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Market Strategy
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London
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A Fair Value Model for US Bonds, Credit and Equities

- **This fair value model allows investors to translate a view on fundamentals into a view on markets**
- **We start from a set of US macroeconomic and financial fundamentals, including monetary and fiscal policy, the business cycle, profits, leverage, and volatility**
- **The model showcases strong interactions between bonds, equities and credit markets and the role of volatility**
- **Misalignments from fair values provide profitable trading signals**
- **The framework can be used for scenario analysis based on diverse forecasts for economic fundamentals**

INVESTMENT STRATEGIES: NO. 11

A framework for asset prices based on fundamentals

Our *Fair Value Model* is a set of empirical models for US bonds, credit and equities. It attempts to quantify the linkages between macroeconomic fundamentals and asset class prices as well as between asset prices themselves. These are not pure forecasting models, but require projections for economic and financial fundamentals to translate a view on the business cycle into fair values for bonds, credit and equities consistent with this view. Of course, value models are useful as medium-term trading signals and are only one input in the investment process. Judgment is required to combine these value signals with one-off factors, short-term flows, and other forces that cannot be easily quantified to arrive at the final investment decision.

We derive equations for 10-year real and nominal US Treasury bond yields, the 10-year swap spread, the HG-swap spread, the JPM Global HY-UST spread, the JPM EMBIG-UST strip spread and the S&P 500 index. We plan to extend the framework to asset classes in other currencies in the future.

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The certifying analyst is indicated by an *. See last page for analyst certification and important legal and regulatory disclosures.

Nikolaos Panigirtzoglou*
(44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com
J.P. Morgan Securities Ltd.

Jan Loeys
(44-20) 7325-5473
jan.loeys@jpmorgan.com
J.P. Morgan Securities Ltd.

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www.morganmarkets.com

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Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

1. Choosing a model

In developing a model to translate macroeconomic into market scenarios, we need to distinguish between pure forecasting models and fair value models.
Forecasting models allow one to forecast the future using only inputs that we know today. Hence, it uses the lagged impact of driving variables, or the momentum or mean reversion of these forces. Fair value models, on the other hand, relate asset prices to other contemporaneous variables. So to generate a projection, forecasts of the future level of these contemporaneous variables are required.

We focus here on the second, fair value approach, as we find that most investors do have views on the macro economy and are in need of a **device to translate these views into market forecasts**.

The models aim to **comply with the theory of economics and finance**, to create consistency and to guard against spurious correlations. They also try to use input variables that are comfortable to forecast and that cover the full depth and breadth of the economic scenarios we are considering.

The relationships need also to **fit historical data** well, be **stable over time** and provide **profitable trading signals**. The last aim is important as a fair value model is more useful when deviations from the fair value correct themselves within a reasonable period of time (i.e. a year or less) to be exploitable. Finally we apply an **economy in explanations** (Occam's Razor) in both the simplicity of the equations and the number of driving variables.

2. Fair value models

Most of the models we describe in this paper exploit the econometric framework of cointegration which applies to cases where two or more variables comove. Cointegration by itself does not imply causality. For simplicity, we apply cointegration using the simple linear regression method. The goodness of fit is simply measured by the R^2 of the regression. The stability and the profitability of trading signals based on model misalignments are tested using recursive estimates. Details about our econometric approach are shown in Box 1.

Economic theory tells us that asset prices should reflect the present value of expected future cash flows discounted to the present with an internal rate of return (IRR). To derive a fair value for asset prices, we thus need to model both expectations of future cash flows and the IRR. Expected future cash flows are a function of the promised cash flows as well as expected inflation, default rates and corporate earnings growth. The IRR components are the real policy rate, inflation, term premia, swap spreads, credit premia and equity premia. The moment we can predict cash flow expectations and what IRRs the market will apply, then we can predict future asset prices and asset returns.

A summary of the equation variables and their interactions is shown in Box 2. It starts with the fundamental economic forces: the business cycle, economic policy, and the supply and demand for capital. The economic policy variables that are most important are the objectives that the central bank and the government set in terms of inflation and its budget balance. We also consider the degree of confidence on whether they will meet these objectives. The latter shows up in both inflation expectations and inflation uncertainty. The supply and demand for capital relates to both public and private sector investment and savings decisions.

These three sets of economic variables – the business cycle, monetary and fiscal policy and the supply and demand for capital – each impinges on the internal rate of return on capital as priced in the capital markets. We start with the *IRR* on default-free assets – the government bond yield – and then add a compensation due to default loss and the uncertainty of future income flows. The properties of these models are described in detail in the following sections.

3. The long bond yield

This section describes the model for the 10-year US Treasury yield. It consists of two components, the real yield and expected inflation. The 10-year real yield can be observed from the market prices of index-linked debt (TIPS). These are securities where both the coupons and the principal are linked to inflation and thus offer investors protection against changes in inflation. However, trading on TIPS started in only 1997, which is a very short period for an econometric analysis as it only includes one full interest rate cycle. In addition, prices and yields of index-linked debt have been distorted by low liquidity (relative to the conventional bond market).

An alternative way of constructing the 10-year real yield is to use a survey measure of 10-year inflation expectations.

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Box 1: Econometric framework

Many of the economic and financial variables used in finance and economics are non-stationary. That is, they exhibit a trend. A deterministic or time trend by itself does not pose a problem. But there are series, like US inflation, the government deficit and the 10-year nominal yield, that are non-stationary even after a time trend has been eliminated (i.e. they are said to be integrated). This creates a problem with simple regression models. When nonstationary series are used in a regression model, it is likely that statistically significant relationships are obtained from what are really unrelated variables (spurious regression).

However, two or more non-stationary series may comove in such a way that a linear combination of them is stationary. In this case the non-stationary time series are said to be cointegrated. The stationary linear combination forms the cointegrating equation and could be interpreted as a long-run equilibrium relationship among the variables. It is important to notice that *cointegration by itself does not imply causality, and it only captures comovements between variables.*

For simplicity, we test for cointegration using the ordinary least squares (OLS) method. *OLS* is valid (i.e. consistent) when the variables co-integrate[1]. In particular, we test whether the residuals from the *OLS* regressions are stationary. The only difference relative to the standard stationarity tests is that the critical values for stationarity tests (i.e Dickey-Fuller critical values) need to be adjusted for the fact that the residuals are estimated.

The stability and the profitability of trading signals based on model misalignments are tested using recursive estimates. That is, at each point in time we estimate the model *using information available up to that time only* and generate the residual from the regression (i.e. recursive residual). Macroeconomic data are only available with a lag and we recognise this by using appropriate lags of the macroeconomic variables *when generating the recursive residuals*. We use a one-month lag for monthly data and a one-quarter lag for quarterly data. However, the available macroeconomic data are not real-time because they are subsequently revised. Therefore the latest available data, which incorporate all past revisions, are likely to be different from the releases that were available to investors at the time. Dealing with this issue requires different vintages of the data. These vintages are available for some series like GDP and capacity utilization (e.g. Real-Time Data Set from Philadelphia Fed) but not for other variables such as corporate financing gap and government deficit. For this reason we decided to run the recursive regressions with the latest available data.

To test for model coefficient stability we use the *CUSUM* test based on the cumulated sum of recursive residuals. When the cumulated sum moves outside the area of two critical lines (that depend on the significance level), this suggests parameter instability. It is appropriate when one is uncertain about when a structural change might have taken place. The cost is that it has less power than other tests of structural change like Chow test.

To test for profitable signals, we use the recursive residuals, which reflect the misalignments from the model fair value. Because we use recursive residuals, the tested trading rules are *out-of-sample*, that is, only available information at each point in time is used. We test whether buying when the current misalignment is half a standard deviation above its fair value and vice versa, can produce decent information ratios above 0.25. The rebalancing frequency of the trading rules is set to be close to the half life of the model residuals.

The two main sources in the US are the University of Michigan's Survey of Consumers 5-10 year CPI inflation expectations (since early 1990s), and the Philadelphia Fed Survey of Professional Forecasters (i.e. economists) 10-year CPI inflation expectations (since 1979). We chose the latter, as it is available for a longer time period. It combines the Blue Chip survey for 1979 Q4 to 1991 Q1, the Livingston survey for 1990 Q2 and 1991 Q2, and the Survey of Professional Forecasters for 1991 Q4 on. More details about this series can be found in http://www.phil.frb.org/files/spf/cpie10.txt.

The period since 1979 includes many interest rate cycles, but not a full inflation cycle. Inflation has been in a downward trend since 1979 and looking at only a disinflation period may bias the econometric results. We have thus tried to extend the Philadelphia Fed 10-year inflation expectations series before 1979 by using an adaptive expectations model. That is, we assume that investors form their expectations by looking at past inflation. Although, adaptive expectations

1 There are two obstacles to consistency with *OLS*. The first is the problem of spurious relationships. The second is that the equation is part of a simultaneous equations model. But neither of these is a problem and the *OLS* estimator has been shown to be consistent. See Greene (2000).

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Box 2: Summary of model interactions

FUNDAMENTALS

Policy rate
Inflation
Real GDP growth
Capacity utilization (manufacturing)
Government deficit
Corporate Profit/GDP
Corporate financing gap
Interest coverage (i.e. interest expense/profits)
Volatility (inflation, GDP and credit spread)

BONDS

10yr yield = 1.22 + 0.38 × short real rate + 0.27 × gov deficit + 0.34 × corp financing gap + 0.34 × inflation volatility - 0.14 × EM curr acc+ 10yr expected inflation

0.95 + 0.31× 2yr CPI inflation + 0.36 × 10yr CPI inflation

2yr yield = average of 3m rates over the next 2 years + 15bp

EQUITIES (S&P 500)

2-stage DDM model: $P = \frac{k \cdot E_0}{EDR - g_{LT}}(1 + g_{LT} + 5 \cdot (g_E - g_{LT}))$

k = dividend payout ratio = 0.50, g_{LT} = long-term earnings growth = 2.2%

g_E = Earnings expectations (5yr real growth) = 11.2 – 0.57 × past 5yr real earnings growth – 1.09 × past E/P

E_0 = Earnings (annual real growth) = 2.2 + 2.7 × (real GDP growth – 3.4)

EDR = Equity Discount Rate = 3.80 + 0.51× inflation volatility + 0.23 × real GDP growth volatility + 0.10 × 10yr real yield

SWAP SPREAD

10yr swap spread = 90.5 – 1.23 × gov deficit + 13.6 × corp financing gap – 1.5 × gov weight in Lehman's US agg

CREDIT

HG-swap spread = 35.4 + 2.81 × HG downgrade rate + 6.22 × spread volatility – 1.31 × 12m S&P500 return

log

0.80 + 2.93 × interest/profits (-1) – 0.10 × 10yr-2yr yield (-1)

HY-UST spread = 166.2 + 29.2 × expected default rate + 26.4 × HY downgrade rate + 10.4 × spread volatility – 0.93 × 12m S&P500 return

log

2.26 – 0.40 × 10yr-2yr yield + 3.93 × interest/profits – 23.2 × profit/GDP

log

1.52 – 0.12 × (capu – capu average to date) + 0.7 × interest/profits – 0.12 × 10yr-2yr yield

EMBIG-UST strip spread = -1.46 + (0.35 – 0.05 × EM curr acc) × 2yr yield + 0.61 × HY-UST spread + 18.0 × spread volatility

Source: JPMorgan

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models are not as appealing as rational expectations, we found that they can explain inflation expectations well in the past. So over the post 1979 period, we found that Philadelphia Fed 10-year CPI inflation expectations cointegrate with past 2- and 10-year CPI inflation. The econometric model is presented in Box 3. The chart in the box shows the actual and the fitted values. The fit is good with R^2 at 96% and standard error at 29bp. The model implies that roughly a third of a 100bp change in either 2-year or 10-year past inflation is passed into 10-year inflation expectations. The chart in Box 3A in the Appendix shows that there is no significant evidence of coefficient instability.

