MASTERARBEIT | MASTER'S THESIS

Titel | Title

What impact do diverse investor groups with non-monetary ESG preferences have on capital allocation and aggregate productivity?

verfasst von | submitted by

Qendrim Beqiri

angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien | Vienna, 2026

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 066 915
Studienrichtung lt. Studienblatt | Degree programme as it appears on the student record sheet:	Masterstudium Betriebswirtschaft
Betreut von | Supervisor:	Univ.-Prof. Dr. Thomas Pfeiffer

Table of Contents

Zusammenfassung

Diese Arbeit untersucht, wie heterogene Investorenpräferenzen speziell Präferenzen für ESG-Kriterien, die Gleichgewichtspreise von Vermögenswerten beeinflussen und welche Implikationen sich daraus für die Kapitalallokation, Produktivität und Wohlfahrt ergeben. Beginnend mit der mit der klassischen Finanztheorie als Referenzpunkt analysiert die Arbeit, wie Investments, die ESG-Kriterien berücksichtigen, die traditionelle Sichtweise infrage stellen, wonach Kapital ausschließlich nach risikogewichteter Rendite und Profitabilität allokiert werden sollte. Dabei dient Xues (2025) Modell als zentraler analytischer Bezugsrahmen, welches in dem breiteren wissenschaftlichen Kontext zu den Themen ESG-Gleichgewichtsbewertung, ESG als Risiko, Kapitalallokation, Produktivität und Wohlfahrt eingeordnet wird. Methodisch folgt die Arbeit einem konzeptionellen und literaturbasierten Ansatz. Xues (2025) Modell wird rekonstruiert und analysiert, um zu untersuchen, wie ESG-Präferenzen, Vermögenspreise, Unternehmensinvestitionen und Offenlegungsanreize beeinflussen. Um die Annahmen, Mechanismen und Implikationen des Models bewerten zu können, wird es mit der klassischen Finanztheorie, anderen ESG-Modellen und Literatur zur Aussagekraft von Preisen, Kapitalallokation und Produktivität verglichen.

Die Analyse zeigt, dass ESG-Präferenzen Vermögenspreise beeinflussen und Kapital von der profitmaximierenden Benchmark umleiten können. Zudem zeigt die Arbeit, dass ESG-Offenlegung eine zentrale Rolle bei der Frage spielt, ob und wie sich die ESG-Präferenzen von Investoren in Unternehmensinvestitionen wiederfinden. Gleichzeitig argumentiert diese Arbeit, dass sowohl die standardmäßige gewinnmaximierende als auch die investorennutzenmaximierende Allokation nicht sozial effizient sind, wenn Unternehmensinvestitionen negative Externalitäten in Form von Emissionen zur Folge haben. In diesem Zusammenhang legt die Analyse dieser Arbeit nahe, dass eine präzisere verpflichtende ESG-Offenlegung unter bestimmten Bedingungen die Effizienz von Unternehmensinvestitionen aus einer breiteren gesellschaftlichen Perspektive verbessern kann, indem sie dazu beiträgt, dass die Produktivitätskosten von Emissionen stärker von Unternehmen internalisiert werden. Insgesamt zeigt die Arbeit, dass das Investieren mit Hinblick auf ESG nicht nur für die finanzielle Bewertung von Vermögensanlagen relevant ist, sondern auch für reale Investitionen von Unternehmen, aggregierte Produktivität und die normative Beurteilung von Kapitalmarkteffizienz.

Abstract

This thesis examines how heterogeneous investor preferences, especially ESG tastes, affect equilibrium prices and what implications this has for capital allocation, productivity, and welfare. Starting from the standard-finance benchmark, the thesis analyzes how ESG investing questions the traditional view that capital should be allocated solely according to risk-adjusted return and profitability. In doing so, the thesis focuses on Xue's (2025) model as its central analytical framework and embeds it into the broader literature on ESG equilibrium pricing, ESG as risk, capital allocation, productivity, and welfare. Methodologically, the thesis follows a conceptual and literature-based approach. Xue's (2025) model is reconstructed and analyzed in order to examine how ESG preferences affect asset prices, firm investment, and disclosure incentives. To evaluate the assumptions, mechanisms, and implications of the model, it is compared with the standard-finance benchmark, other ESG models, and the literature on price informativeness, capital allocation, and productivity.

The analysis shows that ESG preferences can affect asset prices and redirect capital away from the profit-maximizing benchmark. It further shows that ESG disclosure plays a central role in determining whether and how investors' ESG tastes are translated into firm investment. At the same time, the thesis argues that neither the standard profit-maximizing allocation nor the investor-utility-maximizing allocation is necessarily socially efficient when firm investment creates negative externalities in the form of emissions. In this context, the analysis implies that more precise mandatory ESG disclosure can, under certain conditions, improve investment efficiency from a broader social perspective by helping to internalize the productivity costs of emissions. Overall, the thesis shows that ESG investing is not only relevant for financial valuation, but also for real investment, aggregate productivity, and the normative assessment of capital market efficiency.

1. Introduction

1.1 Background and Context

Over the last few years, sustainable investing has become increasingly important in financial markets. Institutional investors, asset managers, and regulators more frequently consider environmental, social, and governance (ESG) characteristics when evaluating firms and investment opportunities. According to the Global Sustainable Investment Review (2024), "sustainable and responsible investing has moved from niche practice to a systematic consideration". From 2018 to 2024, assets managed in accordance with responsible and sustainable investment criteria increased from $902 billion to $16,754 billion. Relative to all assets under management, this marks an increase from 3% in 2018 to 27% in 2024 (GSIA, 2025).

From the viewpoint of standard finance, this development is not unproblematic. Standard finance models investors as rational mean-variance optimizers who allocate capital according to the trade-off between expected return and risk (Markowitz, 1952; Sharpe, 1964; Lintner, 1965). Because firms aim to maximize their market value and investors prefer higher expected returns, capital is allocated efficiently from the perspective of standard finance if it flows to the most profitable projects. If investors instead shift capital more strongly towards firms with better ESG performance and away from firms with worse ESG performance, capital may no longer flow exclusively toward the most profitable firms. In this sense, ESG investing may appear to distort an efficient allocation of capital (Wurgler, 2000; Heinkel et al., 2001; Pastor et al., 2021). However, such a conclusion may be too narrow. A broader finance literature (e.g., Fama & French, 2007; Heinkel et al., 2001; Pedersen et al., 2021) suggests that investors may heterogeneously possess utility functions that include non-pecuniary firm characteristics, so-called tastes. In such a case, investors with ESG tastes gain additional utility from holding assets with strong ESG profiles, which may result in portfolios with better ESG but lower financial performance, because their preferences may compensate for the lower returns (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021). The capital deviation resulting from ESG preferences, therefore, cannot simply be written off as an irrationality from a standard finance perspective. Instead, it creates a conflict between different definitions of efficient capital allocation. While standard finance implies that capital is efficiently allocated when it follows profitability and risk-adjusted return, ESG-finance literature suggests that a capital allocation can also be efficient when it reflects broader investor utility (Pedersen et al., 2021).

This conflict becomes even stronger once aggregate productivity is considered. Literature on capital allocation (Dow & Gorton, 1997; Chen et al., 2007; Bai et al., 2016; Bennett et al., 2020) emphasizes that financial market prices are important for managerial decision-making, firm investment, and productivity, while the misallocation literature shows that distortions in capital allocation can substantially reduce aggregate productivity (e.g., Restuccia & Rogerson, 2008; Hsieh & Klenow, 2009). Against this background, the question of how investor preferences enter prices is relevant not only for financial valuation but also for capital allocation efficiency and broader economic welfare.

Xue's (2025) model brings these tensions together. In his baseline model with homogeneous ESG investors, he derives a capital allocation in which investor utility is maximized. In his large-economy extension, however, firm investments create negative externalities in the form of emissions, which reduce aggregate productivity. According to this framework, both the profit-maximizing and the investor-utility-maximizing allocation may be inefficient from a broader economic perspective, because in both cases, firms fail to fully internalize the productivity cost of emissions. As a result, a third benchmark emerges: the socially optimal capital allocation, in which economy-wide welfare is maximized. The central problem of this thesis, therefore, lies in the tension between three competing benchmarks of capital efficiency: the profit-maximizing benchmark of standard finance, the investor-utility benchmark of ESG-finance, and the social-welfare benchmark that internalizes the productivity effects of emissions.

1.2 Research Objective

The objective of this thesis is to analyze Xue's (2025) theoretical model, in which ESG preferences affect firm-level investment through the information channel of ESG disclosure precision. Depending on the assumptions of his model regarding the number of firms in the economy, investor homogeneity or heterogeneity, and possible externality effects of emissions, Xue (2025) derives different implications for equilibrium asset prices, capital allocation, and aggregate productivity. The aim of this study is to analyze these mechanisms and the quantitative results of the model in detail, to evaluate them critically, and to embed them in a broader theoretical context. Xue's (2025) mechanisms and findings are compared to core theories of standard finance and other ESG models. Further, his implications about capital allocation, aggregate productivity, and welfare are discussed in the broader context.

Based on this objective, the general research question of this thesis focuses on the possible impact that heterogeneous investors with non-monetary ESG preferences may have on financial markets, which may further affect capital allocation and aggregate productivity.

To achieve the research objective of this paper, the following research questions will be addressed:

1. How does Xue's (2025) model relate to standard finance and to other ESG models?
2. Through which mechanisms can heterogeneous ESG preferences affect prices, firm investment, capital allocation, and productivity?
3. How should such effects be evaluated normatively, considering investor utility, social welfare, and possible externalities?

By addressing these research questions, this thesis provides a comprehensive theoretical foundation and contributes to clarifying potential conflicts of interest between socially desirable investment objectives and the economic efficiency of capital markets.

1.3 Methodology

Methodologically, this thesis follows a conceptual and literature-based approach. At its center stands Xue's (2025) model, which is reconstructed and analyzed to examine how ESG preferences affect asset prices, firm investment, and disclosure incentives. To evaluate Xue's (2025) assumptions, mechanisms, and implications, the model is compared with the standard-finance benchmark, other ESG equilibrium models, literature on ESG as risk, capital allocation, and productivity. This comparative approach makes it possible to position Xue's (2025) framework within the broader finance literature and to assess its implications for capital allocation, productivity, and welfare. The goal of this approach is not to test these mechanisms empirically, but to identify and critically discuss the theoretical channels through which non-pecuniary ESG preferences may influence financial markets and real economic outcomes.

1.4 Structure of the Thesis

The thesis is structured as follows. Chapter 2 provides the theoretical and literature-based foundation of the thesis by introducing the standard-finance benchmark, the concept of investor tastes, and the relevant ESG-finance literature. Chapter 3 presents Xue's (2025) model and derives its main mechanisms and implications. Chapter 4 compares Xue's framework with standard finance and other ESG models and discusses its implications for capital allocation and productivity. Chapter 5 provides the normative discussion, while Chapter 6 outlines the limitations of the thesis, and Chapter 7 concludes.

2. Standard Finance, Investor Tastes, and ESG

2.1 The Classical Financial Theory

The classical financial theory, also named standard finance, serves as the benchmark of this thesis. In this framework, investors are modeled as rational mean-variance optimizers, expected returns reflect systematic risk, and prices are treated as efficient aggregators of information. The following subsection discusses only those standard-finance components that are necessary for evaluating whether ESG preferences should be interpreted as a distortion from, or an extension of, financially efficient capital allocation.

2.1.1 Modern Portfolio Theory

Modern Portfolio Theory (MPT) is a normative theory that provides a mathematical framework to construct portfolios based on a trade-off between expected returns and their respective variance (Fabozzi et al., 2002). The core concept of this theory is based on the "mean-variance" framework developed by Markowitz (1952). He dismisses the rule of choosing portfolios solely based on the maximum discounted expected returns, due to the rule not implying diversification. Instead, he proposes the idea that investors want to maximize their expected return while reducing the risk. The "expected returns – variances of returns" (E-V) rule implies that an investor chooses a portfolio based on a combination of expected returns and variances of returns. A rational investor wants to maximize the expected returns given a value of risk, and she wants to minimize the value of risk given an expected return. Reaching the best possible combination of E-V makes a portfolio Pareto-efficient, since increasing the returns (or decreasing the risk) is not further possible without increasing the risk (or decreasing the expected returns).

