Strategic Asset Allocation and Long-Term Investment Policy[1]

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

Outline

1. Some Issues on Long-Term Investment Policy
2. Our Approach
3. Economic Modeling of Asset Returns
4. Economic Modeling of Volatility and Correlations
5. Strategic Asset Allocation in Practice
6. Sensitivity and Scenario Analysis

Some Issues

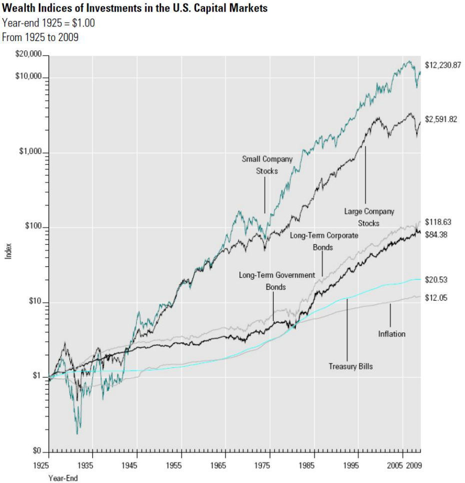
Some questions:

- What is the definition of SAA (Strategic Asset Allocation)?
- What is the long-run?
- What is the difference with TAA (Tactical Asset Allocation)?
- How to define the risk premium?
- Why SAA is important for pension funds?

Some answers:

- Misunderstanding between SAA and Long-Term Investment Policy
- Historical figures (constant-stationary) $\neq$ steady-state (trend-stationary)
- Definition of the long-run depends on the model (Solow, Ramsey, Barro, DSGE, etc.)
- The short rate is not always the right anchor to define a risk premium
- Imitation-based theory = unstable and unsatisfactory equilibrium

Future Returns could not be the same as History

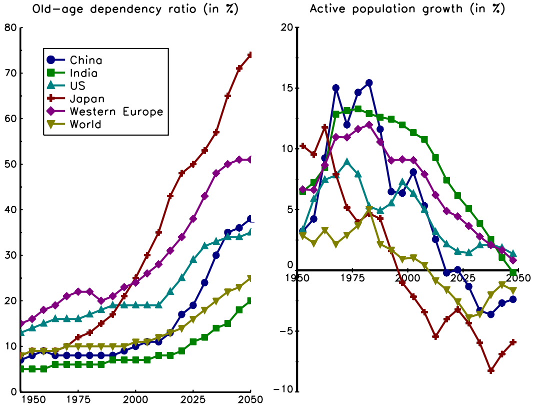


Source: Ibboston (2010)

- Bonds
- Large Caps & Small Caps
- Equity
- T-bills
- Inflation

The World is Changing

- Globalization
- Demographic changes
- Emerging economies
- Natural ressources
- Saving rate



MT, TAA and SAA

Market Timing

- Market sentiment
- No (economic) risk premium

Tactical Asset Allocation

- Business cycle
- Time-varying risk premium

Strategic Asset Allocation

- Growth model
- Stationary risk premium

Micro-Finance

Behavioral model, volatility target.

Macro-Finance

Lucas (1978), Campbell and Cochrane (1999).

Macro-Economics

Solow (1956), fundamental approach.

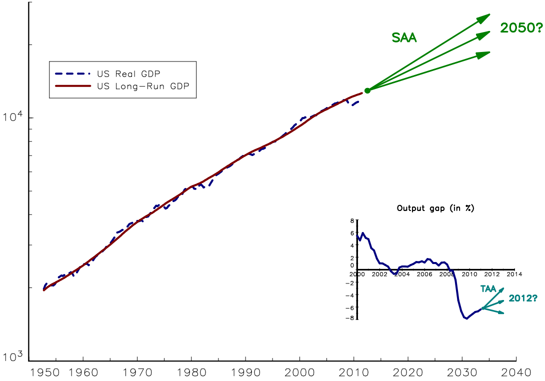
MT	TAA	SAA
1 Day - 1 Month	3 Months - 3 Years	10 Years - 50 Years

The Model

- A comprehensive framework
  - Expected return / Volatility / Correlation
  - Equity / Bond / Currency / Commodity / Real estate / Private Equity / Hedge Funds
  - US / EURO / JAPAN / PACIFIC / EM
- Needs an economic scenario
- Based on economic models (Solow model, Golden rule, Phillips curve, NAIRU, etc.)
- Stationary steady-state (SAA = Stationary Asset Allocation)
- Justifying the distinction between TAA and SAA
- Understanding the concept of risk premium (= most co-integrated relationship)
- Sensitivity and Scenario analysis

