

# **Modeling Credit Risk - A Practitioner's Perspective -**

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# The Migration Towards Credit

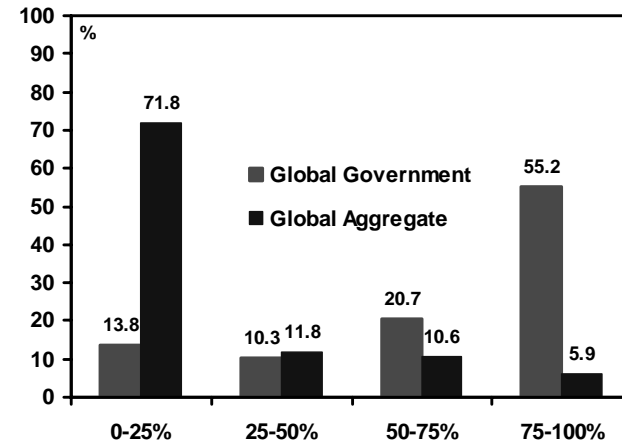
*Structural factors continue to underpin the shift towards credit products.*

□ According to a Goldman Sachs poll of 87 investors managing just under USD 1 trn of international bond funds, the majority of respondents have more than half of assets benchmarked against a global government index, but intend to increase the exposure to credit.

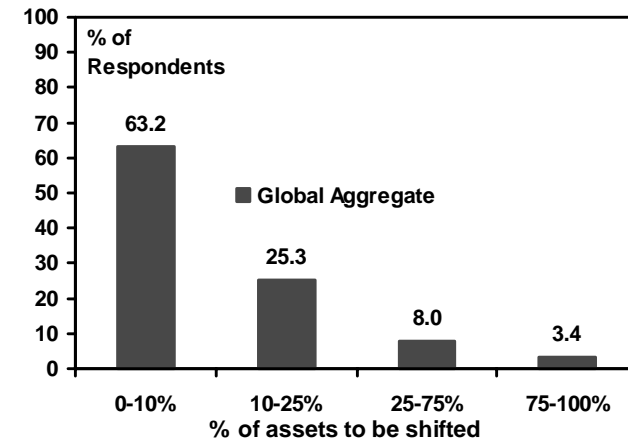
□ Over past years, the shift has been motivated by optimal portfolio analysis and structural factors, such as the advent of EMU, the growing relative size of private sector debt and the rise in Japanese public sector liabilities.

□ In recent quarters, investors have started looking at credit as a way of entering the capital structure with a downside protection, sacrificing the potential upside. Said differently, credit is seen as 'cheap' (in risk-return space) alternative to equities.

**Global Government vs. Global Aggregate Benchmarks**



**Shift to Global Aggregate Benchmark Next 12 Months**



*More heterogeneous classes of investors are now involved in credit products. The demand for top-down analysis has increased.*

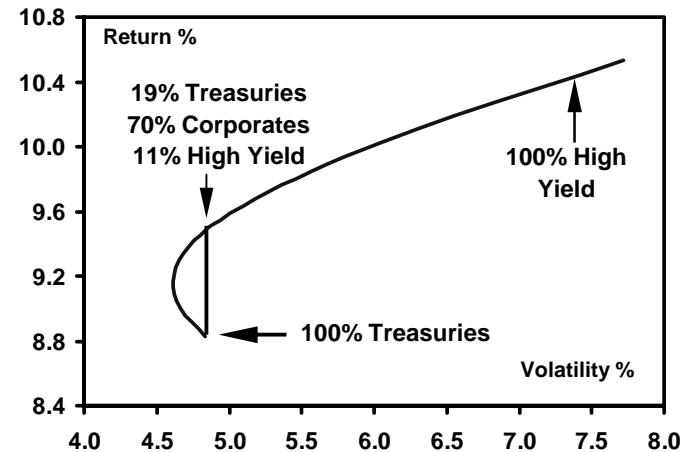
□ Investors are required to formulate a choice between government bonds and spread products and, within the credit universe, among assets with different risk profiles. The relative illiquidity of corporate bonds underscores the **strategic nature** of these decisions.

□ The asset allocation process needs to be increasingly supported by a top-down framework intended to:

✓ Identify the risk factors driving the time-varying premium demanded for bearing generic credit risk.

✓ Assess sector performance contingent upon the stage of the business cycle.

The 'Efficient Frontier'



GS Global Bond Allocation

Asset	Market Neutral	GS Weight	Change
Government	54.5	48.0	-1.5
Agency/Pfandbriefe	10.0	8.0	-
Mortgage	13.0	10.0	-
IG Corporate	15.0	23.0	-3.0
High Yield	4.5	8.0	+4.5
Emerg. Mkt. Debt	3.0	3.0	-
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	

The above table summarises GS recommended weightings relative to a broad global aggregate bond benchmark, broken down by asset category. Last update: 17 Dec 02

# What Drives the Credit Risk Premium?

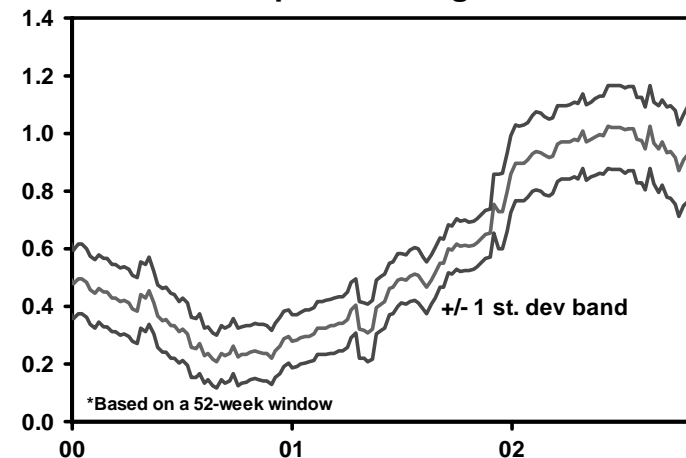
*The point of departure for credit risk analysis is the Merton-Black-Scholes representation of the capital structure.*

- At the **High-Grade** end of the credit spectrum, views on the performance of a host of asset classes ranging from Eurozone peripheral sovereigns and Pfandbriefe to US Agencies are formulated with an eye to the likely direction of swap spreads.
- Swap spreads are, in turn, understood to be influenced by a combination of monetary conditions (e.g., the level of short rates, the slope of the yield curve), shifts in generic credit risk appetite and liquidity factors.

