Commonality in Disagreement and Asset Pricing*

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Abstract

This paper presents a dynamic model to demonstrate that, when differences-of-opinion over individual securities have a common component, the valuation of the aggregate market can be higher than its fundamental even if all investors agree on the market fundamental, and the common disagreement drives discount rate news. Using analyst forecast dispersion to measure disagreement, I find empirical evidence that individual stock disagreements co-move and the common component mean-reverts, the common disagreement has substantial explanatory power for the time-series variation of equity premium, and the common disagreement correlates with discount-rate news rather than cash-flow news and has explanatory power for the time-series variation of value premium.

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1 Introduction

There are two common procedures to value a portfolio of risky assets – the top-down approach and the bottom-up approach. Thomson Financial (2004) defines top-down stock market forecasts as those "... made by market strategists who treat an index as though it were an individual entity," and bottom-up forecasts as those "... weighted average of the ... forecasts for all of the companies comprising the index." In a frictionless market, top-down and bottom-up approaches should yield the same value due to the law of one price (see Cochrane (2005)).

However, the top-down and the bottom-up approaches lead to an apparent contradiction in the following situation. The literature on heterogeneous investors has shown that individual stock prices may be driven up by optimists if there are differences of opinion and some pessimists face short-sales constraint (hence pessimists sit on the sideline and their opinions are not reflected in prices, see for example Miller (1977)). However, it is possible that investors disagree on individual stocks yet agree on the aggregate market. For example, value investors may be bullish in value stocks and bearish in growth stocks such that they are market neutral, while growth investors are bearish in values stocks and bullish in growth stocks such that they are also market neutral. In this case, when the investors are risk-neutral, top-down approach suggests a unique market valuation – discounted present value using risk-free rate of expected future cash flows which is agreed upon by all investors. However, the market valuation is *not* unique using the bottom-up approach. Depending on how strongly growth and value investors are bullish in growth and value stocks respectively, growth and value stocks can be over-valued by an indeterminate amount when some pessimists face short-sales constraint. As a result, the market valuation is higher than its fundamental and indeterminate as long as the individual stock disagreements exhibit commonality, i.e. they do not cancel out each other.

Motivated by this observation, this paper studies the effect of commonality in individual security disagreements on the pricing of portfolios of these securities.[1] In most of this paper, I use "stocks" to denote the individual securities and "market" to denote a portfolio of these securities. I find that, under realistic conditions to be detailed later, commonality in disagreement can affect the market valuation and expected return.

The result is robust to the presence of informed arbitrageurs who are not subject to short-sales constraints. I distinguish two types of arbitrage opportunities in the model of this paper: risky arbitrage and index arbitrage. Risky arbitrageurs engage in stock-picking and short over-valued stocks. However, these directional bets are risky and subject to (endogenous) margin/collateral requirements. As long as the total risky arbitrage capital is insufficient to overcome the other investors' optimism, individual stock prices are over-valued. On the contrary, index arbitrageurs, who place relative-value trades when the index deviates from the sum of its constituent stocks' values, are not subject to margin requirements. This is because index arbitrage is a genuine arbitrage and, understanding this, a clearing firm will waive any additional margin requirements

[1] Common disagreement is defined in Definition 1.

so long as both the long and the short legs of the index arbitrage are held at the same clearing firm. As a result, the market valuation always equals the sum of its constituent stocks. Whenever the individual stocks are over-valued, so is the market even if all investors agree on the market fundamental. It is also interesting to note the efficacy of the two types of arbitrages. Risky arbitrage, which improves market efficiency by moving prices towards fundamental, is constrained along the line of Shleifer and Vishny (1997). On the other hand, index arbitrage, which is a textbook example of arbitrage with zero capital, can push the index away from its fundamental which questions the efficacy of bringing price to fundamental via arbitrage.

The model builds on the premise that individual stock disagreements have a common component and that the common disagreement is mean-reverting. Data from 1981-2006 provides supportive evidence. I use I/B/E/S analyst forecast dispersion on individual stock long-term earnings growth rate to measure individual stock disagreement and find co-movement of individual stock disagreements using the method in Chordia, Roll, and Subrahmanyam (2000). I then use the cross-sectional average of individual stock disagreements as a proxy for the common disagreement. The common disagreement is found to slowly mean-revert. A shock to the common disagreement has a half-life of around one-year and largely mean reverts within three years.

The model predicts that, when the common disagreement is high, the market tends to be over-valued and has low expected subsequent return due to the mean-reversion of the common disagreement. Using ex-post realized market return as a proxy for expected return, I find a negative relationship between the common disagreement and ex-post return. This negative relationship holds across the return horizons of one month to three years. The effect is the strongest for one- to two-year returns, consistent with the speed of mean reversion for the common disagreement. A univariate regression suggests that one standard deviation increase in the common disagreement is associated with a statistically and economically significant reduction in subsequent one-year market return of six percentage points (e.g. from 10% to 4%), see also Figure 3. One standard deviation increase in the common disagreement is associated with reductions of subsequent two- and three-year market returns by 13 and 15 percentage points, respectively.

The commonality in disagreement has substantial explanatory power for the time-series variation of equity premium even after controlling for all the variables reviewed in Campbell and Thompson (2007) which are known to correlate with ex-post market return. These variables include dividend-price ratio, earnings-price ratio and its smoothed version, book-to-market ratio, short-term interest rate, long-term bond yield, the term spread between long- and short-term Treasury yields, the default spread between corporate and Treasury bond yields, the lagged rate of inflation, the equity share of new issues, and the consumption-wealth ratio.[2] For example, for the return horizon of

[2] A partial list of references for these control variables: Rozeff (1984), Fama and French (1988a), Campbell and Shiller (1989) and Campbell and Shiller (1988) 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 return prediction using interest rates on 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.

one year, commonality in disagreement explains an additional 16 percentage points of market return variation (regression adjusted R-square 37.8%, compared to 21.7% when all the variables in Campbell and Thompson (2007) are included but common disagreement is left out). Scatterplot (figure 3) and subsample analysis indicate that the explanatory power exists throughout the entire sample, though perhaps not surprisingly the magnitude is larger during the dot-com era.

Individual stock disagreement can come from two sources: purely idiosyncratic disagreement, and disagreement in the aggregate which is translated to individual stock disagreement through stock loading on the market. Using analyst forecast dispersion of S&P 500 earnings, I find that both the commonality in idiosyncratic disagreement and the commonality in disagreement inherited from disagreement in the aggregate are negatively associated with subsequent market returns, though a majority of the explanatory power comes from commonality in idiosyncratic disagreements.

The common disagreement also has substantial explanatory power for the time-series variation of the value premium because the model (in which the expected market cash flow is fixed and known correctly by all investors) suggests variations in common disagreement ought to correlate more with discount-rate news to which Campbell and Vuolteenaho (2004) find growth stocks are more sensitive than value stocks. In this heterogeneous agent framework, the discount rate news come not from the adjustment of required rate of return of any actual investor, but from the market aggregating time-varying heterogeneous beliefs in the cross-section.

Consistent with this prediction, I find empirically that the variations in the common disagreement correlate contemporaneously with the discount-rate news rather than the cash-flow news. Further, the negative relationship between ex-post return and the common disagreement is stronger for growth stocks than for value stocks. As a result, commonality in disagreement also has substantial explanatory power for the time-series variation in the Fama and French (1993) HML (High-Minus-Low book-to-market portfolio) return premium. For example, one standard deviation increase in the common disagreement is associated with an increase of 6.5 percentage point (e.g. 5% to 11.5%) in HML return in the subsequent year (adjusted R-square 15.2%). Subsample analysis indicates that the explanatory power exists both before and during the 1990s.

This result helps to understand the source of variation in the discount rate. Campbell and Vuolteenaho (2004) (in the cross section), Campbell and Shiller (1989) and Fama and French (1988a) (in the time series) rely on the discount-rate effect to address the value premium and the predictability of the market return by dividend-yield. Campbell and Vuolteenaho (2004) is "... silent on what is the ultimate source of variation in the market's discount rate" and conjectures that "... it is possible that our discount-rate news is simply news about investor sentiment." Fama and French (1988a) echoes that "... 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 (the investment opportunities of firms and the tastes of investors for current versus risky future consumption) - or by animal spirits." This paper provides evidence that some of the discount-rate news are linked to common variations in disagreements over individual stocks.

This paper relates to the literature on short-sales constraint and differences-of-opinion in individual securities, where short-sales constraint implies security prices reflect only optimists' opinion.[3] This is discussed by Miller (1977) under a static setting. Harrison and Kreps (1978), Harris and Raviv (1993), and Scheinkman and Xiong (2003) extend the analysis to a dynamic setting to study trading volume and the option value to re-sell a stock to future optimists. See Hong and Stein (2007) for a recent review of this literature. Diether, Malloy, and Scherbina (2002) and Chen, Hong, and Stein (2002) provide evidence that, in the cross section, stocks with higher differences-of-opinion have lower subsequent returns.

However, as shown in proposition 1 and example 1 of this paper, the effect of common disagreement on market return is harder to be arbitraged away than the effect of individual stock disagreements on cross-sectional stock returns. To see the intuition, let us assume the market has two stocks – stock h with higher disagreement and stock l with lower disagreement. With short-sales constraint, both stocks may be over-priced. If stock h is more over-priced than stock l, risky arbitrageurs will predominately short h. In an extreme case, a risk-neutral arbitrageur will not even short l until h price has been pushed down so that h and l are equally over-priced. At this point, individual stock disagreements do no predict future cross-sectional stock returns. However, the effect discussed in this paper is still present because the market overall remains over-valued. The effect will disappear only when, after driving h price down to the level of l, there is still sufficient risky arbitrage capital left to drive both h and l all the way back to their fundamental values.[4] As illustrated by numerical examples, substantially larger arbitrage capital is required to drive both stocks back to their fundamental than to drive stock h down to the level of l because the arbitrageurs have to confront buying from additional mutual funds who were not sufficiently optimistic originally but are subsequently attracted when the share prices are driven lower by the arbitrageurs.

In this paper, the aggregation result of Lintner (1969) does not hold, i.e. the marginal investor in the aggregate differs from the average marginal investors in the individual stocks. This is due to the constraints in investors' portfolio optimization and the fact that disagreements in individual stocks do not aggregate to disagreement in the market which is different from the investor sentiment indicators reviewed in Baker and Wurgler (2007). The interesting point is that a fairly realistic set of conditions is sufficient to de-link the market valuation from its fundamental and that the empirical explanatory power of common disagreement on ex-post return is substantial. The conditions include the existence of a subset of investors who have differences-of-opinion and are subject to short-sales constraint (e.g. actively managed mutual funds, see Almazan, Brown, Carlson, and Chapman (2004) and Koski and Pontiff (1999)) and that risky arbitrageurs are subject to capital constraint along the line of Shleifer and Vishny (1997).

[3] Pástor and Veronesi (2003) and Pástor and Veronesi (2007) study the effect of uncertainty on stock valuation. However, their models do not have implication on expected stock return.

[4] Therefore, the critiques on the empirical evidence of individual stock disagreements on cross-sectional stock returns made in Qu, Starks, and Yan (2004) and Cen, Wei, and Zhang (2007) do not affect this paper. Johnson (2004), which studies the effect of idiosyncratic uncertainty on the option value of equity holding fixed the market risk premium, is not applicable to this paper because this paper studies market return.

This paper primarily studies the effect of commonality in disagreement on stock market valuation. Nonetheless, the idea is also applicable to other settings such as the valuation of a multi-divisional public company. In this case, knowing the expected cash flow of the whole company may be insufficient. The value of the company may also depend on the investors' differences-of-opinion regarding its individual divisions. If there exist publicly traded companies similar to the individual divisions, higher disagreements over these individual divisions (hence over similar public companies) can translate to higher valuation of the multi-divisional corporation through (risky) arbitrage.

Findings in this paper imply that the typical net present value (NPV) method should be applied with caution. NPV implies that the value of an asset depends on the total cash flow it generates at each point in time in the future. However, this paper points out that the price may also depend on how the total cash flow at each point in time decomposes and how investors form their diverse opinions on these cash-flow components. This can have important implications for asset pricing, especially in light of the fact that the individual constituents of the market portfolio can be re-shuffled through merger, spin-off, etc. Such re-shuffle results in changes in the atoms of the market and changes in the differences-of-opinion on these atoms (see Miller (1977)) almost in an arbitrary way. Similar consideration applies to divisions within a company.

The paper is organized as follows. Section 2 presents a model on commonality in disagreement. Empirical evidence is contained in section 3. Section 4 concludes. All proofs are in the appendix.

2 Model

In this section, I present a parsimonious model that captures the effect of commonality in disagreement on market valuation and subsequent return. There are two time periods $t = 0, 1$.

Assumption 1 (Securities) *There are three types of securities traded in the economy.*

- *A continuum of stocks indexed by $i \in [0, 1]$ each with net supply of one share. Each share of stock i pays off a liquidating dividend $v_i > 0$ in period 1. v_i is random with mean $m_i = m$. Note that v_i may not be purely idiosyncratic. For simplicity of illustration, assume $v_i \in [\underline{v}, \overline{v}]$. Let P_i denote stock i's share price in period 0.*
- *A risk-free asset in zero net supply, each unit pays off one dollar in period 1.*
- *An ETF (Exchange-Traded Fund) tracking the market (value-weighted index of individual stocks). One share of the ETF entitles its holder a risky payoff $\int_0^1 v_i di$ in period 1. The ETF is in zero net supply. Let P_{ETF} denote the ETF's share price in period 0 and let r_{ETF} denote the ETF return from period 0 to 1.*

It turns out that the risk-free rate is zero in the equilibrium. Therefore, the ETF is equivalent to an index futures contract.

Assumption 2 (Market participants) *There are three types of market participants.*

- *Mutual funds: there is a continuum of mutual fund indexed by $f \in [0,1]$ who do not take short or leveraged positions for exogenous reasons. Each mutual fund's net asset value (NAV) is normalized to W. The mutual fund industry overall has capital W.*

- *Risky arbitragers: there is a continuum of risky arbitragers who can both lever and short. Collectively, they have capital W_A.*

- *Index arbitragers: there is a continuum of index arbitragers who can both lever and short. They are assumed to have zero capital.*

It will turn out that index arbitrage requires no capital input. Therefore, the index arbitragers are assumed to have zero capital for simplicity. The role of index arbitragers in the model is to ensure market valuation equals the sum of potentially overvalued individual securities. They are not essential in the context of stocks versus market because the market index is conventionally calculated by summing individual stocks. I choose to explicitly model index arbitragers to distinguish the effect of risky arbitrage from that of index arbitrage. Index arbitrage is not as innocuous and is therefore worth explicit consideration in other contexts such as a company versus its individual divisions, see for example the Palm versus 3Com case (Lamont and Thaler (2003)).

Assumption 3 (Beliefs) *Both the risky arbitrageurs and the index arbitrageurs know the true mean payoff m_i of stock i. Mutual funds disagree on m_i. Let m_i^f denote mutual fund f's belief on the expected payoff of stock i.*

$$m_i^f = m + \sigma_i \cdot \varepsilon_i^f \tag{1}$$

where ε_i^f are random variables with mean zero and are independent and identically distributed (i.i.d.) across f and i. Note that this implies the individual stock difference of opinion is purely idiosyncratic, see (3). Let $F(\cdot)$ denote the cumulative distribution function (CDF) of ε_i^f. For simplicity of illustration, assume $F' > 0$ and ε_i^f is symmetrically distributed around 0, i.e. $F(0) = 1/2$. The magnitude of the disagreement σ_i satisfies

$$\sigma_i = \alpha_i + \beta_i \cdot \sigma \tag{2}$$

where $\beta_i > 0$. Let $\overline{\alpha}, \overline{\beta}$ denote the average of α_i and β_i. $\overline{\beta}$ is normalized to 1.

