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journal homepage: [www.elsevier.com/locate/jfec](http://www.elsevier.com/locate/jfec)Disagreement and return predictability of stock portfolios<sup>☆</sup>

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## ABSTRACT

This paper provides evidence that portfolio disagreement measured bottom-up from individual-stock analyst forecast dispersions has a number of asset pricing implications. For the market portfolio, market disagreement mean-reverts and is negatively related to ex post expected market return. Contemporaneously, an increase in market disagreement manifests as a drop in discount rate. For book-to-market sorted portfolios, the value premium is stronger among high disagreement stocks. The underperformance by high disagreement stocks is stronger among growth stocks. Growth stocks are more sensitive to variations in disagreement relative to value stocks. These findings are consistent with asset pricing theory incorporating belief dispersion.

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## 1. Introduction

This paper analyzes the asset pricing implications of disagreement for a *portfolio* of assets. The idea that disagreement can matter for equilibrium asset price and expected return is shown in Miller (1977)—if pessimists face short-sales constraints, the price of an asset reflects the valuation of optimists. One implication is that greater disagreement is associated with higher price and lower

subsequent return.<sup>1</sup> This prediction is supported by the cross-sectional evidence in Chen, Hong, and Stein (2002) and Diether, Malloy, and Scherbina (2002).

The mechanism in Miller (1977) has a direct corollary for portfolios: greater portfolio disagreement is associated with lower subsequent portfolio return. This prediction is under-explored, with the exception of Park (2005) who finds supportive evidence for the market portfolio by measuring market disagreement top-down using analyst forecast dispersion of Standard & Poor's (S&P) 500 index annual earnings-per-share (EPS). It is not so straightforward, however, to gauge disagreement for a portfolio of assets. Portfolio disagreement can alternatively be constructed bottom-up by aggregating disagreements regarding the individual assets in the portfolio. Bottom-up measure of disagreement likely offers a better signal-to-noise ratio than the top-down measure. Bottom-up disagreement is constructed using thousands of individual-stock forecasts while there are, on average,

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<sup>1</sup> See also Harrison and Kreps (1978), Harris and Raviv (1993), and Scheinkman and Xiong (2003). Hong and Stein (2007) provide a recent review of this literature.

only 20 or so analysts in the sample covering S&P 500 EPS. The analysts' effort likely mirrors investors' focus on stock picking. Some individual-stock disagreements may not be reflected in the top-down disagreement but can be discerned from the bottom-up disagreement. For example, investors may agree on the future prospect of the market. In this case, there may appear to be little disagreement from the top-down measure. However, still waters run deep. Investors may disagree on which stocks will lead/lag the market; hence, strong disagreement may exist and can be discerned from the bottom up, which may make the bottom-up disagreement a better proxy of the belief dispersion within the market.

Using the Institutional Brokers' Estimate System (I/B/E/S) database on analyst forecast, this paper finds that the ex post market return is negatively related to the bottom-up disagreement, consistent with Miller (1977). The bottom-up disagreement works substantially better than the top-down disagreement. The result holds for a variety of bottom-up disagreement constructions, from value-weighting to equal-weighting of individual-stock forecast dispersions, and from using long-term EPS growth rate forecasts to near-term fiscal period EPS forecasts.<sup>2</sup> For example, a one-standard-deviation increase in the bottom-up disagreement measured from value-weighted individual-stock long-term EPS growth rate forecast dispersions is associated with a statistically and economically significant drop in the expected one-year market return of 6.6% (e.g., from 9% to 2.4%). The horizon for the low ex post return is consistent with the speed of mean reversion in disagreement. This paper finds that disagreement mean-reverts slowly. Shocks to the disagreement have a half-life of about one year and largely mean-revert within three years. Consistent with the speed of mean reversion, the return implications are found to be stronger for one-year to three-year return horizons. The effect of disagreement is robust to controlling for a host of alternative hypotheses, including all the variables reviewed in Campbell and Thompson (2008) and Goyal and Welch (2008), which are found by earlier studies to correlate with market return.

The paper also tests a pillar of the disagreement model—positive *contemporaneous* correlation between portfolio return and shocks to disagreement. That is, price becomes higher when there is more disagreement, which is the source of the low ex post return. This indeed holds for the market portfolio. Further, shocks to disagreement are found to correlate more with discount-rate news than with cash-flow news in the Campbell and Shiller (1989) return decomposition. Higher disagreement manifests as lower discount rate. Discount-rate news and cash-flow

news have distinct implications for asset pricing. A number of studies have relied on the discount-rate variation to address asset-pricing challenges. Fama and French (1988a), Campbell and Shiller (1989), and Campbell and Vuolteenaho (2004) use the discount-rate effect to address the time-varying equity premium and the value premium. However, it is unclear what drives the variations in discount rate. Fama and French (1988a, p. 5) point out, "The interesting economic question, motivated but unresolved by our results, is whether the predictability of returns implied by such temporary price components is driven by rational economic behavior ...or by animal spirits." Campbell and Vuolteenaho (2004) echo that their paper is "silent on what is the ultimate source of variation in the market's discount rate" (p. 1270) and conjecture that "it is possible that our discount-rate news is simply news about investor sentiment" (p. 1261). The relation between disagreement and discount-rate news adds to our understanding of discount-rate variations. This relation, together with the empirical finding in Campbell and Vuolteenaho (2004) that growth stocks are more sensitive to the discount-rate news than value stocks, predicts the mean reversion of disagreement affects growth stocks more than value stocks. Consistently, this paper finds that a one-standard-deviation increase in disagreement is associated with a drop in ex post one-year growth (or value) stock return by 8.17% (or 2.58%). Consequently, there is evidence of time-varying expected Fama and French (1993) high-minus-low (HML) book-to-market portfolio return associated with disagreement.

Another implication of the Miller (1977) model that is empirically under-explored is the interaction between disagreement and the optimism of the marginal investor. The negative relation between the ex post return and belief standard deviation should be twice as large if the marginal investor's belief is two standard deviations above fundamental instead of one standard deviation above fundamental. The marginal investor is not directly observable. Nonetheless, this restriction yields a number of testable implications if there exists a set of test assets whose marginal investors have different optimism. This paper uses portfolios sorted on the book-to-market ratio as test assets. Low book-to-market stocks (growth stocks) historically have lower returns than high book-to-market stocks (value stocks). There is some evidence that growth stock investors are overly optimistic.<sup>3</sup> Assuming the marginal investors in growth stocks are more optimistic, the interaction between marginal investor and disagreement implies: (i) high disagreement stocks have low return and the effect is stronger for growth stocks; (ii) growth stocks have low return and the effect is stronger for high disagreement stocks; (iii) contemporaneously, growth stock returns are more positively correlated with variations in disagreement than value stocks; (iv) ex post, growth stock returns are more negatively correlated with disagreement than value

<sup>2</sup> When using forecasts for individual-stock annual or quarterly EPS, the effect of company guidance of annual or quarterly earnings should be accounted for (see Section 4). Annual or quarterly EPS forecasts also requires scaling, which may introduce variations unrelated to disagreement (Qu, Starks, and Yan, 2004; Cen, Wei, and Zhang, 2007). Therefore, in the following discussions, this paper features forecasts on long-term EPS growth rate. Because the top-down forecasts are typically made for value-weighted market benchmarks, this paper features value-weighted bottom-up disagreement to facilitate comparison.

<sup>3</sup> See Lakonishok, Shleifer, and Vishny (1994) and La Porta (1996). The risk-based explanation of the value premium is not the focus of this paper, though the finding that disagreement relates to discount-rate news also has implications for the risk of value/growth stocks.

stocks. These predictions are all confirmed in the data, thus lending further support to the disagreement mechanism and adding to our understanding of the value premium. This finding also provides a potential explanation to the sensitivity of growth stock return to discount-rate news found in Campbell and Vuolteenaho (2004).<sup>4</sup> The bottom-up approach to measuring portfolio disagreement helps here because analysts rarely provide top-down forecasts for customized portfolios.

Taken together, the evidence on equity premium, discount rate, and value premium provides strong support for the hypothesis that disagreement matters for the equilibrium price and expected return in the stock market. It is likely promising to explore the implications of disagreement for other markets. The conditions of disagreement and short-sales constraint likely hold for houses, art, or tulip bulbs with various shapes, etc. The distinction between top-down and bottom-up disagreement will also likely be important. For example, does measuring disagreement top-down capture adequately the belief dispersion in the national housing market if homebuyers tend to focus on the local housing market condition? These questions are left for future work.

This paper is organized as follows. Section 2 discusses the bottom-up measure of disagreement. The relation between disagreement and ex post market return is tested in Section 3. Section 4 compares the bottom-up and top-down approaches. The relation between disagreement, discount-rate news, and time-varying value premium is examined in Section 5. Section 6 analyzes the interaction between disagreement and marginal investor optimism using portfolios sorted by book-to-market ratio. Section 7 performs robustness checks. Section 8 concludes.

## 2. Bottom-up measure of portfolio disagreement

This paper uses analyst forecasts of the earnings-per-share (EPS) long-term growth rate (LTG) as the main proxy for investors' beliefs regarding the future prospects of individual stocks. The data are provided by the I/B/E/S database. This measure is used in a number of studies (e.g., Moeller, Schlingemann, and Stulz, 2007). The long-term forecast has several advantages. First, it features prominently in valuation models. Second, it is less affected by a firm's earnings guidance relative to short-term forecasts (see Section 4). Because the long-term forecast is an expected growth rate, it is directly comparable across firms or across time.

Analyst forecasts from December 1981 through December 2005 are used in this study. For each firm  $i$  in each month  $t$ , the average and the standard deviation of analyst forecasts of EPS LTG are obtained from the unadjusted I/B/E/S summary database and denoted as

$\mu_{i,t}$  and  $\sigma_{i,t}$ , respectively.<sup>5</sup> Monthly stock closing prices and shares outstanding are obtained from the Center for Research in Security Prices (CRSP). Only common stocks (CRSP item SHRC=10 or 11) listed on the NYSE/Amex/Nasdaq are included. Let  $MKTCAP_{i,t}$  denote the market capitalization of stock  $i$  at the end of month  $t$ .

The portfolio disagreement, measured bottom-up, is the cross-sectional value-weighted average of individual-stock disagreement,

$$\sigma_t = \frac{\sum_i MKTCAP_{i,t} \cdot \sigma_{i,t}}{\sum_i MKTCAP_{i,t}} \quad (1)$$

The cross-sectional value-weighted average of individual-stock average forecast is

$$\mu_t = \frac{\sum_i MKTCAP_{i,t} \cdot \mu_{i,t}}{\sum_i MKTCAP_{i,t}}$$

Unless otherwise stated, Sections 3–5 study the disagreement of the market portfolio and Section 6 studies the disagreement of book-to-market sorted portfolios.

Fig. 1 plots the time series of  $\sigma_t$  for the market portfolio. Table 1 provides summary statistics. Both  $\mu_{i,t}$  and  $\sigma_{i,t}$  are in percentages. The time-series average of  $\sigma$  is 3.23% and the time-series average of  $\mu$  is 14.23%. On average, analysts expect the EPS of a typical stock to grow at 14.23% per year and the forecast standard deviation is 3.23%.<sup>6</sup>

## 3. Disagreement and time-varying equity premium

### 3.1. Mean reversion of disagreement

To study the relation between disagreement and return, this section begins by analyzing the mean reversion property of disagreement. In the Miller (1977) model, if disagreement does not vary, it has only a level effect on prices but does not generate time-varying expected returns. Therefore, this section runs the following regression:

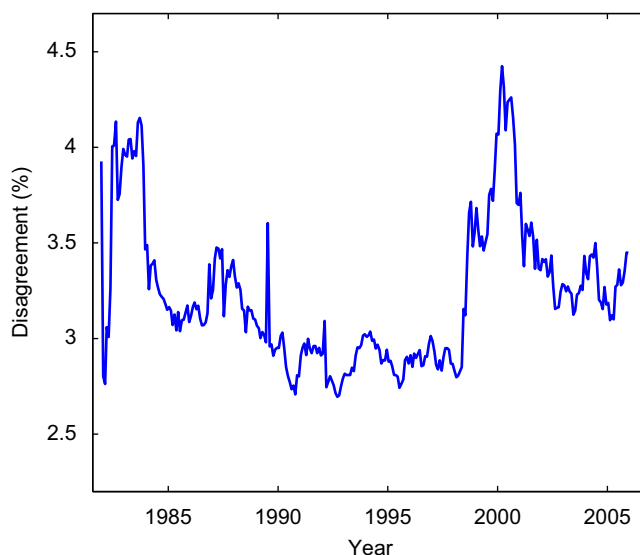
$$\sigma_t = \alpha + \beta \cdot \sigma_{t-lag} + \varepsilon_t \quad (2)$$

The lag ranges from one month to three years. The results are reported in Table 2. Disagreement is positively auto-correlated. At the one-month lag, the auto-correlation

<sup>5</sup> Diether, Malloy, and Scherbina (2002) find that the I/B/E/S summary file closely tracks the summary statistics constructed from the I/B/E/S detailed file.  $\mu_{i,t}$  and  $\sigma_{i,t}$  are winsorized at 1% and 99% levels to account for potential outliers or data errors. Due to the large number of firms involved in the data construction, the result is insensitive to winsorizing. The pairwise correlation between winsorized and non-winsorized disagreement is 0.982 for the market portfolio and the results in this paper are essentially the same using the non-winsorized variables.

