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Disagreement beta☆

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ABSTRACT

When two investors agree to disagree on market prospects and bet against each other, *both* expect to profit from their trades. Hence, an increase in disagreement leads to higher perceived trading profits and lower marginal utilities for both investors, so disagreement betas can affect cross-sectional asset returns. We construct a disagreement measure using professional forecasts of U.S. macroeconomic fundamentals. Betas with respect to this disagreement factor positively explain cross-sectional returns of stocks, corporate bonds, mortgage-backed securities, and government securities. Further tests using portfolio-based test assets confirm the significant pricing power of the disagreement factor on top of influential benchmark factors.

1. Introduction

Much progress has been made in the last few decades in analyzing the role of disagreement (or heterogeneous beliefs) in financial markets (see Basak, 2005, Hong and Stein, 2007, and Xiong, 2013 for recent surveys). In fact, Hong and Stein (2007) advocate that disagreement models "represent the best horse on which to bet... , if behavioral finance will have to move beyond being a large collection of empirical facts and competing one-off models, and ultimately reach a similar sort of consensus".

Somewhat surprisingly, however, the literature has not directly studied the asset pricing implications of a basic economic effect of disagreement: When two investors agree to disagree on market prospects and bet against each other, they *both* expect to profit at the expense of their trading counterparties. An increase in the disagreement level leads to higher perceived trading profits and consequently lower marginal utilities for both investors. Therefore, the *disagreement beta*, the covariance between an asset's return and the change in the disagreement level, should price cross-sectional asset returns. To the best of our knowledge, this basic asset pricing effect of disagreement beta has not been examined in the literature.

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To formalize the above intuition, we construct a simple model in which two (groups of) investors agree to disagree about the future of the market, and trade against each other. When disagreement widens, both investors increase their consumption because of higher perceived trading profits from disagreement-based betting, and hence have lower marginal utility. Consequently, an asset with a high disagreement beta tends to do well when both investors have lower marginal utility but poorly when both have higher marginal utility. Such an asset commands a high expected return in equilibrium.

The main contribution of the paper is to empirically investigate the effect of disagreement betas on cross-sectional returns. To test this disagreement-beta effect, we need choose a specific aspect of the aggregate market that investors disagree on, and construct measures of market-wide disagreement. One natural choice is investors' disagreement on the U.S. macro fundamentals because of its importance in the global economy and readily available data of investor expectations on U.S. macro variables. Specifically, we construct a disagreement measure using professional forecasts of several key U.S. economic variables, including the real GDP growth (RGDP), industrial production growth (IP), unemployment rate (UNEMP), and non-residential investment growth (INV). These forecast data are obtained from the Blue Chip Economic Indicators (BCEI) survey of market participants' expectations that are widely used by market practitioners and available at the monthly frequency over July 1984 – December 2014. For each of the four macro variables in each month, we measure its disagreement as the cross-sectional standard deviation of individual forecasts. The simple average of these four disagreement variables is used as the aggregate disagreement measure in baseline analysis.

Our empirical framework focuses on the disagreement beta effect that our simple model solely focuses on, controlling for the classical effect of economic fundamentals that the model abstracts from. In reality, disagreement is usually high when the market goes south. In this situation, the deterioration of market condition increases marginal utilities of investors, whereas the high trading profits perceived by both investors from high disagreement decreases their marginal utilities. Hence, both channels are accounted for in beta estimation and portfolios analysis to tease out the potentially confounding effect of market risk that is opposite to our disagreement-betting channel. In particular, to estimate an asset's disagreement beta, we regress its monthly excess returns on changes in the disagreement measure, controlling for the market factor and changes in the forecast consensus as proxies of economic fundamentals. Then, within each asset class, assets are sorted into portfolios based on their estimated disagreement betas and examine their future returns.

We find a strong positive relationship between assets' expected returns and their disagreement betas in a variety of U.S. asset markets, including individual stocks and fixed-income securities. Among U.S. individual stocks, the value-weighted return spread between the top and bottom deciles is 0.67% ($t = 3.66$) per month for portfolios formed using New York Stock Exchange (NYSE) breakpoints. The return difference between the top and bottom quartiles is 0.24% per month ($t = 1.84$) and 0.22% per month ($t = 2.04$), respectively, among 16 U.S. corporate bond return indices and 21 mortgage-backed securities (MBS) return indices. The return spread is even stronger, about 0.31% per month ($t = 2.65$), when portfolios are formed by combining corporate bonds, MBS, and government securities to increase the number of securities in each quartile. The return spreads between the top and bottom portfolios remain significant after controlling for standard asset pricing factors. For individual stocks, the Fama and French (2015) five-factor (FF5) alpha is 0.40% per month ($t = 2.12$), while the Hou et al. (2015) four-factor (HXZ4) alpha is 0.55% per month ($t = 2.28$). For fixed-income assets, after adjusting for the long-term corporate bond excess return factor of Asvanunt and Richardson (2015) and the value and momentum factors of Asness et al. (2013) in the bond market (denoted as FI3), the disagreement-beta long-short portfolio has an alpha of 0.30% per month ($t = 2.47$).

Two further tests are conducted on the pricing power of the disagreement as a cross-sectional asset pricing factor relative to standard benchmark factors. First, we show that the disagreement factor reduces the alphas of disagreement beta portfolios on top of the powerful FF5 and HXZ4 factors. In particular, using the long-short disagreement beta portfolio as the tradable disagreement factor, we find that augmenting FF5 and HXZ4 with the disagreement factor reduces the average absolute alphas by about 30% and 40%, respectively. Similar results are found for 25 double-sorting portfolios based on size and disagreement beta.

Second, a broad set of portfolio-based test assets is considered, in particular, the Fama French 75 (FF75) portfolios, including 25 size/BM portfolios, 25 size/OP portfolios, and 25 size/INV portfolios, as well as the 49 industry (IND49) portfolios (Fama and French, 2015 and Lewellen et al., 2010). Given that both FF5 and HXZ4 factors have been show to possess pricing power for these portfolios, we include both of these benchmark factors and use the nonparametric testing procedure of Feng et al. (2017) to evaluate the marginal pricing power of the disagreement factor. This nonparametric test selects the most powerful among the included benchmark factors, which is particularly relevant in our setup as FF5 and HXZ4 factors have large overlaps. Results show that the disagreement factor has significant pricing power for the FF75 and IND49 portfolios, with a factor risk premium of about 50 basis points per month and a t-statistic of 2.36. The significance is even stronger when the decile portfolios sorted on disagreement beta or the 25 double-sorting portfolios based on size and disagreement beta are added, and remains highly significant the fixed-income portfolios sorted on disagreement beta as also included as test assets.

The disagreement-beta effect is also distinct from two related economic mechanisms. First, the disagreement-beta effect is distinct from the well-known effect based on the interaction between disagreement and short-sale constraints. Specifically, a stock's price reflects the valuations of optimists since pessimists stay on the sidelines due to short sales constraints. As a result, high disagreement leads to low future returns (Miller, 1977). For this mechanism based on short-sale constraints, the disagreement is on each individual asset, so assets differ in the *magnitude of the disagreement* among their investors. In our distinct mechanism, the disagreement is about the macro economy and assets differ in their *betas* with respect to the macro disagreement variable. Nevertheless, we construct double-sorting portfolios for U.S. individual stocks and show that, controlling for stock-level disagreement, the average long-short disagreement-beta portfolio return is 0.38 per month with a t-statistic of 3.50.

Second, disagreement can cause wealth share fluctuations and naturally induces volatility (e.g., Dumas et al., 2009 and Xiong and Yan, 2010). Relatedly, forecast dispersion has been used as a proxy for uncertainty or ambiguity in asset pricing studies (see, e.g., Anderson et al., 2009, Drechsler, 2013, Bali et al., 2015, and Della Corte and Krecetovs, 2015 among others). Hence, one might interpret our disagreement-beta effect as an volatility- or uncertainty-beta effect. However, these interpretations' implications run in the *opposite* direction of our empirical evidence: Under these interpretations, high-beta assets are those that do well when there is greater uncertainty associated with increases in investors' marginal utilities, and hence should command *low* expected returns in equilibrium. Therefore, the significant positive relationship between our estimated betas and asset returns refutes the interpretation that our disagreement measure reflects only uncertainty. Yet, we explicitly control for uncertainty-beta effects using the VIX as well as uncertainty measures of Baker et al. (2016) and Jurado et al. (2015). Results provide further support for our disagreement-beta effect.

A number of robustness checks are also conducted. First, the benchmark factors are used as controls in the estimation of disagreement betas. Second, "industry-neutral" portfolios for stocks are considered. Third, the effect of disagreement beta at the quarterly, semi-annual, and even annual portfolio holding horizons is examined. Fourth, alternative disagreement measures are constructed using the first principal component, the AR(1) residual, and the top-minus-bottom-ten average of individual forecasts. Finally, an alternative disagreement measure using more macro variables than those in the baseline analysis is also analyzed. We find that the disagreement beta effect is largely robust to all these alternative specifications.

The literature on heterogeneous beliefs has been expanding substantially since early contributions such as Miller (1977), Harrison and Kreps (1978), and Detemple and Murthy (1994).[1] A generic feature of agree-to-disagree models is that all investors expect to profit at the expense of their counterparties. However, the literature has not directly studied the effect of this channel on economic agents' consumptions and the related effect on asset prices, until recently. Gallmeyer and Hollifield (2008) initially investigated the income versus substitution effects of disagreement on investors' consumption, focusing on pricing the aggregate stock market. Guzman and Stiglitz (2016) coined the term "pseudo wealth" to refer to the perceived profits by both sides of speculative trades, and conducts a comprehensive analysis of its consumption effect. This mechanism has also been used in Ehling et al. (2018) and Iachan et al. (2015) to explain the bond yields and the declining trend in asset returns of recent decades, respectively. Our paper differs by focusing on the disagreement beta and its effects on *cross-sectional* asset returns.

A related work Hong and Sraer (2016) considers the disagreement on aggregate market *with* short-sale constraint imposed.[2] We also analyze the disagreement on aggregate market, but differ in at least two important ways. First, we study the beta with respect to disagreement itself, rather than the betas with respect to market risk or macro risk in these related studies. Second, binding short-sale constraints is not necessary for the disagreement-beta effect which is driven by the disagreement-induced-betting channel. Also closely related is Anderson et al. (2005) that documents a positive dependence of expected returns on disagreement in time series regressions, motivated from a rational asset pricing model with the heterogeneity of beliefs as a risk factor. We differ by focusing on the cross-sectional asset returns associated with disagreement beta, motivated from a distinct generic feature of heterogeneous beliefs - all investors expect to profit at the expense of their counterparties. Yet, Anderson et al. (2005) and our paper complement each other in that both point to the disagreement as an important asset pricing factor in the absence of short-sale constraints.

