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Abstract

This paper investigates the cyclical co-movements between US stocks and interest rates by testing a simple model where divergence between stock and bond price behavior is explained by "stock market strength," where the latter depends on the market climate about future corporate profits—as captured by the corporate bond quality ratio—and an unexplained stock market sentiment. Using two different regression techniques to check for robustness, we find evidence of a statistically significant cyclical correlation between stocks and bonds. On the basis of this finding, we then present a methodology to "deflate" a stock price index such that we can compare stock market strength over time. This is obtained by removing the effect of a changing discount rate—as measured by our regressions—on stock prices. For example, viewed in this light, the past five years in the US stock market reveal a wider fluctuation in stock market strength than we can observe on the basis of stock price indices alone.

JEL classification: D84, G12, G14

Keywords: Stock-bond correlation, Market sentiment, Stock price.

1. INTRODUCTION

Empirical research on the correlation of the movements of bond and stock prices dates at least from the pioneering work of Frederick Macaulay, and has drawn renewed attention over the past twenty years in the light of the theoretical development of general equilibrium asset pricing models, with special reference to the question of optimal portfolio diversification. Financial analysts observe co-movements between stocks and bonds closely, as these have a bearing on portfolio risk. In a strategic asset allocation perspective, a higher stock-bond positive correlation increases overall portfolio risk.

A well-known theoretical account of the relation between bond and stock prices begins with the statement that both bonds and stocks are claims to future cash flows, as they both consist of an exchange of money today for an expectation of money flows in the future. Thus, their price should reflect a market assessment of the present value of the expected future cash stream, and—in a partial equilibrium setting—any change in the market capitalization rate (i.e., a market-consensus estimate of the appropriate discount rate for future cash flows) should equally affect both bond and stock prices. If market participants, lowered (raised) their capitalization rate, both bond and stock prices should rise (fall).

Not surprisingly, however, feedback effects in a general equilibrium setting blur the underlying relationship between bonds and stocks. If, in a recession, a drop in corporate profit and dividend expectations is linked to lower rates, then the correlation between stocks and bonds may show statistically weaker; and, in the event that the impact of lower expectations more than offsets that of a lower capitalization rate, correlation may even turn negative. This is the case when US Treasury bonds rally when stock prices dive, a phenomenon, called “decoupling”, that characterized financial markets in the past few years, when correlation between US stocks and bonds has turned from moderately positive to moderately or strongly negative, and diversification opportunities have been comparatively improved.

Reversals of the stock-bond correlation have fueled interest on the determinants of the changing relation between stocks and bonds, an important question for long-term asset allocation decisions. It is now generally understood that the co-movement of stocks and bonds is time varying, although authors differ in indicating the factors that best forecast the stock-bond correlation. Gulko (2002) showed evidence that stock-bond correlation switches sign during stock market crashes, thus bonds offer a safe heaven to investors “at the time diversification is needed most.” Li (2002) stresses uncertainty about expected inflation as the primary explanatory variable of the trends in stock-bond correlation, and concludes that “diversification opportunities are least available when they are most needed”, i.e., when inflation risk is higher. Stivers and Sun (2002) find that stocks and bonds co-movements are higher during periods of lower stock market uncertainty that they measure with the implied volatility from equity index options. Ilmanen (2003) finds that a negative correlation is more likely with low inflation, slow growth, and when safe-heaven uncertainties overwhelm discount rate and inflation uncertainties. Baur and Lucey (2006) find that higher stock market volatility (and lower bond market volatility) decrease stock-bond correlation, reflecting “flight to quality”.

The search for the ultimate determinants of the time-varying nature of the stock-bond correlation, relevant for strategic asset allocation, is one, though not the primary object of this study. From Macaulay’s work we draw the idea that the cyclical movements of stock and bond prices are much more closely related than the long-term trends. Focusing on the cyclical stock-bond relation we aim to verify empirically the robustness of this cyclical correlation, and use our results to suggest an interpretation of stock market behavior.

Indeed, we notice that a number of market commentators and financial analysts seem not to fully appreciate a consequence of the cyclical correlation between bond and stock prices. Although it is well understood that stock prices are influenced by interest rates it is a common attitude to scrutinize stock market behavior on the basis of outright comparisons of absolute stock price levels over time, when interest rates normally fluctuate. An example of outright comparisons in press commentaries has emerged after the Dow Jones Industrial Average (DJIA) passed the 10,000 mark for the first time in 1999 only to sag back in 2000 and fluctuate within a not too broad range since then. Supposition has been made that investors see the round number mark as a “psychological barrier”: see, for example, Mitchell (2001). In the same fashion, some commentators had explained the fluctuations of the DJIA around the round number of 1,000 in the 60s and 70s. Irrespective of what our readers think of this supposition, it is a fact that we all tend to read stock market behavior by comparing the *absolute* level of stock prices at different dates. All absolute price level comparisons miss the important point that the meaning of the absolute value of a stock price index at any given date is strongly shaped by the level of the current capitalization rate at that date. In other words, a 10,000 Dow-Jones average when the market capitalization rate is 10% reflects stronger market expectations of future cash flows as compared with the same absolute level at a different date when the capitalization rate is 2%.