Definition 1 (Common disagreement) *The common disagreement is the variable σ in (2).*

Aggregating mutual fund f's beliefs for N different stocks,

$$\frac{1}{N}\sum m_i^f = m + \frac{1}{N}\sum \sigma_i \cdot \varepsilon_i^f \rightarrow m \text{ when } N \text{ large} \tag{3}$$

by the law of large numbers.[5] In the case of a continuum of stocks, all investors agree and correctly expect aggregate market payoff to be m. Therefore, ε captures purely idiosyncratic disagreement.

[5] Theorem 19.1 in Davidson (2002).

Although the disagreement (ε) is idiosyncratic in level, its dispersion across mutual funds is not idiosyncratic and is assumed in this paper to have a common component, see (2). That a common belief dispersion might co-exist with purely idiosyncratic beliefs can be seen from the following example. In the dot-com era, it might be difficult to value the internet companies, many of which have yet to make any profits. Should they be valued using earnings, sales growth, visits to website, or something else? This valuation difficulty can potentially lead to a common belief dispersion for the internet firms even though the earnings of each individual firms may be largely idiosyncratic. The common component of belief dispersion can also come from disagreement on the aggregate, which is translated to individual stock disagreements through stocks' loadings on the market. In this section, I assume away disagreement on the market and focus on showing that even purely idiosyncratic disagreements can affect market valuation. In the empirical analysis in section 3.4.5, I distinguish the two sources of common disagreement – idiosyncratic disagreement and disagreement on the market.

Average σ_i in (2) across stocks,

$$\overline{\sigma_i} = \overline{\alpha} + \sigma. \tag{4}$$

Other than a level effect of $\overline{\alpha}$, the cross sectional average of σ_i measures the common disagreement σ. Assuming time invariance of $\overline{\alpha}$, time-series variations in average σ_i capture time-series variations in σ. This is the basis for the proxy of common disagreement in the empirical analysis.

Assumption 4 (Preferences) *All market participants are risk neutral and maximize period 1 wealth.*

Other than simplifying the equilibrium analysis, risk neutrality implies that I do not need to make assumptions on investors' differences-of-opinion on volatility or other higher-order moments of asset payoffs.

Assumption 5 (Multi-advisor mutual fund) *Each mutual fund has a continuum of advisors indexed by $i \in [0, 1]$. Each advisor i is in charge of W capital and chooses only between risk-free rate and stock i.*

This assumption is made to simplify the equilibrium analysis. Without this assumption, a fund f will choose to invest in the stock that f has the most favorable view among all stocks. However, the probability distribution of the maximum of many random variables is very difficult to work with, especially when disagreement varies across stocks.[6] With assumption 5, fund f will include stock i in its portfolio as long as f is optimistic in i even if there may exist other stocks that fund f has more favorable views. To some degree assumption 5 is also realistic. As of 2007, the two largest mutual fund families according to assets under management (American funds, Vanguard) both have multi-advisor funds. For example, the $186 billion Growth fund of America states in

[6] See Sarhan and Greenberg (1962) for more details on order statistics.

its prospectus that it "... uses a system of multiple portfolio counselors in managing mutual fund assets. Under this approach, the portfolio of a fund is divided into segments managed by individual counselors. Counselors decide how their respective segments will be invested." In an earlier version of the paper, I study an equilibrium with two stocks and get similar result without the multi-advisor assumption.

2.1 Margin requirement for risky arbitrageurs

The risky arbitrageurs can take short or leverage positions. However, their directional bets are risky and will endogenously be subject to margin/collateral requirements.[7]

Assumption 6 (Clearing firm) *There is a clearing firm that holds all outstanding securities. It lends stocks for short-selling and lends margin debt. The clearing firm imposes a margin requirement to ensure no default.*

2.1.1 Margin requirement for short-sales

To short-sell a stock i in period 0, the risky arbitrageur borrows s shares from the clearing firm, sells for sP_i, gives the proceeds and additional collateral worth a fraction c_s of the short-sales proceeds to the clearing firm. The collateral earns risk free rate (collateral will be such that the clearing firm won't default).[8] The clearing firm takes the collateral and invests it at the risk-free rate.

In period 1, the stock price is $v_i \in [\underline{v}, \overline{v}]$. The short-seller does not default if

$$sP_i (1 + c_s) (1 + r_f) \geq s\overline{v}$$

i.e., if the collateral value is sufficient to cover the short. This implies

$$c_s \geq \frac{\overline{v}}{P_i (1 + r_f)} - 1 = \underline{c_s} \tag{5}$$

where $\underline{c_s}$ is the minimum margin requirement. Depending on competitions among the clearing firms, the actual margin requirement may be higher than $\underline{c_s}$, though the margin requirement should not be lower than $\underline{c_s}$ if default is to be avoided.

2.1.2 Margin requirement for leverage

The risky arbitrageurs may lever up to buy stock i if the stock is under-valued in period 0. To buy s shares of stock i worth a total of sP_i, a risky arbitrageur puts up capital worth a fraction c_l of

[7] Margin is a realistic requirement. Under Federal Reserve Board Regulation T, firms can lend a customer up to 50% of the total purchase price of a stock for new, or initial, purchases ("initial" margin). Under the rules of NASD and the exchanges, a customer's equity must not fall below 25% of the current market value of the securities in the account ("maintenance" margin). Securities firms have the right to set their own margin requirements – often called "house" requirements – as long as they are higher than the margin requirements under Regulation T or the rules of NASD and the exchanges. See NASD (2007) for further details on the regulation of margin transactions.

[8] This also assumes that the stock is not "on special" which is the case for over 90% of the stocks (D'Avolio (2003)). It only strengthens the result when a stock harder to borrow and short.

the total purchase amount and borrows the rest from the clearing firm. The clearing firm borrows $(1 - c_l)\, sP_i$ from the market and lends the capital to the risky arbitrageur at the risk-free rate. The clearing firm can borrow and lend at the risk-free rate because the collateral ensures that neither the risky arbitrageur nor the clearing firm will default. After the risky arbitrageur buys the stocks, the clearing firm holds the stocks as collateral until the margin loan is repaid.

In period 1, the stock price is $v_i \in [\underline{v}, \overline{v}]$. There is no default if

$$s\underline{v} \geq (1 - c_l)\, sP_i\, (1 + r_f)$$

i.e., if the margin loan repayment is less than the value of the collateral. This implies

$$c_l \geq 1 - \frac{\underline{v}}{P_i\,(1 + r_f)} \equiv \underline{c_l} \tag{6}$$

where $\underline{c_l}$ is the minimum margin requirement for leverage.

2.2 Margin requirement for index arbitrageurs

The index arbitrageurs place relative-value trades when the index ETF value deviates from the sum of index constituent stock prices. For example, if $P_{ETF} < \int_0^1 P_i di$, the index arbitrageurs will short the individual stocks, long the ETF, and profit when the prices converge.

In this model, *no* margin is required for index arbitrageurs because they engage in genuine arbitrage. Understanding this, a clearing firm will waive any additional margin requirements so long as both the long and the short legs of the index arbitrage are held at the same clearing firm. Therefore, even index arbitrageurs with zero capital can place large amounts of trades which ensures that the index value always equals the sum of index constituent stock prices. When individual stock prices deviate from fundamental in a systematic way (i.e. when pricing errors do not cancel out each other), so will the index.

2.3 Static equilibrium

For ease of illustration, the stocks are sorted such that σ_i is increasing in i. Recall c_s is the margin requirement for short-sales imposed by the clearing firm.

Proposition 1 (Static equilibrium) *When $W_A/c_s < W/2 - m$, under Assumptions 1–6 and assuming stocks are sorted such that $\sigma_i < \sigma_j$ whenever $i < j$, there exists an equilibrium in which $r_f = 0$, there exists $\kappa \in [0, 1]$ such that*

$$m < P_i < P_j \quad \textit{for } 0 \leq i < j \leq \kappa$$

$$P_i = P_j \quad \textit{for } \kappa \leq i < j$$

The ETF price is above the fundamental which all investors agree on,

$$P_{ETF} > m.$$

Further, recall from (2) that $\sigma_i = \alpha_i + \beta_i \cdot \sigma$ *where the average of* β_i *is normalized to 1,* P_{ETF} *satisfies*

$$\begin{aligned} \frac{d}{d\sigma} P_{ETF} &> 0 \\ \frac{d}{d\sigma} E\left[r_{ETF}\right] &< 0. \end{aligned} \tag{7}$$

This is a very interesting equilibrium because, as shown after (3), all the investors correctly agree on the expected payoff of the market. However, the market valuation is indeterminate and depends on the common disagreement σ. In this equilibrium, the pessimistic mutual funds sit on the sideline due to short-sales constraint. The individual stock prices are bid up by optimistic mutual funds. The risky arbitrageurs, knowing m, short the stocks. However, the risky arbitrageurs are subject to collateral requirements. As long as the total levered risky arbitrage capital W_A/c_s is insufficient to overcome the mutual funds' optimism, individual stocks are overpriced. The index ETF price is pinned down by the individual stock prices due to index arbitrage and is over-valued whenever individual stocks are.

Commonality in disagreement is essential for the return prediction in proposition 1. Without common disagreement (i.e., if $\beta_i = 0$ for all stocks), there is only a level effect in price ($P_{ETF} > m$) and no effect on market return because the average disagreement across stocks is constant.

This proposition also contrasts the effect of common disagreement on market valuation and the effect of individual stock disagreement on individual stock valuation. A number of papers (e.g. Miller (1977), Diether, Malloy, and Scherbina (2002), and Chen, Hong, and Stein (2002)) document that a stock with higher disagreement tends to be more over-valued. However, this effect is attenuated by the presence of risky arbitrageurs because the most over-valued stocks attract arbitrageurs first. In the equilibrium, the relation between individual stock disagreement and valuation is non-monotone. The stocks indexed by $i \geq \kappa$ are over-valued to the same degree due to risky arbitrageurs' short sales. When the risky arbitrage capital W_A increases, κ decreases. When W_A increases to the point that $\kappa = 0$, all stocks have the same valuation as P_0 and the mechanism described in Miller (1977) is arbitraged away. However, the market remains over-valued as long as $P_0 > m$ which shows that the effect of common disagreement on market valuation is more robust to arbitrageurs than the effect of individual stock disagreement on individual stock valuation. A concrete example is provided next.

Example 1 *For ease of illustration, assume* ε_i^f *is uniformly distributed between* $[-1, 1]$. *Set the parameters* $m = 1$, $W = 4$, $c_s = 1/2$ *(which conforms to the Federal reserve initial margin requirement), and*

$$\sigma_i = \frac{1}{2 - i}.$$

which is obtained from (2) by setting $\sigma = 1, \alpha_i = 0, \beta_i = 1/(2-i)$. *The individual stock disagreement increases from* $\sigma_0 = 1/2$ *to* $\sigma_1 = 1$. *It can be solved from (25) that when* $W_A \leq 1/10$,

$$P_i = \begin{cases} 1 + \frac{1}{5-2i} & \text{if } i \leq \kappa \\ P_\kappa & \text{if } i > \kappa \end{cases}$$

$$\kappa = 1 - 2W_A - \sqrt{2W_A(2W_A + 3)}$$

and when $1/10 \leq W_A \leq 1/2$,

$$P_i = \frac{5}{4} - \frac{1}{2}W_A \quad \text{for all } i.$$

The equilibrium stock prices are plotted in figure 1. When arbitrage capital $W_A = 0$, $\kappa = 1$. *All the individual stocks (hence the market) are over-valued and the prices are shown as line A-B-C in figure 1. In this case, the Miller (1977) prediction holds – stocks with higher disagreement are more over-valued. When* W_A *increases,* κ *decreases and the most over-valued stocks gradually become less over-valued (line A-B-D in figure 1). When* $W_A = 0.1$, $\kappa = 0$ *and all stocks have the same price* $P_0 = 1.2$ *(line A-E in figure 1). At this point, the Miller (1977) mechanism is arbitraged away yet the market is still over-valued than the fundamental* $m = 1$. *The market is arbitraged back to its fundamental (line F-G in figure 1) only if* W_A *increases to* 0.5.

The arbitrage capital required to bring the market valuation back to its fundamental ($W_A = 0.5$ in the example, i.e. the total levered arbitrage capital W_A/c_s equals 100% of the total fundamental value of the market) is substantially larger than the capital required to remove the effect of individual stock disagreement on individual stock over-valuation ($W_A = 0.1$ in the example, i.e. the total levered arbitrage capital W_A/c_s is 20% of the total fundamental value of the market). The reason is that the arbitrageurs have to confront buying from additional mutual funds who did not invest in the stocks originally but are subsequently attracted when the share prices are driven lower by the arbitrageurs.

The previous example shows the effect of arbitrage capital on stock prices. The next example shows the effect of common disagreement on stock prices.

Example 2 *The same setup as in Example 1 except that the common disagreement decreases to* $\sigma = 1/2$ *which implies the disagreement for stock i is*

$$\sigma_i = \frac{1}{4-2i}.$$

It can be similarly calculated that when $W_A \leq 1/9$,

$$P_i = \begin{cases} 1 + \frac{1}{9-4i} & \text{if } i \leq \kappa \\ P_\kappa & \text{if } i > \kappa \end{cases}$$

$$\kappa = 1 - 2W_A - \sqrt{W_A(4W_A + 5)}$$

and when $1/9 \leq W_A \leq 1/2$*,*

$$P_i = \frac{8}{7} - \frac{2}{7} W_A \quad \textit{for all } i.$$

It can then be verified that the stock prices P_i *are lower when the common disagreement* $\sigma = 1/2$ *than when* $\sigma = 1$ *in Example 1 for given arbitrage capital* W_A*, consistent with proposition 1.*

2.4 A dynamic model

In this section, I extend the static equilibrium in the previous section to a dynamic setting to study the effect of common disagreement on time-varying expected return and discount rate news. Specifically, I consider a parsimonious overlapping generations model with two-period-lived investors (Samuelson (1958) and De Long, Shleifer, Summers, and Waldmann (1990)). Because the model here discusses the cross section of stocks in addition to the aggregate market as in De Long, Shleifer, Summers, and Waldmann (1990), I make a few simplifying assumptions to streamline the analysis. First, I assume away the risky arbitragers, i.e., $W_A = 0$. From the previous section, additional risky arbitrage capital merely reduces overvaluation and does not qualitatively change the equilibrium. Given the absence of risky arbitragers, I will refer to a mutual fund (indexed by $f \in [0, 1]$) as an investor. Following De Long, Shleifer, Summers, and Waldmann (1990), the risk free rate, denoted by r_f, is assumed to be exogenous and constant over time. Given the dynamic setting, each stock i is now infinitely lived and pays off dividend $d_{i,t}$ in each period. The true dividend is assumed to be non-random and set to one in each period, i.e., $d_{i,t} = 1$. The fundamental value of each stock is $1/r_f$. However, each investor thinks the dividend is random has difference of opinion of the next period's dividend. Specifically, investor f at time $t-1$ expects the dividend next period is

$$1 + \sigma_{i,t} \varepsilon_{i,t}^{f} \tag{8}$$

where ε is independent and identically distributed across f and i. Since the disagreement is idiosyncratic across stocks, all investors (correctly) agree that the market dividend is 1 hence the market fundamental is $1/r_f$. For simplicity, I assume

$$\sigma_{i,t} = \begin{cases} \sigma_h \geq 0 & \text{with probability } p \\ \sigma_l = 0 & \text{with probability } 1-p \end{cases}$$

where the realization is independent across t. I.e., in some periods the disagreements across all individual stocks are high and, in other periods, there are no disagreement. The independent realization of disagreement implies disagreement is expected to mean revert in one period. Investors are aware that the disagreement changes over time. ε is further assumed to be uniformly distributed between $[-1, 1]$. Let $P_{i,t}$ and $P_{ETF,t}$ denote the ex-dividend price of stock i and the ETF. The model is otherwise identical to that in the previous section.

