Investment and Asset Pricing with ESG Disagreement

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Abstract

This paper analyzes the equilibrium implications of ESG rating disagreement for portfolio decisions and asset pricing. Rating disagreement leads to higher effective risk aversion, higher market premium, and lower demand for stocks. Disagreement also tilts the negative ESG-CAPM alpha relation and affects the systematic risk exposure of individual stocks. Combining ESG ratings from six major rating agencies, we provide supporting evidence for the model predictions. Our findings help reconcile the mixed evidence on the cross-sectional return predictability of ESG ratings and they suggest that the lack of consistency in ESG ratings could distort the risk-return trade-off.

Keywords: ESG, Rating Disagreement, Effective Risk Aversion, Portfolio Choice, Capital Asset Pricing Model

JEL: G11, G12, G24, M14, Q01

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1 Introduction

The global financial market has experienced an exponential growth in sustainable investing, an investment approach that considers environmental, social, and governance (ESG) factors in portfolio selection and management. Since the launch of United Nations Principles for Responsible Investment (PRI) in 2006, the number of signatories has grown from 734 in 2010 to 1,384 in 2015 and 3,038 as of April 2020, with total assets under management of US$ 21 trillion in 2010, 59 trillion in 2015 and 103 trillion as of April 2020.[1] In line with the increasing concerns on global warming, BlackRock CEO Larry Fink wrote in a recent annual letter that climate change will force businesses and investors to shift their strategies, leading to a "fundamental reshaping of finance" and "significant reallocation of capital."[2] As the ESG objective is becoming a primary focus in asset management, reallocation of capital carries major implications for portfolio decisions and equilibrium asset pricing.

Pastor et al. (2020) and Pedersen et al. (2020) are the first, to our knowledge, to comprehensively study equilibrium asset pricing in the presence of ESG preferences. They show how ESG preferences could affect the efficient frontier and expected returns. Both studies take the ESG score as given; hence, they implicitly assume there is a consensus view on a firm's ESG profile. In practice, however, ESG ratings are subject to pronounced disagreement across major rating agencies, as recognized by the financial press (Mackintosh (2018)), academic scholars (Chatterji et al. (2016); Berg et al. (2020); Gibson et al. (2020)), and policy-oriented think tanks (Doyle (2018)). For instance, Berg et al. (2020) document that the average correlation between six major rating providers is 0.54, with scope and measurement divergence being the main drivers of disagreement.

This paper analyzes the equilibrium implications of ESG disagreement for both the aggregate market and the cross section. We first study the aggregate market through a mean-variance setup that consists of the market portfolio and cash. We show that, due to disagreement, a brown-averse agent who extracts nonpecuniary benefits from holding green stocks perceives the market portfolio to be a bundle of two components: (1) the usual market portfolio when ESG preferences are muted and (2) a pseudo asset with positive payoff for a green market and negative payoff for a brown market as well as with volatility that evolves from

[1] See, `https://www.unpri.org/pri`.

[2] See, `https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter`.

disagreement on the market ESG score. The optimal portfolio weight is thus determined by the regular mean-variance demand and an additional demand for equities attributable to ESG preferences. Aggregating these components, we show that the demand for equities falls due to disagreement regardless of whether the market is green or brown.

We then formulate the equilibrium market premium. The market risk rises with disagreement. While higher risk essentially commands higher market premium, there is an offsetting force when the market is green, because the agent extracts nonpecuniary benefits from holding green stocks. The ultimate implication of ESG preferences with disagreement for the market premium is thus inconclusive when the market is green while positive when the market is green-neutral. For perspective, when disagreement is not accounted for and the market is green, the market risk does not change, the demand for risky asset rises, and the market premium drops, relative to ESG indifference.

We further derive an asset pricing model for the cross-section of stock returns. Perhaps surprisingly, although there is a three-fund separation when disagreement is at work, a single-factor CAPM continues to hold. Like the market portfolio, in the presence of disagreement, an individual stock is perceived to be a bundle of (1) the physical stock and (2) a pseudo stock that realizes payoff with mean and volatility reflecting the ESG score and disagreement. These two components along with cash give rise to the three-fund separation in a single-factor environment.

While disagreement does not trigger an additional asset pricing factor, the CAPM alpha and beta do vary cross-sectionally with disagreement. Alpha does not indicate mispricing. Instead, when disagreement is not accounted for, alpha reflects the agent's willingness to hold green stocks purely due to nonpecuniary benefits (e.g., Heinkel et al. (2001); Pastor et al. (2020); Pedersen et al. (2020)). With disagreement, the negative ESG-alpha relation documented in prior work is no longer binding. In particular, consider two firms, A and B, with firm A having higher ESG score but also higher disagreement. Firm A might have a larger alpha (i.e., a positive ESG alpha relation) and moreover the demand for stock B could be higher. In equilibrium, the demand for risky assets and alpha are both subject to a tradeoff between the ESG score and rating divergence.

We move on to empirically test the model implications using U.S. common stocks from 2002 to 2019. We collect ESG ratings from six major rating agencies, including Asset4 (Refinitiv), MSCI KLD, MSCI IVA, Bloomberg, Sustainalytics, and RobecoSAM. Consistent with existing studies, we confirm that there are substantial variations across different rating providers, while the average rating correlation is 0.48. The disagreement about ESG ratings is quite consistent throughout the entire sample period.

We first calibrate the model for plausible values of the equity premium, market volatility, and risk aversion. The investment universe consists of the riskless asset along with 25 portfolios sorted on ESG ratings and rating disagreement. Our calibration considers two distinct agents who observe the returns on investable assets. One agent accounts for ESG preferences with disagreement in assessing the risk-return profile of the optimal portfolio, while the other agent is ESG-neutral. Accounting for disagreement significantly reduces the perceived maximal Sharpe ratio from 0.28 to 0.21 per month, and reduces the certainty equivalent rate of return, corresponding to the maximal expected utility, from 1.99% to 1.25% per month. Our findings are robust to various scenarios when the market is either green-neutral or green, as well as when we permit short selling or impose non-negativity constraints on stock holdings. The calibration results reinforce the notion that the lack of consistency in ESG ratings could distort the risk-return trade-off and reduce economic welfare.

We further examine how ESG ratings and rating disagreement affect investor demand, cross-sectional return predictability, systematic risk exposure of individual stocks, and market premium. Consistent with the model prediction, we find that ESG rating disagreement reduces investor demand for risky assets. For instance, stocks in the top (bottom) ESG rating quintile display an institutional ownership of 73% (71%) when rating disagreement is low and 65% (65%) when rating disagreement is high. The ownership gap between high and low disagreement portfolios is statistically significant and economically meaningful, accounting for 7% to 11% of the average institutional ownership. The results are particularly strong among stocks with extreme ESG ratings, as their investors are likely to be more sensitive to the ESG information.

We next examine the asset pricing implications of ESG rating disagreement. We first sort stocks into quintile portfolios based on their ESG rating disagreement. Within each rating disagreement group, we further sort stocks into quintile portfolios according to their ESG ratings. We find that the ESG rating is negatively associated with future performance among stocks with low rating disagreement. For instance, brown stocks outperform green stocks by 0.59% per month in raw return and 0.40% per month in CAPM-adjusted return. However, the negative return predictability of ESG ratings does not hold for the remaining firms. Our results are robust to adjusting for alternative risk factors and controlling for other firm characteristics in Fama and MacBeth (1973) regressions. Overall, our findings support the model predictions, i.e., brown stocks outperform green stocks in the absence of rating disagreement, while disagreement could tilt such relationship.

In equilibrium, firm's systematic risk varies with ESG rating disagreement. As expected, stocks with higher ESG rating exhibit lower systematic risk. More importantly, only green firms are perceived to be riskier when disagreement is high. Such asymmetric impact highlights the importance of rating disagreement, as green firms could be disproportionally penalized due to the ambiguity in their ESG profile.

In addition to the stock-level tests, we also investigate the aggregate effect of rating disagreement. Consistent with the model prediction, we find that market premium increases with ESG rating disagreement, after controlling for market-wide ESG rating and macroeconomic conditions. Rating disagreement also discourages aggregate investor participation over time.

This paper contributes to several strands of the literature. First, we explicitly model the ESG rating divergence in equilibrium asset pricing in both the aggregate market and the cross section. Accounting for disagreement increases the effective risk aversion and reduces investor demand for equities, and also affects the CAPM alpha and beta in the cross section. Our model predictions and calibration results highlight the importance of considering rating disagreement when analyzing sustainable investing.

Second, we contribute to the growing literature on the cross-sectional return predictability of ESG ratings. Prior studies document mixed evidence based on different ESG proxies (e.g., Gompers et al. (2003); Hong and Kacperczyk (2009); Pedersen et al. (2020)). Our contribution is to propose that ESG rating disagreement could tilt the ESG-performance relationship and serve as a potential mechanism to explain the opposing findings. We show that ESG rating is negatively associated with future performance when there is little disagreement, and that the ESG-performance relationship could be insignificant or positive when disagreement increases. Thus, the sin premium presented by Hong and Kacperczyk (2009) could, at least partially, be attributed to the notion that sin stocks (i.e., companies involved in producing alcohol, tobacco, and gaming) are clearly defined and thus subject to minimal disagreement among investors. On the other hand, other ESG profiles could be more challenging to measure or they could rely on nonstandardized information and methodologies, thereby displaying more divergence and mixed evidence on return predictability.

Our findings also enrich academic and policy discussions on the divergence of ESG ratings. Despite the rapid growth in sustainable investing and ESG data market,[3] the comparability of ESG information remains a critical issue. Due to the lack of standards governing the reporting of ESG information, it is not a trivial task to compare the ESG data of two different companies (Amel-Zadeh and Serafeim (2018)). In addition, the construction of ESG ratings is nonregulated, and methodologies can be opaque and proprietary, leading to substantial divergence across data providers (e.g., Mackintosh (2018); Berg et al. (2020)). Our findings suggest that the lack of consistency across ESG rating agencies makes sustainable investing more risky, and hence reduces investor participation and potentially hurts economic welfare. Moreover, green firms are less likely to benefit from lower cost of capital in the presence of disagreement about their ESG profile, and this could further limit their capacity to make socially responsible investments and generate real social impact.

The remainder of this paper is organized as follows. Section 2 presents the model. Section 3 describes the data and the main variables used. Section 4 calibrates the model and explores its quantitative implications. Section 5 empirically examines how ESG ratings and rating disagreement affect investor demand, cross-sectional return predictability, and systematic risk exposure. Section 6 investigates the market implications in terms of the equity premium and aggregate demand. A conclusion follows in Section 7.

2 ESG and Market Equilibrium

In this section, we formulate the economic setup. We start with a single risky asset, i.e., the market portfolio, while the riskless asset is assumed to be in zero net supply. We derive the optimal portfolio and discuss implications of ESG disagreement for the market premium, the Capital Allocation Line (CAL), and economic welfare. The single-asset setup is then extended to consider multiple risky assets and heterogeneous economic agents who differ in their initial wealth, risk aversion, and ESG preferences. We analyze implications of disagreement for the demand for stocks, and finally derive an asset pricing model for the cross-section of stock returns and discuss incremental effects of disagreement on alpha and

[3] The estimated spending on ESG data was US$ 617 million in 2019 and could approach US$ 1 billion by 2021. See, http://www.opimas.com/research/547/detail/.

beta components of stock returns.

2.1 One Risky Asset

Let $\tilde{r}_M$ denote the rate of return on the market portfolio in excess of the riskless rate, r_f, and let $\tilde{g}_M$ denote the ESG score. We model excess market return and ESG score as

$$\tilde{r}_M = \mu_M + \tilde{\epsilon}_M, \tag{1}$$

$$\tilde{g}_M = \mu_{g,M} + \tilde{\epsilon}_{g,M}, \tag{2}$$

where $E(\tilde{r}_M) = \mu_M$ is the expected market excess return, $E(\tilde{g}_M) = \mu_{g,M}$ is the market average ESG rating, and $\tilde{\epsilon}_M$ and $\tilde{\epsilon}_{g,M}$ are zero-mean innovations. We assume that the innovations obey the bivariate normal distribution with σ_M, $\sigma_{g,M}$, and $\rho_{g,M}$ denoting the standard deviation of return, the standard deviation of ESG score, and the correlation between the innovations, respectively. Essentially, $\sigma_{g,M}$ reflects the degree of disagreement.

Following Pastor et al. (2020), we consider a single-period economy in which an optimizing agent derives nonpecuniary benefits from holdings stocks based on ESG characteristics. The agent trades at time 0 and liquidates the position at time 1. Moreover, preferences are formulated through the exponential utility (CARA) function

$$V\left(\tilde{W}_1, x\right) = -e^{-A\tilde{W}_1 - BW_0 x \tilde{g}_M}, \tag{3}$$

where $\tilde{W}_1 = W_0(1 + r_f + x\tilde{r}_M)$ is the terminal wealth, W_0 is the initial wealth, x is the fraction of wealth invested in the risky asset, A stands for the agent's absolute risk aversion, and B characterizes the nonpecuniary benefits that the agent derives from stock holdings. Positive (negative) B indicates that the agent extracts benefits from holding green (brown) stocks. Hence, B can be interpreted as the absolute brown aversion. Slightly departing from Pastor et al. (2020), we formulate preferences for ESG to be wealth-dependent. Then, the expression BW_0 represents relative brown aversion, just as AW_0 stands for relative risk aversion. As demonstrated below, the ratio B/A plays an important role in asset allocation decisions and asset pricing formulations.

The agent picks x attempting to maximize the expected value of preferences in Equation (3). The first-order condition suggests that the optimal portfolio in the presence of ESG disagreement is given by

$$x^* = \frac{1}{\gamma} \frac{\left(\mu_M + \frac{B}{A}\mu_{g,M}\right)}{\sigma^2_{M,D}}, \tag{4}$$

where $\gamma = AW_0$ stands for the relative risk aversion and $\sigma^2_{M,D} = Var\left(\tilde{r}_M + \frac{B}{A}\tilde{g}_M\right)$ is the market variance, as *perceived* by the agent. That is, the ex ante stock return volatility is no longer σ_M because of disagreement. A sufficient condition for $\sigma^2_{M,D} > \sigma^2_M$ is non-negative correlation between market return and ESG score (i.e., $\rho_{g,M} \geq 0$).

In what follows, we make several assumptions for ease of interpretation. We consider a positive market premium (i.e., $\mu_M > 0$) and assume that the investor is brown-averse (i.e., $B > 0$). A positive market premium is plausible in the presence of risk aversion. The brown aversion assumption is sensible, albeit it is useful merely for illustration. The notation can be adjusted such that the agent is green-averse. Next, it is unlikely that the correlation between return and ESG score is negative to the extent that the perceived stock return variance diminishes relative to ESG indifference. We thus focus on the likely case that stocks are riskier in the presence of disagreement (i.e., $\sigma^2_{M,D} > \sigma^2_M$).[4] Finally, to distill incremental effects of disagreement, we consider two benchmark cases. In the first, the agent is ESG indifferent, and in the second, preference for ESG is accounted for while disagreement is excluded. The latter case is studied by Pastor et al. (2020) and Pedersen et al. (2020) in a multiple-security setup.

Equation (4) presents the optimal stock position with disagreement. The risky asset is perceived to be a package of two distinct securities. The first delivers the market return $\tilde{r}_M$, while the second reflects exposure to ESG disagreement and yields $\frac{B}{A}\tilde{g}_M$.[5] The latter component can be interpreted as investing B/A units in a pseudo asset that pays $\tilde{g}_M$ per unit. As the ratio B/A gets higher, the ESG component of the package becomes more meaningful in investment decisions. Stock investing is thus driven by the relative risk aversion, γ, and the *perceived* price of risk of the portfolio that yields $\tilde{r}_M + \frac{B}{A}\tilde{g}_M$.