Based on the previous model, we extend the Philadelphia Fed 10-year CPI inflation expectations back to 1950s. We then subtract them from the 10-year yield on US Treasuries (available in Fed Reserve Board http://www.federalreserve.gov/releases/) to derive the implied 10-year real yield. In this way, we incorporate the inflation risk premium into the 10-year real yield measure. The real yield and inflation expectations are shown in Chart 1. As with inflation, the real rate followed a long cycle, rising from around 1% in 1957 to almost 8% in the early 1980s, before falling back to a 1-2% range in recent years.

We now turn to the determinants of the real yield. We found four macroeconomic variables to be empirically most important in explaining past fluctuations in this real yield: the price of money (short real rate), inflation volatility, the government deficit and the corporate financing gap. The short real rate is defined as the difference between the 3-month TBill rate and core CPI inflation over the past 12 months. Inflation volatility likely captures the inflation risk premium incorporated into our measure of the 10-year yield and is measured by the standard deviation of annual CPI inflation over the past 5 years. The government deficit and the corporate financing gap capture the demand for capital by the government and corporate sector. They are measured by the federal government net borrowing (US NIPA data) and the corporate business financing gap including financials (US Flow of Funds data) respectively, as a percentage of GDP.

US household borrowing indicators, like the savings ratio or household financial balance or net borrowing (i.e. mortgage plus credit borrowing) were found to be insignificant. One explanation for this result is that it is the pool of global savings that determines the long real yield, and not the US household savings. For example, the US currently depends on massive foreign capital inflows to satisfy the financing needs of the government. In addition, household saving decisions are reactive to real interest rates, rather than a driver. The savings rate was found to lag the 10-year real yield when employing a simple Granger causality test.

We found that savings from emerging economies, measured by their current accountbalance, are significant. This is consistent with the view that it is the pool of global savings that matters and not just that of US savings. It is also a good proxy for the reserve accumulation by emerging economies which received so much attention in recent years. It is difficult to quantify the impact of emerging economy saving into our bond yield model as data on emerging economy

Box 3:
Equation of Phil Fed 10-year CPI inflation expectations

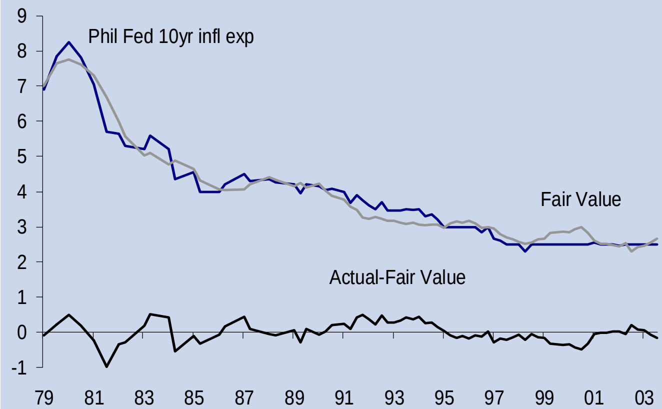
$$\text{Phil Fed 10-year infl exp} = \underset{(0.13)}{0.95} + \underset{(0.02)}{0.31} \times \text{2yr CPI inflation} + \underset{(0.04)}{0.36} \times \text{10yr CPI inflation}$$

(in percent, standard errors in parenthesis)

Sample period	1979 Q4 to 2004 Q3
R^2-adj	96%
Standard Error	0.29%
Residual half life	6 months

Source: JPMorgan

Phil Fed 10yr CPI inflation expectations
Actual vs. model fitted, in percent



Source: Philadelphia Fed and JPMorgan

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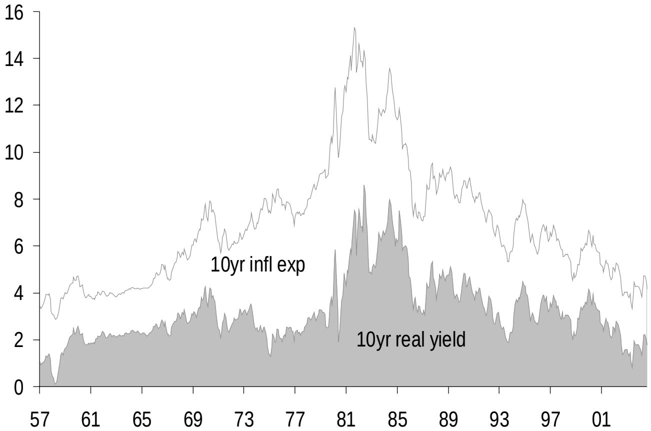
Chart 1: 10-year real yield and inflation expectations
in percent



Source: Federal Reserve Board and JPMorgan

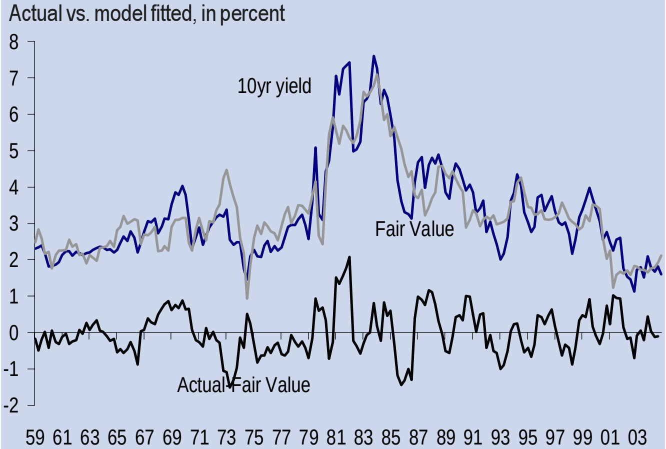
Box 4:
Equation of the 10-year yield

10-year real yield	=	1.22 (0.14)
	+	0.38× 3m real rate(based on core CPI) (0.04)
	+	0.34 × corporate financing gap/GDP (0.07)
	+	0.27 × government deficit/GDP (0.05)
	+	0.34 × 5y inflation stddev (0.09)
	-	0.14 × emerging economy current account (0.07)

(in percent, corporate financing gap, government deficit and emerging economy current account balance as % of US GDP – source: US Fed Flow of Funds, BEA NIPA and IMF respectively; inflation standard deviation is the standard deviation of monthly data on annual inflation over the past five years, standard errors in parenthesis)

Sample period	1959 Q3 to 2005 Q1
R^2-adj	78%
Standard Error	63bp
Residual half life	6 months

10-year real yield
Actual vs. model fitted, in percent



Source: Philadelphia Fed and JPMorgan

Box 5: Trading signal from the 10-year real yield model

Trading strategy: buy the 10yr US Treasuries bond when the observed real rate is half a standard error (i.e. 32bp) above the model fair value, and sell when it is below. Funding is in 3m Treasury Bills.

Period:	1960 Q4 to 2004 Q4
Rebalancing period:	6 months
Trading frequency:	58%
Success rate:	63%
Information ratio:	0.35
Excess return:	2.43%
Volatility:	6.94%

Source: JPMorgan

current account balances are only available annually since 1970. By making the assumption that the emerging economy current account balance was close to zero before 1970 and by interpolating annual data to derive quarterly observations, we are able to quantify the impact of emerging economy saving in our bond yield model. The emerging economy current account appears with a coefficient of -0.14 in the model, that is, a 1% increase in the emerging economy current account balance as a percent of US GDP lowers the fair value of the US bond yield by around 14bp. Since 2000, the increase in saving by emerging economies, and the resultant reserve accumulation, could have contributed around 35bp to the fall in the real bond yield.

Many investors look at economic growth variables as drivers of bond yields. We agree growth is important but theory tells us it should affect yields only via monetary policy, the relative demand and supply of capital, and uncertainty, each of which we use directly here. We found that growth indicators like GDP growth, IP growth, or survey indicators like ISM had no statistical or economic significance when added to the equation above.

The econometric model for the 10-year yield is shown in Box 4. The actual and model fitted values are shown in the box chart. The fit is good with R^2 at 78% and standard error at 63bp. The half life of the residuals is around six months, implying that it takes two quarters for half the misalignment from fair value to be corrected. Box 4A shows there is no significant evidence of coefficient instability.

The model implies that around 40% of the change in the real short rate is passed into the long rate. This response is high but reflects the trending nature of short rates and the high

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correlation between the short rate and forward rates of longer maturities. The coefficient of the corporate financing gap is around double that of the government deficit. A percentage point increase in the financing gap or deficit ratio to GDP increases the real yield by 34bp and 27bp, respectively. The larger response to corporate borrowing is likely to reflect the forward looking information about growth and the return on capital that corporate financing contains. But the difference in the two coefficients is not statistically significant. The response to past inflation volatility is also high. A 100bp increase in the standard deviation of annual CPI inflation rate over the past five years increases the 10-year real yield by 34bp. This term captures the inflation risk premium in our measure of the 10-year real yield. The magnitude of the inflation risk premium implied by the model is currently around 25bp but it has been as high as 100bp in 1970s.

Finally, the trading performance of the misalignments of the model, that is, how profitable it is to trade on half standard error deviations from fair value, is shown in Box 5. The success rate is 63%, above the 50% mark, and the resulting information ratio (IR) is a decent 0.35.