Markowitz (1952) also finds that diversification is not a phenomenon caused by just adding more assets to a portfolio. Diversification reduces portfolio risk when the combined assets are imperfectly correlated. In that sense, investors should not evaluate single assets in isolation, but in terms of their contribution to overall portfolio risk. By that, the E-V framework implies that idiosyncratic risks can be diversified away. Depicting the E-V combinations of all portfolios in a two-dimensional framework, we can draw a line between all efficient portfolios. This line marks the "efficient frontier". Rational investors choose portfolios from the frontier because portfolios deviating from the frontier are either unattainable or inefficient in the E-V framework.

Markowitz's (1952) E-V rule results in optimal investor-specific portfolios including only risky assets. For this thesis, the relevance of the E-V framework lies in the fact that it defines efficient capital allocation in purely financial terms, i.e., as the trade-off between expected return and risk. Non-pecuniary investor preferences, such as ESG tastes, are not considered.

2.1.2 Asset Pricing Theory

Building on the E-V framework and the two-fund separation theorem (Tobin, 1958), Sharpe (1964), Lintner (1965), and Mossin (1966) developed the Capital Asset Pricing Model (CAPM). The CAPM theorizes a relationship between asset prices and their respective risk in market equilibrium. It is a positive theory that hypothesizes how a homogeneous group of rational investors should behave and how these individual portfolio choices combined define asset prices in a competitive equilibrium (Fabozzi et al., 2002).

Sharpe (1964) sets the foundation stone of this model, while Lintner (1965) formalizes the equilibrium, and Mossin (1966) provides a formal general-equilibrium proof of the model. Sharpe's (1964) derivation of his model is based on Markowitz's (1952) definition of a rational investor and his implications on diversification, as well as Tobin's (1958) two-fund separation theorem. The CAPM sets up two additional assumptions to derive the conditions for market equilibrium. First, lending and borrowing money are possible at the same risk-free interest rate. Second, investors have homogeneous expectations regarding expected returns, standard deviations, and correlation coefficients for all assets. Consequently, given some initial asset prices, all investors will view the alternative assets the same.

In the CAPM, investors are assumed to hold combinations of a risk-free asset and the market portfolio. The model implies that the expected return of an asset is determined by its exposure to systematic market risk, measured by its beta. Formally, the expected return of an asset is calculated as follows (Sharpe, 1964; Lintner, 1965; Mossin, 1965; Black, 1972):

$$\mathbb{E}[R_i] = R_f + \beta_i(\mathbb{E}[R_M] - R_f), with\ \beta_i = \frac{Cov[R_i, R_M]}{Var[R_M]}.$$

The expected return of an asset i equals the risk-free rate R_f plus the product of its beta β_i times its risk premium $\mathbb{E}[R_M] - R_f$. Hence, assets with a higher covariance with the market portfolio (the aggregate of all risky assets in the economy) must offer higher expected returns as compensation for their larger systematic risk exposure.

The central implication of the CAPM is that only systematic risk is priced in equilibrium. Because rational investors diversify firm-specific risk away in their portfolio formation, idiosyncratic risk does not command an additional return premium (Perold, 2004). Therefore, expected returns and asset prices are determined by expected future cash flows and exposure to systematic market risk. In this standard-finance benchmark, non-financial firm characteristics and non-pecuniary investor preferences do not influence equilibrium prices or returns. Capital is allocated efficiently when investors direct funds towards assets and projects with the highest risk-adjusted expected returns.

At the beginning of the CAPM's existence, it seemed to be efficient at describing the behavior of asset returns. However, several empirical tests identified anomalies regarding the predictions of the CAPM (Fama, 1991). Nevertheless, it remains the core benchmark for this thesis as it is a theoretical pillar in standard finance. It defines efficient capital allocation in purely financial terms, because differences in expected returns should only reflect differences in systematic risk.

2.1.3 Efficient Market Hypothesis

The primary role of a capital market is the allocation of the economy's capital to individual assets. In an ideal capital market, prices provide accurate signals for resource allocation (Fama, 1970). Fama (1970) defines an efficient market as a market in which security prices fully reflect all available information at any time. He argues that rational profit-maximizing investors incorporate new information into prices rapidly, leaving no systematic arbitrage possibilities in competitive capital markets.

This theory is only empirically verifiable if it is examined within a model of market equilibrium, such as the previously mentioned CAPM. Such market equilibrium models specify the prices when all available information is fully reflected (Fama, 1970). The interconnection of the Efficient Market Hypothesis (EMH) with an asset pricing model leads to the joint-hypothesis problem (JHP) (Fama, 1991). The EMH propagates that capital markets are efficient, implying that prices fully reflect all available information. For testing this hypothesis empirically, one needs to compare observed prices with predicted efficient prices, which are calculated using an asset pricing model. As a result, deviations between observed prices and model-implied efficient prices cannot be used to directly contradict the EMH, since the efficient prices are predicted values from asset models. Therefore, it is not always possible to distinguish whether anomalies are caused by inefficient markets or are part of incomplete asset pricing models.

Fama (1970) sets up the following market conditions that are sufficient for market efficiency. First, no transaction costs for trading assets. Second, all available information is available to all market participants for free. Third, investors are homogeneous; they agree on the implications of the current information set for the current price and the distribution of future prices for each asset. Deviations from these conditions can cause market inefficiencies. Since these conditions are unrealistic, the question focuses not on whether the market is inefficient or not. Instead, Fama (1970) asks the question of how strong the inefficiency is.

The EMH is meant as a benchmark rather than a depiction of real markets; therefore, Fama (1970, 1991) distinguishes three forms of market efficiency. In his first review of market efficiency literature (1970), he divides market efficiency into *weak-form, semi-strong-form,* and *strong-form*. Each efficiency form analyzes whether a specified information set Φ_t is fully reflected in the prices or not. A market is efficient with respect to the information set Φ_t if prices fully reflect all information contained in Φ_t. First, weak-form efficiency defines the historical prices as an information set and investigates whether the prices fully reflect all historical prices of an asset. Second, semi-strong-form efficiency uses all publicly available information as the information set, examining whether prices adjust instantly to public announcements. Thirdly, the strong-form efficiency investigates if all public and private information is incorporated in the prices and whether some investors have private information that is not reflected in prices.

The EMH is closely related to the broader standard-finance view of capital allocation. If prices reflect relevant information about firms' expected cash flows and risks, they can guide capital towards the most productive firms and projects. In this sense, informative prices do not only matter for valuation in financial markets, but also for the efficient allocation of capital in the real economy. Prices incorporate information from market participants and thereby provide a signal about the future financial development of a firm. Consequently, one can imply that the more informative prices are, the more likely it is that capital flows to its financially most productive use.

For the purpose of this thesis, the EMH is relevant as a benchmark in which prices are assumed to reflect financial fundamentals rather than non-pecuniary investor preferences. If ESG preferences influence prices independently of financially relevant information, this may appear inconsistent with a narrow standard-finance interpretation of efficient markets. However, if investors rationally derive utility from ESG characteristics, then ESG-related pricing effects may also be interpreted as an extension of the standard-finance benchmark rather than as a simple market inefficiency. Thus, the EMH provides an important reference point for evaluating whether ESG-based price effects should be understood as distortions from, or modifications of, the classical view of market efficiency.

2.1.4 The Effect of Price Informativeness on Capital Allocation and Productivity

As mentioned earlier, the primary role of a capital market is the allocation of an economy's capital to individual assets. Fama (1970, 1991) arrives at the conclusion that stock prices and subsequently the stock market are efficient. The question, however, remains if stock price efficiency influences the underlying economy, and if so, through which channel the effect happens.

a.) Theoretical Concept: Price Informativeness and Capital Allocation

Dow and Gorton (1997) argue that secondary stock market prices do not have a direct influence on the capital allocation but exert an indirect signaling role. The indirect signaling role originates from two characteristics of secondary stock market prices. First, the investment decision made by firms is delegated by the shareholders to the manager, which leads to the classical Principal-Agent theory, where the shareholders (principal) have to give the manager (agent) the right incentives for them to act according to their preferences. Constructing an optimal manager incentive program inherits two fundamental problems. A manager's investment horizon may be myopic compared to the long-term horizon of shareholders. Thus, a manager might leave the company before any financial effects of the investment are realized (Dow & Gorton, 1997). Further, managers may have private information and have discretion while making the investment decisions. Therefore, shareholders cannot incentivize managers based on present performance (Dow & Gorton, 1997). Second, stock prices reflect the value of a firm as a common value where all investors care about others' information about future cash flows (Dow & Gorton, 1997). Hence, investors want to know as much as possible about other investors' estimates of future cash flows. Based on these characteristics, Dow and Gorton (1997) argue that the flow of information in the stock market may be bidirectional. In their model, they show that information in stock prices guides investment decisions in equilibrium. Capital markets incorporate a prospective role, in which stock prices provide additional information for the manager's investment decision, if all information relevant to the decision is not already contained within the firm. Thus, leading to an information flow from the outside to the manager (Dow & Gorton, 1997). Additionally, the capital market also incorporates a retrospective role, which allows managerial compensation contracts to be linked to performance, providing information about past investment decisions. This increases the stock price's role as a verifiable predictor of a project's eventual outcome, even if a manager might have private information and/ or a myopic view (Dow & Gorton, 1997).

Even though stock prices can be informationally efficient in their model, there exists an equilibrium in which investors do not produce information because they believe that stock prices are not informative (Dow & Gorton, 1997). This equilibrium can arise when the expected profitability of firm-level projects is sufficiently low. Consequently, this belief may lead to stock prices being less informative. The missing information may lead to managers investing suboptimally, even if managerial incentives are correctly aligned to investors' preferences (Dow & Gorton, 1997). In this case, although prices are efficient, firm-level investment decisions are distorted, which, when aggregated on an economy-level, can lead to inefficient capital allocation. Dow and Gorton (1997) therefore establish that the allocative role of prices depends on the production and aggregation of information. If this information production process is distorted, investment and thus capital allocation can be inefficient even when prices appear efficient.

b.) Empirical Evidence: The Influence of Price Informativeness on Capital Allocation

Evidence for the effect of capital markets on capital allocation can be found in Wurgler's (2000) work. In his analysis of 65 countries across 33 years, he shows that financial markets appear to improve capital allocation. In countries with more developed financial markets, growing industries receive more investments, and declining industries receive fewer investments than in countries with less developed financial markets (Wurgler, 2000). This effect is constant even when controlling for the level of income. Less financially developed countries overinvest in their declining industries and underinvest in their growing ones (Wurgler, 2000). His results suggest that financial markets perform a fundamental allocative function. Additionally, Wurgler (2000) identifies three channels consistent with improved allocation. First, countries with stock markets that possess stock prices that reflect more firm-specific information exhibit better capital allocation. He argues that this effect is consistent with the suggestion that more developed markets embed more firm-specific information in prices. This helps investors and managers alike to make better choices. Second, more state ownership leads to less efficient capital allocation, because state-owned companies tend to be less focused on financial goals and more focused on political goals. Lastly, stronger rights for minority investors are linked with better capital allocation. All three mechanisms are consistent with Dow and Gorton's (1997) hypothesis. More firm-specific information leading to better capital allocation supports the theory of a prospective role of capital markets. Both stronger minority investor rights and lower state-owned ownership, increasing capital allocation efficiency, provide evidence for the retrospective role of financial markets.