*Modeling work in this area published by Goldman Sachs indicates that liquidity accounts for a disproportionate component of the variance of swap spreads.*

- For lower-quality **Investment Grade** nonfinancial corporates, the analysis generally tends to be more qualitative. The point of departure is frequently the Merton class of structural models.

**EMU Peripheral Spreads: Rolling Regression Coefficient on Swap Spread Changes**



# Introducing GS-SPREAD

*GS-SPREAD is an econometric model for the cyclical behaviour of triple-B spreads to Treasuries with a Mertonian flavour.*

**GS-SPREAD** is our econometric model for the behaviour of credit spreads over the business cycle.

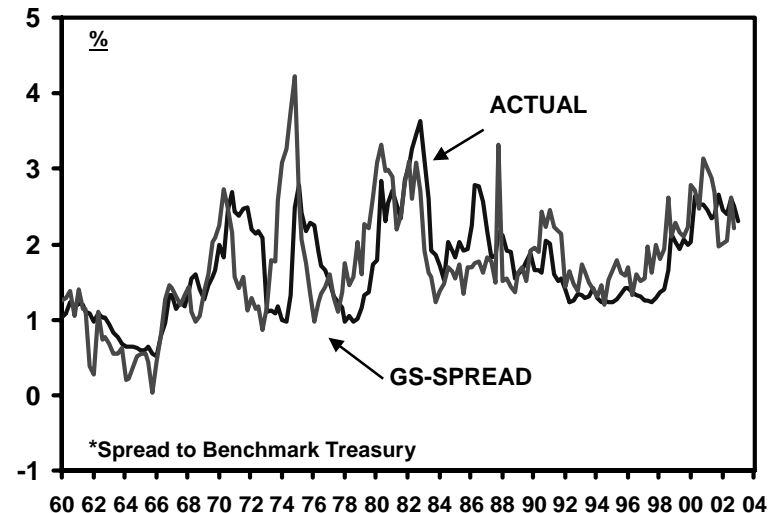
Spreads are defined as the yield difference between Moody's Baa index for nonfinancial seasoned corporate bonds and long term constant maturity Treasury yields. *There are admittedly several problems with this measure as a gauge for credit risk, but the long history available justifies its use.*

**The model has two salient features:**

✓ **Conceptually**, GS-SPREAD preserves some flavour of the specific representation of the capital structure of the firm originally articulated in the works of Merton, Black and Scholes.

✓ **Empirically**, the model exploits the concept of cointegration. A long-run relationship between variables found determining average spreads is estimated in conjunction with the short-run dynamic process of adjustment when there are deviations from 'equilibrium'.

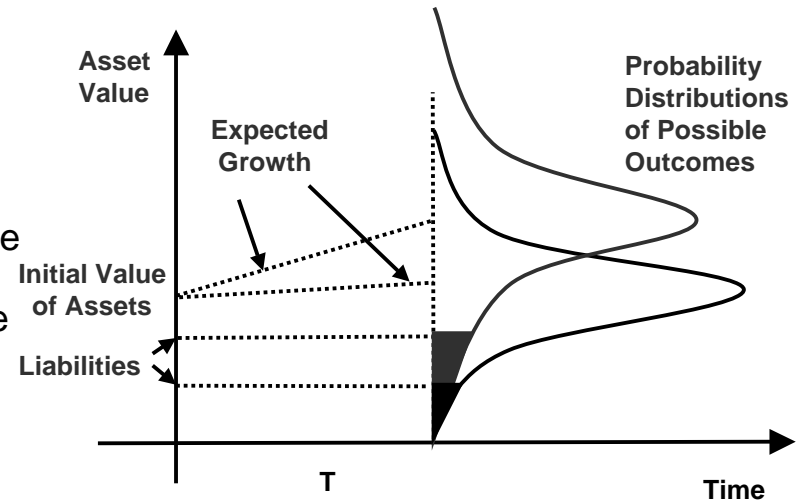
**Baa Corporate Bond Spreads\***



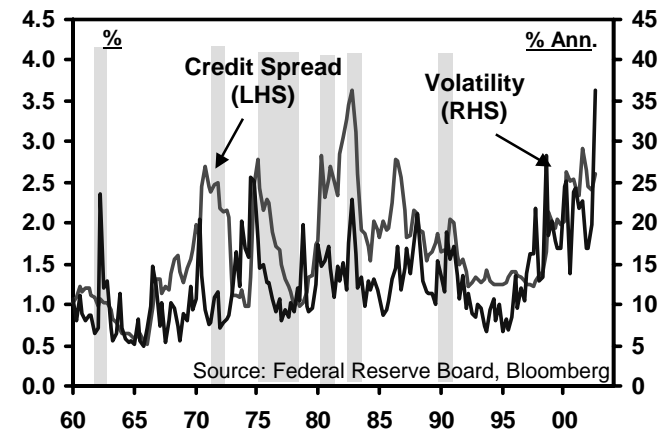
*The model works on four risk factors: the level of risk-free rates, equity volatility, debt growth, and cash flow generation.*

- The payoff from a corporate bond can be replicated using a risk-free bond and a short position in a **put option on the value of a firm's assets**, where the strike price is equal to the face value of the debt outstanding.
- In our modeling effort, we try to translate the variables identified in the Merton pricing framework for individual bonds into aggregate risk factors.
- According to Merton, corporate bond spreads widen as the **leverage** of the firm increases. The proportionality is quite intuitive.
- Additionally, a rise in the **volatility** of the firm's asset value also increases the probability of default, expanding credit spreads. Increased volatility raises the price of the put option, thus reducing the value of corporate debt to the holder.

### An Option Approach to the K Structure



### Credit Spreads vs. Equity Volatility



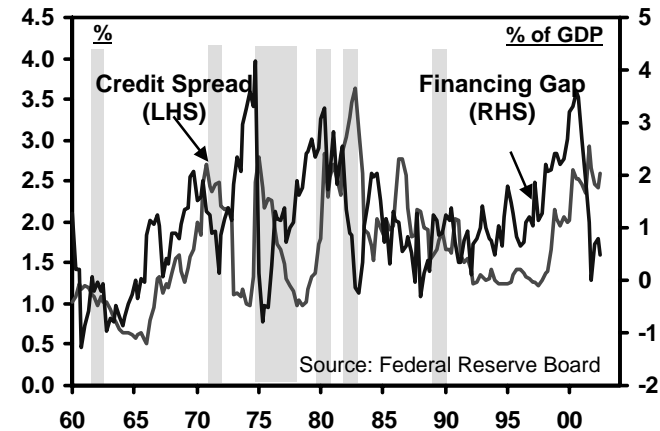
*The model is estimated over the period Q1:60-Q4:99, covering six NBER recessions.*

□ Drawing on these results, we model spreads as a function of the volatility of the stock market, measured as the annualised standard deviation of daily returns on the S&P500 index.

