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THE STOCK MARKET'S REACTION TO UNEMPLOYMENT NEWS, STOCK-BOND RETURN CORRELATIONS, AND THE STATE OF THE ECONOMY*

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We confirm Boyd et al.'s (2005) finding that on average a surprise increase in unemployment is "good news" for stocks during economic expansions and "bad news" during economic contractions. Unemployment news bundles information about future interest rates, equity risk premium, and corporate earnings. For stocks as a group information about interest rates dominates during expansions, and information about future earnings dominates during contractions. Hence, (a) ceteris paribus*, the correlation between stock and bond returns will be greater during economic expansions and (b) stock price responses to the unemployment news will convey information about the state of the economy.*

1 Introduction

In Boyd *et al.* (2005), we investigated the short-run response of stock prices to the monthly announcement of the unemployment rate. We established that the market's response depended on whether the economy is expanding or contracting. Here we replicate, review, and confirm these findings using an updated data set. In addition, we examine some practical implications of this work to investors.[1]

We begin our study by establishing an interesting empirical regularity: on average, the stock market responds positively to news of rising unemployment in expansions, and negatively in contractions. It follows that, since the economy is usually in an expansion phase, the stock market usually rises on bad labor market news. The next step is to try to explain this empirical regularity based on the fundamentals of stock valuation. Conceptually,

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there are just three primitive factors that determine stock prices: the risk-free rate of interest, the expected rate of growth of corporate earnings and dividends, and the equity risk premium. Thus, if unemployment news affects stock prices (which it clearly does), then that news must be conveying information about one or more of these primitives.

The next step is to examine the relationship between news arrival and each of these three primitive factors or "channels." First, we examine the interest rate channel by studying the relationship between unemployment news arrival and bond returns. What we find is that during expansions bad news is significantly associated with rising bond returns. During contractions, however, we find no statistically significant relationship between news arrival and bond returns. These findings have several important implications—in the sense that they *predict* what other relationships must be to be consistent with the theory of stock price valuation. Let us try to explain. The observed stock price news response during expansions could be due to the interest rate channel, since falling interest rates are good for stock prices (e.g. both stock and bond returns rise during expansions). Of course the other two channels, growth expectations and the equity premium, could be operative as well during expansions. During contractions, however, we find that stock prices respond to news arrival but bond prices do not significantly respond. A logical implication of this finding is that one or both of the other two channels must be operative during contractions. Stock prices do respond to the news and *something* must be responsible. Since stock prices fall on bad news during contractions, the prediction is that bad news should be associated with lower growth expectations and/or a rising equity premium.

We are able to wring out one more prediction of what happens due to unemployment news arrival during expansions. We find that during expansions actual stock price responses to unemployment news are much smaller than what would be predicted, based on the interest rate channel alone. The logical implication is that, during expansions, the arrival of bad news must also be associated with declining growth expectations, a rising equity premium, or both. Now, notice that the signs of these predictions for growth expectations and the risk premium are the same as what we have during contractions. However, we are able to show that these effects are predicted to be much greater during contractions than during expansions.

The next step is to take these predictions to the data by studying the relationship between unemployment news arrival, growth expectations, and the equity premium. As will be discussed, we employ proxy variables for both since neither variable is directly observable. What we find is that, consistent with predictions, unemployment news does contain information about growth expectations. Specifically, bad unemployment news signals lower future earnings and dividends growth during both business cycle phases. However, we find that this relation is much stronger during contractions than it is during expansions, which is consistent with the predictions of theory.

We also find a positive and significant relation between unemployment news and the equity risk premium during expansions; that is, bad unemployment news arrival is associated with a rising equity premium. This is consistent with our predictions, but we find no significant relation between news arrival and the equity premium during contractions.

All of these "stylized facts" will be set out and explained in the empirical review that follows in Section 2. For convenience, we have examined how stocks and bonds respond to only one type of news event, the unemployment rate announcement.

However, we believe that our basic finding—that the nature of the information conveyed by macroeconomic news arrival depends importantly on the state of the economy—is likely to be true for many other information events as well. We further believe that macroeconomic news events will mostly convey information about interest rates when the economy is in an expansionary phase, and mostly information about growth expectations during economic contractions (Christiansen and Ranaldo, 2005).

In Section 3 of this study, we explore an interesting implication of our findings, one that has practical implications for portfolio managers. While interest rate news affects prices of both stocks and bonds, news about future earnings and dividend growth has little relevance for bond prices. An implication is that stock and bond return correlations will be higher when the economy is expanding than when it is contracting. We investigate this relationship in Section 3 and find that the prediction appears to be supported by the data. Finally, in Section 3, we investigate another application of our model. Here, we show that the model can provide information about business cycle turning points—well in advance of official announcements from the National Bureau of Economic Research (NBER).

2 Data and methodology

2.1 Measuring unemployment news

The monthly unemployment announcements cover the period from February 1957 to December 2004. Given that we want to examine how stock prices respond to unemployment news, we need a model to measure "news," that is, the unanticipated (news) component of the unemployment figures that are announced every month. For that purpose, we use the following statistical model to forecast the change in the unemployment rate on announcement dates[2]:

$$\begin{aligned} \mathrm{DUMP}_t = b_0 &+ b_1 \cdot \mathrm{IPGRATE}_{t-1} \\ &+ b_2 \cdot \mathrm{IPGRATE}_{t-2} \\ &+ b_3 \cdot \mathrm{IPGRATE}_{t-4} \\ &+ b_4 \cdot \mathrm{DUMP}_{t-1} + b_5 \cdot \mathrm{DTB3}_t \\ &+ b_6 \cdot \mathrm{DBA}_t + e_t \end{aligned} \tag{1}$$

where DUMP_t is the change in the unemployment rate, $\mathrm{IPGRATE}_t$ is the growth rate of monthly index of industrial production (IIP), $\mathrm{DTB3}_t$ is the change in the 3-month T-bill rate and DBA_t is the change in the default yield spread between Baa and Aaa corporate bonds. Forecasts for the change in the unemployment rate from month $t-1$ to month t were constructed by first estimating Eq. (1) using monthly observations up to month $t-1$. Adding back the unemployment rate at month $t-1$ to this forecast gives the predicted unemployment rate in month t.