To further illustrate the mechanism in which ESG disagreement comes to play, we rewrite

[4]Suggestive evidence supports this likely case. In particular, the correlation between ESG score and market return is positive although insignificant in our sample. For perspective, in the presence of disagreement, the perceived volatility diminishes only if $\rho_{g,M} < -\frac{1}{2}\frac{B}{A}\frac{\sigma_{g,M}}{\sigma_M}$.

[5]The no disagreement case can also be interpreted on the basis of two return components, while the ESG component is nonrandom.

the optimal portfolio as

$$x^* = \frac{1}{\gamma_{\mathit{eff}}} \frac{\left(\mu_M + \frac{B}{A}\mu_{g,M}\right)}{\sigma_M^2}, \tag{5}$$

where $\gamma_{\mathit{eff}} = \gamma \frac{\sigma_{M,D}^2}{\sigma_M^2}$ stands for the effective risk aversion. In the presence of disagreement, the effective risk aversion exceeds the actual risk aversion γ.

To give perspective on the notion of effective risk aversion, consider the case that incorporates ESG preferences but excludes disagreement. Then, the perceived volatility of the stock return is still σ_M. Conforming to intuition, the demand for stocks rises as B/A rises and the market is, on average, green. Essentially, stocks are more attractive for a green-loving agent.

When disagreement is accounted for, however, this intuition is no longer binding. To illustrate, we consider two limiting cases. In the first, the ratio B/A grows with no bound. The investor then avoids equities, i.e., $\lim_{B/A \longrightarrow \infty} x^* = \lim_{B/A \longrightarrow \infty} \frac{1}{\gamma} \frac{\mu_M + \frac{B}{A}\mu_{g,M}}{\sigma_{M,D}^2} = 0$. Similarly, when disagreement rises with no bound, the demand for stocks evaporates. That is, both increasing brown aversion and increasing disagreement translate into increasing effective risk aversion. Altogether, a brown-averse agent could substantially reduce stock investing, even when the market is green.

Moving beyond the two limiting cases, we further examine portfolio tilts in the presence of disagreement. For that purpose, we rewrite the optimal portfolio as

$$\begin{aligned} x^* =& \frac{1}{\gamma} \frac{\mu_M}{\sigma_M^2} \left(1 + \frac{B}{A} \frac{\mu_{g,M}}{\mu_M}\right) \\ &- \frac{1}{\gamma} \frac{\mu_M + \frac{B}{A}\mu_{g,M}}{\sigma_{M,D}^2} \left(\left(\frac{B}{A}\right)^2 \frac{\sigma_{g,M}^2}{\sigma_M^2} + 2\frac{B}{A} \frac{\sigma_M \sigma_{g,M} \rho_{g,M}}{\sigma_M^2} \right). \end{aligned} \tag{6}$$

Preferences for ESG generate two incremental terms relative to the benchmark case of ESG indifference. The first term, $\frac{1}{\gamma}\frac{\frac{B}{A}\mu_{g,M}}{\sigma_M^2}$, corresponds to the benchmark case with ESG preferences but no disagreement. It suggests that as B/A rises, the demand for risky asset rises and portfolio tilt intensifies. The second term in Equation (6) purely reflects the incremental effect of disagreement. There are two ratios that come into play in the presence of disagreement. The first ratio, $\frac{\sigma_{g,M}^2}{\sigma_M^2}$, stands for the notion that disagreement makes equity return appear, *ex ante*, riskier. Second, since ESG is not a traded security, the agent employs the market portfolio to hedge against risk evolving from ESG disagreement. This hedging is captured by the ratio $\frac{\sigma_M \sigma_{g,M} \rho_{g,M}}{\sigma_M^2}$. Altogether, the incremental effect of disagreement on stock investing is clearly negative.

In addition, when the market is green-neutral (i.e., $\mu_{g,M} = 0$), the optimal portfolio indicates that ESG preferences (with no disagreement) do not affect stock investing. On the other hand, even when the market is green-neutral, ESG disagreement is associated with portfolio tilts and discourages participation in the equity market. This further highlights the importance of disagreement.

We now turn to analyze the equilibrium implications. Equalizing the optimal stock allocation in Equation (4) to 1 yields the market premium, as the agent holds the market portfolio in equilibrium. We present the market premium for the cases without and with ESG disagreement as

$$\mu_M^{ESG,N} = \gamma \sigma_M^2 - \frac{B}{A} \mu_{g,M}, \tag{7}$$

$$\mu_M^{ESG,D} = \gamma_{\mathit{eff}} \sigma_M^2 - \frac{B}{A} \mu_{g,M}, \tag{8}$$

where the superscripts N and D indicate cases without and with disagreement, respectively.

For perspective, in the standard case of ESG indifference, the market premium is equal to the product of relative risk aversion and market variance, i.e., $\mu_M^{ESG,I} = \gamma \sigma_M^2$, where the superscript I indicates ESG indifference. Retaining the assumptions of a green market and a brown-averse agent, the market premium in Equation (7) diminishes. This is because an agent who extracts nonpecuniary benefits from holding green stocks is willing to compromise on the equity premium when compared to an ESG indifferent agent. Of course, if the market is green-neutral, the equity premium remains unchanged (i.e., equals $\mu_M^{ESG,I}$) even when ESG preferences are accounted for.

Further accounting for disagreement in Equation (8), there are two conflicting forces. On the one hand, the market is perceived to be more risky, thus commanding a higher market premium. On the other hand, the agent extracts nonpecuniary benefits from holding the green market, a force leading to diminishing market premium. The overall effect is inconclusive. Of course, if the market is green-neutral, the equity premium increases relative to both benchmark cases due to the increasing risk channel.

In the presence of ESG preferences, the market risk premium thus incorporates an ESG related α that can be defined as

$$\alpha_M^{ESG,N} = \mu_M^{ESG,N} - \mu_M^{ESG,I} = -\frac{B}{A}\mu_{g,M}, \tag{9}$$

$$\alpha_M^{ESG,D} = \mu_M^{ESG,D} - \mu_M^{ESG,I} = \sigma_M^2\left(\gamma_{\mathit{eff}} - \gamma\right) - \frac{B}{A}\mu_{g,M}. \tag{10}$$

The no disagreement case is associated with negative alpha when the market is green and the agent is brown-averse, while alpha is zero when the market is green-neutral. With disagreement, alpha is positive when the market is green-neutral. Otherwise, with a green market and a brown-averse agent, alpha is inconclusive due to the conflicting forces noted earlier.

The single-security economy establishes a solid benchmark in which to understand the more complex multi-asset setup, to be developed later in the text. While the ESG-alpha relation is negative in the cross section, as advocated in prior work, the single-security case provides the first clue that: (i) a green stock alpha could turn positive in the presence of disagreement, and (ii) there could be a tradeoff, in the cross section, between the ESG score and disagreement.

We next analyze the Sharpe ratio (SR), or the slope of the CAL, from an equilibrium perspective. We fix σ_M to be the market return volatility,[6] while the market premium is given by Equation (8). We derive the ratio of SR measures to assess the total effect of ESG with disagreement

$$\frac{SR^{ESG,D}}{SR^{ESG,I}} = \frac{\gamma_{\mathit{eff}}}{\gamma} - \frac{\frac{B}{A}\mu_{g,M}}{\gamma\sigma_M^2}. \tag{11}$$

The ratio of SR measures is, obviously, subject to the same two conflicting forces as noted earlier. On the one hand, the effective risk aversion exceeds the actual risk aversion, hence the ratio $\frac{\gamma_{\mathit{eff}}}{\gamma}$ is greater than 1. On the other hand, the agent extracts nonpecuniary benefits from holding the green market, as reflected through the negative component $\left(-\frac{\frac{B}{A}\mu_{g,M}}{\gamma\sigma_M^2}\right)$. The overall effect is thus inconclusive. Furthermore, when the market is green-neutral, the ratio of SR measures exceeds 1 due to increasing risk premium. In contrast, with a green market and a brown-averse agent but no disagreement, the ratio drops below 1.

ESG preferences also have welfare implications. To illustrate, the expected utility with

[6] Our setup assumes volatility to be exogenous, while this assumption could be relaxed in future work.

disagreement, evaluated at the optimal solution is given by

$$E\left[V\left(\tilde{W}_1, x^*\right)\right] = -e^{-AW_0\left[1+r_f+\frac{1}{2\gamma}\left(\frac{\mu_M^{ESG,D}+\frac{B}{A}\mu_{g,M}}{\sigma_{M,D}}\right)^2\right]}. \tag{12}$$

Following Back (2010), the term in square brackets represents the investor's certainty equivalent rate of return.[7]

We first consider the case when ESG preferences are in play but disagreement is muted. The welfare change relative to ESG indifference is given by

$$CE^{ESG,N} - CE^{ESG,I} = \frac{1}{2\gamma}\left[\left(\frac{\mu_M^{ESG,N}+\frac{B}{A}\mu_{g,M}}{\sigma_M}\right)^2 - \left(\frac{\mu_M^{ESG,I}}{\sigma_M}\right)^2\right] = 0, \tag{13}$$

where $CE^{ESG,N}$ is the certainty equivalent for ESG preferences with no disagreement, and $CE^{ESG,I}$ represents the corresponding quantity for ESG indifference. In general equilibrium, the difference zeroes out due to two conflicting forces. Intuitively, while holding green stocks has positive impact on welfare, the reduced market premium counters that positive effect. On the other hand, in a partial equilibrium setting where the cost of equity capital does not change with ESG, i.e., $\mu_M^{ESG,N}$ is fixed to be the same as $\mu_M^{ESG,I}$, the welfare gap turns positive for a brown-averse agent who holds the green market. This partial equilibrium analysis is more consistent with the intuition that accounting for ESG preferences in a green market is welfare improving.

The incremental effect of disagreement on welfare is best illustrated through the difference

$$\begin{aligned} CE^{ESG,D} - CE^{ESG,N} &= \frac{1}{2\gamma}\left[\left(\frac{\mu_M^{ESG,D}+\frac{B}{A}\mu_{g,M}}{\sigma_{M,D}}\right)^2 - \left(\frac{\mu_M^{ESG,N}+\frac{B}{A}\mu_{g,M}}{\sigma_M}\right)^2\right] \\ &= \frac{\gamma}{2}\left(\sigma_{M,D}^2 - \sigma_M^2\right), \end{aligned} \tag{14}$$

where $CE^{ESG,D}$ is the certainty equivalent when disagreement is accounted for. The difference is positive because the increasing market premium has stronger impact than increasing equity variation due to disagreement.[8] On the other hand, in a partial equilibrium setup

[7] See equations 2.17 and 2.18 on page 39.

[8] In the same vein, and unrelated to ESG preferences, stock return volatility is welfare improving, when an

in which disagreement does not change the cost of equity capital (i.e., $\mu_M^{ESG,D} = \mu_M^{ESG,N}$), the welfare implication of disagreement turns negative because the market risk increases in the presence of disagreement. To illustrate, consider two agents who observe market return realizations. One agent accounts for ESG disagreement to assess the risk-return profile of the investment, while the other agent does not. Both agents extract nonpecuniary benefits from holding green stocks. Then, disagreement distorts the perceived risk-return trade-off and reduces economic welfare.

Collectively, ESG disagreement affects portfolio selection, market premium, the CAL, and economic welfare. From a general equilibrium perspective, consider a brown-averse investor who holds the green market: (1) without disagreement, the stock investment increases, the market premium declines, and the welfare is unchanged relative to ESG indifference, and (2) with disagreement, the stock investment decreases and the market premium can go either way, while the welfare improves relative to ESG indifference. If we take the cost of equity capital fixed and consider a partial equilibrium setup, accounting for ESG preferences in a green market improves economic welfare relative to ESG indifference, while such welfare improvement deteriorates with disagreement.

2.2 A Multi-asset Economy

We move on to formulate an economy populated with I optimizing agents, N risky assets, and a riskless asset in zero net supply. We aim to derive an asset pricing model for the cross-section of equity returns in the presence of disagreement, while we also extend the analysis of portfolio selection, the CAL, and economic welfare. Before extending to N securities, it is useful to account for heterogeneous agents in the single-asset setup. Thus, consider I agents who differ in their initial wealth, risk aversion, and brown aversion. Market clearing requires that $\sum_{i=1}^{I} \frac{W_{i,0}}{W_0} x_i^* = 1$, where i is an agent specific index and $W_{i,0}$ is agent i's initial wealth. With heterogeneous agents, the market premium in cases without and with disagreement is

investor mixes stocks and cash. Due to the equity premium, the certainty equivalent return of that mixing strategy is higher than the riskless rate.

given by

$$\mu_M^{ESG,N} = \gamma_M \sigma_M^2 - b_M \mu_{g,M}, \tag{15}$$

$$\mu_M^{ESG,D} = \gamma_M \sigma_{M,D}^2 - b_M \mu_{g,M}, \tag{16}$$

where $\gamma_M^{-1} = \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}}$ and $b_M = \sum_{i=1}^{I} \frac{\frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \frac{B_i W_{i,0}}{A_i W_{i,0}}}{\sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}}}$. For perspective, the standard case of ESG indifference generates $\mu_M^{ESG,I} = \gamma_M \sigma_M^2$. The aggregate risk aversion is γ_M and the aggregate brown aversion is b_M. Note that $b_M = B/A$ if agents are identical. Otherwise, b_M is a value-weighted average of B_i/A_i with weights depending on agents' risk aversion and initial wealth.

Next, we model the excess returns and ESG scores on N assets as

$$\tilde{\boldsymbol{r}} = \boldsymbol{\mu}_r + \tilde{\boldsymbol{\epsilon}}_r, \tag{17}$$

$$\tilde{\boldsymbol{g}} = \boldsymbol{\mu}_g + \tilde{\boldsymbol{\epsilon}}_g, \tag{18}$$

where $\boldsymbol{\mu}_r$ is an N vector of mean excess returns and $\boldsymbol{\mu}_g$ is an N vector of mean ESG scores. The residuals from both equations are assumed to obey the multivariate normal distribution. The $N \times N$ covariance matrix of returns is denoted by $\boldsymbol{\Sigma}_r$, the $N \times N$ covariance matrix of disagreement is denoted by $\boldsymbol{\Sigma}_g$, and the $N \times N$ cross-covariance matrix between $\tilde{\boldsymbol{r}}$ and $\tilde{\boldsymbol{g}}$ is denoted by $\boldsymbol{\Sigma}_{r,g}$.

Preferences are, again, formulated using the exponential utility (CARA) function

$$V\left(\tilde{W}_{i,1}, \boldsymbol{X}_i\right) = -e^{-A_i \tilde{W}_{i,1} - B_i W_{i,0} \boldsymbol{X}_i' \tilde{\boldsymbol{g}}}, \tag{19}$$

where $\tilde{W}_{i,1} = W_{i,0}\left(1 + r_f + \boldsymbol{X}_i' \tilde{\boldsymbol{r}}\right)$ is the terminal wealth and $\boldsymbol{X}_i$ is the $N \times 1$ vector of portfolio weights per investor i.

Proposition 1 describes the optimal portfolio in the presence of multiple risky assets. Proofs for all propositions in this subsection are in the Appendix.

Proposition 1. *The optimal portfolio strategy of investor i is given by*

$$\boldsymbol{X}_i^* = \frac{1}{A_i W_{i,0}} \boldsymbol{\Sigma}_i^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right), \tag{20}$$

where $\boldsymbol{\Sigma}_i$ *is the covariance matrix of* $\tilde{\boldsymbol{r}} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \tilde{\boldsymbol{g}}$.

This portfolio strategy is the multi-asset version of Equation (4). It suggests that in the presence of disagreement, investors perceive asset returns as the sum of two components: (1) N stock returns and (2) N returns on fictitious assets that pay $\frac{B_i W_{i,0}}{A_i W_{i,0}} \tilde{\boldsymbol{g}}$.