2. A Simple Model

In this section, a stylized model is analyzed to illuminate the basic intuition of how disagreement-beta drives cross-sectional asset returns. As our goal is to motivate the main testing hypothesis in empirical analysis, rather than providing the most general model, we abstract from all other economic channels and focus solely on the effect of disagreement betting. When tying the model implication to empirical testing in Section 2.4, however, we postulate an empirical framework incorporating the disagreement factor, for which our simple model fleshes out, as well as traditional fundamental factors in pricing cross-sectional asset returns.

[1] It is impossible to survey all studies on heterogeneous beliefs, but to name a few, this framework has been used to study financial bubbles (e.g., Hong and Stein, 2003 and Scheinkman and Xiong, 2003), equity markets (e.g., Basak, 2000, Bhamra and Uppal, 2014, Chabakauri, 2015, and Atmaz and Basak, 2018), options markets (e.g., Buraschi and Jiltsov, 2006), fixed-income markets (e.g., Xiong and Yan, 2010, Carlin et al., 2014, and Buraschi et al., 2014b, currency markets (e.g., Beber et al., 2010), disaster risks (e.g., Dieckmann, 2011, Chen et al., 2012, and Piatti, 2015), volatility and comovement (e.g., Harris and Raviv, 1993, Kandel and Pearson, 1995, David, 2008, Cao and Ou-Yang, 2009, Dumas et al., 2009, Banerjee and Kremer, 2010, and Buraschi et al., 2014a), the effect on real investment (e.g., Baker et al. (2016)), the effect on financial innovation (e.g., Simsek, 2013 and Shen et al., 2014), and survival of irrational investors (e.g., Blume and Easley, 2006, Kogan et al., 2006, and Yan, 2008).

[2] Li (2016) further extends the analysis of Hong and Sraer (2016) by considering the beta with respect to macro risk conditional on the level of disagreement.

2.1. Model setup

Our model setup has two periods, with time $t = 0, 1, 2$. The state of the economy is denoted by a variable S, whose value will be realized at $t = 2$. For simplicity, we assume that S has two possible values, 0 and 1.

There is a continuum of investors with a total population size of 2. They are ex ante identical: All of them have the same endowment W_0 at $t = 0$. They share the same belief about a random variable Δ, which has a uniform distribution on [0,0.5) and whose value will be realized at $t = 1$.

At $t = 1$, each investor, with a 50% probability, becomes one of the two types. Each investor's type is drawn independently. Hence, the population size of each type is 1. The two types of investors agree to disagree on the distribution of S. Type 1 investors' belief is given by

$$S = \begin{cases} 1 & \text{with a probability of } 0.5 + \Delta, \\ 0 & \text{with a probability of } 0.5 - \Delta, \end{cases}$$

while type-2 investors' belief is

$$S = \begin{cases} 1 & \text{with a probability of } 0.5 - \Delta, \\ 0 & \text{with a probability of } 0.5 + \Delta. \end{cases}$$

That is, Δ measures the disagreement between the two types of investors at $t = 1$.[3] The greater the value Δ, the stronger the disagreement.

Investors have access to a risk-free asset and the interest rate is 0 for both periods. Importantly, at $t = 1$, investors can also speculate on the state of the economy by trading a zero-net supply "security a, " which pays one unit of consumption at $t = 2$ if $S = 1$, and 0 otherwise.[4] The price of this security at $t = 1$ is denoted as P_a, and will be determined in equilibrium. As also pointed out by Guzman and Stiglitz (2016), a betting instrument is needed for disagreeing investors to realize perceived profits and attain lower marginal utilities. In practice, economic derivatives written directly on macro variables, such as options on GDP growth, growth of non-farm payrolls, and the Institute for Supply Management manufacturing index, and inflation swaps and options (Grkaynak and Wolfers, 2005, Haubrich et al., 2012, and Fleckenstein et al., 2017), can serve as betting instruments for disagreement on macro risk as one aspect of the economy. Moreover, financial assets such as the stock market index and Treasury bonds can serve as betting instruments for disagreement on the market risk as another aspect of the economy.

Our goal is to analyze the cross-sectional asset returns from $t = 0$ to $t = 1$. We introduce N assets that last for one period from $t = 0$ to $t = 1$. Asset j, for $j = 1, \ldots, N$, is a claim to cash flow D_j at $t = 1$. The distributions of D_j will be specified later. For simplicity, the aggregate supply of asset j is assumed to be 0. The price of asset j at $t = 0$ is denoted as P_j, and is determined in equilibrium. All investors are price takers and consume all their wealth at $t = 2$.

At $t = 1$, after investors' types are realized, a type-i investor's objective (for $i = 1, 2$) is to choose consumption c_1^i, hold θ_i units of security a and invest the rest of the wealth in the risk-free asset to

$$\max_{c_1^i, \theta_i} u\left(c_1^i\right) + E_1^i\left[u(W_2^i)\right], \tag{1}$$

where $E_1^i[\cdot]$ denotes a type-i investor's expectation conditional on the information at $t = 1$, W_2^i is a type i investor's wealth at $t = 2$, and $u(\cdot)$ is the investor's utility function

$$u(c) = \frac{c^{1-\gamma}}{1-\gamma},$$

where γ is the relative risk aversion. Similar to Guzman and Stiglitz (2016), we focus on the case of $\gamma > 1$, where the wealth effect dominates the substitution effect, as is standard in the literature.[5]

At $t = 0$, each investor's objective is to choose his consumption c_0, investment in the N assets and the risk-free asset to

$$\max u(c_0) + E_0\left[V^i(W_1^i)\right], \tag{2}$$

where $E_0[\cdot]$ denotes the investor's expectation conditional on the information at $t = 0$, $V^i(W_1^i) \equiv \max u(c_1^i) + E_1^i\left[u(W_2^i)\right]$ is the value function of a type-i investor, and W_1^i is the investor's wealth at $t = 1$.

The equilibrium is defined as P_a and P_j for $j = 1, \ldots, N$ as well as all investors' consumption and investment choices. Under these prices and consumption and investment choices, all investors maximize their expected utility (1) and (2), and all markets clear in the sense that the aggregate demand is 0 for security a and for each of the N assets.

[3] We assume symmetry between the two beliefs to simplify the calculation. Our main results do not change if asymmetry is allowed.

[4] The role of this market is to allow investors to speculate on the state of the economy. The equilibrium results remain unchanged if we introduce any other securities at $t = 1$ as long as they are different from the risk-free asset.

[5] Many estimates in the literature suggest that the value of γ is greater than 1; see, for example, Cohen and Einav (2007) and the references therein. As has been known since Merton (1973) and Campbell (1993), the risk premium induced by hedging demand disappears for the log case ($\gamma = 1$), and changes sign when γ becomes smaller than 1.

The equilibrium is constructed in two steps. the equilibrium at $t = 1$ is first considered, taking investors' wealth W_1^i as given. This formalizes the intuition that when the two types of investors disagree more widely, they both expect higher trading profits from betting with each other. In the second step, the equilibrium at $t = 0$ is analyzed to demonstrate the effect of the disagreement beta on cross-sectional asset returns.

2.2. Disagreement and perceived profit opportunity

Since all investors are *ex ante* identical, they have the same wealth at $t = 1$, that is, $W_1^1 = W_1^2$. So we can drop the superscript to use W_1 to denote the investor's wealth. The following proposition characterizes the equilibrium prices and investors' consumption choices.

Proposition 1. *At $t = 1$, the price of security a is given by*

$$P_a = \frac{1}{2}. \tag{3}$$

Type-1 investors long θ units of security a and type-2 investors short θ units, where

$$\theta = W_1 \frac{(1+2\Delta)^{1/\gamma} - (1-2\Delta)^{1/\gamma}}{2 + (1+2\Delta)^{1/\gamma} + (1-2\Delta)^{1/\gamma}}. \tag{4}$$

Both types of investors consume the same amount

$$c_1^1 = c_1^2 = \frac{2W_1}{2 + (1+2\Delta)^{1/\gamma} + (1-2\Delta)^{1/\gamma}}. \tag{5}$$

To see how Proposition 1 is obtained, by no arbitrage, the price of the other Arrow security, which pays one unit of consumption at $S = 0$, is $1 - P_a$. Due to the symmetry, the two Arrow securities have the same price, leading to (3). At $t = 2$, type-1 investors' wealth is $W_1 - c_1^1 - P_a\theta + \theta$ in the case of $S = 1$, and is $W_1 - c_1^1 - P_a\theta$ in the case of $S = 0$. Substituting (3) into these expressions, we can rewrite type-1 investors' objective function as

$$\max_{c_1^1,\theta} u\left(c_1^1\right) + (0.5+\Delta)u\left(W_1 - c_1^1 + \frac{1}{2}\theta\right) + (0.5-\Delta)u\left(W_1 - c_1^1 - \frac{1}{2}\theta\right).$$

The first order conditions are

$$u'\left(c_1^1\right) = (0.5+\Delta)u'\left(W_1 - c_1^1 + \frac{1}{2}\theta\right) + (0.5-\Delta)u'\left(W_1 - c_1^1 - \frac{1}{2}\theta\right),$$
$$(0.5+\Delta)u'\left(W_1 - c_1^1 + \frac{1}{2}\theta\right) = (0.5-\Delta)u'\left(W_1 - c_1^1 - \frac{1}{2}\theta\right).$$

From the above Eqs. (4) and (5) are obtained.

This proposition highlights the intuition that when the magnitude of the disagreement between investors increases, they *all* find that their opportunity to profit improves. This is illustrated in Eq. (3): From a type-1 investor's perspective, the expected return on security a is 2Δ.[6] Similarly, a type-2 investor believes that the expected return on security a is -2Δ. Note from (4) that type-1 investors long the security while type-2 investors short it. Hence, for both types, the expected return on their positions in security a is 2Δ, and when the belief dispersion Δ increases, both types of investors expect their trades to be more profitable.

Intuitively, both types of investors believe that they will make profits at the expense of their counterparties. The wider the disagreement, the more the investors think they are taking advantage of their trading counterparties, and therefore they expect higher profits. Naturally, investors bet more when there is wider disagreement (i.e., θ is increasing in Δ in Eq. (4)). A simple differentiation of the investors' consumption $t = 1$ in (5) shows that c_1^i increases in Δ, that is, both types of investors consume more when their perceived trading profits are higher (both investors have the same consumption due to the symmetry in our setup).