4. Equities

This section describes the model for equities applied to the S&P500 index. Equity valuation is more complicated than bond valuation because of the difficulty in measuring expectations of future cash flows, but ultimately equities also need to be analysed in a present value model. That is, the equity price is equal to the expected future cash flows (i.e. dividends) discounted to the present using an equity discount rate (EDR). The equation below illustrates the discounted cash flow model:

$$P = \sum_i \frac{k \cdot E_0 (1+g)^i}{(1+EDR)^i} \qquad (1)$$

where P denotes the equity price, E_0 is current earnings, k is the payout ratio, g is the growth rate of dividends and EDR is the equity discount rate. The three main components that determine the price are:

1) The first is **current earnings** E_0, which is observable (albeit with a reporting lag), and the payout ratio k, that is, the proportion of earnings paid as dividends, which for simplicity we assume to be constant.[2] We use reported earnings until 1988 and operating earnings after that. The difference between the two measures was small in the late 1980s/early 1990s, but they diverged significantly after the mid 1990s. Operating earnings are usually higher mainly because they exclude non-recurring expenses, such as impairment of goodwill or acquisition/merger related expenses. Neither is a perfect measure of corporate profits: operating earnings exclude costs that are real to investors and reported incorporate certain goodwill depreciation costs that are not that relevant (see Siegel 2004). We decided to use operating earnings for the more recent past, because equity investors largely focus on operating earnings as a proxy for firms' underlying profitability.

2) The second component is **expectations of future earnings** which are captured by the growth parameter g. Investors must project earnings into the indefinite future to determine current prices. Investors usually focus on earnings projections for the next few years only because it is difficult to project earnings far into the future and cash flows in earlier years carry more weight on the price. IBES analysts provide forecasts of earnings for 1, 2 and 3 years ahead, plus a long-term growth forecast that corresponds to a business cycle period between 3-5 years. The problem with long-term IBES analyst forecasts, however, is that they appear way too high as they have been well above 10% consistently since 1985. In addition, they were found to be biased and inefficient.[3] Inefficiency implies that analysts neglected important information at the time they made their forecasts.

Given that we have no reliable measures of investors earnings expectations over the next few years, we are forced to make an assumption on how investors formulate their views. For this we assume that investors are rational and do not make systematic errors when predicting the future (i.e. deviations from perfect foresight are random). The model is described in detail below.

3) The third component is the **equity discount rate** (EDR), the internal rate of return for investing on equities. We relate the EDR to output and inflation volatility as well as the long real rate. The model for the EDR is described below.

Earnings expectations model

Equity investors or analysts usually forecast earnings up to a specified point in the future and then make assumptions

2 We set the dividend payout ratio to 50%, the historical average of the dividend payout ratio for the S&P500 index since 1950s. The payout ratio has been moving within a 0.40-0.60 range since 1950s. Although it has fallen in the 1990s, this masks the increased share of buybacks as a means by which companies returned cash to shareholders.

3 see Panigirtzoglou and Scammell (2002) and Harris (1999).

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Box 6:
Equation of 5yr real earnings growth

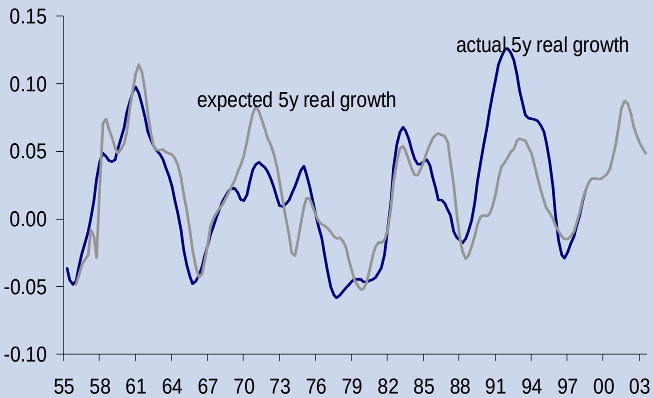
$$\text{5yr real earnings growth} = \underset{(1.6)}{11.2} - \underset{(0.09)}{0.57} \times \text{past 5yr real earnings growth}(-1) - \underset{(0.17)}{1.09} \times E/P(-1)$$

(in percent, annualised, standard errors in parenthesis, 4-quarter moving averages were used for all variables in the regression, one quarter lagged values of the explanatory variables were used as earnings are observed with approximately a lag of one quarter)

Sample period	1960 Q4 to 2004 Q2
R^2-adj	54%
Standard Error	3.1%
Max correlation between explanatory variables	-0.15

Source: JPMorgan

Recursive 5yr real earnings growth expectations vs. actual
in percent, annualised



Source: Standard & Poor's and JPMorgan

about earnings growth beyond that point. That is, they implicitly use two or more stages in their valuation framework. We also follow this approach by employing a two-stage dividend discount model.

We assume investors formulate expectations in a rational manner. Although there is some evidence of irrationality in investors' behaviour, as the voluminous behavioural finance literature argues, over the long run investors tend to adjust their expectations to more "realistic" levels. The burst of the tech bubble in late 1990s is a recent example.

In particular, we use a rational expectations model for the real growth of earnings over the next five years based on information available to investors at the time. Given the cyclical nature of earnings, we found that a rational investor should expect periods of high earnings growth to be followed by periods of low growth. That is, the lagged 5-year growth of earnings had a significant negative coefficient in the earnings forecast equation. Secondly, we found the P/E ratio lagged by one quarter to be a strong predictor of future earnings growth, capturing the multitude of factors that affect investors' expectations and are embedded in past prices. In particular, we found that a higher P/E ratio anticipated higher future profit growth. By lagging the P/E ratio by one quarter we account for the earnings reporting lag. At the same time we avoid circularity in determining the equity price, as only lagged price information is used in earnings expectations, which is one of the equity price determinants.

The model is described in Box 6. It is a forecasting model in that it uses past information to forecast the future. Both 5-year profit growth and the earnings yield (i.e. the inverse of the P/E ratio) were found to be stationary over the sample period and the regression is thus not spurious. The R^2 is a decent 54%. The standard error is 3.1%.

To generate earnings growth expectations, we estimate the model recursively. That is, only data up to the specified date are used. Box 6 shows the estimated parameters using data up to 2004 Q2. The box chart shows the recursive 5-year real earnings growth forecast vs the realised value. The 5-year real earnings growth rate exhibits strong cyclicality and the expected follows the actual quite closely. The stability of the model is shown in Box 6A. There is no strong evidence of coefficient instability.

Chart 2 illustrates shows what the rational expectations 5-year real earnings growth looks like when superimposed on actual EPS. It shows that at high points in the earnings cycle, 5-year ahead expectations are less steep or point downwards, while at low points in the earnings cycle they usually point steeply upwards. That is, rational investors understand that profits move in cycles and apply lower growth rates at high points in the cycle and vice versa. Had we used a one-stage equity model, we would have applied always positive growth rates at high points in the cycle and thus overstate the equity fair value.

In the second stage, we assume that real earnings growth reverts to its long run average since 1950s of g_{LT}=2.2%. Using this *two-stage equity valuation framework* along with the observed price, we can generate the implied EDR using

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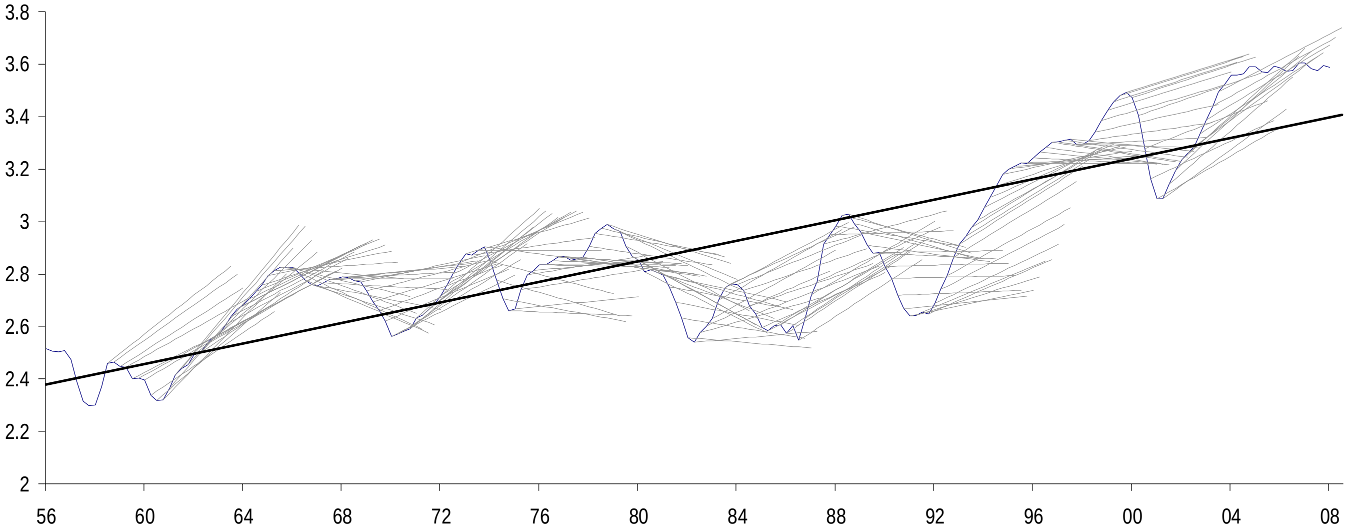
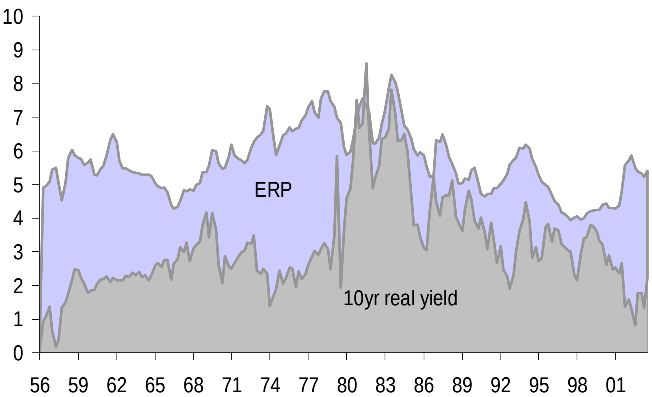
Chart 2: S&P500 real earnings and model 5-yr ahead expectations
log scale in y-axis



Source: Standard & Poor's and JPMorgan

Chart 3: Implied S&P500 EDR and ERP from the 2-stage equity valuation model
in percent, annualised



Source: JPMorgan

equation (1), which can be simplified (see Fuller and Hsia 1984) as follows:

$$P = \frac{k \cdot E_0}{EDR - g_{LT}} \left(1 + g_{LT} + 5 \cdot \left(g_E - g_{LT}\right)\right) \qquad (2)$$

where g_E is the 5-year real profit growth expectation.