Several implications are intriguing. In particular, infinitely brown-averse agents act as if they were infinitely risk averse, as $\lim_{\frac{B_i}{A_i} \to \infty} \boldsymbol{X}_i^* = \mathbf{0}$. In another extreme case when ESG disagreement grows with no bound for all stocks, economic agents also avoid stocks altogether. Hence, disagreement affects the demand for both green and brown stocks. In the intermediate cases, investors could considerably reduce stock holdings, either green or brown, when disagreement is in play.

Next, to study fund separation in the presence of disagreement, it is useful to represent the optimal portfolio using the following decomposition.

Proposition 2. *Let* $\boldsymbol{\Sigma}_{i,D} = \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_g + 2\boldsymbol{\Sigma}_{r,g}$ *and assume that the elements of* $\boldsymbol{\Sigma}_{i,D}$ *are all bounded. Then, the optimal portfolio is given by*

$$\boldsymbol{X}_i^* = \frac{1}{A_i W_{i,0}} \boldsymbol{\Sigma}_r^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right) + \frac{1}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right), \tag{21}$$

where $\boldsymbol{\Psi}_{i,D} = -\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\Sigma}_{i,D} \boldsymbol{\Sigma}_r^{-1} \left(\mathbf{I}_N + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_{i,D} \boldsymbol{\Sigma}_r^{-1} \right)^{-1}$ *and* $\mathbf{I}_N$ *stands for the* $N \times N$ *identity matrix.*

The first term of the optimal portfolio also appears in Pastor et al. (2020) (Equation 4) and Pedersen et al. (2020) (Equation 10). Given ESG preferences, the investor accomplishes the maximum Sharpe ratio in the risk-return universe, where return is represented by $\tilde{\boldsymbol{r}} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \tilde{\boldsymbol{g}}$. The second term is driven by ESG disagreement, reflecting the maximum Sharpe ratio in the space of return disagreement. Note that the covariance matrix of risky assets, $\boldsymbol{\Sigma}_r$, shows up in the second term as well because (1) ESG disagreement brings in additional risk and (2) N risky assets are employed to hedge against risk stemming from disagreement.

What type of fund separation characterizes the optimal portfolio? The fund separation proposed by Pastor et al. (2020) and Pedersen et al. (2020) is also at work in our setup, while risky portfolio positions are tilted by disagreement. In particular, the optimal portfolio can further be represented as

$$\boldsymbol{X}_i^* = \lambda^r \boldsymbol{\Gamma}_{i,eff}^{-1} \frac{\boldsymbol{\Sigma}_r^{-1}\boldsymbol{\mu}_r}{\mathbf{1}'\boldsymbol{\Sigma}_r^{-1}\boldsymbol{\mu}_r} + \lambda^g \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Gamma}_{i,eff}^{-1} \frac{\boldsymbol{\Sigma}_r^{-1}\boldsymbol{\mu}_g}{\mathbf{1}'\boldsymbol{\Sigma}_r^{-1}\boldsymbol{\mu}_g}, \tag{22}$$

where $\lambda^r = \mathbf{1}'\boldsymbol{\Sigma}_r^{-1}\boldsymbol{\mu}_r$, $\lambda^g = \mathbf{1}'\boldsymbol{\Sigma}_r^{-1}\boldsymbol{\mu}_g$, and $\boldsymbol{\Gamma}_{i,eff}^{-1} = \left(\frac{1}{A_i W_{i,0}}\mathbf{I}_N + \frac{1}{B_i W_{i,0}}\boldsymbol{\Psi}_{i,D}\boldsymbol{\Sigma}_r\right)$.

Thus, the model implies three-fund separation, where each agent holds (1) the riskless asset, (2) the maximum Sharpe ratio portfolio in the risk-return space, and (3) the maximum Sharpe ratio portfolio in the risk-ESG space. Since the ESG component of the portfolio is not traded, the N risky assets are employed to form the optimal combination in the risk-ESG universe. Stock positions in the two risky portfolios are clearly affected by disagreement. The mechanism in which ESG disagreement affects the demand for risky assets could be understood through the effective risk aversion channel, as indicated by the $N \times N$ matrix $\boldsymbol{\Gamma}_{i,eff}$, a multivariate extension of γ_{eff}.

To shed light on the optimal portfolio with multiple risky assets, we consider a simplified case of two risky assets (along with the riskless asset): one is green while the other is brown, with expected excess returns denoted by $\mu_{r,green}$ and $\mu_{r,brown}$, respectively. We assume that asset returns are uncorrelated and with identical variance equal to σ_r^2. Further, we assume that ESG scores are uncorrelated with each other and with stock returns, and have variances denoted by $\sigma_{g,green}^2$ and $\sigma_{g,brown}^2$. We finally assume that the mean ESG scores are $\mu_g > 0$ for the green firm and $-\mu_g$ for the brown firm.

The two-asset optimal strategy (derivation in the Appendix) is formulated as

$$X_{i,green}^* = \frac{1}{\gamma_{i,eff,green}} \frac{\left(\mu_{r,green} + \frac{B_i W_{i,0}}{A_i W_{i,0}}\mu_g\right)}{\sigma_r^2}, \tag{23}$$

$$X_{i,brown}^* = \frac{1}{\gamma_{i,eff,brown}} \frac{\left(\mu_{r,brown} - \frac{B_i W_{i,0}}{A_i W_{i,0}}\mu_g\right)}{\sigma_r^2}, \tag{24}$$

where $\gamma_{i,eff,green} = A_i W_{i,0}\left(1 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}\right)$ and $\gamma_{i,eff,brown} = A_i W_{i,0}\left(1 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}\right)$ are the effective risk aversion parameters corresponding to green and brown investing. The optimal portfolio illustrates several important implications of ESG preferences with disagreement. First, both the ratio B/A and the effective risk aversion play an important role in characterizing the demand for risky assets. In addition, there is a tradeoff between ESG score and disagreement: the demand for risky assets falls with disagreement but rises with the ESG score. To illustrate, consider stocks I and II, with I having higher ESG score but also higher disagreement. The demand for stock II could be higher even when the investor is brown averse.

2.3 CAPM with Disagreement

The next two propositions formulate asset pricing implications of ESG preferences with and without disagreement.

Proposition 3. *Excluding disagreement, the equilibrium expected returns of the market and N risky assets are given by*

$$\mu_M^{ESG,N} = \gamma_M \left(\sigma_M^{ESG,N}\right)^2 - b_M \mu_{g,M}, \tag{25}$$

$$\boldsymbol{\mu}_r^{ESG,N} = \mu_M^{ESG,N} \boldsymbol{\beta}_N - b_M \left(\boldsymbol{\mu}_g - \boldsymbol{\beta}_N \mu_{g,M}\right), \tag{26}$$

where $\left(\sigma_M^{ESG,N}\right)^2 = \left(\boldsymbol{X}_M^{ESG,N}\right)' \boldsymbol{\Sigma}_r \boldsymbol{X}_M^{ESG,N}$, $\boldsymbol{\beta}_N = \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M^{ESG,N}}{\left(\sigma_M^{ESG,N}\right)^2}$, $\mu_{g,M} = \left(\boldsymbol{X}_M^{ESG,N}\right)' \boldsymbol{\mu}_g$, *and* $\boldsymbol{X}_M^{ESG,N} = \sum_{i=1}^{I} \boldsymbol{X}_i^{ESG,N} \frac{W_{i,0}}{W_{M,0}}$ *is the N-vector of aggregate market positions in risky assets.*

The overall analysis for the market premium is quite similar to the case of a single risky asset, displayed in Equation (7). In brief, if the market is green and investors are brown-averse on average, the market premium drops relative to ESG indifference. The market premium is unchanged if the market is green-neutral.

Moving to individual stocks, expected returns are affected by ESG preferences through (1) the modified market premium as described above, and (2) the alpha component that stands for excess return unexplained by $\mu_M^{ESG,N} \boldsymbol{\beta}_N$. Alpha depends on the effective ESG score, i.e., the difference between the firm's own ESG score and the market ESG score multiplied by the firm's beta. A numerical example is useful to illustrate. Assume that $\boldsymbol{\beta}_N = 1.2$ and $\mu_{g,M} = 2$. As long as the ESG score is below 2.4, the stock has a positive alpha even when the stock is green. The threshold value 2.4 reflects zero alpha, while alpha turns negative if the ESG score goes above the threshold. For instance, if the ESG score is 3 (2), the effective ESG score is 0.6 (-0.4), and alpha is negative (positive). Altogether, it is not the firm's own

ESG score that dictates the sign and magnitude of alpha. Instead, it is the effective ESG score.

Notice that the no-disagreement beta is identical to beta when ESG preferences are muted. In the presence of ESG preferences, the return on an arbitrary asset is equal to the sum of two components (i) the actual return and (ii) B/A times the ESG score. Because the ESG score is nonrandom in the absence of disagreement, the covariance and variance terms used to define the CAPM beta are unchanged. With disagreement, the ESG score is random; hence, the disagreement beta is no longer identical to the regular CAPM beta.

The next proposition explains the equilibrium expected returns with disagreement, which is the core of our analysis.

Proposition 4. *With ESG disagreement, equilibrium expected excess returns of risky assets and CAPM alpha are formulated as*

$$\mu_M^{ESG,D} = \gamma_{M,eff} \left(\sigma_M^{ESG,D}\right)^2 - \mu_{g,M,D}, \tag{27}$$

$$\boldsymbol{\mu}_r^{ESG,D} = \boldsymbol{\beta}_D \mu_M^{ESG,D} - \left(\boldsymbol{\mu}_{g,D} - \boldsymbol{\beta}_D \mu_{g,M,D}\right), \tag{28}$$

$$\boldsymbol{\alpha}_r^{ESG,D} = \left(\boldsymbol{\beta}_D \mu_M^{ESG,D} - \boldsymbol{\beta}_I \mu_M^{ESG,I}\right) - \left(\boldsymbol{\mu}_{g,D} - \boldsymbol{\beta}_D \mu_{g,M,D}\right), \tag{29}$$

where

$$\begin{aligned}
\gamma_{M,eff} &= \frac{\left(\boldsymbol{X}_M^{ESG,D}\right)' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M^{ESG,D}}{\left(\boldsymbol{X}_M^{ESG,D}\right)' \boldsymbol{\Sigma}_r \boldsymbol{X}_M^{ESG,D}} \\
\boldsymbol{\mu}_{g,D} &= \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g \\
\mu_{g,M,D} &= \left(\boldsymbol{X}_M^{ESG,D}\right)' \boldsymbol{\mu}_{g,D} \\
\boldsymbol{\beta}_D &= \frac{\boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M^{ESG,D}}{\left(\boldsymbol{X}_M^{ESG,D}\right)' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M^{ESG,D}} \\
\boldsymbol{X}_M^{ESG,D} &= \boldsymbol{\Gamma}_{M,eff}^{-1} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_r + \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g \\
\boldsymbol{\Gamma}_{M,eff}^{-1} &= \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \boldsymbol{\Gamma}_{i,eff}^{-1} \\
\mathbf{B}_{M,eff} &= \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Gamma}_{i,eff}^{-1}.
\end{aligned}$$

We explain the equations and notation below. First, the market risk premium with disagreement in Equation (27) is similar to the single risky asset case, formulated in Equation (8), with $\gamma_{M,eff}$ being the market-wide effective risk aversion. In brief, there are conflicting forces of increasing effective risk aversion (thus increasing market premium) versus nonpecuniary benefits from holding green stocks (thus diminishing market premium).

Equations (28) and (29) describe the expected returns and alphas on N risky assets, while $\boldsymbol{\mu}_{g,D}$ is the N-vector of mean ESG ratings adjusted as formulated above. In the presence of disagreement, mean ESG scores are adjusted per the term $\frac{\boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1}}{b_M}$. This term is equal to the identity matrix if disagreement is excluded.

Beta with disagreement departs from the no-disagreement beta. When disagreement is accounted for, the return on an arbitrary asset is equal to the sum of two components (i) the actual return and (ii) B/A times the ESG score of that asset. Because ESG scores for the market and individual assets are random, both the covariance and variance terms used in computing the market beta are impacted. The overall effect of disagreement on beta can go either way. On the other hand, beta does not seem to explicitly depend on the ESG score.

Expected returns and alphas are affected by ESG through the market premium as described above and two additional mechanisms. The first mechanism is related to tilted stock beta. As noted above, the disagreement beta (i.e., $\boldsymbol{\beta}_D$) is adjusted when compared to benchmark cases. Hence the first term in Equation (29), i.e., $(\boldsymbol{\beta}_D \mu_M^{ESG,D} - \boldsymbol{\beta}_I \mu_M^{ESG,I})$, where $\boldsymbol{\beta}_I$ denotes factor loadings when ESG preferences are muted, captures the additional systematic risk of a stock due to its contribution to market-wide effective risk aversion. The second mechanism is related to the disagreement-adjusted ESG rating. That is, the second term of Equation (29), i.e., $(\boldsymbol{\mu}_{g,D} - \boldsymbol{\beta}_D \mu_{g,M,D})$, captures the difference between a stock's own disagreement-adjusted ESG score and stock disagreement beta multiplied by market disagreement-adjusted ESG score. Overall, when the market is green and agents are brown-averse, disagreement could tilt the negative ESG-alpha relation.

To provide more intuition on the implications of disagreement for alpha and beta, we revisit the simplified two-risky-asset setup. Assuming homogeneous agents, expected returns on the green and brown assets, in the presence of disagreement, are formulated as (derivation in the Appendix):

$$\mu_{r,green}^{ESG,D} = \gamma \left(\sigma_M^{ESG,D}\right)^2 \beta_{green}^{ESG,D} \left(1 + \left(\frac{B}{A}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}\right) - \frac{B}{A}\mu_g, \tag{30}$$

$$\mu_{r,brown}^{ESG,D} = \gamma \left(\sigma_M^{ESG,D}\right)^2 \beta_{brown}^{ESG,D} \left(1 + \left(\frac{B}{A}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}\right) + \frac{B}{A}\mu_g, \tag{31}$$

where $\beta_{green}^{ESG,D}$ and $\beta_{brown}^{ESG,D}$ are the equilibrium CAPM betas. While the second term in (30) and (31) suggests a negative relation between mean ESG score and alpha, the increase in effective risk aversion due to ESG disagreement may lead to increasing expected returns to the extent that even a green asset would deliver a positive alpha. Ultimately, a green firm with high disagreement could deliver higher alpha than a brown firm with low disagreement. While betas do depend implicitly on ESG disagreement, as noted earlier, the *effective* beta clearly rises with disagreement. The effective beta of a green stock, to illustrate, is defined as $\beta_{green}^{ESG,D}\left(1 + \left(\frac{B}{A}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}\right)$. The effective beta, rather than the usual beta, is the determinant of expected stock return.

We finally assess how disagreement affects the Sharpe ratio of the tangency portfolio (i.e., SR_{Max}) and investor welfare. To start, the following proposition presents the ratio of SR_{Max} measures with ESG disagreement versus ESG indifference.

Proposition 5. *In equilibrium, the ratio of SR_{Max} is given by*

$$\frac{SR_{Max}^{ESG,D}}{SR_{Max}^{ESG,I}} = \frac{\sigma_M^{ESG,D}}{\sigma_M^{ESG,I}} \left[\frac{\gamma_{M,eff}}{\gamma_M} - \frac{1}{\gamma_M} \frac{\mu_{g,M,D}}{\left(\sigma_M^{ESG,D}\right)^2}\right]. \tag{32}$$

The ratio of SR_{Max} is similar to the single security case in Equation (11), with some adjustments of the parameters. The effective aggregate risk and brown aversion are based on the composition of risky stocks in the market portfolio and $\mu_{g,M,D}$ is the disagreement-adjusted market ESG score, as noted earlier. In brief, the ratio could go either way in the presence of two conflicting forces. For comparison, in the case of no disagreement, the slope drops below 1 when the market effective ESG score is positive and investors are brown-averse.

Given that the optimal portfolio tilts in the presence of disagreement, the following proposition formulates the welfare implications.