Given the symmetry of the individual stocks and the independent realization of disagreement $\sigma_{i,t}$ over time, I look for a stationary equilibrium in which the ex-dividend prices of individual stocks satisfy

$$P_{i,t} = P_{ETF,t} = \begin{cases} P_h & \text{if } \sigma_{i,t} = \sigma_h \\ P_l & \text{if } \sigma_{i,t} = 0 \end{cases}$$

and let b_h denote the cutoff so that investors with belief $\varepsilon \geq b_h$ will hold a stock when there is high disagreement. Present value relation implies

$$\begin{aligned} P_h &= \frac{1}{1+r_f}\left(1 + \sigma_h b_h + pP_h + (1-p)\, P_l\right) \\ P_l &= \frac{1}{1+r_f}\left(1 + pP_h + (1-p)\, P_l\right). \end{aligned} \tag{9}$$

In order for the stock market to clear, the stock market capitalization must equal the amount of funds willing to hold the stock

$$P_h = W\frac{1-b_h}{2} \tag{10}$$

(9) and (10) can be solved to give P_h, P_l, b_h. Let $E_h\left[r_{ETF}\right]$ and $E_l\left[r_{ETF}\right]$ be the expected one-period market return under the true probability when there is high (or low) disagreement.

Proposition 2 (Time-varying expected return) *When $W/2 > 1/r_f$, there exists an equilibrium in which the individual stock and the ETF price is P_h (or P_l) when common disagreement is high (or low).*

$$\begin{aligned} P_h &= \frac{1}{r_f}\left(1 + \frac{(r_f W - 2)}{r_f W\,(1+r_f) + 2\sigma_h\,(r_f + p)}\,(r_f + p)\,\sigma_h\right) \\ P_l &= \frac{1}{r_f}\left(1 + \frac{(r_f W - 2)}{r_f W\,(1+r_f) + 2\sigma_h\,(r_f + p)} p\sigma_h\right) \end{aligned}$$

and the prices are higher than the market fundamental

$$P_h > P_l > \frac{1}{r_f}.$$

Further,

$$E_h\left[r_{ETF}\right] < E_l\left[r_{ETF}\right] = r_f.$$

The above proposition implies that when common disagreement is high, the market price is high and the expected return going forward is low. In those periods when there is no disagreement, the market price is still higher than fundamental because of the possibility to sell shares at a higher price in the future when disagreement emerges. When disagreement completely disappears ($\sigma_h \to 0$), both P_h and P_l converge to the market fundamental $1/r_f$.

In the representative agent framework, one can decompose unexpected stock returns into two components – cash flow news and discount rate news (see for example Campbell and Shiller (1989), Campbell (1991), and Campbell and Vuolteenaho (2004)). Specifically, let r_t denote *log* market return, Campbell and Vuolteenaho (2004) use a loglinear approximate decomposition of returns:

$$\begin{aligned} r_{t+1} - E_t r_{t+1} &= (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j r_{t+1+j} \\ &= NCF_{t+1} - NDR_{t+1} \end{aligned} \tag{11}$$

where d denotes the log dividend, Δ denotes a one-period change, E_t denotes a rational expectation at time t, and ρ is a coefficient used in the loglinear approximation which Campbell and Shiller (1989) set to the average log dividend yield. NCF denotes news about future cash flow and NDR denotes news about future discount rates (i.e., expected returns).

One can map the equilibrium in proposition 2 into (11) to decompose return into cash flow and discount rate news component, where the expectation in (11) can be taken to be any investor's expectation. Because the disagreements are idiosyncratic, all investors agree on the probability distribution of future market dividends and market prices. Specifically, all investors correctly agree that the expected market dividend is 1. There is no cash flow news. Therefore, all unexpected return is attributed to discount rate news which leads to the following proposition.

Proposition 3 (Discount rate news) *Under the setting of proposition 2,*

$$NCF_{t+1} = 0 \quad \text{for all } t$$

$$NDR_{t+1} = \begin{cases} (1-p)\left[\log\left(1+P_l\right) - \log\left(1+P_h\right)\right] < 0 & \text{if } \sigma_{i,t+1} = \sigma_h \\ p\left[\log\left(1+P_h\right) - \log\left(1+P_l\right)\right] > 0 & \text{if } \sigma_{i,t+1} = \sigma_l \end{cases}$$

As a result, if an econometrician decomposes market return into discount rate news and cash flow news using VAR similar to Campbell and Vuolteenaho (2004), the resulting discount rate news but not cash flow news will correlate with innovations in measures of common disagreement. This finding is indeed confirmed in the empirical section 3.5.

2.5 Testable implications

The model is based on the premise that individual stock disagreements have a common component and that this common disagreement is mean reverting. Based on this premise, propositions 1 and 2 imply that expected market return relates negatively to common disagreement.

Proposition 3 implies that variations in the common disagreement ought to correlate more with *contemporaneous* discount-rate news rather than cash-flow news. Therefore, commonality in disagreement is expected to have explanatory power on the time-series variations in the value premium because Campbell and Vuolteenaho (2004) shows growth stocks are more sensitive to discount-rate news than value stocks. Campbell and Vuolteenaho (2004) address unconditional value premium – exposures to discount-rate news make growth stocks less risky. This paper address time-varying expected value premium conditioning on common disagreement. Higher sensitivity of growth stocks to discount-rate news (hence to shocks to common disagreement) makes growth stocks more susceptible to mean reversion of common disagreement. When the common disagreement is high, the ex-post growth stock return is expected to be low.

3 Empirical findings

In this section, I empirically investigate the testable implications in section 2.5. After summarizing the data, I verify the premise that individual stock disagreements co-move and that the common component is mean-reverting. Then I document the negative relationship between common disagreement and ex-post market return and show that the common disagreement has substantial explanatory power even after controlling all the variables reviewed in Campbell and Thompson (2007). Finally, I show that the variations in common disagreement is correlated with discount-rate news rather than cash-flow news and that the common disagreement has explanatory power for the time-series variation in value premium.

3.1 Data

3.1.1 Proxies for beliefs

I use I/B/E/S dataset on analyst forecast of the earnings-per-share (EPS) long-term growth rate (LTG) as the main proxy for investors' beliefs regarding individual stocks' future prospects. This measure is used in a number of studies on differences-of-opinions, see Moeller, Schlingemann, and Stulz (forthcoming) for a recent example. Similar to Moeller, Schlingemann, and Stulz (forthcoming), I feature disagreement constructed from the long-term growth forecast, instead of yearly forecasts, is that it features prominently in valuation models.[9] This long-term forecast also has several other advantages. First, yearly earnings forecasts are affected by how close a firm is to the end of a fiscal year and by how important earnings guidance is for a firm. These considerations are less likely to influence the long-term growth forecast. Second, yearly forecasts typically have to be normalized to be made comparable across firms and the normalization may introduce noise in comparisons of forecasts across firms (Qu, Starks, and Yan (2004) and Cen, Wei, and Zhang (2007)). Because the long-term forecast is an expected growth rate, it is directly comparable across firms.

The sample period is December 1981 – December 2005. From the unadjusted I/B/E/S summary database, I obtain, for each firm i in each month t, the mean and the standard deviation of analyst forecasts of long-term EPS growth rate and denote them $STKLTG_{i,t}$ and $STKDISAG_{i,t}$.[10] Both $STKLTG_{i,t}$ and $STKDISAG_{i,t}$ are in percentage points. From the Center for Research in Security Prices (CRSP), I obtain monthly stock closing prices and shares outstanding. Only

[9] I will construct disagreement from fiscal year forecasts in the robustness checks in section 3.7.

[10] I take the mean and the standard deviation of analyst forecasts directly from I/B/E/S summary database instead of constructing them from I/B/E/S detailed file of individual analyst forecasts so that the results can be readily verified. Diether, Malloy, and Scherbina (2002) find that summary statistics constructed from the detailed I/B/E/S file closely track the values in the summary I/B/E/S file.

common stocks (CRSP item SHRCD = 10 or 11) listed on NYSE / AMEX / NASDAQ are included. Let $MKTCAP_{i,t}$ denote the market capitalization of stock i at the end of month t.

Motivated by (4), the main proxy of common disagreement, denoted by $DISAG_t$, is the cross-sectional value-weighted average of individual stock forecast standard deviation,

$$DISAG_t = \sum_i MKTCAP_{i,t} \cdot STKDISAG_{i,t} \Big/ \sum_i MKTCAP_{i,t}. \tag{12}$$

It has been documented that analyst forecasts may be biased (see for example De Bondt and Thaler (1990), and Chan, Karceski, and Lakonishok (2003)). But it is not clear that a bias in the mean will affect the forecast standard deviation and its time-series variation in a systematic way. The rationale for using value-weight is that the market-wide disagreement would be much higher if difference-of-opinion increases for a big stock than for a small stock. As documented in La Porta (1996), I/B/E/S coverage is tilted towards big stocks compared to CRSP 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 $DISAG$ because of value-weight. I also use equal-weighted individual stock disagreements as a proxy for common disagreement in robustness check section 3.7.

I also construct the cross-sectional value-weighted average of individual stock mean forecast of long-term EPS growth rate and denote it LTG_t,

$$LTG_t = \sum_i MKTCAP_{i,t} \cdot STKLTG_{i,t} \Big/ \sum_i MKTCAP_{i,t}.$$

3.1.2 Stock return data

I obtain from CRSP the monthly NYSE / AMEX / NASDAQ value-weighted index return (including distributions) and the monthly individual stock returns. I also obtain from CRSP the one-month Treasury bill rate. The return data are from 1981 to the end of 2006. Excess market return – denoted by $MRET$ – is constructed by subtracting the Treasury bill rate from the market return. I also obtain data on discount-rate news NDR_t and cash-flow news NCF_t constructed from a return-decomposition in Campbell and Vuolteenaho (2004).[11] The sample period for the discount-rate and cash-flow news is 1981 to the end of 2001.

3.1.3 Other variables that correlate with ex-post market return

I obtain from Robert Shiller's website the level of S&P composite index and its earnings, from which I construct the monthly price-earnings ratio PE_t. From Martin Lettau's website, I obtain quarterly data on the consumption-wealth ratio CAY_t.[12] I also collect from John Camp-

[11] The data are downloaded from the American Economic Review journal website.

[12] In 2003 the BEA revised the definitions of several variables used by Lettau and Ludvigson (2001) to construct their series. I use the updated data available on Martin Lettau's website, not the original series used in Lettau and

bell's website some other variables that are known to correlate with ex-post returns. These variables are reviewed in Campbell and Thompson (2007) and include dividend-price ratio DP_t, smoothed earnings-price ratio $SMOOTHEP_t$, book-to-market ratio BM_t, short-term interest rate $SHORTYIELD_t$, long-term bond yield $LONGYIELD_t$, the term spread between long- and short-term Treasury yields $TERMSPREAD_t$, the default spread between corporate and Treasury bond yields $DEFAULTSPREAD_t$, the lagged rate of inflation $INFLATION_t$, and the equity share of new issues $EQUITYSHARE_t$. Monthly observations on these variables are available from 1981 to 2005.

3.1.4 Summary statistics

Figure 2 plots the time series of the common disagreement proxy $DISAG$. Table 1 provides summary statistics for the sample period of December 1981 – December 2005. The time-series average of common disagreement $DISAG$ is 3.28% and the time-series average of LTG is 14.26%. On average, the analysts expect the EPS of a typical stock to growth at the annual rate of 14.26% and the forecast dispersion, measured by standard deviation, on a typical stock is 3.28%. The average annual excess market return $MRET_{t,t+12}$ is 9.17% with a standard deviation of 16.32%. This table also reports summary statistics for the discount-rate news (denoted NDR) and the cash-flow news (denoted NCF) from Campbell and Vuolteenaho (2004) along with the return predictors reviewed in Campbell and Thompson (2007). The numbers are in line with these other studies.

3.2 Commonality in individual stock disagreements

Figure 2 suggests that the individual stock disagreements have a common component, which is further examined in this section using regression analysis. For each stock i, I follow Chordia, Roll, and Subrahmanyam (2000) and regress monthly proportional changes in individual stock disagreement $STKDISAG$ on proportional changes in the cross-sectional average disagreement $DISAG$,

$$\frac{STKDISAG_{i,t} - STKDISAG_{i,t-1}}{STKDISAG_{i,t-1}} = \alpha_i + \beta_i \frac{DISAG_t - DISAG_{t-1}}{DISAG_{t-1}} + \varepsilon_{i,t}. \quad (13)$$

I remove each individual stock from the computation of the market-wide disagreement $DISAG$ used in that stock's regression, so the right hand side regressor does not contain the left hand side variable and the estimated coefficients are not artificially constrained.

The results are reported in column (1) of table 2. The average slope coefficient β_i across stocks is 0.297, which implies a 1% increase in $DISAG$ is associated with a 0.297% increase in individual stock analyst disagreement. This relationship is statistically significant (t-stat = 2.22). 52% of the

Ludvigson (2001). Data revisions raise the issue that the series may not have been available to investors in real time. Similarly, Goyal and Welch (2005) point out that CAY is constructed using look-ahead data. Our goal is to see if commonality in disagreement has incremental explanatory power controlling for other variables that correlate with ex-post returns. If it is the case even when the control variable uses look-ahead information, this will, if anything, only strengthen our evidence.

time-series slope coefficients β_i are positive. 15.9% of them are positive significant, i.e. 15.9% of the Newey and West (1987) t-statistics in the time-series regressions are higher than 1.645 (the 5% critical level in a one-sided test). The cross-sectional median of β_i is 0.058. A signed test of the null hypothesis that median=0 is rejected in favor of a positive median with a p-value of 0.0005. Similar to Chordia, Roll, and Subrahmanyam (2000), the R-square in the time-series regression is low.

I also run another regression specification similar to (13) except that it also includes one lag of the change in $DISAG$ in the right-hand side to capture lagged adjustment of individual analyst forecast. The results are in column (2) of table 2 and are similar to that in column (1). The lagged changes in $DISAG$ are positively correlated with changes in $STKDISAG$, though both the economic and statistical significances are lower compared to contemporaneous changes in $DISAG$. The sum of the contemporaneous and lagged slope coefficients averages to 0.595 and is statistically significant (t-stat = 2.86). A 1% increase in contemporaneous and lagged $DISAG$ is associated with a 0.595% increase in individual stock analyst disagreement. A signed test of the null hypothesis that the median of sum is zero is rejected in favor of a positive median with a p-value of 0.0010.[13]

3.3 Mean reversion of common disagreement

Having established the commonality in individual stock disagreements, I next study the mean reversion property of the common disagreement which is where return predictability comes from. Specifically, I run the following regression

$$DISAG_t = \alpha + \beta \cdot DISAG_{t-lag} + \varepsilon_t \tag{14}$$

where $DISAG$ is the common disagreement defined in (12). The lag ranges from one month to three years. The results are reported in table 3. The common disagreement is positively auto-correlated. At one-month lag, the auto-correlation coefficient is 0.937 and highly statistically significant (t-stat = 47.76). The auto-correlation gradually decays as the number of elapsed months increases. The speed of decay is roughly in line with what an autoregressive model with order one (AR(1)) would predict. At the one-year horizon, the regression slope is 0.462 which implies that about 54% of a shock to the common disagreement mean reverts in one year. The estimate of β is close to zero at the three-year horizon which implies shocks to $DISAG$ largely mean reverts within three years.

Also reported in table 3 is the mean of $DISAG$ implied by the regression estimates of (14), i.e. implied mean $= \alpha/(1-\beta)$. Irrespective of the number of lags used, the implied mean of $DISAG$ is around 3.2 to 3.3 percentage points, consistent with the average of $DISAG$ reported in the summary statistics table 1.

