Rethinking the Stock-Bond Correlation

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[1]The opinions expressed in this presentation are those of the authors and are not meant to represent the opinions or official positions of Amundi Asset Management.

Stock-bond correlation

Definition

The stock-bond correlation $\rho_{S,B}$ for a given country is the correlation between the returns of the country's benchmark equity index and the returns of the country's long-maturity sovereign bond, from the point of view of the local investor.

Examples:

- S&P 500 & UST 10Y (in USD)
- DAX & Bund 10Y (in EUR)
- MIB & BTP 10Y (in EUR)
- MSCI China & CGB 10Y (in CNY)
- Nifty 50 & IGB 10Y (in INR)
- BIST 100 & TGB 10Y (in TRY)

Quiz

1. What is the natural sign of the stock-bond correlation?
   - ☐ **Negative**
   - ☐ **Positive**
2. What do you prefer from an investment perspective?
   - ☐ A **negative** stock-bond correlation
   - ☐ A **positive** stock-bond correlation
3. Which investors impact the stock-bond correlation the most?
   - ☐ **Long-term** investors
   - ☐ **Multi-asset** fund managers
   - ☐ **Risk parity** fund managers
   - ☐ **CTA** fund managers
4. What is your primary motivation for investing in sovereign bonds?
   - ☐ **Income**
   - ☐ **Diversification**
   - ☐ **Flight to quality**
   - ☐ **Equity hedge**

Quiz

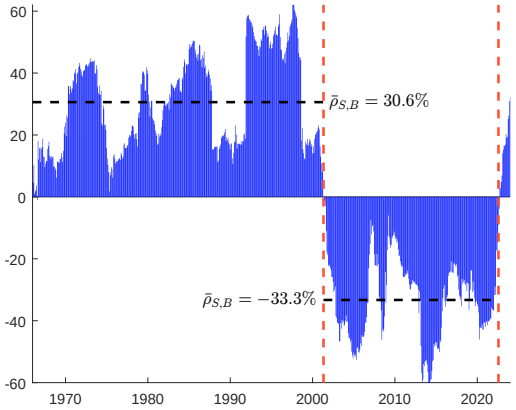
1. What is the sign of the stock-bond correlation used in your strategic asset allocation (SAA) policy?
   - ☐ **Negative**
   - ☐ **Positive**

2. What are the condition(s) to get a negative stock-bond correlation?

Carry	☐ Low	☐ High
Credit risk	☐ Low	☐ High
Inflation risk	☐ Low	☐ High
Growth risk	☐ Low	☐ High
Monetary policy	☐ Accommodative	☐ Tight

US analysis of the stock-bond correlation

Figure: Rolling 4-year stock-bond correlation (US, 10Y, 1965-2023, monthly frequency)



Source: Amundi Investment Institute (2024).

Where we were (five years ago)

Table: Stock-Bond correlation (10Y, monthly returns, December 2019)

Country	$\hat{\rho}_{S,B}$	Country	$\hat{\rho}_{S,B}$	Country	$\hat{\rho}_{S,B}$	Country	$\hat{\rho}_{S,B}$
Argentina		Egypt	−13.2%	Japan	**-66.7%**	Romania	29.2%
Australia	−10.3%	Finland	5.0%	Korea	−33.8%	Russia	33.5%
Austria	**-41.3%**	France	−12.3%	Malaysia	22.6%	Singapore	−17.5%
Belgium	20.7%	Germany	**-33.8%**	Mexico	**41.6%**	South Africa	21.2%
Brazil	**61.2%**	Greece	**76.8%**	Netherlands	−7.5%	Spain	0.0%
Bulgaria	−9.0%	Hong Kong	18.2%	New Zealand	21.2%	Sweden	**-26.0%**
Canada	**-23.1%**	Hungary	10.9%	Norway	−36.2%	Switzerland	**-25.3%**
Chile	9.3%	India	−10.4%	Peru	**50.1%**	Taiwan	16.4%
China	11.0%	Indonesia	**51.0%**	Philippines	**57.1%**	Thailand	
Colombia	30.9%	Ireland	−13.2%	Poland	−1.3%	Turkey	**55.6%**
Czechia	−6.8%	Israel	−2.9%	Portugal	29.8%	UK	15.6%
Denmark	1.1%	Italy	28.6%	Qatar	21.4%	US	**-36.3%**

Source: Amundi Investment Institute (2025).