To understand how markets generate better allocation, firm-level evidence focuses on the informational content of prices. Chen et al. (2007) examine the relation between private information in stock prices and the sensitivity of firm investment to price. They argue that theoretically, private information flows into the price through market participants' trading activities. When making investment decisions, managers will include all existing information in their decision to maximize the expected value of the firm (Chen et al., 2007). This includes all information in the stock price and firm-internal information that is not reflected in the price yet. By this logic, investment will be more sensitive to the stock price if the price provides more new information to the manager. On the other hand, information that is already known to the manager will move the price but will not affect the investment decision. Hence, investment sensitivity to stock price will decrease (Chen et al., 2007). In their analysis, Chen et al. (2007) find evidence that private information is strongly correlated with the sensitivity of investment to price. Additionally, they show that if managers have more access to firm-internal information not known to the public, they will rely less on private information to guide them. Chen et al. (2007) also find evidence for a significant positive relation between private information and a firm's ex post performance, consistent with improved decision quality, which consequently may lead to a more efficient capital allocation. These findings imply that private information in prices is new to managers. Managers will use the stock price to learn this information and include it in their investment decision (Chen et al., 2007). In summary, private information from trading evidently increased capital allocation. However, Chen et al. (2007) also note that prices can be distorted or manipulated, leading to suboptimal feedback influencing investment decisions. In this case, mispricing can translate into capital inefficiencies.

If learning from prices matters, a natural question is whether prices have become more informative over time at horizons relevant for investment. Bai et al. (2016) find in their analysis of US stock market data on S&P 500 nonfinancial firms from 1960 to 2014 evidence that price informativeness has increased substantially at medium and long horizons (three to five years).

The increase in price informativeness is concentrated among firms with greater institutional ownership and share turnover, firms with options trading, and growth firms (Bai et al., 2016).

Based on Bai et al. (2016), options provide incentives to produce market-based information, which may explain the disproportional increase of price informativeness in such firms. For growth firms, the logic lies within the valuation of growth options, which require comparisons with other firms or analyzing market trends (Bai et al., 2016). This is consistent with the evidence that private information in market prices is more strongly reflected in research and development (R&D) spending compared to capital expenditure (CAPX) spending. R&D development is intangible, which makes determining its value harder. Market information is, thus, especially useful (Bai et al., 2016). Therefore, the increase in price informativeness can unlikely be explained solely by an increased quality of disclosure, but rather by an increase in independent, market-based information in prices (Bai et al., 2016). Since investment decisions take years until they are implemented, materializing in profitability even later, the increase in price informativeness at longer horizons might imply a more efficient capital allocation (Bai et al., 2016).

c.) Price Informativeness and Productivity

Price informativeness affects firm productivity (measured by total factor productivity (TFP)) through improved decision-making, thereby influencing allocative efficiency, as Bennett et al. (2020) show in their work. TFP measures the overall efficiency and effectiveness with which capital and labor are used in the production process. Keeping capital and labor fixed, a higher TFP would result in a higher output. Bennett et al. (2020) show that firms with more informative stock prices are associated with higher operational efficiency through higher revenues, lower operating costs, and lower labor expenses. Similar results can also be seen for other efficiency metrics, e.g., ROA, sales-to-assets, and TFP growth.

The channels through which price informativeness affects productivity are not only restricted to investment. While price informativeness results in greater investment efficiency, which subsequently increases a firm's productivity, Bennett et al. (2020) also show that investment efficiency explains only a limited share of the informativeness-TFP relationship. Other channels, such as managerial discipline, also play heavily in this positive relation. The effect of stock price changes can either have a direct impact on managerial decisions, because the management pays attention to stock prices. Or it can have an indirect effect, because stock price changes can trigger actions from shareholders (Bennett et al., 2020). In their work, Bennett et al. (2020) find that when price informativeness falls, CEO turnover becomes less sensitive to

Tobin's Q, meaning that boards rely less on market valuations when evaluating CEOs. Bennett et al. (2020) argue that lower turnover sensitivity is associated with lower productivity. Hence, more informative prices improve managerial decisions through stricter discipline.

In their work, they were able to confirm that productivity is more strongly related to price informativeness for smaller and younger, better-governed or more specialized firms, as well as for firms in more competitive markets. Overall, the effect of price informativeness on productivity is stronger in firms where the market information can be more easily incorporated within the firm or where firms are more exposed to market pressure (Bennett et al., 2020).

2.1.5 External Misallocation and Aggregate Productivity

This subsection examines the effects of capital misallocation on aggregate productivity. While the previous subsection focused on how informative prices may improve capital allocation within firms, the literature discussed here shifts the perspective to the economy level. Its central argument is that aggregate productivity depends not only on firms' technologies and internal efficiency, but also on how capital and labor are allocated across heterogeneous producers. If distortions affect firm size, selection, and reallocation, resources may no longer flow to the most productive firms, which can substantially lower aggregate total factor productivity.

A more specific example of policy distortions impacting aggregate TFP comes from Restuccia and Rogerson (2008). In a frictionless market, resources are allocated efficiently across plants given their productivity, because all producers face the same factor and output prices. Restuccia and Rogerson (2008) introduce idiosyncratic distortions in the form of firm-specific taxes/subsidies on capital and labor, which change the effective price faced by each plant. The price changes lead to misallocation of capital and labor across heterogeneous producers, which can reduce TFP substantially, even if aggregate capital, labor, and prices are unchanged. The effect is especially large when distortions systematically correlate with productivity (Restuccia & Rogerson, 2008).

Building on Restuccia and Rogerson's (2008) work, Hsieh and Klenow (2009) quantify how much resource misallocation lowers aggregate TFP by using plant-level manufacturing data from China, India, and the US. They measure the revenue productivity (TFPR), the product of price and the physical productivity, and find a much larger dispersion of TFPR within industries in China and India than in the United States, indicating substantially greater misallocation. By reallocating capital and labor across plants within each industry in China and India to equalize

TFPR to the US benchmark, Hsieh and Klenow (2009) calculate possible TFP gains of +30-50% for China and +40-60% for India. This provides direct evidence that resource misallocation can have large effects on aggregate productivity.

Syverson (2011) provides a broad survey of the empirical productivity literature and is mainly relevant here as a framework for linking firm-level productivity differences to aggregate allocative efficiency. Rather than developing a single misallocation model, Syverson emphasizes that aggregate productivity depends on whether market conditions allow resources to move toward more productive producers. In this context, he highlights Hsieh and Klenow (2009) as a key study showing that distortions in input allocation can substantially reduce aggregate productivity. He also discusses Maksimovic and Phillips (2001), who examine the market for manufacturing plants as productive assets and find that productivity tends to rise after plant sales, suggesting that asset markets can shift capital toward more efficient owners. They also show that sold plants tend to come disproportionately from less productive segments of the seller's firm. Overall, Syverson's (2011) review supports the central idea of the misallocation literature that distortions in reallocation, rather than technology alone, can be an important source of lower aggregate TFP.

Real world evidence showing how capital misallocation can negatively impact country-level TFP growth is shown in a quantitative analysis of Baltic firm-level data by the IMF (2024). According to the IMF (2024), within-sector allocative efficiency plays an important role in productivity growth in advanced economies. Within-sector allocation efficiency promotes the market exit of inefficient firms, freeing up resources that can be reallocated to more productive firms (IMF, 2024). Additionally, they found significant variation in allocative efficiency across specific sectors in Estonia. The IMF (2024) names the Estonian mining sector as an example, for which several policies (e.g., government subsidies, trade barriers, or price controls) distort market signals, thereby increasing allocative inefficiency. The argument resonates well with Bennett et al.'s (2020) hypothesis that market information can improve firm-level productivity, which, if aggregated, reflects sector-level productivity.

2.2 Investor Heterogeneity and Non-Financial Preferences

Another field in finance emerged as evidence suggested that theories of standard finance may not be as accurate as predicted (Shiller, 2003; Statman, 2018). Behavioral finance describes a field of different financial theories, in which investors are not fully rational beings focused on maximizing the mean-variance objective. It incorporates cognitive and emotional biases and errors in agents' assessments of assets as well as in their decision-making. Further, it acknowledges that agents might also possess additional non-financial preferences besides purely financial ones while choosing assets for their portfolio – the so-called investor tastes (Fama & French, 2007; Statman, 2018).

This stands in stark contrast to standard finance, where investors focus rationally only on risk and return. In addition, the possibility of individual investors having preferences as well as biases while choosing assets for a portfolio implies that investor homogeneity is not guaranteed. If investors have heterogeneous beliefs and/or non-financial preferences, their demand for assets differs systematically, which can move prices and the cost of capital away from fundamentals, and distort the capital allocation.

Investor tastes are especially relevant for the analysis of ESG investing, because one explanation for ESG-oriented portfolio choices assumes that investors derive utility not only from financial returns, but also from environmental, social, or other non-pecuniary characteristics of assets. The following subchapter, therefore, introduces the idea of investor tastes as a theoretical foundation for later discussing ESG preferences in financial markets.

2.2.1 Prosocial Tastes

Andreoni (1988) evaluates in his paper *"Why Free Ride? Strategies and Learning in Public Goods Experiments"* two hypotheses, which could explain how free riding behavior develops in subjects during finitely repeated games. Free riding in laboratory experiments has consistently replicated the same observations. First, there is no significant evidence of free riding in single-shot games, implying that repetition is necessary for free riding to occur. Second, it occurs that if subjects play a repeated game, provisions for a public good reduce toward a free riding level with each repetition. However, the free riding level itself was rarely realized (Andreoni, 1988).

To explain this effect, he establishes two competing hypotheses. First, subjects may not immediately understand the incentives, but by repeating the game, they learn that free riding is the dominant strategy. Eventually, the more repetitions are played, the more free riding is being practiced by subjects, leading eventually to all subjects choosing their optimal Nash equilibrium contribution (Andreoni, 1988). Second, subjects do not necessarily behave rationally, leading to subjects considering cooperating even though the strategy is not dominant at the individual level. The development of multi-period strategies may be superior in the beginning, but the longer the game goes, the more subjects drop out of cooperation, leading again to nearly free riding levels of provisions (Andreoni, 1988). The free-riding pattern is not fully explained by either pure learning or by multi-period strategic play (Andreoni, 1988). However, based on the results, Andreoni (1988) suggests that theories of non-standard behavior may explain the decision-making of subjects. Non-standard behavior, such as altruism, social norms, or bounded rationality, may be a reason why the decision to free ride is rarely fully achieved, even though it is the rational decision on an individual level (Andreoni, 1988).

In his paper from 1989, Andreoni develops a general model of “impure altruism” to explain why classic neutrality results in public-good settings often fail empirically. Impure altruism describes the phenomenon where people receive some personal benefit from giving. The benefit could be status, acclaim, or an experience named as “warm glow”, a utility coming from the act of giving (Andreoni, 1989). Andreoni (1989, 1990) shows that the concept of impure altruism helps to explain empirical gaps, such as why total free riding does not occur constantly. Contrary to models in which people are purely altruistic, in models with impurely altruistic people, the giving of others is an imperfect substitute. Andreoni (1989, 1990) suggests that impurely altruistic people derive some kind of utility from the act of giving, in addition to the utility gained from the public good. The egotistical wish to receive more of the “warm glow” feeling incentivizes further giving. Private gifts from others become imperfect substitutes, leading to a higher total giving to charities (Andreoni, 1989). Analogously, in asset markets, investors may derive utility not only from financial payoffs but also from holding assets with desirable attributes (e.g., social responsibility), implying demand shifts that are not purely payoff driven.

2.2.2 Investor Tastes

By analogy to warm-glow giving, investors may derive direct utility from holding assets with desirable attributes (e.g., social responsibility). The effects of cognitive biases and tastes may lead to systematic differences in demand, which influence asset prices and consequently capital allocation.

a.) Investor Heterogeneity and Investor Tastes in a Theoretical Framework

A theoretical framework explaining how investor heterogeneity and investor tastes can affect asset prices can be found in Fama and French (2007). They provide a simple market-equilibrium framework in which two assumptions of standard finance are relaxed. First, disagreement among investors about the probability distribution of future payoffs of assets exists. Second, investors choose assets not only based on Markowitz's (1952) E-V framework, but also as a consumption good due to tastes. Investors get utility from holding some assets in addition to the utility of general consumption (Fama & French, 2007). In this simple market-equilibrium framework, they study how disagreement and tastes for holding certain assets can distort expected returns and prices in comparison to standard asset pricing models such as the previously introduced CAPM. According to Fama and French (2007), disagreement and investor tastes have a similar effect on asset prices. In both cases, the nonstandard group chooses a risky portfolio that differs from the informed tangency portfolio, which is consistent with standard CAPM logic. The market portfolios become a wealth-weighted combination of an uninformed risky portfolio and the informed tangency portfolio.