Actually, Eq. (1) was estimated in three different ways, depending on what information we assume was available to market participants. Most of the results we present here employ the most "conservative" method (one exception will be noted). That is, we use final release figures for the unemployment rate and the IIP, but only employ data available up to 1 *year before the estimation date*. Then we employ the estimated parameters and the initial release numbers of the unemployment rate data and originally published and subsequently revised IIP to construct our estimate of the unemployment surprise. With this very conservative method, we can be sure we are using only information that was actually available to investors at the time their forecasts were made.[3]

2.2 Properties of unemployment news

In order to understand the properties of the forecasts and forecast errors during expansions and

Table 1 Properties of the forecasted unemployment rate.[a]

	Unemployment rate	DUMP	DUMPF	ERRUMP
Whole sample	6.2937 (0.0707)	−0.0010 (0.0092)	0.0240* (0.0059)	−0.0248∗ (0.0083)
Contractions	6.9204 (0.2443)	0.2130* (0.0281)	0.1541* (0.0250)	0.0589* (0.0265)
Expansions	6.1947 (0.0712)	−0.0349* (0.0084)	0.0032 (0.0047)	−0.0382∗ (0.0085)

[a]Forecasts are made using the following model described in Eq. (1) in the text:

$$\text{DUMP}_t = b_0 + b_1 \cdot \text{IPGRATE}_{t-1} + b_2 \cdot \text{IPGRATE}_{t-2} + b_3 \cdot \text{IPGRATE}_{t-4} + b_4 \cdot \text{DUMP}_{t-1} + b_5 \cdot \text{DTB3}_t + b_6 \cdot \text{DBA}_t + e_t$$

where DUMP_t denotes the change of the unemployment rate from month $t-1$ to t; IPGRATE_t denotes the growth rate of in industrial production; DTB3_t denotes the change in the 3-month T-bill rate; and DBA_t denotes the change in the yield spread between Baa and Aaa corporate bonds. The details of the data description and the forecasting method are specified in Boyd *et al.* (2005). We report the means and the standard errors for the means (in parentheses) for the change of unemployment rate, DUMP_t (in percent, annualized), its forecasted value, DUMPF_t, and the forecast error, $\text{ERRUMP}_t = \text{DUMP}_t - \text{DUMPF}_t$ for the period June 1972 to December 2004 for forecasting Method 3. "*" indicates significance at the 5% level.

contractions, we classified every sample month as an expansion or contraction month, using the NBER's reference dating (see Appendix A). The properties of the unemployment rate forecasts are in Table 1. During the 391 monthly forecasts examined, covering the period from January 1972 to December 2004 the US economy was in an expansion during 337 months and in a contraction during 54 months.[4] There were five contractions and six expansions. The average duration of a contraction was 11 months and the average duration of an expansion was 59 months.

Table 2 gives the distribution of unemployment surprises, when classified according to whether unemployment increased by more or less than forecast. Out of a total of 391 months, there are 226 negative surprises (good news) and 165 positive surprises (bad news). The average surprise is positive during contractions and negative during expansions, indicating some bias in our statistical model for measuring news. To the extent this introduces only noise, it should work against our finding the patterns we report here.

2.3 *Daily Returns on stocks and bonds*

We ignore dividends when computing stock returns and define daily stock returns as the percentage change in the S&P 500 stock index. Daily bond returns are constructed from daily yields. Daily government bond price data were not available to us, so we converted the daily yields into bond prices.

Most unemployment rate announcements are made on Fridays. Therefore, for convenience, we refer to announcement days as Fridays. In Table 3, we show average daily returns for stocks and bonds both for Thursday (day before announcement) and Friday (day of announcement). For this purpose, the data are sorted into "good news" and "bad news" unemployment surprises. With this sort a pattern emerges in the response of stock prices. In contractions, the cumulative average stock returns over the 2-day window are −0.29% on bad news and 0.16% on good news. During expansions the cumulative average stock returns over the 2-day window are 0.36% on bad news and −0.07% on good news. During expansions, bad news has a positive effect

Table 2 Properties of the computed unemployment rate surprises (period: 1972.06–2004.12. Units: %/year).[a]

	"Good news" (actual unemployment less than predicted)		"Bad news" (actual unemployment greater than predicted)	
	Number of observations	Mean (Standard Deviation)	Number of observations	Mean (Standard Deviation)
Contractions	22	−0.1227 (0.1093)	32	0.1837 (0.1269)
Expansions	204	−0.1336 (0.1023)	133	0.1081 (0.0990)

[a]Forecasts are made using the following model described in Eq. (1) in the text:

$$\begin{aligned}\text{DUMP}_t &= b_0 + b_1 \cdot \text{IPGRATE}_{t-1} + b_2 \cdot \text{IPGRATE}_{t-2} + b_3 \cdot \text{IPGRATE}_{t-4}\\ &\quad + b_4 \cdot \text{DUMP}_{t-1} + b_5 \cdot \text{DTB3}_t + b_6 \cdot \text{DBA}_t + e_t\end{aligned}$$

where DUMP_t denotes the change of the unemployment rate from month $t-1$ to t; IPGRATE_tdenotes the growth rate of in industrial production; DTB3_t denotes the change in the 3-month T-bill rate; and DBA_t denotes the change in the yield spread between Baa and Aaa corporate bonds. The details of the data description and the forecasting method are specified in BHJ (2005). Let DUMPF_t denote the forecasted value of ″DUMP_t made using information available prior to month t. We report the means and the standard deviation for the forecast error, $\text{ERRUMP}_t = \text{DUMP}_t - \text{DUMPF}_t$, during expansions and contractions for the period June 1972 to December 2004 for forecasting Method 3, described in Boyd *et al.* (2005). Expansions and contractions are based on NBER's dating of business cycle turning points. Numbers are expressed as annualized percentages.

which is the opposite of its effect during contractions. Good news has little effect in expansions, again in contrast to its effect during contractions. In the case of bonds, during contractions the 2-day cumulative return for good news is the same in sign. Both good and bad news have little effect on bond prices in expansions. To summarize, unlike stock prices, bond prices do not appear to react much differently to good and bad news.

2.4 *Stock price response to the unemployment news*

In this section, we further investigate the response of the S&P 500 stock price index to unemployment news arrival using the following linear model:

$$\begin{aligned}\text{SPRTRN}_t &= \alpha + b_1 \cdot D_t \cdot \text{ERRUMP}_t\\ &\quad + b_2 \cdot (1 - D_t) \cdot \text{ERRUMP}_t\\ &\quad + u_t \qquad (2)\end{aligned}$$

where SPRTRN_t denotes the return on day t on the S&P 500 index ignoring dividends; ERRUMP_t denotes the proxy for unemployment news, that is, the surprise component of the unemployment rate announcement; D_t denotes the dummy variable that takes the value one in contractions and zero, and u_t is the error term. The slope coefficients, b_1 and b_2 measure the stock price response to unemployment news in contractions and expansions respectively.