<sup>6</sup> It is shown that analyst forecasts may be biased (e.g., De Bondt and Thaler, 1990; Chan, Karceski, and Lakonishok, 2003). But it is unclear that a bias in the mean will affect the forecast standard deviation and its time-series variation in a systematic way. As shown in La Porta (1996), I/B/E/S coverage is tilted towards big stocks, though the performance of stocks in I/B/E/S is not statistically different from stocks in CRSP. The lack of small stock coverage in I/B/E/S has minimal impact on  $\sigma$  because of value weight.

<sup>4</sup> The effect from disagreement complements the finding in Campbell, Polk, and Vuolteenaho (2010) that some of the cross-sectional variations in stock return sensitivity to discount-rate news are associated with the cross-sectional variations in the sensitivity of the stock fundamental to discount-rate news.



**Fig. 1.** Time series of disagreement. This figure plots the monthly disagreement  $\sigma$ , which is the cross-sectional value-weighted average of analyst forecast standard deviations of long-term EPS growth rate. The sample period is December 1981–December 2005.

**Table 1**

Summary statistics.

Panel A reports summary statistics for  $\sigma$  and  $\mu$ .  $\sigma$  ( $\mu$ ) is the cross-sectional value-weighted average of analyst forecast standard deviation (average forecast) of individual-stock long-term EPS growth rate. The analysts' forecast standard deviations and average forecasts are winsorized at the 1% and 99% levels to construct  $\sigma$  and  $\mu$ .  $\sigma$  and  $\mu$  are in percentages. Panel B reports summary statistics for various portfolio returns.  $R_{t,t+h}^M$  is the market return measured by the CRSP value-weighted return (including distributions) in excess of linked one-month T-bill rate from month  $t$  to  $t+h$ .  $N^{DR}$  and  $N^{CF}$  are the discount-rate and cash-flow news from the return decomposition in Campbell and Vuolteenaho (2004). For each variable, the sample period, number of observations (# obs), time-series average (avg), standard deviation (std dev), minimum (min), and maximum (max) are reported.

	Sample period $t$	# Obs	Avg	Std dev	Min	Max
<i>Panel A: Proxies of beliefs (%)</i>						
$\sigma_t$	1981.12–2005.12	289	3.23	0.38	2.70	4.42
$\mu_t$	1981.12–2005.12	289	14.23	1.76	12.37	20.82
<i>Panel B: Market portfolio return (<math>\times 100</math>)</i>						
$R_{t,t+1}^M$	1981.12–2005.12	289	0.68	4.41	–23.13	12.43
$R_{t,t+6}^M$	1981.12–2005.12	289	4.37	11.09	–27.97	37.60
$R_{t,t+12}^M$	1981.12–2005.12	289	9.17	16.32	–34.71	58.36
$R_{t,t+24}^M$	1981.12–2004.12	277	18.64	23.60	–48.73	65.59
$R_{t,t+36}^M$	1981.12–2003.12	265	30.93	33.16	–52.48	106.04
$N_{t-1,t}^{DR}$	1981.12–2001.12	241	–0.42	4.83	–17.20	21.18
$N_{t-1,t}^{CF}$	1981.12–2001.12	241	–0.13	2.21	–10.55	5.48

coefficient is 0.93 and highly statistically significant. The auto-correlation gradually decays over longer lags. The speed of decay is roughly in line with an autoregressive model with order one (AR(1)).<sup>7</sup> At the one-year horizon, the regression slope is 0.54, which implies that the half-life of a shock to disagreement is about one year. The slope estimate is close to zero at the three-year horizon, at which point shocks to disagreement have largely reverted. Also reported in Table 2 is the mean of disagreement implied by the regression estimates (i.e., implied mean =  $\alpha/(1-\beta)$ ). The implied mean is around 3.2%, consistent with the sample average in Table 1.

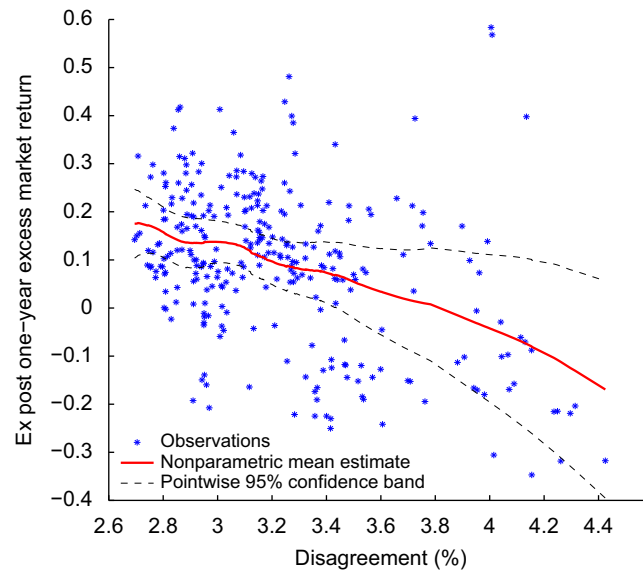
<sup>7</sup> The Bayes information criterion (BIC) also suggests that the autoregressive order of disagreement is one. The BIC result is unreported for brevity.

**Table 2**

Mean reversion of disagreement.

This table reports the regression results of:  $\sigma_t = \alpha + \beta \cdot \sigma_{t-lag} + \varepsilon_t$ , where  $\sigma$  is the cross-sectional value-weighted average of individual-stock disagreements (measured by analyst forecast standard deviations of long-term EPS growth rate). The lag ranges from one month to three years. Also reported is the mean of  $\sigma$  implied by the regression estimates, i.e., implied mean =  $\alpha/(1-\beta)$ . The  $t$ -statistics in parentheses are adjusted for auto-correlation of 36 monthly lags using Newey and West (1987). The sample period is December 1981–December 2005.

	(1)	(2)	(3)	(4)	(5)
Lag (in months)	1	6	12	24	36
$\sigma_{t-lag}$	0.930	0.751	0.540	0.193	0.041
$t$ -stat	(34.40)	(12.04)	(5.96)	(1.46)	(0.24)
Constant	0.225	0.807	1.473	2.556	3.039
$t$ -stat	(2.65)	(3.92)	(4.85)	(5.22)	(4.85)
Implied mean of $\sigma$	3.20	3.24	3.20	3.17	3.17



**Fig. 2.** Disagreement and ex post market return. This figure shows the scatterplot of disagreement  $\sigma$  and ex post one-year CRSP value-weighted market return in excess of the risk-free rate.  $\sigma$  is measured by the cross-sectional value-weighted average of analyst forecast standard deviations of long-term EPS growth rate. Also plotted is a local polynomial nonparametric estimate (Fan and Gijbels, 1996) of the expected ex post one-year excess return conditioning on  $\sigma$  (implemented by the LOWESS procedure in the software package Stata using the default bandwidth). The 95% pointwise confidence band adjusts for the correlation of overlapping annual returns using the Newey and West (1987) standard error with 12 lags. The sample is monthly and spans December 1981–December 2005.

The evidence suggests that disagreement slowly mean-reverts. Only a small fraction of shocks to disagreement decay within one month. Shocks have a half-life of about a year and more than 80% mean-revert in two years. The remaining 20% largely reverts in the third year. This finding indicates that the effect of disagreement on returns is likely stronger for the one- and two-year return horizons, which is confirmed in the subsequent sections.

### 3.2. Disagreement and ex post market return

Monthly data on market returns (NYSE/Amex/Nasdaq value-weighted index returns including distributions), individual-stock returns, and Treasury bill (T-bill) rates from 1981 to the end of 2006 are obtained from CRSP. Let  $R^M$  denote the market return in excess of the T-bill rate. Table 1 shows that  $R^M$  averages to 9.17% per year with a standard deviation of 16.32% in the sample.

Fig. 2 shows a scatterplot of ex post one-year market return against disagreement. A negative relation is visible, which is confirmed by a nonparametric estimate of the expected return conditioning on disagreement. The upper 95% confidence interval for observations with the highest disagreement indicates a 5.64% annual return, which is below the lower 95% confidence interval for the return of observations with the lowest disagreement (10.4% annual return). Observations with low disagreements tend to have positive returns; observations with high disagreements tend to have negative returns (though more volatile). Further, the negative relation between return and disagreement is approximately linear, which motivates the following linear regression:

$$R_{t,t+h}^M = \alpha + \beta \cdot \sigma_t + \varepsilon_t, \quad (3)$$

where  $R_{t,t+h}^M$  is the excess market return from month  $t$  to  $t+h$ .<sup>8</sup> The horizon  $h$  ranges from one month to three years. The results are in Panel A of Table 3. The coefficient of disagreement is negative for all return horizons. Disagreement has the least explanatory power at the one-month horizon, consistent with Table 2 that little disagreement mean-reverts within one month. At the one-year horizon, the coefficient of disagreement is  $-0.174$  and is statistically significant ( $t$ -stat = 2.59). The economic magnitude is large—a one-standard-deviation increase in disagreement is associated with a 6.6% reduction in ex post one-year market return (e.g., 9% to 2.4%). To put the economic magnitude in perspective, the mean and the standard deviation of the one-year market return during the sample period are 9% and 16%, respectively. The effect of disagreement in Panel A roughly doubles going from a one-year to two-year return horizon and further increases slightly for the three-year return horizon. The results are consistent with the mean reversion speed of disagreement.

Next, the regression controls for the expected level of EPS long-term growth rate ( $\mu$ ) and the price-earnings ratio ( $PE$ ),

$$R_{t,t+h}^M = \alpha + \beta \cdot \sigma_t + \gamma \cdot \mu_t + \delta \cdot PE_t + \varepsilon_t. \quad (4)$$

The rationale for these controls is that high disagreement may coexist with expectations of high growth rate and high valuation ratios. Since a measure like  $PE$  is an imperfect indicator of overvaluation, it is useful to see if disagreement provides incremental explanatory power.

<sup>8</sup> All the regressions in this paper have been re-run using raw market return instead of excess return over the risk-free rate. The results are similar and therefore unreported.

**Table 3**

Disagreement and time-varying equity premium.

Panel A reports the regression results of ex post market return in excess of the risk-free rate on  $\sigma$ . Panel B repeats the regression in Panel A, controlling for  $\mu$  and  $PE$  (price-earnings ratio).  $\sigma$  ( $\mu$ ) is the value-weighted average of analyst forecast standard deviation (average forecast) of individual-stock long-term EPS growth rate.  $PE$  is constructed monthly from the S&P composite index and its earnings, both of which are from Robert Shiller's Web site. Panel C repeats the regression in Panel A, controlling for  $PE$  using non-overlapping returns. Panel D reports the Hodrick (1992)  $t$ -statistics for the regression in Panel A except that the market return is in log scale following Hodrick (1992). Panel D also reports the Valkanov (2003)  $t/\sqrt{T}$  statistic and  $p$ -value for the regression  $R$ -square. Panel E regresses one-month ex post excess market return, also in log scale, on lagged  $h$ -month average (denoted  $MA(h)$ ) of  $\sigma$ . Panel E estimates the magnitude of the Stambaugh (1999) bias via a simulation where the "true" coefficients are set to the regression estimates. Panel E reports the  $p$ -value of the lagged average of  $\sigma$  by comparing the  $t$ -statistic in the actual regression to the distribution of the  $t$ -statistics in a second simulation which is identical to the first simulation except that the "true" coefficient is set to zero. Panel E also reports the Campbell and Yogo (2006) Bonferroni  $Q$ -test confidence interval (C.I.) for the lagged average of  $\sigma$ . Panels F and G report the regression results of ex post excess market return on  $\sigma$ , controlling for a host of other variables reviewed in Campbell and Thompson (2008) and Goyal and Welch (2008) that correlate with ex post market return. Panel F controls for these other variables one-by-one. \* / \*\* / \*\*\* indicate statistical significance at the 90%/95%/99% levels. Panel G controls for all of these variables in one regression. The first (second) adjusted  $R$ -square in Panel G is for the regression of ex post market return on all the controls with (without)  $\sigma$ .  $CAY$  is measured quarterly in Panel F and is converted to monthly in Panel G using the last available quarterly observation. The other variables are measured monthly. For brevity, only the coefficient of  $\sigma$  is shown in Panels F and G. The  $t$ -statistics in Panels A–B and F–G are adjusted for auto-correlation using Newey and West (1987), with the number of lags being equal to the return horizons. The  $t$ -statistics in Panels C and E are adjusted for heteroskedasticity (White, 1980). The sample period is December 1981–December 2005.