This character of stock prices is equally overlooked by analysts who discuss "resistance levels" to detect peaks, troughs, and bull and bear cycles, as if a given level of the stock market index meant the same set of expectations with any capitalization rate. Comparison of historical price-earnings ratios as a reference to determine whether current ratios are "high" or "low" is also flawed when one considers that the price of a stock must reflect very different expectations depending on the capitalization rate of the expected cash stream. In other words, a price-earnings ratio of 10 implies a different set of expectations when the market capitalization rate is 10% as opposed to 2%.

Market analysts who choose not to ignore this problem resort to measures that compare stock and bond returns, such as the difference between earnings/price ratios and long-term Treasury yields. Interpretation of such comparison, however, is far from straightforward, given the time-varying character of the correlation between stocks and bonds. Macauley (1938, p. 135) thought "a (hypothetical) stock 'yield' is not an animal of the same species, or even genus, as a (hypothetical) bond yield". We believe that studying stock-bond cyclical correlation may help throwing light on the significance of the stock-bond yields differential, as well.

In two previous studies (Terzi-Verga 1992, 1993), we had considered the cyclical character of the correlation between stocks and government bond yields in the US and other five countries, and had explored the possibility to generating a "sentiment" indicator that would estimate stock market investors' confidence independently of the level of interest rates. This paper extends those results to provide evidence of a cyclical correlation between stock prices and bond yields, and recommend a simple tool to measure the strength of the stock market independent of the level of interest rates as well as to assess the information content of the stock-bond yield differential.

We begin by formulating a simple model where stocks depend on bond yields and a stock-specific factor that we generally call “stock market strength”. This, on its turn, has two components: market expectations of future corporate profits and a separate, unexplained element that we describe as “stock market sentiment”. We then test for the cyclical correlation between long-term government bond yields (that we use as a proxy for investors’ capitalization rates) and stock prices, using the bond quality ratio as a proxy for the market climate about future corporate profits.[1]

Having found evidence of a statistically significant cyclical correlation, we then propose a methodology to “deflate” a stock price index that mirrors that of deflating nominal GDP to find a “real” measure of output. In the same way as a 10 trillion dollar GDP at current prices measures different amounts of output depending on the average price level, a 10,000 Dow-Jones Industrial Average measures different market expectations depending on what the market-consensus capitalization rate is.

When deflating nominal GDP, we use the purchasing power of money with respect to currently produced goods and services, compared to a base year. To deflate the stock market index we use the purchasing power of money with respect to future cash flow streams, i.e., the rate of interest, compared to a reference level. The aim is to remove the effect of a changing capitalization rate over stock prices, and thus unveil stock market strength in such a way that it can legitimately be compared across time. By further removing the effect of the bond quality ratio from stock prices, one can attempt to measure “stock market sentiment” as the residual element explaining stock market behavior.

The paper is organized as follows. In the next section, we discuss our theoretical framework. In section 3 we present our data sample and discuss our empirical analysis, using two different methodologies to check for robustness, and explain our results. In section 4, we discuss the “deflated” stock market index and construct a stock market confidence indicator after removing the cyclical capitalization rate effect.

[1] We interpret the bond quality ratio as combining information about market expectations as well as risk considerations.

2. THEORETICAL BACKGROUND

We begin by assuming that stocks embody an exchange of present money for an expectation of future cash flows, and their price is the present value of an expected future payment stream, discounted with an appropriate capitalization rate. This means that a change in the capitalization rate causes an inverse movement in the present value of future expected streams. Although the degree of sensitivity of stock prices to changes in the capitalization rate must be determined empirically, the inverse relation between price and the capitalization rate is illustrated in the Gordon (1962) constant growth formula: the formula explaining the price of a stock whose dividends are expected to grow at a constant rate takes the form of a ratio between the next expected dividend and the difference between the capitalization rate and the expected dividends growth rate.

More in general, and without formulating the constant dividend growth hypothesis, we assume that stock prices (P_S) depend on the expected payment stream of stocks (E_S), a market capitalization rate of expected streams from stocks (R_S), and a risk factor (ρ_S) that will influence stock prices through the evaluation of the risk-free E_S equivalent:

(1) $$P_S = P_S(E_S, R_S, \rho_S).$$

The market capitalization rate used for pricing stocks is not directly observable, and we assume that it is the same as the market capitalization rate used for pricing default-free long-term bonds. The intuition here is that the yield on the bonds with long maturity (R_B) is the best observable indicator of the capitalization rate (not including a risk factor) for cash streams (such as those from stocks) that extend into the indefinite future. We thus explain stock prices with the following:

(2) $$P_S = P_S(E_S, R_B, \rho_S),$$

where we expect a positive sign for the E_S coefficient and a negative sign for both the R_B and the ρ_S coefficient.