We estimate Eq. (2) using data for the period January 1972 to December 2004. Table 4 presents the estimates when the dependent variables are: the stock index return on the day prior to the announcement day (Thursday), on the announcement day (Friday) and on Thursday and Friday taken together. For all three event windows a consistent pattern emerges. The coefficients are negative in contractions and positive in expansions, and

Table 3 Announcement day (Friday) and pre-announcement day (Thursday) returns (period: 1972.06–2004.12, figures in %).[a]

	Good news	Bad news
S&P 500 Stocks		
Thursday (expansion)	−0.0315 (0.7837)	0.1105 (0.9179)
Thursday (contraction)	0.1075 (0.9732)	−0.1491 (1.4485)
Friday (expansion)	−0.0367 (1.0764)	0.2482 (1.0538)
Friday (contraction)	0.0562 (1.1268)	−0.1410 (0.9849)
1-year Government Bond		
Thursday (expansion)	−0.0092 (0.0588)	−0.000016 (0.0508)
Thursday (contraction)	0.0266 (0.0576)	0.0325 (0.1873)
Friday (expansion)	−0.0048 (0.1116)	0.0221 (0.1071)
Friday (contraction)	0.0768 (0.2696)	0.0733 (0.1123)

[a]Mean (standard deviation), conditional on the state of economy. "Friday" denotes an unemployment announcement day and "Thursday" the day before. Unemployment announcement dates are from the Bureau of labor Statistics. The details are specified in Appendix A of Boyd *et al.* (2005). Expansions and contractions are for the period June 1972 to December 2004, and are based on NBER's dating of business cycle turning points. News is good (bad) when the announced unemployment rate is less (more) than its forecasted value using the model for forecasting Method 3. Figures are in percentages.

are usually statistically significant. Moreover, in all cases the difference between the contraction and expansion coefficients is statistically significant at (at least) the 95% confidence level. In all cases the announcement effect is much larger in absolute value in contractions than it is in expansions.

2.5 *Bond price response to the unemployment news*

The regressions that we estimate for bond returns are identical to Eq. (2) except for the dependent variables. Now, the dependent variables are the return on a hypothetical 1-year government bond, the 3-month T-bill, and the 10-year government bond. Table 5 shows the bond price responses for all event windows. Notice that unemployment news never has a significant effect on bond prices in contractions. In expansions, it has a positive and significant effect for the 1- and 10-year bonds, but not for the 3-month T-bill. The difference in responses across the two states is not statistically significant.

To summarize results so far, government bond price responses to unemployment news arrival are different from stock prices and therefore the former cannot explain the latter. Moreover, the unemployment news must be conveying information about the other two primitive factors, viz., growth rate expectations and the equity risk premium. These two factors affect stock prices but not bond prices, and therefore must account for the differences in their responses.

2.6 *Unemployment news, growth expectations, and the equity risk premium*

To see how the three primitive factors influence stock prices, it is convenient to consider the following variation of the Gordon valuation model that relates equity prices to future dividends, the interest rate, and equity risk premium. Let r be the interest rate on long-term risk free claims, P the price of the stock index portfolio, D the current dividend on

Table 4 Change in the S&P 500 Index in response to unemployment news.[a]

	Thursday	Friday	Thursday and Friday
b_1	−1.48 (−1.57)	−1.44 (−2.20)	−2.92 (−1.97)
b_2	0.6658 (2.29)	0.7247 (1.98)	1.3905 (2.68)
$b_1 - b_2$	−2.145 (−2.18)	−2.165 (−2.85)	−4.31 (−2.74)

[a]The table reports the estimated values of the slope coefficients in the equation,

$$\text{SPRTRN}_t = b_0 + b_1 \cdot D_t \cdot \text{ERRUMP}_t + b_2 \cdot (1 - D_t) \cdot \text{ERRUMP}_t + u_t$$

where SPRTRN_t denotes the return on day t on the S&P 500 index, ignoring dividends. D_t is a dummy variable that takes on the value one in contractions and zero otherwise, according to NBER's dating of business cycle. ERRUMP_t is the surprise component of the unemployment rate announcement. White t-statistics are reported in parentheses. The period covered is June 1972 to December 2004.

Table 5 T-bill and T-bond price responses to unemployment news.[a]

	Thursday (1-year bond)	Friday (1-year bond)	Th + Fr (1-year bond)	Th + Fr (3-month T-bill)	Th + Fr (10-year bond)
b_1	−0.076 (−0.84)	0.0247 (0.22)	−0.051 (−0.30)	−0.009 (−0.20)	−0.304 (−0.40)
b_2	0.0393 (1.49)	0.1105 (2.60)	0.1504 (2.83)	0.0096 (0.46)	0.8157 (2.51)
$b_1 - b_2$	−0.115 (−1.24)	−0.086 (−0.70)	−0.201 (−1.11)	−0.018 (−0.37)	−1.12 (−1.33)

[a]This table reports the slope coefficients in the following equation:

$$\text{BRTRN}_t = b_0 + b_1 \cdot D_t \cdot \text{ERRUMP}_t + b_2 \cdot (1 - D_t) \cdot \text{ERRUMP}_t + u_t$$

for T-bills and bonds. D_t is a dummy variable that takes on the value one in contractions and zero otherwise, according to NBER's dating of business cycle. ERRUMP_t is the surprise component of the unemployment rate announcement. White t-statistics are reported in parentheses. The dependent variables, from left to right, are the Thursday return of a 1-year bond, Friday return of a 1-year bond, Thursday plus Friday return of a 1-year bond, Thursday plus Friday return of a 3-month T-bill, Thursday plus Friday return of a 10-year government. The period covered is June 1972 to December 2004.

the stock index portfolio, g the relevant weighted average of expected future growth rates in D, and π the risk premium (the discount rate on stocks minus the yield on long-term risk free bonds) that investors require to invest in stocks. Then according to the *generalized* Gordon model,

$$P = \frac{D(1+g)}{r+\pi-g} \tag{3}$$

The classical Gordon valuation model assumes that dividends grow at a constant rate over time. Jagannathan *et al.* (2000) show that when growth rates change over time, the *generalized* version of the Gordon model will continue to hold, where, the long run growth rate, g, is a particular weighted average of expected future growth rates. Note that the Gordon valuation model is a mathematical identity relating P, D, g, r, and π. Therefore, given the values of any four of the variables, the value for the fifth can be inferred.

