Master 2 Financial Economics – Université Paris 1 Panthéon-Sorbonne

Empirical Application 2

Asset pricing

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September 2021

EMPIRICAL APPLICATION 2

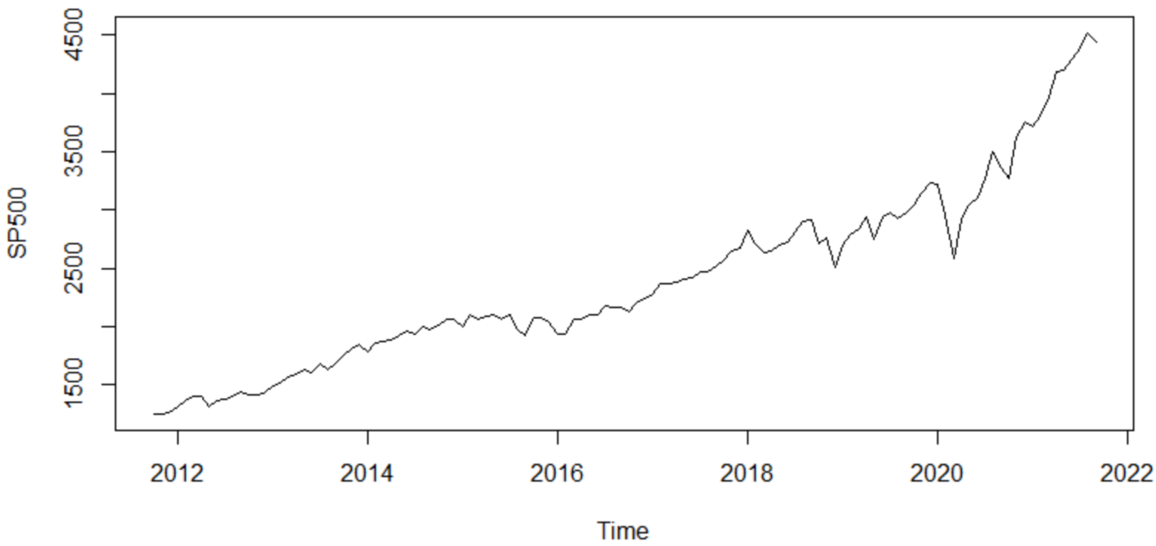
Question 1: Consider the series of the return rates for a stock index over a given period.

We choose to apply our factorial model to the expected returns of the S&P500 stock index.

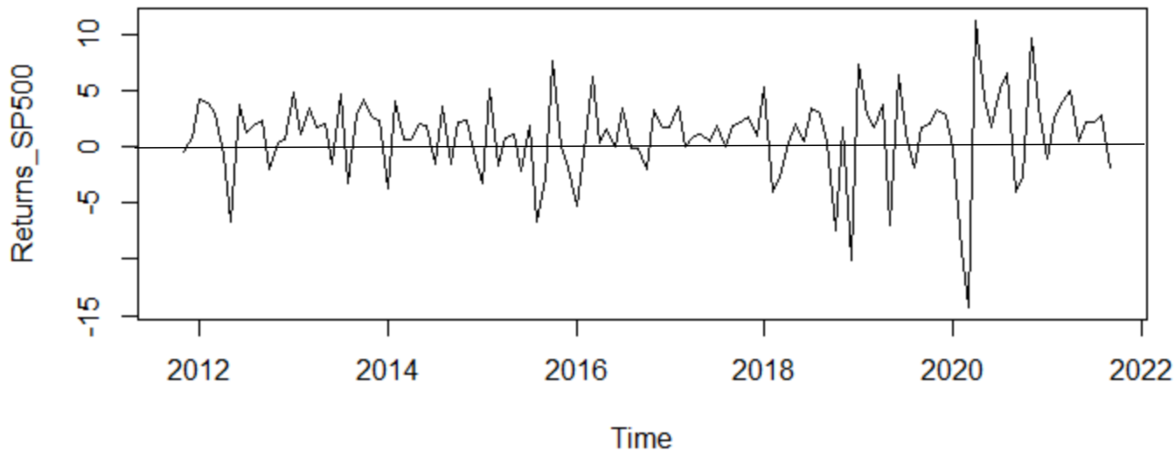
Figure 11

S&P in levels and monthly returns

S&P 500 – In levels:



S&P 500 – Monthly returns (in %):



Question 2: Consider the series of the return rates for a stock index over a given period.