A problem with estimating the parameters of this equation is that regressors are not independent. One would therefore not necessarily expect to find a stable, negative relationship between the capitalization rate and stock prices, as implied by the theoretical, inverse correlation between P_S and R_B. Changes in the other two regressors

(E_S and ρ_S) may empirically obscure the underlying relationship between P_S and R_B if such changes are not independent of changes in R_B. During an economic slowdown, for example, we are likely to observe a drop in E_S and a drop in R_B, simultaneously. If a drop of cash flow expectations from corporate stocks is being concurrent with a drop of the long-term rate, then the downward revision of E_S will push stock prices down at a time when the drop in R_B is pushing prices up. While the effect on bonds is a rise in prices, the net effect on stocks is ambiguous, as it depends on which factor predominates. If the effect of worsening profit expectations outweighs the effect of lower rates, stock prices fall while bond prices rise. This means that if we empirically observe a low (or even negative) correlation between stock and bond prices, this does not necessarily mean that stocks do not respond to changes in the capitalization rate; rather, a negative correlation may be consistent with the hypothesis that lower profit expectations (and possibly a rising risk factor) predominate.

Macaulay (1938) had already recognized this characteristic of the relation between stocks and bonds. Comparing American Railroad stock and bond prices, he observed "no real similarity between the long-term trends of the time series," but found that "the 'cyclical' movement of the two series are much more closely related than are the long term trends" (p.156). The findings for our sample, discussed in the empirical section of this paper, provide more evidence of this statement, and provide the ground for constructing a stock market strength indicator.

There is one additional theoretical point that should be discussed before considering the empirical evidence. If we believe that the correlation between stock prices and bond yields is obscured by varying expectations and risk factors, our empirical correlation should improve if we account for some measure of expectations and risk. This procedure follows Macaulay's consideration of a "prosperity index" as an explanatory factor of changes in stock prices.

It is therefore reasonable to explain divergence between the behavior of stock prices as that of the default-free long-term interest rate with a stock-specific factor, that we call "stock market strength", with two components: a) confidence in future expected corporate profits as captured by an observable market indicator of expected business prosperity, such as a ratio between high-grade and low-grade bonds; and b) an unexplained “stock market sentiment”.

3. EMPIRICAL ANALYSIS

3.1. Data sample and methodology

The empirical analysis that follows aims at bringing to the fore the underlying, or “hidden”, correlation between stocks and the capitalization rate. Within our theoretical framework, this will be accomplished by employing three daily time series:
a) the daily S&P 500, a value-weighted broad market index of 500 leading US companies, is our stock price index (**SP_{500}**);

b) the daily US Treasury 10-year constant maturity annual yield is our long-term government bond yield (**R_{10}**); and

c) the daily average Moody’s seasoned corporate Baa yield for companies with medium investment grade is our yield for corporate bonds with a comparatively lower grade (**R_{BAA}**) that we weigh against R_{10} to obtain a bond quality ratio.

Our sources are Yahoo-Finance for stock prices and the US Federal Reserve for bond yields. The period runs from 2 January 1986 through 31 December 2005. The starting point is imposed by one of our series (the Baa corporate bond yield) not being available on a daily basis for prior years, so the period chosen could hardly extend further in the past. The period, nevertheless, fits appropriately our scope, as it includes sharp fluctuations in stock prices (such as the 1987 crash) while it does not include times of highly variable inflation rates that might pose additional questions.

The stock price series and the US government bond yield series are shown in **Figure 1** for the 1986-2005 period. Visual inspection suggests that for most of the period until 1998 the two series have moved predominantly in opposite fashion (falling yields with rising stocks) whilst occasionally (before 1998), and for most of the period after 1998, movements of these two series appear less clearly associated, and are some time parallel rather than opposite. **Figure 2** confirms and clarifies the visual impression. It shows the 12-month rolling correlation between SP_{500} and R_{10}, predominantly negative in our sample before 1998, and positive for most of the period afterwards. The latter is equivalent to the negative correlation between bond and stock returns often referred to as "decoupling." On the same chart, we show the bond quality ratio, i.e., the ratio between R_{BAA} and R_{10}.[2] Visual comparison with the rolling correlation gives the insight that the correlation between stock returns and bond yields is not extraneous, and often coincident, with the quality ratio. The correlation coefficient between the two series in Figure 2 is 0.86. This suggests that consideration of the bond "quality ratio" in our coefficient regressions should improve the quality of our statistics.

The empirical analysis that follows is thus aimed at testing the validity and the significance of the following linear equation:

(3) $$SP_{500} = \alpha + \beta_0 E_S + \beta_1 \cdot R_{10} + \beta_2 (R_{BAA} / R_{10}) + \varepsilon_t ,$$

where the stock price index is explained by the expected stream of cash flows, the capitalization rate, the quality ratio, and a residual, unexplained stock market sentiment component.

To check for robustness, statistical analysis is carried on using two alternative techniques: a conventional regression analysis of first differences, and a segmented-trend approach. If the underlying phenomenon is strong enough, these two methods should generate similar results. Both aim at testing for cyclical correlation. With the first approach, the use of first differences eliminates the trend effect; with the second approach, a segmented trend technique attains the same scope.

3.2. Regression of first differences

We specify our first model using a first differences approach, based on weekly changes of daily data,[3] where long-term corporate profit expectations can be eliminated.[4] Thus, we explain stock price movements with changes in long-term interest rates (with coefficient β_2), and changes in the bond quality ratio (with coefficient β_3).

On its turn, coefficient β_2 may be seen as a function of the bond quality ratio, on

[2] The ratio is intuitively a better indicator than the difference: when, for example, yields differ by 100 basis points, the corresponding difference in price is bigger when they quote at 2% and 1%, respectively, as compared to when they quote 11% and 10%.