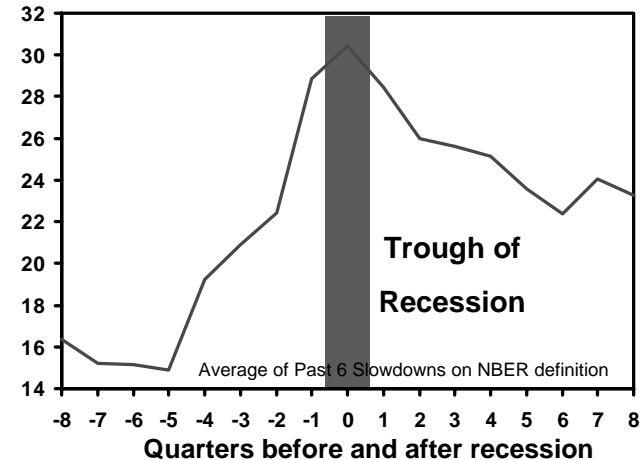
□ The choice of the most appropriate measure of gearing is largely an empirical issue. Our work shows that the **'financing gap'** of the nonfinancial corporate sector - a flow measure - best captures the variance of credit spreads.

□ We also control for the level of risk-free rates and for the stage of the business cycle by including changes in real GDP growth.

### Credit Spreads vs. Financing Gap



### US: Ratio of Baa Credit Spreads To Risk-Free Rate



*The ARDL approach allows us to unearth the long-run relationship between the variables, controlling for their dynamics.*

- The estimation is carried out using a standard Auto-Regressive Distributed Lags (ARDL) approach.

*The ARDL approach to cointegration offers the advantage of being applicable irrespective of whether the regressors are I(0) or I(1), thus avoiding the pre-testing problems on the order of integration of the variables (see Pesaran and Shin, 1997).*

- Our sample ranges from Q1:60 to Q4:99, covering six NBER recessions.

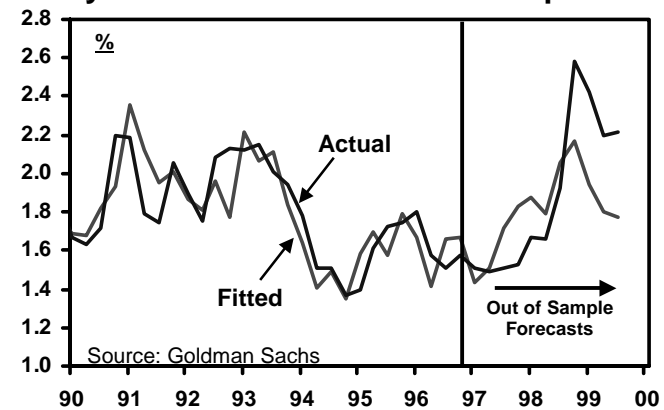
- The long-run specification of the model explains around 50% of the variance of triple-B spreads.

- Out-of-sample forecasts captured the turning points for spreads post-1997.

**GS-Spread: Long Run Coefficients**

	If our Variables . . .	. . . Then Spreads
Real GDP Growth	⬆ by 1% yoy	⬇ by 16bp
Financing Gap	⬆ by 1% of GDP	⬆ by 33bp
Stock Market Volatility	⬆ by 5% annual	⬆ by 22bp
Treasury Bond Yield	⬆ by 100bp	⬆ by 04bp

**Dynamic Forecast for the Baa Spread**



## How Is the Model Used In Practice?

*The model allows us to assess what our views on the macro outlook entail for aggregate lower quality credit spreads.*

- GS-SPREAD operates on two financial variables (equity market volatility and the level of long-bond rates) and two risk factors taken from the national accounts (yearly GDP growth and the corporate financing gap).
- The forward values of the financial factors can be obtained from the marketplace. GDP growth, corporate profits and capital outlays are regularly forecast by our US Economics team.
- The model provides us with an idea of '**fair value**' based on current macroeconomic fundamentals.
- We frequently resort to **scenario analysis** in order to set possible boundary conditions for spreads.

	2002				2003				2004			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Real GDP Growth <sup>1</sup>	1.4	2.2	3.2	2.7	1.9	2.0	1.6	2.2	2.5	3.0	3.2	3.2
Financing Gap <sup>2</sup>	0.7	0.7	0.8	0.6	0.2	0.0	-0.1	0.1	0.0	0.1	0.2	0.3
Stock Market Volatility <sup>3</sup>	17.0	19.8	35.6	27.0	20.0	18.0	16.0	14.0	14.0	14.0	12.0	12.0
Treasury Yield	5.5	5.6	5.1	4.9	4.9	5.0	5.2	5.3	5.3	5.5	5.6	5.8
GS-SPREAD	2.0	2.0	2.6	2.2	1.9	1.7	1.7	1.5	1.5	1.4	1.3	1.4

From Q3:02 onwards, GS forecasts.

1. Year-on-Year % growth. 2. % of GDP. 3. Annualised standard deviation of daily returns.

# What Does GS-SPREAD Currently Tell Us?

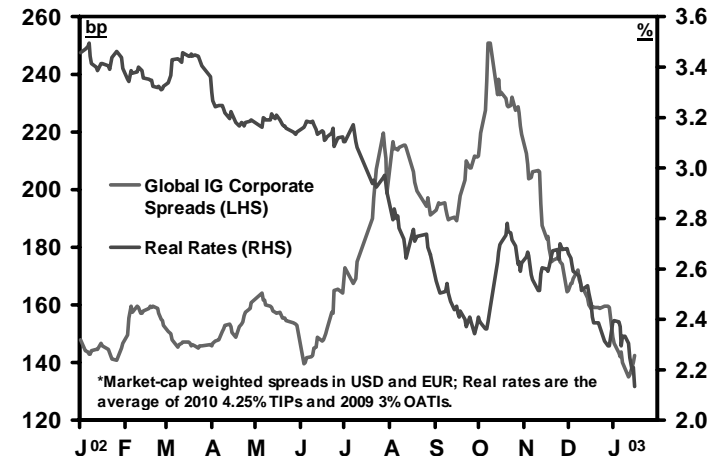
*Risks are well reflected in the current level of spreads. Moreover, the fundamentals for credit are improving.*

□ According to GS-SPREAD, aggregate spreads currently trade at attractive levels. The model places triple-B spreads at 220bp, compared to an actual value of 250bp.