Proposition 6. *For an individual i, the change in certainty equivalent return is given by*

$$CE_i^{ESG,D} - CE_i^{ESG,I} = \frac{1}{2}\frac{1}{A_i W_{i,0}}\left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}}\boldsymbol{\mu}_g\right)' \boldsymbol{\Sigma}_i^{-1}\left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}}\boldsymbol{\mu}_g\right) - \frac{1}{2}\frac{1}{A_i W_{i,0}}\left(\boldsymbol{\mu}_r^{ESG,I}\right)' \boldsymbol{\Sigma}_r^{-1}\boldsymbol{\mu}_r^{ESG,I}. \quad (33)$$

The welfare change is the difference between two squared Sharpe ratios scaled by the agent's risk aversion. The first 'pseudo' Sharpe ratio reflects the optimal portfolio that invests in N risky assets realizing $\tilde{\boldsymbol{r}} + \frac{B_i W_{i,0}}{A_i W_{i,0}}\tilde{\boldsymbol{g}}$, while the second Sharpe ratio emerges from the optimal portfolio of risky assets that excludes ESG considerations. Accounting for disagreement, the mix of green and brown firms plays an important role, and welfare increases as the prominence of green firms intensifies. However, when disagreement is sufficiently high, welfare can drop even if all firms in the economy are green. Overall, the welfare change is inconclusive. For perspective, welfare rises for agents with ESG preferences but do not account for disagreement, as analyzed by Pastor et al. (2020).

3 Data

3.1 Data Sources

Our sample consists of all NYSE/AMEX/Nasdaq common stocks with share code 10 or 11, with daily and monthly stock data obtained from the Center for Research in Security Prices (CRSP). We collect ESG rating data from six data vendors, including Asset4 (Refinitiv), MSCI KLD, MSCI IVA, Bloomberg, Sustainalytics, and RobecoSAM. These data providers represent the major players in the ESG rating market, and their ratings are widely used by practitioners as well as a growing number of academic studies (e.g., Eccles and Stroehle (2018); Berg et al. (2020); Gibson et al. (2020)).

Quarterly and annual financial statement data come from the COMPUSTAT database. Analyst forecast data come from the Institutional Brokers' Estimate System (I/B/E/S). We also acquire quarterly institutional equity holdings from the Thomson-Reuters Institutional Holdings (13F) database.[9] The full sample period ranges from 2002 to 2019. Our sample

[9]The institutional ownership data come from quarterly 13F filings of money managers to the U.S. Secur-

begins in 2002 as we require ESG ratings from at least two data vendors.

3.2 Main Variables

We focus on the overall ESG rating from each data provider, i.e., "ESG Combined Score" from Asset4, "ESG Rating" from MSCI IVA, "ESG Disclosure Score" from Bloomberg, "Sustainalytics Rank" from Sustainalytics, and "RobecoSAM Total Sustainability Rank" from RobecoSAM.[10] For MSCI KLD data, we construct an aggregate ESG rating by summing all strengths and subtracting all concerns (e.g., Lins et al. (2017); Berg et al. (2020)).

ESG rating agencies may differ in sample coverage and rating scale. Panel A of Appendix Table A.1 reports the number of U.S. common stocks covered by each data vendor over time. In addition, Asset4, Bloomberg, Sustainalytics, and RobecoSAM apply a scale from 0 to 100, MSCI IVA uses a seven-tier rating scale from the best (AAA) to the worst (CCC), and the MSCI KLD rating ranges from –11 to +19 in our sample. Panel B further demonstrates that requiring a common sample covered by all data vendors could significantly reduce the sample size and shorten the sample period. Therefore, we focus on the pairwise ESG rating disagreement then average across all rater pairs.

Specifically, we obtain 14 rater pairs from the six data providers.[11] To achieve comparability across rating agencies, we proceed as follows. For each rater pair-year, we sort all stocks covered by both raters according to the original rating scale of the respective data provider and calculate the percentile rank (normalized between 0 and 1) for each stock-rater pair. Then for each stock, we compute the pairwise rating disagreement as the standard deviation of the ranks provided by the two raters in the pair. Finally, we compute the ESG rating disagreement as the average pairwise rating disagreement across all rater pairs. Similarly, we compute the pairwise average rank, and then average across all rater pairs, to obtain the ESG rating. Table 1 provides detailed definitions for each variable.

For perspective, Table 2 Panel A presents the pairwise ESG rating disagreement and

ities and Exchange (SEC). The database contains the positions of all the institutional investment managers with more than $100 million U.S. dollars under discretionary management. All holdings worth more than $200,000 U.S. dollars or 10,000 shares are reported in the database.

[10]Although Bloomberg ESG disclosure score measures the extent of disclosure of ESG-related data by a company, it is positively associated with ESG quality due to the largely voluntary nature of ESG disclosure requirements (Lopez-de Silanes et al. (2020)).

[11]There are 14 (instead of 15) rater pairs because MSCI KLD data is only available until 2015, while RobecoSAM starts in 2016, as shown in Panel A of Appendix Table A.1.

correlation between ESG ratings. The average correlation across all rater pairs is 0.48, and ranges from 0.25 to 0.71. MSCI KLD and MSCI IVA exhibit the lowest correlation and the highest rating disagreement with other raters, and the average correlation is 0.38 and 0.34, respectively. On the other hand, ratings provided by Sustainalytics and RobecoSAM are more correlated with other raters, and the average correlation is 0.59 and 0.56, respectively. Our findings are largely consistent with the existing literature, and echo the growing concerns related to the lack of agreement across ESG rating agencies (e.g., Chatterji et al. (2016); Amel-Zadeh and Serafeim (2018); Berg et al. (2020); Gibson et al. (2020)).

Table 2 Panel B reports the summary statistics for the stock-level data used in the paper. We report the mean, standard deviation, median, and quantile distribution of annual ESG rating and ESG rating disagreement, and other stock characteristics. The average ESG rating is 0.46 and ESG rating disagreement is 0.18. As an example, a company that is ranked by two data providers at the 33^{rd} and 59^{th} percentiles would generate a rating disagreement of 0.18.

4 Calibration

We calibrate the model to quantitatively assess the implications of ESG disagreement for the risk-return trade-off and economic welfare. To pursue the task, we make the innocuous assumption that ESG scores and asset returns are uncorrelated, for both the aggregate market and individual stocks. Prior work offers reasonable estimates for the relative risk aversion, the market premium, and the market volatility. However, the ESG-based parameters, namely, $\frac{B}{A}$, $\mu_{g,M}$, $\sigma^2_{g,M}$, and stock-level counterparts, are largely unknown. In the data section above, we describe ways to map ESG ratings into scores for individual securities, and the market-level ESG rating follows through aggregation. However, the resulting quantities are not in the scale of equity returns and are ordinal in nature. That is, a higher ESG rating indicates greener stocks, while a higher standard deviation among raters amounts to greater disagreement. Thus, stock-level and market-level ratings as well as measures of rating disagreement can comfortably be used in cross-sectional and time-series regressions to evaluate the implications of the model. In the calibration experiments, an additional transformation is required to make the ESG information interpretable from a return perspective. We provide the steps below.

We start with Equation (8) and rewrite it as

$$\gamma = \frac{\mu_M^{ESG,D} + \frac{B}{A}\mu_{g,M}}{\sigma_M^2 + \left(\frac{B}{A}\right)^2 \sigma_{g,M}^2}. \tag{34}$$

We fix the annual mean and standard deviation of the equity premium to be 7% and 16%, respectively, and pick $\gamma = 2$, within reasonable previous measures.[12] We then consider two distinct investors who observe the same return realizations on investable assets. One investor accounts for ESG preferences in assessing the risk-return profile of the optimal portfolio, while the other investor is ESG-neutral. For the former investor, in the presence of ESG disagreement, the market is essentially riskier, as formulated earlier, regardless of whether the market is green, brown, or neutral.

We analyze three values for $\frac{B}{A}$, namely, 0.5, 1, and 2, with the higher measure representing stronger preference for green stocks. We first assume that the market is green-neutral, and use Equation (34) to recover the market disagreement $\sigma_{g,M}$. At the stock level, we tilt the mean ESG scores and rescale the ESG variances so that their cross-sectional averages conform to the market-wide ESG mean and variance, respectively. We next relax the assumption that the market is green-neutral and introduce a positive ESG tilt. To do so, we set the market-level quantity $\frac{B}{A}\mu_{g,M}$ to be 1% per year, meaning that $\mu_{g,M}$ is unique and positive for each of the $\frac{B}{A}$ values. We then adjust the stock-level mean ESG scores $\boldsymbol{\mu}_g$ so that their cross-sectional average equals $\mu_{g,M}$. The calibration experiment is conducted from a partial equilibrium perspective, as we shut down the channel of higher market risk triggering higher market premium.[13] Then, we can make a fair comparison between two agents who observe returns on investable stocks and form estimates for the first and second moments.

Our investment universe consists of the riskless asset and 25 equity portfolios independently sorted on ESG ratings and rating disagreement. Summary statistics for the equity portfolios are presented in Table 2 Panel C. At this point, we are ready to generate the efficient frontier of risky assets, as formulated in the theory section. Altogether, we generate $6 \times 3 \times 2$ efficient frontiers, corresponding to the market being green-neutral (3 cases with

[12]See Mehra and Prescott (1985).

[13]From a general equilibrium perspective, we can learn from Equation (14) that the welfare actually increases in the presence of disagreement, as long as the market premium reflects the increasing risk due to disagreement.

respect to $\frac{B}{A}$ values) and displaying a positive ESG tilt (also 3 cases), all of which are interacted with (1) ESG indifference, (2) ESG preferences without disagreement, and (3) ESG preferences with disagreement, as well as with and without non-negativity constraints on equity positions.

Table 3 reports the monthly maximal perceived Sharpe ratio and welfare corresponding to the maximal expected utility, with Panel A for the market being green-neutral and Panel B for the market being green on average. ESG I, ESG N, and ESG D stand for ESG indifference, ESG preferences without disagreement, and ESG preferences with disagreement, respectively.[14] Accounting for ESG preferences is typically associated with increasing Sharpe ratios, and we find a larger increase when $\frac{B}{A}$ value is higher and when the market is greener. More remarkably, disagreement considerably hurts investment opportunities. To illustrate, consider the case when $\frac{B}{A} = 1$. The monthly Sharpe ratio for ESG N is 0.46 and it sharply falls to 0.22 when disagreement is accounted for. Results for welfare drop are just as striking. For instance, the certainty equivalent drops from 5.39% to 1.32% per month.

Unconstrained mean-variance portfolios are typically associated with extreme stock positions and thus possibly inflated ex ante Sharpe ratios and welfare.[15] Thus, accounting for non-negativity constraints could deliver more reliable measures. Indeed, in the presence of portfolio constraints, the ex ante Sharpe ratios uniformly drop. Still, the maximal Sharpe ratio falls from 0.28 (no disagreement) to 0.21 (with disagreement) per month. The corresponding welfare values are 2.00% and 1.26%. That is, disagreement leads to nearly a 9% annual drop in certainty equivalent rate of return.

As shown in Panel B, the findings are stronger when the market displays a positive ESG tilt. Take the constrained case with $\frac{B}{A} = 1$, as an example. Accounting for disagreement reduces the maximal Sharpe ratio from 0.29 to 0.22 per month, and reduces the certainty equivalent rate of return from 2.26% to 1.30% per month. Overall, we reinforce the observation that the lack of consistency in ESG ratings could distort the risk-return trade-off and reduce economic welfare.

[14]When ESG preferences without disagreement are considered, the perceived Sharpe ratio is the ratio between the ESG-adjusted expected portfolio return and the non-disagreement-adjusted standard deviation of the portfolio return. When the agent accounts for disagreement, it is the ratio between the ESG-adjusted expected portfolio return and the disagreement-adjusted standard deviation of the portfolio return.

[15]The difficulty in estimating mean return and the covariance matrix is discussed by Merton (1980) and Green and Hollifield (1992), among others.

5 Investor Demand, Stock Return, and Risk

5.1 Investor Demand

We start with the first testable hypothesis generated from the model, i.e., investor demand for risky assets diminishes with disagreement due to higher effective risk aversion, as formulated in Proposition 2 along with equations (23) and (24). In particular, we rely on institutional ownership to proxy for investors' interest in owning a stock. At the end of each year t, we independently sort stocks into quintile portfolios based on their ESG ratings and rating disagreement, to generate 25 (5×5) portfolios. The Low (High) ESG rating and ESG rating disagreement portfolio is comprised of the bottom (top) quintile of stocks based on the ESG rating and ESG rating disagreement, respectively. We compute the quarterly institutional ownership in year $t+1$ for each of the 25 portfolios, and the difference in institutional ownership between low and high ESG rating portfolios ("LMH") as well as between high and low ESG rating disagreement portfolios ("HML"). The standard errors in all estimations are corrected for autocorrelation using the Newey and West (1987) method.

As shown in Table 4, ESG rating disagreement reduces investor demand, especially for stocks with extreme ESG ratings. For instance, green stocks (i.e., stocks in the top ESG rating quintile) with low rating disagreement display an institutional ownership of 73%, while it declines to 65% for green stocks with high rating disagreement. Moving to brown stocks (i.e., stocks in the bottom ESG rating quintile), the institutional ownership is 71% when the rating disagreement is low and declines to 65% when the rating disagreement is high. The ownership gap between high and low disagreement portfolios is statistically significant and economically meaningful, accounting for 7% to 11% of the average institutional ownership in our sample. Not surprisingly, investor demand is less affected among stocks ranked in the middle 60% in terms of ESG ratings, as such investment may not be ESG-driven, and hence the rating disagreement plays a minor role in asset allocation decisions.

In addition, we do not find strong evidence showing that institutional investors are in favor of greener firms, partially because we focus on the subset of stocks covered by at least two ESG rating agencies and employ the average ESG rating across all data providers. However, in line with our working hypothesis, we find that the ownership gap between low and high ESG rating portfolios attenuates when disagreement increases. Overall, our findings support the model prediction that ESG rating disagreement reduces investor demand, especially when investors are sensitive to the ESG information. We will further examine the asset pricing implications of disagreement in the next subsection.

5.2 Cross-sectional Return Predictability

In line with Pastor et al. (2020), our model predicts a negative relationship between the ESG rating and CAPM alpha when there is no disagreement in ESG ratings (Proposition 3). The negative return predictability stems from nonpecuniary benefits from holding green stocks. However, the ESG-alpha relationship is less clear in the presence of ESG disagreement, due to the conflicting forces of the disagreement-adjusted stock beta and ESG rating (Proposition 4).

We assess return predictability using a conventional portfolio sort. In particular, at the end of each year t, we sort stocks into quintile portfolios based on their ESG rating disagreement. Within each rating disagreement group, we further sort stocks into quintile portfolios according to their ESG ratings and generate 25 (5×5) portfolios.[16] The Low (High) ESG rating and ESG rating disagreement portfolio is comprised of the bottom (top) quintile of stocks based on the ESG rating and ESG rating disagreement, respectively. We compute the value-weighted monthly return in year $t+1$ for each of the 25 portfolios. Within each quintile of portfolios sorted by ESG rating disagreement, we also implement the zero-cost trading strategy by taking long positions in the bottom quintile of stocks (lowest ESG rating) and selling short stocks in the top quintile (highest ESG rating). The payoff of the long-short investment strategy is computed as the low (bottom quintile) minus high (top quintile) portfolio return ("LMH"), indicating the return predictability of ESG ratings after controlling for rating disagreement.