Return horizon (in months)	1	6	12	24	36
<b>Panel A: Ex post excess market return on disagreement <math>\sigma</math></b>					
$\sigma$	−0.006	−0.061	−0.174	−0.351	−0.443
$t$ -stat	(0.88)	(1.51)	(2.59)	(2.92)	(2.12)
Constant	0.027	0.240	0.654	1.317	1.734
$t$ -stat	(1.21)	(1.94)	(3.16)	(3.48)	(2.70)
Adj $R^2$	−0.1%	4.0%	16.2%	32.8%	27.4%
<b>Panel B: Controlling for expected long-term growth rate <math>\mu</math> and price-earnings ratio <math>PE</math></b>					
$\sigma$	−0.000	−0.041	−0.163	−0.280	−0.335
$t$ -stat	(0.00)	(0.95)	(2.82)	(2.69)	(1.73)
$\mu$	−0.002	−0.003	0.004	−0.017	−0.023
$t$ -stat	(0.65)	(0.29)	(0.24)	(0.53)	(0.44)
$PE$	−0.000	−0.003	−0.007	−0.007	−0.012
$t$ -stat	(1.19)	(1.73)	(2.03)	(1.37)	(1.50)
<b>Panel C: Non-overlapping return regressions</b>					
$\sigma$	−0.004	−0.061	−0.127	−0.281	−0.704
$t$ -stat	(0.58)	(1.23)	(2.06)	(1.92)	(2.68)
$PE$	−0.001	−0.003	−0.005	−0.008	−0.003
$t$ -stat	(1.83)	(1.77)	(1.41)	(1.97)	(0.22)
Number of observations	289	49	25	12	8
<b>Panel D: Hodrick (1992) <math>t</math>-statistics and Valkanov (2003) <math>t/\sqrt{T}</math> statistics</b>					
$\sigma$	−0.007	−0.064	−0.174	−0.321	−0.378
Hodrick (1992) $t$ -stat	(0.04)	(1.59)	(2.16)	(2.21)	(2.03)
$t^{OLS}/\sqrt{T}$	−0.057	−0.234	−0.492	−0.770	−0.725
$p$ -value of $t^{OLS}/\sqrt{T}$	0.374	0.112	0.018	0.006	0.018
$R^2$	0.3%	5.2%	19.6%	37.4%	34.6%
$p$ -value of $R^2$	0.327	0.092	0.012	0.004	0.014
<b>Panel E: Non-overlapping return regressions using Hodrick (1992) specification</b>					
$MA(h)$ of $\sigma$	−0.0067	−0.0118	−0.0189	−0.0218	−0.0186
$t$ -stat	(0.96)	(1.59)	(2.40)	(2.40)	(1.81)
Adj $R^2$	0.0%	0.6%	1.9%	2.0%	1.0%
Stambaugh (1999) bias	−0.0008	−0.0011	−0.0013	−0.0023	−0.0028
$p$ -value of $\sigma$	0.350	0.121	0.018	0.019	0.074
<b>Campbell and Yogo (2006) 90% C.I.</b>					
Lower	−0.0165	−0.0247	−0.0310	−0.0349	−0.0338
Upper	0.0070	0.0007	−0.0051	−0.0062	−0.0001
<b>Panel F: Coefficients of disagreement <math>\sigma</math>, controlling one-by-one for other return predictors</b>					
$PE$	−0.004	−0.048	−0.152***	−0.323***	−0.394***
$CAY$ (quarterly)	−0.012	−0.056	−0.166**	−0.285**	−0.233
$DP$	−0.006	−0.058	−0.168***	−0.344***	−0.433***
$SMOOTH$	−0.007	−0.068**	−0.190***	−0.372***	−0.481***
$BM$	−0.006	−0.063*	−0.179***	−0.358***	−0.457***
$SHORTYIELD$	−0.006	−0.064*	−0.185***	−0.361***	−0.467**
$LONGYIELD$	−0.006	−0.064*	−0.184***	−0.366***	−0.472***
$TERMSPREAD$	−0.006	−0.059	−0.169***	−0.337***	−0.419**
$DFSPREAD$	−0.009	−0.085**	−0.226***	−0.402***	−0.523***
$INFLATION$	−0.006	−0.061	−0.173***	−0.350***	−0.441**
$EQUITYSHARE$	−0.006	−0.074**	−0.207***	−0.415***	−0.572***

Table 3 (continued)

Return horizon (in months)	1	6	12	24	36
<i>Panel G: Coefficients of disagreement <math>\sigma</math>, controlling for other return predictors together</i>					
$\sigma$	0.004	-0.064	-0.261	-0.438	-0.412
t-stat	(0.45)	(1.66)	(6.27)	(7.56)	(6.72)
All other variables	...	...	...	...	...
Adj $R^2$	4.1%	22.1%	38.9%	58.6%	65.4%
Adj $R^2$ without $\sigma$	4.4%	20.1%	21.7%	34.4%	54.3%

The results are shown in Panel B of Table 3. The economic and statistical significances of disagreement remain similar. The level of the expected growth rate has essentially no effect on return, consistent with the explanation that the aggregate market has incorporated the level of expected future growth.<sup>9</sup> The market return is negatively associated with *PE*. The effect of *PE* is statistically significant for the one-year return horizon, and is marginally significant for the other horizons. This raises the question of whether the effect of disagreement is robust to controlling for alternative mechanisms that affect the equity premium. Before investigating this, some econometric issues related to the baseline specification (3) are addressed in Sections 3.3 and 3.4.

### 3.3. Long-horizon return regression

The return horizons in regression (3) range from one month to three years. An econometric issue arises because observations of long-horizon returns overlap, which potentially biases the test towards rejecting the null hypothesis of zero explanatory power (e.g., Richardson and Stock, 1989; Hodrick, 1992). Newey and West (1987) *t*-statistics have been used to account for the overlapping returns. Additional econometric tests are now applied to ensure valid inference.

When the return horizon is  $h$ , the simplest way to avoid overlapping returns is to use only observations sampled at time  $t = 0, h, 2h, 3h, \dots$ . In this case, the return from time 0 to  $h$  does not overlap with the return from time  $h$  to  $2h$ . The result using this simple non-overlapping specification is in Panel C of Table 3, which also controls for *PE*, found earlier to correlate with returns. Returns of all horizons remain negatively correlated with disagreement and the relation is statistically significant for the one- to three-year horizons. However, this simple non-overlapping specification is not ideal. The problem is that very few observations are left in the long-horizon regressions and the inference depends on the small sample performance of the asymptotic distribution. This problem results from a loss of information in the simple specification. Because only observations at time  $0, h, 2h, \dots$  are used, in-between information on disagreement is discarded. Two methods are used to address this problem. The first method, studied in the rest of this section, uses the overlapping return specification in (3) but applies asymptotic distributions in

Hodrick (1992) and Valkanov (2003) that are specifically designed for the overlapping regression setup. The second method, studied in Section 3.4, uses a non-overlapping return specification in Hodrick (1992) that does not result in a loss of information.

Following Hodrick (1992) and Valkanov (2003), the rest of this section and Section 3.4 use log excess return (denoted by lower case  $r^M$ ) as dependent variable although similar results are obtained using simple excess return  $R^M$ .<sup>10</sup> Panel D of Table 3 shows the results using the standard error in Hodrick (1992, Eq. (8)), which is shown by Ang and Bekaert (2007) to perform well in small samples. The statistical significance is consistent with that from the Newey and West (1987) standard error in Panel A.

Valkanov (2003) constructs a  $t/\sqrt{T}$  test statistic from dividing the ordinary least squares (OLS) *t*-statistic by the square root of the sample length. The test allows for persistent right-hand-side regressors. Valkanov (2003) provides asymptotic distributions for the  $t/\sqrt{T}$  statistic and for the OLS *R*-square. The results are shown in Panel D of Table 3.<sup>11</sup> The negative relation between disagreement and ex post market return is statistically significant for all return horizons of one to three years. Under the null hypothesis of no effect from disagreement, the probability of observing the high regression *R*-square by chance is less than 2%.

### 3.4. Non-overlapping return regression

This section uses an alternative specification that uses non-overlapping returns and involves no loss of information. Specifically, Hodrick (1992) suggests the following specification:

$$r_{t,t+h}^M = \alpha + \beta \cdot \left( h^{-1} \sum_{\tau=0}^{h-1} \sigma_{t-\tau} \right) + \varepsilon_t, \quad (5)$$

which regresses the one-month return on the lagged  $h$ -month average of disagreement.<sup>12</sup> The regression results are in Panel E of Table 3. There is a negative

<sup>10</sup> The log excess market return is defined as  $\log(1 + \text{market return}) - \log(1 + \text{T-bill return})$ , which is the log market return when T-bill instead of cash is used as numeraire.

<sup>11</sup> The asymptotic distributions in Valkanov (2003) can be obtained by simulation and depend on a nuisance parameter  $c$ . Following Valkanov (2003),  $c$  is set to  $-19.41$  using the procedure in Stock (1991). The other parameters used in the Valkanov (2003) test are  $\delta = 0.1619$ , number of simulation sample paths = 10,000, and the step size in discretizing the continuous-time stochastic processes =  $1/10,000$ .

<sup>12</sup> The intuition is that the slope coefficient of regressing  $h$ -horizon return  $r_{t,t+h}^M$  on disagreement  $\sigma_t$  is derived from  $\text{cov}(r_{t,t+h}^M, \sigma_t) = \text{cov}(r_{t,t+h}^M, r_{t,t+h}^M + r_{t+1,t+h}^M + \dots + r_{t+h-1,t+h}^M, \sigma_t)$  which, for stationary series, is equivalent to  $\text{cov}(r_{t,t+h}^M, \sigma_t + \sigma_{t-1} + \dots + \sigma_{t-h+1})$ .

<sup>9</sup> This time-series result differs but is not inconsistent with the cross-sectional result in La Porta (1996), who finds that stocks with rosy analyst expectations tend to do poorly afterwards.

relation between disagreement and ex post return and the effect is stronger using the lagged one-year or two-year average of disagreement. The adjusted  $R$ -squares are lower than those in Panel A because the dependent variable is the one-month return.

Stambaugh (1999) discusses a regression bias that arises when return is regressed on a lagged regressor and innovations to the regressor and return are correlated. Unlike dividend yield studied in Stambaugh (1999), disagreement does not mechanically relate to the market return. Nonetheless, a simulation is conducted in Panel E of Table 3 to measure the potential magnitude of the bias.<sup>13</sup> The bias is small relative to the actual estimate (e.g., the estimated bias is  $-0.0013$  compared to the coefficient of  $-0.0189$  in the actual one-year regression). This panel also shows the  $p$ -value for the null hypothesis that disagreement has no effect by comparing the  $t$ -statistic in the actual regression (5) to the percentiles of the  $t$ -statistics in a second simulation.<sup>14</sup> The  $p$ -value from simulation is consistent with the  $t$ -statistic in the actual regression.

Panel E of Table 3 further constructs a Campbell and Yogo (2006) Bonferroni  $Q$ -test confidence interval for the coefficient of disagreement in (5). The test is motivated by the uniformly most powerful test and allows broad dynamics of the regressor (e.g., a finite-order autoregressive process with the largest root less than, equal to, or even greater than one). Only 90% confidence intervals are shown because Campbell and Yogo (2005, 2006) tabulate for one-sided tests of 5%  $p$ -value.<sup>15</sup> The confidence intervals are consistent with the  $t$ -statistics in Panel E.<sup>16</sup>

### 3.5. Alternative hypotheses

Motivated by the finding in (4), this section studies whether the effect of disagreement is driven by alternative mechanisms that affect the equity premium. Specifically, this section controls for a host of other variables that correlate

with ex post market return, which are reviewed in Campbell and Thompson (2008) and Goyal and Welch (2008). These variables include the price-earnings ratio  $PE$ , consumption-wealth ratio  $CAY$ , dividend-price ratio  $DP$ , smoothed earnings-price ratio  $SMOOTHPE$ , book-to-market ratio  $BM$ , short-term interest rate  $SHORTYIELD$ , long-term bond yield  $LONGYIELD$ , the term spread between long- and short-term Treasury yields  $TERMSPREAD$ , the default spread between corporate and Treasury bond yields  $DFSPREAD$ , the lagged rate of inflation  $INFLATION$ , and the equity share of new issues  $EQUITYSHARE$ .<sup>17</sup> Quarterly data on  $CAY$  are obtained from Martin Lettau's Web site. Monthly data for the other variables can be obtained from the Web site of Amit Goyal.

First, these variables are added one-by-one into regression (3). The regressions are monthly except for  $CAY$  (quarterly). Panel F of Table 3 shows the results. The coefficients of disagreement are negative across the return horizons and the additional control variables.<sup>18</sup> The estimates are in line with those in Panel A of Table 3 and are statistically significant for all regressions involving the one- and two-year return horizons and for most three-year regressions.

Next, all of the control variables are added into the regression.<sup>19</sup>

$$R_{t,t+h}^M = \beta_0 + \beta_1 \cdot \sigma_t + \beta_2 \cdot PE_t + \beta_3 \cdot CAY_t + \beta_4 \cdot DP_t + \beta_5 \cdot SMOOTHPE_t + \beta_6 \cdot BM_t + \beta_7 \cdot LONGYIELD_t + \beta_8 \cdot TERMSPREAD_t + \beta_9 \cdot DFSPREAD_t + \beta_{10} \cdot INFLATION_t + \beta_{11} \cdot EQUITYSHARE_t + \varepsilon_t. \quad (6)$$

The results are in Panel G of Table 3. The coefficient of interest is  $\beta_1$ . It remains statistically and economically significant at the one-year to three-year horizons. Panel G provides two adjusted  $R$ -squares. The first  $R$ -square is for the regression specification (6). The second  $R$ -square is for a regression that is otherwise identical to (6) except that disagreement is omitted. Due to the econometric issues associated with overlapping regressions (see Section 3.3), these  $R$ -squares cannot be compared across different return horizons. Instead, they illustrate, for a given return horizon, the effect of adding one extra regressor of disagreement. This also applies to the other tables in this paper that use overlapping regressions. In Panel G of Table 3, there is substantial improvement in regression fit when disagreement is included. For example, when including all the

<sup>13</sup> The simulation is similar to those in Kothari and Shanken (1997), Lewellen (2004), and Ang and Bekaert (2007). In the simulation, the "true" coefficients are set to the estimates of (5). Disagreement is assumed to follow an AR(1) process with coefficients given by column 1 of Table 2. The error terms are drawn with replacement from the joint empirical distribution of the two residuals in the regression (5) and in the regression in column 1 of Table 2. 10,000 simulated samples are drawn. The bias is measured by the difference between the average simulation estimate of disagreement in regression (5) and the "true" coefficient.