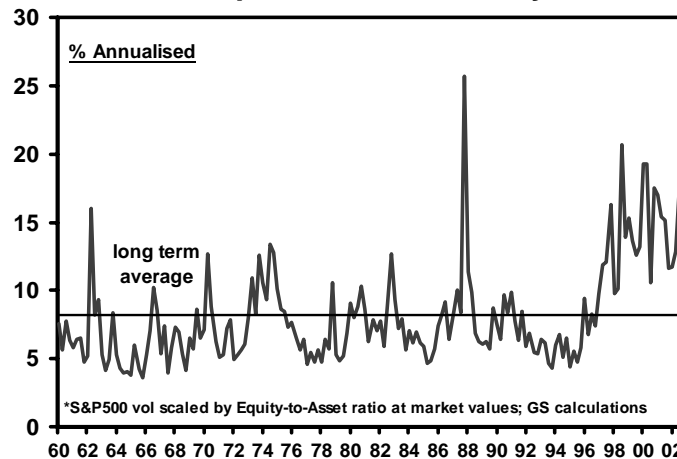
□ The rally since October has partly made up for the large overshooting of spreads in Q3:02. It appears to have been mostly driven by the decline in equity market volatility.

□ Yet, the compensation required for moving down the credit ladder remains elevated, as investors perceive the risk of lower-quality Investment Grade precipitating into High Yield as tangible.

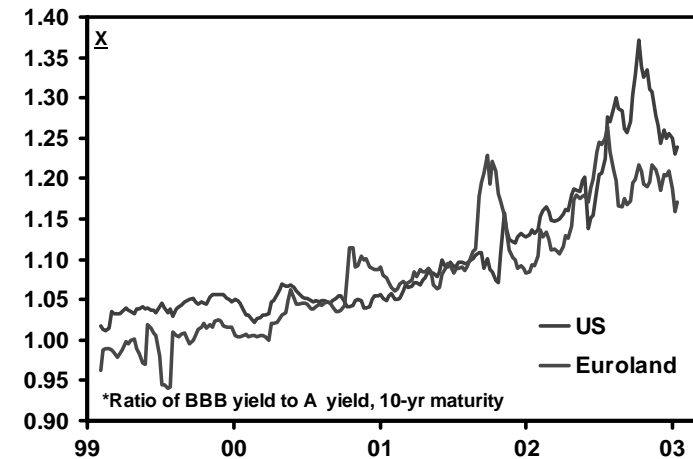
**Credit Spreads and Real Rates**



**Implied Asset Volatility**



**Credit Risk Premium**



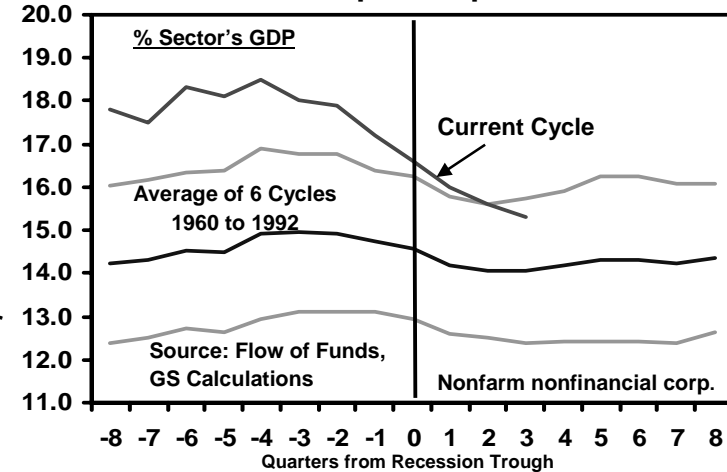
*Continued deleveraging and moderate but uninterrupted output growth bode well for the credit outlook.*

□ US corporates are continuing to make progress in deleveraging. Emphasis on cost-control has succeeded in arresting the slide in profitability.

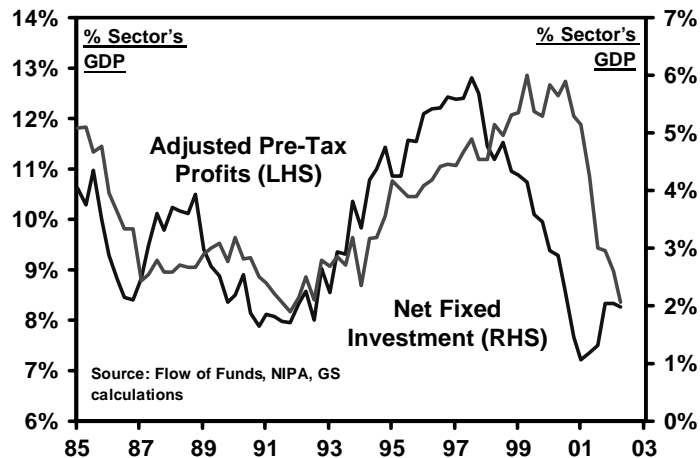
□ Meanwhile, capex is being held back and more cash is being squeezed out of working capital management.

□ Cash flow from operations is now 77 cents for every 1\$ of EbitDA - 12 cents above cyclical norms; gross capex, however, remains at 61 cents per dollar EbitDA, close to historical averages.

