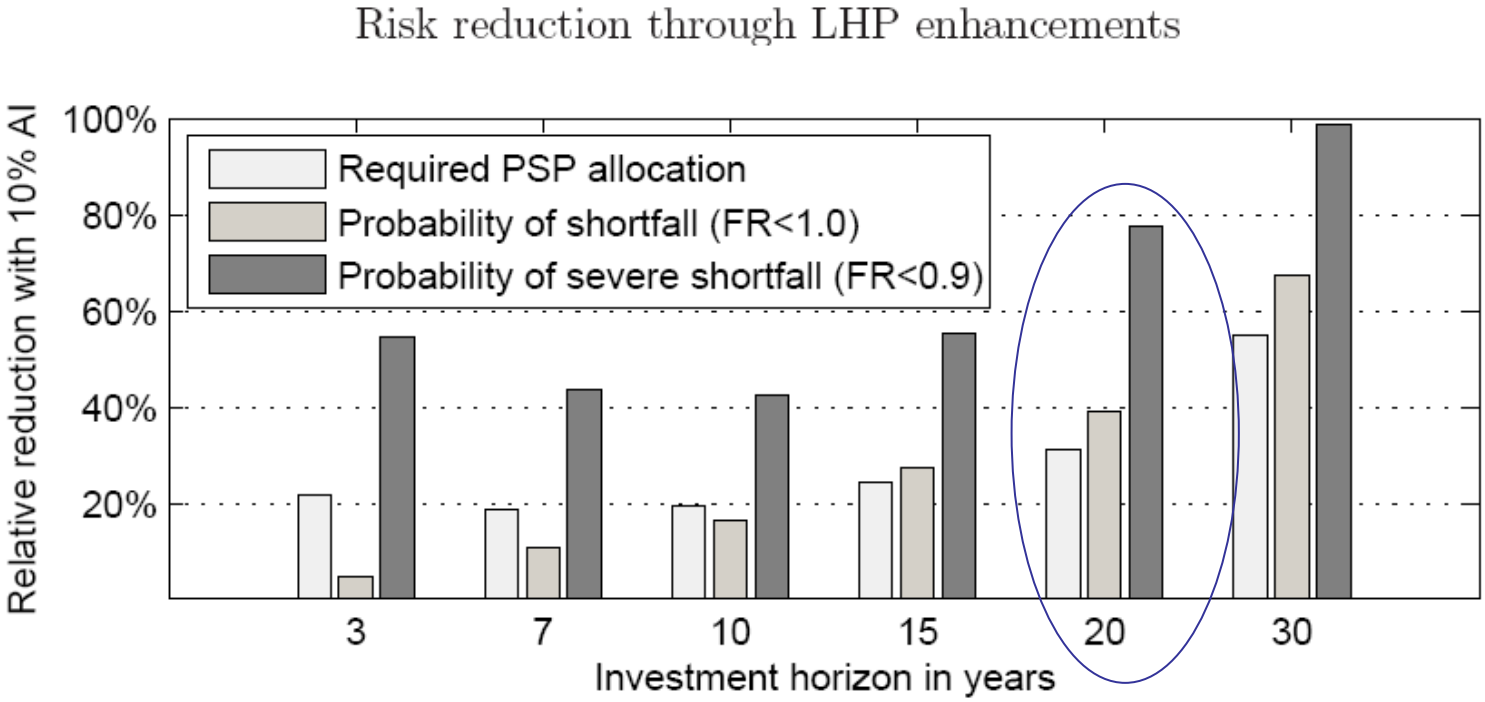
# Enhancing the LHP

If horizon = 20 years and LHP is enhanced (10% AI), only need 28% PSP to reduce contributions by same amount as when using 40% PSP, and 60% TIPS LHP.




This figure shows the impact of enhancing the LHP beyond TIPS. The enhanced LHP consists of 90% TIPS and 10% alternative investments. The graph shows the required allocations to the PSP needed to obtain on average the same expected return as with the LHP (TIPS).

# Risk Reduction




If horizon = 20 years and LHP is enhanced (10% AI), can reduce the allocation to PSP by 30% (28% instead of 40%), which leads to an 40% decrease in probability of shortfall and almost 80% decrease in probability of an extreme shortfall.

We consider the base case of an investment of 40% in the PSP and 60% in the traditional LHP and compare this portfolio to the case where the LHP is enhanced by 10% AI.

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# *Conclusion*

- Some alternative forms of investment (in particular commodities and real estate) exhibit attractive inflation hedging properties while offering compelling returns.
- Introduction of suitably selected alternatives in institutional investors' portfolios allows for a significant reduction in the required allocation to the PSP for a given level of performance (or required contributions).
- As a result of introducing liability-hedging portfolios with enhanced performance, as opposed to generating performance through the performance-seeking portfolio only, funding risk is significantly reduced.
- PSP could also be improved by the introduction of alternative assets.


# *Extensions*

- While we have focused on real estate and commodities, institutional investors have recently shown an increasing interest in other alternatives such as private equity and infrastructures, for which the intuition suggests that attractive inflation-hedging properties could also be obtained.
- More generally, one may envision to select securities or asset classes on the basis of their liability hedging properties, as opposed to selecting them on the basis of their expected abnormal performance.
- On the alternative side, precious metals and retail real estate, among others, show particularly attractive liability LT hedging benefits.