In addition to raw portfolio returns, we report risk-adjusted returns from **(1)** CAPM, i.e., only adjusting for the market factor (MKT, defined as the excess return on the value-weighted CRSP market index over the one-month Treasury bill rate); **(2)** Fama-French-Carhart 4-factor model (FFC) consisting of the market factor (MKT), the size factor (SMB, defined as small minus big firm return premium), the book-to-market factor (HML, defined as high book-to-market minus low book-to-market return premium) (Fama and French (1993)), and Carhart (1997) momentum factor (MOM, defined as winner minus loser return premium),

[16] We employ a conditional sort to better control for the rating disagreement, while an independent sort yields similar findings (Table 2 Panel C3).

and **(3)** Fama-French 6-factor model (FF6) consisting of the market factor (MKT), the size factor (SMB), the book-to-market factor (HML), the profitability factor (RMW, defined as robust minus weak return premium), the investment factor (CMA, defined as conservative minus aggressive return premium), and the momentum factor (MOM) (Fama and French (2018)).[17] The standard errors in all estimations are corrected for autocorrelation using the Newey and West (1987) method.

Table 5 reports the results, with Panel A for raw return and CAPM-adjusted return, and Panel B for FFC-adjusted return and FF6-adjusted return. Several findings are worth noting. First, the ESG rating is negatively associated with future performance among stocks with low rating disagreement and the long-short portfolio return is a significant 0.59% per month. Brown stocks (i.e., stocks in the bottom ESG rating quintile) continue to outperform green stocks (i.e., stocks in the top ESG rating quintile) after adjusting for risk exposures, i.e., the long-short portfolio yields a CAPM-adjusted (FFC-adjusted, FF6-adjusted) return of 0.40% (0.46%, 0.50%) per month.

Second, the negative return predictability of ESG ratings no longer holds for the remaining firms, and even turns positive in some cases. Collectively, our findings support the model predictions, i.e., brown stocks outperform green stocks in the absence of rating disagreement, and disagreement could tilt such a relationship via conflicting forces as illustrated in Proposition 4.

Finally, we consider a univariate portfolio sort based on ESG ratings and report similar statistics in the column "All". The ESG rating does not predict stock returns in the full sample, and this is consistent with the existing literature showing weak return predictability of the overall ESG rating (e.g., Pedersen et al. (2020)) and mixed evidence based on different ESG proxies (e.g., Gompers et al. (2003); Hong and Kacperczyk (2009); Bolton and Kacperczyk (2020)). Our results further highlight the importance of rating disagreement, as it not only affects the investor demand, but also has meaningful asset pricing implications. The lack of consistency across ESG rating agencies could be a barrier for investors to use the ESG information and optimize their asset allocation.

As a robustness check, we perform regression analysis to further control for other firm characteristics. Specifically, we estimate the following monthly Fama and MacBeth (1973)

[17] We thank Kenneth French for making the common factor returns available via his website: `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`.

regression:

$$Perf_{i,m} = \alpha_0 + \beta_1 ESG_{i,m-1} + \beta_2 ESG_{i,m-1} \times Low\ ESG\ Disagreement_{i,m-1} + \beta_3 Low\ ESG\ Disagreement_{i,m-1} + \boldsymbol{\beta}_4' M_{i,m-1} + e_{i,m}, \quad (35)$$

where $Perf_{i,m}$ refers to the excess return or CAPM-adjusted return of stock i in month m, $ESG_{i,m-1}$ refers to the ESG rating, $Low\ ESG\ Disagreement_{i,m-1}$ refers to a dummy variable that takes the value of 1 if the ESG rating disagreement is in the bottom quintile across all stocks in that month and 0 otherwise. The vector M stacks all other control variables, including the *Log(Size)*, *Log(BM)*, *6M Momentum*, *Log(Illiquidity)*, *Gross Profitability*, *Corporate Investment*, *Leverage*, *Log(Analyst Coverage)* and *Analyst Dispersion*. The parameter of interest is β_2. Since the model predicts a negative ESG-performance relationship when there is no rating disagreement, we should see a negative value of β_2. Table 1 provides detailed definitions for each variable. We also report Newey and West (1987) adjusted t-statistics.

We tabulate the results in Table 6, with models 1 to 4 for excess return and models 5 to 8 for CAPM-adjusted return. First, the ESG rating does not predict stock returns in the full sample. More importantly, the ESG rating is negatively associated with future stock performance when the rating disagreement is low, and this relation is significant across all regression specifications. Overall, we confirm the early results in the portfolio sort and provide supporting evidence for the ESG-adjusted CAPM after considering rating disagreement.

5.3 Systematic Risk Exposure

Beyond financial performance, an extensive literature also documents that a better ESG profile reduces a firm's risk exposure (e.g., Albuquerque et al. (2019); Hoepner et al. (2019); Ilhan et al. (2020)). Intuitively, given the high uncertainty in ESG issues, a higher standard of corporate ESG practice helps mitigate the legal, regulatory, operational, and financial risks. Albuquerque et al. (2019) show that firms with a high corporate social responsibility (CSR) score display higher profit margins, less cyclical profits, and lower systematic risk. Our model further considers the disagreement in ESG ratings, and implies that such disagreement also contributes to a firm's systematic risk, i.e., disagreement-adjusted stock beta (Proposition 4 and equations (30) and (31)).

We implement a portfolio analysis similar to that in Table 5, and report stock beta for each of the 25 portfolios first sorted by ESG rating disagreement then by ESG ratings. The stock beta is estimated from daily stock returns in a 12-month rolling window, following Hong and Sraer (2016). We tabulate the results in Table 7. Consistent with existing studies, stocks with a higher ESG rating exhibit lower systematic risk and this finding holds in all quintile portfolios sorted by rating disagreement.

More importantly, the beta spread between brown and green stocks declines with rating disagreement, i.e., from 0.25 for low disagreement stocks to 0.09 for high disagreement stocks. This pattern is due to a significant increase in green firms' risk exposure when disagreement is high, i.e., the beta increases from 1.04 for low disagreement stocks to 1.16 for high disagreement stocks. In contrast, rating disagreement does not affect the systematic risk among brown firms. Our findings imply that rating disagreement increases the ambiguity of the firms' ESG profile, and the effect is likely to be stronger for green firms as they are originally perceived to be safer. Such asymmetric impact also highlights the importance of rating disagreement, as green firms could be disproportionally punished.

6 Aggregate Market Implications

6.1 Market Premium

While our model describes a single-period economy, it is still useful to assess the relation between ESG rating, rating disagreement and stock return from an aggregate perspective through predictive regressions. In particular, Equation (8) indicates that (1) the market premium should increase with ESG disagreement due to higher effective risk aversion, (2) the market premium should decrease with ESG rating due to nonpecuniary benefits from holding green stocks, and (3) the effective risk aversion channel is stronger when market volatility is low.

We perform regression analysis to test the model predictions, and explicitly control for other macroeconomic predictors (e.g., Avramov (2002); Van Binsbergen and Koijen (2010)).

Specifically, we estimate the following monthly time-series regression:

$$\begin{aligned} RMRF_m &= \alpha_0 + \beta_1 ESG_{m-1} + \beta_2 ESG\ Disagreement_{m-1} \\ &\quad + \beta_3 ESG\ Disagreement_{m-1} \times High\ VIX_{m-1} + \boldsymbol{\beta}_4' M_{m-1} + e_m, \end{aligned} \quad (36)$$

where $RMRF_m$ refers to the market premium in month m, defined as the CRSP value-weighted index return minus the one-month Treasury bill rate. ESG_{m-1} and $ESG\ Disagreement_{m-1}$ refer to the value-weighted average of ESG ratings and ESG rating disagreement across all stocks, respectively. $High\ VIX_{m-1}$ refers to a dummy variable that takes the value of 1 if the monthly VIX index of implied volatilities of S&P 500 index options is in the top quintile over the entire sample period and 0 otherwise.[18] M_{m-1} refers to a set of other proxies for market conditions, including lagged market premium; dividend price ratio (DP), defined as the difference between the log of dividends and the log of prices; term spread ($TERM$), defined as the difference between the average yield of 10-year Treasury bonds and three-month T-bills, and default spread (DEF), defined as the difference between the average yield of bonds rated BAA and AAA by Moody's. We also report Newey and West (1987) adjusted t-statistics.[19]

The results are presented in Panel A of Table 8. We find that the market premium increases with ESG rating disagreement, after controlling for market-wide ESG rating and macroeconomic conditions. As shown in Model 2, a one-standard-deviation increase in the rating disagreement is related to 0.65% higher market premium per year.[20] Furthermore, we do not find strong evidence of the negative relationship between market premium and ESG rating, as well as the substitution effect between rating disagreement and market volatility (indicated by the β_3 coefficient), although the signs are consistent with model predictions as indicated in models 3 to 5 (when we jointly consider ESG rating and disagreement). The lack of statistical significance could be due to our relatively short sample period. In addition, at the market level, the nonpecuniary benefits are possibly not strong enough because the

[18]We obtain the monthly VIX index from the CBOE website: `http://www.cboe.com/products/vix-index-volatility/vix-options-and-futures/vix-index/vix-historical-data`.

[19]Conducting the diagnostic test of Amihud and Hurvich (2004), we find no evidence of small sample bias in the estimated slope coefficient due to high autocorrelation in the predictive variable.

[20]The impact of rating disagreement is 0.65%, computed as $0.481 \times 0.112 \times 12$, where 0.481 is the regression coefficient in Model 2, and 0.112 is the standard deviation of *ESG Disagreement* as shown in Panel B of Table 2.

market is not sufficiently green. Either way, we confirm the model prediction that the market premium rises with ESG disagreement.

6.2 Aggregate Investor Demand

Finally, we investigate whether and how the rating disagreement affects the aggregate investor demand over time. We employ the same regression specification as in Equation (36), but we replace the dependent variable with market-level institutional ownership IO_m, defined as the value-weighted average of institutional ownership across all stocks.

The results are tabulated in Panel B of Table 8. Consistent with the model prediction that rating disagreement reduces investor demand due to higher effective risk aversion, we find a significant negative relationship between rating disagreement and institutional ownership over time. As shown in Model 2, a one-standard-deviation increase in the rating disagreement is related to a 6% lower institutional ownership, which is economically sizable and translates into an 8% decline relative to the average institutional ownership. Although it seems puzzling that the ESG level also reduces the aggregate demand, unreported results show an insignificant relationship when we do not control for macroeconomic conditions. In addition, we do not find strong evidence on the substitution effect between rating disagreement and market volatility. Overall, our findings complement the analysis in Table 4 that explores the heterogeneous investor demand across firms, and confirm that rating disagreement discourages investor participation in the stock market.

7 Conclusion

We comprehensively analyze the equilibrium implications of ESG rating disagreement for portfolio choice and asset pricing. Starting with the market portfolio as the single risky asset, we show that rating disagreement leads to higher effective risk aversion and higher market premium, as well as lower investor demand. Next, we consider multiple risky assets and heterogeneous economic agents, and derive an ESG augmented CAPM for the cross-section of stock returns. In particular, we propose that ESG disagreement could tilt the ESG-CAPM alpha relationship and serve as a potential channel to explain the mixed evidence in prior studies.

We collect ESG ratings from six major rating agencies, and calibrate the model to assess its quantitative implications in the presence of rating disagreement. Our findings reinforce the observation that the lack of consistency in ESG ratings could distort the risk-return tradeoff and reduce economic welfare. We also empirically test the model implications and provide supporting evidence. First, ESG rating disagreement reduces investor demand for stocks, especially among stocks with extreme ESG ratings. Second, brown stocks outperform green stocks when the rating disagreement is low, and the negative return predictability of ESG ratings does not hold for the remaining firms. In addition, only green stocks are perceived to be riskier when disagreement is high. Finally, rating disagreement has an aggregate impact on the entire market over time. Higher disagreement is associated with higher market premium and lower investor demand for risky assets.

Overall, our analysis suggests that rating disagreement has important implications for asset allocation, investor welfare, and equilibrium asset pricing. Our findings echo the growing concerns regarding the lack of consistency of ESG information disclosure and ratings provided by different rating agencies. We document that disagreement in ESG ratings makes sustainable investing more risky, hence it reduces investor participation. Meanwhile, green firms are less likely to benefit from lower cost of capital in the presence of rating disagreement, and this could further limit their capacity to make socially responsible investments and generate real social impact.

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Table 1: Variable Definitions

Variables	Definitions
A. ESG Rating Measures	
ESG	We collect ESG rating data from six data vendors: Asset4 (Refinitiv), MSCI KLD, MSCI IVA, Bloomberg, Sustainalytics, and RobecoSAM. For each rater pair-year, we sort all stocks covered by both raters according to the original rating scale of the respective data provider and calculate the percentile rank (normalized between 0 and 1) for each stock-rater pair. Then for each stock, we compute the pairwise average rating as the average rank across the two raters in the pair. Finally, we compute the ESG rating as the average pairwise rank across all rater pairs.
ESG Disagreement	For each rater pair-year, we sort all stocks covered by both raters according to the original rating scale of the respective data provider and calculate the percentile rank (normalized between 0 and 1) for each stock-rater pair. Then for each stock, we compute the pairwise rating disagreement as the standard deviation of the ranks provided by the two raters in the pair. Finally, we compute the ESG rating disagreement as the average pairwise rating disagreement across all rater pairs.
B. Other Stock Characteristics	
Excess Return	Stock return minus the one-month Treasury bill rate in a given month.
CAPM-adjusted Return	Stock excess return minus the product of a stock's beta and excess return on the market in a given month. The excess return on the market is computed as the CRSP value-weighted index return minus the one-month Treasury bill rate. The beta of the stock is estimated in a five-year rolling window.
IO	The institutional ownership in a given quarter q is computed as follows: $IO_{i,q} = \sum_f SHR_{i,f,q}/SHROUT_{i,q}$, where $SHR_{i,f,q}$ refers to the number of shares of stock i held by institution f in quarter q, and $SHROUT_{i,q}$ refers to the shares outstanding at the same time.
Log(Size)	The logarithm of stock market capitalization, computed as the number of common shares outstanding times share price as reported in CRSP.
Log(BM)	The logarithm of the book-to-market ratio of a stock, and the book-to-market ratio is computed as book value of equity divided by market capitalization at fiscal year-end, following Fama and French (2015).
6M Momentum	Formation period return for six-month momentum in a given month m is computed as the cumulative return from month $m-6$ to month $m-1$, following Jegadeesh and Titman (1993).
Log(Illiquidity)	The logarithm of the stock illiquidity. Stock illiquidity in a given month m is computed as follows: $ILLIQ_{i,m} = \left(\sum_{d\in m} \left\|R_{i,d,m}\right\| / VOLD_{i,d,m}\right)/D_{i,m} \times 10^8$, where $R_{i,d,m}$ refers to the percentage return of stock i in day d of month m, $VOLD_{i,d,m}$ refers to the dollar trading volume at the same time, and $D_{i,m}$ is the number of trading days for stock i in month m, following Amihud (2002).
Gross Profitability	Gross profitability in a given year t is computed as follows: $GP_{i,t} = (REVT_{i,t} - COGS_{i,t})/ASSET_{i,t}$, where $REVT_{i,t}$ refers to the total revenue (COMPUSTAT annual item REVT) of stock i in year t, $COGS_{i,t}$ refers to the cost of goods sold (item COGS), and $ASSET_{i,t}$ is the total assets (item AT), following Novy-Marx (2013).
Corporate Investment	Corporate investment in a given quarter q is computed as follows: $CI_{i,q} = PPE_{i,q} - (PPE_{i,q-1} + PPE_{i,q-2} + PPE_{i,q-3})/3$, where $PPE_{i,q}$ refers to the ratio of change in net property, plant, and equipment (COMPUSTAT quarterly item PPENTQ) divided by sales (item SALEQ) of stock i in quarter q. If SALEQ is 0 or negative, then replace SALEQ with 0.01, following Titman et al. (2004).
Leverage	Total liabilities (COMPUSTAT annual item LT) divided by market capitalization at fiscal year-end, following Bhandari (1988).
Log(Analyst Coverage)	The logarithm of the number of analysts following the firm as reported in I/B/E/S in each quarter.
Analyst Dispersion	The standard deviation of analysts' earnings (earnings per share, EPS) forecasts divided by the absolute value of the median earnings forecast as reported in I/B/E/S in each quarter.
Beta	Stock beta in a given month m is computed as follows using a 12-month rolling window: $R^e_{i,d,m} = \alpha_{i,m} + \sum_{k=0}^{5} \beta_{i,k,m} RMRF_{d-k,m} + e_{i,d,m}$, where $R^e_{i,d,m}$ refers to the excess return of stock i in day d of month m, computed as the stock return minus the one-month Treasury bill rate. $RMRF_{d-k,m}$ refers to the excess market return on day $d-k$, computed as the value-weighted return of all CRSP firms incorporated in U.S. and listed on the NYSE, Amex, and Nasdaq minus the one-month Treasury bill rate. Stock beta is the sum of the six coefficients, i.e., $\beta_{i,m} = \sum_{k=0}^{5} \beta_{i,k,m}$, following Hong and Sraer (2016).