Economic Dynamics and Asset Prices

- SAA is concerned by the long-run dynamics of macro-economic variables (eg. GDP)
- TAA is concerned by the short-term dynamics of macro-economic variables (eg. output gap)



Economic Dynamics and Asset Prices

Long-run investment policy is concerned by the price dynamics of financial assets

A robust long-term investment policy is defined by:

1. a SAA process
2. a TAA process
3. (maybe) a MT process
4. a link between these three processes

Economic Dynamics and Asset Prices

Anchor variable

Risk premium

Return of the financial asset

$$R_t = \ln P_t - \ln P_{t-1} = \rho_t + \mathscr{R}_t$$

Let X_t be a set of economic and financial variables.

We assume that $P_t \sim I(1)$ and $X_t \sim I(1)$.

The vector $Z_t = (P_t, X_t)$ is cointegrated:

$$\boxed{P_t - \beta^\top X_t \sim I(0)}$$

SAA

The error correction model is:

TAA

$$\Phi(L)\,\Delta Z_t = c_t + \alpha Z_{t-1} + \eta_t$$

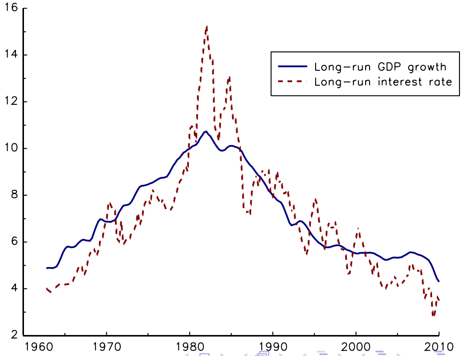
MT

Long-term investors don't want only to be hedged against $\beta^\top X_\infty$!

Asset prices vary with business cycles over the medium term ...

... and converge to their *fundamental* value over the long run

Returns of financial assets converge towards the returns of physical assets



The Two Economic Pillars

Potential Growth

Inflation

$\Downarrow$

Long-run Returns on Asset Classes

Short Rate $\Rightarrow$ Government Bonds $\Rightarrow$

- Equities
- Corporate Bonds
- Commodities
- Other Asset Classes

The Two Economic Pillars

In the Solow model, the economy tends to a stationary steady-state which depends on 3 factors:

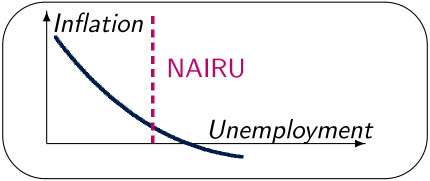
1. Productivity growth
2. Employment growth
3. Investment rate

The model takes into account technological shocks and dynamics of working population.

Its framework assumes social welfare maximization

Phillips curve = trade-off between unemployment and inflation

On the long-run, the unemployment rate converges to the NAIRU



Long-run inflation depends on expectations and structural factors

Economic Forecasts

Economic forecast for GDP

	1980-1990	1990-2000	2000-2010	2020	2030	2050
US	3.1%	3.1%	3.9%	2.4%	2.5%	2.6%
EURO	2.1%	2.2%	1.8%	1.6%	1.7%	1.7%
JAPAN	3.7%	1.7%	1.5%	1.3%	1.4%	1.4%
PACIFIC	3.4%	3.3%	2.9%	3.1%	2.8%	2.7%
EM	3.5%	3.3%	5.9%	5.7%	4.8%	4.4%

Economic forecast for inflation

	1980-1990	1990-2000	2000-2010	2020	2030	2050
US	5.6%	3.0%	2.5%	2.1%	2.2%	2.2%
EURO	5.9%	2.6%	2.2%	2.0%	2.1%	2.1%
JAPAN	2.7%	1.2%	−0.6%	1.1%	1.2%	1.2%
PACIFIC	8.4%	2.5%	3.2%	2.5%	2.5%	2.5%
EM	10.0%	8.0%	6.8%	4.1%	4.5%	4.7%