We intend to decompose the returns of the S&P500 index into a factorial part, which accounts for the systematic risk, driven by multiple exogenous risk factors that we have chosen – namely economic activity, stock market volatility, inflation risk, real interest rates and credit spreads – and an idiosyncratic part.

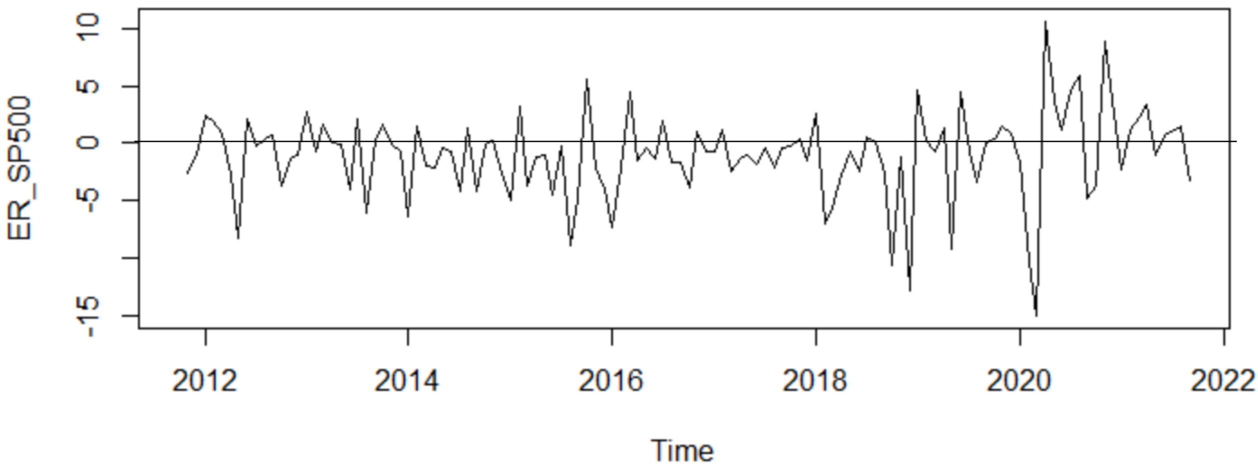
We therefore need to gather as much historical data as available on the S&P500 index and those exogenous factors from the FRED Database. The frequency of our time series is monthly, starting in October 2011 and ending in August 2021. Our sample is gapless within the observation period. We chose monthly data as it is the finest degree of time granularity available to us.

Question 3: Estimate the risk premium (by choosing a relevant so-called free risk asset)

We assume a long-term investment horizon (following traditional fundamental-based and value-based investment strategies). We therefore estimate S&P500 returns against the 10-Years Treasury Yield, that we deem the most appropriate proxy for a risk-free asset in this context.

Figure 12

S&P500 excess returns (in %)



After estimating the behavior of the S&P500 risk premium, we then continue the analysis by decomposing the returns of the S&P500 into a factorial part which accounts for the systematic risk and an idiosyncratic part

Question 4: Develop the econometric analysis which provides the multi-beta relationship.

In the fashion of Chen, Roll and Ross[1] (1986), we model the returns of the S&P500 assuming that "they follow a factor model in the form":

$$Returns_{S\&P500} = a + \sum_{k=1}^{K} \beta_{jk} F_k + u_j$$

Where:

(i) a is a constant

(ii) F_k the chosen risk factors

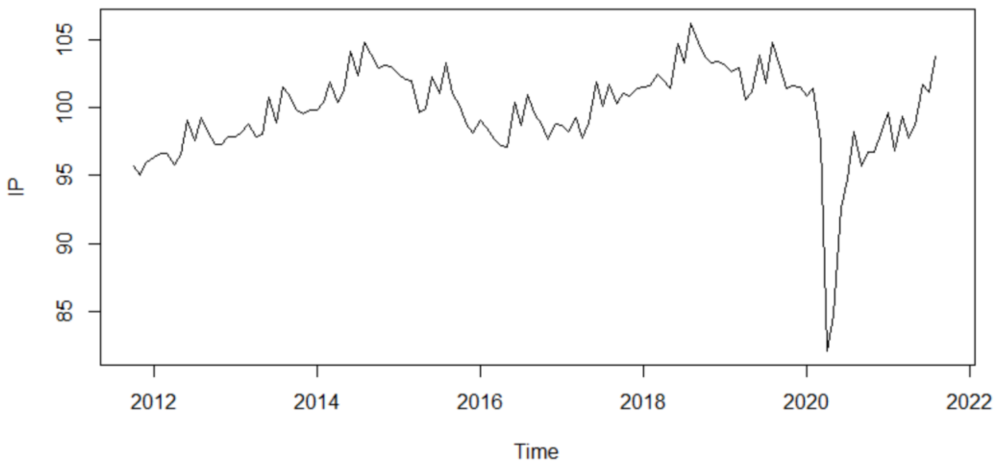
(iii) β_{jk} the weight for each factor.

A. We have therefore chosen 5 traditional exogenous macroeconomic risk factors (drawn from the example of the June 2012 Callan Investments Institute research piece) to test whether those risks, along with S&P500 idiosyncratic risk, drive the index's expected returns.

Figure 13

Industrial Production in index units and month-on month growth

F1: Industrial Production (in index units):



[1] N-F. Chen, R. Roll, S. Ross, Economic Forces and the Stock Market, The Journal of Business, Jul. 1986, p. 394

In % month-on-month growth:

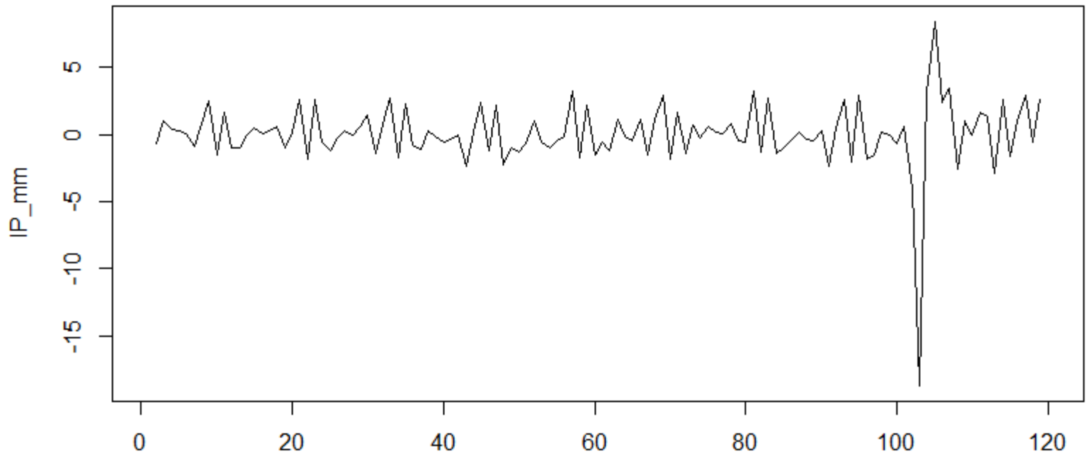
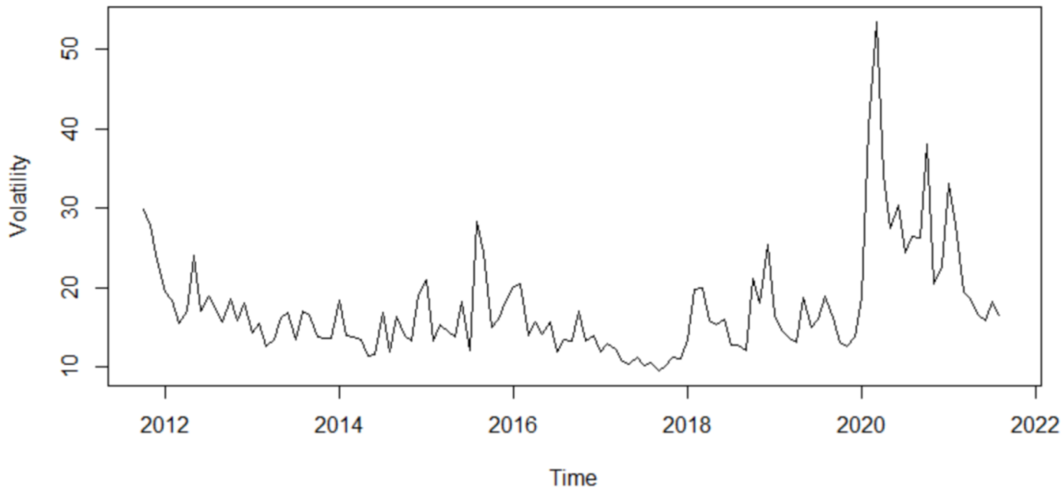