2.3. Disagreement beta and expected returns

To analyze equilibrium at $t = 0$, we first note that investors are identical at this stage and hence they have zero holdings in all N assets and have the same consumption c_0. Moreover, as noted in Eq. (5), both investors have the same consumption at $t = 1$. Hence, we can simply use c_1 to denote all investors' consumption at $t = 1$, and the price of asset i at $t = 0$ is given by

$$P_i = E_0\left[\frac{u'(c_1)}{u'(c_0)} D_i\right]. \tag{6}$$

[6] Type-1 investors' expected return is given by $\frac{(0.5+\Delta)\times 1 + (0.5-\Delta)\times 0}{1/2} - 1 = 2\Delta$.

To analyze the effect of the disagreement beta, we rewrite the dividend from asset i as

$$D_i = \bar{D}_i + \beta_i\left(\Delta - \bar{\Delta}\right) + \epsilon_i, \tag{7}$$

where $\bar{D}_i$ and $\bar{\Delta}$ are the expected values of D_i and Δ, respectively, β_i is the "disagreement beta" of asset i, and ϵ_i is the residual that has a mean of zero, finite variance, and is independent of Δ.

Substituting (7) into (6) gives

$$P_i = \bar{D}_i + \frac{\beta_i}{u'(c_0)} E_0\left[u'(c_1)\left(\Delta - \bar{\Delta}\right)\right].$$

Substituting (5) into the above equation, we obtain

$$P_i = \bar{D}_i + \frac{\beta_i}{u'(c_0)(W_0 - c_0)^\gamma} E_0\left[\left(1 + \frac{1}{2}(1+2\Delta)^{1/\gamma} + \frac{1}{2}(1-2\Delta)^{1/\gamma}\right)^\gamma \left(\Delta - \bar{\Delta}\right)\right]. \tag{8}$$

The expectation in (8) is equal to the covariance of the two terms given that the expectation of the second term $E_0[\Delta - \bar{\Delta}] = 0$. Moreover, the fact that the first term decreases and the second term increases in Δ implies that this covariance is negative. Therefore, we have $\frac{\partial P_i}{\partial \beta_i} < 0$, which further leads to the following proposition.

Proposition 2. *An asset's expected return increases with its disagreement beta:* $\frac{\partial E[r_i]}{\partial \beta_i} > 0$, *where* $r_i \equiv \frac{D_i}{P_i} - 1$ *is the return of asset* i.

This proposition shows that there is a positive relationship between an asset's expected return and its disagreement beta. The intuition is as follows: A high disagreement-beta asset tends to perform poorly when there is less disagreement, and as noted in Proposition 1, exactly when investors expect low future returns, consume less, and have high marginal utility. Therefore, an asset with a higher disagreement beta commands a higher expected return in equilibrium.

2.4. Tie model implications with empirical testing

In this section, we link the model implications on the disagreement-beta effect with the empirical tests to be conducted. Most of all, our simplified model abstracts from the classical effect of fluctuations of economic fundamentals, and hence investors' marginal utility depends only on the disagreement-induced trading profits. Conceivably, a dynamic model, e.g., by extending the framework of Guzman and Stiglitz (2016), can have both the economic fundamentals and disagreement driving the marginal utility and hence pricing assets. To tease out the potential confounding effect of economic fundamentals, we incorporate the pricing effect from both channels in the empirical setting. That is, assets' expected returns follows $E[rx_i] = \lambda^d \beta_i^d + \lambda^f \beta_i^f$, where β_i^d is the disagreement beta that our simplified model focuses on, and β_i^f is the beta with respect to economic fundamentals (such as market beta and macro beta) that our model abstracts from. We shall control empirical proxies of economic fundamentals in both disagreement-beta estimation and portfolios analysis.

Our simple model also exemplifies several important aspects of the disagreement-beta effect that can be tested empirically: First, in our framework, the disagreement is on the macro economy rather than on each asset, and differences in asset returns are driven by the differences in each asset's *beta* with respect to the macro disagreement variable. Therefore, our disagreement-beta effect is different from the well-known effect of disagreements on individual assets with short-sales constraints (Miller, 1977, Chen et al., 2002, and Diether et al., 2002).

Furthermore, the disagreement-beta effect is derived from the (ex-ante) perceived profits from the disagreement-based betting. This is distinct from the channel that disagreement causes (ex-post) wealth share fluctuations and induces volatility as in, e.g., Dumas et al. (2009) and Xiong and Yan (2010)). Moreover, the disagreement-beta effect is also distinct from that of the volatility or uncertainty, for which many studies use the analyst forecast dispersion to proxy.[7] The cross-sectional asset pricing implication of uncertainty, however, runs *opposite* to our disagreement-beta effect: High uncertainty-beta effect assets tend to do well when there is greater uncertainty associated with increases in investors' marginal utilities, and hence should command *low* expected returns in equilibrium (Ang et al., 2006).

3. Disagreement measure and test assets

In this section, we construct our disagreement measure and then introduce the set of test assets used in our empirical analysis.

[7] The motivation is that analysts are likely to disagree more widely when there is greater uncertainty or ambiguity. See, e.g., Johnson (2004) and Zhang (2006), Anderson et al. (2009), Drechsler (2013), Bali et al. (2015), and Della Corte and Krecetovs (2015).

3.1. Macroeconomic forecast and disagreement

Investors can disagree on various dimensions and indicators of the economy or market. To empirically test the disagreement-beta effect, we need choose a specific aspect of the aggregate market that investors disagree on, and construct measures to capture this market-wide disagreement. As a natural choice, we focus on investors' disagreement on the U.S. macro fundamentals because of its importance in the global economy and readily available data of investor expectations on U.S. macro variables. Specifically, we use the BCEI survey of market participants' expectations on key U.S. macro variables to construct our disagreement measure. One advantage of BCEI forecasts is their availability at monthly frequency. Consequently, disagreement beta estimation can be conducted at monthly frequency, which tend to be more accurate than estimations at lower frequencies such as quarterly and semi-annually using other survey data, e.g., from the Survey of Professional Forecasters (SPF) and Livingston Survey of the Federal Reserve Bank of Philadelphia.

The BCEI survey provides forecasts for a variety of U.S. macro variables from a large number of professional economists in leading financial institutions including banks, broker-dealers, and consulting firms. To keep our construction parsimonious, forecasts of several key U.S. economic variables are used in our baseline analysis, including the real GDP growth (RGDP), industrial production growth (IP), unemployment rate (UNEMP), and non-residential fixed investment growth (INV), following the macro-finance literature (Drechsler, 2013, Segal et al., 2015, Orlik and Veldkamp, 2015, and Ludvigson et al., 2016).[8] Forecasts of additional variables are also considered in Section 5 for robustness checks.

The BCEI collects forecasts for both the current calendar year and next calendar year. For example, the January 2005 survey contains forecasts for 2005 and 2006, with forecasting horizons of 12 and 24 months, respectively. However, the February 2005 survey uses one-month-shorter forecasting horizons of 11 and 23 months for 2005 and 2006, respectively. This particular data feature of diminishing forecasting horizons from this month to next month generates forecasting seasonality. The standard U.S. Census Bureau procedure based on an X-12 ARIMA filter is applied to the raw forecast series to remove such seasonality. The forecasts of RGDP, IP, and INV are all based on year-on-year percentage changes, while those of UNEMP are based on the annual average unemployment rate. Moreover, the BCEI survey is usually conducted on the first two business days of each month and published on the tenth. Therefore, the survey results are known by market participants at each month's end, which makes monthly portfolio analysis based on the survey implementable.

Table 1 reports summary statistics for these forecasts, including the mean, median, standard deviation (Std. Dev.), minimum (Min), maximum (Max), first quartile (Q1), and third quartile (Q3). Our sample period runs from July 1984 through December 2014. The table reports the time-series averages of these statistics for both the full sample and various sub-samples. On average, there are about 50 professional forecasters involved each month. The forecast standard deviation appears to be lower in recent years than in earlier periods in our sample. Moreover, the mean and median forecasts vary significantly over time.

For each of the four variables in each month, its disagreement is measured as the cross-sectional standard deviation of individual professional forecasts for the current calendar year. Specifically, denote $f_{i,t}^k$ as individual i's forecast of a macro variable k, for $k \in \{\text{RGDP}, \text{IP}, \text{UNEMP}, \text{INV}\}$, in month t. We measure the disagreement on variable k as

$$Disagree_t^k = \sqrt{\frac{1}{N_t^k}\sum_{i}^{N_t^k}\left(f_{i,t}^k - \overline{f}_t^k\right)^2},$$

where N_t^k is the number of forecasts of variable k in month t, and $\overline{f}_t^k = \sum f_{i,t}^k / N_t^k$ is the consensus forecast, i.e., the cross-sectional average of the individual forecasts.[9]

The simple monthly average of these four disagreement variables is then used as our disagreement measure, denoted as $Disagree_t$, in capturing the disagreement on overall U.S macro fundamentals. Similarly, we measure the forecast consensus for the U.S. economy, $Consensus_t$, as the monthly average of the cross-sectional median of individual forecasts of RGDP, IP, UNEMP, and INV. Fig. 1 plots the monthly time series of the disagreement and consensus measures $Disagree_t^k$ and $Consensus_t^k$ for the four macroeconomic variables as well as the measures $Disagree_t$ and $Consensus_t$ for the overall U.S. economy. We observe that both $Disagree_t$ and $Consensus_t$ vary significantly over time. Furthermore, $Disagree_t$ usually spikes during significant events, such as the 9/11 terrorist attack in 2001 and the 2007–2008 global financial crisis, and is negatively correlated with $Consensus_t$ (the correlation is −0.36), implying that market participants tend to disagree more widely when the consensus forecast is low.[10]

[8] In addition to these four macro variables, the BCEI survey also includes Nominal GDP, the GDP Price Index, the Consumer Price Index, Disposable Personal Income, Personal Consumption Expenditure, Corporate Profits, the 3-Month Treasury Bill Rate, the 10-year Treasury Note Rate, Housing Starts, Auto & Light Truck Sales, and Net Exports.

[9] Consistent with the framework of heterogenous beliefs, we find that forecasters have persistently different forecasts. Specifically, a forecaster whose forecast is above the 75th (below the 25th) percentile of all in month t has a probability of 53–61% (53–60%) in making a forecast in the same bin in month $t+1$. This probability is 65–85% if we categorize forecasts as above or below the median.

[10] The increase in disagreement is less obvious during the Asian financial crisis in 1997, which is perhaps because our measure captures disagreement on the U.S. macroeconomy.