Let u denote the unanticipated surprise in the unemployment rate (ERRUMP) and du represent a small surprise increase in the unemployment rate u. Suppose the unemployment rate unexpectedly increases by one basis point. Then, $(dP/P)/du$ denotes the corresponding percentage change in the price of the equity portfolio, dr/du denotes the resulting change in the long-term interest rate, $d\pi/du$ denotes the resulting change in the equity risk premium, and dg/du denotes the corresponding change in earnings/dividends growth expectations. It can be shown that

$$\begin{aligned}\frac{(dP/P)}{du} &= -\left(\frac{P}{D}\right)\left(\frac{1}{1+g}\right)\left[\frac{dr}{du}+\frac{d\pi}{du}\right.\\ &\quad \left.-\left(1+\left[\frac{D}{P}\right]\right)\frac{dg}{du}\right]\\ &\approx -\left(\frac{P}{D}\right)\left[\left(\frac{dr}{du}\right)+\left(\frac{d\pi}{du}-\frac{dg}{du}\right)\right]\end{aligned} \tag{3a}$$

Now, recall that we already have separate estimates of the effect of the unemployment surprise u on stock prices P, which is the left-hand side of Eq. (3a), $(dP/P)/du$. From our estimates of the relation between the change in bond prices and unemployment news we can infer how long-term interest rates respond to unemployment news, that is, dr/du. P/D, the inverse of the dividend yield, is easily estimated using historical data. It is possible therefore to solve Eq. (3a) for $((d\pi/du) - (dg/du)) \equiv z$, where z is the change in the risk premium in excess of the change in growth expectations in response to a one-basis point rise in unanticipated unemployment.[5]

Contractions. Now, there is no evidence that during contractions unemployment news has any effect on interest rate expectations. Therefore, we set $dr/du = 0$ during contractions. We found that there is a negative and significant relationship between (bad) unemployment news and stock prices (Table 4) during contractions. The implication from Eq. (3a) is that during contractions $((d\pi/du) - (dg/du)) > 0$. Simply put, interest rates do not respond to innovations in u, but stock prices do. Therefore, either the risk premium, growth expectations, or both must be responding to innovations in u. Equation (3a) further tells us that, during contractions, an unexpected increase in unemployment should be associated with an *increase* in the equity risk premium, a *decrease* in growth expectations, or both.

Expansions. During expansions, a one-basis point increase in the unanticipated unemployment rate results in 0.8157 basis point increase in the ten year bond price (see Table 5). That implies, given that the 10-year government bond has a duration of about 7.4, a long-term interest rates decrease of $0.8157/7.4 = 0.1102$ basis points. That alone, from Eq. (3a), should lead to an increase of $(P/D) \times (-dr/du) = 30.966 \times 0.1102 = 3.4133$ basis points in equity prices. However, equity prices actually increase only by 1.3905 basis points (see Table 4). Therefore, the equity premium and growth expectations must be affected in such a way as to attenuate the influence of the fall in future interest rates by $3.4133 - 1.3905 = 2.0228$ basis points. Therefore, growth expectations minus the equity premium must come down by, $(D/P)((dP/P)/du) = (1/30.996) \times 2.0228 = 0.0653$ basis points. Similar calculations imply that growth expectations minus the equity premium must come down by 0.1294 basis points when unemployment increases by one basis point during contractions, that is, the effect on growth expectations minus equity premium during economic contractions is $0.1294/0.0653 \approx 2$ times that during economic expansions.

Thus our findings based solely on the stock and bond price responses to unemployment news reported in Tables 4 and 5 imply predictions for the other primitive variables' news response. In the following section, we separately examine the responses of growth expectations and the equity risk premium to see if these predictions hold true. As we will see, these predictions are nicely supported by the data.

2.7 *The equity risk premium: Its response to unemployment news*[6]

The equity risk premium is not directly observable and therefore we have to employ a proxy that is observed. Lee *et al.* (1999) show that the intrinsic value to price ratio V/P of Dow 30 stocks has a statistically and economically significant ability to predict future excess returns on the Dow 30 stocks. Lee and Swaminathan (1999) reach a similar conclusions when V/P computed with the Dow 30 stocks is used to predict future excess returns on the S&P 500 index portfolio and on a small-stock index portfolio. We therefore employ the V/P ratio they computed as a proxy for the equity premium.[7]

Our findings are given in Table 6. When the change in V/P ratio is used as the proxy for the change in the equity risk premium, the slope coefficient is not significantly different from zero during contractions but is positive and statistically significant during expansions.[8] This finding is consistent with the predictions we reached by back-solving the Gordon Model. That is, to explain observed stock price responses during economic expansions, the risk premium would have to increase (or growth expectations would have to decrease) in response to bad news arrival. We find some evidence that the risk premium does increase during expansions, but we find no evidence that the risk premium responds during contractions.

Finally, from Table 6, we see that a one-basis point increase in unanticipated unemployment is associated with a 0.0480 basis point increase in the equity risk premium when the economy is in an expansion; so growth expectations must decline by $0.0653 - 0.0480 = 0.0173$ basis points. Since there is no effect on the equity risk premium during contractions, the effect on short run growth expectations during contractions is about $0.1294/0.0173 = 7.5$ times more than in expansions, that is, unemployment news must have a much larger effect on growth expectations during contractions than expansions.

2.8 *Growth expectations: Their response to unemployment news*

Our approach was to construct an indirect measure of growth expectations. We assumed that equity investors are good econometricians who study the

Table 6 The reaction of the risk premium to the unemployment surprise.[a]

Variable	Change in risk premium (i.e. Change in $VP31_t$)
Intercept, contraction a_1	−0.0024 (−0.28)
Intercept, expansion a_2	0.0024 (0.91)
Slope coefficient, contraction b_1	−0.0223 (−0.43)
Slope coefficient, expansion b_2	0.0480 (2.59)

[a]This table is reproduced from Boyd *et al.* (2005, p. 665). It gives the estimated coefficients for the following equation:

$$\mathrm{DVP31}_t = a_1 \cdot \mathrm{XRIC}_t + a_2 \cdot (1 - \mathrm{XRIC}_t) + b_1 \cdot \mathrm{XRIC}_t \cdot \mathrm{ERRUMP}_t + b_2 \cdot (1 - \mathrm{XRIC}_t) \cdot \mathrm{ERRUMP}_t + \eta_t$$

where $\mathrm{DVP31}_t$ denotes the change in $\mathrm{VP31}_t$, our proxy for the risk premium, as expained in the text. $\mathrm{VP31}_t$ is one of the intrinsic value to market price ratios computed by Lee *et al.* (1999, p. 1702 and Panel C, Table III, p. 1720). We have their measure only for the period examined in Boyd *et al.* (2005), ending in June 1996. XRIC_t is the experimental coincident recession index constructed by Stock and Watson (1989) that indicates the probability that the economy was in a recession. ERRUMP_t is the surprise component of the unemployment rate announcement. The period covered is June 1972 to June 1996.

data and make forecasts. On that basis, we estimated the *true* relationship between the announced unemployment rate (the actual rate, not the surprise component) and subsequent dividend growth, using the IIP as a monthly proxy for corporate dividends.[9] The idea was to see if this actual real sector relationship is significantly different in contractions than in expansions. If that is true, then that fact should be reflected in the expectations formation of investors.