Table 2: Summary Statistics

We collect ESG rating data from six data vendors: Asset4 (Refinitiv), MSCI KLD, MSCI IVA, Bloomberg, Sustainalytics, and RobecoSAM. Panel A reports the average ESG rating disagreement and correlation for each rater pair. For each rater pair-year, we sort all stocks covered by both raters according to the original rating scale of the respective data provider and calculate the percentile rank (normalized between 0 and 1) for each stock-rater pair. Then for each stock, we compute the pairwise rating disagreement as the standard deviation of the ranks provided by the two raters in the pair. Finally, we compute the average ESG rating disagreement across all stocks for each rater pair-year and average over time. Similarly, we compute the correlation in the percentile ranks for each rater pair-year then average over time. Panel B presents the summary statistics for the stock-level data used in the paper. We report the mean, standard deviation, median, and quantile distribution of annual ESG rating and ESG rating disagreement, monthly stock performance, quarterly institutional ownership, and other annual and monthly stock characteristics. Panel C presents the summary statistics for the portfolio-level data used in the paper. At the end of year t, stocks are independently sorted into quintiles according to their ESG ratings and ESG rating disagreement, to generate 25 (5×5) portfolios. We report the value-weighted ESG rating, ESG rating disagreement, and return in year $t+1$ for each of the 25 portfolios. Our sample period ranges from 2002 to 2019. Table 1 provides detailed definitions for each variable.

Panel A: Pairwise ESG Disagreement and Correlation

	Asset4 MSCI KLD	Asset4 MSCI IVA	Asset4 Bloomberg	Asset4 Sustainalytics	Asset4 RobecoSAM	MSCI KLD MSCI IVA	MSCI KLD Bloomberg
ESG Disagreement	0.185	0.185	0.134	0.144	0.149	0.180	0.183
Correlation	0.321	0.326	0.639	0.595	0.547	0.349	0.310

	MSCI KLD Sustainalytics	MSCI IVA Bloomberg	MSCI IVA Sustainalytics	MSCI IVA RobecoSAM	Bloomberg Sustainalytics	Bloomberg RobecoSAM	Sustainalytics RobecoSAM
ESG Disagreement	0.151	0.195	0.171	0.181	0.133	0.138	0.119
Correlation	0.547	0.253	0.411	0.353	0.677	0.645	0.707

Panel B: Quantile Distribution of Stock Characteristics

	Mean	Std.Dev.	Quantile Distribution				
			10%	25%	Median	75%	90%
ESG	0.461	0.202	0.219	0.310	0.437	0.595	0.753
ESG Disagreement	0.180	0.112	0.051	0.097	0.162	0.246	0.330
Return	1.049	11.171	-11.257	-4.627	1.005	6.443	12.964
Excess Return	0.980	11.174	-11.330	-4.698	0.936	6.373	12.897
CAPM-adjusted Return	-0.195	9.796	-10.840	-5.028	-0.231	4.410	10.128
IO	0.734	0.256	0.343	0.636	0.811	0.920	0.996
Log(Size)	14.726	1.608	12.703	13.575	14.669	15.792	16.890
Log(BM)	-0.772	0.808	-1.819	-1.243	-0.688	-0.213	0.149
6M Momentum	0.054	0.264	-0.235	-0.085	0.045	0.175	0.333
Log(Illiquidity)	-7.119	2.079	-9.698	-8.647	-7.278	-5.736	-4.303
Gross Profitability	0.313	0.303	0.037	0.109	0.273	0.460	0.696
Corporate Investment	0.159	7.035	-0.077	-0.018	0.000	0.018	0.092
Leverage	1.596	3.222	0.090	0.227	0.546	1.378	4.558
Log(Analyst Coverage)	2.175	0.815	1.099	1.609	2.303	2.773	3.135
Analyst Dispersion	0.121	0.365	0.007	0.014	0.030	0.079	0.224
Beta	1.198	0.649	0.499	0.774	1.107	1.515	2.013

Table 2 (continued)

Panel C: Portfolio Characteristics Sorted by ESG Rating and ESG Disagreement					
Rank of ESG Rating	Rank of ESG Disagreement				
	Low	2	3	4	High
Panel C1: ESG Rating					
Low	0.252	0.259	0.277	0.287	0.305
2	0.368	0.386	0.384	0.390	0.373
3	0.474	0.479	0.467	0.487	0.483
4	0.575	0.589	0.600	0.603	0.597
High	0.848	0.811	0.753	0.732	0.702
Panel C2: ESG Disagreement					
Low	0.135	0.146	0.179	0.215	0.275
2	0.159	0.152	0.172	0.207	0.317
3	0.131	0.156	0.179	0.207	0.293
4	0.139	0.136	0.172	0.208	0.295
High	0.093	0.114	0.160	0.193	0.260
Panel C3: Return					
Low	1.117	1.149	0.733	1.003	0.916
2	1.353	1.133	0.976	1.061	0.831
3	1.009	0.855	0.951	1.101	1.050
4	0.857	0.856	1.169	1.147	0.916
High	0.664	0.784	0.840	1.158	1.026

Table 3: Sharpe Ratio and Welfare Calibration

We report the monthly maximum perceived Sharpe ratio and certainty equivalent for an investment universe consisting of a riskless asset (one-month Treasury bill) as well as 25 portfolios sorted on ESG ratings and ESG rating disagreement. The annual mean and standard deviation of the equity premium are set to be 7% and 16%, respectively, while $\gamma = 2$. We consider three values for $\frac{B}{A}$, i.e., 0.5, 1 and 2, with the higher measure representing stronger preference for green stocks. Altogether, we generate $6 \times 3 \times 2$ efficient frontiers, corresponding to the market being green-neutral (Panel A, 3 cases with respect to $\frac{B}{A}$ values) and on average green (Panel B, also 3 cases), all of which are interacted with ESG indifference (ESG I), ESG preferences without disagreement (ESG N), and ESG preferences with disagreement (ESG D), as well as with (Unconstrained) and without non-negativity constraints (Constrained) on equity positions.

	Panel A: Green-Neutral Market					
	Unconstrained			Constrained		
	ESG I	ESG N	ESG D	ESG I	ESG N	ESG D
	Sharpe Ratio					
$\frac{B}{A} = 0.5$	0.43	0.41	0.20	0.24	0.25	0.20
$\frac{B}{A} = 1$	0.43	0.46	0.22	0.24	0.28	0.21
$\frac{B}{A} = 2$	0.43	0.68	0.29	0.24	0.33	0.26
	Certainty Equivalent (%)					
$\frac{B}{A} = 0.5$	4.71	4.37	1.14	1.57	1.72	1.11
$\frac{B}{A} = 1$	4.71	5.39	1.32	1.57	2.00	1.26
$\frac{B}{A} = 2$	4.71	11.54	2.18	1.57	2.84	1.84
	Panel B: Green Market					
	Unconstrained			Constrained		
	ESG I	ESG N	ESG D	ESG I	ESG N	ESG D
	Sharpe Ratio					
$\frac{B}{A} = 0.5$	0.43	0.43	0.21	0.24	0.27	0.21
$\frac{B}{A} = 1$	0.43	0.48	0.22	0.24	0.29	0.22
$\frac{B}{A} = 2$	0.43	0.69	0.27	0.24	0.35	0.26
	Certainty Equivalent (%)					
$\frac{B}{A} = 0.5$	4.71	4.65	1.18	1.57	1.97	1.17
$\frac{B}{A} = 1$	4.71	5.76	1.33	1.57	2.26	1.30
$\frac{B}{A} = 2$	4.71	12.07	1.95	1.57	3.17	1.81

Table 4: Institutional Ownership Sorted by ESG Rating and Disagreement

At the end of year t, stocks are independently sorted into quintiles according to their ESG ratings and ESG rating disagreement, to generate 25 (5×5) portfolios. The Low (High) ESG rating and ESG rating disagreement portfolio is comprised of the bottom (top) quintile of stocks based on the ESG rating and ESG rating disagreement, respectively. This table reports the quarterly institutional ownership in year $t+1$ for each of the 25 portfolios, and the difference in institutional ownership between low and high ESG rating portfolios ("LMH") as well as between high and low ESG rating disagreement portfolios ("HML"). Table 1 provides detailed definitions for each variable. Newey-West adjusted t-statistics are shown in parentheses. Numbers with "*", "**", and "***" are significant at the 10%, 5%, and 1% level, respectively.

Rank of ESG Rating	Rank of ESG Disagreement						
	Low	2	3	4	High	HML	t-stat
Low	0.705	0.736	0.729	0.724	0.654	-0.051***	(-2.75)
2	0.703	0.741	0.774	0.778	0.715	0.012	(1.18)
3	0.737	0.759	0.745	0.770	0.730	-0.007	(-0.87)
4	0.763	0.758	0.749	0.746	0.737	-0.026***	(-2.89)
High	0.730	0.742	0.743	0.727	0.647	-0.084*	(-1.91)
LMH	-0.026	-0.006	-0.014	-0.003	0.007		
	(-1.25)	(-0.44)	(-0.85)	(-0.14)	(0.11)		

Table 5: Stock Returns Sorted by ESG Rating and Disagreement

At the end of year t, stocks are first sorted into quintiles according to their ESG rating disagreement. Within each ESG rating disagreement group, stocks are further sorted into quintiles according to their ESG ratings, to generate 25 (5×5) portfolios. The Low (High) ESG rating and ESG rating disagreement portfolio is comprised of the bottom (top) quintile of stocks based on the ESG rating and ESG rating disagreement, respectively. Panel A reports the value-weighted monthly return in year $t+1$ for each of the 25 portfolios, as well as the investment strategy of going long (short) the Low (High) ESG rating stocks ("LMH"). The column "All" reports similar statistics for portfolios sorted by ESG ratings. Portfolio returns are further adjusted by the CAPM. Panel B reports similar statistics when portfolio returns are adjusted by the Fama-French-Carhart 4-factor model (FFC) and Fama-French 6-factor model (FF6). Table 1 provides detailed definitions for each variable. Newey-West adjusted t-statistics are shown in parentheses. Numbers with "*", "**", and "***" are significant at the 10%, 5%, and 1% level, respectively.

Panel A: Value-weighted Returns to Investment Strategies Sorted by ESG Disagreement and ESG Rating

Rank of ESG Rating	Return						CAPM-adjusted Return					
	Rank of ESG Disagreement					All	Rank of ESG Disagreement					All
	Low	2	3	4	High		Low	2	3	4	High	
Low	1.235***	1.113***	0.767**	0.875**	0.760**	0.923**	0.168	0.064	-0.311*	-0.141	-0.101	-0.101
	(2.95)	(2.99)	(1.98)	(2.30)	(2.32)	(2.58)	(0.93)	(0.40)	(-1.82)	(-0.89)	(-0.58)	(-0.84)
2	1.245***	1.026***	1.093***	1.043***	1.095***	0.963***	0.187	0.076	0.115	0.042	0.151	-0.008
	(3.36)	(2.84)	(3.30)	(2.74)	(2.91)	(2.85)	(1.16)	(0.38)	(0.77)	(0.29)	(0.77)	(-0.07)
3	1.096***	0.965***	1.050***	1.104***	0.949***	1.021***	0.040	-0.031	0.002	0.064	0.079	0.053
	(2.69)	(2.83)	(2.86)	(2.89)	(3.15)	(3.11)	(0.23)	(-0.20)	(0.02)	(0.46)	(0.42)	(0.64)
4	0.730**	0.695*	1.105***	1.019***	0.990***	1.017***	-0.192	-0.389***	0.108	0.040	0.006	0.095
	(2.09)	(1.81)	(2.90)	(2.96)	(2.68)	(3.42)	(-1.24)	(-3.28)	(0.55)	(0.34)	(0.03)	(1.32)
High	0.642*	0.842**	0.855***	1.184***	0.854***	0.805**	-0.230*	-0.063	-0.012	0.245*	-0.001	-0.095
	(1.97)	(2.53)	(3.06)	(3.62)	(2.81)	(2.57)	(-1.95)	(-0.55)	(-0.10)	(1.83)	(-0.01)	(-1.49)
LMH	0.594***	0.271	-0.088	-0.309	-0.094	0.118	0.398*	0.128	-0.299	-0.387*	-0.100	-0.006
	(2.72)	(1.30)	(-0.39)	(-1.43)	(-0.42)	(0.78)	(1.86)	(0.58)	(-1.25)	(-1.75)	(-0.42)	(-0.04)

Panel B: Value-weighted Returns to Investment Strategies Sorted by ESG Disagreement and ESG Rating

Rank of ESG Rating	FFC-adjusted Return						FF6-adjusted Return					
	Rank of ESG Disagreement					All	Rank of ESG Disagreement					All
	Low	2	3	4	High		Low	2	3	4	High	
Low	0.214	0.054	-0.329*	-0.115	-0.113	-0.091	0.251	0.091	-0.327*	-0.155	-0.030	-0.092
	(1.28)	(0.37)	(-1.91)	(-0.76)	(-0.64)	(-0.76)	(1.49)	(0.65)	(-1.88)	(-1.02)	(-0.15)	(-0.78)
2	0.209	0.099	0.095	0.062	0.140	-0.005	0.189	0.193	0.019	0.055	0.131	-0.001
	(1.37)	(0.49)	(0.69)	(0.44)	(0.70)	(-0.04)	(1.15)	(1.03)	(0.13)	(0.37)	(0.65)	(-0.01)
3	0.111	0.006	0.018	0.090	0.048	0.051	0.113	0.031	0.043	0.171	-0.009	0.052
	(0.65)	(0.05)	(0.16)	(0.65)	(0.26)	(0.63)	(0.69)	(0.22)	(0.36)	(1.24)	(-0.05)	(0.61)
4	-0.215	-0.344***	0.172	0.093	0.042	0.124*	-0.179	-0.301***	0.145	0.094	0.119	0.117
	(-1.41)	(-2.94)	(0.92)	(0.77)	(0.20)	(1.71)	(-1.24)	(-2.62)	(0.77)	(0.77)	(0.58)	(1.60)
High	-0.246**	-0.041	0.012	0.304**	-0.012	-0.090	-0.250**	-0.017	-0.049	0.297**	-0.084	-0.094*
	(-2.13)	(-0.39)	(0.10)	(2.25)	(-0.09)	(-1.61)	(-2.13)	(-0.16)	(-0.39)	(2.04)	(-0.65)	(-1.71)
LMH	0.459**	0.095	-0.341	-0.419*	-0.101	-0.002	0.501**	0.109	-0.277	-0.452**	0.054	0.003
	(2.30)	(0.49)	(-1.42)	(-1.96)	(-0.42)	(-0.01)	(2.36)	(0.61)	(-1.14)	(-2.02)	(0.22)	(0.02)

Table 6: ESG Rating, Disagreement, and Stock Returns

This table presents the results of the following monthly Fama-MacBeth regressions, as well as their corresponding Newey-West adjusted t-statistics:

$$Perf_{i,m} = \alpha_0 + \beta_1 ESG_{i,m-1} + \beta_2 ESG_{i,m-1} \times Low\ ESG\ Disagreement_{i,m-1} + \beta_3 Low\ ESG\ Disagreement_{i,m-1} + \boldsymbol{\beta}_4' M_{i,m-1} + e_{i,m},$$

where $Perf_{i,m}$ refers to the excess return (models 1 to 4) or CAPM-adjusted return (models 5 to 8) of stock i in month m, $ESG_{i,m-1}$ refers to the ESG rating, $Low\ ESG\ Disagreement_{i,m-1}$ refers to a dummy variable that takes the value of 1 if the ESG rating disagreement is in the bottom quintile across all stocks in that month and 0 otherwise. The vector M stacks all other control variables, including the Log(Size), Log(BM), 6M Momentum, Log(Illiquidity), Gross Profitability, Corporate Investment, Leverage, Log(Analyst Coverage) and Analyst Dispersion. Table 1 provides detailed definitions for each variable. Numbers with "*", "**", and "***" are significant at the 10%, 5%, and 1% level, respectively.