<sup>14</sup> This second simulation is identical to the first simulation except that the "true" coefficient is set to zero.

<sup>15</sup> Following Campbell and Yogo (2005), the autoregressive order of the regressor is determined by the Bayes information criterion when computing the confidence interval.

<sup>16</sup> The intuition for why the  $t$ -statistics perform well is that the disagreement does not mechanically relate to returns. For example, in the one-year regression, the Campbell and Yogo (2006)  $\delta$  (defined as the correlation between innovations to return and innovations to disagreement) is only 0.165. This contrasts with the dividend-price ratio, which has close to perfect correlation with return (Campbell and Yogo, 2006, Table 4). According to Campbell and Yogo (2006, Table 1), with such a low  $\delta$ , the conventional  $t$ -statistics are valid unless the auto-correlation coefficient of disagreement is above 0.993. From column 1 of Table 2 in this paper, the actual auto-correlation in the sample is only 0.93.

<sup>17</sup> A partial list of references for these variables includes Rozeff (1984), Fama and French (1988a), and Campbell and Shiller (1988, 1989) on the dividend-price ratio, the earnings-price ratio and its smoothed version; Kothari and Shanken (1997) and Pontiff and Schall (1998) on the book-to-market ratio; Keim and Stambaugh (1986), Campbell (1987), Fama and French (1989), and Hodrick (1992) on interest rates of Treasury and corporate debt securities; Fama and Schwert (1977) and Fama (1981) on inflation; Baker and Wurgler (2000) on the equity share of new issues; Lettau and Ludvigson (2001) on the level of consumption in relation to wealth.

<sup>18</sup> The coefficients of the other control variables are in line with earlier studies. Judging by the regression  $R$ -square in a separate univariate regression of market return on these control variables one-by-one, price-earnings ratio has the most explanatory power in the sample followed by dividend-price ratio. These results are unreported for brevity.

<sup>19</sup> In this regression,  $CAY$  is converted into monthly data using the last available quarterly value.  $SHORTYIELD$  is omitted because of multicollinearity with  $LONGYIELD$  and  $TERMSPREAD$ .

**Table 4**

Compare top-down and bottom-up disagreement measures.

Panel A reports the pairwise correlation coefficients among  $\sigma_{TD}$ ,  $\sigma_{ANN}^{NG}$ , and  $\sigma^{NG}$ .  $\sigma_{TD}$  is the disagreement measured top-down by the analyst forecast standard deviation of S&P 500 earnings scaled by the most recent realized S&P 500 earnings.  $\sigma^{NG}$  ( $\sigma_{ANN}^{NG}$ ) is measured bottom-up as the cross-sectional value-weighted average of analyst forecast standard deviation of individual-stock long-term EPS growth rate (individual-stock annual EPS), using only firms that issue no quarterly or annual guidelines. Panels B, C, D, and E report the regression results of ex post S&P 500 returns in excess of the risk-free rate on  $\sigma_{TD}$ ,  $\sigma_{ANN}^{NG}$ ,  $\sigma^{NG}$ , and all three disagreement measures together, respectively. The *t*-statistics are adjusted for auto-correlation using Newey and West (1987), with the number of lags being equal to the return horizons. The sample period is January 1982–July 2001.

Panel A: Correlation matrix					
	$\sigma_{TD}$	$\sigma_{ANN}^{NG}$	$\sigma^{NG}$		
$\sigma_{TD}$	1				
$\sigma_{ANN}^{NG}$	0.447	1			
$\sigma^{NG}$	0.270	0.381	1		
Return horizon (in months)	1	6	12	24	36
Panel B: Ex post market return on top-down disagreement measure					
$\sigma_{TD}$	-0.227	-0.921	-1.703	-4.942	-6.238
<i>t</i> -stat	(1.51)	(1.88)	(2.27)	(3.42)	(2.55)
Adj <i>R</i> <sup>2</sup>	0.6%	2.5%	4.2%	14.1%	11.3%
Panel C: Ex post market return on bottom-up disagreement measure from annual EPS forecasts					
$\sigma_{ANN}^{NG}$	-0.495	-3.748	-6.892	-14.594	-17.255
<i>t</i> -stat	(2.02)	(4.52)	(4.05)	(5.27)	(3.56)
Adj <i>R</i> <sup>2</sup>	1.2%	15.6%	24.3%	41.2%	29.3%
Panel D: Ex post market return on bottom-up disagreement measure from long-term forecasts					
$\sigma^{NG}$	-0.001	-0.052	-0.157	-0.319	-0.407
<i>t</i> -stat	(0.26)	(2.25)	(5.02)	(5.67)	(4.55)
Adj <i>R</i> <sup>2</sup>	-0.4%	6.1%	27.2%	42.1%	35.0%
Panel E: Ex post market return on all three disagreement measures					
$\sigma_{ANN}^{NG}$	-0.509	-3.428	-4.702	-8.852	-9.284
<i>t</i> -stat	(1.54)	(3.16)	(2.63)	(4.72)	(1.67)
$\sigma^{NG}$	0.004	-0.018	-0.108	-0.224	-0.308
<i>t</i> -stat	(0.64)	(0.84)	(3.46)	(6.26)	(4.14)
$\sigma_{TD}$	-0.125	0.082	0.259	-1.103	-1.699
<i>t</i> -stat	(0.70)	(0.16)	(0.39)	(1.05)	(1.19)

controls but no disagreement, the *R*-square in the one-year regression is 21.7% compared to 38.9% when disagreement is added. The two- and three-year results are similar. Substantial improvement in *R*-square when disagreement is added is similarly observed in the regressions in Panel F of Table 3 where the other control variables are included one-by-one. These results are unreported for brevity.

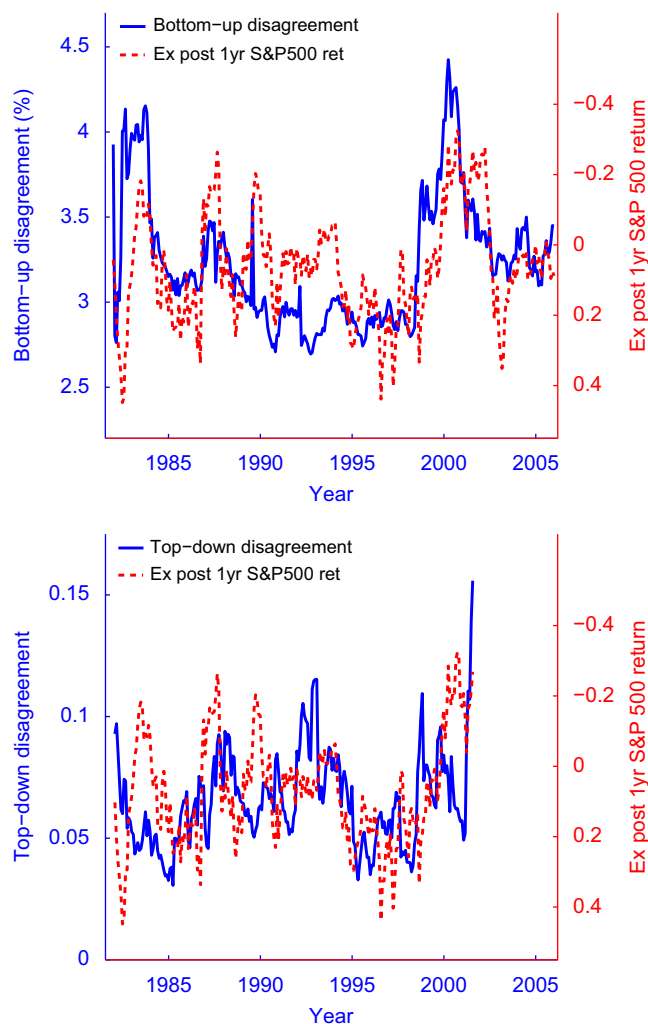
#### 4. Compare bottom-up and top-down disagreement measures

This paper constructs portfolio disagreement bottom-up using individual-stock disagreements. Park (2005) measures disagreement of the market portfolio top-down using analyst forecasts of S&P 500 earnings. This section compares these disagreement measures. Specifically, Park (2005) takes the I/B/E/S analyst forecasts of annual S&P 500 earnings and uses the forecast standard deviation scaled by the most recent realized S&P 500 earnings to measure market disagreement. To prevent the mechanical drop in dispersion of annual forecasts as the fiscal year-end becomes closer, Park (2005) uses a rolling measure of disagreement—disagreement in December of year *y*–1, January and February of year *y* is set to the forecast dispersion for the fiscal year *y* while disagreement in March to November of

year *y* is set to a weighted average of the forecast dispersions for the fiscal years *y* and *y*+1 (the weight for year *y*+1 increases linearly from 3/12 in March to 11/12 in November). This section constructs the top-down measure in the same way and denotes it  $\sigma_{TD}$ .<sup>20</sup> Panel B of Table 4 shows the regression results of ex post S&P 500 return in excess of the risk-free rate on the top-down disagreement  $\sigma_{TD}$ . The regression covers January 1982–July 2001, the sample period in Park (2005).<sup>21</sup> There is a negative relation between S&P 500 return and disagreement, confirming Park

<sup>20</sup> Analyst forecast standard deviation of the S&P 500 earnings for the second nearest fiscal year is missing for three months in the early part of the sample period, due to insufficient analyst coverage. It is unclear how Park (2005) incorporates the missing data in the rolling measure of market disagreement. The current section sets these three observations of market disagreement to missing. Nonetheless, the regression results are similar to those reported in Park (2005).

<sup>21</sup> The  $\sigma_{TD}$  series is not extended further beyond July 2001 because analysts switched to forecasting S&P 500 operating EPS instead of reported EPS shortly afterwards. This paper has also tried several methods to link the dispersion series from reported EPS and the dispersion series from operating EPS, including linking the two raw series directly, adding or multiplying a constant to the raw series to remove the discontinuities at the link point, and varying the time of the link point. The results are similar, and the bottom-up disagreement still performs better.



**Fig. 3.** Compare top-down and bottom-up disagreement measures. The first plot shows the time series of bottom-up disagreement  $\sigma$  and ex post one-year S&P 500 return in excess of the risk-free rate.  $\sigma$  is the cross-sectional value-weighted average of analyst forecast standard deviations of long-term EPS growth rate. For each month  $t$ , the plot shows the disagreement  $\sigma_t$  and the ex post S&P 500 return from  $t$  to  $t+12$ . To facilitate comparison, the S&P 500 return is plotted upside down. The sample period is December 1981–December 2005. The second plot shows the same ex post one-year S&P 500 excess return against the top-down disagreement  $\sigma_{TD}$ , which is measured by the analyst forecast standard deviation of S&P 500 earnings scaled by the most recent realized S&P 500 earnings. The sample period of the second plot is January 1982–July 2001, which is the sample period in Park (2005).

(2005), though the top-down disagreement has less explanatory power than the bottom-up disagreement in Panel A of Table 3.<sup>22</sup> To visualize the correlation between ex post return and the top-down and bottom-up disagreement measures, Fig. 3 shows the time-series plot of ex post one-year excess S&P 500 return alongside each of the two disagreement measures, respectively. Since the correlation is negative, the S&P 500 return is plotted upside down to facilitate comparison. The first plot in Fig. 3 uses the bottom-up disagreement  $\sigma$ . A positive relation between  $\sigma$

and the (inverted) S&P 500 return can be seen. For example, a number of spikes and subsequent drops in the (inverted) return matches the spikes and drops in  $\sigma$  such as those around years 1983, 1987, 1989, the dot-com era, etc. There are many reasons that can potentially affect the equity premium, which may make the plot noisy. Nonetheless, the relation between the bottom-up disagreement and return is visually less noisy than the relation between the top-down disagreement and return shown in the second plot of Fig. 3, confirming the formal regression results.

The disagreement measures  $\sigma$  and  $\sigma_{TD}$  differ in (i)  $\sigma$  is constructed bottom-up while  $\sigma_{TD}$  is constructed top-down; (ii)  $\sigma$  uses forecasts of EPS long-term growth rate while  $\sigma_{TD}$  employs annual EPS forecasts. To see the relative contribution of (i) and (ii), this section constructs a third disagreement measure bottom-up using forecasts of individual-stock annual EPS. Specifically, let  $\sigma_{i,t}^{ANN}$  denote the month  $t$

<sup>22</sup> The result in Panel A of Table 3 is similar (somewhat stronger) when restricted to the sample period of Park (2005). To facilitate comparison, the dependent variable in Table 4 is S&P 500 return used by Park (2005). Nonetheless, the results in this section are similar if CRSP value-weighted return is used. The results are also similar if real S&P 500 return is used instead of S&P 500 return in excess of the risk-free rate.

standard deviation of analyst forecasts of annual EPS for stock  $i$ . To prevent the mechanical drop in forecast standard deviation when the fiscal year-end is near, a weighted average of the nearest and the second nearest fiscal year EPS forecast standard deviations are used to construct  $\sigma_{i,t}^{ANN}$  in the same way as Park (2005) to facilitate comparison. Recall the top-down disagreement  $\sigma_{TD}$  in Park (2005) is S&P 500 forecast dispersion scaled by the most recent S&P 500 EPS. The bottom-up measure of market disagreement using annual EPS forecasts, denoted by  $\sigma_{ANN,t}$ , is constructed by replacing the dispersion in market EPS (the numerator in  $\sigma_{TD}$ ) with  $\sqrt{\sum_i (s_{i,t} \cdot \sigma_{i,t}^{ANN})^2}$ , where  $s_{i,t}$  is the number of shares outstanding for firm  $i$  at time  $t$ .<sup>23</sup> This parallels the top-down measure in Park (2005) except that the disagreement regarding market EPS is inferred bottom-up using individual-stock disagreement over annual EPS. Since  $\sigma_{TD}$  and  $\sigma_{ANN}$  both use annual forecasts, comparing them shows the effect of top-down versus bottom-up approaches. Because  $\sigma_{ANN}$  and  $\sigma$  both use bottom-up construction, comparing them shows the effect of using annual forecasts versus long-term forecasts.