Misinformed investors or investors with tastes value assets differently than informed or rational investors. In the CAPM, market clearing requires informed investors to hold the complement of the portfolio held by misinformed/taste investors (Fama & French, 2007). Hence, if misinformed investors underweight the asset relative to the tangency weights, informed investors have to overweight them and vice versa (Fama & French, 2007). According to Fama and French (2007), complete offsetting is generally not possible because taking the opposite side is risky, and informed investors are risk-averse. Therefore, there will remain some effects from the misinformed prices, which leads to the market portfolio distancing itself from the "true" tangency portfolio of informed investors (Fama & French, 2007). This gap leads to distortions in expected returns compared to the classic CAPM. The magnitude of this distortion depends on several factors, such as the share of invested wealth by misinformed investors and the price gap between the informed and misinformed valuations. Additionally, whether the mispricing affects a wide set of assets (Fama & French, 2007). And lastly, if assets mispriced by misinformed investors in different directions (under- or overweight) are not highly correlated. According to Fama and French (2007), this leads to informed investors facing worse diversification when offsetting. The mentioned effects are consistent for both misinformed investors and investors with tastes. However, tastes are exogenous and do not disappear with time, while disagreement between investors may be temporary, if misinformed investors converge their beliefs towards the beliefs of informed investors (Fama & French, 2007). If this does not happen, informed investors do not have an incentive to offset price effects further, which keeps the distortion of expected returns unchanged (Fama & French, 2007).

b.) Socially Responsible Investment: Effects on the expected Returns of Portfolios

Socially responsible (SR) investing describes an investment strategy in which personal values and societal concerns are incorporated into investors' decisions, in addition to the financial desire to maximize expected returns given a risk preference. This can occur through shareholder activism, community investment, and social screening of assets (Bollen, 2007). Screens can be negative, where companies with weak environmental, social, and governance records get excluded from the pool of available assets or their portfolio weights get reduced. Or they can be positive, which means certain assets get included, or their weights get increased, because of good records (Statman & Glushkov, 2009). Examples for screening criteria can be individual scores for companies regarding environmental (E), social (S), or governance (G) issues, as well as the aggregated ESG score.

Hong and Kacperczyk (2009) show that "sin" stocks are held less frequently by norm-constrained institutional investors and earn higher risk-adjusted returns, consistent with lower demand and weaker risk sharing. Their findings suggest that investor tastes or social norms can affect prices, expected returns, and firms' cost of capital. Further, Statman and Glushkov (2009) analyze the returns of SR investing from 1992 – 2007 by comparing the performance of both positive and negative screens separately, against standard asset-pricing benchmarks. For the positive screening, they show that stocks with a higher SR score yield higher returns than stocks with lower scores. The effect of higher returns is especially evident when comparing the benchmarks against a portfolio consisting of assets where the investor holds long positions on companies scoring well on SR characteristics, and short positions on companies scoring worse (Statman & Glushkov, 2009). Statman and Glushkov (2009) incorporate negative screens of SR investors by shunning companies such as sin companies (Hong & Kacperczyk, 2009), as well as companies associated with firearms, military, and nuclear operations. Consistent with Hong and Kacperczyk (2009), the performance of negative screening is significantly worse than the benchmarks. Statman and Glushkov (2009) also show evidence that SR investing can either have positive or negative effects on the performance of SR portfolios compared against conventional market portfolios, depending on the type of screens being used. Combining both types of screens results in the out- and underperformance nullifying themselves (Statman & Glushkov, 2009). The findings imply that SR investors can create a high-performing SR portfolio if they focus on including stocks with high SR ratings (Statman & Glushkov, 2009).

c.) Socially Responsible Investing as an Investment Taste

Using negative screens for SR investing has a negative impact on the performance of a portfolio, which implies that investors accept lower risk-adjusted returns in exchange for pleasing social concerns (Hong & Kacperczyk, 2009; Statman & Glushkov, 2009). These results imply that investors incorporate some taste into their investment decisions from which they receive additional utility. The positive effect on expected returns by using positive screens in SR investing, however, leaves the possibility open that investors use SR investing as a superior investment strategy (Statman & Glushkov, 2009). This could challenge the argument that investors participate in SR investing because of non-financial investment tastes.

Evidence for SR as investment tastes can be found in the work by Bollen (2007). In his study of the dynamics of investor cash flows in SR mutual funds from 1991 – 2001, SR mutual funds depict a significantly lower monthly fund flow volatility compared to conventional funds. Further, he finds strong evidence that annual flows into SR funds are more sensitive to lagged positive returns than flows into conventional funds. Weaker evidence also shows that annual cash outflows from SR funds are less sensitive to lagged negative returns (Bollen, 2007). These results imply a multi-attribute utility function for investors, in which they receive separable utility from SR attributes, next to the utility derived from an investment's risk and return (Bollen, 2007). Bollen (2007) argues that investors may view investing in an SR fund as consuming the SR attribute, consistent with Fama and French (2007). To smooth the consumption of SR attributes, investors may personally overvalue the positive performance and undervalue the negative performance of SR mutual funds, which subsequently leads to higher cash inflows and lower cash outflows. The utility from consuming SR attributes may make investors more willing to tolerate lower financial performance (Bollen, 2007). His study shows constant and persistent results throughout the observation period, implying the persistent effect of investor tastes for SR preferences on financial markets (Bollen, 2007).

Additional evidence supporting taste-driven SR investing comes from Riedl and Smeets (2017). By linking administrative data to survey responses and behavior in a controlled and anonymous one-shot trust game experiment, they find evidence that social preferences and social signaling may explain SR investment decisions (Riedl & Smeets, 2017). Their strongest and most robust result shows that intrinsic social preferences play an important role in determining SR investing. In a game, where a first mover transfers an amount of money to the second mover, the amount then gets tripled, and the second mover can decide how much, if any, money she can send back, players sharing their money equally are more likely to hold an SR equity fund compared to selfish players who keep all their money. Furthermore, SR investors state that they donate more to charity than conventional investors. According to Riedl and Smeets (2017), financial motives are unlikely to be the cause behind SR investing. Investors not only expect SR funds to be financially less attractive than conventional funds due to underperformance, but they are also willing to pay significantly higher management fees compared to conventional funds (Riedl & Smeets, 2017). Even though expecting SR funds to underperform compared to conventional funds reduces the likelihood of investors holding such funds, investors holding SR funds suggest that some investors are willing to accept worse financial performance to satisfy their social tastes. Riedl and Smeets (2017) do not find a significant relationship between social tastes and the percentage invested in SR funds. They argue that SR tastes are needed to generally invest in an SR fund; however, the tastes are less important in choosing the fraction of the portfolio. How much investors allocate to SR funds depends more on the financial performance of the fund.

2.3 ESG as an Investment Criterion

2.3.1 ESG and green Investing

SR investing has developed into a sizeable market segment with various strategies such as negative and positive screening, and engagement (CSIA, 2024; Renneboog et al., 2008). Previously mentioned literature showed a negative or at best mixed relation between SR and expected returns for portfolios, implying that non-pecuniary investor tastes compensate for lower financial performance (e.g., Hong & Kacperczyk, 2009; Zerbib, 2019). These results are mostly consistent with Friede et al.'s (2015) results in their second-level review of 60 review studies, aggregating >3.700 study results. In their review of more than 2000 empirical studies, they find aggregated evidence that the relation between ESG criteria and corporate financial performance (CFP) is positive. These findings suggest that ESG investments are not disadvantageous for financial performance and can often even be lucrative (Friede et al., 2015). However, they also find that the ESG-CFP relation for portfolio studies is at best neutral/ mixed. Regarding the contrary results for portfolio studies, they argue that the findings are less positive due to three reasons. First, most ESG funds use both negative and positive ESG-screened funds, which may result in a cancellation of any positive effect, an argument consistent with the previously mentioned findings of Statman and Glushkov (2009). Second, portfolio studies include management fees and other costs (e.g., performance fees, trading costs). Firm-level studies typically do not include such fees or costs (Friede et al., 2015). Third, potential ESG alphas are distorted in portfolio-level tests by noise due to overlapping market and nonmarket factors (Friede et al., 2015). Not accounting for these problems, the ESG-CFP relation for portfolio-related studies may be positive rather than neutral or negative (Friede et al., 2015). More recent evidence for a negative ESG-CFP relation in portfolios can be found in Zerbib's (2019) work. He finds a small negative green premium (-2 basis points on average) by comparing the yield of green bonds and conventional bonds (Zerbib, 2019). Comparing the yield of a green bond to an identical counterfactual conventional bond allows him to largely control for risk and to isolate the impact of pro-environmental preferences. Consequently, the negative green premium cannot be easily explained by standard risk premia (Zerbib, 2019). Zerbib (2019) concludes that the small negative premium demonstrates investors' appetite for green bonds.

2.3.2 Theoretical Models of ESG Tastes in Asset Pricing

Due to accumulating evidence implying that investors factor in individual tastes (such as taste for ESG) within the decision-making process of their portfolios, more modern financial literature creates several asset-pricing models that try to reflect how heterogeneous investors with ESG tastes may affect the cost of capital, expected return, and the price of assets in equilibrium.

a.) ESG Investors' Effects on Firms through Exclusion and Engagement

i. Exclusion Model (Heinkel et al., 2001)

Heinkel et al. (2001) create a model of exclusion where green investors avoid investing in firms with polluting tech, which leads to a higher cost of capital for these firms and, under certain circumstances, to polluting firms' investing in clean technologies. The model consists of two types of risk-averse investors and three types of firms. Neutral investors care only about maximizing their standard mean-variance utility, while green investors also include environmental preferences in their investment decisions (Heinkel et al., 2001). Firms using polluting technology are labeled "unacceptable". They are held only by neutral investors. "Acceptable" firms with clean technology are held by both types of investors. Unacceptable firms can transform into acceptable firms by investing a fixed amount to transform their technology. These acceptable firms with reformed polluting technology are only held by green investors, because they have the same risk-return characteristics as unacceptable firms but a higher share price, making investments into them inefficient for neutral investors (Heinkel et al., 2001). The underlying mechanism transforming unacceptable firms to acceptable ones is based on green investors boycotting unacceptable firms due to their personal ethical preferences. Because of that, only neutral investors are available to hold stock of these firms, which limits the risk-sharing opportunities in the whole market (Heinkel et al., 2001). In equilibrium, the remaining neutral investors must hold more of the polluting firms than they would hold under a model of investor homogeneity. To compensate for that, neutral investors demand higher expected returns, which increases the cost of capital for unacceptable firms, and therefore, reduces a firm's share price (Heinkel et al., 2001). In their model, a firm wants to maximize its share price. If the price differential between its price when the firm is unacceptable, and its price when the firm transforms is bigger than the cost of transforming its technology to clean, then the firm will reform to an acceptable one. This broadens the risk-sharing opportunities again and reduces the price differential (Heinkel et al., 2001).

Heinkel et al. (2001) perform comparative statics in equilibrium by changing key parameters. The number of reformed firms decreases with an increase in the costs of transformation, risk tolerance, and the number of originally acceptable firms (Heinkel et al., 2001). An increase in risk tolerance results in fewer reformed firms, because more risk-averse investors do not value the additional diversification possibilities as much. Additionally, with more originally clean firms, the diversification loss of green investors avoiding unacceptable firms is lower, thereby the share price of these firms is relatively high, which provides less incentive to reform (Heinkel et al., 2001). Higher cost of transformation results in lower cost of capital for reformed firms, because a larger drop is required to justify the investment. Meanwhile, an increase in the number of green investors leads to a larger number of reformed firms. More green investors lead to lower prices for unacceptable firms. Since in equilibrium, the price of reformed firms equals the price of unacceptable firms plus the investment, a lower unacceptable firm's price implies a lower reformed firm price, thus implying a higher cost of capital (Heinkel et al., 2001). However, this implication is not general. The model shows that a minimum fraction of the economies' capital needs to be controlled by green investors for the reforming mechanism to apply. Before that, an increase in the number of green investors will result in an increase in the weighted average cost of capital across all firms, which implies inefficient capital allocation without any environmental benefits (Heinkel et al., 2001).

ii. Engagement Model (Gollier & Pouget, 2022)

Gollier and Pouget (2022) investigate how active SR shareholders can influence corporate behavior, a contrary mechanism to Heinkel et al.'s (2001) exclusion mechanism. In their asset pricing model, active shareholders try to incorporate their pro-social preferences in corporations by voting on strategic decisions during shareholder meetings. This model contains two types of investors: standard investors caring only for financial performance and SR investors, who also care about externalities due to impure altruism (in the sense of Andreoni, 1990). In the one-firm baseline model, the shareholder invests depending on their expectation of which strategy will be chosen. The strategy can be standard, which generates no externalities, or responsible, which generates a positive externality at a financial cost for the firm (Gollier & Pouget, 2022).