The derived EDR and its two components, the Equity Risk Premium (ERP) and the 10-year real yield, are shown in Chart 3. The *ERP* is the residual from subtracting the 10-year real yield from the EDR. Chart 3 shows that the ERP declined significantly in the late 1970s/early 1980s, driven by higher real rates, and also in the second half of 1990s as a result of the equity bubble. The ERP has been 2.5% on average since

Box 7:
Equation of EDR

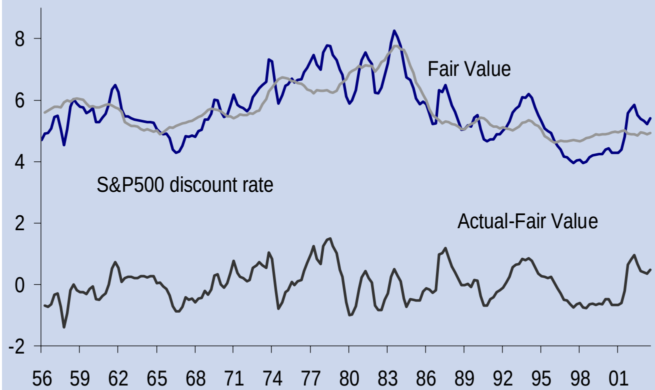
Equity Discount Rate	=	3.80 (0.26)
	+	0.51 × 5y inflation stddev (0.09)
	+	0.23 × 5y GDP growth stddev (0.06)
	+	0.10 × 10y real yield (0.05)

(in percent, inflation standard deviation is the standard deviation of monthly data on annual inflation over the past five years, GDP growth standard deviation is the standard deviation of quarterly annualised GDP growth over the past five years, standard errors in parenthesis)

Sample period	1957 Q1 to 2004 Q2
R^2-adj	65%
Standard Error	57bp
Residual half life	15 months

Source: JPMorgan

S&P500 EDR
Actual vs. model fitted, in percent



Source: JPMorgan

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Box 8: Trading signal from the EDR model

Trading strategy: buy the S&P500 when the observed EDR is half a standard error (i.e. 28bp) above the model fair value, and sell when it is below. Funding is in 3m Treasury Bills.

Period:	1958 Q1 to 2004 Q2
Rebalancing period:	15 months
Trading frequency:	54%
Success rate:	65%
Information ratio:	0.19
Excess return:	2.16%
Volatility:	11.65%

Source: JPMorgan

1956, but it has been lower in 1980s and 1990s than in previous periods.

Equity Discount Rate model

To model the EDR, we have a choice of treating it as a spread to bonds, thus trying to explain the ERP, or explaining the EDR directly. We chose the latter as we observe that the real bond yield is highly negatively correlated with the ERP, such that a rise in bond yields does not have much impact on EDR. Therefore, we cannot treat equities as a spread model to bonds as we do with credit.

We found that a rise in the real bond yield pushes up the EDR only by a tenth (0.10), and that all other variables driving the EDR consisted of measures of risk: volatility of real growth and volatility of inflation over the past five years. The presence of inflation variability may appear puzzling given that equities are supposed to be real assets. But it likely reflects the impact of inflation uncertainty on real variables like investment, output and real earnings. There is an extensive literature arguing that high inflation and inflation uncertainty, frequently as the result of negative supply shocks in the past, increase macro- and microeconomic risks, and lead to restrictive macroeconomic policies, all of which are consistent with a rise in investors' required equity return. Equity price volatility itself was not found to covary significantly with the EDR.

The model is shown in Box 7. One way to judge whether the coefficients make sense to us is to calculate the fair value for the EDR when there is no variability in real growth or inflation, that is, when there is minimal macroeconomic uncertainty. Under this condition, the model implies an EDR of around 4%, not far from the historical average of real bond yield of 3.2%. The 80bp difference between the two likely reflects that real growth and inflation variability are not the only sources of systematic risk priced by equity investors, or that past 5-year standard deviation is a not a perfect proxy for investors' uncertainty.

The chart in Box 7 shows the actual and fitted values. The R^2 is 66% and the standard error is 56bp. The periods in late 1970s and in the second half of 1990s showed the longest misalignments from the model. The half life is five quarters, more than double the half life of the bond model. Box 7A shows that there is no strong evidence of coefficient instability.

The trading performance of the signal generated from the EDR model is shown in Box 8. That is, we buy the S&P500 when the actual EDR is half a standard deviation above the model 'fair' value and vice versa. The success rate is 65%, well above the 50% mark, and the resulting IR is a decent 0.19. It is though smaller than a long only strategy of holding equities vs. Treasury bills, that yielded an IR of 0.31 over the same period.

5. Swap spread

This section describes a model for the 10-year US swap spread.[4] From a microeconomic point of view, the difference between swap rates and government bond yields reflects the systemic risk of the banking sector, as swaps contract with reference to the LIBOR curve. In theory, the swap spread should be driven by expectations about the future spread between LIBOR and general collateral (GC) repo rate, which proxies for interbank lending risk or the expected loss on unsecured loans in the interbank market. But previous literature has found persistent deviations in swap spreads from the LIBOR-GC repo spread.[5] Other factors, like supply and demand and proxies for liquidity and risk premia also appear to be important drivers.

One problem with modelling the swap spread is that the market experienced a structural break in the early 1990s. Before 1993, the notional size was significantly lower and the bid-ask spreads significantly higher and volatile. In addition, the potential effect on interest rate markets of the

4 This model co-exists with other swap spread models we have published and which are based on shorter, more recent sample periods. See Fransolet et al. (2001) and Belton et al. (2004)
5 See Cortes (2003) and Cooper and Scholtes (2001).
6 See Gupta and Subrahmanyan (2000).

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Box 9:
Equation of the 10-year swap spread

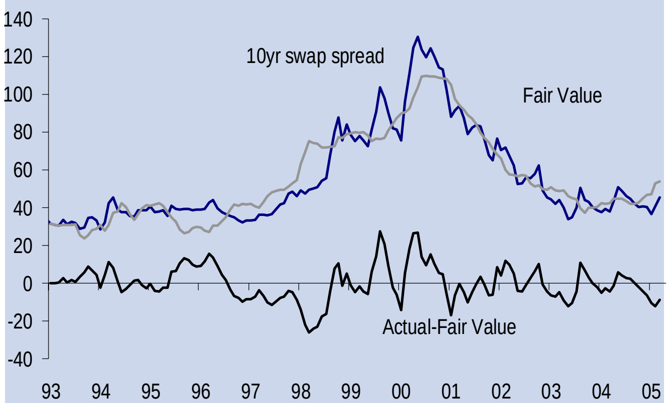
10-year swap spread = 90.5 (3.4)
- 1.23 × government deficit/GDP (1.5)
+ 13.6 × corporate financing gap/GDP (2.8)
- 1.49 × gov weight in Lehman's US agg (0.21)

(in bps, corporate financing gap and government deficit as % of GDP – source: US Fed Flow of Funds and BEA NIPA respectively, standard errors in parenthesis)

Sample period	1993 Jan to 2005 Mar
R^2-adj	86%
Standard Error	9.5bp
Residual half life	3 months

Source: JPMorgan

10-year swap spread
Actual vs. model fitted, in bp



Source: JPMorgan

Box 10: Trading signal from the 10yr swap spread model

Trading strategy: be long the 10yr US interest rate swap vs. 10yr Treasury bond when the observed swap spread is half a standard error (i.e.4bp) above the model fair value, and be short when it is below. Funding is in 3m Treasury Bills for 10yr Treasury bond and in 3m LIBOR for 10yr swap.

Period:	1993 Mar to 2005 Mar
Rebalancing period:	3 months
Trading frequency:	41%
Success rate:	76%
Information ratio:	0.49
Excess return:	0.96%
Volatility:	1.96%

Source: JPMorgan

Savings and Loan Crisis in the US and some evidence of systematic mispricing in the late 1980s and early 1990s, justify the use of the post 1993 period for our analysis.[6]

Among the determinants of the swap spread, we found that government and corporate debt supply indicators, which we proxy by the government deficit and the corporate financing gap (including financials) respectively, were important. Although the effect of the first is clear, with falling government debt supply causing spread widening, the effect of corporate debt supply can be in both directions. In particular, spreads will tend to rise when the market demands a premium for absorbing new corporate issuance, and when underwriters hedge the new issue by paying in swaps. But spreads could narrow if issuers swap out of paying fixed into floating or underwriters of corporate securities hedge the new issue by selling government bonds. We found that the coefficient on corporate financing gap is positive, implying that the former, swap spread widening factors, dominate.

The inclusion of *flow*-based indicators for government and corporate debt supply can be a good proxy for the relative supply of government debt, but they do not capture the shift over time of the relative weight of the *stock* of government securities in the fixed income universe. In addition, they do not capture the relative supply of non-corporate debt, such as securitised debt and agencies. To capture these two effects we introduce in the model the weight of government securities in Lehman's US aggregate index. This weight has fallen from 44% in 1992 to 24% in 2005, putting some upward pressure on swap spreads since late 1990s.

Past studies (see Cortes 2003 and Fransolet et al. 2001) have found that swap spreads covary negatively with the slope of the yield curve, a cyclical indicator. We found no evidence of a cyclical influence. We also examined the 10-year US Treasury off/on-the-run spread to proxy for liquidity premia, and the S&P500 volatility proxying for credit or other risk premia. Both of these variables were found statistically insignificant.

The model for swap spreads is shown in Box 9. The actual and model fitted values are shown in the box chart. The fit is good with R^2 at 86% and standard error at 9.5bp. The model implies that a 1% rise in the deficit causes a reduction of swap spreads by 1.2bp, while the same change in the corporate financing gap causes spread widening by almost

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Box 11:
Equation of the HG credit spread

HG spread (over UST) = 35.4 (6.6)

+ 2.81 × 12m HG downgrade rate (1.57)

+ 6.22 × 12m HG spread stddev (3.95)

- 1.31 × S&P500 12-month return (0.20)

+ 1.0 × 10yr swap spread

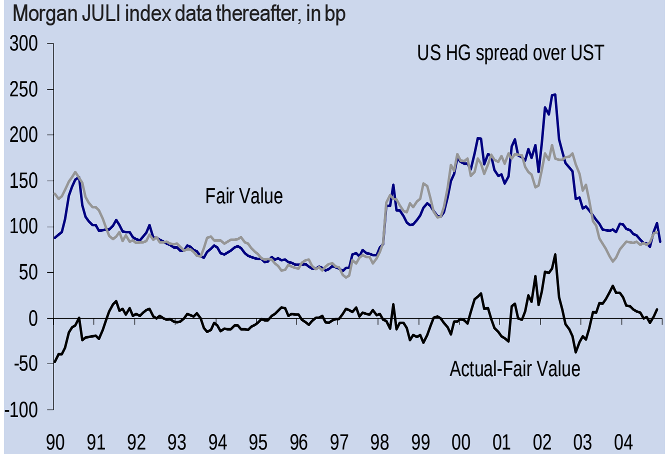
(in bps, downgrade rate in %, spread stddev in bps per day, S&P500 12-month return is a 3-month moving average in %, standard errors in parenthesis)

Sample period	1990 Jun to 2005 Apr
R^2-adj	85%
Standard Error	17bp
Residual half life	3 months

Source: JPMorgan

HG credit spread

Actual vs. model fitted, spread over UST, Lehman's data before 2000, JP Morgan JULI index data thereafter, in bp



Source: Lehman's and JPMorgan

Box 12: Trading signal from the HG credit spread model

Trading strategy: buy HG corporates vs. US Treasuries when the observed credit spread is half a standard error (i.e.8.5bp) above the model fair value, and sell when it is below. Funding is in 3m Treasury Bills.