We studied the relation between IIP in the same month and one to three months following the reference month of the unemployment announcement. We estimated the following equation:

$$\text{IPGRATE}_s = a_0 + a_1 \cdot D_t \cdot \text{DUMP}_t + a_2 \cdot (1 - D_t) \cdot \text{DUMP}_t + v_t \qquad (4)$$

where IPGRATE is the change in the IIP, s is the number of leads before announcement dates ($s = t, t+1, t+2,$ and $t+3$), and v_t is an error term. The results with Eq. (4) are shown in Table 7. The coefficients a_1, a_2 in Eq. (4) are consistently negative in sign at all four forecast horizons, and most of the coefficients are significantly different from zero. For expansion periods, however, the coefficients are much smaller in absolute value than they are during contractions. The sum of the slope coefficients in contractions is 10.782, which is 3.88 times that during expansions, not statistically significantly different from what we expected based on our discussions in the earlier section. This suggests that equity investors should be revising their growth expectations much more strongly in contractions than in expansions.

These findings are of course consistent with what we expected to find. Our qualitative prediction was that, during contractions either growth expectations decrease in response to bad unemployment news arrival, or the risk premium increases. We found no evidence of the latter but we do find evidence of the former. Notice, finally, that the downward revision of growth expectations during expansions (although estimated to be smaller than during contractions) is also consistent with Table 6 predictions. What is predicted there is that, during expansions, either the risk premium increases, growth expectations decrease, or both. We find some evidence that it is "both."

2.9 *Summary*

We have documented that on average stock prices rise on bad labor market news during expan-

Table 7 Linear relation between unemployment rates and growth rates of industrial production.[a]

	Same month	One month ahead	Two months ahead	Three months ahead
a_1	−3.722 (−7.90)	−3.296 (−6.22)	−2.551 (−5.70)	−1.213 (−1.73)
a_2	−1.222 (−5.90)	−0.425 (−2.01)	−0.364 (−1.62)	−0.766 (−3.58)
$a_1 - a_2$	−2.50 (−4.82)	−2.871 (−4.93)	−2.187 (−4.38)	−0.447 (−0.60)

[a]This table reports the slope coefficient in the regression of the growth rates in industrial production on the changes in the unemployment rate,

$$\text{IPGRATE}_s = a_0 + a_1 \cdot D_t \cdot \text{DUMP}_t + a_2 \cdot (1 - D_t) \cdot \text{DUMP}_t + v_t$$

where IPGRATE_s denotes the growth rate in industrial production during month s; we consider $s = t, t+1, t+2,$ and $t+3$, that is, same month to 3 months ahead; $DUMP_t$ denotes the change of the unemployment rate from month $t-1$ to t; and D_t is a dummy variable that takes on the value one in contractions and zero otherwise, according to NBER's dating of business cycle. White t-statistics are reported in parentheses. The period covered is June 1972 to December 2004.

sions, and fall during contractions. This pattern cannot be explained solely based on bond price reactions. On average, bond prices rise on bad unemployment news during expansions, but do not respond significantly during contractions. Stock price responses during contractions are therefore unexplained. Logically, there are two factors that affect the price of stocks but do not affect the price of risk-free government bonds. One is the equity risk premium and the other is the expected future growth rate of dividends. Since stock prices respond differently from bond prices, it seems that unemployment news must contain information about one or both of these factors. Our empirical work suggests that this is true. Both growth expectations and the equity risk premium seem to react to unemployment news arrival in ways that could explain the observed response of stock and bond prices.

3 The state of the economy and stock–bond return correlations

We have seen that interest rate effects dominate stock price responses to unemployment news during economic expansions. Interest rate expectations fall on bad labor market news with positive effects on both stock and bond prices. During expansions, therefore, our results suggest a positive *ceteris paribus* correlation between stock and bond returns (since both are primarily responding to changes in interest rate expectations). During contractions, however, things are quite different according to our findings. Changes in growth expectations appear to dominate stock price responses. Growth expectations decline on bad labor market news with the result that stock prices decline. However, growth expectations would not be expected to have first-order effects on risk-free bond returns. Moreover, we find scant evidence that, during contractions, interest rate expectations are affected by labor market news. Taken together, these findings suggest that during contractions the stock and bond return correlation should be much lower than during expansions.[10]

A complete investigation of the business-cycle dependence of stock and bond return correlations is beyond the scope of the present study; indeed it amounts to a major new research undertaking. However, there has been recent work on this topic and some of it is related to state-dependency in stock–bond return correlations. Several studies conclude that stock–bond return correlations are far from constant, and in fact vary a great deal over time (Campbell and Ammer, 1998; Kwan, 1996; Li, 2002). Cotter *et al.* (2003) investigated the correlation of stock and bond returns in the United States over the period 1986–2001. They used daily return data and compute correlations for each (non-overlapping) month during this sample period for several bond maturities and several stock price indices. During this period, they find dramatic changes in the correlation between returns on stocks and bonds.[11] During the late 1980s and into the 1990s this correlation was positive and averaged about 0.5. Then, in late 1997 the estimated correlation went negative and averaged about −.5. Over the entire sample period 1986–2001, the average correlation between the S&P 500 and the 10 year bond portfolio was positive and about 0.3. Obviously, however, the positive average correlation conceals an enormous amount of variation over time.

Cotter *et al.* (2003) do not directly investigate the business cycle phase dependence of stock–bond return correlations. However, they do present empirical results that provide indirect evidence on this issue. They regress the stock–bond return correlation on the 30-year mortgage rate, the 10-year and 3-month government yield spread, and a measure of the historical volatility of the stock market. Now, the 10-year and 3-month government yield spread has been frequently used as a proxy for an expanding or contracting economy.[12] In an expanding economy, the term spread tends to widen and in a contracting economy it tends to narrow or even become negative (e.g. an inverted yield curve). These authors find a positive and significant relationship between the interest rate spread and the stock–bond return correlation. This is obviously consistent with the predictions of our theory, at least to the extent that the government yield spread is a reliable proxy variable for the state of the macro-economy.