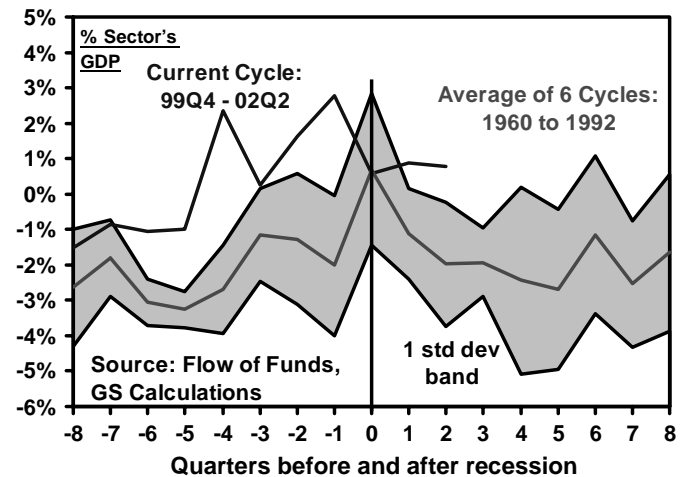
**Gross Capital Expenditure**



**Pre-Tax Profit and Net Capex**



**Cash Generated by Working Capital**



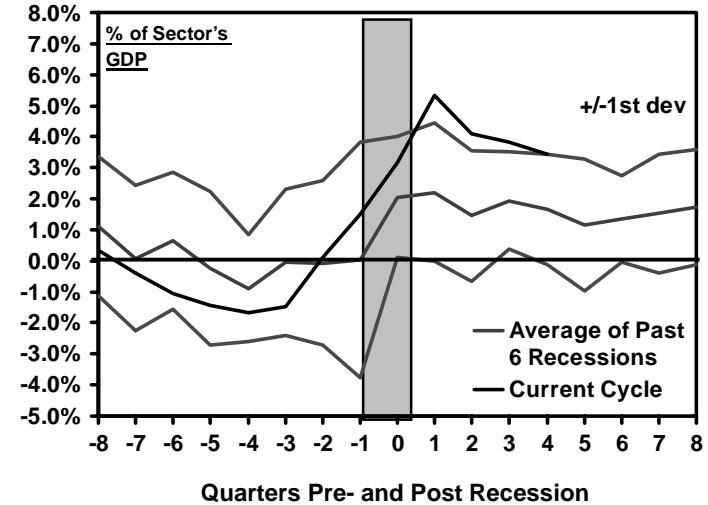
*Net issuance of corporate bonds is expected to be again very low this year.*

□ Free cash flow (16 cents per 1\$ EBITDA) are generous for this stage of the cycle, but profit distribution (i.e., dividend payments) has kept the profile of the financing gap in line with historical norms.

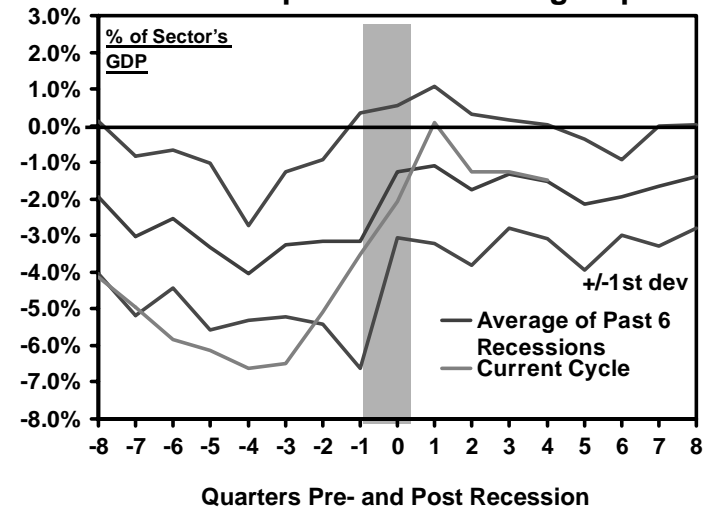
□ Capex is unlikely to pick up meaningfully unless profit margin recovers more significantly. We project investment spending to stagnate for most of this year. Leading indicators (order books, capacity utilisation) support this view.

□ A gradual pick up in earnings and subdued capex will act to keep the corporate financing gap low for a protracted period. Net debt growth –which has already been stabilised in real terms- is likely to turn negative.

**US Corporates: Free Cash Flow**



**US Corporates: Financing Gap**



# Peaking Into the Gap

*Greater reliance on external funds has been a fairly widespread phenomenon across the economy.*

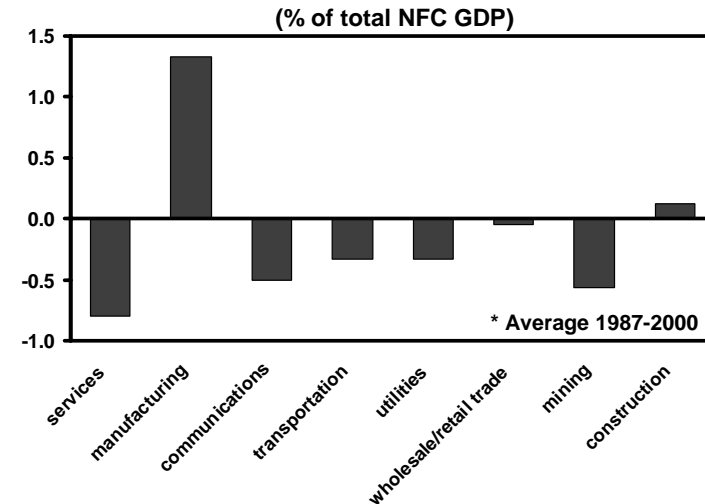
□ In the US, the greater reliance on borrowed funds has been a widespread phenomenon.

*The heaviest weighting sectors (i.e., Services and Manufacturing) are responsible for around two-thirds of the increase in the financing gap over the period 1994-2000.*

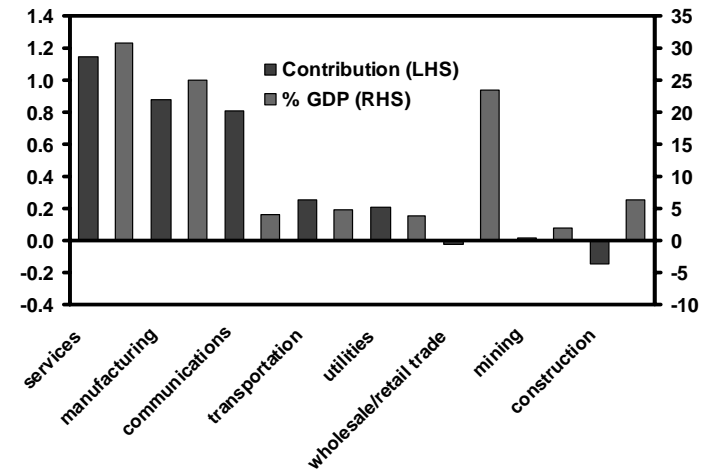
□ The contribution of the Telecom sector to the increase in the total financing gap is extremely large (25%) for an industry representing only 4.1% of the corporate sector's output.