Period:	1989 Sep to 2005 Mar
Rebalancing period:	3 months
Trading frequency:	52%
Success rate:	53%
Information ratio:	0.20
Excess return:	0.35%
Volatility:	1.71%

Source: JPMorgan

14bp. Finally, a percentage point increase in the government weight in Lehman's US aggregate index reduces the swap spread by 1.5bp.

The stability properties of the model are shown in Box 9A. There is no significant evidence of coefficient instability. Finally, the information content of the misalignments of the model, that is, how profitable it is to trade on half standard error deviations from the fair value, is shown in Box 10. The success rate at 76% is well above the 50% mark and the resulting IR is 0.49.

6. High Grade

This section describes the model for the high-grade corporate spread. The first issue we face is the choice of data. Credit spread data in our own JULI index start in 2000, a sample that does not include a full credit cycle. Moody's provides yield data since 1950s but only for long (10+ years) maturity US corporate bonds, unadjusted for embedded options. We instead decided to use Lehman's corporate bond data on option-adjusted spreads (OAS) for high-grade US corporates over US Treasuries since June 1989. From 2000, we splice our own JULI z-spread data over Treasuries, as they have been tracking Lehman's data closely for that period.

To explain the HG corporate spread, we start with a discounted future cash flow framework as in equities and bonds. For credit, the discount rate incorporates investors' compensation for ratings migration risk and the uncertainty around it. We use a direct proxy for migration risk measured by the downgrade rate of HG rated US corporates over the past 12 months taken from Moody's. The downgrade rate is a weighted average of the downgrade rate for AA, A and BBB rating sectors using weights of 20%, 40% and 40% respectively.

We proxy uncertainty by using the 12-month HG corporate spread volatility. We also tried historical and implied S&P500 volatility, but they were outperformed by spread volatility. Equity returns tend to correlate negatively with credit

8 A corporate issuer can issue debt in different currencies and can use currency and interest rate swaps to achieve the desired payment structure. The cheapest funding corresponds to the currency, which offers the smallest spread of the coupon the company would have to pay on a par bond in this currency, over the respective swap rate. The spread over government yields does not affect the company's decision on which currency to issue. See Scholtes (2002) and Churm and Panigirtzoglou (2004).

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spreads and we use the S&P 500 12-month returns to proxy for changes in expectations about profits and/or risk premia. We use the 10-year swap spread as swap rates are considered to be more appropriate benchmarks for corporate debt than government yields.[8] The swap spread also serves as a proxy for liquidity and systemic banking sector risk.

Our model is shown in Box 11. The HG spread over Treasuries cointegrates with the downgrade rate, spread volatility, the 10-year swap spread and the S&P500 12-month return. The actual and model fitted values are shown in the chart of Box 11. The fit is good with R^2 at 85% and standard error at 17bp. The coefficient on the 10-year swap spread is restricted to one, as in the unconstrained regression its coefficient is not statistically significant different from one. The equation provides therefore a model on the HG spread over swaps. A percentage point increase in the downgrade rate increases the spread by around 3bp; a 1bp per day increase in spread volatility increases the spread by 6bp and a percentage point increase in equity return reduces the credit spread by around 1.3bp.

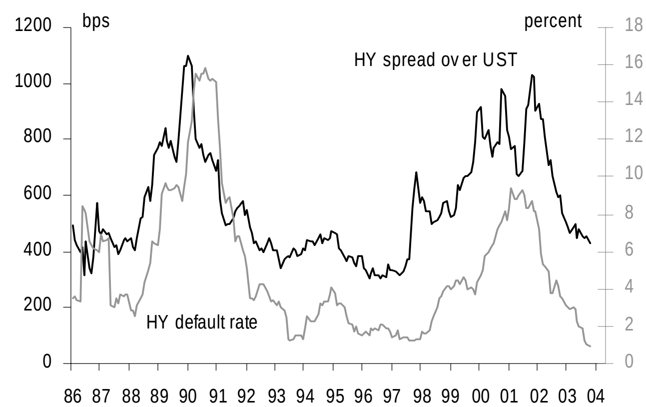
The stability properties of the model are shown in Box 11A. There is no evidence of coefficient instability. Finally, the information content of the misalignments of the model, that is, how profitable it is to trade on half standard error deviations from the fair value, is shown in Box 12. The success rate at 53% is above the 50% mark and the resulting IR is a decent 0.20.

7. High Yield

This section describes the model for US high-yield corporate spreads. We use JPMorgan's US High-Yield Index data that begin in 1987. The spread is over US Treasuries and is based on the yield to worst. This is the lowest of all yields to call or the yield to maturity. The yield to call is the yield that would be realized on a callable bond in the event that the bond is redeemed by the issuer on the next available call date.

High-yield bonds are bonds that are rated speculative, that is, below investment-grade. They encompass bonds rated BB, B, CCC, CC, C and D (defaulted). They offer a higher spread than high-grade bonds to compensate investors for the higher probability of default. As such the spread should be mainly driven by the expected default rate and the uncertainty around this.

Chart 4: High-yield credit spread and default rate
Credit spread over UST in bp, default rate in %



Source: JPMorgan

Indeed, the high-yield spread and default rate are highly correlated. Chart 4 shows the high-yield credit spread along with the 12-month default rate from Moody's. However, the default rate is backward looking and tends to lag the credit spread. By employing a Granger causality test, we found that the high-yield credit spread "causes" the default rate at a 5% significance level. There was no significant evidence of "causality" from the default rate to high-yield spread. This result is probably because credit spreads should reflect information about expected future rather than past default rates. Therefore, we approach the fair value for the high-yield spread in two stages. In the first stage we develop a rational expectations model of the future default rate and in the second stage we model the spread as a function of the expected future default rate and other variables that proxy for uncertainty or corporate bond supply.

The future high-yield default rate should be driven by variables that affect corporate credit quality, such as, operating leverage (capacity utilization, profit/GDP ratio), financial leverage (capital leverage, interest coverage) and borrowing costs (the level of the long or short rate). Expectations of future economic growth should be also relevant given that defaults rise significantly during recessions. We proxy the cyclical position of the economy by using capacity utilization and the slope of the yield curve.

The model for the future 12-month default rate is shown in Box 13. The slope of the yield curve, interest coverage and the profit/GDP ratio cointegrate well with future default rates. Actual and model fitted values are shown in the box chart. The fit is good with R^2 at 88% and standard error at 1.35%.

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Box 13:
Equation of 12-month ahead HY default rate

Log(12m ahead HY default rate) = 2.26 (0.61)

- 0.40 × yield curve slope 10yr-2yr yield (0.04)

+ 0.039 × interest expense/profits (0.005)

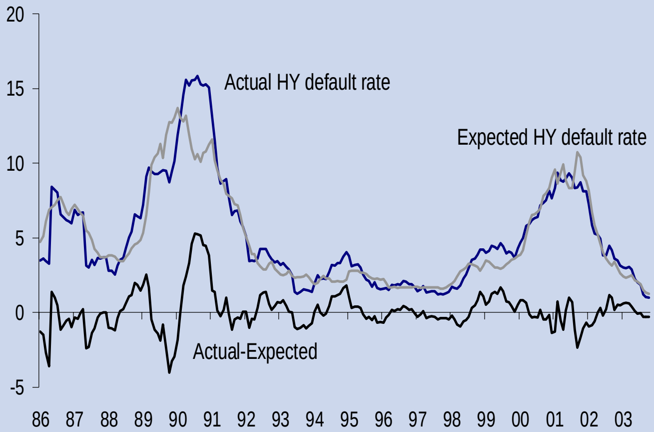
- 0.23 × profit/GDP (0.05)

(default rate in %, the logarithm of the default rate is used to ensure positivity, interest expense/profits and profit/GDP in % – source: BEA NIPA and US Flow of Funds respectively, standard errors in parenthesis)

Sample period	1985 Dec to 2004 Aug
R^2-adj	87%
Standard Error	1.35%
Residual half life	4 months

Source: JPMorgan

HY default rate
Actual vs. model fitted, in %



Source: JPMorgan

The stability properties of the model are shown in Box 13A. There is no significant evidence of coefficient instability.

By employing a Granger causality test we found that there is significant, at 5% level, "causality" from the expected 12-month default rate of the above model to both the high-yield credit spread and the past default rate. This is another confirmation that the expected default rate is more informative about current credit spreads than the past default rate.

We now proceed to the model for the high yield spread. Apart from the expected default rate, we need to take into account the downgrade rate. It is measured by the weighted

Box 14:
Equation of HY credit spread

HY credit spread = 166.2 (37.0)

+ 29.2 × expected 12m default rate (3.9)

+ 26.4 × 12m HY downgrade rate (5.7)

+ 10.4 × 12m HY spread stddev (3.1)

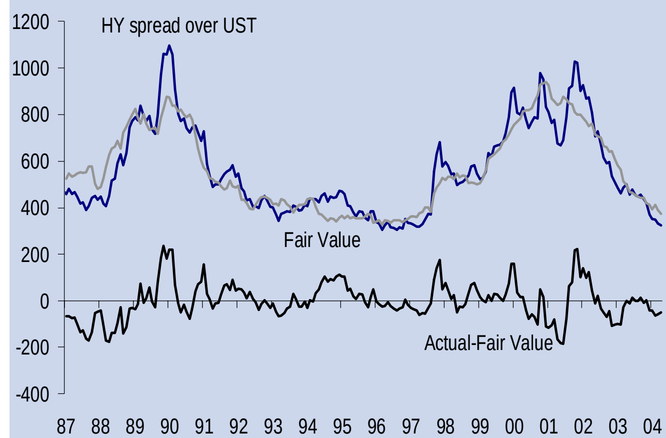
- 0.93 × S&P500 12-month return (0.87)

(in bps, default and downgrade rate in %, downgrade of BB and B rated credit spread ex defualt, stddev in bps per day, S&P500 12-month return is a 3-month moving average in %, standard errors in parenthesis)

Sample period	1987 Dec to 2005 Mar
R^2-adj	83%
Standard Error	80bp
Residual half life	4 months

Source: JPMorgan

HY credit spread
Actual vs. model fitted, in %, spread over UST



Source: JPMorgan

Box 15: Trading signal from the HY credit spread model

Trading strategy: buy high-yield corporates vs. US Treasuries when the observed credit spread is half a standard error (i.e. 40bp) above the model fair value, and sell when it is below. Funding is in 3m Treasury Bills.