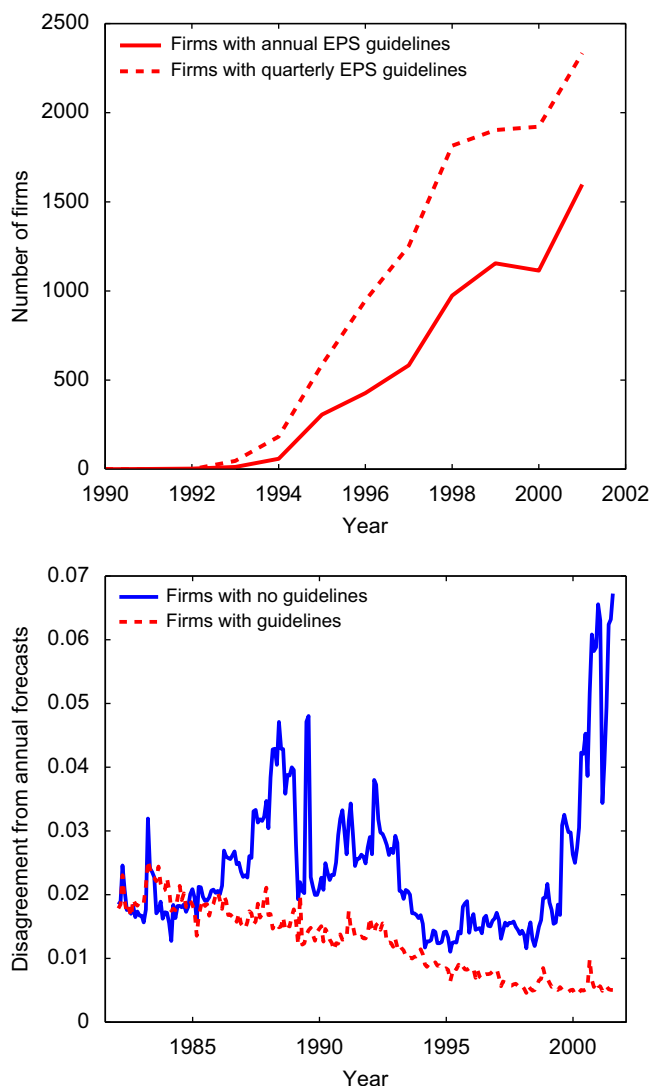
It is important, however, to note the effect of earnings guidance prior to using disagreement measures based on individual-stock annual EPS forecasts. Fig. 4 shows the number of firms issuing annual or quarterly earnings guidelines. The First Call database collects data on company-issued guidelines since August 1990, which may be a subset of actual guidance since companies may have guided prior to 1990 or through channels outside First Call coverage. Nonetheless, there are a lot of observed guidelines. In recent years, there are more than 1,500 firms issuing annual EPS guidelines and over 2,000 firms issuing quarterly EPS guidelines. Such guidelines will likely affect forecast dispersion because low forecast dispersion may reflect superior earnings guidance instead of genuinely low disagreement. To see the effect of guidance, the second plot in Fig. 4 shows the time series of bottom-up disagreement  $\sigma_{ANN}$  from annual EPS forecasts, separately for the set of firms that issue guidelines and for the rest of the firms. The “disagreement” of those firms that guide declines almost monotonically throughout the sample to about half a cent per \$1 earnings near the end of the sample period. Although the guidance of a firm may also be informative for other firms that do not guide (e.g., firms in the same industry), the measured disagreement for firms that do not guide

exhibits substantial fluctuations over time. Therefore, the rest of this section focuses on the bottom-up disagreement constructed from annual EPS forecasts of those firms that issue no earnings guidelines, denoted by  $\sigma_{ANN}^{NG}$ . Although the earnings guidance does not appear to substantially affect the bottom-up disagreement  $\sigma$  constructed from long-term EPS growth rate ( $\sigma$  for firms that guide/do not guide have a correlation of 0.622 and their plots are both similar to Fig. 1), the rest of this section focuses on  $\sigma$  constructed for the set of firms that do not guide, denoted  $\sigma^{NG}$ , for the ease of comparison. The results are similar if  $\sigma$  measured from all firms is used.

Panel A of Table 4 shows that the top-down disagreement  $\sigma_{TD}$  and the two bottom-up measures  $\sigma_{ANN}^{NG}$  and  $\sigma^{NG}$  are positively correlated with the correlation coefficient ranging from 0.270 (between bottom-up  $\sigma^{NG}$  from long-term forecasts and top-down  $\sigma_{TD}$  from annual forecasts) to 0.447 (between  $\sigma_{ANN}^{NG}$  and  $\sigma_{TD}$  which both use annual forecasts). All the correlation coefficients are statistically significant at the 99% level. Panels C and D of Table 4 show the regression results of ex post S&P 500 excess return on  $\sigma_{ANN}^{NG}$  and  $\sigma^{NG}$ , respectively. The ex post returns are negatively related to  $\sigma_{ANN}^{NG}$  and  $\sigma^{NG}$ .  $\sigma_{ANN}^{NG}$  and  $\sigma^{NG}$  have similar explanatory power, though  $\sigma_{ANN}^{NG}$  is somewhat stronger for short-horizon returns while  $\sigma^{NG}$  is stronger at the longer horizons. This is consistent with Panel E of Table 4, which regresses ex post S&P 500 excess return on all three disagreement measures. The top-down measure  $\sigma_{TD}$  is no longer statistically significant. Similar to the univariate regression,  $\sigma_{ANN}^{NG}$  is stronger at the short horizon. Dispersion from annual forecasts may tilt more towards those disagreements that will be resolved sooner (e.g., when the annual report is released) than dispersion from long-term forecasts. Consistently,  $\sigma^{NG}$  affects longer-horizon returns more.

Overall,  $\sigma_{ANN}^{NG}$  and  $\sigma^{NG}$  perform similarly and both perform better than the top-down measure  $\sigma_{TD}$ . This suggests that the improvement comes more from top-down versus bottom-up construction than from annual versus long-term forecasts. Why does the bottom-up approach do better? There are a number of explanations. First, the bottom-up approach likely has a better signal-to-noise ratio. Fig. 5 shows the time-series plots of the number of firms with non-missing stock-level disagreement, along with the average number of analysts following each stock. The sample contains a large number of firms. There are more than 700 stocks in the early part of the sample and around 2,000 stocks towards the end of the sample. The average number of analysts per firm is stable at around five to seven analysts per firm. Therefore, the bottom-up disagreement constructed at any given time uses thousands of forecasts. This is far more than the top-down approach, where, on average, only 23 analysts cover the next year's S&P 500 earnings. Even fewer analysts cover the subsequent years' S&P 500 earnings. There are often more analysts covering a single large stock than the S&P 500. One caveat is that when the bottom-up disagreement is constructed out of annual forecasts, one needs to control for the practice of earnings guidance. Interestingly, the top-down approach does not immediately appear to be affected by earnings guidance—Fig. 3

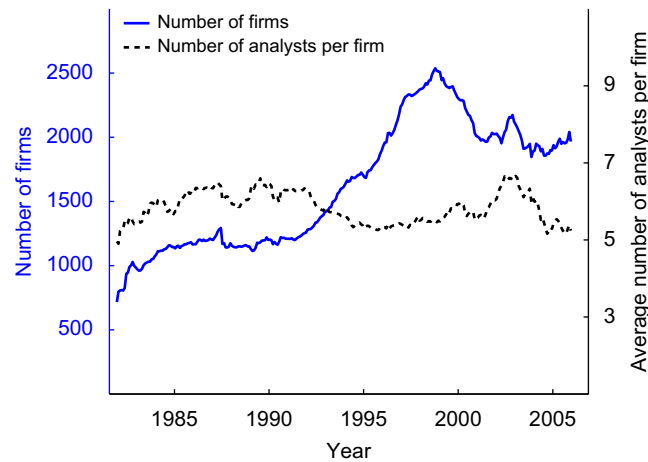
<sup>23</sup> This assumes the forecasts for different firms are uncorrelated because, letting  $x_i$  denote the next annual EPS forecast for firm  $i$ , the forecast variance of market earnings  $\text{Var}(\sum_i s_i x_i) = \sum_i (s_i \sigma_i^{ANN})^2$  if  $x_i$  are uncorrelated with  $x_j$  for  $i \neq j$ . There are likely market- or industry-wide factors that drive the EPS of many firms and generate correlation, but measuring forecast correlation across firms is difficult because an analyst does not usually cover many firms. A random pair of firms often has no analyst covering both firms. However, the result in this section is similar if the bottom-up disagreement  $\sigma_{ANN,t}$  is measured instead by replacing the numerator of  $\sigma_{TD}$  with  $\sum_i s_{i,t} \cdot \sigma_{i,t}^{ANN}$  (which amounts to assuming EPS forecasts for different stocks are perfectly correlated). The bottom-up measures constructed from these two alternative assumptions on forecast correlation have a pairwise correlation coefficient of 0.791. Therefore, forecast correlation across firms does not appear to influence the results in this section.



**Fig. 4.** Earnings guidance and annual forecasts. The first plot shows the time series of the number of firms issuing annual or quarterly EPS guidelines in a given year. The First Call database collects data on company issued guidelines since August 1990. The second plot shows the disagreement measured bottom-up using individual-stock annual EPS forecasts during the sample period January 1982–July 2001, separately for the set of firms that issue guidelines and for the rest of the firms. A firm is considered to issue guidelines as long as it has at least one observation of either annual or quarterly EPS guidelines in the First Call database.

does not show any monotonic drop in top-down disagreement even when Fig. 4 reveals an increasing number of guidelines. This is likely because some market strategists forecast index earnings top-down by treating an index as though it were an individual entity while other analysts forecast bottom-up by averaging EPS forecasts of companies comprising the index. For example, Standard & Poor's Web site provides both types of forecasts for the S&P 500. The presence of top-down index earnings forecasts may make the top-down disagreement less affected by individual firm guidance. The earnings guidance may even lead to apparently larger top-down disagreement if the bottom-up index earnings forecasts are guided away from the top-down index earnings forecasts, which may not represent genuine variations of belief dispersion in the market.

Further, bottom-up and top-down disagreement measures are not identical in theory. For ease of illustration, assume for now that there are  $n$  firms each with a weight of  $1/n$  in the market. Assume an investor's belief regarding firm  $i$ 's earning  $\varepsilon_i$  is random with mean  $\varepsilon$ . This investor's belief regarding the market is  $n^{-1}\sum_i \varepsilon_i \rightarrow \varepsilon$  when there are many firms. This holds by the law of large numbers under fairly general conditions, including but not restricted to the case when  $\varepsilon_i$  is homoskedastic and i.i.d. across firms. In this case, there is no disagreement regarding the market earnings in the top-down sense since all investors believe market earnings to be  $\varepsilon$ . However, there is disagreement measured bottom-up since investors may disagree over individual stocks unless all  $\varepsilon_i$  are degenerate random variables. Therefore, there can be disagreement even if the top-down disagreement measure is zero.



**Fig. 5.** Number of firms and number of analysts. This figure shows the monthly number of firms covered by at least two analysts (left vertical axis) so that forecast standard deviation can be computed, along with the average number of analysts covering each firm (right vertical axis).

On the contrary, if there is no bottom-up disagreement, there is no top-down disagreement (apart from measurement errors). Mathematically, the bottom-up disagreement differs from the top-down disagreement because the average of the standard deviation (i.e., the average of individual-stock disagreement) differs from the standard deviation of the average (i.e., the disagreement over the market). If investors focus on picking individual stocks, as suggested by the analysts' focus on individual stocks, the bottom-up disagreement likely reflects the belief dispersion better than the top-down disagreement measures.

This section shows that the choice between annual EPS forecasts and long-term EPS forecasts is less important. Nonetheless, this paper features bottom-up disagreement constructed from long-term forecasts in the discussion. As discussed previously, long-term forecasts face less complication introduced by the annual and quarterly earnings guidelines.<sup>24</sup> Standard deviation from annual EPS forecasts requires scaling, which may introduce variations unrelated to disagreement (Qu, Starks, and Yan, 2004; Cen, Wei, and Zhang, 2007). As pointed out by Moeller, Schlingemann, and Stulz (2007), because the long-term forecast is an expected growth rate, it is directly comparable across firms or across time.