In their baseline model, a firm may choose a responsible strategy, in equilibrium, even if SR investors are in a minority. They base their findings on SR investors tending to overweight firms with expected responsible strategies compared to conventional investors. As a result, they outnumber conventional investors in these firms even if they are a minority in the whole economy. For this to happen, the proportion of responsible investors needs to be large enough, and investors' risk aversion as well as the level of risk need to be low enough (Gollier & Pouget, 2022). According to Gollier and Pouget (2022), the choice of a responsible strategy is, however, fragile, because SR investors outvoting standard investors is more likely to occur if SR investors already believe that the firm will choose a responsible strategy. If SR investors do not believe that the firm will choose a responsible strategy, they are less likely to invest, which results in less voting power and a standard strategy. Thus, several equilibria can coexist in their model (Gollier & Pouget, 2022).

Extensions to this model alter the results. First, if the model adds negative externalities to the standard strategy of the firm, SR investors are more likely to underweight the non-responsible firm, which consequently leads to the firm choosing a responsible strategy to be less likely in equilibrium. Second, if policy regulators add laws or rules enhancing a firm's commitment power towards SR strategies, such as a rule requiring a two-thirds super-majority vote to overturn a responsible strategy to a standard one, the likelihood that a responsible strategy is chosen increases (Gollier & Pouget, 2022).

b.) ESG in Equilibrium Models: ESG-adjusted expected Return and Prices

i. Two-Factor Asset-Pricing Model (Pastor et al., 2021)

Pastor et al. (2021) develop an equilibrium asset-pricing model to show how heterogeneous investors with ESG tastes may affect financial markets and social welfare. In their model, ESG tastes affect expected returns and the cost of capital of firms, hence, the equilibrium prices of assets. Additionally, ESG preferences cause real investments to shift from dirty to green firms, which increases the aggregate social impact. This model differs from the previous ones, because it does not assume that investment shifts towards green firms/ investment options come from a lack of risk sharing or shareholder activism.

The baseline model incorporates many heterogeneous firms, from which green ones produce varying positive externalities for society and brown ones produce varying negative externalities. Investors care unequally about their financial wealth and two sustainability-related preference components: direct utility from holding green assets, and utility from the aggregate social impact of firms (Pastor et al., 2021). The model setup implies a three-fund separation theorem, where each investor holds the market portfolio, a risk-free asset, and an "ESG portfolio", whose composition is based on the assets' social impact. If investors have stronger-than-average ESG tastes, they overweight green assets and underweight brown ones, resulting in their personal portfolio deviating from the market. Naturally, weaker-than-average ESG tastes also lead to deviations, but with opposite weights. The deviations are larger when risk aversion is lower and overall ESG tastes are stronger (Pastor et al., 2021).If ESG tastes among investors are homogeneous, all investors hold the market, because asset prices then fully adjust to reflect those tastes. Pastor et al. (2021) conclude that for the ESG industry to exist, heterogeneous ESG tastes are necessary. They also imply that the size of the ESG market depends on the dispersion in tastes. The greater the dispersion between investors, the larger the industry (Pastor et al., 2021).

Prices in their model are shaped by two factors: the market portfolio and an ESG factor, which incorporates the excess return of a green-minus-brown portfolio going long on green assets and short on brown assets. In a standard CAPM, green assets exhibit negative alphas and brown assets positive alphas, because the omitted ESG factor has a negative risk premium. Due to the utility derived from holding shares of green firms, investors with stronger ESG tastes do not necessarily derive less total utility holding a portfolio tilted more towards green firms, even though they earn lower expected returns than less ESG-focused investors (Pastor et al., 2021). The negative CAPM alpha does not always ensure lower expected returns for green assets. The

ESG factor captures unexpected changes in the model's ESG concerns. If concerns unexpectedly shift, due to customer shifting demands towards goods from green firms or investors changing their ESG tastes, ESG factors affect the relative performance of assets. Thereby, if concerns strengthen unexpectedly, green assets can outperform brown ones (Pastor et al., 2021).

Pastor et al.'s (2021) model implies that sustainable investing improves social welfare. A firm's social impact is the product of its positive externalities and its scale. ESG-conscious investors' willingness to pay more for greener firms lowers the firms' cost of capital, while increasing the cost of capital of brown firms. This shift in the cost of capital results in real investments in the economy, shifting from brown firms to green ones. Additionally, value-maximizing managers have an incentive to shift investments to greener alternatives, because green firms command higher market values. Both mechanisms increase the social welfare of the model. While the first increases the scale of green firms, the second mechanism decreases their negative externalities or further increases the positive ones, which subsequently leads to increases in their market value (Pastor et al., 2021).

ii. ESG-adjusted CAPM (Pedersen et al., 2021)

Pedersen et al.'s (2021) ESG-adjusted CAPM provides a framework for how ESG preferences and scores can be factored into an investor's portfolio problem. The solution for ESG-aware and conscious investors is a four-fund portfolio that is located on an ESG-efficient frontier. Further, they derive an ESG-adjusted CAPM, where expected excess returns depend on the usual market beta and an additional term, which includes the asset's ESG score and the relative importance of each investor type in the market (Pedersen et al., 2021). The model consists of three types of investors. Type-U investors are unaware of ESG scores and invest according to standard mean-variance criteria. Type-A investors also try to maximize their mean-variance utility, but they incorporate information coming from an asset's ESG score into their beliefs about the performance of the respective assets. Lastly, type-M investors display ESG tastes and hence, use ESG information. Depending on their preferences, they seek a portfolio that optimally balances expected return, risk, and average ESG score (Pedersen et al., 2021).

Pedersen et al. (2021) argue that the investor's portfolio problem can be reduced to a trade-off between the Sharpe ratio and ESG. They compute an ESG-SR frontier, which marks the highest attainable Sharpe ratio for each level of ESG. The hump-shaped line illustrates all efficient portfolios when investors care about expected return, risk, and ESG. Like in the standard

CAPM, the tangency portfolio marks the portfolio with the highest Sharpe ratio attainable regardless of individual investor tastes (Pedersen et al., 2021). Each type of investor chooses a different portfolio. Type-U investors, unaware of ESG scores, choose portfolios lying below the frontier because they ignore additional information contained in the ESG score and construct portfolios using the classical two-fund separation theorem. Type-A and type-M investors use four funds to construct their portfolios: the risk-free asset, the tangency portfolio, the minimum-variance portfolio, and the ESG-tangency portfolio. While type-A only incorporates the additional information to choose the highest point of the frontier with the maximum Sharpe ratio, type-M investors' ESG tastes lead to investors choosing portfolios on the ESG-SR frontier further to the right of the maximum. Higher ESG tastes lead to investors choosing a portfolio further away from the maximum, compensating lower financial performance (lower Sharpe ratio) with higher ESG scores (Pedersen et al., 2021).

Equilibrium prices and expected returns are derived by the ESG-adjusted CAPM. Pedersen et al. (2021) show that the effect of ESG on expected return is not fixed and depends on whether ESG predicts future profits, and which investor type dominates the market. If ESG scores predict profits, in a market dominated by type-U investors, ESG information is underused, which results in high-ESG stocks being underpriced relative to their fundamentals; hence, a higher ESG score implies higher expected returns. In a type-A dominated market, the positive impact of ESG on expected returns is fully incorporated in prices, and the ESG-return relation is neutral. Lastly, in a type-M-dominated market, investors overprice high-ESG stocks due to their tastes. The possibly positive ESG-expected return relation gets reversed, and ESG stocks end up with lower expected returns compared to their fundamentals. Pedersen et al. (2021) use four ESG proxies (one for each letter of ESG and one for the ESG score overall) to empirically test for possible correlation with expected returns. They show that the proxy for governance predicts positive returns in their sample, while the proxy for social predicts negative returns. The proxies for environment and ESG overall correlate positively with investor demand and high valuation, but they have no statistically significant link to returns. These findings may explain why studies of the ESG-expected return relation are inconsistent (Pedersen et al., 2021). Additionally, Pedersen et al.'s (2021) model may explain why negative ESG portfolio screens may lead to lower expected returns, as shown by Statman and Glushkov (2009). Investors not using a negative screen can short low ESG score assets to hedge out risks or to finance larger positions in high ESG score assets. Screening out low ESG score assets restricts these options. Pedersen et al. (2021) find that investors who use negative screens build optimal portfolios with lower aggregate ESG scores compared to investors who do not impose restrictions.

Additionally, they find that the ESG-SR frontier of non-constraining investors strictly dominates the frontier of negatively screening ones, which implies a lower financial performance for negative screening investors too (Pedersen et al., 2021).

2.3.3 ESG Preferences, Information, and Rating Frictions

a.) Information friction due to ESG Rating Uncertainty (Avramov et al., 2022)

Another effect that may explain the contrary evidence in the relationship between ESG tastes and expected returns of assets may also be driven by ESG score uncertainty. Across ESG rating agencies, scores for firms can vary systematically, which complicates measuring the true ESG-return relation. Avramov et al. (2022) show in their model how uncertainty regarding ESG scores may influence asset prices and portfolios. In their model, agents gain, next to their standard mean-variance utility, non-pecuniary utility from holding the green market (represented by a single risky asset) and disutility from holding the brown market. Their demand for equities reflects the standard risk-return trade-off and an additional ESG component, which consists of a positive (negative) payoff for a green (brown) market as well as volatility coming from uncertainty about the market's ESG score. Based on the aggregate demand, they show that ESG uncertainty reduces overall demand, even when the market is green (Avramov et al., 2022). They confirm these findings of their model empirically by examining the demand for greener firms from norm-constrained institutions, which display preferences for greener firms, and hedge funds, which consist mostly of neutral arbitrageurs. Both types of institutional investors reduce their demand for ESG stocks with increasing rating uncertainty. This effect is stronger for high-ESG stocks, which suggests that rating uncertainty is especially impacting ESG-investments of ESG-sensitive investors (Avramov et al., 2022).

In the equilibrium of their model, when the market is green, but ESG uncertainty exists, the uncertainty increases the perceived risk, resulting in a higher market premium as compensation. However, green markets also lower the market premium due to green investors' non-pecuniary preference for holding green assets. Depending on the balance between green tastes and ESG uncertainty, the market premium may be higher or lower, which may help explain the conflicting empirical evidence of the ESG-return relation. Avramov et al. (2022) imply that the lack of consistency across ESG rating agencies increases the risk for sustainable investing, which reduces investor demand and potentially hurts economic welfare. Additionally, ESG uncertainty increases the reduced demand for green firms, which may have a negative social impact on these firms ' cost of capital. Policy makers could increase both social and economic welfare by introducing a clear taxonomy for ESG performance and a unified disclosure standard for sustainable reporting (Avramov et al., 2022).

b.) ESG Preferences and Information Aggregation in Prices (Goldstein et al., 2022)

Goldstein et al. (2022) study how heterogeneous investors with ESG preferences affect the aggregated information in prices through strategic interactions between them and traditional investors. By learning from their private signals and trading, both groups of investors influence the information content of the price. The equilibrium price of an asset and its loaded information depend on which group dominates the market; hence, multiple equilibria can coexist. In their model, two risky components, the financial cash flows and an ESG component, jointly determine the payoff of an asset. While traditional investors only value financial payoffs, ESG investors value both payoff components. Both groups receive heterogeneous informative signals about both payoff components, and due to their heterogeneous preferences, they seek to extract different dimensions of information from the price. While the green investors care directly about the ESG component, traditional investors care only about the additional information contained in the ESG component to better interpret prices. Consequently, the investor groups end up trading differently while receiving similar signals (Goldstein et al., 2022).