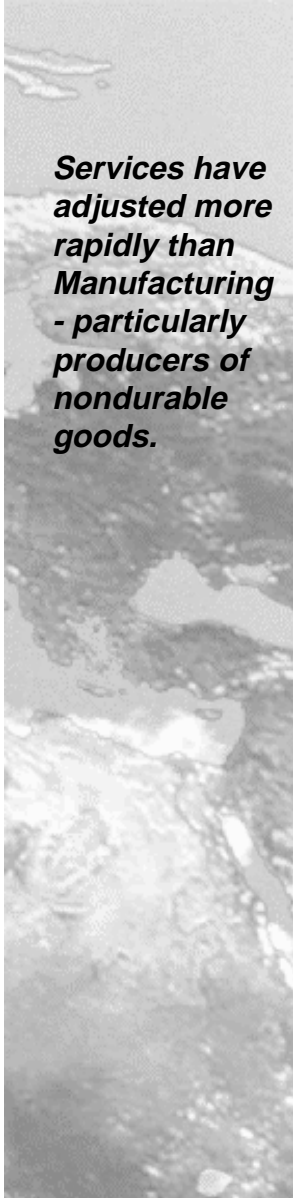
Between 1987 and 1993, the average operating deficit - after taxes and the remuneration of capital - was equivalent to 7% of its output. Over the seven year period between 1994 and 2000, the average shortfall rose to 18% of GDP, reaching a peak of 29% in 1999.

**US Financing Gap\* by Industry**



**Contribution to the Change in the US Financing Gap: 1994-2000**





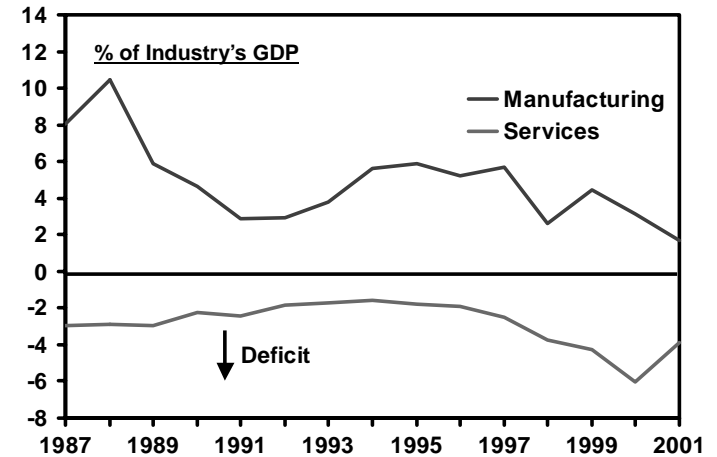
*Services have adjusted more rapidly than Manufacturing - particularly producers of nondurable goods.*

□ National account figures for 2001 allow us to monitor developments since the funding shortfall peaked the year earlier.

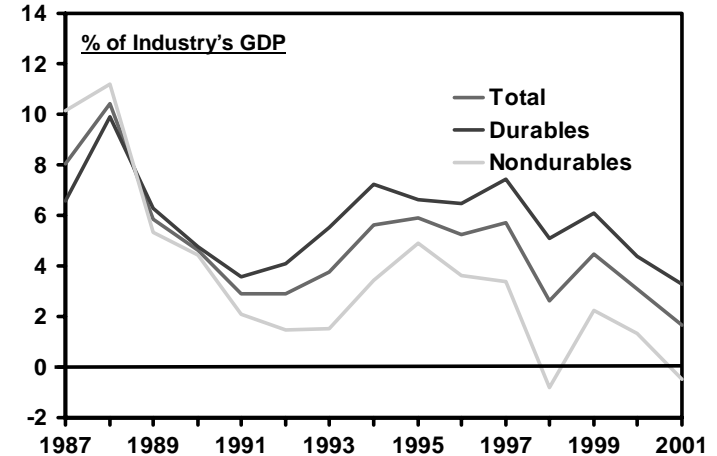
□ The funding position in Manufacturing continued to deteriorate in 2001. Among producers of Durables savings declined, while investment remained relatively stable. Developments were even worse in the Nondurables sector.

□ Services as a whole fared much better, as savings rose while capex was being cut aggressively. Among the smaller sectors, Telecoms and Transportation posted the sharpest turnaround, but from a disastrous starting point.

**US: Financing Gap by Industry**



**US Manufacturing: Financing Gap**



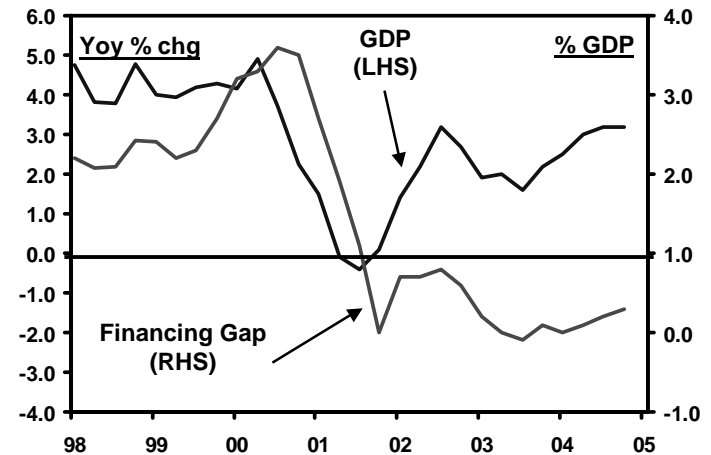
*We hold a positive stance on credit products relative to government bonds, with a preference for the lower-quality end of the market.*

□ Our central macroeconomic assumptions – detailed on slide 10 – are consistent with a gradual tightening of credit spreads. On the Moody’s definition, triple-Bs could trade around 75bp narrower by the second half of 2003.