The evidence suggests that the common disagreement mean reverts. The speed of mean re-

[13] For robustness, I have also run the regressions using equal-weighted average instead of value-weighted average of individual stock disagreements and the results are similar. The results are also similar using the level change as opposed to the proportional change in disagreement. These results are omitted for brevity and can be obtained from the author upon request.

version is slow. Less than seven percent of a shock to $DISAG$ mean reverts within one month. Roughly half of a shock to $DISAG$ mean reverts in one year. Almost all of the shocks to $DISAG$ mean reverts within three years.

3.4 Commonality in disagreement and subsequent market return

Having established that differences-of-opinion regarding individual stocks have a common component and that this common component mean reverts, I next examine the negative relationship between common disagreement and expected market return predicted by proposition 1 and 2.

Figure 3 shows the scatterplot of the common disagreement $DISAG_t$ and subsequent one-year market return in excess of linked one-month Treasury bill rate, denoted by $MRET_{t,t+12}$. A negative relationship between $DISAG_t$ and subsequent return is visible which is confirmed by a nonparametric local polynomial estimate of the expected subsequent one-year excess return conditioning on the common disagreement.[14] The upper 95% band for observations with large $DISAG_t$ is lower than the lower 95% band for observations with small $DISAG_t$. Therefore, figure 3 provides visual evidence on the negative relationship between common disagreement and ex-post market return. Further, the negative relationship is approximately linear. Therefore, I next run the following linear regression

$$MRET_{t,t+h} = \alpha + \beta \cdot DISAG_t + \varepsilon_t \qquad (15)$$

where $MRET_{t,t+h}$ is the excess market return from month t to $t+h$.[15] The horizon h ranges from 1 (one month) to 36 (three years). The results are in panel A of table 4. The point estimates of β are negative for all return horizons. $DISAG_t$ has the least explanatory power at the one month horizon, consistent with the finding in table 3 that only a small fraction of a shock to $DISAG_t$ mean reverts in one month. At the one-year horizon, the coefficient of $DISAG$ is -0.145 and is statistically significant (t-stat = 2.46). The economic magnitude is large – one standard deviation increase in $DISAG_t$ is associated with six percentage point reduction in subsequent one-year market return (e.g. 10% to 4%). To put the economic magnitude in perspective, the mean and the standard deviation of one-year market return during the same sample period are 9% and 16%, respectively. β roughly doubles when moving from one-year to two-year return. It further increases slightly when moving to three-year return. The results are consistent with the mean reversion property of common disagreement that a majority (86.2%) of a shock to $DISAG_t$ mean reverts in two years and therefore most of the explanatory power is expected to concentrate on one- and two-year return horizons.

[14] The nonparametric estimation is implemented by the LOWESS procedure in the statistical software package Stata using the default bandwidth. See Fan and Gijbels (1996) for more details on local polynomial estimation. The 95% pointwise confidence band adjusts for the correlation of overlapping annual returns using Newey and West (1987) with twelve lags.

[15] All the regressions in this paper have been re-run using raw market return instead of excess return over risk-free rate. The results are similar and therefore suppressed. They are available from the author upon request.

3.4.1 Econometric issues

The return horizons in equation (15) range from one month to three years. An econometric issue arises for long-horizon regressions because observations on long-horizon returns overlap which potentially biases the test statistics towards rejecting the null hypothesis of no predictive power, see for example Richardson and Stock (1989) and Hodrick (1992). I have used Newey and West (1987) t-statistics to account for the overlapping returns. In this section, I further examine this issue via two methods. The first method uses asymptotic distributions in Hodrick (1992) and Valkanov (2003) that are specifically designed for the long-horizon regression setup. The second method uses a different regression specification that does not rely on overlapping observations advocated in Hodrick (1992). To be consistent with Hodrick (1992) and Valkanov (2003), I present results using log excess returns as dependent variables although similar results are obtained using simple excess returns. The log excess market return from time t to $t+h$, denoted by $LOGMRET_{t,t+h}$, is defined as the log market return minus the log Treasury bill return, which is the log market return when Treasury bill instead of cash is used as numeraire.

Panel B of table 4 shows the t-statistics for common disagreement constructed from the Hodrick (1992) standard error which is shown to perform well in small samples by Ang and Bekaert (2007).[16] The point estimates using log returns are very similar to those using simple returns in panel A. The statistical significance implied by the Hodrick (1992) standard error is consistent with the Newey and West (1987) standard error in panel A.

Valkanov (2003) constructs a $t \Big/ \sqrt{T}$ test statistic from dividing the ordinary least-squares (OLS) t-statistic by the square root of the length of the sample period. The $t \Big/ \sqrt{T}$ statistic is designed specifically for the long-horizon regression setup and also allows for persistent right-hand-side regressors. Valkanov (2003) provides asymptotic distributions for the $t \Big/ \sqrt{T}$ statistic and the OLS R-square which are shown by simulation to have good small sample properties.[17] The results are shown in panel C of table 4. The negative relationship between common disagreement and ex-post return is statistically significant for all the return horizons of one to three years. Under the null hypothesis of zero slope coefficient for $DISAG$, the probability of observing the high regression R-square by chance is less than five percent.

Hodrick (1992) advocates an alternative regression specification that does not use overlapping returns. The idea is that the slope coefficient of regressing h-horizon return $LOGMRET_{t,t+h}$ on common disagreement $DISAG_t$ is derived from

$$cov\left(LOGMRET_{t,t+1} + \cdots + LOGMRET_{t+h-1,t+h}, DISAG_t\right)$$

[16] Specifically, the standard error is calculated using equation (8) in Hodrick (1992).

[17] These asymptotic distributions can be obtained by simulation and depend on a nuisance parameter c which I construct using the procedure in Stock (1991) which is suggested by Valkanov (2003).The nuisance parameter is set to $c = -16.482$. The other parameters used in Valkanov (2003) are set to $\delta = 0.1725$, number of simulation sample paths = 10000, step size in discretizing the continuous-time stochastic processes = 1/10000.

which, for stationary series, is equivalent to

$$cov\left(LOGMRET_{t,t+1}, DISAG_t + \cdots + DISAG_{t-h+1}\right).$$

This suggests a regression specification of one-month return on lagged h-month moving average ($MA(h)$) of common disagreement,

$$LOGMRET_{t,t+1} = \alpha + \beta \cdot \left(h^{-1}\sum_{\tau=0}^{h-1} DISAG_{t-\tau}\right) + \varepsilon_t. \tag{16}$$

The estimation results are in panel D of table 4. Similarly, I find a negative relationship between common disagreement and ex-post market return. The relationship is the strongest for return horizons around one to two years. The adjusted R-squares are lower than those in panel A because the dependent variable is one-month return now.

Stambaugh (1999) discusses a regression bias that arises when return is regressed on a lagged stochastic regressor and innovations to the regressor and return are correlated. Unlike the example of dividend-yield studied in Stambaugh (1999), the regressor disagreement in this paper is constructed without using price and does not mechanically relate to the market return. Nonetheless, I conduct a simulation to measure the potential magnitude of the Stambaugh (1999) bias. The simulation is similar to those in Kothari and Shanken (1997), Ang and Bekaert (2007), and Lewellen (2004). In the simulation, the "true" coefficients are set to the estimates of equation (16). $DISAG$ is assumed to follow an AR(1) process with coefficients given by column (1) of table 3. The error terms are drawn with replacement from the joint empirical distribution of the two residuals in the regression (16) and in the regression in column (1) of table 3. The Stambaugh (1999) bias in panel D of table 4 is measured by the difference between the average β coefficient of regression (16) in the simulation and the "true" coefficient. The bias is very small compared to the actual estimate. For example, in the one-year return regression, the estimate of β is -0.0149 and the bias is -0.0010 which is much smaller than the Stambaugh (1999) bias for dividend-yield. This panel also shows the p-value of a two-sided test that β is zero by comparing the t-statistic in the actual regression (16) to the percentiles of the t-statistics in a second simulation which is identical to the first simulation except that the "true" β is set to 0. The p-value from simulation is consistent with the p-value implied by the asymptotic distribution in the actual regression.

3.4.2 Control for turnover

In panel E of table 4, I repeat the regression (15) by including market turnover as control variable. Higher turnover can imply lower required rate of return due to reduced trading cost (see Amihud, Mendelson, and Pedersen (2005) for a recent survey). The literature on disagreement in individual securities when investors face short-sales constraint can imply that high turnover is also a proxy for disagreement, see for example Scheinkman and Xiong (2003) and Baker and Stein (2004). I measure market turnover by the average monthly turnover in the past twelve months and denoted it by $TURNOVER$. I use turnover in the past twelve months to avoid seasonality in turnover within a year (see Hong and Yu (2006)). Turnover has increased sharply in recent years. Following Baker and Stein (2004), I stochastically detrend $TURNOVER$ by subtracting the average turnover in the previous five years from it and the regression includes as additional control variables dividend-price ratio DP and equity share of new issues $EQUITYSHARE$. Panel E of table 4 reports regression results both with and without $DISAG$. Without including $DISAG$ in the regression, the coefficients of $TURNOVER$ are negative and statistically significant for the one- to three-year return horizons. To the extent that turnover can be a proxy for disagreement, this is supportive evidence for the model predictions of this paper. However, I take the conservative stance by controlling turnover to account for potential liquidity explanation when adding $DISAG$ into the regression. When $DISAG$ is included in the regression, the statistical and economic significance of $TURNOVER$ is reduced. The coefficients of $DISAG$ are statistically significant and have similar magnitudes to those in table 4. There are also substantial improvements in the regression adjusted R-squares. This suggests $DISAG$ has explanatory power for market return in addition to the information contained in turnover.

3.4.3 Control for other market return predictors

I next run the same regression as in (15) except that I also control for the expected long-term growth rate of earnings-per-share (LTG) and the price-earnings ratio (PE),

$$MRET_{t,t+h} = \alpha + \beta \cdot DISAG_t + \gamma \cdot LTG_t + \delta \cdot PE_t + \varepsilon_t \tag{17}$$

The rationale for controlling LTG and PE is that the sample period contains the dot-com era. From anecdotal evidence, investors have high differences-of-opinion in this era, high expectation of the growth rate of dot-com companies which are also awarded high valuation ratios. This regression is intended to see if the common disagreement has additional explanatory power beyond LTG and PE. The results are shown in panel F of table 4. Both the economic and statistical significances of $DISAG$ remain similar to those in regression (15). The expected long-term growth rate LTG has almost no effect on subsequent market return, which differs from the cross-sectional result in La Porta (1996). This is consistent with the explanation that expectations regarding the market are, on average, not too far off from the true value which is assumed in the model in section 2. Unlike LTG, the coefficient of PE is statistically significant for the one-year return horizon, and is marginally significant for other horizons. This raises the question of whether the effect of $DISAG$ on return will persist if other variables known to correlate with ex-post market return are controlled for, which I investigate next.

I include in regression (15) a host of other variables that are known to correlate with ex-post market returns. These variables are reviewed in Campbell and Thompson (2007) and Goyal and Welch (2005) and include price-earnings ratio PE, consumption-wealth ratio CAY, dividend-price ratio DP, smoothed earnings-price ratio $SMOOTHEP$, 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 $DEFAULTSPREAD$, the lagged rate of inflation $INFLATION$, and the equity share of new issues $EQUITYSHARE$.

I start by adding these other variables one at a time into equation (15). The regressions use monthly data except for CAY (quarterly). The results are presented in panel A1 and A2 of table 5. In panel A1, the slope coefficients of $DISAG$ are universally negative across the return horizons and the added control variables. The estimates are statistically significant for all regressions involving the one- and two-year return horizons and for most three-year return horizons. The magnitudes of the estimates are stable across different control variables and are in line with those in panel A of table 4. Panel A2 shows the slope coefficients of the control variables and regression R-squares. For brevity, only results from the one-year return regressions are shown. The results using the two- and three-year returns are similar. When I run univariate regressions of the one-year ex-post market return on the other return predictors one by one (i.e. when $DISAG$ is not included), the coefficients of these other return predictors are largely similar to those reported by earlier literature. Most of the valuation ratios such as price-earnings ratio, dividend-price ratio are statistically significant, though the interest rate predictors such as term spread and default spread are less statistically significant than other studies using longer time-series data. When $DISAG$ is included in the regression in addition to the other univariate control, the regression fit improves substantially. For example, price-earnings ratio alone accounts for 14.9% of the variations in one-year market return. When $DISAG$ is included in addition to the price-earnings ratio, the regression adjusted R-square improves to 26.5%. Similar improvements are observed for other control variables. The better fit from $DISAG$ even improves the statistical significance of some return predictors such as the smoothed earnings-price ratio, the book-to-market ratio, the default spread, and the equity share of new issues.

Next, I add these return predictors all at once into regression specification (15).[18] Specifically, I run the following regression

$$\begin{aligned} MRET_{t,t+h} &= \beta_0 + \beta_1 \cdot DISAG_t + \beta_2 \cdot PE_t + \beta_3 \cdot CAY_t + \beta_4 \cdot DP_t + \beta_5 \cdot SMOOTHEP_t \\ &\quad + \beta_6 \cdot BM_t + \beta_7 \cdot LONGYIELD_t + \beta_8 \cdot TERMSPREAD_t \\ &\quad + \beta_9 \cdot DEFAULTSPREAD_t + \beta_{10} \cdot INFLATION_t \\ &\quad + \beta_{11} \cdot EQUITYSHARE_t + \varepsilon_t \end{aligned} \tag{18}$$

The variable $SHORTYIELD$ is omitted from the right-hand side because it is multicollinear with $LONGYIELD$ and $TERMSPREAD$. The results are in panel B of table 5. The coefficient for common disagreement, β_1, is the one of interest. β_1 remains statistically and economically significant at the one-year to three-year return horizons. Panel B provides two adjusted R-squares.

[18] In this case, I convert CAY into monthly data by assigning to a missing CAY the last available quarterly CAY value.

The first R-square is for the regression (18). The second R-square is for a regression that is otherwise identical to (18) except that it leaves out $DISAG_t$. There is substantial improvement in regression fit when common disagreement is included. For example, even after controlling for all of the known return predictors, the adjusted R-square in the one-year return regression is only 21.7% compared to 37.8% when $DISAG_t$ is added. Substantial improvements in fit are also observed in two- and three-year return regressions.

3.4.4 Subsample analysis

The scatterplot in figure 3 indicates that the return predictability results in table 5 are not driven entirely by the dot-com era, which is further corroborated using subsample analysis in this section. Specifically, I break the entire sample period of December 1981 – December 2005 in the middle into two subsamples.[19] 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. I then apply regression specification (18) separately to each subsample.

The results are in table 6. Similar to panel B of table 5, there is a statistically and economically significant negative relationship between common disagreement and return for horizons ranging from one- to three-years, consistent with the mean reversion speed of $DISAG$ documented in table 3. In both subsamples, the slope coefficients of $DISAG$ have similar magnitudes for the one-year horizon. For the two- and three-year horizons, the effect of $DISAG$ is larger in the dot-com era though it is also statistically and economically significant in the earlier subsample. Judging from the regression adjusted R-squares, common disagreement provides additional explanatory power in both the dot-com era and the earlier subsamples. I have also repeated the subsample analysis controlling the other return predictors one-by-one using only those variables that are statistically significant in Panel A2 of table 5 and the results are similar.[20]

3.4.5 Commonality in idiosyncratic disagreement or disagreement in the aggregate?

In section 2, the model assumes away disagreement in the aggregate market to single out the effect of commonality in purely idiosyncratic disagreements. In reality, disagreement in the market can also contribute to common individual stock disagreement through individual stocks' loadings on the market, which can affect market valuation through the same mechanism as in section 2. This section aims to disentangle the effect on market return from commonality in purely idiosyncratic disagreement and from commonality in disagreement inherited from disagreement in the market.

The I/B/E/S dataset provides analyst forecasts on annual S&P 500 index earnings in the sample period of 1982-2001.[21] Following Diether, Malloy, and Scherbina (2002), I measure disagreement in

[19] I have used other subsample classifications such as before/after year 1990 and obtained similar results. These results are suppressed for brevity and are available from the author upon request.