In this model, positive signals about one payoff component lead to the group that values the component to increase their demand for the stock, while the opposite group reduces their demand. The increased demand leads to increased trades by the benefiting group, which loads the prices with more information about what the investors from the benefiting group care about. Further, the price gets less informative about what investors from the other group care about (Goldstein et al., 2022). This mechanism results in a feedback loop. If investors of one group trade more intensively on their private signals than the other group, the preferences of the dominating group are more reflected in the price, which makes the price more informative to them. This reduces the uncertainty they face while holding the stock, thereby stimulating even more intensive trading. Depending on which group of investors dominates trading, the model achieves a different equilibrium (Goldstein et al., 2022). However, multiple equilibria in this model do not generally occur. Preference heterogeneity needs to be strong enough for the investor groups to learn similar information from the price. Additionally, both investor groups need to receive informative signals about both payoff components, or else they will not be able to trade against the signal of the component they do not value, thus preventing the price from being informative about it. Further, if the masses of investors are too unevenly distributed, one investor group will always dominate the trading. Lastly, if noise traders' demand is too volatile, price informativeness about both components will be low, making them uninformative for all rational investors (Goldstein et al., 2022).

They imply from their model that, due to the increasing amount of ESG investors, financial markets are moving away from strict cash flow equilibria to markets where multiple equilibria are possible. As the share of green investors increases, prices load more information regarding ESG, thereby they become more informative for green investors and less informative for traditional ones (Goldstein et al., 2022). This shift has consequences for a firm's cost of capital, since it reflects the average information risk faced by rational investors. An increase in green investors increases the cost of capital until the maximum, where investor groups are balanced, is reached. At this point, the information contained in the price is not particularly informative for any investor group; hence, both groups require higher compensation for bearing the information risk. If the distribution further tilts towards green investors, the price informativeness increases for this group and the firm's cost of capital sinks again. Goldstein et al. (2022) argue that their findings may help to explain the contradictory empirical results on the cost of capital for green firms. While green investors expect lower financial gains for non-pecuniary utility, their model implies that firms attracting green investors can increase the informational risk for traditional investors already holding the asset. Consequently, they may demand a higher financial return as compensation (Goldstein et al., 2022).

2.4 Interim Conclusion and Link to Xue (2025)

Chapter 2 introduced the theoretical foundation relevant to this thesis. Standard finance provides the benchmark in which rational investors allocate capital according to the trade-off between expected return and risk, while asset prices reflect financial fundamentals and available information. In this framework, efficient prices are closely linked to efficient capital allocation within firms and across the economy.

Chapters 2.2 and 2.3 extended this benchmark by showing that investors may also possess non-pecuniary preferences, especially ESG tastes. These preferences can affect expected returns, prices, and firms' cost of capital, thereby changing capital allocation relative to the standard-finance case. However, the reviewed models do not place the information channel at the center of the analysis in the same way as Xue (2025). His model explicitly links investor preferences, ESG disclosure precision, price informativeness, and firm investment decisions. Chapter 3, therefore, presents Xue's (2025) model in detail as the central analytical framework of this thesis.

3. ESG Disclosure, Market Forces, and Investment Efficiency

Xue's (2025) model is the key component for answering the central question of this thesis: How do heterogeneous investors with non-standard tastes affect capital allocation and productivity? At the core, his model addresses questions regarding the economic role and optimal design of ESG disclosure. Firms choose an investment k to maximize their stock price. The investment k affects both profit $v(k)$ and ESG performance, more precisely, emissions $F(k)$. Individual investors care about both, but don't observe the investment k directly. They trade on private signals, public earnings signals, and ESG disclosure.

The model will be introduced first, with homogeneous investors that possess a taste for environmentally friendly investments, desiring a balance between financial profit and reducing emissions. Later, the investors get separated into solely profit-driven investors, who do not care about the emissions of the investments, and ESG-conscious investors, who still care about both. On a micro-level, Xue (2025) shows and explains why ESG disclosure is needed to ensure that firms make investments in accordance with investors' tastes. Additionally, he derives the optimal ESG disclosure, as well as the forces that influence it. Furthermore, he extends the model on a macro-level by incorporating the negative externalities of emissions as a factor, which reduces economy-wide productivity. Xue (2025) derives conditions under which mandating a more precise ESG disclosure by regulators would be more socially beneficial compared to a voluntary precision set by firms. This section summarizes the main mechanisms and results of Xue (2025) and explains how they inform the link between investor heterogeneity, capital allocation, and aggregate productivity.

Even though Xue's (2025) work focuses primarily on questions about ESG disclosure, it contains valuable implications for this thesis. First, investors' preferences deviate from the classical E-V framework (Markowitz, 1952), which is one core assumption of standard finance. The model depicts how (heterogeneous) investors with preferences for low-emission firms influence the stock price of a firm, resembling Fama and French's (2007) view of tastes for "assets as consumption goods". The ESG disclosure functions as an information channel, which, if not or wrongly implemented, can result in systematic misallocation of capital. Second, the results focusing on that part of the model, where a large economy with emissions as negative externalities is depicted, imply how missing or lax ESG disclosure regulation can lead to lower aggregate productivity due to emissions.

3.1 One-Firm Baseline Model

Xue (2025) sets the baseline model by setting a firm that chooses an investment k to maximize its individual stock price p. Investment k also influences the firm's profit $v(k)$ as follows:

$$v(k) = \lambda k - \frac{k^2}{2} + \psi. \tag{1}$$

The parameter λ describes the marginal return of the investment, while $\frac{k^2}{2}$ describes the cost of an investment. A normally distributed noise term $\psi \sim N(0, \tau_v^{-1})$ with precision τ_v^{-1} includes all unknown effects that might affect the firm's profits (Xue, 2025). The firm's investment k additionally affects its ESG performance/ emissions $F(k)$:

$$F(k) = f(k) + \phi, and\ f(k)\ is\ monotonic. \tag{2}$$

The term $f(k)$ incorporates the positive or negative impact of investment k on the ESG performance. If $f'(k) < 0$ the investment reduces emissions and can be labeled as "green". Consequently, $f'(k) > 0$ would mark "dirty" investments, which increase emissions. The noise term $\phi \sim N(0, \tau_F^{-1})$ captures the effects of unknown factors outside the firm's control. Thus $F(k)$ is affected by the known emissions of the investment and the random unknown factor ϕ (Xue, 2025). Furthermore, due to $f(k)$ being monotonic, Xue's (2025) model assumes that larger investments impose, on average, a greater impact on the firm's ESG performance. Investors i's utility is $U(x_i) = -\exp(-\rho x_i)$, where $\rho > 0$ is the risk-aversion parameter. The investors value both financial returns and ESG performance. Hence, the individual wealth parameter x_i equals

$$x_i = (v - p)q_i - s * F\, q_i. \tag{3}$$

The first part of this function marks the financial results of the investor if she invests q_i at the price p and receives a profit v. The second part, the "ESG Consideration", includes the investor's disutility associated with investing q_i in a firm with emissions F. According to Xue (2025), the term Fq_i can also be interpreted as investor i's "share" of the firm's total emissions F. Depending on the investor's taste for ESG $s \geq 0$, the investor's wealth x_i decreases with a higher s, since she dislikes investing in a polluting company. Because the "ESG Consideration" has a negative impact on x_i and is subject to noise, investors dislike both higher average emissions and higher uncertainty (Xue, 2025).

Investment k is not directly observable to the investors. They rely on private and public signals to assess the firm's profit υ and ESG performance F. For the profit, the firm releases an earnings report $R = \upsilon + \zeta$, with $\zeta \sim N(0, \tau_R^{-1})$, and precision τ_R, which captures the quality of the earnings report. Investors also observe individually a private signal about profit $y_i = \upsilon + \eta_i$, where the noise term $\eta_i \sim N(0, \tau_\eta^{-1})$ is independently distributed across all investors. Information about ESG performance F comes solely from a firm's public ESG disclosure $D = F + \xi$, with $\xi \sim N\left(0, \tau_\xi^{-1}\right)$, where τ_ξ is the precision of the disclosure (Xue, 2025).

The stock price p is determined in a rational expectations equilibrium (REE). In Xue's (2025) model, the REE must hold the following conditions. First, given their information (e.g., signals, disclosure, pricing function), each risk-averse investor $i \in [0,1]$ computes an expected payoff. Based on that, she solves her individual portfolio problem by choosing her optimal demand of stock q_i to maximize her expected utility function. Second, markets must clear; there exists a linear equilibrium pricing rule p such that the aggregate demand of all investors equals the total supply (i.e. $\sum_i q_i = 1$). Third, the consistency condition must hold. The pricing rule that investors think holds is the same as the pricing rule that emerges when everyone trades optimally. The latter introduced a linear pricing function p that maps signals and disclosures with their respective coefficients to the stock price. Under REE, investors' beliefs of how this function looks are equal to the actual function after the equilibrium is set (Xue, 2025).

3.2 First-Best Benchmark and Effects of Missing ESG Disclosure

To understand how information frictions distort capital allocation, we first characterize the optimal first-best investment choice and a perfect-information benchmark, where investors' tastes for ESG are fully reflected. Xue (2025) creates the benchmark by allowing investors to form a new firm, in which they can choose the investment k directly. By allowing that, he transforms the model to a single-person optimization problem, where owners want to maximize the following certainty equivalent:

$$CE_i = \mathbb{E}[\upsilon(k) - sF(k)] - \frac{\rho}{2} var[\upsilon(k) - sF(k)]. \tag{4}$$

Since the variance only contains exogenous parameters, optimality can be reached by substituting $\upsilon(k)$ with (1) and $F(k)$ with (2) and maximizing k in $\mathbb{E}[\upsilon(k) - sF(k)]$ alone.

$$\frac{\partial CE_i}{\partial k} = \frac{\partial}{\partial k} \mathbb{E}\left[\lambda k - \frac{k^2}{2} + \psi - s(f(k) + \phi)\right]$$

$$\frac{\partial CE_i}{\partial k} = \mathbb{E}\left[\frac{\partial}{\partial k}(\lambda k - \frac{k^2}{2} + \psi - s(f(k) + \phi))\right]$$

$$\mathbb{E}[\lambda - k^{FB} - sf'(k^{FB})] = \lambda - k^{FB} - sf'(k^{FB}) = 0$$

This leads to investors investing at the first-best solution k^{FB} so that the marginal financial benefit equals the marginal cost, including the investors' valuation of the impact on emissions:

$$\lambda = k^{FB} + sf'(k^{FB}). \tag{5}$$

A benchmark more in line with the core model by Xue (2025) introduces incentive frictions and the stock market but assumes perfect information by eliminating noise ($\psi = 0$ & $\phi = 0$). In this case, the firm investment k is publicly observable. Hence, investors know the firm's profit $v(k)$ and emissions $F(k)$ exactly. Xue (2025) derives the market-clearing price for the perfect-information-benchmark by maximizing the investor's wealth parameter x_i (substitute (1) and (2) into (3) and deviate w.r.t. q_i) :

$$\frac{\partial x_i}{\partial q_i} = \frac{\partial}{\partial q_i}[(\lambda k - \frac{k^2}{2} - p)q_i - s * f(k)\, q_i] = 0$$

$$\lambda k - \frac{k^2}{2} - p - sf(k) = 0$$

$$p = \lambda k - \frac{k^2}{2} - sf(k) \tag{6}$$

In this perfect-information benchmark, the firm will choose the optimal investment k^{FB}. As information is complete, prices fully internalize the investors' tastes for ESG (Xue, 2025). By maximizing its stock price, the firm chooses the same optimal investment k^{FB} as in the benchmark with no delegation, leading to an efficient capital allocation.