Related and supporting results are presented in a recent study by Christiansen and Ranaldo (2005). They employ very high frequency data to study stock–bond return correlations over the period 1988–2003. They investigate both realized variances and realized return correlations for very narrow time windows (usually about 90 min) surrounding several different types of news announcements. Interestingly, they report a time pattern in stock-bond return correlations that is very similar to that reported by Cotter *et al.* (2003). Figure 1 is taken from Christiansen and Ranaldo (2005) and we thank them for allowing us to reproduce their work. It shows that over the period 1988–1998 the correlation was positive and averaged about 0.25. Then in late 1999 it started to decline and, by the end of their sample period in mid-2003, had reached a value of approximately −0.6. This, of course, is very similar to the results reported by Cotter *et al.* (2003).

Christiansen and Ranaldo (2005) also investigate the macro-economic state dependence of stock–bond return correlations by employing a dummy variable that takes on the value 1 during periods of economic contraction, and zero otherwise. They find that the stock–bond return correlation is strongly dependent on the state of the economy dummy variable. As they put it, "Our results …suggest that the interpretation of macroeconomic news items depend on the economic situation. The influence of these factors varies over economic conditions and so do bond–stock co-movements" (p. 16). Recall that these authors investigate stock bond correlations around several different kinds of news announcements. Interestingly, they find that the macro-economic state dependence of stock–bond return correlations depends on the specific kind of news announcement. This leads them to conclude, "…the discount rate tends to dominate the information content of some macroeconomic news items during expansions, whereas the cash flow effects stand out during contractions" (p. 16). This is exactly consistent with the predictions of our theory.

To summarize, although these two studies are methodologically quite different and look at somewhat different time periods, they both present evidence that the stock–bond return correlations depend significantly on the state of the macro-economy. Both studies suggest that interest rate effects tend to dominate during expansions with the result that stock–bond return correlations are larger in absolute value during expansions than during contractions. In addition, both report a similar time trend in the stock–bond return correlation, moving from positive in most of the 1990s to negative and down trending in the 2000s. Both these features of the data may be important for asset managers that invest in both common stocks and in bonds. A key task for future research is to try to explain what other factors, if any, besides the state of the economy are producing such marked changes in stock–bond return correlations.

4 Information about the state of the economy in the way stock prices respond

In the earlier sections we empirically demonstrated that the way stock prices respond to unemployment news depends on the state of the economy. In

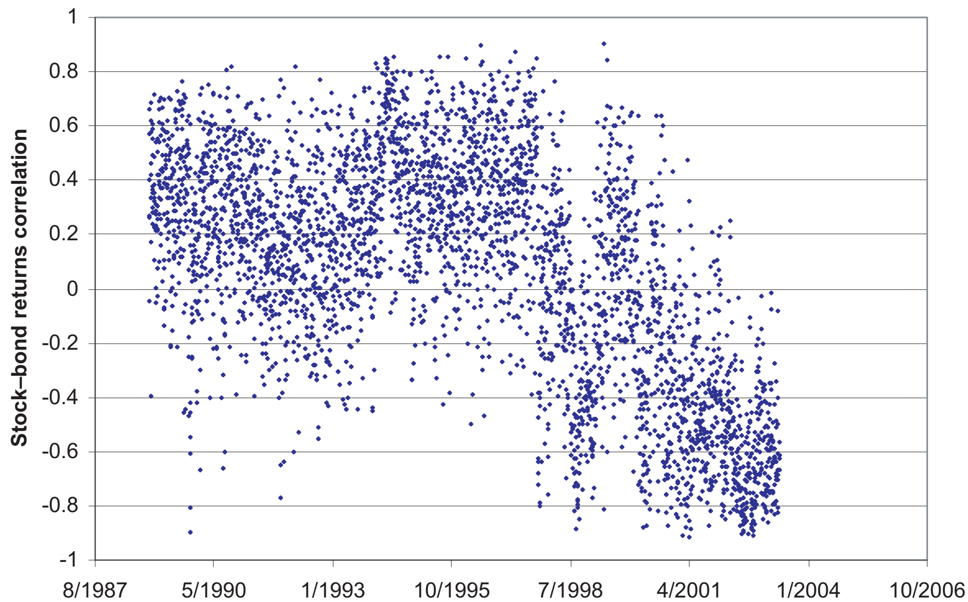

Figure 1 Bond–stock realized return correlations, 1988–2003.
This figure is taken from Christiansen and Ranaldo (2005) and we thank the authors for their permission to reproduce it here. It shows the time-series of the bond-stock realized correlation applying in the interval between 9:50 am and 11:30 am each day.

principle, therefore, one might be able to observe the unemployment news and the response of the stock market thereto, and infer whether market participants believe the economy is expanding or contracting. The information learned about the state of the economy might be useful because of the frequently long lags in NBER's official dating of cyclical turning points.[13] Around suspected business cycle turning points, analysts would undoubtedly like to know in real time if the economy is shifting from expansion to contraction or vice versa. In this section, we ask whether the unemployment news, and the stock market's reaction thereto, provide real-time information concerning the state of the economy. The answer is, "Yes they do." We view this work as an extension and robustness check of our model. It is not (and is not intended to be) a full econometric investigation of forecasting turning points (see Note 17).

For this purpose, we use the following *Probit* Model to forecast the economic state (D); whether it is in a contraction ($=1$) or an expansion ($=0$) at month t:

$$\begin{aligned} P(D_t = 1) = F(b_0 &+ b_1 \cdot \mathrm{ERRUMP}_t \\ &+ b_2 \cdot \mathrm{ERRUMP}_{t-1} \\ &+ b_3 \cdot \mathrm{ERRUMP}_{t-2} \\ &+ b_4 \cdot \mathrm{DUM1}_t \cdot \mathrm{ERRUMP}_t \\ &+ b_5 \cdot \mathrm{DUM2}_t \cdot \mathrm{TWO}_t + \varepsilon_t) \quad (5) \end{aligned}$$

where P denotes the probability of recession, F is the cumulative normal distribution function, ERRUMP is the unemployment surprise, TWO denotes the sum of the stock index return on the day prior to the announcement day and on the announcement day, and ε_t is an error term.[14] The model includes two dummy variables DUM1 and DUM2. DUM1 takes on the value one when ERRUMP > 0 and TWO < 0; that is, when there is *both* bad news both from the labor market and from the stock market. DUM2 takes on the value one when ERRUMP < 0 and TWO > 0; that is, when there is *both* good news from the labor market and from the stock market.[15]

To obtain our forecasts of the state of the macro-economy, we estimated the coefficients of Eq. (5) month by month as more observations were added. Our forecasts started in January 1972 using the first 120 months of data beginning from January 1962 and then we updated and repeated this procedure until the end of 2004. The monthly forecasts of the economic state are based on the following criterion: if the fitted probability from Eq. (5) is greater than 0.5, we predict that the economy is in contraction; otherwise we predict that it is in expansion.