##### 5. Disagreement, discount rate, and time-varying value premium

An important pillar of the Miller (1977) model is the positive *contemporaneous* correlation between portfolio return and shocks to disagreement. That is, price becomes

higher when there is more disagreement, which is the source of the low ex post return. Campbell and Shiller (1989) decompose return into discount-rate news and cash-flow news, which have distinct implications for asset pricing. A number of studies have relied on the discount-rate variation to address asset-pricing challenges. For example, Fama and French (1988a), Campbell and Shiller (1989), and Campbell and Vuolteenaho (2004) use the discount-rate effect to address the time-varying equity premium and the value premium. However, it is unclear what drives the variations in discount rate. Does variation in disagreement correlate contemporaneously with discount-rate news or cash-flow news? This is studied in the following regression:

$$\sigma_t - \sigma_{t-h} = \alpha + \beta \cdot N_{t-h,t}^{DR} + \gamma \cdot N_{t-h,t}^{CF} + \varepsilon_t, \quad (7)$$

where  $\sigma$  is the market disagreement measured bottom-up in (1). Monthly data on discount-rate news  $N^{DR}$  and cash-flow news  $N^{CF}$  are obtained from the return decomposition in Campbell and Vuolteenaho (2004) (data are downloaded from the Web site of the *American Economic Review*). The sample period for the discount-rate and cash-flow news is 1981 to the end of 2001.  $N_{t-h,t}^{DR}$  ( $N_{t-h,t}^{CF}$ ) is the discount-rate news (cash-flow news) from month  $t-h$  to  $t$ , constructed as the sum of the monthly discount-rate news  $N_{t-h,t-h+1}^{DR}, \dots, N_{t-1,t}^{DR}$  (monthly cash-flow news  $N_{t-h,t-h+1}^{CF}, \dots, N_{t-1,t}^{CF}$ ).  $h$  ranges from six months to three years.<sup>25</sup> The regression results are presented in Panel A of Table 5. An increase in disagreement is associated with a contemporaneous drop in the discount rate. The relation is statistically significant for all horizons. In contrast, the

<sup>24</sup> Specifically,  $\sigma_{ANN}^{NG}$  identifies firm guidance using information in the entire First Call sample. If a firm's decision to guide does not depend on market return, this will not bias the return regressions. Alternatively, this paper has identified firm guidance using only a firm's past guidance information. The return regression results are still statistically significant but less so compared to using  $\sigma_{ANN}^{NG}$  (e.g., the  $t$ -stat in the one-year return regression is 1.97 compared to 4.05 in Panel C of Table 4). A firm that prefers to guide may do so via a channel not covered by First Call or before First Call initiates coverage, which can introduce more noise when guidance is measured with less information.

<sup>25</sup> The one-month horizon is excluded because, at this frequency, the measured change in disagreement does not entirely coincide with the return. This is because analyst disagreement is measured using the latest available forecasts prior to the month-end and the return is measured using prices at the month-end. This issue is less pronounced for longer horizons. Nonetheless, the regression has been repeated for the one-month horizon and the result is similar. This result is unreported for brevity.

**Table 5**

Disagreement and time-varying value premium.

Panel A reports the regression results of  $\sigma_t - \sigma_{t-h} = \alpha + \beta \cdot N_{t-h,t}^{DR} + \gamma \cdot N_{t-h,t}^{CF} + \varepsilon_t$ , where  $\sigma$  is the cross-sectional value-weighted average of analyst forecast standard deviation of individual-stock long-term EPS growth rate.  $N_{t-h,t}^{DR}$  ( $N_{t-h,t}^{CF}$ ) is the discount-rate news (cash-flow news) from month  $t-h$  to  $t$  constructed as the sum of the monthly discount-rate news (cash-flow news) from the return decomposition in Campbell and Vuolteenaho (2004). Panel B regresses the value-weighted portfolio returns (in excess of the risk-free rate) of low or high book-to-market stocks (denoted by  $R^L$  or  $R^H$ , respectively) from month  $t-h$  to  $t$  on contemporaneous changes of  $\sigma$ :  $R_{t-h,t}^L$  (or  $R_{t-h,t}^H$ ) =  $\alpha + \beta \cdot (\sigma_t - \sigma_{t-h}) + \varepsilon_t$ . Panel C regresses ex post returns  $R^L$  or  $R^H$  on  $\sigma$ :  $R_{t,t+h}^L$  (or  $R_{t,t+h}^H$ ) =  $\alpha + \beta \cdot \sigma_t + \varepsilon_t$ . Panel D regresses ex post Fama and French (1993) HML (high-minus-low book-to-market portfolio) returns on  $\sigma$ :  $HML_{t,t+h} = \alpha + \beta \cdot \sigma_t + \varepsilon_t$ , where  $HML_{t,t+h}$  is the linked monthly HML return from month  $t$  to  $t+h$ . The HML returns are downloaded from Kenneth French's Web site. Panel E repeats the regression in Panel D, controlling for  $LOGBM_H - LOGBM_L$ .  $LOGBM_H$  (or  $LOGBM_L$ ) is the log of the value-weighted book-to-market ratio for the value (or growth) stock portfolio. The  $t$ -statistics are from Newey and West (1987) with  $h$  lags. The sample period is December 1981–December 2005.

$h$	6	12	24	36	
<i>Panel A: Disagreement <math>\sigma</math> and discount-rate news</i>					
$N_{t-h,t}^{DR}$	-0.926	-1.419	-1.253	-1.094	
$t$ -stat	(2.91)	(4.54)	(3.07)	(3.19)	
$N_{t-h,t}^{CF}$	-1.476	-0.268	0.665	1.294	
$t$ -stat	(1.81)	(0.30)	(0.80)	(1.47)	
<i>Panel B: Contemporaneous book-to-market portfolio returns on changes in <math>\sigma</math></i>					
Low B/M stocks					
$\sigma_t - \sigma_{t-h}$	0.151	0.298	0.373	0.495	
$t$ -stat	(2.65)	(6.23)	(4.55)	(4.60)	
High B/M stocks					
$\sigma_t - \sigma_{t-h}$	0.001	0.063	0.021	0.083	
$t$ -stat	(0.01)	(0.88)	(0.20)	(0.57)	
Return horizon (in months)	1	6	12	24	36
<i>Panel C: Ex post book-to-market portfolio returns on <math>\sigma</math></i>					
Low B/M stocks					
$\sigma$	-0.008	-0.080	-0.215	-0.450	-0.608
$t$ -stat	(1.05)	(1.81)	(3.07)	(3.72)	(2.88)
Adj $R^2$	0.0%	5.9%	20.8%	39.3%	37.3%
High B/M stocks					
$\sigma$	0.002	-0.008	-0.068	-0.160	-0.240
$t$ -stat	(0.32)	(0.24)	(1.29)	(2.53)	(1.87)
Adj $R^2$	-0.3%	-0.3%	2.2%	7.7%	9.5%
<i>Panel D: Ex post HML returns on <math>\sigma</math></i>					
$\sigma$	0.008	0.070	0.178	0.315	0.335
$t$ -stat	(1.08)	(1.63)	(2.39)	(3.40)	(3.61)
Constant	-0.021	-0.200	-0.519	-0.904	-0.927
$t$ -stat	(0.92)	(1.51)	(2.22)	(2.93)	(2.99)
Adj $R^2$	0.5%	8.2%	22.3%	34.0%	36.9%
<i>Panel E: Ex post HML returns on <math>\sigma</math>, controlling for the difference in book-to-market ratios</i>					
$\sigma$	0.005	0.057	0.157	0.284	0.294
$t$ -stat	(0.81)	(1.57)	(2.47)	(3.59)	(3.72)
$LOGBM_H - LOGBM_L$	0.014	0.073	0.118	0.169	0.223
$t$ -stat	(1.48)	(1.38)	(1.56)	(1.52)	(2.59)
Adj $R^2$	1.3%	11.3%	25.8%	37.4%	42.8%

estimates for cash-flow news flip signs depending on the horizon and none of them are statistically significant.

Campbell and Vuolteenaho (2004) find empirically that growth stocks have higher discount-rate beta than value stocks after the 1960s. This, together with the finding in regression (7), suggests that the growth and value stock returns may have different sensitivities to contemporaneous variations in disagreement. This prediction is tested below. Following Fama and French (1993), growth and value portfolios are formed at the end of June each year. Growth/value stocks are defined as those with the lowest/highest 30% book-to-market ratio using NYSE breakpoints. Book-to-market ratios are constructed as in Daniel and Titman (2006) and firms

with negative book values are excluded. Let  $R_{t-h,t}^L$  (or  $R_{t-h,t}^H$ ) denote the value-weighted portfolio returns of low (or high) book-to-market stocks from month  $t-h$  to  $t$  in excess of the linked one-month T-bill rate. The following time-series regression is run separately for growth and value portfolios:

$$R_{t-h,t}^L \text{ (or } R_{t-h,t}^H) = \alpha + \beta \cdot (\sigma_t - \sigma_{t-h}) + \varepsilon_t.$$

The return horizon  $h$  ranges from six month to three years. The results are in Panel B of Table 5. Contemporaneously, growth stock returns are positively correlated with shocks to disagreement. The correlation is statistically significant for all return horizons. In contrast,

the correlations for value stocks, though positive, are smaller and less statistically significant.<sup>26</sup>

Having found that growth stocks go up more when disagreement is on the way up, then when disagreement reaches a peak and subsequently mean-reverts, the same sensitivity implies growth stocks go down more than value stocks (i.e., the negative relation between disagreement and *ex post* return should be stronger for growth stocks than for value stocks). To examine this, *ex post* growth (value) portfolio returns are regressed on disagreement:

$$R_{t,t+h}^L \text{ (or } R_{t,t+h}^H) = \alpha + \beta \cdot \sigma_t + \varepsilon_t. \quad (8)$$

Panel C of Table 5 shows the results. Consistent with the prediction, both growth and value stock returns correlate negatively with disagreement, and the effect is stronger for growth stocks. A one-standard-deviation increase in disagreement is associated with a reduction in *ex post* one-year growth (value) stock return by 8.17% (2.58%).

The difference in growth/value stocks' sensitivities to disagreement implies that disagreement has explanatory power for the time-series variations in the Fama and French (1993) HML (high-minus-low book-to-market portfolio) return. To test this prediction, the HML returns (downloaded from Kenneth French's Web site) are regressed on disagreement:

$$HML_{t,t+h} = \alpha + \beta \cdot \sigma_t + \varepsilon_t, \quad (9)$$

where  $HML_{t,t+h}$  refers to the linked HML return from month  $t$  to  $t+h$ . The results are presented in Panel D of Table 5. The coefficient of disagreement is positive and statistically significant for return horizons from one to three years. Disagreement alone accounts for 22.3% of the one-year HML return variations. The next regression further controls for the book-to-market ratio of value stocks relative to growth stocks:

$$HML_{t,t+h} = \alpha + \beta \cdot \sigma_t + \gamma \cdot (LOGBM_H - LOGBM_L) + \varepsilon_t, \quad (10)$$

where  $LOGBM_H$  (or  $LOGBM_L$ ) refers to the log of the value-weighted book-to-market ratio for the value (or growth) stock portfolio. The results are presented in Panel E of Table 5. Even after controlling for book-to-market ratios, the disagreement has a statistically and economically significant effect on *ex post* HML return. The coefficient of disagreement in the one-year return regression is 0.157 ( $t$ -stat = 2.47). A one-standard-deviation increase in disagreement is associated with an increase of 5.97% (e.g., 2% to 7.97%) in *ex post* one-year HML return.

## 6. Disagreement of book-to-market sorted portfolios

The Miller (1977) model gives rich implications based on the interaction between disagreement and the optimism of

the marginal investor. To see this, assume that the average belief of a stock is  $\mu_i$  and the belief dispersion is  $\sigma_i$ . Assume the marginal investor's valuation of stock  $i$  is  $\mu_i + b_i \cdot \sigma_i$ . When  $b_i=0$ , the marginal investor's belief is the average belief. When  $b_i > 0$  ( $b_i < 0$ ), the marginal investor is more optimistic (pessimistic) than the average belief. When there is disagreement, the marginal investor can be overly optimistic for two reasons: (i) the average belief  $\mu_i$  is overly optimistic (e.g., Lakonishok, Shleifer, and Vishny, 1994; La Porta, 1996); (ii)  $b_i > 0$ ; or both. To simplify illustration, the discussion in this section assumes the average belief is correct and focuses on the effect due to  $b_i$ . The effect due to  $\mu_i$  being overly optimistic will be analyzed in Section 7. The marginal investor is generally unobservable. However, assuming the availability of a set of assets with different optimism  $b_i$ , the following implications are testable.

*Testable implications.* In this setting, a stock is more overvalued if  $b_i \cdot \sigma_i$  is higher. Therefore,

1. Given  $b_i > 0$ , high disagreement stocks have lower expected returns than low disagreement stocks. This effect is stronger for stocks with higher optimism  $b_i$ .
2. Given  $\sigma_i$ , the expected return of stocks with higher optimism  $b_i$  is lower. This effect is stronger for high disagreement stocks.
3. Contemporaneously, the returns of stocks with high optimism  $b_i$  are more positively correlated with variations in disagreement.
4. *Ex post*, returns of stocks with high optimism  $b_i$  are more negatively correlated with disagreement.

To test these implications, this paper uses portfolios sorted on the book-to-market (B/M) ratio as test assets by making the following assumption. The empirical findings form a joint test of this assumption and the disagreement mechanism.

**Assumption.** Low book-to-market stocks (growth stocks) have higher optimism  $b_i$  than high book-to-market stocks (value stocks). Further, for the lowest book-to-market portfolio,  $b_i > 0$ .