Short Rates

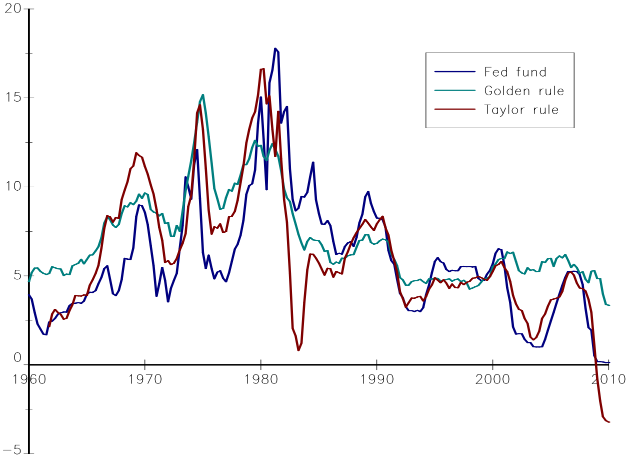
We propose to derive long-run short rates r_∞ from the lower bound of the normative Golden rule:

$$r_\infty = g_\infty + \pi_\infty$$

where g_∞ is the long-run real potential output growth and π_∞ is the long-run inflation.

	1980-1990	1990-2000	2000-2010	2020	2030	2050
US	8.7%	6.1%	6.4%	4.5%	4.7%	4.8%
EURO	8.0%	4.8%	4.0%	3.6%	3.7%	3.8%
JAPAN	6.4%	2.9%	0.9%	2.4%	2.5%	2.6%
PACIFIC	14.5%	7.2%	5.5%	5.6%	5.3%	5.2%
EM				9.8%	9.3%	9.1%

Short Rates


20
15
10
5
0
−5
1960
1970
1980
1990
2000
2010
Fed fund
Golden rule
Taylor rule

Sovereign Bonds

The long-run value of the nominal bond yield R_∞^b is equal to:

$$R_\infty^b = \mathscr{R}_\infty^{\mathrm{b}} + \pi_\infty$$

where $\mathscr{R}_\infty^{\mathrm{b}}$ is the long-run real bond yield $\mathscr{R}_\infty^{\mathrm{b}}$ and π_∞ is the long-run inflation.

To estimate $\mathscr{R}_\infty^{\mathrm{b}}$, we consider the following regression model:

$$\mathscr{R}_t^{\mathrm{b}} = \beta_0 + \beta_1 \mathfrak{r}_t + \beta_2 \sigma_t^\pi + \beta_3 \left(B/Y\right)_t + \varepsilon_t$$

where $\mathfrak{r}_t$ is the real short rate, σ_t^π is the inflation risk and $\left(B/Y\right)_t$ is the government balance on output ratio (proxy for debt risk).

Bonds

Economic forecast of the 10-year bond yield

	2010	2020	2030	2050
Sovereign bonds				
US	2.8%	4.9%	5.1%	5.1%
EURO	2.6%	4.5%	4.7%	4.8%
JAPAN	1.1%	3.3%	3.5%	3.6%
PACIFIC	5.5%	6.5%	6.3%	6.2%
EM	5.5%	9.4%	10.1%	10.7%
Corporate bonds				
IG US	6.5%	6.3%	6.4%	6.5%
IG EURO	3.5%	4.8%	5.0%	5.1%
HY US	7.8%	10.2%	10.3%	10.3%
HY EURO	7.8%	10.1%	10.2%	10.2%

Bonds

Expected returns of bonds are deduced from the economic forecast of the 10-year bond yield using a sensitivity/duration hypothesis.

	1980-1990	1990-2000	2000-2010	2020	2030	2050
			Sovereign bonds			
US	11.5%	9.3%	6.1%	1.9%	3.5%	4.3%
EURO	8.4%	8.2%	5.5%	1.8%	3.2%	4.0%
JAPAN		7.3%	2.5%	0.0%	1.7%	2.6%
PACIFIC		12.5%	6.8%	5.5%	6.1%	6.2%
EM		14.2%	10.0%	5.6%	7.6%	9.0%
			Corporate bonds			
IG US		8.0%	6.8%	6.1%	6.2%	6.3%
IG EURO			4.0%	3.7%	4.3%	4.6%
HY US		11.0%	7.0%	8.9%	9.6%	9.9%
HY EURO			4.0%	8.6%	9.4%	9.8%

Other Assets

1. Small cap
2. Commodities
3. Hedge funds
4. Real estate
5. Foreign exchanges

- Liquidity risk
- Globalization / Convergence
- Ressources / Consumption

Other Assets

Equity

	1980-1990	1990-2000	2000-2010	2020	2030	2050
US	15.2%	18.3%	−1.2%	9.2%	8.4%	9.1%
EURO	12.8%	16.8%	0.4%	9.7%	8.2%	8.7%
JAPAN	20.1%	−0.5%	−3.4%	8.8%	4.9%	5.6%
PACIFIC		14.0%	8.7%	14.7%	9.1%	9.5%
EM		8.4%	14.0%	10.7%	10.4%	10.8%