[20] These results are suppressed for brevity and are available from the author upon request.

[21] After 2001, most analysts cease issuing forecasts of S&P 500 earnings and issue forecasts of S&P 500 operating earnings instead.

the market by the analyst forecast standard deviation of S&P 500 earnings as a percentage of average analyst forecast and denote it $MKTDISAG$. Within a year, as additional quarterly earnings reports are released, the disagreement over the annual earning is likely to decrease mechanically. To address this, I measure $MKTDISAG$ in each December using forecasts for fiscal year ending in December next year and set $MKTDISAG$ in January–November to its value in December of previous year.[22]

I study the effect of disagreement in the aggregate on subsequent market return by running the following two regression specifications,

$$MRET_{t,t+h} = \alpha + \beta \cdot MKTDISAG_t + \varepsilon_t \tag{19}$$

$$MRET_{t,t+h} = \alpha + \beta \cdot MKTDISAG_t + \gamma \cdot DISAG_t + \varepsilon_t. \tag{20}$$

The regression results are presented in table 7. Panel A indicates that the disagreement in the aggregate, measured by $MKTDISAG$, is negatively associated with ex-post market return and the effect is stronger for one- and two-year returns, consistent with the prediction in section 2. Even after disagreement in the aggregate is controlled for, panel B shows that common (individual stock) disagreement has a significantly negative relationship with ex-post market return. The magnitudes of the negative relationship are similar to those in table 4. A one-standard-deviation increase in $MKTDISAG$ (or $DISAG$) is associated with a drop of 4.09 (or 7.70) percentage point in market return of the subsequent 12 months with a t-statistic of 3.24 (or 4.69). For the 12 month return horizon, the regression adjusted R-square for the univariate regression (19) using only $MKTDISAG$ is 7.2% and is 35.4% for the bi-variate regression (20) using both $MKTDISAG$ and $DISAG$. Results for other return horizons similarly suggest that, even though disagreement in the aggregate is negatively associated with subsequent returns, a majority of the explanatory power is due to the commonality in idiosyncratic disagreements. When interpreting the results, it is worth noting that $MKTDISAG$ may be a noisy measure of the true disagreement in the market. In the sample period, there is an average of 22 analysts forecasting S&P 500 earnings in a given month. Compared to $DISAG$ constructed from many analysts and then averaged across many stocks, $MKTDISAG$ is likely to be noisier. With this caveat in mind, the evidence suggests that ex-post market return is to a larger extent affected by commonality in idiosyncratic disagreement than by disagreement in the market.

3.5 Commonality in disagreement and discount-rate news

Proposition 3 shows that innovations in common disagreement correlate with *contemporaneous* discount-rate news insteaad of cash flow news. To test this implication, I run the following regression

$$DISAG_t - DISAG_{t-h} = \alpha + \beta \cdot NDR_{t-h,t} + \gamma \cdot NCF_{t-h,t} + \varepsilon_t \tag{21}$$

[22] I have also used the raw monthly observations of $MKTDISAG$ and the results are fairly similar. These results are omitted for brevity and available from the author upon request.

where $DISAG$ is the common disagreement. $NDR_{t-h,t}$ is the discount-rate news from month $t-h$ to t, constructed as the sum of the monthly discount-rate news $NDR_{t-h+1}, ..., NDR_t$ from the return decomposition in Campbell and Vuolteenaho (2004). Similarly, $NCF_{t-h,t}$ is the cash-flow news from month $t-h$ to t, constructed as the sum of the monthly cash-flow news $NCF_{t-h+1}, ..., NCF_t$ in Campbell and Vuolteenaho (2004). The length of the window h ranges from one month to three years.

The results are presented in table 8. The changes in common disagreement correlate negatively with contemporaneous discount-rate news and the relationship is statistically significant for all h. I.e., an increase in common disagreement is associated with a contemporaneous reduction in discount rate. In contrast, the estimated coefficients for cash-flow news have different signs depending h and none of them are statistically significant. This confirms the prediction that the variations in the common disagreement relate primarily to discount-rate news rather than cash-flow news. I note that, in this heterogeneous agent framework, the discount rate news come not from the adjustment of required rate of return of any actual investor, but from the market aggregating time-varying heterogeneous beliefs in the cross-section.

3.6 Commonality in disagreement and the value premium

The previous section finds evidence that the variations in common disagreement correlate mainly with discount-rate news rather than cash-flow news. Campbell and Vuolteenaho (2004) find that growth stocks have much higher discount-rate beta than value stocks since 1960s. This suggests that growth stocks are more susceptible to swings in the common disagreement and that mean reversion in the common disagreement has a bigger impact on growth stocks than on value stocks. In this section, I provide evidence supportive of this prediction and document the explanatory power of common disagreement on the time-series variations of Fama and French (1993) HML factor return.

I begin by studying the sensitivity of growth/value stock returns to contemporaneous variations in $DISAG$. 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 value using NYSE breakpoints.[23] Let $LRET_{t-h,h}$ (or $HRET_{t-h,h}$) refer to the value-weighted portfolio returns of growth (or value) stocks from month $t-h$ to t in excess of linked one-month Treasury bill rate, I run the following regression separately for growth and value stocks,

$$LRET_{t-h,h} \text{ (or } HRET_{t-h,h}) = \alpha + \beta \cdot (DISAG_t - DISAG_{t-h}) + \varepsilon_t. \tag{22}$$

The return horizon h ranges from one month to three years. The results are in panel A of table 9. Contemporaneously, growth stock returns are positively correlated with shocks to $DISAG$. The correlation is statistically significant for all return horizons. In contrast, the correlations between value stock returns and variations in $DISAG$, though positive, have smaller magnitudes and less statistical significance. As predicted, growth stocks are more sensitive to shocks in common

[23] Book-to-market ratios are constructed as in Daniel and Titman (2006) and I exclude firms with negative book values.

disagreement than value stocks.[24]

When the common disagreement is high, it tends to mean revert (see table 3). Given that growth stock returns are more sensitive to the variations in $DISAG$, one would expect the negative relationship between $DISAG$ and subsequent return to be stronger for growth stocks than for value stocks. To examine this, I regress ex-post growth/value stock portfolio returns separately on $DISAG$,

$$LRET_{t,t+h} \text{ (or } HRET_{t,t+h}) = \alpha + \beta \cdot DISAG_t + \varepsilon_t. \tag{23}$$

Panel B of table 9 shows the results. Consistent with section 3.4, both growth and value stock portfolios correlate negatively with $DISAG$, especially so for the one- to three-year return horizons. As expected, the negative relationship is stronger for growth stocks than for value stocks, both in terms of the economic and statistical significance of β and in terms of the regression R-squares.

Given the different effect of common disagreement on ex-post growth and value stock returns, one might wonder whether $DISAG$ has explanatory power for the time-series variations of the Fama and French (1993) HML factor premium. To study this, I download the HML returns from Kenneth French's website and run the following regression,

$$HML_{t,t+h} = \alpha + \beta \cdot DISAG_t + \varepsilon_t \tag{24}$$

where $HML_{t,t+h}$ refers to HML return from month t to $t+h$. The results are presented in panel C of table 9. The coefficients of $DISAG$ are all positive and are statistically significant for return horizons from one to three years, consistent with the previous finding that the relationship between ex-post return and $DISAG$ is less negative for value stocks than for growth stocks. The coefficient of $DISAG$ for the one-year return horizon is 0.152 (t-stat = 2.38). This implies that one standard deviation increase in $DISAG$ is associated with an increase of 6.5 percentage point (e.g. 5% to 11.5%) in HML factor premium in the subsequent year, which is economically significant. The economic magnitude is also large for the two- to three-year return horizons. The adjusted R-squares range from 21.4% in the one-year regression to 35.7% in the three-year regression. To ensure the result is not entirely driven by the dot-com era, I conduct a subsample analysis by breaking the sample period in the middle and run the regression specification (24) separately for the two subsample periods. The results are presented in panel D of table 9. Equation (24) has better fit and the economic magnitude is larger in the dot-com era. Nonetheless, the coefficient of $DISAG$ is also statistically and economically significant in the earlier subsample.

[24] The difference is statistically significant for all return horizons except one-month. This conclusion is reached by running a pooled regression of growth and value stock returns on changes in $DISAG$, a dummy variable that equals 1 (0) for growth (value) stock portfolio, and their interactions. The coefficient in front of the interactive term is statistically significant at 99% level for all return horizons except one-month. This regression result is suppressed for brevity and is available from the author upon request.

3.7 Robustness checks

In this section, two types of robustness checks are conducted. I construct alternative proxies of common disagreement and consider some additional control variables.

The first alternative proxy of common disagreement is the equal-weighted average of individual stock disagreements (denoted by $EWDISAG$). Equation (15) is then re-estimated using $EWDISAG$ to replace $DISAG$. The results are presented in panel A of table 10. Similar to table 4, there is a statistically and economically significant negative relationship between common disagreement and ex-post market returns.

I have also run the regression of ex-post market return on common disagreement (both value-weighted and equal-weighted) except that the sample is restricted to stocks with at least five analysts. The results are similar to those in panel A of table 4 and panel A of table 10.[25]

The next proxy of common disagreement is constructed using the I/B/E/S analyst forecasts of next fiscal-year earnings-per-share (EPS) instead of forecasts of long-term EPS growth rate. To avoid data mining, I follow Diether, Malloy, and Scherbina (2002) and measure the disagreement over a stock by analyst forecast standard deviation scaled by the absolute value of average forecast. Value-weighted average of this alternative proxy of individual stock disagreement is used to measure common disagreement, denoted by $FYDISAG$. Within a fiscal year, as additional quarterly earnings reports are released, the disagreement over the fiscal-year EPS is likely to decrease mechanically. To address this, I include only firms whose fiscal years end in December. I measure $FYDISAG$ in each December by using forecasts for fiscal year ending in December next year and set $FYDISAG$ in January–November to its value in December of previous year. Column (1) of panel B reports the regression results of ex-post one-year excess market return on $FYDISAG$. I similarly find a negative relationship between common disagreement and ex-post return. However, when both $DISAG$ and $FYDISAG$ are included in the regression in column (2) of panel B, the coefficient of $FYDISAG$ becomes insignificant yet the coefficient of $DISAG$ remains statistically significant with similar magnitude to that in table 4. One possible reason why $DISAG$ drives out the effect of $FYDISAG$ is that $DISAG$ – constructed from forecasts of long-term growth rate – is a better proxy of disagreement than $FYDISAG$ which only uses forecasts for the next fiscal year. The construction of $FYDISAG$ also requires scaling the standard deviation of EPS forecasts. As pointed out in Qu, Starks, and Yan (2004) and Cen, Wei, and Zhang (2007), scaling by the absolute value of average forecast as in Diether, Malloy, and Scherbina (2002) may include other variations unrelated to disagreement which makes it a noisy proxy.

I then consider some other control variables when studying the relationship between common disagreement and subsequent market return. De Bondt and Thaler (1985) and Fama and French (1988b) show that the stock market exhibits negative autocorrelation for long-horizon returns, see also Summers (1986). In panel C of table 10, I control for lagged excess market return $MRET_{t-h,t}$ when regressing ex-post market return $MRET_{t,t+h}$ on common disagreement $DISAG_t$. The coefficient of lagged return is negative and statistically significant for the three-year horizon, consistent

[25] The results are suppressed for brevity and available from the author upon request.

with Fama and French (1988b). However, even after controlling for lagged return, the point estimate and the statistical significance of $DISAG$ remain similar to those in table 4.

4 Conclusion

"Prices change in substantial measure because the investing public en masse capriciously changes its mind." (Shiller (1989)) In this paper, I study the effect on market valuation and its subsequent returns from changing disagreements over many individual stocks. Disagreements, together with short-sales constraint facing *some* investors, lead to over-valuation of the individual stocks which is translated to over-valuation of the market through index arbitrage, even if all investors agree correctly on the prospect of the aggregate market.

I report empirical evidence of statistically and economically significant explanatory power of commonality in disagreement on the time-series variations of equity premium, even after controlling for all the variables reviewed in Campbell and Thompson (2007) that are known to correlate with ex-post market returns. The result is unlikely due to data-snooping. The empirical test is motivated by theory and the return horizons at which common disagreement has the strongest explanatory power are consistent with the speed of mean reversion in common disagreement. The result is robust in different subsample periods. Commonality in disagreement is also found to explain the time-series variations of the value premium. This is because both the model and the data indicate variations in the common disagreement correlate primarily with discount-rate news to which growth stock returns are more sensitive than value stocks (Campbell and Vuolteenaho (2004)).

The theory proposed in this paper implies market over-valuation can sustain even if all investors are aware of it which has implications for the dot-com era. If individual stocks such as internet companies are held by optimistic investors, the market valuation simply aggregates these optimistic views. Even if all investors know the market is over-valued, price does not return to fundamental without risky arbitrageurs. Considering that the early short-sellers in internet stocks suffered substantial losses, the risky arbitrage capital is likely to be constrained exactly when over-valuation is the greatest.

There are many dimensions along which the model in this paper can be extended in the future. The model implies that the market valuation can be driven by the extent of investor disagreement and can exhibit excess volatility unrelated to the fundamental, as documented in Shiller (1989). I have focused on a two-period model for simplicity of illustration. Other interesting behaviors can be present in a multi-period setting. For example, risky arbitrageurs may choose to ride the bubble created by disagreement instead of shorting the it (Brunnermeier and Nagel (2004)) which can magnify the effect documented in this paper. I have also taken differences-of-opinion as given and do not study the source of disagreement or the question of whether disagreement will disappear after sufficiently long periods of learning. Acemoglu, Chernozhukov, and Yildiz (2006) suggest that 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 documented in this paper can potentially persist for a long time.

References

Acemoglu, Daron, Victor Chernozhukov, and Muhamet Yildiz, 2006, Learning and disagreement in an uncertain world, NBER working paper 12648.

Almazan, Andres, Keith C. Brown, Murray Carlson, and David A. Chapman, 2004, Why constrain your mutual fund manager?, *Journal of Financial Economics* 73, 289–321.

Amihud, Yakov, Haim Mendelson, and Lasse Heje Pedersen, 2005, Liquidity and asset prices, *Foundations and Trends in Finance* 1, 269–364.

Ang, Andrew, and Geert Bekaert, 2007, Stock return predictability: Is it there?, *Review of Financial Studies* 20, 651–707.

Baker, Malcolm, and Jeremy C. Stein, 2004, Market liquidity as a sentiment indicator, *Journal of Financial Markets* 7, 271–299.

Baker, Malcolm, and Jeffrey Wurgler, 2000, The equity share in new issues and aggregate stock returns, *Journal of Finance*.

——— , 2007, Investor sentiment in the stock market, *Journal of Economic Perspectives* 21, 129–151.

Brunnermeier, Markus K., and Stefan Nagel, 2004, Hedge funds and the technology bubble, *Journal of Finance*.

Campbell, John Y., 1987, Stock returns and the term structure, *Journal of Financial Economics* 18, 373–399.

——— , 1991, A variance decomposition for stock returns, *Economic Journal* 101, 157–179.

——— , and Robert J. Shiller, 1988, Stock prices, earnings, and expected dividends, *Journal of Finance*.

——— , 1989, The dividend-price ratio and expectations of future dividends and discount factors, *Review of Financial Studies* 1, 195–228.

Campbell, John Y., and Samuel B. Thompson, 2007, Predicting excess stock returns out of sample: Can anything beat the historical average?, *Review of Financial Studies* forthcoming.

Campbell, John Y., and Tuomo Vuolteenaho, 2004, Bad beta, good beta, *American Economic Review*.

Cen, Ling, K. C. John Wei, and Jie Zhang, 2007, Dispersion in analysts' earnings forecasts and the cross section of stock returns: What is the driving factor?, working paper.

Chan, Louis K. C., Jason Karceski, and Josef Lakonishok, 2003, The level and persistence of growth rates, *Journal of Finance*.