Period:	1988 Aug to 2005 Feb
Rebalancing period:	3 months
Trading frequency:	58%
Success rate:	61%
Information ratio:	0.40
Excess return:	2.17%
Volatility:	5.47%

Source: JPMorgan

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average of the downgrade rates for BB and B rated credits with 50% weight each. The two variables have a relatively low correlation of 0.20, likely capturing potential different information. We proxy uncertainty by using the 12-month HY corporate spread standard deviation and the S&P500 volatility. We also use S&P 500 12-month returns to proxy for changes in expectations about profits and/or risk premia.

The model is shown in Box 14. The high-yield credit spread cointegrates with the expected default rate, the downgrade rate, spread volatility and equity returns. Actual and model fitted values are shown in the chart of Box 14. The fit is good with R^2 at 83% and standard error at 80bp. The effect of the expected default rate is around the same as that of the downgrade rate. The sensitivity of the spread to its volatility is twice as large as that of the high-grade model, but the sensitivity to equity returns is smaller.

The stability properties of the model are shown in Box 14A. There is no significant evidence of coefficient instability. Finally, the information content of the misalignments of the model, that is, how profitable it is to trade on half standard error deviations from the fair value, is shown in Box 15. The trading performance of this model is much more encouraging than the high-grade model. The success rate at 61% is above the 50% mark and the IR is a decent 0.40.

8. Emerging Market external debt

This section describes the model for Emerging Market (EM) external debt. We use the JPMorgan's EMBIG stripped spread series that begins in 1991. From 2001on, we exclude Argentinian defaulted debt and we use the stripped spread of JPMorgan's EMBIG index adjusted for Argentina. The spread is over US Treasuries and excludes the collateralised principal of sovereign bonds (stripped spread).

To explain the EMBIG spread, we need to use variables that proxy for the expected loss due to default on this debt and uncertainty around this loss. Estimates of sovereign default rates have high uncertainty because of the small number of issuers available. We use instead, for each rating category in the EMBIG basket, Moody's default data on the much larger

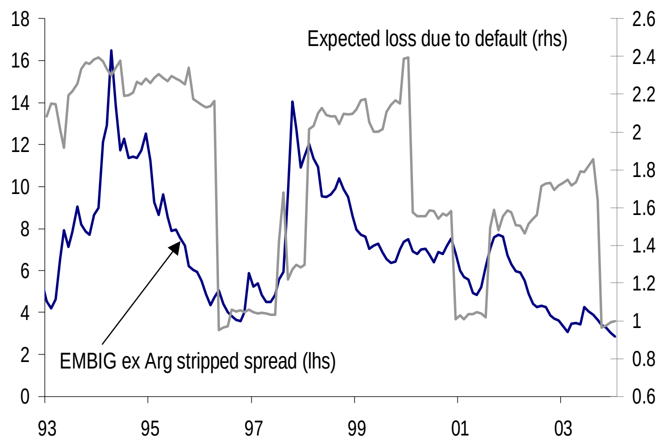
9 Sovereign credit ratings depend on factors like political risks, external liquidity and external debt burden, monetary stability and fiscal flexibility.

10 We start with the expected losses due to default on each of the rating categories in the EMBIG index, based on Moody's corporate default history since 1983 (data before 1983 are less reliable): 0.5% for BBB, 1.5% for BB and 7.0% for B. We then weigh these losses by the capitalization shares of these ratings in the EMBIG index. There is a percentage of bonds in the EMBIG basket that are non-rated. This is distributed among BBB, BB and B based on their relative proportions.

11 We weigh the corporate spreads of each rating category by the capitalization shares of these ratings in the EMBIG index.

Chart 5: EMBIG spread and proxy for expected loss due to default

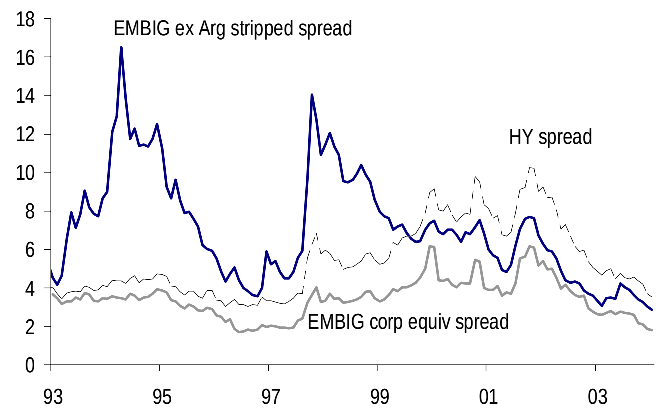
in %



Source: JPMorgan

Chart 6: EMBIG, corporate equivalent and US high yield spread

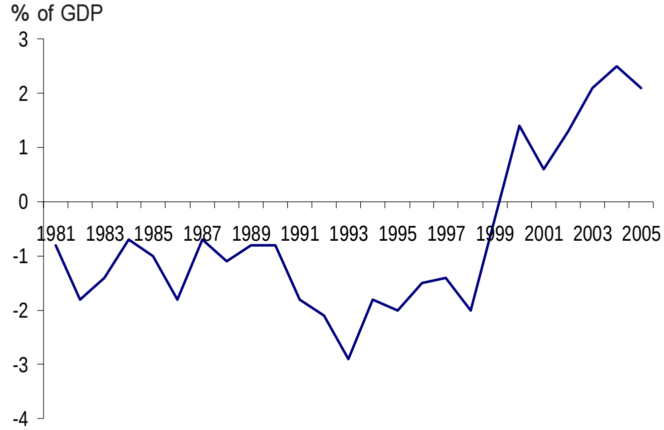
in %



Source: JPMorgan

Chart 7: EM economies current account balance

% of GDP



Source: IMF

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Box 16:
Equation of EMBIG ex Arg credit spread

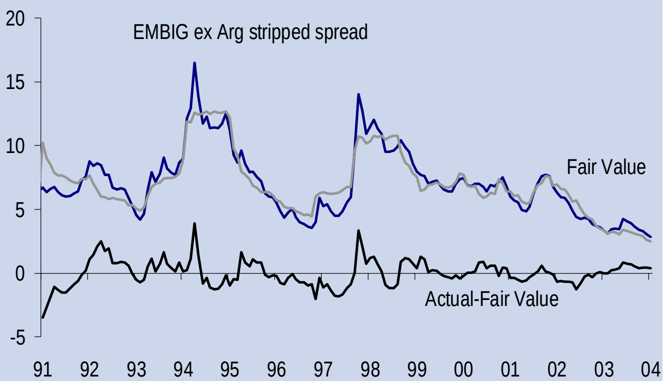
EMBIG spread	= -1.46 (0.65)
	+ (0.35 - 0.05 × EM curr acc) × 2yr UST yld (0.08) (0.03)
	+ 0.61 × HY spread (0.04)
	+ 18.0 × 12m EMBIG spread stddev (1.66)

(in %, spread stdev in bps per day, standard errors in parenthesis)

Sample period	1991 Dec to 2004 Dec
R^2-adj	84%
Standard Error	104bp
Residual half life	2 months

Source: JPMorgan

EMBIG ex Arg credit spread
Actual vs. model fitted, in %, stripped spread over UST



Source: JPMorgan

Box 17: Trading signal from the EMBIG credit spread model

Trading strategy: buy EM external debt vs. US Treasuries when the observed credit spread is half standard error (i.e.52bp) above the model fair value, and sell when it is below. Funding is in 3m Treasury Bills.

Period:	1992 Mar to 2004 Dec
Rebalancing period:	3 months
Trading frequency:	59%
Success rate:	47%
Information ratio:	0.34
Excess return:	6.6%
Volatility:	19.3%

Source: JPMorgan

universe of corporates. In particular, we combine sovereign credit ratings[9] with historical corporate default loss rates to construct an EMBIG loss-due-to-default variable[10] (Chart 5), or with corporate spreads to construct an EMBIG corporate equivalent spread[11] (Chart 6), or we use the credit spread of corporate high-yield directly, as high-yield is a competing asset class with similar risk/return characteristics.

We found that the corporate high-yield spread outperforms the EMBIG loss-due-to-default or the EMBIG corporate equivalent spread, in terms of statistical significance. The high-yield spread does not only capture default risk and the overall appetite for credit for high-yield corporates, but also the impact of many crossover investors that hold both EM and high-yield debt and treat them as substitutes. One reason for the underperformance of the two rating-based variables, the EMBIG loss-due-to-default and the EMBIG corporate equivalent spread, could be that the EMBIG spread seems to price rating changes before they happen, *leading* the expected loss variable. This is confirmed by a simple Granger causality test.

To proxy for uncertainty, we tried the volatility of the S&P 500 index, the volatility of the MSCI world equity index, and the 12-month volatility of the EMBIG spread. We found that the EMBIG spread volatility is a very important variable in explaining movements in the EMBIG spread level.

Sovereign credit cycles tend to track economic cycles. To capture this, we use variables that proxy for growth (GDP and IP), inflation (CPI), and policy rates in emerging markets, both in levels and as differences from corresponding aggregates in developed economies. We also tried commodity prices, oil and non-oil, as many emerging economies are commodity producers, and higher commodity prices tend to support their external debt prices. We found none of these variables to be significant in explaining past movements in the EMBIG spread.

Emerging market external debt is denominated in US dollars and thus the level of US yields is likely to be an important variable. The higher the level of US yields, the larger the debt servicing costs and the higher the premium that investors require for holding EM external debt. Indeed we found that the 2-year US yield is important. But the coefficient on the 2-year yield is not stable over time, likely reflecting the declining rate sensitivity of EM economies over the past decade. EM economies have become capital exporters since 2000, reflecting the adjustment (a reduction in external debt and increase in foreign assets) to a sequence of crises in 1990s, the accumulation of reserves and greater

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reliance on local financial markets (see *Global Financial Stability Report*, IMF, Sep 2004). As shown in Chart 7, the current account balance (% of GDP) of EM economies has been in deficit in 1980s and 1990s, but has moved to a surplus since 2000. To account for this structural change, we make the coefficient on the 2-year yield a function of EM current account balance.

The model is shown in Box 16. The EMBIG strip spread cointegrates with the 2-year UST yield, the high-yield spread and the EMBIG spread volatility. The actual and model fitted values are shown in the box chart. The fit is decent with R^2 at 84% and standard error at 102bp.