[3] We use weekly changes to avoid the problems raised by the non-contemporaneous collection of stock prices and bond yields at any given market day.

[4] Since expected earnings and interest rate first differences can be considered independent, the absence of expected earnings in the regression is not distorting coefficients.

the basis of the observation above regarding the co-movement of the stock-bond correlation with the bond quality ratio. In other words, not only we expect that an increase (decrease) of the bond quality ratio is correlated with a decrease (increase) of stock prices, but also that a low (high) bond quality ratio is correlated with a high (low) β_2 coefficient, such that:

(4) $$\beta_1 = \beta_1^{'} + \beta_1^{''} \cdot (R_{BAA} / R_{10}) .$$

We thus estimate the following equation:

(5)

$$\Delta_5 \ln SP_{500} = \alpha + \beta_1^{'} \cdot \Delta_5 \ln R_{10} + \beta_1^{''} \cdot \ln(R_{BAA} / R_{10}) \cdot \Delta_5 \ln R_{10} + \beta_2 \cdot \Delta_5 \ln(R_{BAA} / R_{10}) + \varepsilon_t$$

where Δ_5 is the weekly variation based on daily data, and ε_t is the unexplained factor component.

We expect a negative sign for all coefficients: both the long-term interest and the bond quality ratio should move inversely with stock prices; in addition, the bond quality ratio should negatively affect the β_2 coefficient: a higher product of the change in the long-term interest rate and the level of the quality ratio means a bigger (negative) impact on stock prices.

Table 1 shows our estimated equation. The estimated coefficients have the expected signs and statistically highly significant: stock prices are found to move inversely with changes in government yields, the quality ratio, and the product of the change in interest rates with the level of the quality ratio. This means that the coefficient describing the relation between stocks and Government bonds is influenced by the level of the quality ratio. The direct elasticity of stock price changes with respect to changes in the quality ratio is approximately 73%, while the direct elasticity of stock price changes with respect to changes in the long-term interest rate is computed as the means of the β_2 coefficient, which equals –0.563.

Table 1 – Regression of first differences: statistical results

Variable	Coefficient	t-Statistic	Prob.

α [Constant]	0.002	3.09	0.002
β_1' [$\Delta_5 \ln (R_{10})$]	-0.174	-14.77	0.000
β_1'' [$\ln(R_{BAA}/R_{10})\ \Delta_5 \ln (R_{10})$]	-2.035	7.71	0.000
β_2 [$\Delta_5 \ln (R_{BAA}/R_{10})$]	-0.726	-4.30	0.000

Method: Least Squares with Newey-West HAC Standard Errors & Covariance (lag truncation=9); Sample (adjusted): 9/01/1986 - 31/12/2005; R-squared: 0.149; S.E. of regression: 0.021. Calculation with Eviews 5.1. Our results will also pass a CUSUM stability test (within the standard 5% band).

Figure 3 shows the β_1 coefficient varying with the bond quality ratio: the higher the latter, the greater the tendency to flight to quality, which weakens the correlation between stock prices and long-term interest rates, and may even change its sign.

3.3. The segmented linear trend regression

We specify our second model using a segmented trend approach: we explain stock prices with long-term interest rates (with coefficient β_1), the bond quality ratio (with coefficient β_2), and a segmented linear trend (with a number of additional coefficients as many as there are trends) aimed to capture the effect of long-term expectations on the expected cash stream.

The segmented trend technique allows for several structural breaks in long-term expectations. To identify possible structural breaks in the trend of stock prices we first use a smoothing filter to generate a smoothed series of the S&P 500 index (generated by a 2-year centered moving average with triangular weights) and find the local maximum points in the smoothed S&P 500 series.

Our segmented trend is obtained by combining subsequent trends: the first trend is a standard linear trend; the second trend equals zero until the first maximum point in the smoothed series, and from that point on it becomes a standard linear trend; the third trend equals zero until the second maximum and from that point on it becomes a standard linear trend. This generates a segmented trend, whose corners correspond to the peaks of the smoothed stock price series. Within each trend, we then study the cyclical relationship between the stock price index and appropriate yields to capture the underlying correlation between stock prices and yields over each cycle.

We then estimate the following equation:

(6) $$\ln SP500 = \alpha + \beta_1 \cdot \ln y_{10} + \beta_2 \cdot \ln(y_{BAA} / y_{10}) + \sum_{i=1}^{n} \alpha_i T_i + \varepsilon_t ,$$

where T_i is the segmented trend.

A problem inherent in this technique is that, except for a truly remarkable coincidence, the series does not end with a turning point. This may affect the significance of the statistical results on the last segment of the trend. To prevent this problem affect the quality of our estimates, we limit our statistical test following this technique to those segments of the trends that are clearly defined by our smoothing technique and thus fall within the series period, i.e., from June 1987 (i.e., the first local maximum in our smoothed stock index series) through March 2000 (i.e., the last local maximum).

Table 2 shows the statistical results. The segmented trend approach confirms the robustness of the link: stock prices are found to move inversely with cyclical changes in government yields and the quality ratio. The signs of the estimated coefficients are as expected and coefficients are highly significant. Changes in yields again explain a significant portion of stock price movements.