Alternative Assets

	1980-1990	1990-2000	2000-2010	2020	2030	2050
COMMO	1.1%	4.0%	5.5%	8.4%	8.6%	9.0%
HF		10.9%	4.0%	7.1%	7.3%	7.4%
RE		−0.9%	3.8%	8.2%	7.4%	8.1%
PE			2.5%	12.5%	11.7%	12.1%

Volatility

Volatility

- Historical figures
- Mean-reverting property (OU process)
- Macro-economic volatility

$$\mathrm{d}\sigma_t = \kappa\left(\bar{\sigma} - \sigma_t\right)\mathrm{d}t + \xi\,\mathrm{d}W_t$$

Mean-reverting parameter

$$\sigma_\infty = \bar{\sigma} + \varepsilon$$

Long-run volatility

Vovol

$$\varepsilon = f\left(\sigma_\infty^g, \sigma_\infty^\pi, \xi\right)$$

Macro-economic volatility

Volatility

	1980-1990	1990-2000	2000-2010	2020	2030	2050
Sovereign bonds						
US	8.7%	6.5%	7.7%	5.0%	5.0%	5.0%
EURO	7.7%	5.1%	5.0%	5.0%	5.0%	5.0%
JAPAN	7.2%	5.4%	4.0%	8.0%	8.0%	8.0%
PACIFIC				15.0%	15.0%	15.0%
EM		7.2%	16.8%	15.0%	12.0%	10.0%
Corporate bonds						
IG US				7.0%	7.0%	7.0%
IG EURO				7.0%	7.0%	7.0%
HY US		5.4%	8.9%	8.5%	8.5%	8.5%
HY EURO			17.0%	10.0%	10.0%	10.0%
Equity						
US	15.2%	12.6%	19.9%	15.0%	15.0%	15.0%
EURO	11.0%	12.1%	18.5%	15.0%	15.0%	15.0%
JAPAN	12.6%	18.4%	21.3%	15.0%	15.0%	15.0%
PACIFIC		14.9%	14.8%	17.0%	17.0%	17.0%
EM		18.0%	17.5%	18.0%	18.0%	18.0%
Small cap		13.0%	18.1%	17.0%	17.0%	17.0%
Alternative investments						
Commodity		17.0%	25.0%	30.0%	30.0%	30.0%
Hedge funds		7.0%	6.0%	8.0%	8.0%	8.0%
Real estate		15.5%	19.1%	15.0%	15.0%	15.0%
Private equity			30.4%	25.0%	25.0%	25.0%

Correlation

Correlation

- Historical figures
- Time-varying correlations
- Flight-to-quality & globalization
- Inflation regime $\Rightarrow$ stock-bond correlation

- Regime-Switching
- State variables $= g_t$ & π_t

Correlation

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	US	100%							
(2)	EURO	80%	100%						
(3)	JAPAN	30%	30%	100%					
(4)	EM	10%			100%				
(5)	IG US	60%	40%	20%	50%	100%			
(6)	IG EURO	20%	30%		30%	60%	100%		
(7)	HY US	−20%	−20%		60%	60%	40%	100%	
(8)	HY EURO	−30%	−20%		50%	40%	40%	80%	100%

Equity:

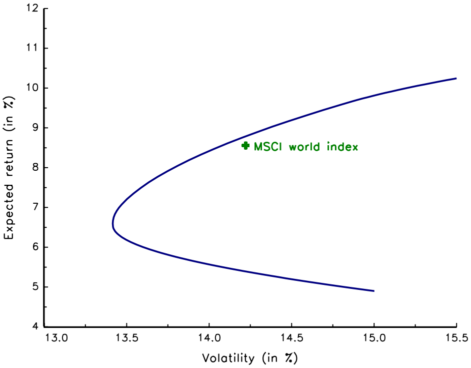
		(9)	(10)	(11)	(12)	(13)	(14)
(9)	US	100%					
(10)	EURO	90%	100%				
(11)	JAPAN	70%	60%	100%			
(12)	PACIFIC	80%	80%	60%	100%		
(13)	EM	70%	70%	70%	80%	100%	
(14)	Small cap	80%	80%	70%	80%	80%	100%