Table 1

Summary Statistics of BCEI Macroeconomic Forecasts Panels A to D in this table report time-series averages of the cross-sectional descriptive statistics, including the mean, median, standard deviation (Std. Dev.), minimum (Min), maximum (Max), first quartile (Q1), and third quartile (Q3) of professional forecasts on U.S. macro variables. In particular, in each month from July 1984 through December 2014, we calculate these statistics across the forecasts of one macro variable by different professional analysts. Then we compute the time-series averages of these statistics for each macro variable. We obtain individual forecasts from about 50 professional forecasters on average, provided by the Blue Chip surveys of economic indicators (BCEI), and follow standard U.S. Census Bureau procedure in performing an *X*-12 ARIMA filter on the raw forecast series to remove seasonality. We include four macro variables: the year-over-year real GDP growth (RGDP), industrial production growth (IP), annual average unemployment rate (UNEMP), and real non-residential fixed investment growth (INV). The economy-wide disagreement (consensus) measure is computed as the average of the disagreement (consensus) measures of the four macro variables. Panels E and F report the summary statistics of these two variables. We report summary statistics for both full sample and various sub-samples.

	Mean	Median	Std. Dev.	Min	Q1	Q3	Max
A: Real GDP growth (RGDP)							
Full sample	2.57	2.58	0.30	1.66	2.41	2.74	3.32
1984:07–1989:12	3.21	3.24	0.44	1.65	3.02	3.46	4.16
1990:01–1999:12	2.49	2.49	0.32	1.49	2.32	2.66	3.29
2000:01–2009:12	2.41	2.42	0.26	1.76	2.26	2.57	3.11
2010:01–2014:12	2.35	2.35	0.21	1.82	2.23	2.47	2.88
B: Industrial production growth (IP)							
Full sample	2.56	2.54	0.69	0.74	2.20	2.93	4.44
1984:07–1989:12	3.85	3.89	0.83	1.23	3.48	4.31	5.86
1990:01–1999:12	2.70	2.64	0.68	1.02	2.31	3.05	4.62
2000:01–2009:12	1.06	1.04	0.73	-0.71	0.67	1.44	3.21
2010:01–2014:12	3.87	3.88	0.48	2.53	3.61	4.17	4.98
C: Unemployment rate (UNEMP)							
Full sample	6.20	6.19	0.14	5.86	6.12	6.28	6.58
1984:07–1989:12	6.44	6.43	0.17	6.09	6.34	6.52	7.04
1990:01–1999:12	5.79	5.79	0.15	5.40	5.70	5.87	6.16
2000:01–2009:12	5.50	5.50	0.12	5.21	5.42	5.57	5.81
2010:01–2014:12	8.15	8.15	0.13	7.81	8.08	8.23	8.47
D: Non-residential fixed investment (INV)							
Full sample	4.89	4.90	1.42	1.02	4.12	5.66	8.62
1984:07–1989:12	5.47	5.47	1.72	0.70	4.56	6.41	9.69
1990:01–1999:12	6.41	6.48	1.46	2.38	5.63	7.27	9.92
2000:01–2009:12	2.74	2.72	1.38	-1.17	2.00	3.49	6.25
2010:01-2014:12	5.49	5.44	1.09	3.05	4.88	5.99	9.57
E: Disagreement							
Full Sample	0.64	0.60	0.18	0.32	0.51	0.75	1.41
1984:07-1989:12	0.79	0.81	0.17	0.47	0.69	0.91	1.25
1990:01-1999:12	0.65	0.63	0.12	0.35	0.57	0.72	1.03
2000:01-2009:12	0.62	0.57	0.20	0.34	0.49	0.72	1.41
2010:01-2014:12	0.48	0.44	0.13	0.32	0.38	0.53	0.87
F: Consensus							
Full Sample	4.05	4.53	2.48	-5.45	2.93	5.50	11.54
1984:07-1989:12	4.76	4.28	2.35	2.15	3.01	5.52	11.54
1990:01-1999:12	4.35	4.88	1.83	-0.04	3.11	5.58	6.78
2000:01-2009:12	2.92	3.11	3.18	-5.45	1.62	5.37	7.07
2010:01-2014:12	4.96	5.10	0.84	3.46	4.28	5.80	6.18

3.2. Test assets

The essence of the cross-sectional pricing power of disagreement beta for the *N* assets is that investors who speculate on the disagreement are also the marginal investors for these *N* assets. Given our disagreement measure is on U.S. macro fundamentals, we naturally choose U.S. securities as the test assets, such as U.S. equities and fixed-income securities, because marginal investors of these assets are likely to be those speculating on the prospects of the U.S. macro economy.

The summary statistics on monthly excess returns (in excess of the one-month U.S. T-bill rate) for U.S. individual stocks, corporate bonds, mortgage-backed securities, and government securities are reported in Table 2. For most variables, the sample period is July 1984 - December 2014, corresponding to the availability of our BCEI forecast data, but the starting months vary for some assets, based on availability.

The U.S. stock sample contains CRSP common stocks (with share code 10 or 11) from the NYSE/Amex/Nasdaq exchanges (with exchange code 1, 2, or 3). Panel A of Table 2 shows that the average monthly return is about 0.68%, with positive skewness.

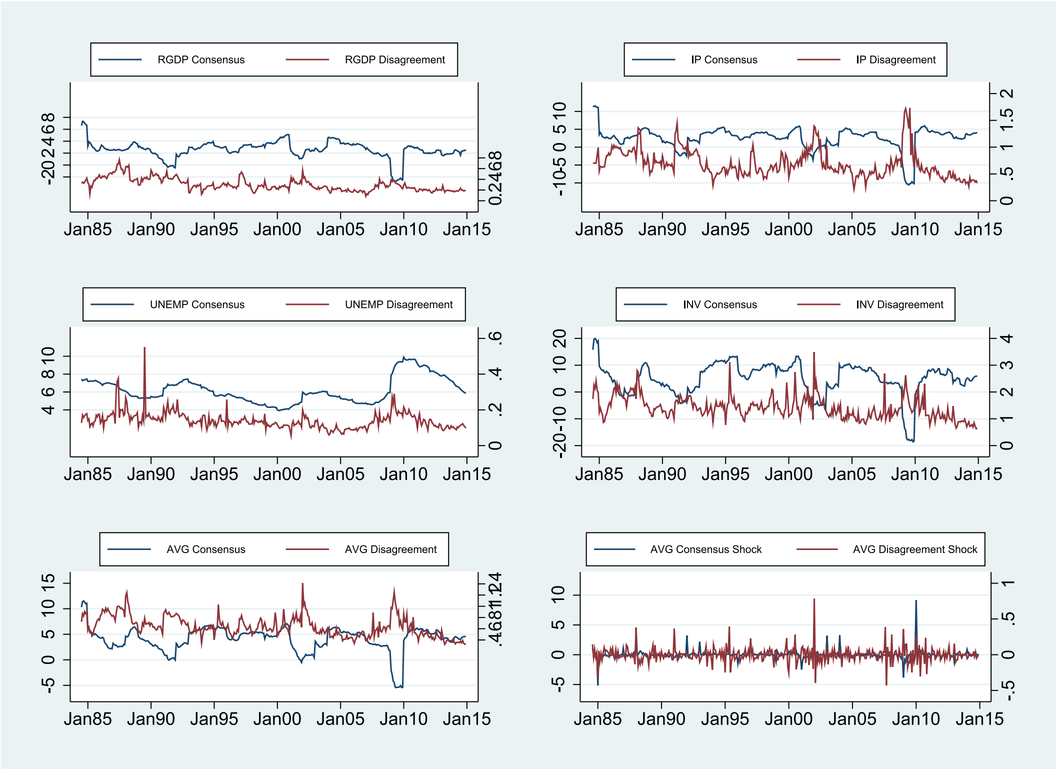

Fig. 1. Time Series of the Forecast Disagreement and Consensus This figure plots monthly time series of the forecast disagreement and consensus measures on the real GDP growth (RGDP), industrial production growth (IP), unemployment rate (UNEMP), and non-residential investment growth (INV). The raw forecast series are from the Blue Chip surveys of economic indicators (BCEI), and the sample period is July 1984 – December 2014. We obtain individual forecasts from about 50 professional forecasters on average, and follow standard U.S. Census Bureau procedure in performing an *X*-12 ARIMA filter on the raw forecast series to remove seasonality. The forecast disagreement is estimated as the cross-sectional standard deviation of individual forecasts (with the scale on the right axis), while the forecast consensus is the median (with the scale on the left axis). We plot the separate forecast consensus and disagreement series on the four macro variables in the top and middle panels. We then construct economy-wide disagreement and consensus measures by the respective average of the disagreement and consensus measures of the four macro variables, plotted in the bottom left panel. The bottom right panel plots the first order differences (changes) of the economy-wide disagreement and consensus measures, respectively.

Our sample of fixed-income assets are from Barclays Capital (via Datastream). In particular, the U.S. corporate bond sample contains 16 corporate bond return indices, with various combinations of credit ratings (e.g., AAA, AA, A, BAA, High Yield and so on) and maturities (long and intermediate). The MBS sample contains 16 investment-grade commercial mortgage-backed security return indices (with ratings from BBB through AAA) of varying maturities (1–3.5 years through 8.5 years or more), four agency MBS return indices, and one asset-backed security return index. The U.S. government securities sample contains four aggregate return indices, i.e., US agency, US government, US TIPS, and US Treasury. Panels B, C, and D of Table 2 report the list of corporate bond, MBS, and government security indices, respectively, and their summary statistics. On average, the monthly return is 0.43% for corporate bonds, 0.31% for MBS, and 0.28% for government securities, with mostly negative skewness.

4. Disagreement beta and asset returns

This section presents our empirical tests of the explanatory power of disagreement beta for asset returns. To estimate the disagreement beta, we control for empirical proxies of economic fundamentals such as the market factor, as discussed in Section 2.4. Moreover, as is clear in the simple model, the disagreement beta effect is also on top of the consensus forecast, which is also included as a control variable. As shown in Fig. 1, disagreement is usually correlated with the market and consensus forecast negatively, hence controlling for the consensus forecast and market return in the estimation of disagreement beta can tease out the confounding effect due to this negative correlation.

Specifically, for each asset, we estimate its disagreement beta β^d by regressing its monthly excess returns rx_t on the change of disagreement measure $\Delta Disagree_t$ ($=Disagree_t - Disagree_{t-1}$), controlling for the market factor MKT_t (the CRSP value-weighted market excess returns in the U.S. sample) and the change in forecast consensus $\Delta Consensus_t$ ($=Consensus_t - Consensus_{t-1}$):

$$rx_t = \alpha + \beta^d \cdot \Delta Disagree_t + \beta^c \cdot \Delta Consensus_t + \beta^m \cdot MKT_t + \varepsilon_t.$$

Table 2
Summary Statistics of Asset Returns This table presents summary statistics of monthly excess returns (in excess of the one-month US T-bill rate), including mean, standard deviation, skewness and kurtosis, for US common stocks from CRSP (Panel A), as well 16 US corporate bond indices (Panel B), 21 US mortgage-backed security indices (Panel C), 4 government security indices (Panel D) from Barclays Capital through Datastream/Bloomberg. The overall sample period is July 1984 through December 2014, with various availability for different assets. The average across securities in each asset class is reported at the end of each panel.