Chen, Joseph, Harrison Hong, and Jeremy C. Stein, 2002, Breadth of ownership and stock returns, *Journal of Financial Economics* 66, 171–205.

Chordia, Tarun, Richard Roll, and Avanidhar Subrahmanyam, 2000, Commonality in liquidity, *Journal of Financial Economics* 56, 3–28.

Cochrane, John H., 2005, *Asset Pricing* (Princeton University Press) revised edn.

Daniel, Kent, and Sheridan Titman, 2006, Market reactions to tangible and intangible information, *Journal of Finance*.

Davidson, James, 2002, *Stochastic Limit Theory* (Oxford University Press).

D'Avolio, Gene, 2003, The market for borrowing stock, *Journal of Financial Economics* 66, 271–306.

De Bondt, Werner F. M., and Richard Thaler, 1985, Does the stock market overreact?, *Journal of Finance*.

De Bondt, Werner F. M., and Richard H. Thaler, 1990, Do security analysts overreact?, *American Economic Review Papers and Proceedings* pp. 52–57.

De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldmann, 1990, Noise trader risk in financial markets, *Journal of political economy* 98.

Diether, Karl, Christopher Malloy, and Anna Scherbina, 2002, Differences of opinion and the cross-section of stock returns, *Journal of Finance* 57, 2113–2141.

Fama, Eugene F., 1981, Stock returns, real activity, inflation, and money, *American Economic Review*.

——— , and Kenneth R. French, 1988a, Dividend yields and expected stock returns, *Journal of Financial Economics* 22, 3–25.

——— , 1988b, Permanent and temporary components of stock prices, *Journal of Political Economy* 96.

——— , 1989, Business conditions and expected returns on stocks and bonds, *Journal of Financial Economics* 25, 23–49.

———, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.

Fama, Eugene F., and G. William Schwert, 1977, Asset returns and inflation, *Journal of Financial Economics* 5, 115–146.

Fan, J., and I. Gijbels, 1996, *Local Polynomial Modelling and Its Applications* (Chapman Hall: London, U.K.).

Goyal, Amit, and Ivo Welch, 2005, A comprehensive look at the empirical performance of equity premium prediction, *Review of Financial Studies* forthcoming.

Harris, Milton, and Artur Raviv, 1993, Differences of opinion make a horse race, *Review of Financial Studies* 6, 473–506.

Harrison, Michael, and David Kreps, 1978, Speculative investor behavior in a stock market with heterogeneous expectations, *Quarterly Journal of Economics* 92, 323–336.

Hodrick, Robert J., 1992, Dividend yields and expected stock returns: Alternative procedures for inference and measurement, *Review of Financial Studies* 5, 357–386.

Hong, Harrison, and Jeremy C. Stein, 2007, Disagreement and the stock market, *Journal of Economic Perspectives* 21.

Hong, Harrison, and Jialin Yu, 2006, Gone fishin': Seasonality in trading activity and asset prices, working paper.

Johnson, Timothy C., 2004, Forecast dispersion and the cross section of expected returns, *Journal of Finance.*

Keim, Donald B., and Robert F. Stambaugh, 1986, Predicting returns in the stock and bond markets, *Journal of Financial Economics* 17, 357–390.

Koski, Jennifer Lynch, and Jeffrey Pontiff, 1999, How are derivatives used? evidence from the mutual fund industry, *Journal of Finance.*

Kothari, S.P., and Jay Shanken, 1997, Book-to-market, dividend yield, and expected market returns: A time-series analysis, *Journal of Financial Economics* 44, 169–203.

La Porta, Rafael, 1996, Expectations and the cross-section of stock returns, *Journal of Finance.*

Lamont, Owen, and Richard H. Thaler, 2003, Can the stock market add and subtract? mispricing in tech stock carve-outs, *Journal of Political Economy* 111, 227–268.

Lettau, Martin, and Sydney Ludvigson, 2001, Consumption, aggregate wealth, and expected stock returns, *Journal of Finance.*

Lewellen, Jonathan, 2004, Predicting returns with financial ratios, *Journal of Financial Economics* 74, 209–235.

Lintner, John, 1969, The aggregation of investor's diverse judgments and preferences in purely competitive security markets, *Journal of Financial and Quantitative Analysis* 4, 347–400.

Miller, Edward, 1977, Risk, uncertainty and divergence of opinion, *Journal of Finance* 32, 1151–1168.

Moeller, Sara B., Frederik P. Schlingemann, and René M. Stulz, forthcoming, How do diversity of opinion and information asymmetry affect acquirer returns?, *Review of Financial Studies.*

NASD, 2007, *Purchasing on Margin, Risks Involved With Trading in a Margin Account.*

Newey, Whitney K., and Kenneth D. West, 1987, A simple, positive, semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703–708.

Pontiff, Jeffrey, and Lawrence D. Schall, 1998, Book-to-market ratios as predictors of market returns, *Journal of Financial Economics* 49, 141–160.

Pástor, Lubos, and Pietro Veronesi, 2003, Stock valuation and learning about profitability, *Journal of Finance.*

——— , 2007, Was there a nasdaq bubble in the late 1990s?, *Journal of Financial Economics* forthcoming.

Qu, Shisheng, Laura Starks, and Hong Yan, 2004, Risk, dispersion of analyst forecasts and stock returns, working paper.

Richardson, Matthew, and James H. Stock, 1989, Drawing inferences from statistics based on multiyear asset returns, *Journal of Financial Economics* 25, 323–348.

Rozeff, Michael S., 1984, Dividend yields are equity risk premiums, *Journal of Portfolio Management.*

Rudin, Walter, 1976, *Principles of Mathematical Analysis* (McGraw-Hill) third edn.

Samuelson, Paul A., 1958, An exact consumption-loan model of interest with or without the social contrivance of money, *Journal of Political Economy* 66, 467–482.

Sarhan, Ahmed E., and Bernard G. Greenberg (eds.), 1962, *Contributions to order statistics* (Wiley).

Scheinkman, José, and Wei Xiong, 2003, Overconfidence and speculative bubbles, *Journal of Political Economy.*

Shiller, Robert J., 1989, *Market Volatility* (MIT press).

Shleifer, Andrei, and Robert W. Vishny, 1997, The limits of arbitrage, *Journal of Finance*.

Stambaugh, Robert F., 1999, Predictive regressions, *Journal of Financial Economics* 54, 375–421.

Stock, James H., 1991, Confidence intervals for the largest autoregressive root in u.s. macroeconomic time series, *Journal of Monetary Economics* 28, 435–459.

Summers, Lawrence H., 1986, Does the stock market rationally reflect fundamental values?, *Journal of Finance*.

Thomson Financial, 2004, *A Guide to Understanding Thomson Financial Terms and Conventions for the First Call and I/B/E/S Estimates Databases*.

Valkanov, Rossen, 2003, Long-horizon regressions: theoretical results and applications, *Journal of Financial Economics* 68, 201–232.

White, Halbert, 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48.

Appendix

Proof of Proposition 1: I now construct the equilibrium with over-valuation (i.e. $P_i > m$). In the equilibrium,

$$P_i \geq P_j \text{ for } i > j$$

otherwise, if $P_i < P_j$, less hedge funds short i and strictly more mutual funds buy i relative to j (the fraction of mutual funds that buy i is $1 - F\left(\left(P_i - m\right)/\sigma_i\right)$, also recall $\sigma_i > \sigma_j$ for $i > j$), no market clearing. Further, the inequality in the above equation is strict if arbitrageurs do not short stocks i and j.

The risk-free rate $r_f = 0$ because the demand for borrowing is zero and the supply is positive — pessimistic mutual funds sit on the sideline due to short-sales constraint and invest in the risk-free rate, optimistic mutual funds do not lever, risky arbitrageurs short-sell, index-arbitrageurs long-short index/stocks when index deviate from sum of stock prices. The pessimistic mutual funds are essentially holding cash.

To clear the market, the mutual funds have to absorb all outstanding shares, including the shares shorted by risky arbitrageurs,

$$\begin{aligned} \left(1 - F\left(\frac{P_i - m}{\sigma_i}\right)\right) W &= P_i \qquad \text{for } i < \kappa \\ \left(1 - F\left(\frac{P - m}{\sigma_i}\right)\right) W &= P + W_A\left(i\right) \qquad \text{for } i \geq \kappa \\ \int_\kappa^1 W_A\left(i\right) di &= \frac{W_A}{c_s} \end{aligned} \tag{25}$$

Due to the multi-advisor structure of mutual funds, a mutual fund invests W in a stock when it is optimistic in this stock. $W_A\left(i\right)$ is the risky arbitrage capital shorting stock i. For those most over-valued stocks that attract arbitrageurs, their share prices have to be the same ($P_i = P$ for $i \geq \kappa$) because the risk-neutral arbitrageurs will not trade in less over-valued stocks. c_s is the collateral requirement for short-sales.

To prove (7), applying the implicit function theorem (see Rudin (1976)) to the first equation in (25) gives

$$\frac{d}{d\sigma} P_i = \left(P_i - m\right) b_i / a_i \quad \text{for } i < \kappa$$

where

$$\begin{aligned} a_i &= 1 + \frac{W}{\sigma_i} F'\left(\frac{P_i - m}{\sigma_i}\right) > 0 \\ b_i &= \frac{W\beta_i}{\sigma_i^2} F'\left(\frac{P_i - m}{\sigma_i}\right) > 0 \end{aligned}$$

The last two equations in (25) implies

$$W\int_{\kappa}^{1}\left(1-F\left(\frac{P-m}{\sigma_i}\right)\right)di-P\left(1-\kappa\right)=\frac{W_A}{c_s} \tag{26}$$

and a similar application of the implicit function theorem implies

$$\frac{d}{d\sigma}P=(P-m)\int_{\kappa}^{1}b_i di\Big/\int_{\kappa}^{1}a_i di$$

Therefore, in an equilibrium with over-valuation (i.e. $P_i > m$ and $P > m$), $dP_i/d\sigma > 0$ and $dP/d\sigma > 0$. The return implication in (7) then follows because the cash flow in the last period is unaffected by σ. When period 0 price is higher due to high σ, the return is lower.

Finally, I find the region of W_A that allows over-valuation. To begin, I calculate the cutoff W_A that removes over-valuation in which case $P_i = P = m$ for all stocks and $\kappa = 0$. (25) implies

$$\frac{W_A}{c_s}=W/2-m$$

Another application of the implicit function theorem to (26) gives

$$\frac{d}{dW_A}P=-\frac{1}{c_s}\Big/\int_{\kappa}^{1}a_i di<0.$$

Therefore, when $W_A/c_s < W/2 - m$, one obtains an equilibrium with over-valuation. ∎

Proof of Proposition 2: (9) and (10) can be solved to give P_h, P_l, b_h. P_h and P_l are given in the proposition.

$$b_h=1-\frac{2(1+r_f)+2\sigma_h\left(r_f+p\right)}{r_f W\left(1+r_f\right)+2\sigma_h\left(r_f+p\right)}>0$$

under the condition $W/2 > 1/r_f$. In those periods when there is no disagreement, the fraction of investor stock holdings is P_l/W to clear the market. That $E_h\left[r_{ETF}\right] < E_l\left[r_{ETF}\right]$ follows directly from $P_h > P_l$ and the fact that the dividend and stock price next period is unaffected by current period's disagreement. $E_l\left[r_{ETF}\right] = r_f$ because agents correctly forecast next period's dividend when there is no disagreement, see (9). ∎

Proof of Proposition 3: This proposition follows from

$$r_{t+1}-E_t r_{t+1}=\begin{cases}(1-p)\left[\log\left(1+P_h\right)-\log\left(1+P_l\right)\right] & \text{if } \sigma_{i,t+1}=\sigma_h\\ p\left[\log\left(1+P_l\right)-\log\left(1+P_h\right)\right] & \text{if } \sigma_{i,t+1}=\sigma_l\end{cases}$$

where r is the log return of the index ETF and can be calculated using the prices in proposition **2**. ∎

Table 1: Summary Statistics

This table reports summary statistics of the variables used in the paper. For each variable, the sample period, number of observations (# obs), time-series mean, standard deviation (std dev), minimum (min) and maximum (max) are reported. Panel A reports summary statistics for the three proxies of beliefs. $DISAG_t$ is the cross-stock average (weighted by market capitalization) of analyst forecast standard deviation of long-term growth rate of individual stock earnings per share (EPS). LTG_t is the cross-stock average (weighted by market capitalization) of average analyst forecast of long-term growth rate of individual stock EPS. $MKTDISAG_t$ is the standard deviation of I/B/E/S analyst forecasts of annual S&P 500 earnings scaled by average analyst forecast. $MKTDISAG_t$ is sampled in December each year using analyst forecasts of S&P 500 earnings for fiscal year ending in December next year. $MKTDISAG_t$ in January – November is set to its value in December of the previous year. $DISAG_t$, LTG_t, and $MKTDISAG_t$ are in percentage points. Panel B reports summary statistics for various measures of market returns. $MRET_{t,t+h}$ is the excess market return measured by CRSP value-weighted return (including distributions) over linked one-month Treasury bill rate from month t to $t+h$. NDR and NCF are the discount-rate and cash-flow news from the return decomposition in Campbell and Vuolteenaho (2004). Panel C reports summary statistics for various variables known to correlate with ex-post market return. They include PE_t (price-earnings ratio), CAY_t (consumption-wealth ratio in Lettau and Ludvigson (2001)), DP_t (dividend-price ratio), $SMOOTHEP_t$ (smoothed earnings-price ratio), BM_t (book-to-market ratio), $SHORTYIELD_t$ (short-term interest rate), $LONGYIELD_t$ (long-term bond yield), $TERMSPREAD_t$ (the term spread between long- and short-term Treasury yields), $DEFAULTSPREAD_t$ (the default spread between corporate and Treasury bond yields), $INFLATION_t$ (the lagged rate of inflation), $EQUITYSHARE_t$ (the equity share of new issues in Baker and Wurgler (2000)).

Panel A. Proxies of beliefs (%)

	sample period t	# obs	mean	std dev	min	max
$DISAG_t$	1981.12–2005.12	289	3.28	0.43	2.70	4.80
LTG_t	1981.12–2005.12	289	14.26	1.77	12.39	20.93
$MKTDISAG_t$	1982.12–2001.11	228	5.50	1.41	2.84	8.00

Panel B. Excess market return (×100)

	sample period t	# obs	mean	std dev	min	max
$MRET_{t,t+1}$	1981.12–2005.12	289	0.68	4.41	-23.13	12.43
$MRET_{t,t+6}$	1981.12–2005.12	289	4.37	11.09	-27.97	37.60
$MRET_{t,t+12}$	1981.12–2005.12	289	9.17	16.32	-34.71	58.36
$MRET_{t,t+24}$	1981.12–2004.12	277	18.64	23.60	-48.73	65.59
$MRET_{t,t+36}$	1981.12–2003.12	265	30.93	33.16	-52.48	106.04
$NDR_{t-1,t}$	1981.12–2001.12	241	-0.42	4.83	-17.20	21.18
$NCF_{t-1,t}$	1981.12–2001.12	241	-0.13	2.21	-10.55	5.48

Panel C. Other variables that correlate with ex-post market return

	sample period t	# obs	mean	std dev	min	max
PE_t	1981.12–2005.12	289	21.43	8.35	7.93	49.52
CAY_t	1981.Q4–2005.Q4	97	0.003	0.015	-0.031	0.036
DP_t	1981.12–2005.12	289	0.026	0.012	0.011	0.060
$SMOOTHEP_t$	1981.12–2005.12	289	0.055	0.027	0.021	0.145
BM_t	1981.12–2005.12	289	0.441	0.188	0.173	1.035
$SHORTYIELD_t$	1981.12–2005.12	289	0.053	0.025	0.009	0.133
$LONGYIELD_t$	1981.12–2005.12	289	0.073	0.026	0.034	0.144
$TERMSPREAD_t$	1981.12–2005.12	289	0.020	0.011	-0.006	0.044
$DEFAULTSPREAD_t$	1981.12–2005.12	289	0.010	0.004	0.005	0.027
$INFLATION_t$	1981.12–2005.12	289	0.033	0.015	0.011	0.110
$EQUITYSHARE_t$	1981.12–2005.12	289	0.161	0.092	0.075	0.430

Table 2: Commonality in Individual Stock Disagreements

Column (1) of this table conducts, for each stock, a time-series regression of the monthly proportional changes in individual stock analyst forecast standard deviation of long-term growth rate $STKDISAG$ on contemporaneous proportional changes in value-weighted cross-sectional average of $STKDISAG$. The cross-sectional average of the time-series regression slope coefficients is reported with t-statistics adjusted for heteroskedasticity in the parenthesis. "% positive" reports the percentage of positive slope coefficients, while "% positive significant" gives the percentage of time-series regression t-statistics (from Newey and West (1987)) that are greater than 1.645 (the 5% critical level in a one-sided test). Column (2) conducts a time-series regression of monthly proportional changes in individual stock $STKDISAG$ on contemporaneous and lagged proportional changes in value-weighted cross-sectional average of $STKDISAG$. "Sum" is the sum of the slope coefficients in front of the contemporaneous and lagged changes in the cross-sectional average of $STKDISAG$. "Median" is the median of the time-series slope coefficients in columns (1) and is the median of "Sum" in column (2). "p-value" is the p-value of a signed test of the null hypothesis that median=0. Cross-sectional average adjusted R-square of the time-series regressions is also reported. A stock is excluded from the computation of the cross-sectional average of $STKDISAG$ in its own time-series regression. The sample period is December 1981 – December 2005.