Alternative Assets:

		(15)	(16)	(17)	(18)
(15)	Commodity	100%			
(16)	Hedge funds	40%	100%		
(17)	Real estate	10%	30%	100%	
(18)	Private equity	10%	40%	10%	100%

Equity Portfolio

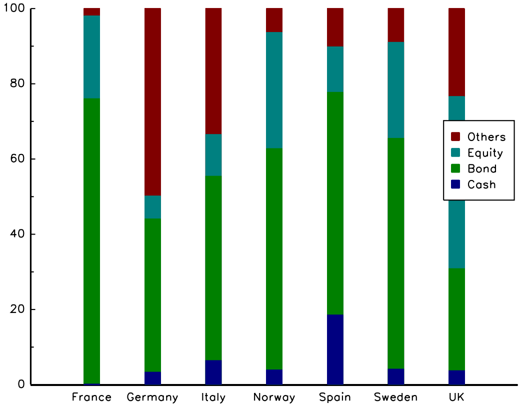
- US ($\simeq$)
- EURO ($-$)
- JAPAN ($--$)
- PACIFIC ($+$)
- EM ($++$)



$\Rightarrow$ Consistent with our economic scenario in the case of the Black-Litterman approach

Equity-Bond Asset Mix Policy

Figure: Average allocation of European pension funds

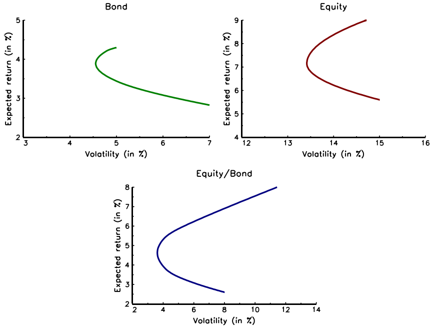


Equity-Bond Asset Mix Policy

VOL	Weights		ER
	Bond	Equity	
3.6%	82.8%	17.2%	4.6%
4.0%	76.2%	23.8%	5.3%
4.5%	69.5%	30.5%	5.6%
4.6%	68.1%	31.9%	5.7%
5.0%	64.5%	35.5%	5.9%
5.5%	60.5%	39.5%	6.1%
6.0%	56.9%	43.1%	6.2%
8.0%	43.4%	56.6%	6.9%
10.0%	30.5%	69.5%	7.5%
12.0%	18.0%	82.0%	8.2%
15.0%	0.0%	100.0%	9.1%

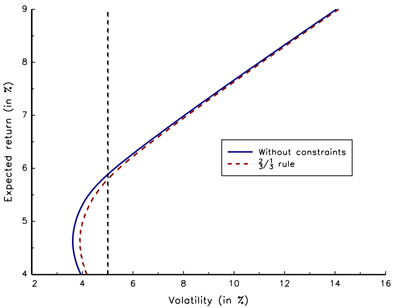
Standard risk-aversion for long-term investors: $\gamma = 5$.

Strong diversification effect.



The Place of Alternative Investments

- Alternative assets = substitute of equities (not of bonds).
- The $2/3 - 1/3$ rule (for risk-seeking long-term investors).
- Liquidity risk $\Longrightarrow$ Tactical asset allocation.



Sensitivity and Scenario analysis

Economic scenario

- Expectation $\longrightarrow$ Probability
- Stress scenario

Risk premium

- Confidence intervals
- Scenario analysis

Table: Coefficient estimates for bond regressions

	Study Period	Constant	r_t	σ_t^π	$(B/Y)_t$	R^2
US	1982–2009	0.008 (2.006)	0.59 (3.63)	0.67 (1.51)	−0.11 (−1.00)	0.82
EURO	1982–2009	0.007 (1.988)	0.47 (4.15)	2.03 (2.07)	−0.10 (−0.84)	0.94
JAPAN	1982–2009	0.011 (3.379)	0.66 (5.57)	0.21 (1.82)	−0.05 (−1.10)	0.85
PACIFIC	1982–2009	0.017 (1.212)	0.47 (3.96)	0.15 (0.19)	−0.32 (−2.42)	0.69

Conclusion

- A comprehensive methodology to build long-run assumptions on asset returns, in order to derive consistent strategic allocations
- Importance of the economic scenario
- Distinction between MT, TAA and SAA
- Understanding the articulation between TAA and SAA
- A building-block for long-term investment policy

For Further Reading

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Long-Run Relationship for Risky Bond

The long-run bond yield R_∞^{cr} is equal to:

$$R_\infty^{\mathrm{cr}} = R_\infty^{\mathrm{b}} + s_\infty^{\mathrm{cr}}$$

where R_∞^{b} is the US long-run bond yield and s_∞^{cr} is the long-run spread.