The coefficient of the 2-year US yield is a function of the EM current account balance, with a decline in the coefficient by -0.05 per 1% increase in the EM current account balance. Currently, an EM current account surplus of around 2% implies a sensitivity to the 2-year yield of around 0.25, that is, a 100bp rise in the 2-year yield suggests a widening in the EMBIG spread by around 25bp. The sensitivity of the EMBIG spread to high-yield is around 0.6. The sensitivity of the spread to its volatility is around double that of the high-yield model. Spread volatility has a high correlation of 0.83 with EMBIG spread and is the most significant variable in the model in terms of explaining the historical variation of the EMBIG spread, showing that uncertainty is an important factor in the investment decision process of EM investors. The strong dependence on spread volatility makes the EMBIG model the most difficult to use for forecasting.

The stability properties of the model are shown in Box 16A. There is no significant evidence of coefficient instability. Finally, the information content of the misalignments of the model, that is, how profitable it is to trade on half standard error deviations from the fair value, is shown in Box 17. The success rate at 47% below the 50% mark, but the resulting IR is a decent 0.34.

Box 18: Forecasts of fundamentals

	US 3M Tbill %	GDP growth q/q saar %	CPI oya %	EM Current Account ar % GDP	CAPU Mfg %	Gov Deficit ar % GDP	Financing Gap ar % GDP	Profit/GDP	Interest Coverage
Sep-05	3.80	4.00	2.40	3.09	78.60	2.90	0.20	0.108	0.26
Dec-05	4.25	3.50	2.60	3.15	79.20	2.80	0.25	0.107	0.26
Mar-06	4.50	3.50	2.60	3.00	79.60	2.70	0.31	0.105	0.27
Jun-06	4.50	3.00	2.70	2.85	80.00	2.60	0.38	0.104	0.28
Sep-06	4.50	3.00	2.80	2.60	80.40	2.55	0.45	0.102	0.28
Dec-06	4.50	3.00	2.80	2.45	80.70	2.50	0.50	0.101	0.29
Mar-07	4.75	2.75	2.85	2.35	80.90	2.50	0.55	0.099	0.30
Jun-07	5.00	3.00	2.90	2.25	80.80	2.60	0.72	0.098	0.31
Sep-07	5.50	3.25	2.95	2.15	80.60	2.60	0.80	0.096	0.31
Dec-07	6.00	3.50	3.00	2.00	80.50	2.60	0.88	0.095	0.32
Mar-08	5.75	3.00	2.95	1.90	80.30	2.80	0.96	0.093	0.33
Jun-08	5.50	2.60	2.90	1.80	80.10	3.00	1.04	0.092	0.33
Sep-08	5.25	2.50	2.85	1.70	80.05	3.10	1.12	0.090	0.34
Dec-08	5.25	2.50	2.80	1.60	80.00	3.20	1.20	0.089	0.35
Mar-09	5.00	2.50	2.80	1.50	80.00	3.20	1.20	0.087	0.35
Jun-09	5.00	2.60	2.80	1.50	80.00	3.20	1.20	0.086	0.36
Sep-09	5.00	2.80	2.80	1.50	80.00	3.20	1.20	0.084	0.37

Source: JPMorgan

Box 19: US asset price projections

	10y UST	S&P 500	10yr swap spread	HG-swap spread	HY-UST spread	EMBIGxArg UST spread
30-Jun-05	3.94	1200	0.41	0.40	4.05	2.90
Fair value	4.70	1430	0.52	0.46	4.28	2.67
Projected fair values						
Sep-05	4.87	1233	0.53	0.46	4.26	2.84
Dec-05	4.95	1280	0.53	0.47	4.35	3.00
Mar-06	5.06	1296	0.53	0.47	4.40	3.15
Jun-06	5.04	1297	0.54	0.48	4.45	3.24
Sep-06	5.04	1291	0.55	0.49	4.63	3.61
Dec-06	5.06	1256	0.55	0.57	4.77	3.81
Mar-07	5.17	1201	0.56	0.65	4.87	3.97
Jun-07	5.35	1139	0.57	0.73	4.92	4.06
Sep-07	5.57	1112	0.58	0.76	4.91	4.09
Dec-07	5.79	1113	0.59	0.73	4.80	4.03
Mar-08	5.81	1136	0.59	0.64	4.75	3.98
Jun-08	5.83	1164	0.60	0.55	4.69	3.92
Sep-08	5.83	1202	0.60	0.47	4.66	3.89
Dec-08	5.92	1248	0.61	0.42	4.60	3.86
Mar-09	5.85	1305	0.61	0.40	4.63	3.88
Jun-09	5.85	1365	0.60	0.37	4.64	3.86
Sep-09	5.85	1447	0.60	0.34	4.64	3.84

Source: JPMorgan

9. Projecting with the models

This section discusses how we can use the models to translate a set of fundamentals forecasts into projections for asset prices.

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

As shown in Box 1, the models rely on a set of fundamentals that relate to monetary and fiscal policies, corporate operating and financial leverage and volatility. The forecasts for these fundamentals are shown in Box 18. The forecasts imply that Fed tightening continues into 2007 and peaks at 6% as inflation rises. GDP grows at a 3-3.5% pace but slows significantly in 2008 in response to Fed tightening. Capacity utilization grows slowly and peaks at close to its historical average of 81% in Mar 07. The government deficit falls towards 2.6% in the next few years but rises in 2008 as economic growth decreases. The corporate sector is forecast to continue to expand at a gradual pace and the financing gap reaches 1.2% of GDP in Dec 08, close to the historical average of 1.3%. Both profit/GDP and interest expense/ profits ratio are forecast to rise towards their historical averages by Dec 08.

The equations for the high-grade and high-yield spread contain the downgrade rate as an input. We found that the HG downgrade rate is related to interest expense/profits ratio – a financial leverage proxy, and the slope of the yield curve – a cyclical proxy. The HY downgrade rate is also related to interest expense/profits and the slope of the yield curve as well as capacity utilization – a profit margin or operating leverage proxy. The equations for the HG and HY downgrade rates are shown in Box 1.

Some equations contain volatility variables as inputs. Forecasting volatility or relating it to fundamentals is a formidable task and beyond the scope of this paper. We rather take a simplistic approach to forecasting volatility. We expect the macro volatility variables, that is inflation and GDP growth volatility, to gradually revert towards their 1990s averages by the end of the forecast horizon. These two macro volatility variables are the drivers of the S&P 500 equity discount rate. We assume that the EDR moves only slowly to its fair value, reflecting the long half life of the EDR model residuals.

The EMBIG volatility forecast is the main driver of the EMBIG model. It is currently at a historical low. To forecast EMBIG volatility we first generate a projection of the EMBIG spread by assuming that volatility remains unchanged and equal to the current level. We then exploit the strong relation between the EMBIG spread and its volatility. A 100bp rise in the EMBIG spread was associated in the past with a rise in the EMBIG spread volatility of 2.2bp per day. We use this historical relationship to transform the unchanged-volatility EMBIG spread into a volatility projection. In this way, the volatility projection is driven by the forecast for the 2-year US yield and the high-yield spread.

We cannot do the same for the high-grade and high-yield spread volatility, because there has not been as strong association between spread level and volatility in the past. We instead assume that volatility will rise only gradually by the end of the forecast horizon to a level that is only half the historical average.

Box 19 contains the quarterly forecasts for different US asset prices. The models project that the 10-year bond yield fair value will reach 5.07% by Dec 06, mainly driven by Fed tightening, as we expect the Fed to continue raising the funds rate to 4.5% by that time. The corporate financing gap exerts an upward pressure on bond yields but only gradually. The S&P 500 is forecast to peak at 1297 by Jun 06, but then it slows as earnings and earnings expectations slow. It reaches a bottom of 1112 in Sep 07, but it quickly recovers afterwards on improved earnings and earnings expectations. The pattern of the S&P 500 forecast is mainly driven by earnings and earnings expectations, as the EDR is allowed to drift upwards towards its fair value only slowly.

The swap spread is currently around one standard error or 10bp tighter than fair value and the fair value is forecasted to rise gradually to almost 60bp by the end of the forecast horizon as corporate financing requirements increase. The HG spread is currently slightly tighter than its fair value. The fair value is forecast to remain close to current levels through 2006, but it gradually rises from 2007 as equity returns slow. The HY spread is also slightly tighter than its fair value. The fair value is forecast to stay within 450-500bp to 2009. The 12-month ahead default rate in particular is forecast to rise from its current value of 1.7% to around 4% by the end of the forecast horizon.

The EMBIG spread fair value depends on the HY spread fair value. Using the current fair value of the HY spread, the EMBIGxArg spread fair value is 268bp, slightly below the market price of 288bp. Going forward, the EMBIG spread fair value gradually increases reaching 400bp by Sep 07.

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Appendix

Box 3A: Equation of Phil Fed 10yr CPI inflation expectations

Residuals stationarity - evidence of cointegration:

ADF[1] statistic = -3.69

Critical value (N=3 [2], no-trend, 5% level) = -3.74

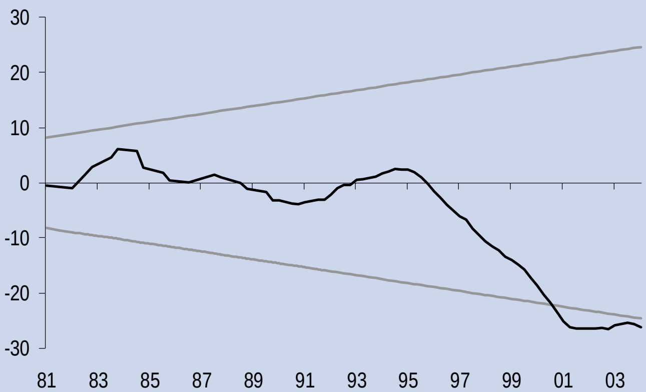
Max correlation[3] between explanatory variables: 0.71

[1] Augmented Dickey-Fuller unit root test.

[2] N=3 because all three variables in the equation were non-stationary, i.e. I(1), at 5% significance level.

[3] The maximum correlation between explanatory variables is reported for indication of multicollinearity. Usually a high correlation above 0.70 may indicate a problem of multicollinearity, reflected in large standard errors and high Rsqs. However, intercorrelation between variables is not necessarily a problem and standard errors and t-ratios give us more inormation about how serious the problem is. See Maddala (1992), Chapter 7. In our regression high t-ratios and low standard errors do not indicate a problem.