	Begin date	End date	Mean	Std. Dev.	Skewess	Kurtosis
A: US individual stocks	7/31/1984	12/31/2014	0.68%	0.138	1.812	51.816
B: US corporate bond indices						
AGG CORP A INTERMEDIATE	7/31/1984	12/31/2014	0.32%	0.013	−1.467	12.803
AGG CORP A LONG	7/31/1984	12/31/2014	0.49%	0.025	0.053	5.568
AGG CORP AA INTERMEDIAT	7/31/1984	12/31/2014	0.30%	0.011	−0.376	3.464
AGG CORP AA LONG	7/31/1984	12/31/2014	0.52%	0.025	0.572	5.419
AGG CORP AAA INTERMEDIA	7/31/1984	12/31/2014	0.29%	0.011	−0.699	5.893
CORP : AAA LONG	7/31/1984	12/31/2014	0.45%	0.028	−0.278	9.817
AGG CORP BAA INTERMEDIA	7/31/1984	12/31/2014	0.36%	0.013	−1.119	9.349
AGG CORP BAA LONG	7/31/1984	12/31/2014	0.55%	0.024	−0.441	4.927
CORPORATE A+	7/31/1984	12/31/2014	0.38%	0.015	−0.211	2.771
CORPORATE ENHANCED BB	5/31/1993	12/31/2014	0.47%	0.020	−1.328	11.456
HIGH YIELD B	7/31/1984	12/31/2014	0.43%	0.025	-0.808	6.874
HIGH YIELD BA	7/31/1984	12/31/2014	0.52%	0.019	−1.460	10.733
HIGH YIELD CAA	7/31/1984	12/31/2014	0.36%	0.039	−0.430	6.851
HIGH YIELD CA TO D	1/29/1993	12/31/2014	0.57%	0.079	2.976	32.625
HY YIELD 2% ISSUER CAP	1/29/1993	12/31/2014	0.45%	0.025	−1.069	9.954
HY BA/B 1% ISSUER CAP	1/29/1993	12/31/2014	0.43%	0.022	−1.372	11.739
Average			0.43%	0.025	−0.466	9.390
C: US MBS indices						
CMBS INVT GRADE A 1–3.5Y	6/28/2002	12/31/2014	0.51%	0.017	−3.380	27.832
CMBS INVT GRADE A 3.5–6Y	12/31/1999	12/31/2014	0.33%	0.033	−6.904	70.227
CMBS INVT GRADE A 6–8.5Y	6/30/1997	12/31/2014	0.21%	0.051	−6.602	66.826
CMBS INVT GRADE A 8.5+Y	1/31/1997	12/31/2014	0.08%	0.055	−4.693	43.973
CMBS INVT GRADE AA 1–3.5Y	10/31/2001	12/31/2014	0.41%	0.013	−3.193	25.860
CMBS INVT GRADE AA 3.5–6Y	4/30/1999	12/31/2014	0.34%	0.028	−6.408	63.042
CMBS INVT GRADE AA 6–8.5Y	1/31/1997	12/31/2014	0.22%	0.048	−7.159	74.934
CMBS INVT GRADE AA 8.5+Y	1/31/1997	12/31/2014	0.00%	0.051	−7.067	70.995
CMBS INVT GRADE AAA 1–3.5Y	4/30/1997	12/31/2014	0.27%	0.010	−1.048	21.042
CMBS INVT GRADE AAA 3.5–6Y	1/31/1997	12/31/2014	0.37%	0.020	0.683	29.487
CMBS INVT GRADE AAA 6–8.5Y	1/31/1997	12/31/2014	0.45%	0.034	0.082	25.579
CMBS INVT GRADE AAA 8.5+Y	1/31/1997	12/31/2014	0.37%	0.041	-0.909	24.497
CMBS INVT GRADE BBB 1–3.5Y	6/28/2002	12/31/2014	0.61%	0.024	−4.377	38.667
CMBS INVT GRADE BBB 3.5–6Y	12/31/1999	12/31/2014	0.44%	0.039	−5.711	56.214
CMBS INVT GRADE BBB 6–8.5Y	6/30/1997	12/31/2014	0.31%	0.052	−4.550	40.255
CMBS INVT GRADE BBB 8.5+	1/31/1997	12/31/2014	0.11%	0.052	−3.638	24.967
FHLMC 15Y	8/30/1985	12/31/2014	0.24%	0.009	−0.083	1.533
FNMA 15Y	8/30/1985	12/31/2014	0.25%	0.009	−0.070	1.339
FNMA 30Y	7/31/1984	12/31/2014	0.35%	0.010	0.210	2.442
GNMA 30 YEARS	7/31/1984	12/31/2014	0.35%	0.011	0.257	2.849
ASSET BACKED SECS	1/31/1992	12/31/2014	0.20%	0.010	0.530	14.215
Average			0.31%	0.029	−3.049	34.608
D: US Government						
US Agency	1/31/1990	12/31/2014	0.25%	0.010	−0.088	1.288
US Government	1/31/1990	12/31/2014	0.26%	0.012	−0.094	0.947
US TIPS	3/31/1997	12/31/2014	0.31%	0.017	−0.763	4.774
US Treasury	7/31/1984	12/31/2014	0.30%	0.014	−0.012	0.643
Average			0.28%	0.013	−0.307	3.179

Standard rolling-window regressions are used, based on past-36-month observations and with at least 24 months of available data to ensure a reasonable number of observations in the estimation.

4.1. Baseline results

In our baseline analysis, at the end of each month from July 1986 through November 2014, 10 decile portfolios are formed for U.S. individual stocks according to their disagreement betas. To alleviate the concern that microcaps are driving the results, we follow Hou et al. (2017) in using NYSE breakpoints to form portfolios and focusing on value-weighted (VW) portfolio returns. The portfolios are held for a month and then rebalanced. For our sample of fixed-income securities, we form four quartile portfolios according to their disagreement betas, and calculate the equally-weighted monthly rebalancing portfolio returns.

The first column of Table 3 reports the monthly excess returns on the ten disagreement-beta portfolios for U.S. individual stocks, whereas the last column reports the disagreement beta estimates. Low (high) disagreement-beta portfolios consist of assets with the lowest (highest) disagreement betas.[11] We observe that the disagreement beta increases from negative values in the first five deciles to positive values in the last five deciles. The excess return of low (high) disagreement-beta stocks is 0.32% (0.98%) per month and the return difference is 0.67% per month (with a Newey-West t-statistic of 3.66). Consistent with our model prediction of Section 2, there is a strong positive relationship between the disagreement beta and the expected stock return.[12]

The second and third columns of Table 3 report the factor-adjusted returns on the disagreement-beta portfolios for U.S. individual stocks. Adjusting for the Fama and French (2015) five factors (FF5), the alpha for the low disagreement-beta decile is -0.11 ($t = 1.22$), whereas the alpha for the high disagreement-beta decile is 0.30 ($t = 2.17$). Adjusting for the Hou et al. (2015) four factors (HXZ4), the alpha for the low disagreement-beta decile is -0.18 ($t = 1.37$), whereas the alpha for the high disagreement-beta decile is 0.34 ($t = 2.23$). The alphas of high-minus-low disagreement-beta portfolios of U.S. individual stocks are 0.40% per month ($t = 2.12$) and 0.55% per month ($t = 2.28$) adjusting for FF5 and HXZ4 factors, respectively.

The last nine columns of Table 3 show that the excess returns and alphas are mostly monotonically increasing in the disagreement beta for fixed-income markets. For corporate bond return indices, the low (high) disagreement-beta quartiles earn 0.31% (0.55%) per month, with a return difference of 0.24% per month and a t-statistic of 1.84. For MBS return indices, low (high) disagreement-beta portfolios earn 0.15% (0.36%) per month, and the return on the high-minus-low disagreement-beta portfolio is 0.22% per month with a t-statistic of 2.04. The lower return spreads for these two asset classes are perhaps due to the small number of assets in each quartile portfolio, with only about four or five indices within each. To increase the testing power, we pool corporate bonds, MBSs, and government securities return indices together and form four quartile portfolios, with results reported in the last two columns. Both the economic and statistical significance improved, e.g., the return on the high-minus-low disagreement-beta portfolio is 0.31% per month with a t-statistic of 2.65.

Adjusting for the long-term corporate bond excess return factor of Asvanunt and Richardson (2015) and the value and momentum factors of Asness et al. (2013) in the bond market (denoted as FI3), the alphas of high-minus-low disagreement-beta portfolios are 0.23% ($t = 1.74$), 0.24% ($t = 2.21$), and 0.30% ($t = 2.47$) for corporate bonds, MBSs, and the combined fixed-income market, respectively.[13] Overall, the above evidence suggests that disagreement beta has a significant explanatory power for cross-sectional returns in the U.S. asset markets that is distinct from existing return predictors.[14]

4.2. Pricing power of the disagreement factor

Having shown that the disagreement beta has a strong positive effect on asset returns as above, two tests are conducted in this section on the pricing power of the disagreement as a cross-sectional asset pricing factor relative to standard benchmark models.

First, we study whether the disagreement factor reduces the alphas of disagreement beta portfolios on top of the powerful FF5 and HXZ4 factors. In particular, following Fama and French (2015), we calculate the GRS test statistic of Gibbons et al. (1989) and the average absolute intercept $A|a_i|$ for the disagreement beta decile portfolios, using models with the FF5 and HXZ4 factors augmented with the disagreement factor.[15] The average R^2 of the time series regressions is also reported. Given that the FF5 and HXZ4 factors are all return-based factors, the long-short disagreement beta portfolio is used as the factor-mimicking portfolio and its return as the tradable disagreement factor.[16]

The first four columns in Panel A of Table 4 report the results for the disagreement decile portfolios in our baseline analysis. We observe that the average absolute alpha of the model with only two factors, the market and the disagreement factor, is 7 bps, which is lower than the 10 and 13 bps of the FF5 and HXZ4 models, respectively. In fact, augmenting the FF5 and HXZ4 models with the disagreement factor reduces the average absolute alphas by about 30% and 40% to 7 and 8 bps,

[11] In unreported results, for U.S. stock market, high disagreement-beta stocks have significantly higher book-to-market values, lower investments, and lower net stock issue, but most other characteristics including market value, past returns, profitability, idiosyncratic volatility, co-skewness, and idiosyncratic skewness have no bearing on disagreement betas. For U.S. fixed-income markets, we do not observe significant difference in credit rating and maturity between the high and low disagreement-beta portfolios. Moreover, there is significant persistence in disagreement betas based on the average portfolio transition probability one, three, six, and twelve months ahead.