Stock Returns Regressed on Lagged ESG Rating and ESG Disagreement

	Excess Return				CAPM-adjusted Return			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
ESG	0.002	0.098	0.062	0.199	0.042	0.139	0.162	0.301
	(0.01)	(0.65)	(0.33)	(1.03)	(0.23)	(0.91)	(0.77)	(1.65)
ESG × Low ESG Disagreement			-0.163*	-0.223*			-0.254**	-0.312**
			(-1.91)	(-1.75)			(-2.26)	(-2.36)
Low ESG Disagreement			0.114*	0.109			0.125**	0.114
			(1.86)	(1.38)			(2.20)	(1.61)
Log(Size)	-0.100	-0.036	-0.101	-0.038	-0.044	0.111	-0.044	0.111
	(-1.28)	(-0.27)	(-1.30)	(-0.29)	(-0.59)	(0.77)	(-0.60)	(0.77)
Log(BM)	0.001	0.009	-0.001	0.008	-0.021	0.019	-0.024	0.017
	(0.01)	(0.14)	(-0.01)	(0.12)	(-0.19)	(0.18)	(-0.21)	(0.17)
6M Momentum	0.336	0.188	0.335	0.194	0.275	0.105	0.276	0.111
	(0.70)	(0.40)	(0.69)	(0.42)	(0.50)	(0.20)	(0.50)	(0.21)
Log(Illiquidity)		0.056		0.056		0.103**		0.103**
		(1.00)		(1.03)		(2.17)		(2.15)
Gross Profitability		0.178		0.180		0.355*		0.359*
		(0.99)		(1.00)		(1.83)		(1.85)
Corporate Investment		0.037		0.037		-0.005		-0.007
		(0.49)		(0.50)		(-0.08)		(-0.09)
Leverage		-0.037		-0.037		-0.034		-0.034
		(-0.78)		(-0.79)		(-0.73)		(-0.73)
Log(Analyst Coverage)		-0.019		-0.019		-0.174		-0.175
		(-0.15)		(-0.14)		(-1.40)		(-1.41)
Analyst Dispersion		-0.536***		-0.539***		-0.828***		-0.831***
		(-2.67)		(-2.71)		(-4.37)		(-4.37)
Constant	2.309*	1.800	2.281*	1.775	0.591	-0.555	0.533	-0.614
	(1.71)	(1.09)	(1.70)	(1.09)	(0.46)	(-0.31)	(0.42)	(-0.34)
Obs	283,671	254,873	283,671	254,873	272,728	245,451	272,728	245,451
R-squared	0.045	0.080	0.048	0.082	0.043	0.076	0.045	0.078

Table 7: Stock Beta Sorted by ESG Rating and Disagreement

At the end of year t, stocks are first sorted into quintiles according to their ESG rating disagreement. Within each ESG rating disagreement group, stocks are further sorted into quintiles according to their ESG ratings, to generate 25 (5×5) portfolios. The Low (High) ESG rating and ESG rating disagreement portfolio is comprised of the bottom (top) quintile of stocks based on the ESG rating and ESG rating disagreement, respectively. This table reports the monthly stock beta in year $t+1$ for each of the 25 portfolios, and the difference in beta between low and high ESG rating portfolios ("LMH") as well as between high and low ESG rating disagreement portfolios ("HML"). Table 1 provides detailed definitions for each variable. Newey-West adjusted t-statistics are shown in parentheses. Numbers with "*", "**", and "***" are significant at the 10%, 5%, and 1% level, respectively.

Rank of ESG Rating	Rank of ESG Disagreement						
	Low	2	3	4	High	HML	t-stat
Low	1.291	1.293	1.256	1.214	1.240	-0.050	(-1.65)
2	1.248	1.206	1.240	1.204	1.184	-0.064**	(-2.33)
3	1.231	1.184	1.198	1.189	1.199	-0.032	(-1.10)
4	1.122	1.133	1.154	1.169	1.173	0.050***	(3.52)
High	1.041	1.050	1.049	1.127	1.155	0.114***	(5.59)
LMH	0.249***	0.243***	0.207***	0.087***	0.085***		
	(9.55)	(9.32)	(8.02)	(5.20)	(4.92)		

Table 8: Market Premium and Aggregate Institutional Ownership

Panel A presents the results of the following monthly time-series regressions, as well as their corresponding Newey-West adjusted t-statistics:

$$RMRF_m = \alpha_0 + \beta_1 ESG_{m-1} + \beta_2 ESG\ Disagreement_{m-1} + \beta_3 ESG\ Disagreement_{m-1} \times High\ VIX_{m-1} + \boldsymbol{\beta}_4' M_{m-1} + e_m,$$

where $RMRF_m$ refers to the market premium in month m, defined as the CRSP value-weighted index return minus the one-month Treasury bill rate. ESG_{m-1} and $ESG\ Disagreement_{m-1}$ refer to the value-weighted average of ESG rating and ESG rating disagreement across all stocks, respectively. $High\ VIX_{m-1}$ refers to a dummy variable that takes the value of 1 if the VIX index is in the top quintile over the entire sample period and 0 otherwise. M_{m-1} refers to a set of other proxies for market conditions, including lagged market premium; dividend price ratio (DP), defined as the difference between the log of dividends and the log of prices; term spread (TERM), defined as the difference between the average yield of 10-year Treasury bonds and three-month T-bills, and default spread (DEF), defined as the difference between the average yield of bonds rated BAA and AAA by Moody's. Panel B reports similar statistics while replacing the dependent variable with market-level institutional ownership IO_m, defined as the value-weighted institutional ownership across all stocks. Table 1 provides detailed definitions for each variable. Numbers with "*", "**", and "***" are significant at the 10%, 5%, and 1% level, respectively.

Panel A: Market Premium Regressed on Lagged ESG Rating and ESG Disagreement

	Model 1	Model 2	Model 3	Model 4	Model 5
ESG	0.023		-0.122	-0.092	-0.072
	(0.15)		(-0.73)	(-0.56)	(-0.42)
ESG Disagreement		0.481***	0.502***	0.508***	0.491**
		(2.85)	(2.82)	(2.79)	(2.55)
ESG Disagreement × High VIX					-0.161
					(-0.43)
RMRF	0.145	0.164	0.167	0.213*	0.191*
	(1.40)	(1.62)	(1.62)	(1.74)	(1.94)
DP	0.096**	0.161***	0.169***	0.169***	0.156***
	(2.22)	(3.40)	(3.33)	(3.21)	(2.91)
TERM	0.072	0.003	0.035	-0.097	-0.021
	(0.32)	(0.02)	(0.16)	(-0.38)	(-0.09)
DEF	-2.769**	-4.154***	-4.388***	-5.531***	-4.658***
	(-2.17)	(-3.21)	(-3.10)	(-2.79)	(-3.25)
VIX				0.086	
				(1.29)	
High VIX					0.043
					(0.61)
Constant	0.397*	0.595***	0.701***	0.680***	0.620**
	(1.74)	(3.30)	(2.76)	(2.65)	(2.35)
Obs	193	193	193	193	193
R-squared	0.052	0.089	0.091	0.097	0.101

Table 8 (continued)

Panel B: Institutional Ownership Regressed on Lagged ESG Rating and ESG Disagreement					
	Model 1	Model 2	Model 3	Model 4	Model 5
ESG	-0.523***		-0.399**	-0.434**	-0.483**
	(-2.83)		(-2.07)	(-2.40)	(-2.58)
ESG Disagreement		-0.497**	-0.428**	-0.434**	-0.336*
		(-2.44)	(-1.98)	(-2.08)	(-1.77)
ESG Disagreement × High VIX					-0.308
					(-0.58)
RMRF	0.158***	0.131***	0.139***	0.085	0.127***
	(3.08)	(2.62)	(2.77)	(1.39)	(2.64)
DP	0.304***	0.216***	0.242***	0.242***	0.260***
	(8.98)	(5.47)	(5.88)	(5.67)	(5.67)
TERM	-0.580*	-0.651**	-0.548	-0.394	-0.456
	(-1.69)	(-2.11)	(-1.64)	(-1.29)	(-1.38)
DEF	-7.109***	-4.967***	-5.730***	-4.400**	-5.669***
	(-7.42)	(-4.61)	(-4.89)	(-2.42)	(-4.92)
VIX				-0.100	
				(-0.99)	
High VIX					0.045
					(0.44)
Constant	2.319***	1.716***	2.060***	2.084***	2.166***
	(12.07)	(11.93)	(9.49)	(9.56)	(9.41)
Obs	193	193	193	193	193
R-squared	0.479	0.497	0.515	0.526	0.528

Appendix

In all proofs that follow, the expectation operators are taken under the joint distribution of returns and ESG ratings.

Proof of Proposition 1

The welfare of agent i can be written as

$$\begin{aligned} E\left[V\left(\tilde{W}_{i,1}, \boldsymbol{X}_i\right)\right] &= E\left[-e^{-A_i \tilde{W}_{i,1} - B_i W_{i,0} \boldsymbol{X}_i' \tilde{\boldsymbol{g}}}\right] \\ &= E\left[-e^{-A_i W_{i,0}\left(1+r_f+\boldsymbol{X}_i'\tilde{\boldsymbol{r}}\right) - B_i W_{i,0} \boldsymbol{X}_i' \tilde{\boldsymbol{g}}}\right] \\ &= -e^{-A_i W_{i,0}(1+r_f)} E\left[e^{-A_i W_{i,0} \boldsymbol{X}_i' \left(\tilde{\boldsymbol{r}} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \tilde{\boldsymbol{g}}\right)}\right]. \end{aligned} \tag{A.1}$$

Note that

$$\tilde{\boldsymbol{r}} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \tilde{\boldsymbol{g}} \sim \mathcal{N}\left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g, \boldsymbol{\Sigma}_i\right), \tag{A.2}$$

where

$$\boldsymbol{\Sigma}_i = \boldsymbol{\Sigma}_r + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \boldsymbol{\Sigma}_g + 2 \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_{r,g}. \tag{A.3}$$

Then, the expected utility is solved analytically

$$\begin{aligned} E\left[V\left(\widetilde{W}_{i,1}, \boldsymbol{X}_i\right)\right] &= -e^{-A_i W_{i,0}(1+r_f)} E\left[e^{-A_i W_{i,0} \boldsymbol{X}_i' \left(\tilde{\boldsymbol{r}} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \tilde{\boldsymbol{g}}\right)}\right] \\ &= -e^{-A_i W_{i,0}(1+r_f)} e^{-A_i W_{i,0} \boldsymbol{X}_i' \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right) + \frac{\left(A_i W_{i,0}\right)^2}{2} \boldsymbol{X}_i' \boldsymbol{\Sigma}_i \boldsymbol{X}_i}. \end{aligned} \tag{A.4}$$

The investor picks the optimal portfolio through minimizing the expression

$$-A_i W_{i,0} \boldsymbol{X}_i' \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right) + \frac{\left(A_i W_{i,0}\right)^2}{2} \boldsymbol{X}_i' \boldsymbol{\Sigma}_i \boldsymbol{X}_i. \tag{A.5}$$

The first order condition is

$$0 = -A_i W_{i,0} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right) + \left(A_i W_{i,0}\right)^2 \boldsymbol{\Sigma}_i \boldsymbol{X}_i. \tag{A.6}$$

The optimal portfolio that solves this equation is given by

$$\boldsymbol{X}_i^* = \frac{1}{A_i W_{i,0}} \boldsymbol{\Sigma}_i^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right). \tag{A.7}$$

Proof of Proposition 2

We have

$$\begin{aligned}\boldsymbol{\Sigma}_i &= \boldsymbol{\Sigma}_r + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}} \right)^2 \boldsymbol{\Sigma}_g + 2 \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_{r,g} \\ &\equiv \boldsymbol{\Sigma}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_{i,D},\end{aligned} \tag{A.8}$$

where we define

$$\boldsymbol{\Sigma}_{i,D} = \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_g + 2 \boldsymbol{\Sigma}_{r,g}. \tag{A.9}$$

Then,

$$\boldsymbol{\Sigma}_i^{-1} = \left(\boldsymbol{\Sigma}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_{i,D} \right)^{-1}. \tag{A.10}$$

We are looking for $\boldsymbol{\Psi}_{i,D}$ to solve the equation

$$\boldsymbol{\Sigma}_i^{-1} = \boldsymbol{\Sigma}_r^{-1} + \frac{A_i W_{i,0}}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D}. \tag{A.11}$$

The solution obtains as

$$\boldsymbol{\Psi}_{i,D} = - \left(\frac{B_i W_{i,0}}{A_i W_{i,0}} \right)^2 \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\Sigma}_{i,D} \boldsymbol{\Sigma}_r^{-1} \left(\mathbf{I}_N + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_{i,D} \boldsymbol{\Sigma}_r^{-1} \right)^{-1}. \tag{A.12}$$

The optimal strategy can then be written as

$$\begin{aligned}\boldsymbol{X}_i^* &= \frac{1}{A_i W_{i,0}} \left(\boldsymbol{\Sigma}_r^{-1} + \frac{A_i W_{i,0}}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \right) \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right) \\ &= \frac{1}{A_i W_{i,0}} \boldsymbol{\Sigma}_r^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right) + \frac{1}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right).\end{aligned} \tag{A.13}$$

Proof of Proposition 3

To avoid cumbersome notations, we drop the superscript ^{ESG,N}, although it is important to remember that in Proposition 3 we refer to an equilibrium where disagreement is not taken into account. As the riskless asset is in zero net supply, the market portfolio consists exclusively of risky assets and is given by

$$\begin{aligned}\boldsymbol{X}_M &= \sum_{i=1}^{I} \boldsymbol{X}_i^* \frac{W_{i,0}}{W_{M,0}}, \\ &= \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \boldsymbol{\Sigma}_r^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right). \end{aligned} \tag{A.14}$$

Then, it follows that

$$\frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \sigma_M^2 = \left(\sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \right) \boldsymbol{\mu}_r + \left(\sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \frac{B_i W_{i,0}}{A_i W_{i,0}} \right) \boldsymbol{\mu}_g, \tag{A.15}$$

which entails that

$$\boldsymbol{\mu}_r = \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \gamma_M \sigma_M^2 - b_M \boldsymbol{\mu}_g. \tag{A.16}$$

For the market portfolio, we have

$$\mu_M = \boldsymbol{X}_M' \boldsymbol{\mu}_r = \gamma_M \sigma_M^2 - b_M \boldsymbol{X}_M' \boldsymbol{\mu}_g, \tag{A.17}$$

which yields

$$\mu_M + b_M \boldsymbol{X}_M' \boldsymbol{\mu}_g = \gamma_M \sigma_M^2. \tag{A.18}$$

Finally,

$$\begin{aligned}\boldsymbol{\mu}_r &= \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \left(\mu_M + b_M \boldsymbol{X}_M' \boldsymbol{\mu}_g \right) - b_M \boldsymbol{\mu}_g \\ &= \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \mu_M + b_M \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \boldsymbol{X}_M' \boldsymbol{\mu}_g - b_M \boldsymbol{\mu}_g. \end{aligned} \tag{A.19}$$

The result then follows.