Figure 14

Stock market volatility in index units and month-on month growth

F2: Stock market volatility (in index units):



In % month-on-month growth:

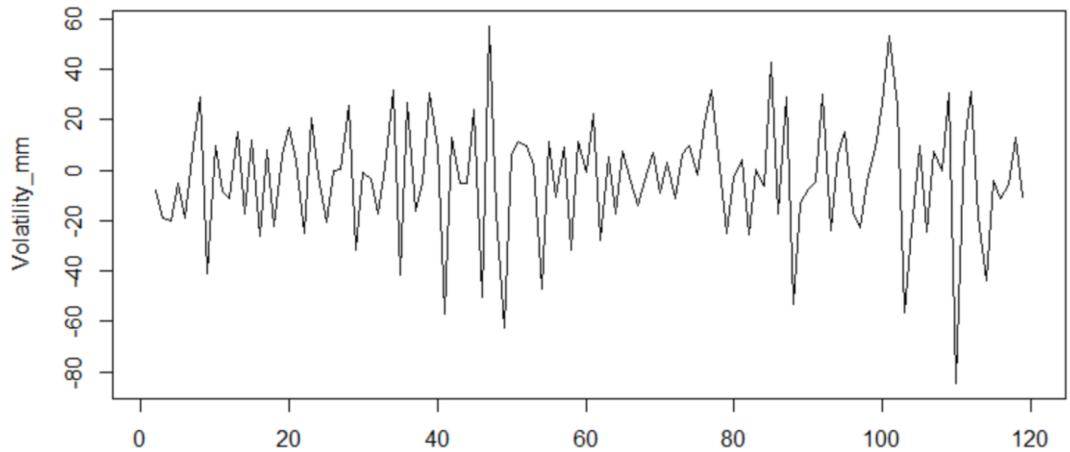
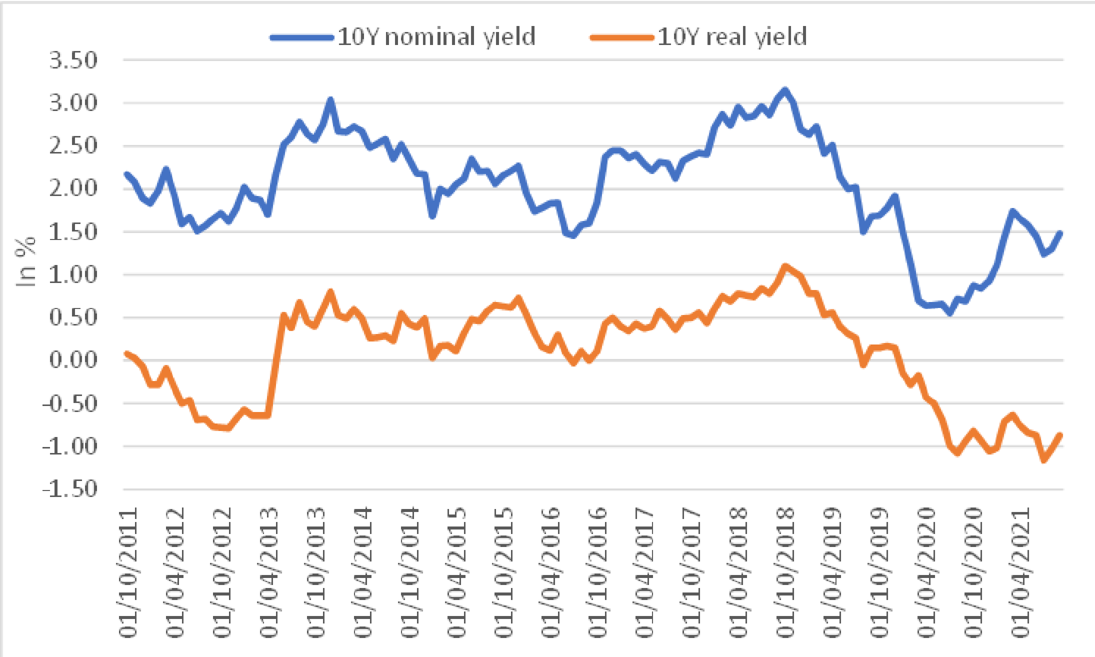