Where we are (current picture)

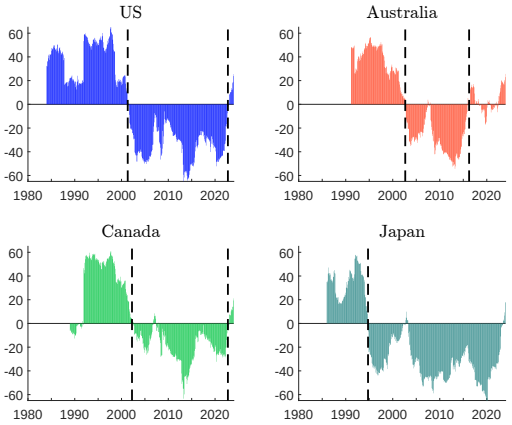
Table: Stock-Bond correlation (10Y, monthly returns, December 2024)

Country	$\hat{\rho}_{S,B}$	Country	$\hat{\rho}_{S,B}$	Country	$\hat{\rho}_{S,B}$	Country	$\hat{\rho}_{S,B}$
Argentina	29.0%	Egypt	**-26.1%**	Japan	20.9%	Romania	**51.7%**
Australia	**47.8%**	Finland	38.9%	Korea	**49.0%**	Russia	
Austria	27.8%	France	**52.9%**	Malaysia	27.1%	Singapore	29.8%
Belgium	35.4%	Germany	**52.9%**	Mexico	24.6%	South Africa	**60.9%**
Brazil	**51.5%**	Greece	23.4%	Netherlands	**60.8%**	Spain	25.4%
Bulgaria	26.0%	Hong Kong	39.8%	New Zealand	**60.6%**	Sweden	**44.9%**
Canada	**50.4%**	Hungary	**41.6%**	Norway	**-15.2%**	Switzerland	**43.5%**
Chile	17.3%	India	28.7%	Peru	28.9%	Taiwan	39.3%
China	**-22.9%**	Indonesia	26.4%	Philippines	33.5%	Thailand	12.6%
Colombia	6.9%	Ireland	38.4%	Poland	34.3%	Turkey	10.2%
Czechia	13.7%	Israel	**52.5%**	Portugal	24.1%	UK	**44.4%**
Denmark	35.5%	Italy	**44.6%**	Qatar	27.3%	US	**62.3%**

Source: Amundi Investment Institute (2024).

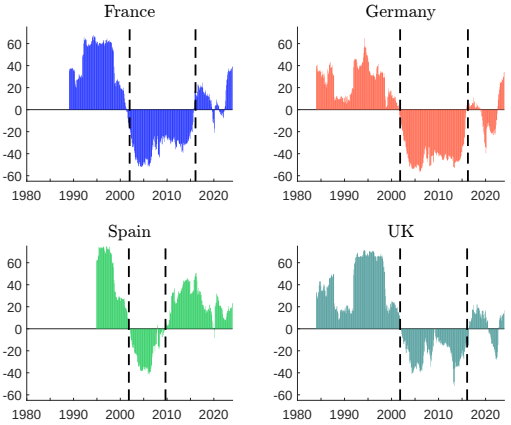
Country analysis of the stock-bond correlation — The case of DM countries

Figure: US, Australia, Canada, Japan



Source: Amundi Investment Institute (2024).

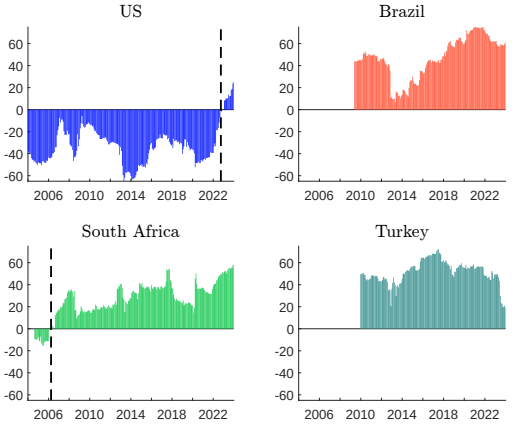
Figure: France, Germany, Spain, UK



Source: Amundi Investment Institute (2024).