Proof of Proposition 4

For ease of notation, we drop the superscript ^{ESG,D}, although it is important to remember that in Proposition 4 we refer to an equilibrium where disagreement is not taken into account. Market clearing implies that, as the riskless asset is in zero net supply, the market portfolio consists exclusively of risky assets and is given by

$$\begin{aligned}
\boldsymbol{X}_M &= \sum_{i=1}^{I} \boldsymbol{X}_i^* \frac{W_{i,0}}{W_{M,0}} \\
&= \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \boldsymbol{\Sigma}_i^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right) \\
&= \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \left(\boldsymbol{\Sigma}_r^{-1} + \frac{A_i W_{i,0}}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \right) \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g \right) \\
&= \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \left(\mathbf{I}_N + \frac{A_i W_{i,0}}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \boldsymbol{\Sigma}_r \right) \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_r \\
&+ \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \frac{B_i W_{i,0}}{A_i W_{i,0}} \left(\mathbf{I}_N + \frac{A_i W_{i,0}}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \boldsymbol{\Sigma}_r \right) \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g. \qquad \text{(A.20)}
\end{aligned}$$

We define some notation

$$\boldsymbol{\Gamma}_{M,eff}^{-1} = \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \left(\mathbf{I}_N + \frac{A_i W_{i,0}}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \boldsymbol{\Sigma}_r \right) \qquad \text{(A.21)}$$

$$\mathbf{B}_{M,eff} = \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{1}{A_i W_{i,0}} \frac{B_i W_{i,0}}{A_i W_{i,0}} \left(\mathbf{I}_N + \frac{A_i W_{i,0}}{B_i W_{i,0}} \boldsymbol{\Psi}_{i,D} \boldsymbol{\Sigma}_r \right). \qquad \text{(A.22)}$$

Then we have

$$\boldsymbol{X}_M = \boldsymbol{\Gamma}_{M,eff}^{-1} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_r + \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g,$$

hence

$$\frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \sigma_M^2 = \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff}^{-1} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_r + \boldsymbol{\Sigma}_r \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g, \qquad \text{(A.23)}$$

and therefore

$$\boldsymbol{\mu}_r = \left[\boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff}^{-1} \boldsymbol{\Sigma}_r^{-1}\right]^{-1} \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \sigma_M^2 - \left[\boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff}^{-1} \boldsymbol{\Sigma}_r^{-1}\right]^{-1} \boldsymbol{\Sigma}_r \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g \quad \text{(A.24)}$$

$$= \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}_M}{\sigma_M^2} \sigma_M^2 - \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g. \quad \text{(A.25)}$$

In addition,

$$\mu_M = \boldsymbol{X}_M' \boldsymbol{\mu}_r = \frac{\boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M}{\boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{X}_M} \sigma_M^2 - \boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g. \quad \text{(A.26)}$$

Therefore,

$$\left(\frac{\boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M}{\sigma_M^2}\right)^{-1} \mu_M + \left(\frac{\boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M}{\sigma_M^2}\right)^{-1} \boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g = \sigma_M^2. \quad \text{(A.27)}$$

The vector of expected asset returns is then given by

$$\boldsymbol{\mu}_r = \frac{\boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M}{\boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M} \mu_M \quad \text{(A.28)}$$

$$- \left(\boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g - \frac{\boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M}{\boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \boldsymbol{X}_M} \boldsymbol{X}_M' \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}_{M,eff} \mathbf{B}_{M,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_g\right). \quad \text{(A.29)}$$

The result then follows.

Proof of Proposition 6

The welfare is defined as

$$E\left[V\left(\widetilde{W}_{i,1}, \boldsymbol{X}_i^*\right)\right] = -E\left[e^{-A_i \tilde{W}_{i,1} - B_i W_{i,0} \left(\boldsymbol{X}_i^*\right)' \tilde{\boldsymbol{g}}}\right]. \quad \text{(A.30)}$$

Given normality of the random variables, the expected utility can be computed explicitly as

$$E\left[V\left(\widetilde{W}_{i,1}, \boldsymbol{X}_i^*\right)\right] = -e^{-A_i W_{i,0}\left(1 + r_f + \left(\boldsymbol{X}_i'\right)^* \left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right) - \frac{A_i W_{i,0}}{2} \left(\boldsymbol{X}_i'\right)^* \boldsymbol{\Sigma}_i \boldsymbol{X}_i^*\right)}. \quad \text{(A.31)}$$

Then, it follows that

$$
\begin{aligned}
&(\boldsymbol{X}_i')^* \left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right) - \frac{A_i W_{i,0}}{2} (\boldsymbol{X}_i')^* \boldsymbol{\Sigma}_i \boldsymbol{X}_i^* \\
&= \frac{1}{2} \frac{1}{A_i W_{i,0}} \left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right)' \boldsymbol{\Sigma}_i^{-1} \left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right). \qquad \text{(A.32)}
\end{aligned}
$$

The certainty equivalent returns are given by

$$
CE_i^{ESG,D} = 1 + r_f + \frac{1}{2} \frac{1}{A_i W_{i,0}} \left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right)' \boldsymbol{\Sigma}_i^{-1} \left(\boldsymbol{\mu}_r^{ESG,D} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right) \qquad \text{(A.33)}
$$

$$
CE_i^{ESG,I} = 1 + r_f + \frac{1}{2} \frac{1}{A_i W_{i,0}} \left(\boldsymbol{\mu}_r^{ESG,I}\right)' \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_r^{ESG,I}. \qquad \text{(A.34)}
$$

The result immediately follows.

Derivations for the Two Risky Asset Case

In the two risky asset case, we assume that ESG disagreement is in play and, again, for ease of notation, we drop the superscript ^{ESG,D}. Denoting by $\mathbf{I}_2$ the 2×2 identity matrix, we assume that

$$
\boldsymbol{\Sigma}_r = \sigma_r^2 \mathbf{I}_2, \qquad \text{(A.35)}
$$

$$
\boldsymbol{\Sigma}_g = \begin{bmatrix} \sigma_{g,green}^2 & 0 \\ 0 & \sigma_{g,brown}^2 \end{bmatrix}, \qquad \text{(A.36)}
$$

$$
\boldsymbol{\Sigma}_{r,g} = \mathbf{0}. \qquad \text{(A.37)}
$$

In this case, we have

$$
\boldsymbol{\Sigma}_i = \boldsymbol{\Sigma}_r + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \boldsymbol{\Sigma}_g = \begin{bmatrix} \sigma_r^2 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \sigma_{g,green}^2 & 0 \\ 0 & \sigma_r^2 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \sigma_{g,brown}^2 \end{bmatrix}, \qquad \text{(A.38)}
$$

$$
\boldsymbol{\Sigma}_{i,D} = \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\Sigma}_g, \qquad \text{(A.39)}
$$

and

$$\Sigma_i^{-1} = \left(\Sigma_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \Sigma_{i,D}\right)^{-1}$$

$$= \left(\sigma_r^2 \mathbf{I}_2 + \frac{B_i W_{i,0}}{A_i W_{i,0}} \frac{B_i W_{i,0}}{A_i W_{i,0}} \begin{bmatrix} \sigma_{g,green}^2 & 0 \\ 0 & \sigma_{g,brown}^2 \end{bmatrix}\right)^{-1}, \tag{A.40}$$

$$\Psi_{i,D} = -\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^3 \sigma_r^{-4} \Sigma_g \left(\mathbf{I}_2 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \sigma_r^{-2} \Sigma_g\right)^{-1}$$

$$= -\frac{B_i W_{i,0}}{A_i W_{i,0}} \frac{1}{\sigma_r^2} \begin{bmatrix} \frac{\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}}{1+\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}} & 0 \\ 0 & \frac{\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}}{1+\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}} \end{bmatrix}, \tag{A.41}$$

$$\Gamma_{i,eff}^{-1} = \frac{1}{A_i W_{i,0}} \mathbf{I}_2 + \frac{1}{B_i W_{i,0}} \Psi_{i,D} \Sigma_r$$

$$= \frac{1}{A_i W_{i,0}} \begin{bmatrix} \frac{1}{1+\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}} & 0 \\ 0 & \frac{1}{1+\left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}} \end{bmatrix}. \tag{A.42}$$

We also assume that a green firm has a mean ESG score $\mu_g > 0$, while the brown firm has a mean score $-\mu_g$. We can write the equilibrium strategy as

$$X_{i,green}^* = \frac{1}{A_i W_{i,0}} \frac{\mu_{r,green} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \mu_g}{\sigma_r^2 \left(1 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}\right)}, \tag{A.43}$$

$$X_{i,brown}^* = \frac{1}{A_i W_{i,0}} \frac{\mu_{r,brown} - \frac{B_i W_{i,0}}{A_i W_{i,0}} \mu_g}{\sigma_r^2 \left(1 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}\right)}. \tag{A.44}$$

Notice that, for $\sigma_{g,green}, \sigma_{g,brown} > 0$,

$$\lim_{B_i \longrightarrow \infty} X^*_{i,green} = \lim_{B_i \longrightarrow \infty} \frac{1}{A_i W_{i,0}} \frac{\mu^r_{green} + \frac{B_i W_{i,0}}{A_i W_{i,0}} \mu_g}{\sigma_r^2 \left(1 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma^2_{g,green}}{\sigma_r^2}\right)} = 0, \tag{A.45}$$

$$\lim_{B_i \longrightarrow \infty} X^*_{i,brown} = \lim_{B_i \longrightarrow \infty} \frac{1}{A_i W_{i,0}} \frac{\mu^r_{brown} - \frac{B_i W_{i,0}}{A_i W_{i,0}} \mu_g}{\sigma_r^2 \left(1 + \left(\frac{B_i W_{i,0}}{A_i W_{i,0}}\right)^2 \frac{\sigma^2_{g,brown}}{\sigma_r^2}\right)} = 0. \tag{A.46}$$

We now attempt to determine the equilibrium expected excess returns of the two risky assets. Starting from the optimal portfolio for agent i,

$$\boldsymbol{X}^*_i = \boldsymbol{\Gamma}^{-1}_{i,eff} \boldsymbol{\Sigma}_r^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right), \tag{A.47}$$

we pre-multiply by $\boldsymbol{\Sigma}_r$ and aggregate across agents to obtain

$$\sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}^*_i}{\sigma_M^2} \sigma_M^2 = \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}^{-1}_{i,eff} \boldsymbol{\Sigma}_r^{-1} \left(\boldsymbol{\mu}_r + \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g\right). \tag{A.48}$$

Recalling that $\boldsymbol{\Sigma}_r = \sigma_r^2 \mathbf{I}_2$ and defining $\boldsymbol{\beta} = \frac{\boldsymbol{\Sigma}_r \boldsymbol{X}^*_i}{\sigma_M^2}$, we get

$$\sigma_M^2 \boldsymbol{\beta} = \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}^{-1}_{i,eff} \boldsymbol{\Sigma}_r^{-1} \boldsymbol{\mu}_r + \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}^{-1}_{i,eff} \boldsymbol{\Sigma}_r^{-1} \frac{B_i W_{i,0}}{A_i W_{i,0}} \boldsymbol{\mu}_g. \tag{A.49}$$

Solving for $\boldsymbol{\mu}_r$ leads to the equilibrium expected excess returns

$$\begin{aligned} \boldsymbol{\mu}_r &= \left(\sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}^{-1}_{i,eff} \boldsymbol{\Sigma}_r^{-1}\right)^{-1} \sigma_M^2 \boldsymbol{\beta} \\ &\quad - \left(\sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}^{-1}_{i,eff} \boldsymbol{\Sigma}_r^{-1}\right)^{-1} \left(\sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \boldsymbol{\Sigma}_r \boldsymbol{\Gamma}^{-1}_{i,eff} \boldsymbol{\Sigma}_r^{-1} \frac{B_i W_{i,0}}{A_i W_{i,0}}\right) \boldsymbol{\mu}_g. \end{aligned} \tag{A.50}$$

Assuming that all agents have the same relative risk aversion and the same relative brown aversion ($A_i W_{i,0} = \gamma$ and $\frac{B_i}{A_i} = \frac{B}{A}$ for any i), recalling (A.42), it turns out that

$$\begin{aligned}
\mathbf{\Gamma}_{M,eff}^{-1} &= \sum_{i=1}^{I} \frac{W_{i,0}}{W_{M,0}} \mathbf{\Gamma}_{i,eff}^{-1} \\
&= \frac{1}{\gamma} \begin{bmatrix} \frac{1}{1+\left(\frac{B}{A}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}} & 0 \\ 0 & \frac{1}{1+\left(\frac{B}{A}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}} \end{bmatrix},
\end{aligned}$$

The equilibrium expected excess returns in (A.50) can then be rewritten as

$$\boldsymbol{\mu}_r = \mathbf{\Gamma}_{M,eff} \sigma_M^2 \boldsymbol{\beta} - \frac{B}{A} \boldsymbol{\mu}_g. \tag{A.51}$$

It follows that

$$\mu_{r,green} = \gamma \sigma_M^2 \beta_{green} \left(1 + \left(\frac{B}{A}\right)^2 \frac{\sigma_{g,green}^2}{\sigma_r^2}\right) - \frac{B}{A} \mu_g, \tag{A.52}$$

$$\mu_{r,brown} = \gamma \sigma_M^2 \beta_{brown} \left(1 + \left(\frac{B}{A}\right)^2 \frac{\sigma_{g,brown}^2}{\sigma_r^2}\right) + \frac{B}{A} \mu_g. \tag{A.53}$$

Table A.1: Number of Stocks Over Time

Panel A reports the number of stocks covered by each data vendor on a year-by-year basis. Panel B reports the number of stocks covered by N data vendors on a year-by-year basis, where N ranges between 1 and 5.

Panel A: Number of Stocks Covered By Each Data Vendor

Year	Asset4	MSCI KLD	MSCI IVA	Bloomberg	Sustainalytics	RobecoSAM
2002	398	1,055	0	0	0	0
2003	400	2,805	0	0	0	0
2004	535	2,851	0	0	0	0
2005	600	2,687	0	125	0	0
2006	606	2,655	528	209	0	0
2007	620	2,566	609	709	0	0
2008	789	2,580	600	984	0	0
2009	892	2,598	599	1,065	0	0
2010	915	2,630	551	1,957	0	0
2011	912	2,472	537	2,077	0	0
2012	895	2,418	2,253	2,149	0	0
2013	890	2,125	2,388	2,242	0	0
2014	885	2,098	2,328	2,380	413	0
2015	1,436	2,124	2,282	2,514	441	0
2016	2,083	0	2,255	2,530	460	419
2017	2,218	0	2,139	2,658	452	616
2018	2,178	0	2,104	2,794	473	818
2019	1,225	0	2,136	1,845	486	1,380

Panel B: Number of Stocks Covered By Multiple Data Vendors

Year	N = 1	N = 2	N = 3	N = 4	N = 5	N ≥ 2
2002	677	388	0	0	0	388
2003	2409	398	0	0	0	398
2004	2324	531	0	0	0	531
2005	2199	518	59	0	0	577
2006	2069	241	349	100	0	690
2007	1756	380	264	299	0	943
2008	1579	505	320	351	0	1,176
2009	1601	487	373	365	0	1,225
2010	1240	1,093	385	368	0	1,846
2011	1136	1,109	392	367	0	1,868
2012	631	702	1,060	625	0	2,387
2013	741	591	1,038	652	0	2,281
2014	781	586	1,030	289	381	2,286
2015	851	341	811	669	431	2,252
2016	797	645	1,119	87	391	2,242
2017	781	512	1,140	162	442	2,256
2018	817	425	1,042	336	446	2,249
2019	721	485	787	610	116	1,998