[12] It is worth noting that disagreement in our framework is related to “perceived” future profit opportunities, which differ from the future fundamental investment opportunities in the standard intertemporal capital asset pricing model (Merton, 1973). In fact, empirical evidence documented in the literature suggests that disagreement is not positively related to fundamental investment opportunities. For example, Yu (2011) shows that aggregate disagreement is negatively related to future market return. We find that our disagreement measure is not significantly related to future market return.

[13] The long-term corporate bond excess return factor and the bond market value and momentum factors are downloaded from the AQR data library: https://www.aqr.com/library.

[14] One natural concern about the analysis based on the pooled sample of corporate bond and MBS indices is that the top and bottom quartiles might be dominated by distinct types of indices, and hence the high-minus-low portfolio return is essentially the average return difference of two asset classes. In unreported results, we find that during most of our sample period, the top and bottom quartiles contain both corporate bonds and MBS. Moreover, the asset composition of the portfolio varies substantially over time, indicating that corporate bonds and MBSs have time-varying loadings on disagreement.

[15] Similar to Fama and French (2015), p-values of the GRS test statistic are not reported. After all, “asset pricing models are simplified propositions about expected returns that are rejected in tests with power”(Fama and French, 2015).

[16] Results are similar when using the long-short disagreement beta portfolios for fixed-income assets as the factor-mimicking portfolio.

Table 3

Monthly Returns of Disagreement-β Portfolios This table presents monthly mean excess returns (in percentage), factor-adjusted returns (in percentage), and Newey-West t-statistics (in parentheses) of portfolios formed on disagreement β in U.S. individual stocks, 16 Barclays corporate bond return indices, 21 mortgage-backed security return indices, and 4 government security return indices. A security's disagreement β is obtained by monthly regressing its excess returns on the change in disagreement measure $\Delta Disagree$, controlling for the market factor and change in macro forecast consensus $\Delta Consensus$. We construct 10 decile portfolios for U.S. stocks using NYSE breakpoints and four quartile portfolios for corporate bonds, MBSs, corporate bonds and MBSs combined, and all fixed-income assets combining the three types. We hold the portfolios for a month and calculate value-weighted (VW) portfolio returns for U.S. stocks and equally-weighted (EW) portfolio returns for fixed-income assets. The first portfolio formation months are 07/1986, 07/1986, and 07/1987 respectively, within individual stocks, corporate bonds, MBSs, respectively, while the last portfolio formation month is 11/2014 for all. For individual stocks, we adjust for the Fama and French (2015) five factors (FF5) and Hou et al. (2015) four factors (HXZ4). For fixed-income assets, we adjust for the long-term corporate bond excess return factor of Asvanunt and Richardson (2015) as well as the value and momentum factors of Asness et al. (2013) in the bond market (VAL and MOM). The time-series averages of median disagreement beta estimates across assets within each portfolio are reported for U.S. stocks and all fixed-income assets. *, **, and *** denote significance levels at 10%, 5%, and 1%.

Disagreement-β Portfolio	Ret	FF5 Alpha	HXZ4 Alpha	β	Disagreement-β Portfolio	Corp Bond Ret	Corp Bond Alpha	MBS Ret	MBS Alpha	Corp+MBS Ret	Corp+MBS Alpha	Corp+MBS+GOV Ret	Corp+MBS+GOV Alpha	Corp+MBS+GOV β
1(Low)	0.317	−0.107	−0.177	−0.374	1(Low)	0.306	0.192	0.145	0.091	0.132	0.06	0.145	0.078	−0.028
	(0.888)	(−1.224)	(−1.370)			(2.078)	(1.486)	(0.840)	(0.541)	(0.823)	(0.401)	(0.957)	(0.546)	
2	0.442	−0.209	−0.265	−0.183										
	(1.474)	(−2.218)	(−2.516)											
3	0.559	−0.128	−0.151	−0.114										
	(2.332)	(−1.344)	(−1.465)											
4	0.684	−0.012	−0.059	−0.065	2	0.255	0.183	0.238	0.211	0.298	0.242	0.291	0.242	−0.012
	(2.697)	(−0.130)	(−0.435)			(2.687)	(2.223)	(2.099)	(1.984)	(3.106)	(2.729)	(3.043)	(2.742)	
5	0.581	−0.161	−0.161	−0.024										
	(2.532)	(−2.261)	(−1.676)											
6	0.744	0.07	0.07	0.016										
	(3.025)	(0.919)	(0.824)											
7	0.695	−0.009	0.011	0.058	3	0.386	0.284	0.356	0.327	0.364	0.315	0.378	0.336	−0.001
	(2.680)	(−0.129)	(0.158)			(3.893)	(3.637)	(4.253)	(3.949)	(4.799)	(4.536)	(5.424)	(5.320)	
8	0.775	0.018	0.061	0.107										
	(3.352)	(0.238)	(0.718)											
9	0.739	−0.003	0.007	0.18										
	(2.521)	(−0.026)	(0.066)											
10(High)	0.983	0.297	0.376	0.387	4(High)	0.55	0.423	0.363	0.335	0.491	0.403	0.459	0.377	0.012
	(2.943)	(2.168)	(2.229)			(4.514)	(4.165)	(2.971)	(2.780)	(4.507)	(4.130)	(4.354)	(3.931)	
High-Low	0.666***	0.404**	0.553**	0.761	High-Low	0.244*	0.231*	0.218**	0.244**	0.359***	0.342***	0.314***	0.299**	0.041
	(3.664)	(2.121)	(2.279)			(1.839)	(1.739)	(2.036)	(2.209)	(2.875)	(2.713)	(2.652)	(2.469)	

Table 4

Pricing Power of the Disagreement Factor This table reports the pricing power of the disagreement factor, which is the return of the long-short portfolio constructed based on the disagreement beta. Panel A presents the GRS statistic testing whether the expected value of the 10 or 25 intercept estimates are zero, the average adjusted R^2, the average standard error of the intercepts, and the average absolute value of the intercepts $A|\alpha|$. The first column reports the factors in the regression model. We augment the market model, FF5 model, and HXZ4 model with the disagreement factor in row two, four, and six. Column 2–5 report the results using the ten disagreement β deciles as test assets. Column 6–9 report the results using the 25 size-disagreement β portfolios as test assets. Panel B reports the estimated factor risk premium (in basis points per month) and the corresponding t-statistics using the double-selection LASSO method in Feng et al. (2017). The first column indicates the test assets used to estimate the factor risk premium. FF75 includes the 25 size-BM, 25 size-OP, 25 size-INV portfolios used in Fama and French (2015). IND represents the Fama-French 49 industry portfolios. Disp10 represents the ten disagreement β deciles. SizeDisp25 represents the 25 size-disagreement β portfolios. BD quartiles include all the quartile portfolios form by disagreement β within corporate bonds, corporate bonds and MBSs, and all fixed-income securities. In the first three rows, we control for FF5 and HXZ4 factors (9 factors in total) in the estimation process. In the last three rows, we control for FF5, HXZ4, and the three bond market factors (12 factors in total).

A: Pricing errors of disagreement-β Portfolios

Factors	Disagreement beta deciles *GRS*	R^2	MSE	A|α|	25 Size × Disagreement beta *GRS*	R^2	MSE	A|α|
MKT	1.696	0.859	0.103	0.159	1.329	0.774	0.143	0.178
MKT+ Disagreement	0.567	0.883	0.094	0.074	0.961	0.785	0.141	0.143
FF5	1.421	0.885	0.097	0.101	0.674	0.901	0.099	0.063
FF5 + Disagreement	0.997	0.907	0.085	0.074	0.577	0.911	0.095	0.051
HXZ4	1.665	0.876	0.102	0.134	1.121	0.885	0.107	0.106
HXZ4 + Disagreement	0.892	0.898	0.091	0.079	0.859	0.896	0.103	0.061

B: FGX Test

Test Assets	# of Factors Controlled	λ	t-stat
FF75+IND	9	46.85	2.361
FF75+IND+Disp10	9	58.85	2.901
FF75+IND+SizeDisp25	9	72.38	3.634
FF75+IND+BD quartiles	12	80.06	3.948
FF75+IND+Disp10+BD quartiles	12	77.86	3.819
FF75+IND+SizeDisp25+BD quartiles	12	79.69	3.934

Table 5
Disagreement-β vs Potential Alternative Interpretations This table reports independent double-sorting portfolios based on the disagreement-β and stock-level disagreement. For each individual stock, we extract financial analyst one-quarter-ahead earnings forecasts on this stock from I/B/E/S, and use the cross-sectional standard deviation scaled by the mean of earning forecasts as the measure of stock-level disagreement. We require at least five available forecasts in computing this stock-level disagreement measure. We sort stocks independently into 4 by 4 portfolios based on the disagreement beta and stock-level disagreement using the NYSE breakpoints for each variable, and compute value-weighted returns. Then, for each of the four disagreement beta rankings, we take the average across the four stock-level disagreement portfolios to obtain four quartiles of disagreement beta. We report the return difference between quartile 4 and quartile 1 as "High-Low". FF5/HXZ4 alphas and the corresponding t-statistics for the long-short portfolio are also reported. The next three columns report independent double-sorting portfolios based on the disagreement-β and each of the three volatility/uncertainty betas, with respect to the economic policy uncertainty measure of Baker et al. (2016), to the macro uncertainty measure of Jurado et al. (2015), and to (the month-to-month change of) VIX. These volatility and uncertainty betas are estimated in the same way as the disagreement beta. For U.S. individual stocks, we first form 4 by 4 independent double-sorting portfolios based on the disagreement beta and one volatility/uncertainty beta, and follow the same procedure as for stock-level disagreement. The last three columns report the independent double-sorting results on the disagreement-β and each of the three volatility/uncertainty betas for all fixed-income assets. We form 2 by 2 independent double-sorting portfolios to ensure an adequate number of assets in each portfolio given the smaller number of assets in the fixed-income market. We report the return differences and three-factor alphas for fixed-income assets. Newey-West t-statistics are reported in parentheses. *, **, and *** denote significance levels at 10%, 5%, and 1%.