Table 8A presents our forecasts of the state of the economy around all the turning points during the sample period. The Probit model does appear to have some predictive power. All the coefficients are significant at the 1% level or higher, and the in-sample "predictive power" is 80.5% (not reported in Table 8). This means that with more than 80% odds, our predicted probability in a contraction month is more than 0.5, and less than 0.5 in the expansion month. In terms of out-of-sample forecasts, as shown in Table 8A, we are able to accurately predict 5 out of the 10 turning points, at least within a month. Among the five turning points that we miss, we still can "shed some light" on four of them, in the following sense. In these four cases, the Probit model predicts a turning point within seven months after the actual turn, which is earlier than the 11 months in takes on average for an official NBER announcement.[16]

Where the Probit model is relatively weak is that, although it predicts 5 out of the 10 turning points accurately (within 1 month), it does a poor job of predicting the runs of contraction months that typically follow a cyclical downturn. The NBER announced 54 contraction months from January 1972 to December 2004, whereas our model only predicts 20 contraction months. The reasons for this model property are not entirely clear.[17]

To more formally evaluate our forecasts, we employ the following "naive forecast" as a benchmark for comparison. Our hypothetical "naïve forecaster" predicts that next month will always be the same as this month *until (s)he observes an official turning point announcement from the NBER.* When that occurs, the forecast is changed and thereafter (s)he returns to the rule, "next month will be the same as this month." Announcement date information on the turning point of the macro-economy is available from the NBER website since June 1980 and is provided in Appendix A.

Table 8B compares the forecasts from Eq. (5) with the naïve forecast. Panel B1 gives the percentage of correct forecasts for each model, conditional on the monthly economic state transition. There are just four transition possibilities: "expansion to expansion", "expansion to contraction", "contraction to expansion", and "contraction to contraction". The numbers in brackets are from the naive forecast, and those outside are from Eq. (5). Panel B2 is provided for completeness, and shows the total number of observations for each of the four kinds of transition. For example, we have 34 cases in which the current month was a contraction and the next month was also a contraction. In three of the four transitions, the Probit model has a higher success rate than the naive forecast. Only in the case of transition from one contraction month to another does our model do worse. Obviously this occurs because, as noted earlier, we cannot forecast runs in contractions.

Overall, the Probit model correctly classifies 88.0% of the data while the naïve forecast correctly classifies 72.6%. Perhaps more important, the Probit model actually predicts some turning points while the naive model can, by construction, predict none; for example, the NBER announcement of a turning point always occurs months after the fact. We should note that we have intentionally restricted the variables in Eq. (5) to ones that are consistent with our theory. That is, we strictly limit the explanators

Table 8A Business cycle timing forecast: Turning point forecast.[a]

Time	Change in State of the economy		Forecast
1973.12	Downturn		Miss
1975.04		Upturn	'Hit' (one month early)
1980.02	Downturn		Hit
1980.08		Upturn	Miss
1981.08	Downturn		Miss
1982.12		Upturn	Hit
1990.08	Downturn		"Hit" (one month late)
1991.04		Upturn	Miss
2001.04	Downturn		Miss
2001.12		Upturn	Hit

[a]Forecasts are made using the following model described in Eq. (5) in the text:

$$P(D_t = 1) = F(b_0 + b_1 \cdot \text{ERRUMP}_t + b_2 \cdot \text{ERRUMP}_{t-1} + b_3 \cdot \text{ERRUMP}_{t-2} + b_4 \cdot \text{DUM1}_t \cdot \text{ERRUMP}_t + b_5 \cdot \text{DUM2}_t \cdot \text{TWO}_t + \varepsilon_t),$$

where P denotes the probability of recession; F is the cumulative normal distribution function; ERRUMP_t is the surprise component of the unemployment rate announcement, constructed from Method 2 described in Boyd *et al.* (2005); TWO denotes the sum of the stock index return on the day prior to the announcement day (Thursday) and on the announcement day (Friday). DUM1 takes on the value one when ERRUMP > 0 and TWO < 0; DUM2 takes on the value one when ERRUMP < 0 and TWO > 0. The sample period used for estimation is January 1962 to December 2004. Our forecasts start from January 1972. The monthly forecasts of the economic state are based on the following criterion: if the fitted probability from Eq. (5) is greater than 0.5, we predict that the economy is in contraction; otherwise we predict that it is in expansion. Forecasts are then compared with NBER's dating of business cycle turning points to decide whether they make the correct prediction.

Table 8B Business Cycle Timing Forecast: Comparison with "naive forecast".[a]

Panel B1: Percentage forecast success rates

Percentage	Next, contraction	Next, expansion
Current, contraction	18% (41%)	100% (0%)
Current, expansion	25% (0%)	98% (79%)

Panel B2: Number of state transitions of each type

Number of observations	Next, contraction	Next, expansion
Current state, contraction	34	4
Current state, expansion	4	257

[a]This table compares the forecasts from the Probit model, as described in Eq. (5) with those from a "naïve forecaster." The "naïve forecaster" predicts that next month will always be the same as this month until (s)he observes an official (NBER) turning point announcement. If and when that occurs the forecast is changed and thereafter returns to the rule, "next month will be the same as this month." Announcement date information on the turning point of the macro-economy is available from the NBER website since June 1980 and is provided in Appendix A. Panel B1 gives the percentage of correct forecasts for each model, conditional on the monthly economic state transition: "expansion to expansion," "expansion to contraction," "contraction to expansion," and "contraction to contraction." The numbers in brackets are from naive forecast, and those outside are from Eq. (5). Panel B2 reports the total number of observations for each of the four kinds of transition.

to variables that represent unemployment surprises and/or stock price responses thereto. In other specifications (not shown) we can obtain somewhat better forecasts by including other variables (e.g. interest rate spreads).