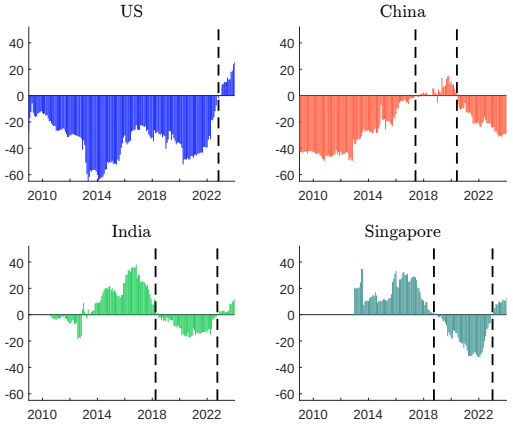
Country analysis of the stock-bond correlation — The case of EM countries

Figure: Brazil, South Africa, Turkey



Source: Amundi Investment Institute (2024).

Figure: China, India, Singapore



Source: Amundi Investment Institute (2024).

Estimation of risk premium

Implied Risk Premium (Sharpe & Black-Litterman models)

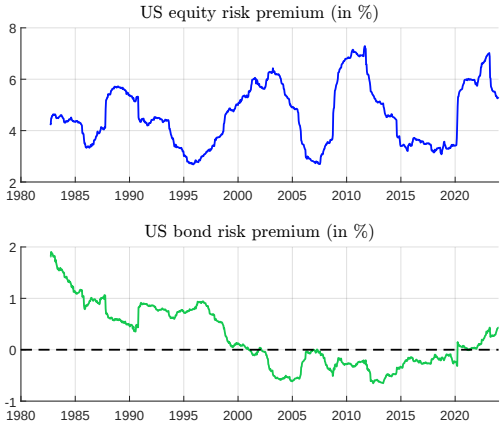
- The implied risk premium is the risk premium derived from the market portfolio
- It is the risk premium **valued or required by the market**
- It has two components:
  1. A variance risk premium
  2. A covariance risk premium
- The equity and bond risk premia depend on the stock-bond correlation

Risk premium (ex-ante) $\neq$ historical return (ex-post)

Distinction between performance assets & hedging assets

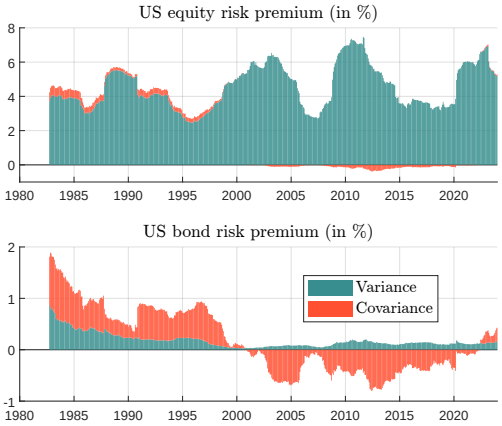
US analysis of the implied risk premium

Figure: US risk premia



Source: Amundi Investment Institute (2024).

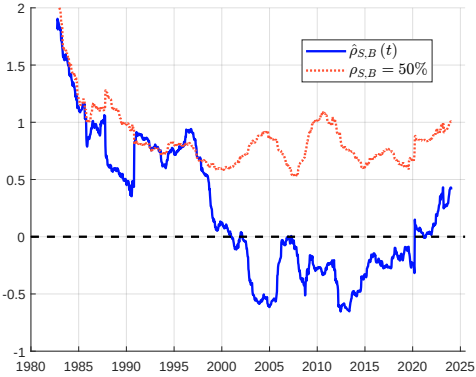
Figure: Variance and covariance premia



Source: Amundi Investment Institute (2024).

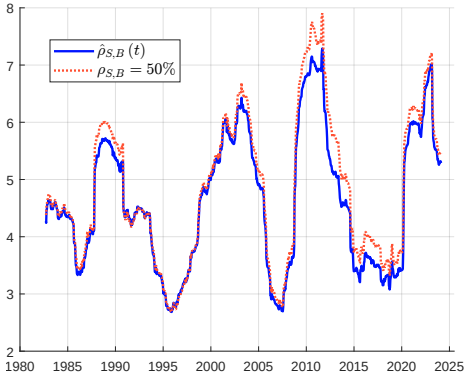
US analysis of the implied risk premium

Figure: US bond risk premium under different hypothesis on the stock-bond correlation



Source: Amundi Investment Institute (2024).