A: U.S. Stocks					B: U.S. Fixed-Income			
Disagreement-β	Individual Stock	Uncertainty			Disagreement-β	Uncertainty		
Portfolio	Disagreement	EPU	JLN	VIX	Portfolio	EPU	JLN	VIX
1 (Low)	0.484	0.504	0.496	0.541	1 (Low)	0.229	0.279	0.245
	(1.666)	(1.733)	(1.698)	(1.899)		(1.491)	(1.966)	(1.739)
2	0.645	0.63	0.673	0.682				
	(2.756)	(2.569)	(2.789)	(2.759)				
3	0.732	0.712	0.75	0.753				
	(2.872)	(2.924)	(2.996)	(3.042)				
4 (High)	0.864	0.792	0.798	0.853	2 (High)	0.412	0.381	0.409
	(2.948)	(2.717)	(2.754)	(2.998)		(3.290)	(2.867)	(3.111)
High-Low	0.380***	0.288***	0.302***	0.312***	High-Low	0.184**	0.102*	0.164**
	(3.504)	(3.146)	(3.343)	(3.533)		(2.106)	(1.893)	(2.555)
FF5 Alpha	0.260**	0.232*	0.263**	0.228**	FI3 Alpha	0.176*	0.105*	0.159**
	(2.034)	(1.936)	(2.563)	(2.290)		(1.955)	(1.741)	(2.386)
HXZ4 Alpha	0.376***	0.305**	0.354***	0.310***				
	(2.653)	(2.294)	(2.980)	(2.681)				

respectively. Relatedly, when the disagreement factor is added to the FF5 (HXZ4) model, the GRS test statistic decreases from 1.421 (1.665) to 0.997 (0.892), while the average R^2 increases from 0.885 (0.876) to 0.907 (0.898). Similar results are also found for 25 double-sorting portfolios based on size and disagreement beta, as reported in the last four columns of Panel A. Overall, the disagreement factor does bring additional pricing power for cross-sectional stock returns relative to the FF5 and HXZ4 models.

Second, a broad set of portfolio-based test assets are included, in addition to the disagreement beta portfolios. In particular, we consider the FF75 portfolios, including 25 size/BM portfolios, 25 size/OP portfolios, and 25 size/INV portfolios, as well as 49 industry (IND49) portfolios (Fama and French, 2015 and Lewellen et al., 2010). To assess our factor's marginal pricing power relative to FF5 and HXZ4, and account for the overlap between FF5 and HXZ4, we adopt the methodology in Feng et al. (2017) (FGX), which is designed to evaluate the marginal pricing power of a new factor relative to a large set of existing pricing factors.

Panel B of Table 4 reports the FGX test of the disagreement factor against the nine benchmark factors (FF5 and HXZ4) for the FF75 and IND49 portfolios in the first row. The factor risk premium for the disagreement factor is 47 bps (per month) with a t-statistic of 2.36, indicating significant pricing power of the disagreement factor for these portfolio-based test assets. The second and third rows add the 10 disagreement beta disagreement portfolios and the 25 size and disagreement beta portfolios to the set of test assets, from which we observe higher factor risk premium at about 60–70 bps with higher t-statistics of 2.9–3.6. The last three rows further include the fixed-income disagreement beta quartile portfolios to the set of test assets in each of the first three rows. Accordingly, the FI3 factors are also included in the set of benchmark factors. The factor risk premium for the disagreement factor is about 80 bps with t-statistics above 3.9. In sum, the disagreement factor has significant cross-sectional pricing power for a broad set of portfolios-based test assets on top of the benchmark factors.[17]

4.3. Disagreement-Beta vs stock-Level disagreement and uncertainty beta

As discussed in Section 2.4, the economic mechanism of disagreement-beta effect is distinct from that based on disagreement about individual securities and that of uncertainty beta. In this section, we empirically distinguish our finding from these two related effects.

[17] In fact, Feng et al. (2017) show that among all the factors introduced after 2011, only the RMW and CMA factors from FF5 and the IA and ROE factors from HXZ4 have incremental pricing power for cross-sectional stock returns. These factors are included in the benchmark factors we control.

Table 6

Disagreement β Estimation Controlling for Benchmark Factors This table presents monthly mean excess returns (in percentage), factor-adjusted returns (in percentage), and Newey-West t-statistics (in parentheses) of portfolios formed on disagreement β in U.S. individual stocks, and fixed-income assets. We choose the Hou-Xue-Zhang-four-factor model (HXZ4) and the Fama-French-five-factor model(FF5) as two benchmark models for U.S. stocks, and the three factors model (FI3) including the long-term corporate bond excess return ($CORP_{XS}$) factor of Asvanunt and Richardson (2015) as well as the value and momentum factors of Asness et al. (2013) in the bond market (VAL_{BD} and MOM_{BD}) for fixed-income assets. For each factor in a benchmark model, we control for that factor in the disagreement beta estimation step, construct 10 disagreement beta decile portfolios for U.S. stocks or four disagreement beta quartile portfolios for all fixed-income assets, and then report the long-short returns and the alphas according to that benchmark model. The remaining empirical settings are the same as those in Table 3. *, **, and *** denote significance levels at 10%, 5%, and 1%.

	A: HXZ4			
Disagreement-β Portfolio	MKT	ME	IA	ROE
1(Low)	0.315	0.404	0.381	0.525
	(0.873)	(1.106)	(0.983)	(1.407)
2	0.538	0.54	0.506	0.581
	(1.844)	(1.861)	(1.593)	(2.007)
3	0.674	0.694	0.574	0.564
	(3.007)	(2.800)	(2.260)	(2.220)
4	0.636	0.585	0.605	0.742
	(2.557)	(2.636)	(2.271)	(3.241)
5	0.596	0.663	0.647	0.726
	(2.459)	(2.916)	(2.904)	(3.168)
6	0.718	0.736	0.75	0.571
	(3.162)	(3.117)	(3.445)	(2.308)
7	0.707	0.686	0.707	0.69
	(2.670)	(2.562)	(2.879)	(2.836)
8	0.734	0.771	0.823	0.747
	(3.012)	(3.305)	(3.660)	(3.145)
9	0.734	0.509	0.672	0.636
	(2.685)	(1.645)	(2.547)	(2.071)
10(High)	0.844	0.888	0.916	0.787
	(2.377)	(2.491)	(2.813)	(2.358)
High-Low	0.529***	0.484***	0.535***	0.262*
	(3.499)	(3.105)	(2.819)	(1.730)
HXZ4 Alpha	0.543**	0.671***	0.375**	0.655***
	(2.519)	(3.341)	(2.015)	(3.074)

	B: FF5				
Disagreement-β Portfolio	MKTRF	SMB	HML	RMW	CMA
1(Low)	0.313	0.426	0.29	0.446	0.339
	(0.871)	(1.123)	(0.784)	(1.345)	(0.856)
2	0.522	0.623	0.631	0.589	0.54
	(1.805)	(2.210)	(2.299)	(2.017)	(1.662)
3	0.68	0.651	0.594	0.622	0.56
	(3.019)	(2.633)	(2.498)	(2.458)	(2.213)
4	0.608	0.572	0.631	0.72	0.611
	(2.380)	(2.465)	(2.517)	(3.145)	(2.485)
5	0.628	0.714	0.69	0.613	0.694
	(2.664)	(3.153)	(2.908)	(2.606)	(3.036)
6	0.71	0.689	0.673	0.656	0.67
	(3.058)	(2.934)	(3.034)	(2.854)	(3.000)
7	0.697	0.775	0.783	0.704	0.803
	(2.659)	(3.062)	(3.196)	(3.015)	(3.277)
8	0.728	0.725	0.707	0.84	0.786
	(2.888)	(3.009)	(2.574)	(3.631)	(3.317)
9	0.74	0.539	0.641	0.554	0.71
	(2.760)	(1.797)	(2.470)	(1.797)	(2.806)
10(High)	0.852	0.832	0.847	0.783	0.945
	(2.446)	(2.380)	(2.284)	(2.066)	(3.002)
High-Low	0.539***	0.406**	0.557***	0.337*	0.606***
	(3.503)	(2.586)	(3.437)	(1.952)	(3.037)
FF5 Alpha	0.391**	0.443***	0.425**	0.663***	0.324*
	(2.093)	(2.675)	(2.183)	(3.299)	(1.858)

	C: FI3		
Disagreement-β Portfolio	$CORP_{XS}$	VAL_{BD}	MOM_{BD}
1(Low)	0.2	0.1	0.157
	(1.468)	(0.547)	(0.949)
2	0.307	0.288	0.257
	(3.663)	(2.835)	(2.440)
3	0.291	0.369	0.371
	(2.899)	(5.349)	(5.427)
4(High)	0.465	0.507	0.487
	(4.161)	(5.438)	(5.179)
High-Low	0.265**	0.406**	0.331**
	(2.128)	(2.294)	(2.188)
FI3 Alpha	0.198*	0.402**	0.342**
	(1.674)	(2.371)	(2.306)

First, following the literature, financial analyst one-quarter-ahead earnings forecasts for U.S. individual stocks are extracted from I/B/E/S, and their cross-sectional standard deviation scaled by the mean of earning forecast are used as the measure of disagreement on individual stocks (at least five available forecasts are required in computing this disagreement measure). Then 4×4 independent double-sorting portfolios are formed based on the disagreement beta and the stock-level disagreement using NYSE breakpoints and compute the value-weighted portfolio returns. For each of the four disagreement-beta rankings, an average is taken across the four stock-level disagreement portfolios. This procedure creates a set of disagreement-beta quartiles with similar levels of stock-level disagreement, but varying levels of disagreement beta. The results are reported in the first column of Table 5. It is observed that disagreement beta has a significant positive effect on cross-sectional stock returns controlling for stock-level disagreement. The return spread between the high and low disagreement-beta portfolio is 0.38% per month with a t-statistic of 3.50, whereas the FF5 and HXZ4 alphas are 0.26% and 0.38% with t-statistics of 2.03 and 2.65, respectively.

Furthermore, we investigated the trading activity across stocks with different disagreement betas. As expected, trading activity is typically increasing in the stock-level disagreement. In contrast, trading activity has a U-shape pattern with respect to disagreement beta, higher for deciles 1 and 10, and lower for intermediate deciles. This further highlights the difference between the disagreement beta effects and the effects of disagreement at the individual asset level.[18]

Second, as discussed in Section 2.4, the cross-sectional asset pricing implication of uncertainty runs opposite to our disagreement-beta effect. Hence, the significant positive relationship between our estimated betas and asset returns documented so far is *opposite* to the interpretation that our disagreement measure reflects only uncertainty (The correlation between the disagreement measure and uncertainty/volatility measures is between 0.15 to 0.38). Nevertheless, we explicitly control for assets' uncertainty-beta effect using VIX and uncertainty measures of Baker et al. (2016) and Jurado et al. (2015). Each asset's uncertainty betas are estimated based on the same rolling-window beta-estimation procedures as those used for our disagreement betas.

For U.S. individual stocks, 4×4 independent double-sorting portfolios are formed based on disagreement betas and uncertainty betas with respect to the EPU, JLN, and VIX measure, respectively. For each of the four disagreement-beta rankings, the average returns across the four uncertainty beta portfolios are reported in the second, third, and fourth columns of Panel

[18] Details of these analyses are available upon request.