	(1)	(2)
Concurrent	0.297	0.426
t-stat	(2.22)	(3.09)
% positive	52.0	52.0
% positive significant	15.9	14.6
Lag		0.168
t-stat		(1.47)
% positive		47.8
% positive significant		12.1
Sum		0.595
t-stat		(2.86)
Median	0.058	0.075
p-value	0.0005	0.0010
Average adj R^2	0.76%	0.70%

Table 3: Mean Reversion of Commonality in Disagreement

This table reports the regression result of

$$DISAG_t = \alpha + \beta \cdot DISAG_{t-lag} + \varepsilon_t$$

where $DISAG$ is the common disagreement defined as the cross-sectional value-weighted average of individual stock disagreements, which are measured by analyst forecast standard deviations of long-term growth rate of earnings per share. The lag ranges from one month to three years. Also reported is the mean of $DISAG$ implied by the autoregressive model and the regression estimates, i.e. implied mean = $\alpha/(1-\beta)$. The t-statistics in the parentheses adjust 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
$DISAG_{t-lag}$	0.937	0.741	0.462	0.138	0.005
t-stat	(47.76)	(11.40)	(3.96)	(1.07)	(0.03)
constant	0.204	0.853	1.753	2.766	3.196
t-stat	(3.31)	(3.98)	(4.41)	(5.72)	(5.46)
adj R^2	88.4%	55.6%	22.9%	2.8%	-0.4%
Implied mean $DISAG$	3.26	3.30	3.26	3.21	3.21

Table 4: Commonality in Disagreement and subsequent Market Return

Panel A of this table reports the regression result of ex-post market return in excess of risk-free rate on common disagreement $DISAG_t$. The return horizon ranges from one month to three years. Panel B reports the Hodrick (1992) t statistics for $DISAG$ in the regression of panel A except that the dependent variable excess market return is in log scale following Hodrick (1992). Panel C reports the Valkanov (2003) $t\Big/\sqrt{T}$ statistics for the same regression as in panel B. Panel C also reports the p-value for the $t\Big/\sqrt{T}$ statistic and the percentile of regression R-square against the asymptotic distributions under the null hypothesis that the coefficient of $DISAG_t$ is zero. The asymptotic distributions in Valkanov (2003) depend on a nuisance parameter c. Following Valkanov (2003), c is set to $c = -16.482$ using the procedure in Stock (1991). Panel D regresses one-month ex-post excess market return, also in log scale, on lagged h-month moving average of $DISAG_t$. The order of moving average, h, ranges from one to thirty-six (three years). Panel D also conducts a simulation to measure the Stambaugh (1999) bias. In the simulation, the "true" coefficients are set to the regression estimates. $DISAG$ is assumed to follow an AR(1) process with coefficients given by column (1) of table 3. The error terms are drawn with replacement from the joint empirical distribution of the two residuals in the regression of Panel D and in the regression in column (1) of table 3. 10,000 samples are drawn in the simulation. The Stambaugh (1999) bias is measured by the difference between the average slope coefficients in the regression of monthly return on lagged moving average of $DISAG$ in the simulation and the "true" coefficient. Panel D also shows the p-value of a two-sided test that the slope coefficient for the moving average of $DISAG$ is zero by comparing the t-statistic in the actual regression in panel D to the percentiles of the t-statistics in a second simulation which is identical to the first simulation except that the "true" coefficient for the moving average of $DISAG$ is set to zero. Panel E reports the results for the regression in panel A controlling for the average monthly turnover in the past year, denoted by $TURNOVER$. Following Baker and Stein (2004), $TURNOVER$ is stochastically detrended by subtracting the average turnover in the previous five years from it and the regression includes as additional control variables the dividend-price ratio DP and the equity share of new issues $EQUITYSHARE$. Both regression results with and without $DISAG$ are reported. Panel F conducts the same regression as in panel A except that it also controls for the expected long-term growth rate of earnings-per-share LTG_t and price-earnings ratio PE_t. The t-statistics in panels A, E and F 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 panel D are adjusted for heteroskedasticity (White (1980)). The sample period is December 1981 – December 2005.

Panel A. Ex-post excess market return on common disagreement

Return horizon (in months)	1	6	12	24	36
$DISAG$	-0.003	-0.047	-0.145	-0.293	-0.355
t-stat	(0.56)	(1.37)	(2.46)	(2.54)	(1.73)
constant	0.018	0.199	0.567	1.145	1.472
t-stat	(0.92)	(1.84)	(3.10)	(3.16)	(2.31)
adj R^2	-0.2%	3.1%	14.7%	30.0%	23.2%

Panel B. Hodrick (1992) t statistics, log ex-post excess market return on $DISAG$

Return horizon (in months)	1	6	12	24	36
$DISAG$	-0.004	-0.050	-0.144	-0.266	-0.305
t-stat	(0.03)	(1.48)	(2.15)	(2.19)	(2.00)

Panel C. Valkanov (2003) $t\Big/\sqrt{T}$ statistics, log ex-post excess market return on $DISAG$

Return horizon (in months)	1	6	12	24	36
$DISAG$	-0.004	-0.050	-0.144	-0.266	-0.305
$t^{OLS}/\sqrt{T}$	-0.036	-0.207	-0.461	-0.710	-0.646
p-value of $t^{OLS}/\sqrt{T}$	0.600	0.160	0.026	0.012	0.046
R^2	0.1%	4.1%	17.6%	33.7%	29.6%
R^2 percentile	47.0	86.5	98.2	99.2	96.6

Panel D. Hodrick (1992) specification: monthly excess return on lagged moving average (MA) of $DISAG$

h (in months)	1	6	12	24	36
$MA(h)$ of $DISAG$	-0.0038	-0.0096	-0.0149	-0.0152	-0.0133
t-stat	(0.63)	(1.57)	(2.28)	(2.10)	(1.83)
constant	0.018	0.037	0.054	0.056	0.050
t-stat	(0.94)	(1.89)	(2.59)	(2.36)	(2.08)
adj R^2	0.1%	0.8%	1.7%	1.5%	1.1%
Stambaugh (1999) bias	-0.0008	-0.0009	-0.0010	-0.0012	-0.0014
p-value of $DISAG$	0.540	0.121	0.025	0.038	0.067

Panel E. Control for turnover

Return horizon (in months)	1	6	12	24	36
without $DISAG$					
$TURNOVER$	-0.121	-1.475	-3.115	-7.461	-9.898
t-stat	(0.52)	(1.80)	(2.21)	(2.26)	(3.51)
adj R^2	0.4%	8.8%	18.7%	23.4%	24.4%
with $DISAG$					
$DISAG$	0.004	-0.026	-0.125	-0.298	-0.414
t-stat	(0.57)	(0.77)	(2.44)	(3.37)	(2.39)
$TURNOVER$	-0.165	-1.178	-1.679	-3.501	-2.688
t-stat	(0.69)	(1.36)	(1.24)	(1.09)	(0.53)
adj R^2	0.1%	9.1%	25.6%	42.9%	42.4%

Panel F. Control for expected long-term growth rate (LTG) and price-earnings ratio (PE)

Return horizon (in months)	1	6	12	24	36
$DISAG$	0.002	-0.031	-0.138	-0.230	-0.254
t-stat	(0.31)	(0.88)	(2.98)	(2.55)	(1.48)
LTG	-0.002	-0.004	0.003	-0.020	-0.030
t-stat	(0.80)	(0.35)	(0.19)	(0.61)	(0.60)
PE	-0.0005	-0.0035	-0.0071	-0.0069	-0.0124
t-stat	(1.14)	(1.75)	(2.10)	(1.48)	(1.58)
constant	0.037	0.272	0.647	1.370	1.843
t-stat	(1.52)	(2.33)	(2.91)	(3.97)	(3.43)
adj R^2	0.7%	10.8%	26.3%	40.1%	39.3%

Table 5: Controlling for other Variables that Correlate with ex-post Market Return

This table reports the regression results of ex-post market return in excess of risk-free rate on common disagreement $DISAG_t$, controlling for a host of other variables that correlate with ex-post market return. In panel A1 and A2, I control these other variables one-by-one. In panel B, I control all of these other variables in one regression. These other variables include price-earnings ratio PE, consumption-wealth ratio CAY, dividend-price ratio DP, smoothed earnings-price ratio $SMOOTHEP$, 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 $DEFAULTSPREAD$, the lagged rate of inflation $INFLATION$, and the equity share of new issues $EQUITYSHARE$. CAY is measured quarterly in panel A and is converted to monthly in panel B by setting a missing observation equal to the last available quarterly observation. The other variables are measured monthly. For brevity, I list the slope coefficients of other controls only for the one-year return regressions (both with and without $DISAG$) in panel A2 and use */**/*** to indicate statistical significance at the 90%/95%/99% levels. In panel B, I list only the estimates for $DISAG_t$ and omit the estimates for other control variables. Also shown in panel B are two adjusted R-squares. The first R-square is for the regression of ex-post market return on $DISAG_t$ and all the other control variables, the second R-square is for the regression of ex-post market return on all the other control variables but without $DISAG_t$. The standard errors in both panels A and B 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.

Panel A1. Slope coefficients of common disagreement in return regressions, controlling for other variables that correlate with ex-post market return one by one

Return horizon (in months)	1	6	12	24	36
PE	-0.002	-0.039	-0.130***	-0.274***	-0.322**
CAY (quarterly)	-0.006	-0.040	-0.135**	-0.232**	-0.169
DP	-0.003	-0.048	-0.145***	-0.293***	-0.359***
$SMOOTHEP$	-0.004	-0.056*	-0.165***	-0.319***	-0.401***
BM	-0.004	-0.052*	-0.155***	-0.305***	-0.378***
$SHORTYIELD$	-0.003	-0.051	-0.157***	-0.305***	-0.381**
$LONGYIELD$	-0.003	-0.051	-0.157***	-0.311***	-0.388**
$TERMSPREAD$	-0.003	-0.046	-0.141***	-0.280***	-0.335*
$DEFAULTSPREAD$	-0.006	-0.070**	-0.194***	-0.341***	-0.429**
$INFLATION$	-0.003	-0.047	-0.145***	-0.292***	-0.356*
$EQUITYSHARE$	-0.003	-0.061**	-0.180***	-0.360***	-0.485***

Panel A2. Slope coefficients of other return predictors and adjusted R-squares in one-year return regressions, controlling for other variables that correlate with ex-post market return one by one

	Slope of control variables		Adj R^2	
	without $DISAG$	with $DISAG$	without $DISAG$	with $DISAG$
PE	-0.008**	-0.007**	14.9%	26.5%
CAY (quarterly)	2.450	0.330	3.4%	11.3%
DP	4.523**	4.536**	10.0%	24.8%
$SMOOTHEP$	1.820*	2.198**	8.9%	27.7%
BM	0.276*	0.302**	9.8%	26.5%
$SHORTYIELD$	-0.796	-1.241	1.2%	18.0%
$LONGYIELD$	-1.251	-1.584	3.5%	20.5%
$TERMSPREAD$	2.509	2.015	2.6%	16.2%
$DEFAULTSPREAD$	8.138	15.105***	3.9%	27.4%
$INFLATION$	-1.952	-1.933	2.8%	17.4%
$EQUITYSHARE$	-0.153	-0.458*	0.4%	20.2%

Panel B. Slope coefficients of common disagreement in return regressions, controlling for all of the other variables that correlate with ex-post market return

Return horizon (in months)	1	6	12	24	36
$DISAG$	0.005	-0.053	-0.213	-0.351	-0.328
t-stat	(0.66)	(1.78)	(6.88)	(6.42)	(6.43)
all other variables	...	...	...	...	...
adj R^2	4.2%	22.0%	37.8%	56.3%	64.1%
adj R^2 without $DISAG$	4.4%	20.1%	21.7%	34.4%	54.3%

Table 6: Subsample Analysis

This table reports subsample analysis results for the regression specification in panel B of table 5. Specifically, the entire sample period is broken into two subsamples: December 1981 – December 1993 and January 1994 – December 2005. The regression specification in panel B of table 5 is applied separately to the two subsample periods. Panel A presents the regression results for the earlier sample period and panel B presents the regression results for the latter sample period. The t-statistics are from Newey and West (1987) with the number of lags being equal to the return horizons.

Panel A. Subsample: December 1981 – December 1993

Return horizon (in months)	1	6	12	24	36
$DISAG$	0.013	-0.041	-0.134	-0.182	-0.157
t-stat	(1.36)	(1.57)	(5.10)	(4.85)	(3.89)
all other variables	...	...	...	...	...
adj R^2	17.9%	61.7%	78.2%	64.9%	64.6%
adj R^2 without $DISAG$	17.7%	60.7%	71.0%	53.3%	58.4%

Panel B. Subsample: January 1994 – December 2005

Return horizon (in months)	1	6	12	24	36
$DISAG$	0.001	0.000	-0.132	-0.338	-0.359
t-stat	(0.07)	(0.00)	(2.08)	(3.76)	(5.69)
all other variables	...	...	...	...	...
adj R^2	3.8%	32.2%	60.9%	84.7%	93.4%
adj R^2 without $DISAG$	4.5%	32.7%	57.8%	76.6%	89.6%

Table 7: Commonality in Disagreement vs Disagreement in the Aggregate

Panel A of this table reports the results for the regression

$$MRET_{t,t+h} = \alpha + \beta \cdot MKTDISAG_t + \varepsilon_t$$

where $MRET_{t,t+h}$ is excess market return over risk-free rate from month t to $t+h$. $MKTDISAG$ is the standard deviation of I/B/E/S analyst forecasts of annual S&P 500 earnings as a percentage of average analyst forecast. $MKTDISAG$ is sampled in December each year using analyst forecasts of S&P 500 earnings for fiscal year ending in December next year. $MKTDISAG$ in January – November is set to its value in December of the previous year. Panel B reports regression results for

$$MRET_{t,t+h} = \alpha + \beta \cdot MKTDISAG_t + \gamma \cdot DISAG_t + \varepsilon_t$$

where $DISAG$ is the common (individual stock) disagreement. The return horizon h ranges from one month to three years. The t-statistics are from Newey and West (1987) with the number of lags being equal to the return horizons. The sample period is December 1981 – November 2001.