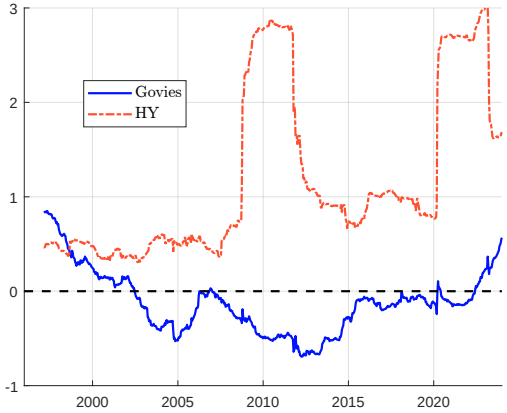
Figure: US equity risk premium under different hypothesis on the stock-bond correlation



Source: Amundi Investment Institute (2024).

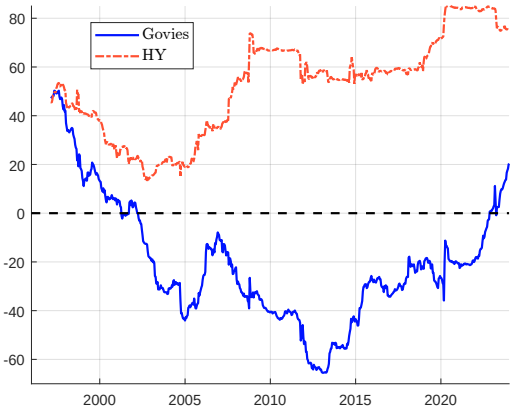
US analysis of the implied risk premium

Figure: US risk premia (10Y vs. high yield)



Source: Amundi Investment Institute (2024).

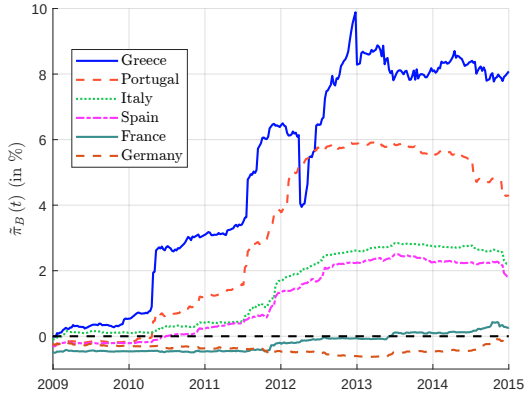
Figure: US stock-bond correlation



Source: Amundi Investment Institute (2024).

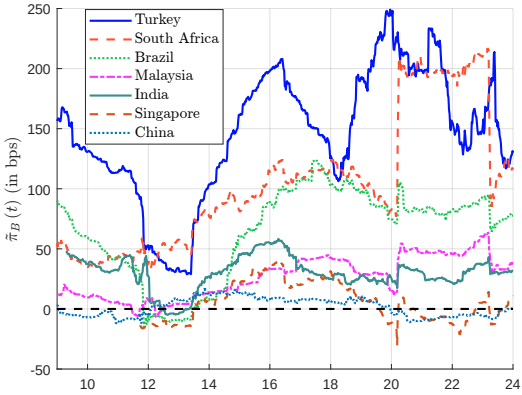
Country analysis of the implied risk premium

Figure: Bond risk premium during the European debt crisis



Source: Amundi Investment Institute (2024).

Figure: Bond risk premium of EM countries (local currency)



Source: Amundi Investment Institute (2024).

Aggregate vs. individual stock-bond correlation

- The stock-bond correlation can be written as:

$$\rho_{S,B}(t) = \sum_{i=1}^{n} w_i(t)\,\gamma_i(t)\,\rho_{i,B}(t) = \mathscr{L}(\omega) \sum_{i=1}^{n} \tilde{w}_i(t)\,\rho_{i,B}(t) \geq \bar{\rho}_{i,B}(t)$$

  where $\gamma_i(t) = \dfrac{\sigma_i(t)}{\sigma_S(t)}$ is the volatility ratio, $\mathscr{L}(\omega) = \sum_{i=1}^{n} w_i(t)\,\gamma_i(t)$ is the correlation leverage ratio and $\tilde{w}_i(t) = \dfrac{w_i(t)\,\gamma_i(t)}{\mathscr{L}(\omega)}$

- Diversification creates **correlation leverage**:

$$\mathscr{L}(\omega) = \mathbf{DR}(w) \geq 1$$

  where $\mathbf{DR}(w)$ is the Choueifaty-Coignard diversification ratio
- The contribution of stock i to the stock-bond correlation is an increasing function of its weight and its volatility ratio
- The stock-bond correlation is mainly driven by large-cap and highly volatile stocks

The mathematics of aggregate stock-bond correlation

Rule of thumb (impact of diversification on variance/covariance risk)

- In a diversified portfolio, volatility risk is **divided by three**
- In a diversified portfolio, correlation risk is **multiplied by two**

Diversification generates volatility deleverage and correlation leverage!