Table 2 – Segmented trends regression: statistical results

Variable	Coefficient	t-Statistic	Prob.
α - Constant	6.94	45.29	0.000
β_1 - ln (R_{10})	-0.60	-10.11	0.000
β_2 - ln (R_{BAA} / R_{10})	-0.41	-3.66	0.000
T_1	0.36	6.92	0.000
T_2 (Dec 89)	-0.26	-4.53	0.037
T_3 (Dec 93)	-0.62	39.30	0.000

Method: Least Squares with Newey-West HAC Standard Errors & Covariance (lag truncation=8); Sample (adjusted): 15/06/1987 - 15/03/2000; R-squared: 0.985; S.E. of regression: 0.062. Calculation with Eviews 5.1.

Under both techniques, coefficients have the expected sign, and have the same order of magnitude, which suggests a good quality of our estimates. Coefficient sizes from the segmented trend approach are close to coefficients obtained through the regression of first differences: the sensitivity of stock prices to the long-term Treasury yield varies is a negative 0.60, close to the means (-0.56) of the same coefficient when calculated through first differences, while sensitivity to the quality ratio is a negative 0.41, not far from the same coefficient when calculated through first differences (-0.73).

4. UNVEILING STOCK MARKET STRENGTH

The empirical analysis developed in the previous section will now be used to devise a methodology to "deflate" stock prices. This may be paralleled to the technique of deflating nominal GDP to obtain real GDP: in the same fashion as nominal GDP means a different level of output depending on the general price index, stock prices mean a different level of stock market strength, depending on the level of interest rates. This amounts to calculating an **interest-deflated stock market index**, or a stock price index appropriately modified to remove the capitalization rate effect from stocks, and aimed to capture market expectations of future cash flows at a given, invariant capitalization rate.

Following this, and based on the evidence that the bond quality ratio partially explains stock movements, we attempt a further step: the stock price movements that remain unexplained when considering the effects of the capitalization rate and the bond quality ratio can be seen as a measure of stock market sentiment. This should be a gauge based on comparison of the actual stock price series with the theoretical series explained, in the previous statistical section, by the Treasury yields and the quality ratio.

We thus proceed to calculate each and suggest future possible applications.

4.1. An interest-deflated stock market index

In section 3 we found that a significant component of the cyclical variations of stock prices is explained by changes in the long-term interest rate. This is coherent with the theoretical interpretation of stock prices as the present value of an expected cash streams. By removing the capitalization rate effect from a given stock price series one should obtain a modified stock price series where the estimated effect of changes in the capitalization rate is eliminated. This modified stock price series is an indicator of stock market strength, independent of the current capitalization rate. It shows, in other words, how would a stock price series have moved, had the capitalization rate been fixed at a pre-assigned level.[5] We thus use the following transformation:

(7) $$\ln SP_{500}{}^{D} = \ln SP_{500} + \delta \ln(y_{10} \div \overline{y_{10}{}^{*}}),$$

and

(8) $$SP_{500}{}^{D} = \exp\left(\ln SP_{500}{}^{D}\right),$$

where $SP_{500}{}^{D}$, obtained with reference to a pre-assigned and invariant long-term rate ($R_{10}{}^{*}$), is the interest-deflated stock price index; and δ is the means (-0.58) of the β_1

[5] In the same way as the choice of the base year is irrelevant to the rate of change of real GDP, the choice of the pre-assigned level of the long-term rate is irrelevant to the rate of change of the stock price series.

coefficient as generated by our regressions.

Figure 4 shows an application for the January 1999 - March 2001 period. While the solid line is the actual S&P500 index series, the dotted line is our estimate of what the value of stocks would have been at any given point in time had the capitalization rate remained constant at the same level as of the beginning of period (1 Jan 1999 = 4.65%). A rather fascinating finding here is that when we observe the interest-deflated stock price index we see an even stronger rise in expectations during the last phase of what many have dubbed the "New Economy bubble", indicating an even stronger wave of optimism than could be observed on market prices alone. Notice, also, that the interest-deflated stock price series peaks before the actual series, indicating a reversal of expectations that could not be directly observed through market prices. Indeed, a reason why we believe the interest-deflated series is interesting is that it should indicate reversals of expectations more clearly than can be seen in the actual stock price series. The obvious counterpart of all this is that long-term interest rates had a stabilizing role in the US stock market between 1999 and 2001, and beyond.

Figure 5 shows an application for the January 2000-December 2005 period. The downward movement of the interest-deflated stock index between 2000 and 2002 was considerably wider than what has been observed on the basis of absolute price indices alone, for the index fall has been partially softened by falling long-term interest rates. Equivalently, the stock market recovery following 2002 was more significant in size than what is observed on prices alone, thus indicating a "hidden" higher volatility of stock market strength.[6] Notice how on both circumstances illustrated in Figures 4 and 5, the long-term interest rate has played a stabilizing influence on stock prices. We believe financial analysts may benefit from adding an interest-deflated stock index to the set of tools they use to investigate the strength of stock markets.

4.2. A stock market sentiment indicator

We call "market sentiment" the unexplained component in our regressions. We do not attempt here to explain this component, nor it is our intention to test for rationality. Following Macaulay, we prefer to "trust the opinion of the market" (p.98) and limit our inquiry to suggesting the view that this sentiment indicator is a better signal of stock market-specific confidence than the absolute level of the index. It may be a question for future research to explore whether variations in the sentiment index are more or less "rational".