Next, Xue (2025) assumes that ESG disclosure D does not exist to see how information friction can affect stock prices. Investor i still prefers a balance between financial profits and ESG compatibility. Xue (2025) derives investor demand q_i for a firm's share as follows. Let $\mathcal{F}_i$ mark investor i's information set before trading. Based on (3), the conditional expectation and variance can be defined as:

$$\mathbb{E}[x_i|\mathcal{F}_i] = q_i\mathbb{E}[v - p - sF|\mathcal{F}_i] = q_i\mathbb{E}[v - sF|\mathcal{F}_i] - p, and \tag{I}$$

$$var(x_i|\mathcal{F}_i) = var(q_i(v - p - sF|\mathcal{F}_i) = q_i^2 var(v - sF|\mathcal{F}_i). \tag{II}$$

According to Xue (2025), it is known that:

$$CE_i = \mathbb{E}(x_i|\mathcal{F}_i) - \frac{\rho}{2} var(x_i|\mathcal{F}_i), and \tag{III}$$

$$\mathbb{E}[-\exp{(-\rho x_i)}|\mathcal{F}_i] = -\exp{(-\rho CE_i)} \tag{IV}$$

Substituting (I), (II), and (III) into (IV) results in:

$$\mathbb{E}[-\exp{(-\rho x_i)}|\mathcal{F}_i] = -\exp\left[-\rho q_i(\mathbb{E}[v - sF|\mathcal{F}_i] - p) + \frac{\rho^2}{2} q_i^2 var(v - sF|\mathcal{F}_i)\right].$$

Because $-\exp{(\cdot)}$ is strictly monotone in its exponent, maximizing expected utility is equivalent to maximizing the exponent:

$$Define\ g(q_i) \equiv -\rho q_i(\mathbb{E}[v - sF|\mathcal{F}_i] - p) + \frac{\rho^2}{2} q_i^2 var(v - sF|\mathcal{F}_i)$$

$$\frac{\partial g}{\partial q_i} = \frac{\partial}{\partial q_i}\left[-\rho q_i(\mathbb{E}[v - sF|\mathcal{F}_i] - p) + \frac{\rho^2}{2} q_i^2 var(v - sF|\mathcal{F}_i)\right] = 0$$

$$-\rho(\mathbb{E}[v - sF|\mathcal{F}_i] - p) + \rho^2 q_i\ var(v - sF|\mathcal{F}_i) = 0$$

$$\rho^2 q_i\ var(v - sF|\mathcal{F}_i) = \rho(\mathbb{E}[v - sF|\mathcal{F}_i] - p)$$

$$q_i = \frac{\mathbb{E}[v - sF|\mathcal{F}_i] - p}{\rho\ var(v - sF|\ \mathcal{F}_i)}. \tag{7}$$

Keeping everything equal, the demand q_i increases if investors expect higher profits and lower carbon emissions. To get the equilibrium price function, Xue (2025) first guesses a linear pricing function for $\mathcal{F}_i = \{p, y_i, R, D\}$,

$$p = \alpha_0 + \beta v + \gamma R - \alpha_F D - \alpha_M M - \alpha_\epsilon \epsilon. \tag{8}$$

Price p is informationally equivalent to $m = \frac{p - \alpha_0 - \gamma R + \alpha_F D + \alpha_M M}{\beta} = v - \frac{\alpha_\epsilon}{\beta}\epsilon$, which is a noisy signal of v with some precision. Because $(v - sF,\ y_i,\ m,\ D,\ R,\ M)$ are jointly normal, Xue (2025) shows that the conditional mean $\mathbb{E}[v - sF|\mathcal{F}_i]$ is linear in $(y_i,\ m,\ D,\ R)$ and the variance $var(v - sF|\ \mathcal{F}_i)$ is a constant, for all i. He solves for the market-clearing price p by substituting the conditional mean and variance into (7) and imposing the following market clearing condition:

$$\int_i q_i di = M + \epsilon.$$

Because each q_i is linear in the signals, the aggregate demand is linear in $(v,\ R,\ D,\ M,\ \epsilon)$. By comparing the coefficients in the market-clearing price p, $(\alpha_0,\ \beta,\ \gamma,\ \alpha_F,\ \alpha_M,\ \alpha_\epsilon)$, to those of (8), Xue (2025) determines the equilibrium price function in his REE model as

$$p = \alpha_0 + \alpha_v v + \alpha_R \zeta - \alpha_F D - \alpha_M M - \alpha_\epsilon \epsilon \qquad (9)$$

Using $\mathbb{E}[v] = \mu_v, \mathbb{E}[F] = \mu_F, and\ \mathbb{E}[\epsilon] = 0$ the linear price function satisfies

$$\mathbb{E}[p] = \mu_v, -s\mu_F - \alpha_M M, \qquad with\ \alpha_M = \rho var(v - SF|\mathcal{F}_i), \qquad (10)$$

for a given distribution of profit v and emissions F. The expected price $\mathbb{E}[p]$ decreases with expected emissions $\mathbb{E}[F]$ and increases with expected profits $\mathbb{E}[v]$. Due to $\frac{\partial \mathbb{E}(p)}{\partial s} = \mu_F < 0$, an increase in investors' ESG taste s lowers the price, a result consistent with Pastor et al. (2021) (Xue, 2025).

While it seems intuitive that firms respond to more ESG-concerned investors by investing more into cutting emissions, Xue (2025) shows in this No-Disclosure part of the model that an increase in the investors' ESG taste s does not influence firm investments. Even though a stronger ESG-taste lowers the expected price, the firm will always choose $k^{\emptyset} \equiv \lambda$ (Xue, 2025). Without ESG disclosure, i.e., $\tau_\xi = 0 \rightarrow \alpha_F = 0$, the pricing function (9) turns into

$$p = \alpha_0 + \alpha_v v + \alpha_R \zeta - \alpha_M M - \alpha_\epsilon \epsilon.$$

For investors' conjecture about what the firm will choose, $\hat{k}$, and the actual investment chosen by the firm k, Xue (2025) derives the expected price:

$$\mathbb{E}[p|k, \hat{k}] = \alpha_0(\hat{k}) + \alpha_v \mathbb{E}[v|k] - \alpha_M M.$$

$\alpha_0(\hat{k}) = \frac{\tau_v}{\tau_\Sigma}\mu_v - s\mu_F$ is influenced by $\hat{k}$, because it depends on the beliefs about average profit $\mu_v(\hat{k}) = \lambda\hat{k} - \frac{\hat{k}^2}{2}$ and emissions $\mu_F(\hat{k}) = f(\hat{k})$. The parameters $\alpha_R \zeta$ as well as $\alpha_\epsilon \epsilon$ drop out, because $\mathbb{E}[\zeta] = 0$ and $\mathbb{E}[\epsilon] = 0$.

To assess the effect of a firm's actual investment choice k on the expected price, we take the derivative w.r.t k:

$$\frac{\partial \mathbb{E}[p|k, \hat{k}]}{\partial k} = \alpha_v \frac{\partial \mathbb{E}[v|k]}{\partial k}.$$

The marginal effect of changing k on the expected price depends only on how k changes expected profit, not on how it changes emissions, because emissions only enter through the belief-dependent intercept $\alpha_0(\hat{k})$. Substituting $\mathbb{E}[p|k, \hat{k}]$ with (1), we get

$$\frac{\partial \mathbb{E}[p|k, \hat{k}]}{\partial k} = \alpha_v(\lambda - k^{\emptyset}) = 0.$$

Because price is increasing in profit ($\alpha_{\upsilon} > 0$), $\alpha_{\upsilon}(\lambda - k^{\emptyset}) = 0$ only if $k^{\emptyset} = \lambda$ (Xue, 2025). Since investors cannot directly observe the firm's investment k, they rely on disclosure to form beliefs, consequently leading to individual demand. In this case, however, investors only have access to public/private information about firm profits υ. With no ESG disclosure and no private information function about ESG, investors cannot fully see k, so they have to form their own conjecture $\hat{k}$. As a result, prices only reflect the expected emissions under $\hat{k}$ and not the firm's actual choice. Firms realize ex ante that influencing conjecture $\hat{k}$ is not possible in a model without ESG disclosure, accepting $\hat{k}$ as given. Thereby, they choose to solely focus on profit-maximization, resulting in $k^{\emptyset} = \lambda$. Investors anticipate this choice and value the firm less than in the first-best benchmark because the price does not reflect their ESG tastes while choosing k (Xue, 2025). This result also holds whenever investment k is reported with noise, i.e., $\tau_{\theta} < \infty$ (Xue, 2025). The noise investment signal $I = k + \theta$ is related to the firm's ESG performance F through investment k. In this model, k is an endogenous choice of the firm in equilibrium to maximize its price. In pure strategies, investors attribute any difference between the reported investment I and their conjecture $\hat{k}$ to the noise θ, because they view their conjecture as constant (Xue, 2025). Incorporating investors' conjecture $\hat{k}$ about the firm's policy into the firm's best-response leads to $k^{\emptyset} = \lambda$, as shown above. Therefore, observing I does not change investor beliefs about the firm's equilibrium strategy.

3.3 The Effect of ESG Disclosure on Prices and Capital Allocation

By disclosing its own ESG performance, i.e., introducing disclosure D, a firm can influence investors' conjecture $\hat{k}$, allowing emission reduction to become an additional criterion in the search for the optimal investment k. However, the question arises about how the ESG disclosure needs to be set to optimally align investor preferences and a firm's investment choice. For a given ESG disclosure precision $\tau_{\xi} \geq 0$, the linear pricing function in Xue's (2025) REE model can be defined through (9). The price coefficients satisfy $\frac{d\alpha_{\upsilon}}{d\tau_{\xi}} > 0$ and $\frac{d\alpha_{F}}{d\tau_{\xi}} > 0$, meaning that the sensitivity of the price function to firm profits υ, α_{υ}, increases with a more precise ESG disclosure D. The same applies to the sensitivity of the price function to ESG performance F, α_{F} (Xue, 2025). As a result, the price function becomes more responsive when ESG disclosure D becomes more precise. While $\frac{d\alpha_{F}}{d\tau_{\xi}} > 0$ is intuitively understandable, $\frac{d\alpha_{\upsilon}}{d\tau_{\xi}} > 0$ is more intriguing, since ESG disclosure $D = F + \xi$ does not contain any information about profits. Xue (2025) refers to a spillover effect due to investors' risk consideration. A more precise ESG disclosure lowers the uncertainty affecting ESG performance F. Therefore, investors trade more aggressively on their information, leading to an increase in the investors' aggregate signals y_i about firm profits.

Both price coefficients α_v and α_F are important for determining the firm's investment k. While α_v captures how much the firm internalizes the investors' utility derived from higher profits, α_F captures the extent to which the firm internalizes the investors' taste against higher emissions. An increase in ESG disclosure D induces a stronger incentive to cut emissions and increases the investors' perceived benefits of higher profits. Including ESG disclosure in the firm's first-order condition results in:

$$\lambda = k^* + \frac{\alpha_F(\tau_\xi,\ s)}{\alpha_v(\tau_\xi,\ s)} f'(k^*). \tag{11}$$

The ratio $\frac{\alpha_F(\tau_\xi, s)}{\alpha_v(\tau_\xi, s)}$ captures the weight a firm places on the emissions produced by the investment relative to its financial gain. As one can see, this ratio is dependent on both the ESG precision τ_ξ, as well as on investors' taste s. Subsequently, the net effect of increasing the ESG disclosure depends on how fast the firm's perceived marginal value of reducing emissions increases relative to increasing profits (Xue, 2025). Comparing this formula for λ with the benchmark case from chapter 3.2. highlights that k^{FB} can be achieved, if ESG precisions τ_ξ is set such that

$$\frac{\alpha_F(\tau_\xi^*,\ s)}{\alpha_v(\tau_\xi^*,\ s)} = s. \tag{12}$$

The optimal precision τ_ξ^* aligns the firm's incentive for maximizing the stock price with the investors' preferences, ensuring that firms value the tradeoff between financial and non-financial preferences (the firm's ESG tradeoff) the same way as investors (investors' ESG tradeoff s) do. It does not matter whether the investment is "green" or "dirty" (Xue, 2025).