For the investment grade and high yield spreads, the regression model is:

$$s_t^{\mathrm{cr}} = \beta_0 + \beta_1 \sigma_t^e + \beta_2 g_t + \varepsilon_t$$

where σ_t^e denotes the equity volatility and g_t is the output growth. For the emerging bond spread, the regression model becomes:

$$s_t^{\mathrm{cr}} = \beta_0 + \beta_1 \sigma_t^e + \beta_2 \left(CA/Y\right)_t + \varepsilon_t$$

where $\left(CA/Y\right)_t$ is the current account on output ratio.

Long-Run Relationship for Equity

The long-run equity return is equal to:

$$R^{\mathrm{e}}_{\infty} = R^{\mathrm{b}}_{\infty} + \mathscr{R}^{\mathrm{e}}_{\infty}$$

where R^{b}_{∞} is the long-run bond yield and $\mathscr{R}^{\mathrm{e}}_{\infty}$ is the equity excess return.

The regression model is:

$$\mathscr{R}^{\mathrm{e}}_{t+10} = \beta_0 + \beta_1 \, \mathrm{PE}_t + \beta_2 R^{\mathrm{b}}_t + \varepsilon_t$$

where PE_t is the price earning ratio and R^{b}_t is the 10-year bond yield.

Long-Run Relationship for Commodity

The long-run commodity return is equal to:

$$R_{\infty}^{\mathrm{co}} = r_{\infty} + \mathscr{R}_{\infty}^{\mathrm{co}}$$

where r_{∞} is the long-run short rate and $\mathscr{R}_{\infty}^{\mathrm{co}}$ is the commodity excess return.

The regression model is:

$$\mathscr{R}_t^{\mathrm{co}} = \beta_0 + \beta_1 \Delta \left(Y^{\mathrm{EM}} / Y^{\mathrm{W}} \right)_t + \beta_2 g_t^{\mathrm{W}} + \varepsilon_t$$

where $\Delta \left(Y^{\mathrm{EM}} / Y^{\mathrm{W}} \right)_t$ represents the change of emerging output over world output ratio, and g_t^{W} represents the world output growth.

Results of Regression models

Bond

	Constant	r_t	σ_t^{π}	$(B/Y)_t$	σ_t^{e}	g_t	$(CA/Y)_t$	R^2
US	0.008 (2.006)	0.59 (3.63)	0.67 (1.51)	−0.11 (−1.00)				0.82
EURO	0.007 (1.988)	0.47 (4.15)	2.03 (2.07)	−0.10 (−0.84)				0.94
JAPAN	0.011 (3.379)	0.66 (5.57)	0.21 (1.82)	−0.05 (−1.10)				0.85
PACIFIC	0.017 (1.212)	0.47 (3.96)	0.15 (0.19)	−0.32 (−2.42)				0.69
EM	0.046 (4.200)				0.05 (0.78)		−0.51 (−2.64)	0.34
IG US	0.012 (4.878)				0.03 (2.57)	−0.09 (−2.15)		0.44
IG EURO	0.017 (1.212)				0.04 (2.31)	−0.03 (−0.57)		0.50
HY US	0.054 (6.056)				0.12 (3.40)	−0.80 (−4.90)		0.73
HY EURO	0.011 (0.571)				0.38 (4.25)	−0.79 (−2.59)		0.80

Results of Regression models

Equity & Commodity

	Constant	PE_t	R_t^{b}	$\Delta\left(Y^{\mathrm{EM}}/Y^{\mathrm{W}}\right)_t$	g_t^{W}	R^2
US	0.433 (3.587)	−11.16 (−3.52)	−0.89 (−1.73)			0.40
EURO	0.703 (6.409)	−20.64 (−6.16)	−1.14 (−4.30)			0.62
JAPAN	0.760 (4.944)	−18.88 (−5.79)	−1.38 (−1.89)			0.72
PACIFIC	0.509 (9.414)	−12.18 (−7.84)	−1.33 (−7.17)			0.75
COMMODITY	−0.313 (−4.673)			2.98 (1.32)	8.90 (4.45)	0.47