Figure 6 shows the residuals of the estimated equation from 3.1 above that we venture to call a stock market sentiment indicator, or the component of the S&P500 index that cannot be explained in our model with a varying capitalization rate or a varying bond quality ratio. In other words, if this indicator is rising, it is not because of a declining capitalization rate, nor because of an improving market climate as captured by a falling bond quality ratio. This "unexplained" component of stocks reflects stock market-specific sentiment that is not captured in our models. When it deviates above an upper bound, it signals particularly buoyant stock prices, higher than the capitalization rate and the quality ratio would justify. When it deviates below a lower bound, it signals gloomy stock prices, lower than the capitalization rate and the quality ratio would justify. It behaves in a very similar fashion as the differential between the stock yield (or earnings/price ratio) and the long-term interest rate.[7]

5. CONCLUSIONS

The fascinating work by Macauley (1938) on interest rates can still provide inspiration for studying the behavior of stock prices with reference to interest rate movements. In this paper, we have tested a simple hypothesis about stock market behavior: that stock price deviations from their trend are significantly correlated with the default-free long-term interest rate, when a good proxy for market climate is included in the regression. Stock prices are found to respond to the long-term interest rate (a proxy for the capitalization rate of corporate earnings and dividends), and the bond quality ratio (a proxy for the market climate about the future of corporate earnings). The component of stock price movements that remains unexplained may be seen as a residual stock-specific market sentiment.

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[6] Remind that stock market strength combines stock market expectations and market sentiment.
[7] Notice that, different from the stock-bond yield differential, our residual "sentiment" does not require information on corporate earnings.

The statistical significance of our estimates and the stability of our regressions strongly support the notion that long-term interest rates and the bond quality ratio explain a significant component of stock market behavior. Our findings provide a basis for the construction of an interest-deflated stock market index that measures stock market strength, independent of the capitalization rate.

Applications to two sub-periods of our sample illustrate how stock market strength has been more volatile than stock prices revealed. We have paralleled our attempt to measuring stock market strength under the hypothesis of a constant capitalization rate to the technique of measuring real GDP under the hypothesis of a constant price level. Such an interest-deflated stock market index was found to explain a large component of the divergence between stock and bond movements.

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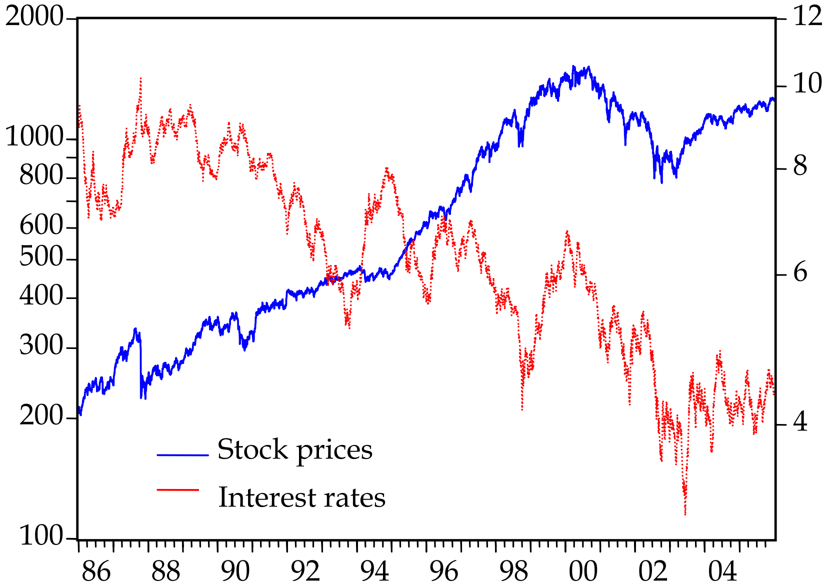
FIGURE 1

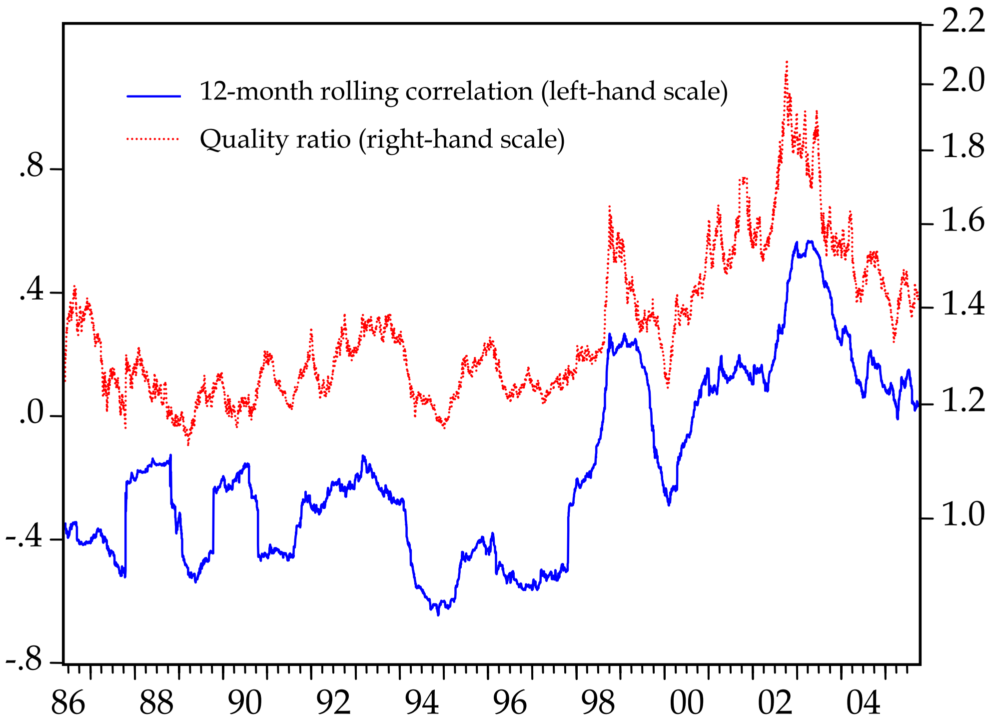
US stock prices and long-term interest rates: 1986-2005