It may not be practical for many analysts to replicate our forecasts, since that would involve the tedious task of updating the data and re-estimated the Probit model each month. Yet, we believe there is still practically useful information in what we have presented. If the analyst suspects that a macroeconomic turning point may be near, (s)he should observe the unemployment surprise and the resulting short term stock price response. *Ceteris paribus*, a bad (good) unemployment surprise accompanied by a stock price runoff (run up) signals a recession (expansion). The absolute size of both the unemployment surprise and the stock price response contain information too, with larger innovations providing a stronger signal of a turning point.

To be sure, we would not "bet the bank" using this method! However, we think that the way stock prices respond to macro economic information events can provide useful information for assessing the state of the economy.

Appendix A

We use NBER's dating of business cycles, which is published on their web site (http://www.nber.org/cycles/cyclesmain.html). For our sample period,

Table A1 Business cycle timing

Period	State of the economy / Number of months
1970.12–1973.11	Expansion/36
1973.12–1975.03	*Contraction/16*
1975.04–1980.01	Expansion/58
1980.02–1980.07	*Contraction/ 6*
1980.08–1981.07	Expansion/12
1981.08–1982.11	*Contraction/16*
1982.12–1990.07	Expansion/92
1990.08–1991.03	*Contraction/8*
1991.04–2001.03	Expansion/120
2001.04–2001.11	*Contraction/8*
2001.12–2004.12	Expansion/37

Table A2 Announcement dates

The November 2001 trough was announced July 17, 2003
The March 2001 peak was announced November 26, 2001
The March 1991 trough was announced December 22, 1992
The July 1990 peak was announced April 25, 1991
The November 1982 trough was announced July 8, 1983
The July 1981 peak was announced January 6, 1982
The July 1980 trough was announced July 8, 1981
The January 1980 peak was announced June 3, 1980

from January 1972 to December 2004, there were 342 expansion months and 54 contraction months. Table A1 provides a summary. The NBER states that a recession is a recurring period of decline in total output, income, employment, and trade, usually lasting from six months to a year, and marked by widespread contractions in many sectors of the economy. Table A2 provides announcement dates information. It is available since 1980. All announcements from NBER since 1980 are at least with 6 months lag. The typical lag time is 6 months to 1 year.

Notes

1 With one exception, all empirical estimates have been updated to the most recently available data. Reassuringly, in no case did we find qualitative or significant quantitative differences between the old and new findings.

2 The consensus forecasts from the *Wall Street Journal* and other sources would be good for this purpose. Unfortunately, they are only available for about 10 years, and using them would greatly reduce our sample size.

3 Actually, our results do not depend a great deal on which method is employed. The interested reader is referred to Boyd *et al.* (2005).

4 The initial release data begin in January 1972. In addition, we use the first 5 months of data in Eq. (1) to generate the unemployment rate forecast. Therefore, the unemployment surprise series begin from June 1972.

5 Put differently, employing the estimates from Table 4 and calculating P/D from historical data, we know everything in Eq. (3a), except $d\pi/du - dg/du$. Obviously, at this point we cannot make separate predictions for $d\pi/du$ *and* dg/du, but only for the difference $d\pi/du - dg/du$.

6 The material in this section and in Table 6 has not been updated and is essentially the same as in Boyd *et al.* (2005). The estimates of the equity risk premium that we employ depend on a data series originally provided by Swaminathan that we have not updated. The Experimental Coincident Recession Index (XRIC) that indicates the probability that the economy was in a recession is used in Table 6. When $XRIC_t$ takes the binary form, that is, $\text{XRIC}_t \equiv D_t$, which takes the value of 1 in contractions and 0 in expansions, the results will not change qualitatively.

7 This procedure is discussed in much greater detail in Boyd *et al.* (2005). We thank Swaminathan for making the V/P series available to us.

8 Arguably, a default interest rate spread can be employed as a proxy for the equity premium. When the change in the default interest rate spread (Baa – Aaa) is used as the dependent variable and the unemployment surprise is the independent variable, results are very similar to what we report with the value-price ratio. The slope coefficient is not significantly different from zero during contractions, but is positive and marginally significant during expansions. For brevity, these results are not reported.

9 The correlation between the annual rate of growth in dividends and the IIP is only 0.247. However, it is well known that dividend payments are intentionally smoothed, even at annual frequencies. The correlation between quarterly earnings growth and IIP growth is a more respectable 0.464. Unfortunately, we know of no better proxy variable for dividends that is observable at monthly intervals.

10 Of course, all our findings pertain to asset price responses to a *particular kind of information arrival*, the arrival of unemployment news. We expect the pattern we document for unemployment rate announcements to hold for a number of other types of macro economic information events, that is, such events are likely to convey more information about future interest rates when the economy is in an expansion and more information about future equity earnings and dividends when the economy is in a contraction. However, stock and bond returns are determined by a myriad of other factors and, therefore, our predictions for overall correlations are, at best, suggestive.

11 To represent stock returns, Cotter *et al.* (2003) employ the S&P 500, DJIA, and NASDAQ. For bond returns, they employ both 5- and 10-year US government bonds.

12 Harvey (1989) argues that the term structure of interest rates can be used to forecast economic growth. Using a simple single variable linear regression, he shows that the yield spread between the 10-year and 3-month Treasury yield can predict annual GNP with about 35% out-of-sample R-squared.

13 All announcements from the NBER since 1980 have been with at least a 6-months lag. The extreme cases were the last two trough announcements which took over 20 months.

14 For this purpose, we employ the unemployment rate forecast obtained with Method 2 in Boyd *et al.* (2005). This gives us a longer time series data of the unemployment rate forecast, which is useful for our forecast of the state of the the macro-economy. Note that with Method 2, we have not used the dummy variable. The only difference from

Method 3 is that we use the final release data for Method 2 (see Boyd *et al.*, 2005, for details).

[15] As in Eq. (1), we looked for a probit model that had the lowest AIC and SBC values, with all regression coefficients being statistically significant. The final model we used to predict the state of the economy is presented in the paper. This model also has the highest in sample "predictive power", which means the percentage of answering the following question correctly: Does the case with a 1 have a higher predicted value (based on the probit model) than the case with a 0?

[16] For example, with the two upturns in August 1980 and April 1991, both our forecasts are 5 months earlier than the turning points identified by NBER. For the two downturns in August 1981 and April 2001, both our forecasts are 7 months later than the turning points. However, they are still earlier than the corresponding official NBER announcement dates.

[17] We can easily statistically capture the runs in both contractions and expansions by including one or more lagged values of the state variable, D_t. However, this would not be a "fair" forecasting model since, in reality, it usually takes many months before the true state of the economy is known.

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