Not one stock-bond correlation, but many stock-bond correlations

- Stocks
- Portfolios
- Sectors
- Factors

Aggregate vs. individual stock-bond correlation

Figure: Confidence interval of the individual stock-bond correlation (US, monthly return)

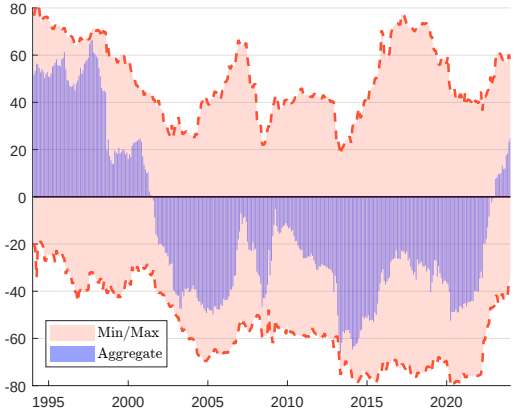
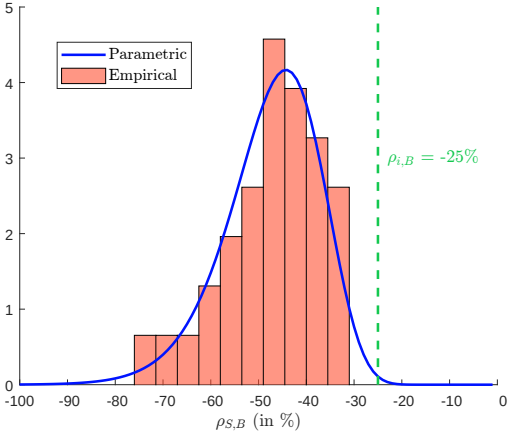
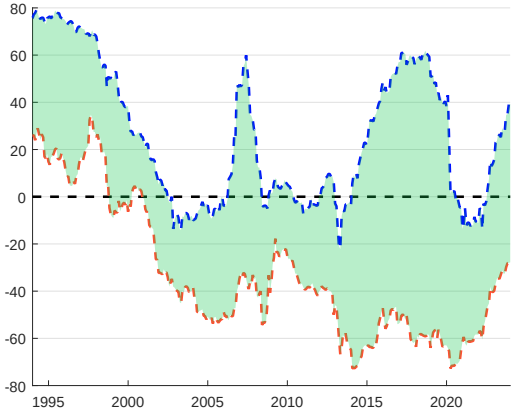


Figure: Amplifying effect of the individual stock-bond correlation (1990–2023)



Sector analysis (aggregate stock-bond correlation)

Figure: Sector range of US stock-bond correlation



Source: Amundi Investment Institute (2024).

Sector analysis (aggregate stock-bond correlation)

Table: Difference $\rho_{S,B}^{\text{Sector}} - \rho_{S,B}^{\text{Index}}$ in % (S&P 500)

Sector	1995 1999	2000 2004	2005 2009	2010 2014	2015 2019	2020 2023	1995 2003
Communication Services	−0.9	7.8	12.3	34.6	36.2	13.7	17.4
Consumer Discretionary	−21.4	−6.9	2.9	5.8	2.0	9.2	−1.7
Consumer Staples	−12.8	14.2	19.6	26.2	43.7	10.6	17.1
Energy	−11.7	13.8	9.5	−1.1	−3.0	−26.2	−2.5
Financials	3.1	2.7	8.1	0.7	−23.9	−21.6	−4.7
Health Care	−14.5	20.7	19.5	16.5	18.8	9.8	11.9
Industrials	−8.6	−3.1	−4.4	3.8	−2.3	−10.5	−4.0
Information Technology	−27.3	2.7	1.0	−5.0	5.1	14.9	−1.9
Materials	−25.3	1.9	−9.2	1.0	−1.7	−5.0	−6.4
Real Estate			23.0	16.1	71.1	24.4	34.5
Utilities	18.7	16.5	42.4	35.9	82.4	21.4	36.7

Source: Amundi Investment Institute (2024).