Panel A. Ex-post excess market return and disagreement in the market

Return horizon (in months)	1	6	12	24	36
$MKTDISAG$	-0.001	-0.009	-0.030	-0.080	-0.062
t-stat	(0.40)	(1.16)	(2.06)	(2.67)	(1.40)
constant	0.011	0.090	0.244	0.612	0.633
t-stat	(0.94)	(1.94)	(2.98)	(4.54)	(3.27)
adj R^2	-0.4%	1.1%	7.2%	19.8%	6.0%

Panel B. Ex-post excess market return, disagreement in the market, and common (individual stock) disagreement

Return horizon (in months)	1	6	12	24	36
$MKTDISAG$	-0.001	-0.009	-0.029	-0.078	-0.060
t-stat	(0.39)	(1.26)	(3.24)	(5.44)	(2.18)
$DISAG$	-0.006	-0.069	-0.179	-0.323	-0.401
t-stat	(0.98)	(2.53)	(4.69)	(4.40)	(2.30)
constant	0.031	0.312	0.820	1.651	1.924
t-stat	(1.33)	(3.29)	(6.14)	(8.12)	(3.90)
adj R^2	-0.4%	10.0%	35.4%	55.2%	34.6%

Table 8: Commonality in Disagreement and Discount-rate News

This table reports the regression results of

$$DISAG_t - DISAG_{t-h} = \alpha + \beta \cdot NDR_{t-h,t} + \gamma \cdot NCF_{t-h,t} + \varepsilon_t$$

where $DISAG$ is the common disagreement. $NDR_{t-h,t}$ is the discount-rate news from month $t-h$ to t constructed as the sum of the monthly discount-rate news $NDR_{t-h+1}, ..., NDR_t$ from the return decomposition in Campbell and Vuolteenaho (2004). Similarly, $NCF_{t-h,t}$ is the cash-flow news from month $t-h$ to t constructed as the sum of the monthly cash-flow news $NCF_{t-h+1}, ..., NCF_t$ in Campbell and Vuolteenaho (2004). h ranges from one month to three years. The t-statistics are from Newey and West (1987) with the number of lags being equal to h. The sample period is December 1981 – December 2005.

h	1	6	12	24	36
$NDR_{t-h,t}$	-0.686	-1.180	-1.693	-1.454	-1.236
t-stat	(2.53)	(2.99)	(3.93)	(3.02)	(3.20)
$NCF_{t-h,t}$	0.116	-1.363	-0.347	0.638	1.388
t-stat	(0.25)	(1.48)	(0.34)	(0.66)	(1.40)
constant	-0.005	-0.037	-0.009	-0.180	-0.163
t-stat	(0.50)	(0.88)	(1.50)	(1.44)	(1.14)
adj R^2	3.3%	17.0%	30.6%	40.0%	49.7%

Table 9: Commonality in Disagreement and Value/Growth Stock Returns

Panel A of this table reports the regression results of growth/value stock portfolio returns in excess of risk-free rate (denoted $LRET/HRET$, respectively) on contemporaneous changes in the common disagreement,

$$LRET_{t-h,h} \text{ (or } HRET_{t-h,h}) = \alpha + \beta \cdot (DISAG_t - DISAG_{t-h}) + \varepsilon_t$$

where $LRET_{t-h,h}$ (or $HRET_{t-h,h}$) refers to the value-weighted portfolio returns of growth (or value) stocks from month $t-h$ to t. 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 values using NYSE breakpoints. Book-to-market ratios are constructed as in Daniel and Titman (2006). $DISAG$ is the common disagreement. Panel B reports the regression results of ex-post growth/value portfolio returns in excess of risk-free rate on the common disagreement,

$$LRET_{t,t+h} \text{ (or } HRET_{t,t+h}) = \alpha + \beta \cdot DISAG_t + \varepsilon_t.$$

Panel C reports the regression results of ex-post Fama and French (1993) HML factor returns on the common disagreement,

$$HML_{t,t+h} = \alpha + \beta \cdot DISAG_t + \varepsilon_t$$

where $HML_{t,t+h}$ refers to the HML return from month t to $t+h$. The HML returns are downloaded from Kenneth French's website. Panel D repeats the regression specification in panel C separately for the subsample periods before and after December 1993, which is the middle of the sample period. The t-statistics are from Newey and West (1987) with the number of lags being equal to h. The sample period is December 1981 − December 2005.

Panel A. Contemporaneous growth/value stock returns on changes in common disagreement

h	1	6	12	24	36
growth stocks					
$DISAG_t - DISAG_{t-h}$	0.060	0.150	0.238	0.323	0.428
t-stat	(2.65)	(3.20)	(6.45)	(4.19)	(3.77)
adj R^2	3.0%	13.7%	31.8%	32.6%	34.0%
value stocks					
$DISAG_t - DISAG_{t-h}$	0.022	0.021	0.064	0.013	0.057
t-stat	(1.38)	(0.48)	(1.24)	(0.16)	(0.47)
adj R^2	0.2%	0.0%	2.3%	-0.3%	0.7%

Panel B. Ex-post growth/value stock returns on common disagreement

Return horizon (in months)	1	6	12	24	36
growth stocks					
$DISAG$	-0.005	-0.064	-0.181	-0.379	-0.498
t-stat	(0.77)	(1.71)	(2.97)	(3.28)	(2.40)
adj R^2	-0.2%	5.0%	19.2%	36.5%	32.9%
value stocks					
$DISAG$	0.003	-0.003	-0.059	-0.137	-0.190
t-stat	(0.57)	(0.12)	(1.32)	(2.33)	(1.50)
adj R^2	-0.2%	-0.3%	2.2%	7.4%	7.8%

Panel C. Ex-post Fama and French (1993) HML returns on common disagreement

Return horizon (in months)	1	6	12	24	36
$DISAG$	0.006	0.060	0.152	0.271	0.287
t-stat	(1.00)	(1.69)	(2.38)	(3.32)	(3.35)
constant	-0.015	-0.170	-0.444	-0.777	-0.789
t-stat	(0.81)	(1.54)	(2.21)	(2.84)	(2.74)
adj R^2	0.3%	7.9%	21.4%	33.1%	35.7%

Panel D. Subsample analysis – HML returns on common disagreement

Return horizon (in months)	1	6	12	24	36
1981.12–1993.12					
$DISAG$	0.003	0.045	0.106	0.147	0.131
t-stat	(0.68)	(1.50)	(2.44)	(2.71)	(2.16)
adj R^2	-0.3%	7.4%	20.9%	16.7%	11.1%
1994.1–2005.12					
$DISAG$	0.009	0.080	0.212	0.430	0.483
t-stat	(0.83)	(1.22)	(1.87)	(5.15)	(12.62)
adj R^2	0.4%	8.8%	24.9%	53.4%	69.4%

Table 10: Robustness Checks

This table reports various robustness check results. Panel A repeats the regression specification in panel A of table 4 except that the common disagreement is measured by the equal-weighted (instead of value-weighted) average of individual stock disagreements which is denote by $EWDISAG$. In Panel B, I construct individual stock disagreement using analyst forecasts of next fiscal year earnings per share (EPS). The disagreement over a stock is measured by analyst forecast standard deviation scaled by the absolute value of average forecast. Value-weighted average of this alternative proxy of individual stock disagreement is used to measure common disagreement, denoted by $FYDISAG$. Only firms whose fiscal years end in December are included. I measure $FYDISAG$ in each December using forecasts for fiscal year ending in December next year and set $FYDISAG$ in January–November to its value in December of the previous year. Two sets of results are reported. In Column (1), the independent variable is $FYDISAG$. In Column (2), the independent variables include $DISAG$ and $FYDISAG$. The regression dependent variable in panel B is the subsequent one-year excess market return over risk-free rate. Panel C regresses ex-post market return in excess of risk-free rate $MRET_{t,t+h}$ from month t to $t+h$ on $DISAG_t$ and lagged market return $MRET_{t-h,t}$. For brevity, estimates of the regression intercepts are suppressed in this table. The standard errors 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.

Panel A. Equal-weighted average of individual stock disagreements

Return horizon (in months)	1	6	12	24	36
$EWDISAG$	-0.004	-0.045	-0.102	-0.172	-0.212
t-stat	(0.98)	(2.57)	(3.23)	(2.74)	(2.33)
adj R^2	0.1%	7.4%	18.4%	26.2%	20.9%

Panel B. Ex-post one-year market return on disagreement constructed from forecasts of next fiscal year EPS

	(1)	(2)
$DISAG$		-0.143
t-stat		(1.91)
$FYDISAG$	-0.282	-0.023
t-stat	(2.09)	(0.13)
adj R^2	2.6%	14.4%

Panel C. Controlling for lagged market return

h	1	6	12	24	36
$DISAG_t$	-0.003	-0.047	-0.141	-0.300	-0.347
t-stat	(0.59)	(1.35)	(2.22)	(2.73)	(1.85)
$MRET_{t-h,t}$	0.051	-0.005	-0.177	-0.151	-0.378
t-stat	(0.81)	(0.05)	(1.07)	(1.33)	(3.16)
adj R^2	-0.3%	2.8%	17.9%	32.2%	37.5%

Figure 1: Cross section of stock prices in Example 1. This figure shows the equilibrium prices in Example 1 for stocks indexed by $0 \leq i \leq 1$. The stocks are sorted such that individual stock disagreement is increasing in i. When the risky arbitrage capital $W_A = 0$, line A-B-C is the equilibrium stock prices. When $0 < W_A < 0.1$, line A-B-D is the equilibrium prices (A-B-D shown corresponds to $W_A = 0.05$). When $W_A = 0.1$, the equilibrium price is the flat line A-E. When W_A increases to 0.5, the equilibrium price decreases to line F-G where all stocks are priced at the fundamental value of 1.

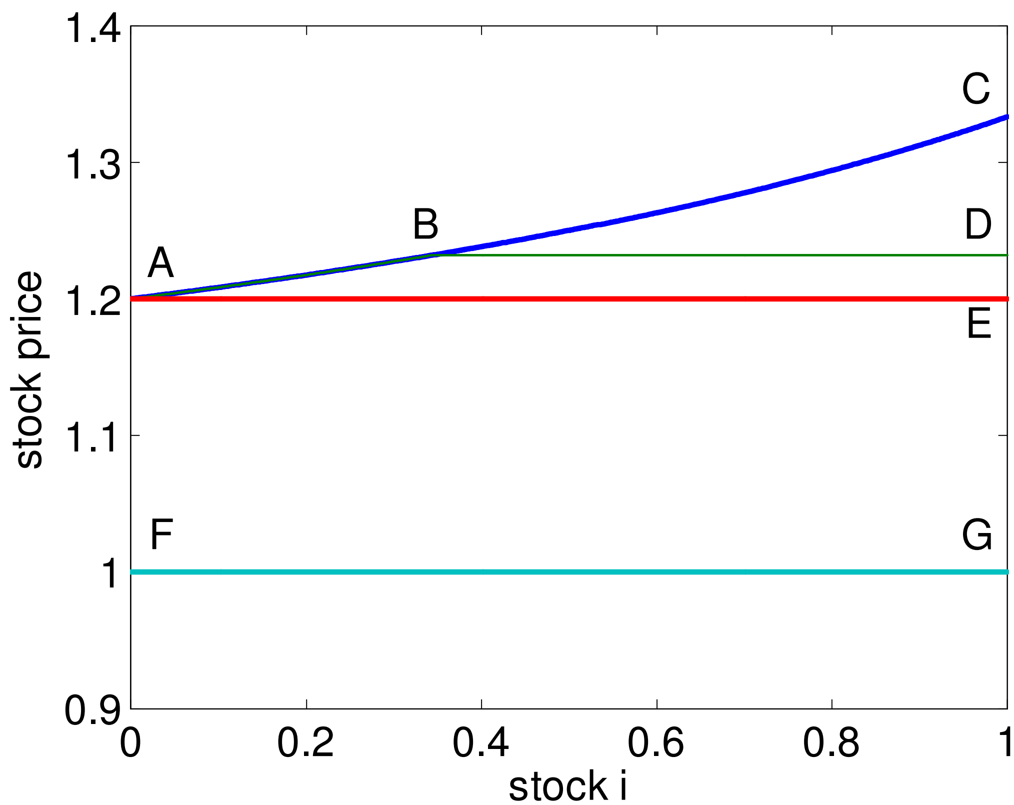

Figure 2: Time series of common disagreement. This figure plots the time series of the common disagreement, which is measured by the cross-stock average (weighted by market capitalization) of analyst forecast standard deviations over long-term earnings growth rate.. The sample period is December 1981 – December 2005.

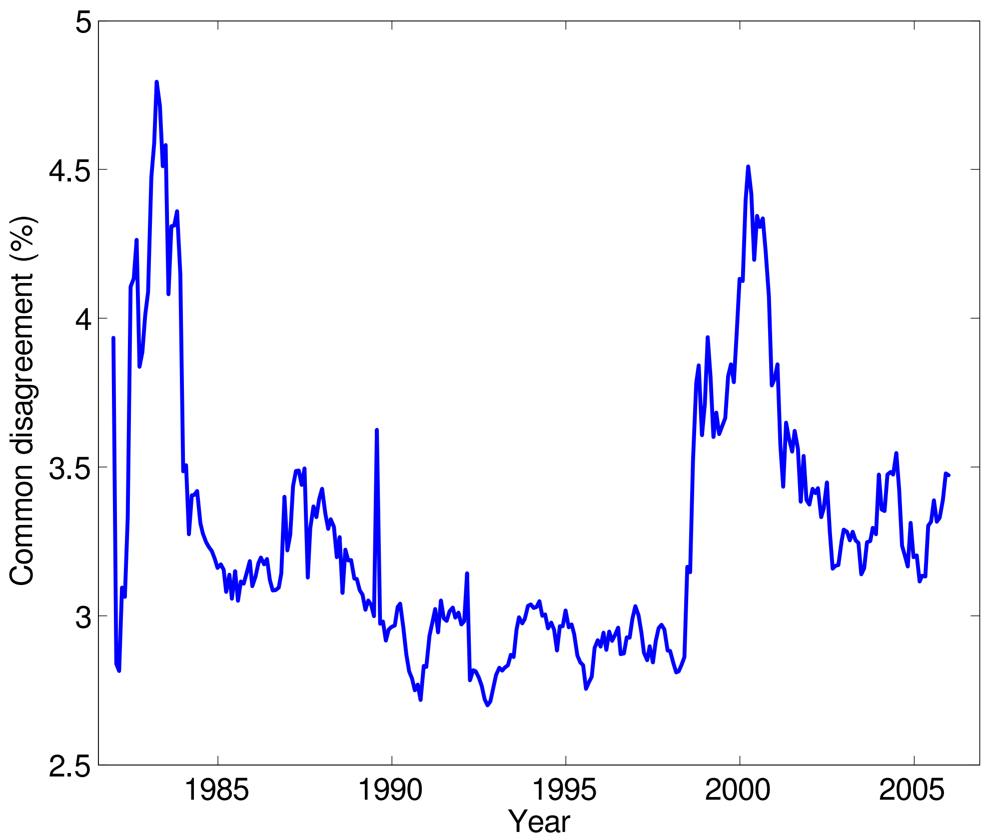

Figure 3: Commonality in disagreement and subsequent market return. This figure shows the scatterplot of monthly commonality in disagreement and subsequent one-year CRSP value-weighted market return (including distributions) in excess of the risk free rate. Commonality in disagreement is measured by the cross-stock average (weighted by market capitalization) of analyst forecast standard deviations over long-term earnings growth rate. The one-year risk-free rate is measured by the linked Ibbotson one-month Treasury bill rate. Also plotted is a local polynomial nonparametric estimate of the expected subsequent one-year excess return conditioning on the common disagreement (implemented by the LOWESS procedure in the statistical software package Stata using the default bandwidth). The 95% pointwise confidence band adjusts for the correlation of overlapping annual returns using Newey and West (1987) with twelve lags.