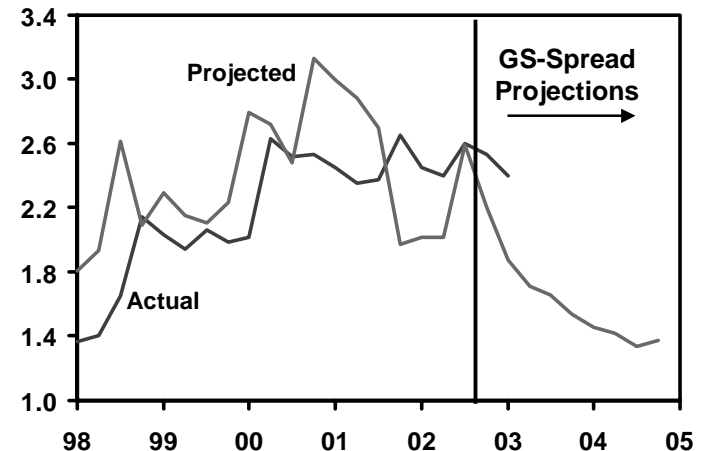
□ Consistently, our model fixed income portfolio is presently net long of credit products versus government bonds.

□ Within the credit universe, we hold a large overweight in Investment Grade, a comparatively smaller but still significant exposure to High Yield, and an underweight stance in High Grade.

**Financing Gap and GDP Growth**



**GS-SPREAD Projections**



# Could It Still End in Tears?

*A moderate recovery represents the best scenario for credit products.*

- ❑ Stock leverage metrics are stretched in the US. As of end-September, corporate net interest bearing liabilities were 3.1 times EBITDA, higher than the 2.9X peak during the 90-91 downturn.
- ❑ At 7.1 times, net interest cover is still safely above the worrisome levels seen in the early 90s (around 5 times).

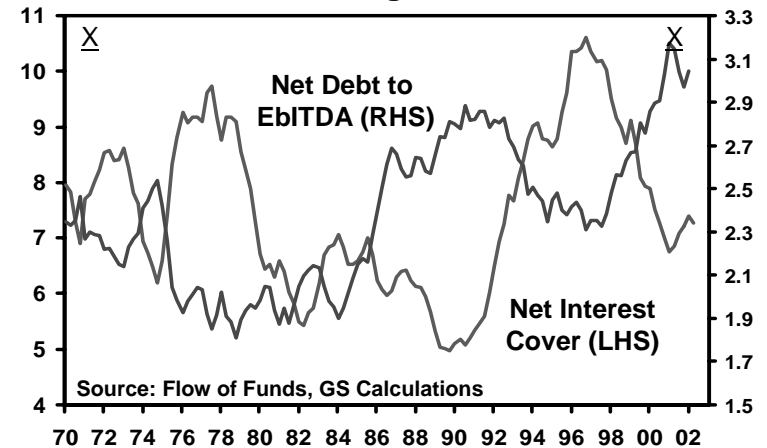
## Two damaging scenarios for investors:

- ✓ A 'double-dip' outcome, where deflation forces a painful balance sheet adjustment.
- ✓ A 'boom' scenario, where the financing gap would probably not close and the chances of a correction at a later stage would rise.

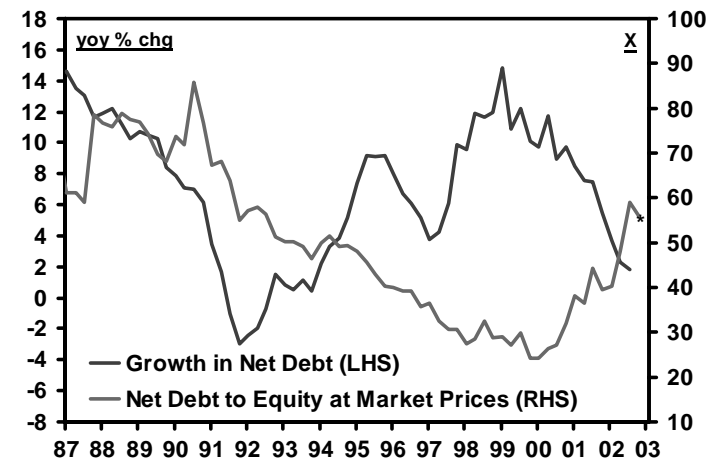
## Neither these two outcomes appears likely.

*The substantial policy stimulus will sustain growth, while large private sector imbalances will keep the pace of the expansion in check.*

Leverage Metrics



Net Debt Growth vs. D/E Ratio

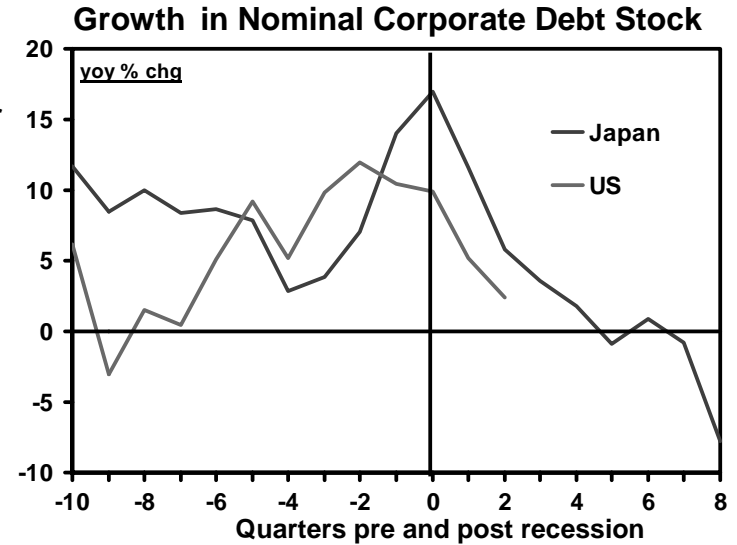


\* Latest data point Dec02

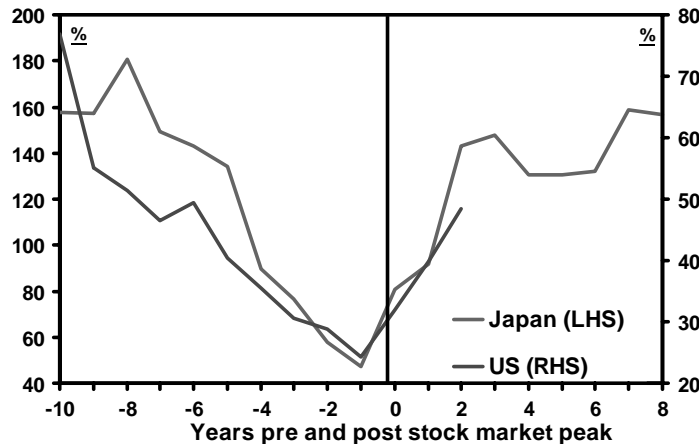
*The main risk to our constructive stance on corporate bonds is a Japan-style deflationary trap.*

□ The main risk to our views is that the US and continental Europe go down the Japan route, characterised by persistent asset and consumer price deflation. Firms would need to undergo a painful adjustment to pay down debt.