- Real estate $\gg$ Index
- Utilities $\gg$ Index
- Communication services $>$ Index
- Consumer staples $>$ Index
- Health care $>$ Index

Factor analysis (aggregate stock-bond correlation)

Table: Difference $\rho_{S,B}^{\text{Factor}} - \rho_{S,B}^{\text{Index}}$ in % (S&P 500)

Period	Pure Value	Pure Growth	High beta	Low Vol.	Momen-tum	High Div.	Qua-lity
1995-1999	−4.1	−5.5	−8.3	6.2	5.0	0.6	8.4
2000-2004	7.3	−2.8	−4.6	14.2	11.8	7.9	8.5
2005-2009	7.7	3.8	3.3	16.9	0.6	16.0	1.9
2010-2014	−1.0	−2.0	−5.3	18.1	−3.2	16.1	3.4
2015-2019	−13.6	7.9	−15.2	43.6	9.7	33.3	3.7
2020-2023	−27.4	9.2	−12.5	6.0	10.2	−22.1	2.8
2000-2023	−4.6	2.8	−6.7	19.9	5.6	11.1	4.2

Source: Amundi Investment Institute (2024).

- Low volatility $\gg$ Index
- High dividend $>$ Index
- Quality $>$ Index
- Growth $>$ Value

Macroeconomic models of the stock-bond correlation

Many models, but three families:

- Inflation-centric model(s)
- Real-centric model(s)
- Growth-inflation model(s)

$\Rightarrow$ In most theoretical models, the stock-bond correlation is positive

Positive correlation

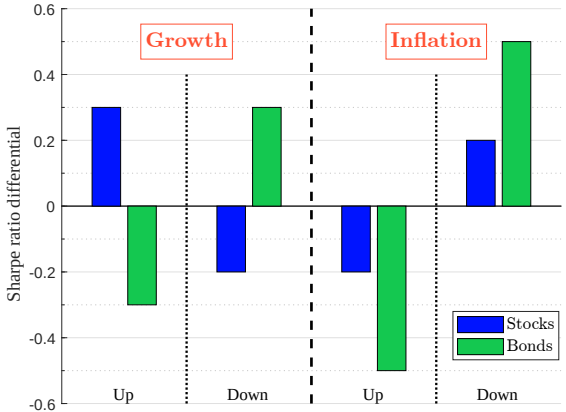
- Real interest rate
- Inflation risk
- Discounting (DCF)

Negative correlation

- Flight to quality
- Accommodative monetary policy
- Growth risk

Growth-inflation model

Figure: Sharpe ratio differentials by macroeconomic environment (US, January 1972-June 2022)



Source: Brixton *et al.* (2023, Exhibit 3, page 5).

Why can correlation be negative?

What conditions must be in place for the correlation between equities and bonds to turn negative again?

- Growth risk $\gg$ Inflation risk (no real rate influence)
- Low carry (so that bonds can be used as hedging assets)
- Low credit risk (to allow flight to quality)
- Accommodative monetary policy

The US 10Y bond was the **universal hedging asset** for exposure to DM equity markets from 2005 to 2020 $\Rightarrow$ Negative risk premium

Why has the Bund partially lost its status of hedging asset for exposure to European equity markets?

Local correlation vs. average correlation

- Most of the time, **the stock-bond correlation is zero**
- Stock-bond correlation is explained by a **small number of observations** (bad and good times)
- Distinction between average and local correlation

Table: Local correlation in % of stock-bond market regimes (US, daily returns, $\alpha = 10\%$)

Stock-bond market regime	1980-1999		2000-2019		2021-2023	
	$\mathscr{B}ad$	$\mathscr{G}ood$	$\mathscr{B}ad$	$\mathscr{G}ood$	$\mathscr{B}ad$	$\mathscr{G}ood$
$\mathscr{B}ad$	**44.17**	12.49	−12.36	**−55.06**	**26.38**	**−20.63**
$\mathscr{G}ood$	22.35	**37.22**	**−45.05**	−19.35	4.28	11.05
Full period	34.2		−33.7		5.83	

Nonlinear bond payoff (conditional vs. unconditional expected return)

Figure: US monthly returns (1980–1999)