Table 7
Industry-Neutral Portfolios and Alternative Holding Horizons This table presents results for industry-neutral portfolios for stocks and results with alternative holding horizons for stocks and fixed-income securities. Panel A presents monthly mean excess returns (in percentage) and Newey-West t-statistics (in parentheses) of industry-neutral portfolios formed on disagreement-β in U.S. individual stocks. Each month, we obtain the NYSE breakpoints of disagreement β for stocks within each Fama-French 12-industry classification according to their Standard Industry Classification codes. Then, we form ten industry-neutral decile portfolios, and compute the value-weighted returns for these portfolios. We hold the portfolio for a month before rebalancing. We report excess returns as well as abnormal returns adjusted for the FF5/HXZ4 factors for each decile. Panel B reports monthly mean excess returns (in percentage) of disagreement-β portfolios similar to Table 3, but with quarterly(Q), semi-annual(S), and annual(A) holding horizons. Column 3 to 5 present the results for U.S. stocks, whereas column 7–9 present the results for all fixed-income securities, respectively. *, **, and *** denote significance levels at 10%, 5%, and 1%.

	A: Industry-neutral	B: Alternative holding horizons						
Disagreement	(Stock)	Stock			Disagreement	Fixed income		
β Portfolio		Q	S	A	β Portfolio	Q	S	A
1(Low)	0.416	0.312	0.416	0.541	1(Low)	0.216	0.205	0.161
	(1.200)	(0.888)	(1.134)	(1.532)		(1.800)	(1.532)	(1.151)
2	0.451	0.425	0.472	0.542				
	(1.558)	(1.473)	(1.629)	(1.971)				
3	0.737	0.657	0.509	0.517				
	(3.292)	(2.679)	(1.990)	(1.979)				
4	0.563	0.647	0.753	0.721				
	(2.232)	(2.555)	(2.916)	(2.817)	2	0.248	0.278	0.309
5	0.647	0.582	0.583	0.6		(3.252)	(3.590)	(3.888)
	(2.879)	(2.523)	(2.487)	(2.440)				
6	0.67	0.802	0.78	0.685				
	(2.650)	(3.344)	(3.215)	(2.799)				
7	0.736	0.639	0.658	0.672				
	(2.708)	(2.474)	(2.793)	(2.698)	3	0.381	0.350	0.366
8	0.766	0.727	0.787	0.759		(4.478)	(4.344)	(4.614)
	(3.178)	(3.123)	(3.465)	(3.405)				
9	0.702	0.865	0.773	0.742				
	(2.459)	(3.115)	(2.814)	(2.715)				
10(High)	0.855	0.966	0.972	0.979	4(High)	0.428	0.510	0.491
	(2.599)	(2.952)	(3.010)	(3.001)		(3.297)	(4.883)	(4.921)
High-Low	0.439***	0.654***	0.556***	0.438**	High-Low	0.199**	0.295**	0.330**
	(3.595)	(3.548)	(3.094)	(2.368)		(1.989)	(2.197)	(2.381)
FF5 Alpha	0.295**	0.323*	0.142	0.011	FI3 Alpha	0.174*	0.271**	0.311**
	(2.092)	(1.852)	(0.859)	(0.069)		(1.659)	(2.033)	(2.261)
HXZ4 Alpha	0.380**	0.457**	0.212	0.048				
	(2.261)	(2.108)	(1.113)	(0.279)				

A of Table 5 to control for the uncertainty beta effects. The return spreads between the high and low disagreement-beta portfolios are about 0.30% per month with t-statistics larger than 3, whereas the FF5 and HXZ4 alphas range from 0.23% to 0.35% per month with t-statistics mostly larger than 2.29. Panel B of Table 5 reports similar results controlling for the uncertainty-beta effect for all fixed-income assets. We form 2×2 independent double-sorting portfolios to have enough assets in each portfolio. The return spreads and FI3 alphas between the high and low disagreement-beta portfolios are smaller than those for stocks, not surprisingly, ranging from 0.10% to 0.18% per month, but still marginally significant with t-statistics from 1.74 to 2.56. Overall, these results confirm that disagreement beta has a significant positive effect on cross-sectional stock and fixed-income asset returns after controlling for uncertainty betas.

5. Robustness

A number of robustness checks are conducted. First, the benchmark factors are controlled for in the estimation of disagreement betas. Given that a 36-month rolling window is used for estimation, including all of the benchmark factors in one regression can add too much noise and distort the estimation precision substantially. Therefore, the benchmark factors are included one by one. Table 6 reports the decile portfolios for stocks with the beta estimation controlling for each of the HXZ4 and FF5 factors in Panels A and B, respectively, and the quartile portfolios controlling for each of the FI3 factors in Panel C. The alphas for the long-short disagreement beta portfolios are calculated using the corresponding benchmark model. We observe that both the return spreads and alphas are significant as in the baseline results.

Second, Panel A of Table 7 reports the monthly excess returns of disagreement beta portfolios that account for the well-documented industry effects in U.S. cross-sectional stock returns. In particular, we obtain the NYSE breakpoints of disagreement β for stocks within each Fama-French 12-industry classification according to their Standard Industry Classification codes, form ten industry-neutral decile portfolios accordingly, and compute the value-weighted returns for these ten portfolios. The return spread between high and low disagreement beta portfolios is 0.44% per month with a t-statistic of 3.60, whereas the FF5 and HXZ4 alphas are 0.30% and 0.38% per month with t-statistics of 2.09 and 2.26, respectively.

Table 8
Alternative Measures of the Disagreement Factor This table reports disagreement-β portfolios similar to the baseline results in Table 3, but with disagreement β estimated using alternative constructions of the disagreement measure. Panel A reports the results for stocks and Panel B reports the results for fixed-income assets. In column 2, we use the top-minus-bottom ten averages, namely the difference between the average over the top 10% of the individual analysts' macro forecasts and the average over the bottom 10%, as the disagreement measure for each macro variable. In column 3, we measure the shock in disagreement as the average of the AR(1) residuals of the forecast dispersion measures of all four macro variable. In column 4, we measure disagreement as the first principal component of the forecast dispersion measures on the four macro variables. In column 5, we measure disagreement using forecasts of the consumer price index (CPI) and pre-tax corporate profits (CORP) in addition to the RGDP, IP, UNEMP, and INV. The forecast consensus measures are constructed accordingly. For brevity, we only present results of the two extreme portfolios as well as the long-short portfolios. Factor-adjusted returns for the long-short portfolios are reported accordingly. *, **, and *** denote significance levels at 10%, 5%, and 1%.

A: Stock

Disagreement-β	Alternative construction			Alternative macro variables
Portfolio	Top minus bottom	AR(1)	PC	
1 (Low)	0.294	0.343	0.292	0.404
	(0.828)	(0.937)	(0.832)	(1.061)
10 (High)	0.891	0.866	0.854	0.895
	(2.441)	(2.435)	(2.277)	(2.599)
High-Low	0.597***	0.523***	0.561***	0.491***
	(3.143)	(2.981)	(3.743)	(2.700)
FF5 Alpha	0.323	0.212	0.281*	0.383*
	(1.547)	(1.219)	(1.735)	(1.953)
HXZ4 Alpha	0.497**	0.405*	0.412**	0.419*
	(2.094)	(1.766)	(2.167)	(1.783)

B: Fixed Income

Disagreement-β	Alternative Construction			Alternative Macro Variables
Portfolio	Top Minus Bottom	AR(1)	PC	
1 (Low)	0.166	0.095	0.188	0.205
	(1.085)	(1.071)	(0.512)	(1.269)
4 (High)	0.463	0.441	0.457	0.434
	(4.316)	(4.636)	(4.875)	(4.397)
High-Low	0.297***	0.346*	0.270*	0.229
	(2.602)	(1.904)	(1.744)	(1.644)
FI3 Alpha	0.310***	0.354**	0.281*	0.235*
	(2.663)	(2.009)	(1.847)	(1.708)

Third, Panel B of Table 7 reports disagreement beta portfolios at quarterly, semi-annual, and annual holding horizons. For stocks, the return spread of high-minus-low disagreement-beta portfolios decreases from 0.65% to 0.44%, all statistically significant, while the alphas are significant only at the quarterly horizon. For fixed-income securities, the performance of high-minus-low disagreement-beta portfolios have stronger performance at longer holding horizons, with the return spread and alpha increasing from 0.20% to 0.33% and from 0.17% to 0.31%, respectively.

Fourth, the first three columns of Table 8 report the disagreement beta portfolios (in Panel A for stocks and in Panel B for fixed-income securities) with three alternative constructions of the disagreement measure. The first alternative measure uses the top-minus-bottom-ten average forecasts (rather than the cross-sectional standard deviation) in month t as $Disagree_t$. Specifically, in each month and for each macro variable, we sort all individual analysts' forecasts from low to high, calculate the average over the bottom ten forecasts and the average over the top ten forecasts. Disagreement is measured by the difference between these two averages. The second alternative measure uses the AR(1) residual (rather than the first-order difference, $\Delta Disagree_t$) as the shock to disagreement. The third alternative measure uses the first principal component (rather than the simple average) as $Disagree_t$. The results based on these alternative measures remain similar to those in the baseline analysis. In particular, the high-minus-low disagreement-beta portfolios for individual stocks significantly earn 0.52% to 0.60% per month with t-statistics larger than 2.98, with less significant FF5 alphas but significant HXZ4 alphas. The high-minus-low disagreement-beta portfolios for fixed-income assets also have significant return spreads and alphas.

Finally, the last column of Table 8 reports disagreement beta portfolios using a disagreement measure based on a larger set of macro variables than those in the baseline analysis. The consumer price index (CPI) and pre-tax corporate profits (CORP) are included in addition to RGDP, IP, UNEMP, and INV. The results are slightly less significant than the baseline results for individual stocks, and marginally significant for fixed-income assets.[19]

[19] In addition, we also find that the disagreement-beta effect is robust to the firm-level Amihud (2002) illiquidity measure and the Pastor and Stambaugh (2003) liquidity factor, in unreported analysis.

6. Conclusion

When two investors agree to disagree on future economic prospects and speculate with each another, they *both* expect to profit at the expense of their trading counterparties. Exploring this basic and widely-adopted intuition in a simple model, we show that an increase in the disagreement magnitude leads to higher perceived trading profits for both investors and consequently lower marginal utilities, and assets with higher disagreement betas should have higher expected returns.

Based on this theoretical motivation, we construct a disagreement measure using professional forecasts of the U.S. economy, and document that the betas with respect to this single disagreement factor price cross-sectional asset returns for a variety of U.S. asset markets, including U.S. individual stocks, corporate bonds, MBS, and government securities. Moreover, using a broad set of portfolio-based test assets, we show that the disagreement factor has a positive risk premium that is both economically and statistically significant after controlling for all the factors in the FF5 and HXZ4 models using the double-selection LASSO method in Feng et al. (2017).

In addition, we show that the disagreement beta effect is distinctive from the uncertainty or volatility beta effect and the well-known disagreement effect coupled with short-sale constraints, and is robust under a variety of alternative specifications.

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