Note: US stock prices are measured with the S&P 500; long-term interest rates are constant maturity 10-year US Government bond yields.

FIGURE 2

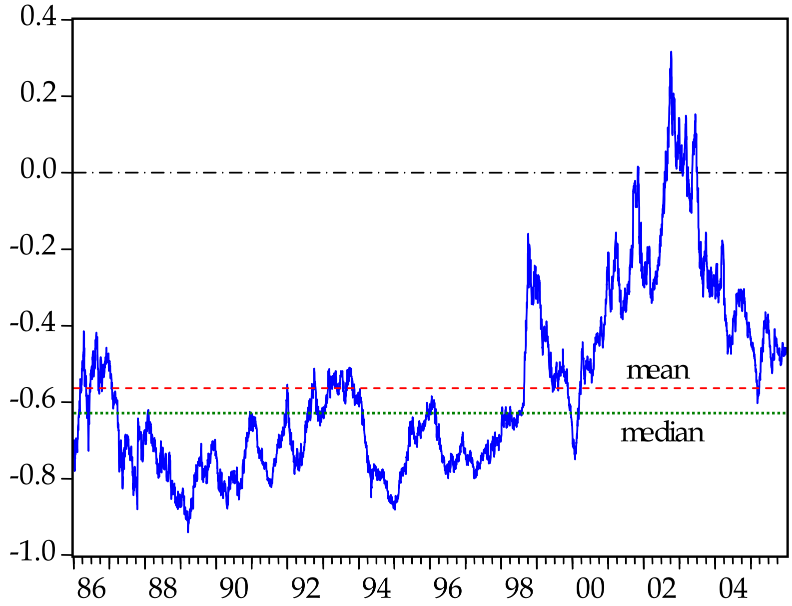
Stock-bond correlation and market climate: 1986-2005



Note: The measure of stock-bond correlation is a 12-month rolling correlation between the S&P 500 index and the 10-year constant maturity Government bond yield; Market climate is captured by the bond quality ratio between Government bond and Moody's Baa corporate bond yields.

FIGURE 3

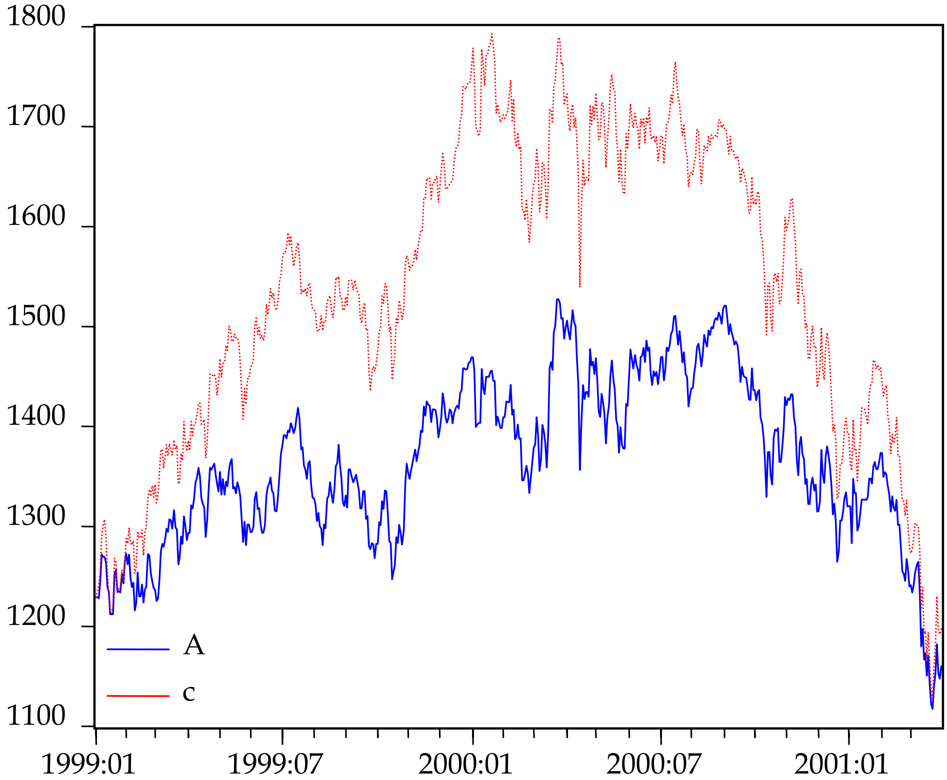
Estimated coefficient β_1



<u>Note</u>: The mean is –0.563; the median is 0.628.