The B/M ratio is constructed in the same way as in Section 5. Stocks are sorted into quintile portfolios based on the B/M ratio. Panel A of Table 6 shows summary statistics of the five portfolios. On average, the low B/M portfolios (growth stock portfolios) have more stocks, larger market capitalization, more analyst coverage, and lower return.

Panel C1 of Table 6 shows, for portfolios double sorted by individual-stock B/M ratio and disagreement, the annual return alphas relative to the market factor. Consistent with Testable Implication 1, high disagreement stocks have lower return alpha than low disagreement stocks, and the underperformance is more pronounced for growth stocks. For example, within the top growth stock quintile, high disagreement stocks have an annual return alpha of  $-4.42\%$  compared to low disagreement stocks whose alpha is  $2.80\%$ , a difference of  $-7.22\%$  ( $t$ -stat = 2.17). The underperformance of high disagreement stocks diminishes monotonically for portfolios with higher B/M ratios. Within the

<sup>26</sup> The difference between value and growth stocks is statistically significant. This conclusion is based on a pooled regression of growth and value stock returns on changes in  $\sigma$ , a dummy variable that equals one (zero) for the growth (value) stock portfolio, and their interactions. The coefficient in front of the interactive term is statistically significant at the 95% level for all return horizons. This result is unreported for brevity.

**Table 6**

Disagreement of book-to-market sorted portfolios.

Panel A shows the time-series average of the number of stocks, the average market capitalization (in millions US dollars), the average number of analysts covering a stock, and the value-weighted portfolio return for each of the book-to-market (B/M) quintile portfolios. The B/M portfolios are formed at the end of June each year using NYSE breakpoints. Disagreement for each B/M portfolio (denoted by  $\sigma(i)$  for  $i=1,2,\dots,5$ ) is constructed as the value-weighted average of analyst forecast standard deviation of individual-stock long-term EPS growth rate using only stocks in the corresponding B/M portfolio. Panel B shows the pairwise correlation coefficients of  $\sigma(i)$  among the five B/M portfolios. Panels C1 and C2 show the ex post value-weighted portfolio return alphas relative to the market factor (measured by the CRSP value-weighted return) for portfolios sorted independently by individual-stock B/M and disagreement. In Panel C1, the "3-1" return is constructed within each B/M quintile as the return difference between the high and low disagreement portfolios. The diff-in-diff portfolio return is the difference of the "3-1" return between the top and bottom B/M quintiles. Alphas for only the diff-in-diff portfolio are reported in Panel C2. Panel D shows, for each of the B/M portfolios  $i=1,2,\dots,5$ , the estimates of  $\beta$  in the regression:  $R_{t-h,t}(i) = \alpha + \beta \cdot (\sigma_t(i) - \sigma_{t-h}(i)) + \varepsilon_t$ .  $R_{t-h,t}(i)$  denotes the value-weighted return from  $t-h$  to  $t$  of B/M portfolio  $i$  in excess of the risk-free rate. Panel E shows, for each B/M portfolio, the estimates of  $\beta$  in the regression:  $R_{t,t+h}(i) = \alpha + \beta \cdot \sigma_t(i) + \varepsilon_t$ . The  $t$ -statistics in parentheses are from Newey and West (1987) with the number of lags being equal to the return horizons. The sample period is December 1981–December 2005.

	1 (Low B/M)	2	3	4	5 (High B/M)
<i>Panel A: Summary statistics of B/M portfolios</i>					
Number of stocks	459	343	291	232	175
Market capitalization (M\$)	4596	2896	2075	1888	1665
Analysts per stock	6.8	6.0	5.7	5.7	5.1
Monthly return (%)	0.74	0.80	0.88	0.91	1.02
<i>Panel B: Correlation matrix of disagreement of B/M portfolios</i>					
1 (Low B/M)	1				
2	0.555	1			
3	0.465	0.564	1		
4	0.208	0.229	0.299	1	
5 (High B/M)	0.090	0.132	0.214	0.550	1
<i>Panel C1: Ex post annual return alpha (<math>\times 100</math>) relative to the market</i>					
	Disagreement				
	1 (Low)	2	3 (High)	3-1	$t$ -stat
1 (Low B/M)	2.80	-0.77	-4.42	-7.22	(2.17)
2	5.60	1.76	-1.16	-6.76	(2.61)
3	5.99	3.62	2.06	-3.93	(1.70)
4	5.69	3.14	4.37	-1.31	(0.69)
5 (High B/M)	7.11	6.63	6.84	-0.26	(0.13)
5-1	4.31	7.41	11.27	6.96	
$t$ -stat	(1.63)	(2.06)	(2.15)	(1.97)	
<i>Panel C2: Ex post return alpha (<math>\times 100</math>) relative to the market for other return horizons</i>					
Months	1	6	12	24	36
Alpha (diff-in-diff portfolio)	0.47	3.70	6.96	17.56	20.71
$t$ -stat	(1.30)	(1.89)	(1.97)	(3.28)	(3.02)

Table 6 (continued)

Panel D: Contemporaneous B/M portfolio returns on changes in portfolio disagreement		6	12	24	36
h (in months)					
1 (Low B/M)		0.099 (2.09)	0.167 (2.09)	0.286 (2.65)	0.368 (2.53)
2		0.023 (0.80)	0.108 (2.06)	0.156 (2.41)	0.181 (1.78)
3		0.014 (0.70)	0.076 (0.78)	0.059 (0.43)	0.179 (1.70)
4		-0.011 (0.78)	-0.009 (0.03)	-0.044 (0.94)	-0.074 (2.42)
5 (High B/M)		0.000 (2.08)	-0.017 (2.08)	-0.061 (2.84)	-0.100 (2.73)
5-1		-0.098	-0.185	-0.347	-0.468
Panel E: Ex post B/M portfolio returns on portfolio disagreement		6	12	24	36
h (in months)					
1 (Low B/M)		0.000 (0.01)	-0.173 (1.42)	-0.342 (2.12)	-0.501 (2.36)
2		-0.010 (1.98)	-0.152 (2.74)	-0.261 (4.21)	-0.328 (3.55)
3		-0.007 (1.24)	-0.062 (2.01)	-0.067 (2.16)	-0.159 (1.66)
4		0.003 (0.76)	0.038 (1.37)	0.018 (1.07)	0.057 (0.60)
5 (High B/M)		0.004 (1.16)	0.047 (1.33)	0.072 (1.39)	0.106 (2.10)
5-1		0.004 (0.47)	0.219 (2.01)	0.415 (2.64)	0.607 (2.82)

top value quintile, the alpha spread between the high and low disagreement stocks is only  $-0.26\%$  per year, which is statistically insignificant. The difference between the extreme value and growth quintiles is  $6.96\%$  per year ( $t$ -stat = 1.97). The monotonic patterns across portfolios are similar for other return horizons. The results are statistically significant at the 95% level for the return horizons of one to three years, and significant at the 90% level for the return horizon of six months (Panel C2 of Table 6). The results using raw portfolio returns are similar though noisier because the high disagreement stocks tend to have high market beta. The results are also similar when controlling the SMB size factor and the UMD momentum factor. These results are unreported for brevity. I do not control for the Fama and French (1993) HML factor when computing the return alphas because this section studies portfolios sorted by B/M ratio.

Consistent with Testable Implication 2, Panel C1 shows that, among high disagreement stocks, the value stocks have an annual alpha of  $6.84\%$  compared to growth stocks whose annual alpha is  $-4.42\%$ , a difference of  $11.27\%$  ( $t$ -stat = 2.15). This outperformance by value stocks diminishes monotonically for portfolios with lower disagreement. Among the portfolio of stocks with the lowest disagreement, the alpha spread between value and growth stocks is only  $4.31\%$  per year ( $t$ -stat = 1.63).

Panels D and E of Table 6 provide evidence supportive of Testable Implications 3 and 4 regarding the contemporaneous and ex post relation between return and disagreement of growth/value stock portfolios. For each book-to-market sorted portfolio, disagreement is constructed bottom-up using long-term EPS growth rate forecasts. The bottom-up approach facilitates the study of such portfolio disagreement because analysts rarely produce top-down estimates for customized portfolios. Let  $\sigma_t(i)$  for  $i=1,2,\dots,5$  denote the disagreement of each of the five B/M portfolios in month  $t$ . Panel B shows the correlation matrix of the five portfolio disagreements. They are positively correlated, though the correlation diminishes for portfolios that are further apart in terms of the B/M ratio. Panel D conducts the following regression for each of the five B/M portfolios:

$$R_{t-h,t}(i) = \alpha + \beta \cdot (\sigma_t(i) - \sigma_{t-h}(i)) + \varepsilon_t.$$

$\sigma_{t-h,t}(i)$  denotes the value-weighted return from  $t-h$  to  $t$  in excess of the linked T-bill rate for each B/M portfolio  $i=1,2,\dots,5$ . The results in Panel D show that the growth stock returns are more positively related to the contemporaneous changes in portfolio disagreement.<sup>27</sup> The difference between growth and value stocks is statistically significant and holds across various return horizons, consistent with Testable Implication 3.

<sup>27</sup> There is some suggestive evidence in Panels D and E of Table 6 that value stocks may even have pessimists ( $b_i < 0$ ) as the marginal investor so that the value stocks' contemporaneous return drops when disagreement increases and ex post return is high following high disagreement. However, this interpretation is subject to the caveat that it is unclear what the benchmark relation is in these two panels. Therefore, this paper focuses on the difference between growth and value portfolios.

To examine Testable Implication 4, Panel E of Table 6 conducts, for each B/M portfolio  $i=1,2,\dots,5$ , the following regression:

$$R_{t,t+h}(i) = \alpha + \beta \cdot \sigma_t(i) + \varepsilon_t.$$

Consistent with Testable Implication 4, the results in Panel E show that the ex post growth portfolio returns are more negatively related to portfolio disagreement.<sup>28</sup>

Taken together, the results show an interesting link between disagreement and the value/growth stock returns. Evidence in this section suggests that, controlling for disagreement, the marginal investor in growth stocks displays more optimism (in the sense of higher  $b_i$ ). This translates into a number of cross-sectional and time-series predictions regarding growth/value stock returns, which are supported by the data. The results also provide a potential explanation to the finding in Campbell and Vuolteenaho (2004) that growth stocks are more sensitive to discount-rate news. This is because an increase in disagreement is associated with higher stock price (which can manifest as lower discount rate), and the effect is stronger for growth stocks (higher  $b_i$ ) than value stocks.

## 7. Robustness checks

The scatterplot and the nonparametric estimate in Fig. 2, along with Fig. 3, indicate that the effect of disagreement on market return is not driven by just a few observations. To further confirm that it is not driven entirely by the dot-com era, a subsample analysis is conducted by dividing the sample period into two. The first subsample spans December 1981–December 1993, a total of 145 monthly observations. The second subsample starts from January 1994 and ends in December 2005, a total of 144 monthly observations. Regression (6) is run separately for each subsample. The results are in Panel A of Table 7. In both subsamples, there is a statistically and economically significant negative relation between market return and disagreement for the one- to three-year horizons. The effect of disagreement is similar in the subsamples for the one-year return and is somewhat stronger for the two- and three-year returns in the latter sample.<sup>29</sup> Other subsample classifications such as before/after year 1990 give similar results. A subsample analysis is also conducted for the HML return regression (10). The effect of disagreement on HML return is statistically and economically significant for both subsamples, though somewhat stronger in the more recent subsample. These results are unreported for brevity.

<sup>28</sup> Similar to Fig. 2, I have checked the scatterplots of ex post return on portfolio disagreement for each of the B/M portfolios and the results in Panel E of Table 6 do not appear driven by just a few observations. I have also repeated the analysis for portfolios constructed by a double sort on B/M ratio and market capitalization. The result is similar except that it is somewhat noisier for small stocks, consistent with Panel B of Table 7. These results are unreported for brevity.

<sup>29</sup> I have repeated the subsample analysis by including the controls one-by-one using only those control variables that are statistically significant in the regressions in Panel F of Table 3 and the results are similar. These results are unreported for brevity.

Panel B of Table 7 studies the effect of disagreement for size-sorted portfolios. Similarly, ex post size portfolio returns are negatively related to portfolio disagreement and the effect is stronger for the return horizons of one to three years. The statistical significance is stronger for large stocks, likely because they tend to have more analyst coverage, hence better measurement of disagreement. For example, a large stock may sometimes be followed by over 30 analysts. In contrast, some of the small stocks in the sample may have only two or three analysts. Also, when a single arbitrageur cannot undo the mispricing of a large stock, the synchronization problem among arbitrageurs (Abreu and Brunnermeier, 2002, 2003; Brunnermeier and Nagel, 2004) may create limits to arbitrage or even amplify the mispricing.

High turnover can reflect disagreement (e.g., Scheinkman and Xiong, 2003; Baker and Stein, 2004). This paper has constructed disagreement using turnover (note that top-down and bottom-up turnovers coincide), and finds that turnover correlates negatively with ex post return. To the extent that turnover can be a proxy for disagreement, this is supportive evidence for the disagreement mechanism. However, turnover may have other interpretations (e.g., Amihud, Mendelson, and Pedersen, 2005). Therefore, Panel C of Table 7 controls for turnover when regressing market return on disagreement. The effect of disagreement remains statistically significant and is similar in magnitude to that in Panel A of Table 3. Compared to the regression with turnover alone (unreported), adding disagreement substantially increases explanatory power measured by the adjusted  $R$ -squares.