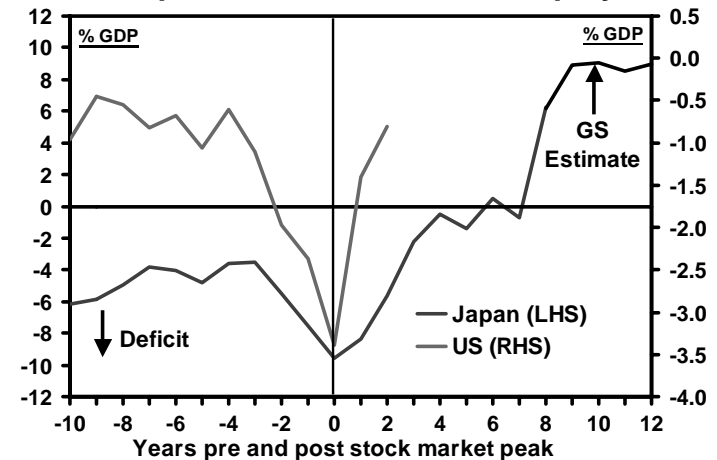
□ In such scenario, investors are likely to chase the highest yielding nominal securities with the smallest degree of credit risk – longer-dated government bonds. Between equities and corporate bonds, the latter seem the safer choice.



Japan vs. US: Financing Gap



Japan vs. US: Net Debt to Equity



# Where Does Euroland Stand?

*Leverage is high also in the Eurozone. Long-term exposure is concentrated with the domestic banking system.*

- Since the mid-90s, Eurozone nonfinancial corporates have relied increasingly on external funds to finance their expansion.

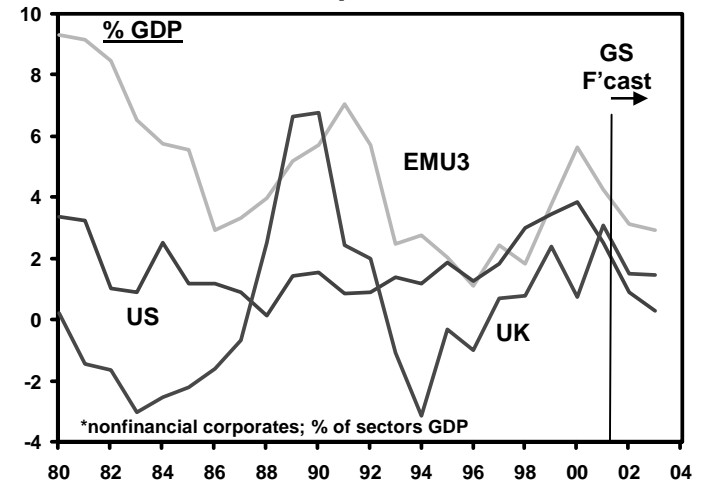
*This pattern is similar to the one observed in the US and the UK.*

- As a share of the sector's GDP, nonfinancial corporate debt in Euroland is now on par with the US.

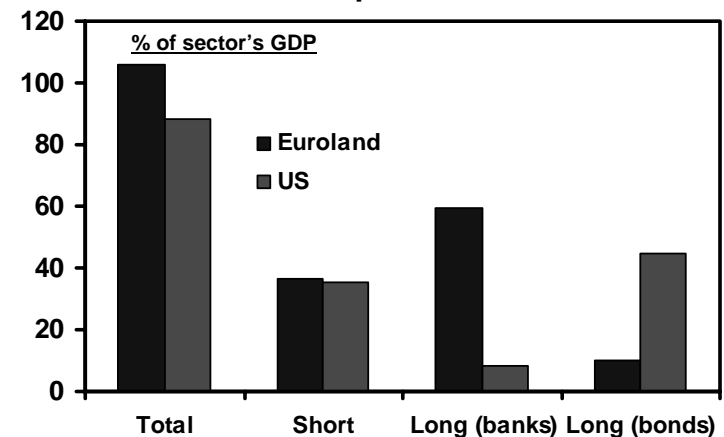
- A distinguishing factor is that the bulk of long-term exposure is with the domestic banking sector rather than the public markets.

- Arguably, the higher level of indebtedness with the banking sector means that the latter's balance sheet (and the government's) will act as a shock absorber, leaving *pari passu* bondholders better protected.

**Financing Gap: International Comparisons\***



**Nonfinancial Corporate Indebtedness**



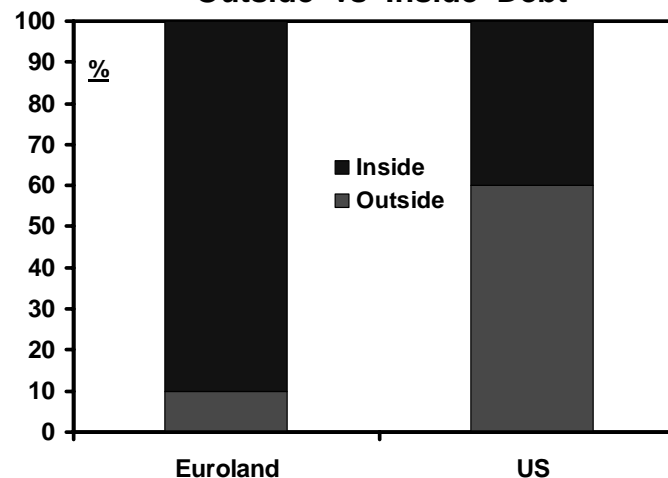
**A greater proportion of corporate interest bearing liabilities is subject to the market's scrutiny in the US than in Euroland.**

□ Only 10% of interest bearing liabilities of the representative nonfinancial corporation domiciled in the Eurozone can be categorised as 'outside debt' (Fama, 1985) – i.e., in the form of a contract where the debt-holder relies only on publicly available information. The remaining 90% is 'inside debt'. In the US, the ratio is 60-40 in favour of outside debt.

□ Incidentally, this helps explain why debt liabilities in the US are more responsive to macroeconomic factors than in Euroland.

Statistical analysis indicates that the information content of US corporate bond spreads is relevant for European spreads, but not *vice versa*.

**'Outside' vs 'Inside' Debt**



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