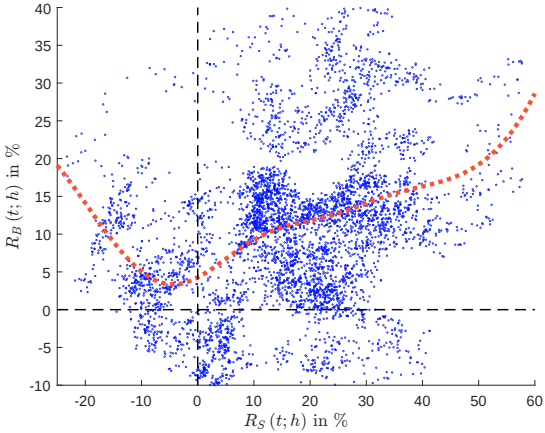
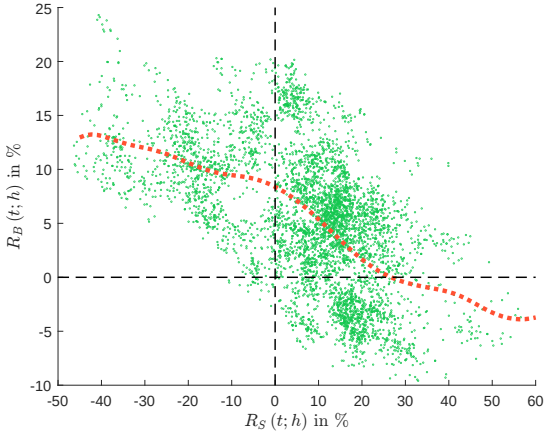
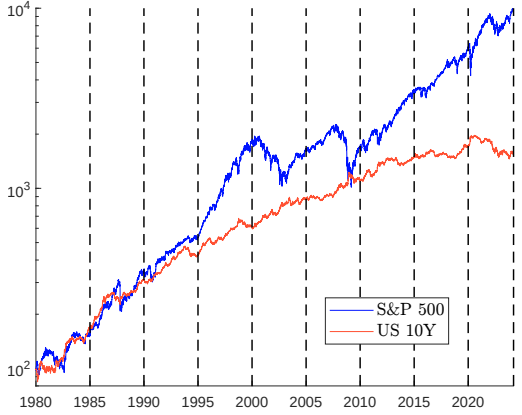


Figure: US monthly returns (2000–2019)



Long-term dependence

Figure: Cumulative performance of the S&P 500 Index and the generic US 10Y bond



Remark

The non-overlapping five-year stock-bond correlation has been equal to +19% between 1980 and 2023

The coherence puzzle of strategic asset allocation (SAA)

Common practice of strategic asset allocation

Risk premia are estimated by economists and strategists, while risk metrics are estimated by quants and statisticians

SAA assumptions at Year t

- $\pi_S = 6\%$
- $\pi_B = 1\%$
- $\sigma_S = 15\%$
- $\sigma_B = 3\%$
- $\rho_{S,B} = -30\%$

SAA assumptions at Year $t+1$

- $\pi_S = 6\%$
- $\pi_B = 3\%$
- $\sigma_S = 15\%$
- $\sigma_B = 4\%$
- $\rho_{S,B} = -30\%$

Can we do that?

The common practice of independently estimating risk premia and cross-correlations is flawed!

Stock-bond correlation & strategic asset allocation (SAA)

Assumptions:

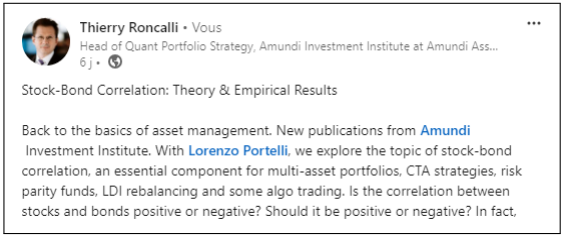
- Equity: $\mu_S = 8\%$, $\sigma_S = 15\%$
- Bond: $\mu_B = 2.5\%$, $\sigma_B = 6\%$
- Cash: $r = 1\%$