Figure 15

Inflation risk and Credit Spread

F3: Inflation risk (defined as the difference between 10Y nominal yield and 10Y TIPS yield)



F4: Credit spread (defined as the difference between BBB-rated US corporate bond yields and 10Y TIPS yield), in %

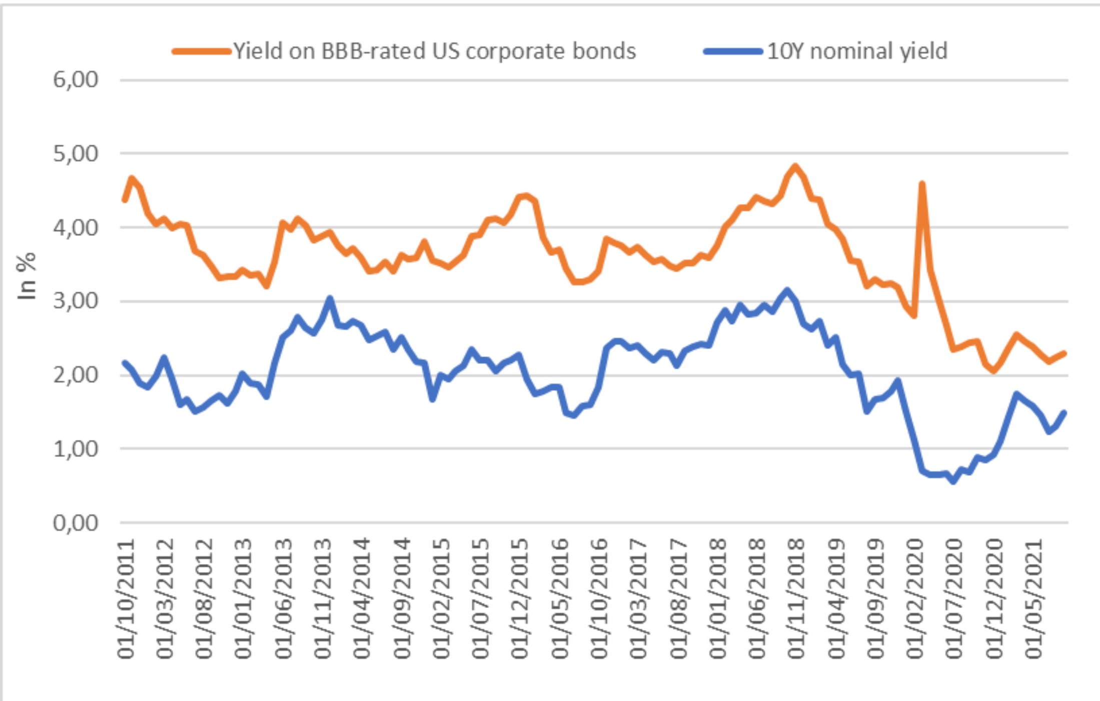
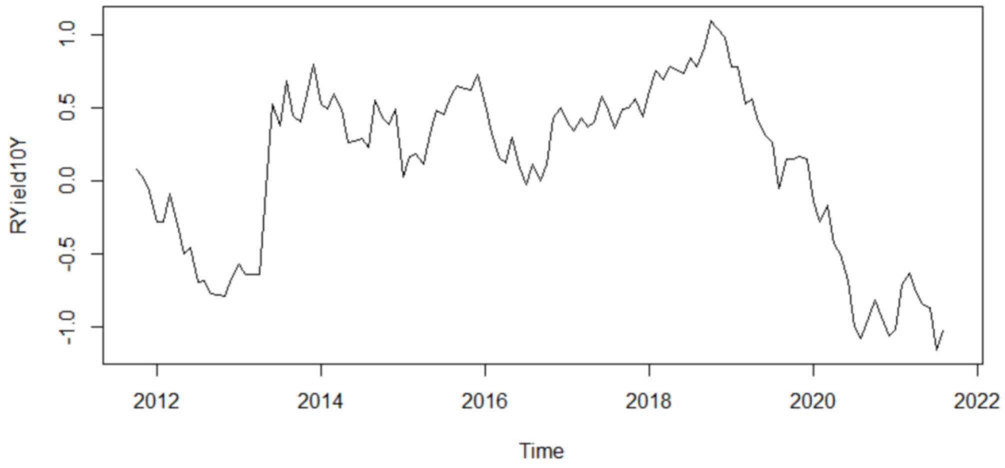