FIGURE 4

The interest-deflated S&P 500: 1999 (Jan)-2001(March)

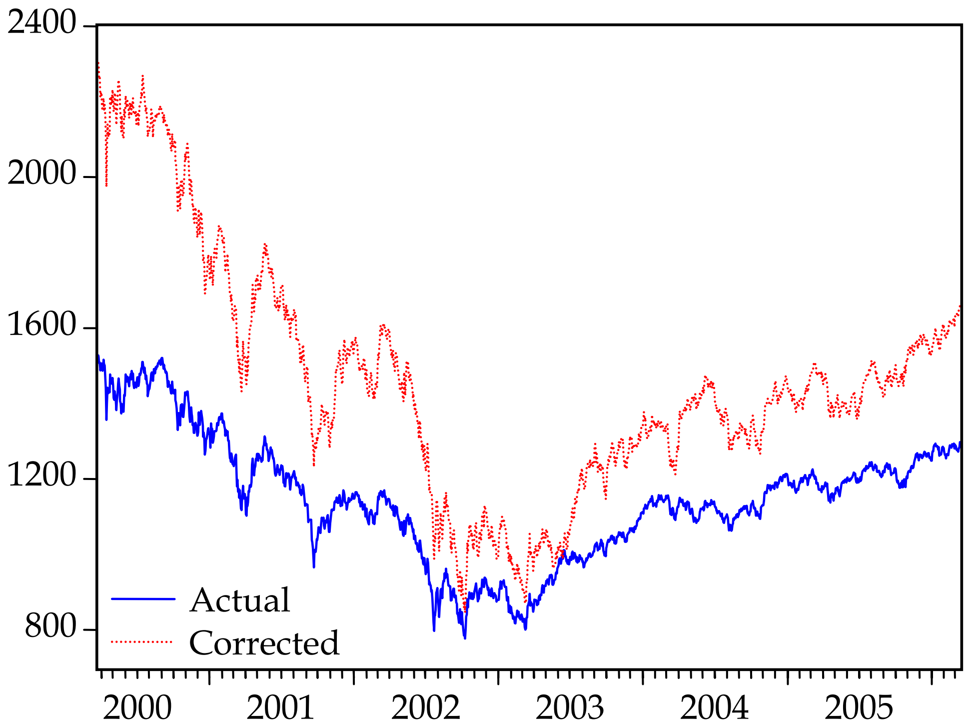


A = Actual S&P 500

C= Deflated S&P 500

FIGURE 5

The interest-deflated S&P 500: 2000-2005

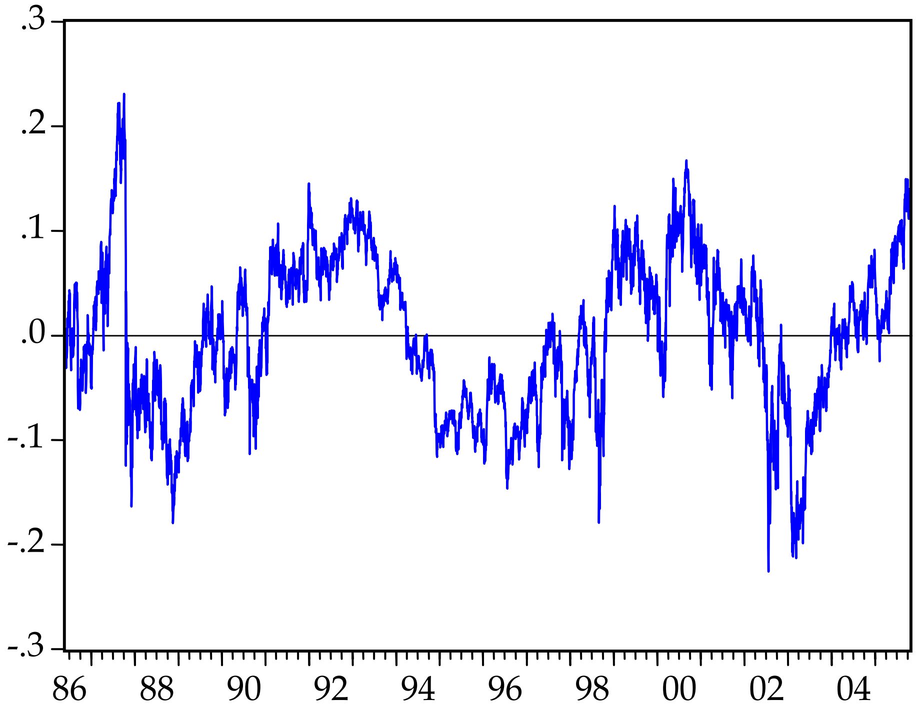


Actual = Actual S&P 500

Corrected= Deflated S&P 500

FIGURE 6

A stock market sentiment indicator: 1986-2005



Note: This is the residual (ε) of our equation 5.

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