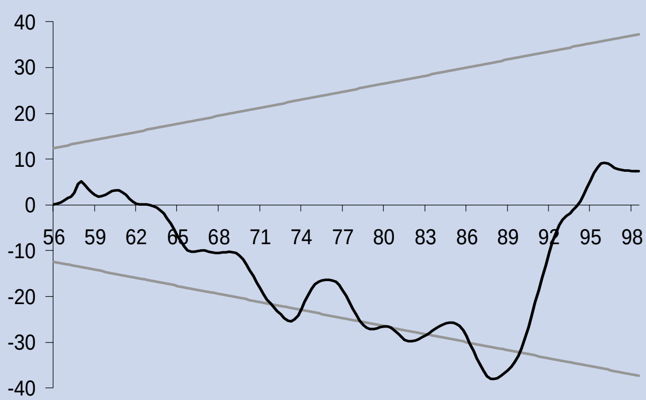
Stability test of the Phil Fed 10yr CPI inflation expectations model
standardised cumulative sum of recursive residuals with 5% significance lines



Source: JPMorgan

Box 6A: Stability test of the 5y real rearnings growth model

standardised cumulative sum of recursive residuals with 5% significance lines



Source: JPMorgan

Box 4A: Equation of the 10yr yield

Residuals stationarity - evidence of cointegration:

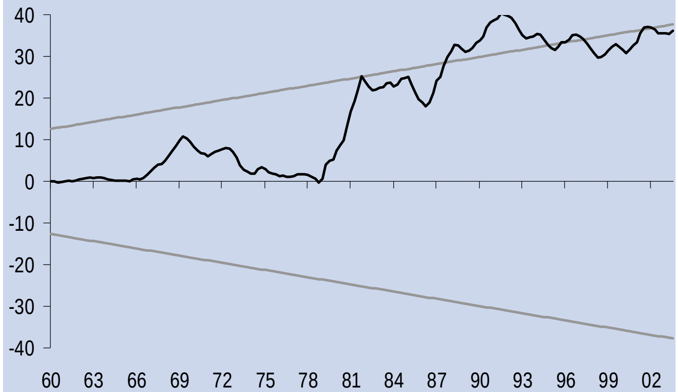
ADF statistic = -5.40

Critical value (N=4[4], no-trend, 5% level) = -4.10

Max correlation between explanatory variables: 0.52

[4] N=3 because there were three non-stationary variables in the equation, the 10yr real rate, the deficit, the EM current account balance and 5yr inflation standard deviation (at 5% significance level).

Stability test of the 10yr real rate model
standardised cumulative sum of recursive residuals with 5% significance lines



Source: JPMorgan

Box 7A: Equation of EDR

Residuals stationarity - evidence of cointegration:

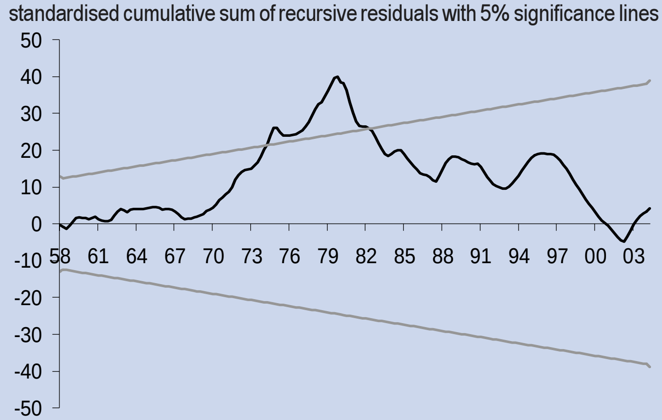
ADF statistic = -6.09

Critical value (N=3[5], no-trend, 5% level) = -3.74

Max correlation between explanatory variables: 0.61

[5] N=3 because there were three non-stationaryvariables in the equation, the 10yr real rate, the 5yr inflation and 5yr real GDP standard deviation (at 5% significance level).

Stability test of the EDR model
standardised cumulative sum of recursive residuals with 5% significance lines



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Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

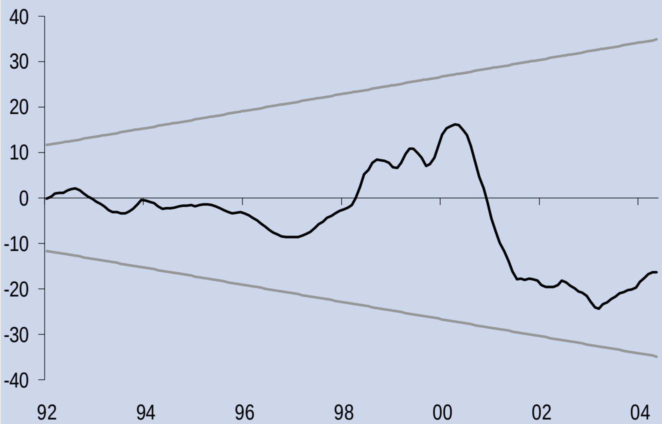
Box 9A: Equation of the 10yr swap spread

Residuals stationarity - evidence of cointegration:
ADF statistic = -6.04
Critical value (N=3[6], no-trend, 5% level) = -3.74

Max correlation between explanatory variables: 0.81

[6] N=3 because from the 4 variables in the regression only the financing gap is stationary in the sample period (at 5% significance level).

Stability test of the 10yr swap spread model
standardised cumulative sum of recursive residuals with 5% significance lines



Source: JPMorgan

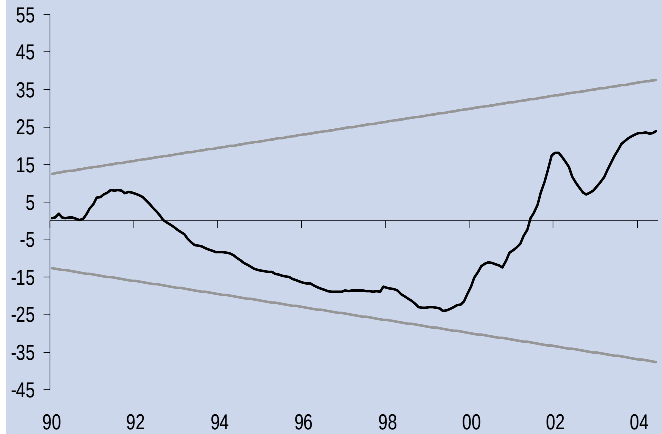
Box 11A: Equation of the HG credit spread

Residuals stationarity - evidence of cointegration:
ADF statistic = -4.47
Critical value (N=3[7], no-trend, 5% level) = -3.74

Max correlation between explanatory variables: 0.77

[7] N=3 because from the 4 variables in the regression only the S&P500 6-month return is stationary in the sample period (at 5% significance level).

Stability test of the HG credit spread model
standardised cumulative sum of recursive residuals with 5% significance lines



Source: JPMorgan

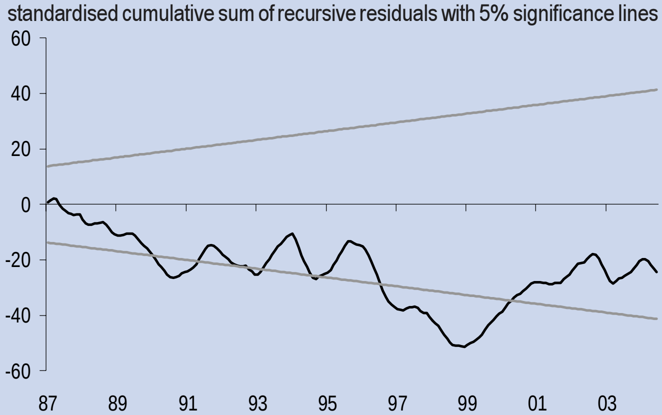
Box 13A: Equation of 12-month ahead HY default rate

Residuals stationarity - evidence of cointegration:
ADF statistic = -5.12
Critical value (N=4[8], no-trend, 5% level) = -4.10

Max correlation between explanatory variables: 0.79[9]

[8] N=4 because all 4 variables in the regression are non-stationary in the sample period (at 5% significance level).
[9] Although the correlation between profit/GDP and income gearing is high in the sample period, the Rsq of the regression of profit/GDP to the other explanatory variables is 0.60, well below the Rsq=0.82 of the regression. In addition, high t-ratios imply that the high correlation between explanatory variables is unlikley to pose a multicillinearity problem.

Stability test of the HY default rate model
standardised cumulative sum of recursive residuals with 5% significance lines



Source: JPMorgan

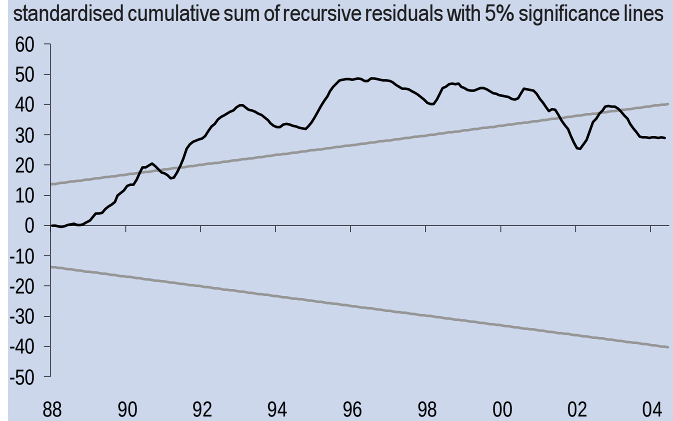
Box 14A: Equation of HY credit spread

Residuals stationarity - evidence of cointegration:
ADF statistic = -4.31
Critical value (N=4[10], no-trend, 5% level) = -4.10

Max correlation between explanatory variables: 0.60

[10] N=4 because from the 5 variables in the regression only the S&P500 6-month return is stationary in the sample period (at 5% significance level).

Stability test of the HY credit spread model
standardised cumulative sum of recursive residuals with 5% significance lines



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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

Box 16A: Equation of EMBIG credit spread

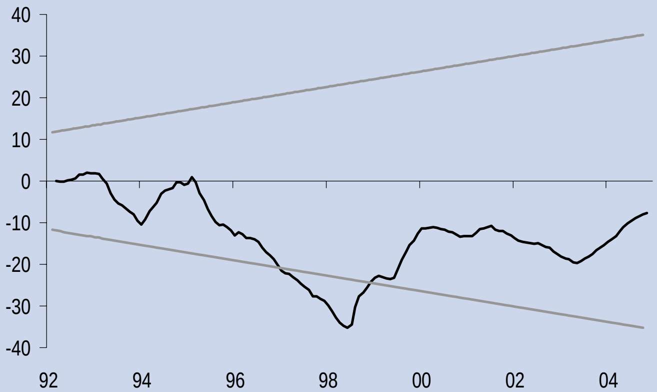
Residuals stationarity - evidence of cointegration:
ADF statistic = -5.31
Critical value (N=5[11], no-trend, 5% level) = -4.42

Max correlation between explanatory variables: 0.65

[11] N=4 because all 5 variables in the regression are non stationary in the sample period (at 5% significance level).

Stability test of the EMBIG credit spread model

standardised cumulative sum of recursive residuals with 5% significance lines



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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

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J.P. Morgan Securities Ltd.
Nikolaos Panigirtzoglou (44-20) 7777-0386
nikolaos.panigirtzoglou@jpmorgan.com

Jan Loeys (44-20) 7325-5473
jan.loeys@jpmorgan.com

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