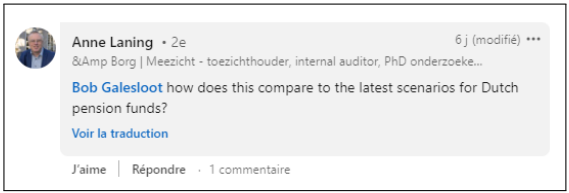
Table: Tangency portfolios

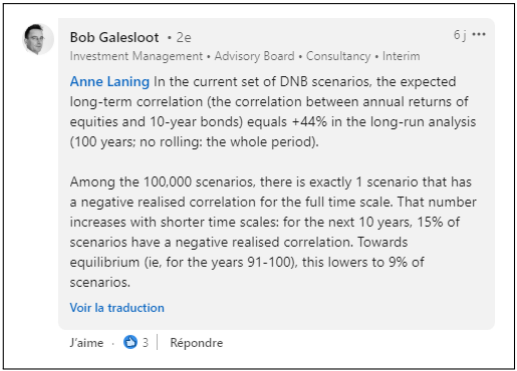
$\rho_{S,B}$	-40%	-20%	0%	20%	40%
Equity	34.2%	37.6%	42.7%	51.5%	69.8%
Bond	65.8%	62.4%	57.3%	48.5%	30.2%

$\Rightarrow$ European Pension Funds' SAA $\neq$ Sovereign Wealth Funds' SAA

Dutch pension funds use a stock-bond correlation of 40% for their SAA







Implications for tactical asset allocation

Who participates in setting the stock-bond correlation?

- Tactical multi-asset managers
- CTA hedge funds and momentum investors
- Risk parity funds
- Some quantitative managers

Who's not participating?

- Buy and hold investors
- Single-asset class managers (*e.g.*, equity or bond managers)?

In fact, a very small proportion of investors and market participants are involved in the formation of the stock-bond correlation

Implications for tactical asset allocation

Long-term investors (SAA) prefer a positive stock-bond correlation, while most of short-term investors (TAA) prefer a negative stock-bond correlation

$\Rightarrow$ A second coherence puzzle: Stock-bond correlation & constant-mix strategy (how to solve it?)

Two completely different motivations:

- CTA hedge funds prefer a negative stock-bond correlation for **equity short selling**, because they do not want to pay the vega risk!
- Risk parity funds prefer a negative stock-bond correlation for **equity hedging**

Stock-bond correlation & tactical asset allocation (TAA)

- What is the cost to hedge an equity exposure with a bond exposure?
- What is the cost to hedge an equity exposure with a put option?

Ex-ante

- The cost of both strategies is negative
- Expected hedge ratio
- Expected Gamma costs

Ex-post

- The cost of strategies can diverge
- Realized hedge ratio
- Observed Gamma costs
- A newcomer: **Delta**

$\Rightarrow$ Parallel with the straddle option & the trend-following strategy (option profile vs. trading P&L)

Implications for asset allocation

The magic formula

Positive long-term correlations in the long-run, but...

...negative short-term correlations in bad times 

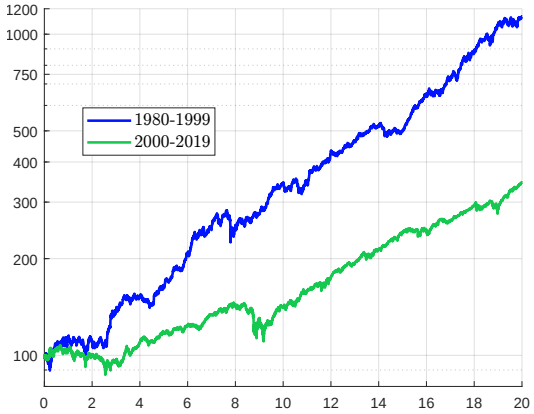
But real life is more complex...

Conclusion

- Performance concerns vs. risk concerns
- The special status of US bonds: universal hedging asset?
- US-centric view of the stock-bond correlation
  - Currency risk
  - Debt risk
- On the importance of the carry
- Relationship between stock-bond correlation and the covariance risk premium of bonds
- Stock-bond correlation & conditional expected return
- Bonds exhibit non-linear payoff
- In normal market regimes, the stock-bond correlation can be assumed to be zero
- Flight-to-quality episodes account for 90% of the stock-bond correlation since 2005

Conclusion

Figure: Cumulative performance of US 50/50 equity-bond constant-mix portfolio



Behavioral finance theory

Negative stock-bond correlation $\Longrightarrow$ **Hedging** property of bonds

or

Effective hedging of bonds $\Longrightarrow$ **Negative** stock-bond correlation

Amundi Working Paper

Figure: Amundi Working Paper

Portelli, L., and Roncalli, T. (2024). Stock-Bond Correlation: Theory & Empirical Results. Amundi Working Paper, WP-160, 146 pages, May.

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