Figure 16

Real interest rates

F5: Real interest rates (%)



As highlighted by S&P Global in 2015, BBB is the median credit rating for US corporates. Given the objective of stability of credit ratings over time and the absence of significant worldwide crisis over the observed period , we can assume that we can still rely on the BBB-median hypothesis.

We estimate the S&P 500 expected returns based on the above 5 risk factors.

We convert the two variables in index units to month-on-month variations.

B. We will now decompose the returns of the S&P500 with those risk factors, based on an APT decomposition model

R-Code 17

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Call:
lm(formula = Returns_SP500 ~ IP_mm + Inflation_Risk + RYield10Y +
    Volatility_mm + Credit_Spread)

Residuals:
    Min      1Q  Median      3Q     Max
-7.3578 -1.3212  0.2044  1.4094  6.1181

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)     4.282250   2.128453   2.012   0.0466 *
IP_mm          -0.051123   0.090785  -0.563   0.5745
Inflation_Risk -0.034529   0.790891  -0.044   0.9653
RYield10Y      -0.916405   0.383358  -2.390   0.0185 *
Volatility_mm  -0.115029   0.009156 -12.563  < 2e-16 ***
Credit_Spread  -2.229765   0.535409  -4.165 6.16e-05 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.28 on 112 degrees of freedom
  (2 observations deleted due to missingness)
Multiple R-squared:  0.643,     Adjusted R-squared:  0.6271
F-statistic: 40.35 on 5 and 112 DF,  p-value: < 2.2e-16
```

Over this sample period, the industrial production and the inflation risk variables are not significant.

The coefficient for the US industrial production is not statistically significant, as its p-value exceeds the 10% significance level. This result is surprising, as we could expect that news of improved industrial production – which is an indicator published with a couple of months lag – would be seen as good news for investors, who can expect higher earnings for companies, which in turns makes stocks more attractive. As in Chen, Roll and Ross (1986), we would have expected a positive sign to this coefficient, reflecting "the value of insuring against real systematic production risk".

This result is however not necessarily surprising with regards to the inflation risk, as studies of the impact of inflation on stock market returns have produced contradictory results. Indeed, on one hand, we could argue that higher-than-expected inflation would lead investors to turn away from bonds – whose prices are particularly sensitive to inflation news and to the resulting monetary policy path – towards stocks. However, on the other hand, higher unexpected inflation leads to higher expected future costs for companies, thereby lowering investors' expectations of firms' earnings growth.

The risk premium associated with 10-year real interest rates is statistically significant, at the 5% level, with a negative sign. This is consistent with our expectations. In line with Chen, Roll and Ross (1986), "after long-term real rates decrease, there is subsequently a lower real return on any form of capital. Investors who want protection against this possibility will place a relatively higher value on assets whose price increases when real rates decline, and such assets will carry a negative risk premium". Indeed, a decrease in real rates imply lower cost of funding for companies, implying higher expected earnings and cashflows, which boosts companies' returns and therefore stock prices.

When it comes to volatility, the highly significant and negative risk premium can indicate that investors turn away from stock markets during periods of heightened stock price volatility, seeking to shift to safer assets. This exposure of the S&P500 index to the volatility risk is therefore surprising, as we would have expected a positive risk premium.

Finally, the risk premium on credit spreads is negative and highly significant. The negative sign on this coefficient is surprising: we would have expected that investors would want to hedge against "unanticipated increases in the aggregate risk premium occasioned by the increase in uncertainty", as materialized by increased credit spreads.