De Bondt and Thaler (1985) and Fama and French (1988b) show that the stock market exhibits negative autocorrelation at long horizons. Panel D of Table 7 controls for lagged market return when regressing ex post market return on disagreement, and the effect of disagreement remains similar to that in Table 3.

Panel E of Table 7 measures disagreement bottom-up using quarterly EPS forecasts (constructed in the same way as  $\sigma_{ANN}^{NG}$  in Section 4 except that the standard deviation of annual EPS forecasts for a stock is replaced with the standard deviation of quarterly EPS forecasts times four). To overcome the mechanical drop in forecast standard deviation when a fiscal quarter-end becomes closer, a rolling mechanism similar to that in Section 4 is used. Specifically, the forecast standard deviation in December is measured using forecasts for the fiscal quarter ending in March next year. The forecast standard deviation in January is a weighted average with 2/3 weight on forecast standard deviation for the March quarter and 1/3 weight for the June quarter. In February, 2/3 weight is on the June quarter and only 1/3 weight is on the March quarter. In March, the entire weight is shifted to the June quarter (similarly for other months). Quarterly forecasts may incur noise relating more to the seasonal fluctuations rather than the long-run prospect of a company. Nonetheless, the results in this panel are similar (though somewhat stronger for short-horizon returns and weaker for long-horizon returns) relative to the results using longer-horizon forecasts.

**Table 7**

Robustness checks.

Panel A conducts subsample analysis for the regression in Panel G of Table 3. Panel B shows, for each size portfolio, the regression results of ex post value-weighted portfolio return in excess of the risk-free rate on portfolio disagreement. The size portfolios are constructed monthly. Big/medium/small stocks are defined as those with the highest 30%/middle 40%/lowest 30% market capitalization using NYSE breakpoints. The portfolio disagreements are constructed as the value-weighted average of analyst forecast standard deviation of long-term EPS growth rate using stocks in each size portfolio. Panel C repeats the regression in Panel A of Table 3, controlling for the average monthly turnover in the past year. Following Baker and Stein (2004), turnover is stochastically detrended by subtracting the average turnover in the previous five years from it and the regression controls for the dividend-price ratio  $DP$  and the equity share of new issues  $EQUITYSHARE$ . Panel D regresses ex post  $h$ -month excess market return  $R_{t,t+h}^M$  on  $\sigma_t$ , controlling for lagged  $h$ -month market return  $R_{t-h,t}^M$ . Panel E repeats the regression in Panel A of Table 3 except that the disagreement  $\sigma_{QTR}^{NG}$  is constructed bottom-up from the analyst forecasts of quarterly EPS, using firms that issue no annual or quarterly EPS guidelines. Panel F repeats the regression in Panel A of Table 3 except that the disagreement is measured by the equal-weighted average of individual-stock analyst disagreements over the long-term EPS growth rate,  $\sigma^{EW}$ . Panel G repeats the regression in Panel A of Table 3, controlling for the idiosyncratic risk in Goyal and Santa-Clara (2003). Panels H1 and H2 repeat Panels C1 and C2 of Table 6 except that the disagreement portfolio is sorted conditioning on the idiosyncratic volatility in Ang, Hodrick, Xing, and Zhang (2006). Panel I repeats the regressions in Panel E of Table 6, controlling for the cross-sectional value-weighted average of individual-stock idiosyncratic volatility for stocks in each book-to-market sorted portfolio. The  $t$ -statistics in parentheses are from Newey and West (1987), with the number of lags being equal to the return horizons. The sample period is January 1982–July 2001 in Panel E, and is December 1981–December 2005 in other panels.

Return horizon (in months)	1	6	12	24	36
<i>Panel A: Subsample analysis</i>					
December 1981–December 1993					
$\sigma$	0.018	−0.043	−0.156	−0.239	−0.206
$t$ -stat	(1.47)	(1.09)	(3.16)	(3.87)	(3.88)
January 1994–December 2005					
$\sigma$	−0.003	−0.015	−0.162	−0.366	−0.396
$t$ -stat	(0.16)	(0.24)	(2.50)	(3.84)	(6.26)
<i>Panel B: Ex post size portfolio returns on portfolio disagreement</i>					
1 (Big)	−0.005	−0.057	−0.165	−0.360	−0.481
	(0.74)	(1.35)	(2.35)	(2.76)	(2.11)
2	−0.005	−0.045	−0.090	−0.116	−0.121
	(0.70)	(1.94)	(2.61)	(2.53)	(2.03)
3 (Small)	0.000	−0.010	−0.034	−0.048	−0.037
	(0.05)	(0.37)	(0.82)	(1.16)	(0.54)
<i>Panel C: Controlling for turnover</i>					
$\sigma$	0.001	−0.034	−0.145	−0.351	−0.517
$t$ -stat	(0.18)	(0.81)	(2.27)	(3.36)	(2.69)
<i>Panel D: Controlling for lagged market return</i>					
$\sigma$	−0.006	−0.061	−0.174	−0.360	−0.438
$t$ -stat	(0.90)	(1.51)	(2.53)	(3.16)	(2.32)
<i>Panel E: Disagreement measured bottom-up using quarterly EPS forecasts</i>					
$\sigma_{QTR}^{NG}$	−0.588	−2.461	−4.466	−8.165	−9.553
$t$ -stat	(2.66)	(3.40)	(2.89)	(2.49)	(1.75)
Adj $R^2$	3.1%	11.5%	17.4%	18.9%	13.0%
<i>Panel F: Equal-weighted average of individual-stock long-term forecast dispersions</i>					
$\sigma^{EW}$	−0.007	−0.055	−0.117	−0.194	−0.257
$t$ -stat	(1.36)	(2.95)	(3.22)	(2.55)	(2.45)
Adj $R^2$	0.5%	9.0%	19.3%	26.5%	24.2%
<i>Panel G: Controlling for idiosyncratic risk</i>					
$\sigma$	−0.006	−0.059	−0.167	−0.332	−0.405
$t$ -stat	(0.89)	(1.47)	(2.70)	(3.61)	(2.50)

Panel H1: Ex post annual return alpha ( $\times 100$ ) relative to the market, SMB (size), and UMD (momentum) when disagreement is sorted conditional on idiosyncratic volatility

	Disagreement				t-stat
	1 (Low)	2	3 (High)	3-1	
1 (Low B/M)	2.32	-0.94	-5.47	-7.79	(2.31)
2	5.63	2.01	-0.10	-5.73	(2.74)
3	7.05	5.98	3.45	-3.60	(1.71)
4	7.35	6.48	6.11	-1.24	(0.70)
5 (High B/M)	9.78	7.64	9.98	0.21	(0.11)
5-1	7.46	8.58	15.46	8.00	
t-stat	(3.69)	(3.39)	(3.09)	(1.97)	

Panel H2: Ex post return alpha ( $\times 100$ ) relative to the market, SMB, and UMD for other return horizons when disagreement is sorted conditional on idiosyncratic volatility

Months	1	6	12	24	36
Alpha (diff-in-diff portfolio)	0.33	3.78	8.00	25.38	40.69
t-stat	(0.98)	(1.71)	(1.97)	(4.21)	(4.36)

Panel I: Ex post B/M portfolio returns on portfolio disagreement, controlling for idiosyncratic volatility

h (in months)	1	6	12	24	36					
1 (Low B/M)	0.005	(0.60)	-0.044	(1.12)	-0.148	(1.96)	-0.270	(1.98)	-0.381	(1.93)
2	-0.014	(2.23)	-0.080	(2.73)	-0.152	(3.95)	-0.221	(3.17)	-0.229	(2.01)
3	-0.010	(1.60)	-0.042	(2.46)	-0.066	(2.13)	-0.041	(0.89)	-0.115	(1.34)
4	0.003	(0.72)	0.026	(1.36)	0.040	(1.13)	0.021	(0.71)	0.062	(1.83)
5 (High B/M)	0.004	(1.26)	0.024	(1.42)	0.051	(1.58)	0.076	(2.34)	0.117	(2.53)
5-1	-0.001	(0.08)	0.068	(1.82)	0.198	(2.55)	0.347	(2.47)	0.498	(2.25)

The construction of bottom-up disagreement features value-weighting of individual-stock disagreements so far, which facilitates comparison with top-down disagreement because analysts typically make top-down forecasts for value-weighted market benchmarks. Because small stocks tend to have less analyst coverage compared to big stocks, value-weighting also helps reduce the measurement error of disagreement associated with small stocks. A concern with value-weighting is that it may potentially accentuate the unusual disagreement dynamics of a few big stocks. This unlikely drives the results because, while it is possible that the measured disagreement is pushed too high by a few big stocks, it is also possible that the measured disagreement is pushed too low. On average, it actually tends to bias against finding a relation between disagreement and return, from results on measurement error in the regression literature. Nonetheless, a direct check using equal-weighted individual-stock disagreements is helpful to guard against such a concern. Therefore, Panel F of Table 7 repeats the regression (3) except that the disagreement is constructed using the equal-weighted individual-stock long-term EPS forecast dispersions and the results are similar to those in Table 3. In addition, results similar to Table 4 and Panel E of Table 7 are obtained from equal-weighted individual-stock annual and quarterly EPS forecast dispersions (unreported for brevity). Therefore, the results are unlikely driven by the weighting scheme of individual-stock disagreements.

I have also used disagreement in log scale, a binary measure of disagreement (high versus low), disagreement constructed without first winsorizing individual-stock disagreements, and disagreement constructed using only stocks covered by at least five analysts. The results are largely similar and are unreported for brevity.

High disagreement may be associated with high uncertainty and volatility.<sup>30</sup> Goyal and Santa-Clara (2003) find that the equity premium is affected by the average stock variance, which is controlled for in Panel G of Table 7. The effect of disagreement remains similar. This paper has also replaced the average stock variance in Goyal and Santa-Clara (2003) with average idiosyncratic volatility, where the idiosyncratic volatility is estimated from the residual of stock return relative to the Fama and French (1993) three-factor model (see Ang, Hodrick, Xing, and Zhang, 2006, 2009), the effect of disagreement remains similar. Controlling other variables such as the market return volatility and skewness, or the Baker and Wurgler (2007) sentiment index yields similar results (unreported for brevity).

Panel H of Table 7 repeats Panel C of Table 6, except that the disagreement portfolios are sorted conditioning on idiosyncratic volatility in Ang, Hodrick, Xing, and Zhang (2006). Specifically, stocks are first sorted into three portfolios of high/mid/low idiosyncratic volatility. Stocks within each idiosyncratic volatility portfolio are further sorted into three portfolios of high/mid/low

disagreement. The three high disagreement portfolios with high/mid/low idiosyncratic volatilities are then combined to form the final high disagreement portfolio. The mid/low disagreement portfolios are constructed similarly. Panels H1 and H2 show that the results after controlling for idiosyncratic volatility remain similar to Panels C1 and C2 of Table 6. The result is also similar if stocks are first sorted into decile portfolios of idiosyncratic volatility to give a finer control. Panel I of Table 7 repeats Panel E of Table 6, controlling for the value-weighted average of individual-stock idiosyncratic volatility for each B/M portfolio. The results are similar. In particular, the “5–1” coefficient for the control of idiosyncratic volatility is insignificant (unreported). Therefore, idiosyncratic volatility does not appear to drive the difference in growth/value stock return sensitivity to disagreement.

Overly optimistic average belief can also contribute to overvaluation (i.e., when  $\mu_i$  in Section 6 is above the fundamental). For example, Lakonishok, Shleifer, and Vishny (1994) and La Porta (1996) find supportive evidence of expectation errors. To account for potential errors related to the average forecast, this paper has repeated Panels H1, H2, and I of Table 7 replacing the idiosyncratic volatility with the average analyst forecast. The results are similar and unreported for brevity.

## 8. Conclusion

This paper studies the asset pricing implications of disagreement, with a focus on its implications for stock portfolios. It shows that measuring portfolio disagreement from the bottom-up gives strong support for asset pricing theories incorporating disagreement such as Miller (1977). For the market portfolio, the ex post expected return is low following high disagreement and the horizon for low return is consistent with the speed of mean reversion in disagreement. Contemporaneously, variations in disagreement correlate positively with market return. In particular, an increase in disagreement manifests as a drop in discount rate. In the cross-section, this paper finds interesting implications from the interaction between disagreement and investor optimism, using book-to-market sorted portfolios as test assets. High disagreement stocks underperform low disagreement stocks, and the effect is stronger for growth stocks. The value premium is stronger among high disagreement stocks. Growth stocks are more sensitive to variations in portfolio disagreement than value stocks. These findings show that disagreement matters for important asset pricing issues including the equity premium, discount rate, and the value premium.

It will be interesting in future work to see if the contrast between bottom-up and top-down disagreement applies to other markets. Such distinction may also apply in a corporate context (e.g., a corporation with multiple subsidiaries) which can generate potential implications for mergers and acquisitions or spin-offs. One may question whether disagreement will disappear after sufficiently long periods of learning. Acemoglu,

<sup>30</sup> Pastor and Veronesi (2003, 2006) study the effect of uncertainty on stock valuation, though their models do not focus on expected stock return.

Chernozhukov, and Yildiz (2006) suggest that the disagreement among Bayesian-learning agents may never disappear and can in some cases diverge, even after observing an infinite sequence of signals, if there is uncertainty regarding the interpretation of the signals. This suggests that the effect shown in this paper can potentially persist for a long time.

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