Fixing the quality of disclosure τ_ξ^*, one can see that an increase in s makes price more responsive to the reported emissions leading to a rising ESG tradeoff of the firm. Reason for that is the increasing relevance emission F has in investors' portfolio decisions due to the increasing s, leading to an increase in α_F. However, simultaneously it also decreases α_v, because an increase in s leads to a decreasing relevance for profits v and to an increase in the risk $(v - s\mathcal{F})$ investors face. Both effects make investors trade less intensively on their private signals about profit y_i, which reduces the information content of the price and consequently, the price sensitivity to profit α_v (Xue, 2025). In Xue's (2025) model, an increase in ESG taste s actually implies lower optimal disclosure precision τ_ξ^*, thus $\frac{d\tau_\xi^*}{ds} < 0$. The optimal ESG disclosure precision τ_ξ^*, hence, reduces if investors care more about the environmental impact of firm action. Xue (2025) remarks that this finding does not necessarily claim that a stronger taste for ESG would always need to be accompanied by lower ESG disclosure. His results are based on the assumption that private signals about emissions do not exist. In an extension, where he includes observable private signals about F, he also shows that $\frac{d\tau_\xi^*}{ds} < 0$ holds, but only for a certain value of $s < \sqrt{\frac{\tau_F}{\tau_v}}$.

3.4 Large-Economy Extension: Effects on Aggregate Productivity

Xue (2025) extends the model to obtain implications on a macroeconomic level by including the negative externalities of emissions, which lower economy-wide productivity. Many firms $i \in [0,1]$ choose an investment $k_i > 0$. Financial profit $v(k_i)$ and emissions $F(k_i)$ are defined as in the single-firm model from before. The same applies to the firm i's earnings report R_i and ESG disclosure D_i. The various noise terms of all functions are independent of each other and across different firms, excluding potential spillover effects between firms (Xue, 2025). The aggregated emissions resulting from each individual firm i's investments k_i are defined as

$$\overline{F} = \int_j F(k_j)dj. \tag{13}$$

These aggregated emissions decrease the marginal return of investment λ, since they reduce the economy-wide productivity:

$$\overline{\lambda} \equiv \overline{\lambda}\left(\overline{F}\right) \geq 0, with\, \overline{\lambda}'(\cdot) < 0. \tag{14}$$

To visualize how misaligned ESG disclosure can lead to systematic distortion in capital allocation, Xue (2025) compares a socially optimal benchmark to an equilibrium with voluntary ESG disclosure. For the benchmark, he imagines a single conglomerate that owns all firms, choosing a socially optimal investment k^S to balance its financial and environmental impacts on the whole economy. Therefore, k^S is chosen to maximize

$$\int_i [v_i(k) - s\,F_i(k)]di = \overline{\lambda}\,k - \frac{k^2}{2} - sf(k). \tag{15}$$

Substituting (12) into (13) results in the first-order condition, which characterizes k^S:

$$\bar{\lambda}\big(f(k^S)\big) = k^S + sf'(k^S) + \left|\frac{d\bar{\lambda}}{d\bar{F}}\right| f'(k^S)\, k^S. \tag{16}$$

The third term on the right-hand side captures the externalities coming from higher investment in economy-wide productivity $\bar{\lambda}$ by changing aggregate emissions $\bar{F}$. Its inclusion into the first-order condition ensures that the social optimum reflects the costs of emissions coming from additional investments (Xue, 2025).

To show how voluntary ESG disclosure leads to productivity decreases, Xue (2025) changes the model by allowing each firm i to choose its own voluntary disclosure τ_ξ^V. Under this condition, each firm will choose its own optimal ESG disclosure according to the logic from chapter 3.3, i.e., $\tau_\xi^V = \tau_\xi^*$. The investment k^V in this decentralized equilibrium results in over-pollution compared to the socially optimal k^S. Individual firms take other firms' investment choice and the equilibrium $\bar{\lambda}$ as given. Based on the previously shown condition, by which firms aim to maximize their valuation by aligning their ESG tradeoff with the investors' one, the firms will always choose τ_ξ^*. Additionally, we also know that, given (12), a firm anticipates an investment k^V from others and chooses its investment k_i so that $\bar{\lambda}\big(f(k^V)\big) = k_i + sf'(k_i)$ (Xue, 2025). Each firm in the decentralized equilibrium under voluntary disclosure picks k^V solving:

$$\bar{\lambda}\big(f(k^V)\big) = k^V + sf'(k^V). \tag{17}$$

Comparing (17) to (16) explains why over-polluting occurs in a model with voluntary disclosure. As we can see, the term measuring the externality, which captures the effects additional firm investment has on aggregate productivity $\left|\frac{d\bar{\lambda}}{d\bar{F}}\right| f'(k^S)\, k^S$, is missing. Firms overlook the negative impact, even though they have a positive incentive to choose emission-reducing investments. However, since they take the other firms' investments as given, they have an incentive to free ride on others' emission-cutting efforts. Hence, each firm aligns investments only according to their investors' preferences. That would mean that for "dirty" ("clean") investments, where $f(k) > 0$ ($f(k) < 0$), we would have an over-investment in emission-intensive projects (under-investment in emission-low projects), i.e., $k^V > k^S$ ($k^V < k^S$) (Xue, 2025). A regulator can, however, reduce the over-pollution by mandating a more precise ESG disclosure $\tau_\xi^M > \tau_\xi^*$. Assuming that he wants to ensure the social optimum k^S, he has to change the mandatory precision τ_ξ^M such that k^S satisfies an individual firm's first-order condition:

$$\bar{\lambda}(f(k^S)) = k^S + \frac{\alpha_F(\tau_\xi^M)}{\alpha_v(\tau_\xi^M)} f'(k^S). \tag{18}$$

Additionally, he needs to choose the mandatory precision τ_ξ^M such that the private cost of investment (left-hand side) aligns with its social cost (right-hand side):

$$\frac{\alpha_F(\tau_\xi^M)}{\alpha_v(\tau_\xi^M)} f'(k^S) = \left(s + \left|\frac{d\bar{\lambda}}{d\bar{F}}\right| k^S\right) * f'(k^S). \tag{19}$$

By mandating precision $\tau_\xi^M > \tau_\xi^*$, the regulator avoids the tragedy of the commons and implements the socially optimal k^S. Investors with a stronger taste for low emissions prefer a smaller k^S, i.e., less "dirty" investment. Mandating a higher precision than voluntarily chosen would therefore increase the stock valuations of all firms by lowering total emissions $\bar{F}$ and, thus, increasing aggregate productivity $\bar{\lambda}$ (Xue, 2025). Setting the private cost of an investment equal to its social cost implies that $\frac{\alpha_F}{\alpha_v} > s$. This inequality is necessary to ensure that firms internalize the social value of the investment. The firm alone would have no incentive to deviate from the private-value maximization, i.e. $\frac{\alpha_F}{\alpha_v} = s$. While $\frac{\alpha_F}{\alpha_v} > s$ results in a socially optimal productivity, it also leads to misallocation, as seen in Chapter 3.3.

3.5 Investor Heterogeneity and Representation in Prices

To incorporate investor heterogeneity into the model, Xue (2025) assumes that only a fraction of investors $\omega \in [0,1]$ share the ESG taste s, as discussed in the models before. These ESG-conscious investors care about both firms' financial profits and emissions. On the contrary, the remaining $1 - \omega$ profit-only investors are solely profit-motivated. Xue (2025) derives that a higher fraction of ESG-conscious investors ω lowers the valuation of firms with positive emissions F. This can be seen by looking into the price coefficient α_F, which depicts the sensitivity of price to reported emissions,

$$\alpha_F = \omega * \frac{\tau_\xi}{\tau_\xi + \tau_F} * R. \tag{20}$$

The representation factor $R \leq 1$ captures the under-representation of ESG-conscious investors' preferences in the stock price:

$$RF = \frac{var(v|\mathcal{F})}{\omega var(v|\mathcal{F}) + (1-\omega) var(v - F|\mathcal{F})}. \tag{21}$$

Xue (2025) argues that ESG-conscious investors face higher uncertainty than profit-only investors due to them caring about profit v and emissions F, i.e., $var(v - F|\mathcal{F}) > var(v|\mathcal{F})$. This results in ESG-conscious investors trading less aggressively than the profit-only investors. Thus, the ESG-conscious investors' preferences get underrepresented in the stock price. Meanwhile, the profit-only investors trade relatively aggressively compared to their ESG-conscious counterparts, resulting in their preferences being over-represented in price (Xue, 2025). Firms choose the optimal investment to maximize their expected price. Therefore, we know that firms choose their k according to

$$\lambda = k + \frac{\alpha_F}{\alpha_v}\left(\tau_\xi, \omega\right) * f'(k). \tag{22}$$

Both ESG-disclosure precision τ_ξ and the weight of ESG-conscious investors ω influence the ratio $\frac{\alpha_F}{\alpha_v}$, which is comparable to Chapter 3.3 with homogeneous investors, where Xue (2025) derives that $\frac{\alpha_F(\tau_\xi,s)}{\alpha_v(\tau_\xi,s)}$ are functions of ESG-disclosure τ_ξ and ESG taste s. To derive the optimal ESG disclosure τ_ξ^*, Xue (2025) starts by determining the first-best solution, where investors choose the firms' investments directly. As a first step, he determines the first-best investment k^{FB} for each group of investors analogous to the first-best benchmark in Chapter 3.2. By calculating the geometric average of the expected utility of both investor groups, he determines the weighted expected utility. Maximizing the weighted expected utility, leaves us with the optimal investment k^{FB} for all investors:

$$\lambda = k^{FB} + \omega f'(k^{FB}). \tag{23}$$

Equating this formula with (4), we can see that at the optimum $\omega = \frac{\alpha_F\left(\tau_\xi^*,\omega\right)}{\alpha_v\left(\tau_\xi^*,\omega\right)}$. Again, this equation is comparable to the results with homogeneous investors in Chapter 3.3., i.e., (12). The fraction of ESG-conscious investors ω has analogous effects on the price as s has in the homogeneous investors case. An increase in the fraction of ESG-conscious investors ω reduces the information that prices contain about firm profit. Therefore, α_v decreases while α_F increases (Xue, 2025). By shutting down the price-informativeness channel (no private signals on v, i.e. $\tau_\eta = 0$), Xue (2025) shows that the optimal disclosure satisfies that an increase in ESG-conscious fraction ω reduces the optimal disclosure precision τ_ξ^*, i.e. $\frac{d\tau_\xi^*}{d\omega} < 0$. A result similar to the homogeneous investors model in 3.3.

According to Xue (2025), the representation factor RF increases in ω. As the fraction of ESG-conscious investors ω increases, so does RF, which leads to ESG-conscious investors to be less underrepresented in the stock price. Because profit-only investors perceive less risk than ESG-conscious investors, they trade more aggressively. Since the representation factor RF also measures the ESG-conscious investors' trading intensity relative to the average trading intensity of the market, $RF \leq 1$. As ω increases the gap in trading intensity between ESG-conscious and profit-only investors closes reducing the under-representation of ESG-conscious investors (Xue, 2025). Therefore, the higher the fraction of ESG-conscious investors is, the less corrective ESG disclosure is needed to compensate these types of investors, leading to a less precise optimal disclosure τ_ξ^*. In a more general specification, Xue (2025) shows that, when ESG-conscious investors face less risk than profit-only ones, they can be even over-represented in the stock price. However, as long as prior beliefs about emissions are noisy, ESG-conscious investors will always face higher risk than risk-only investors.

3.6 ESG-Investing as a Social Goal

Xue (2025) also took an alternative view on his model by introducing a social planner that wants to move firm investment towards some socially optimal target, independently of the share of ESG-conscious investors, who share the planner's concern for externality. In this non-shareholder-centric view, the social planner aims to implement an investment k that balances its financial profit and the externality, in the form of emissions $F(k)$. The socially optimal investment is obtained from:

$$\lambda = k^* + f'(k^*). \tag{24}$$

k^* is in this case independent of the fraction of ESG-conscious investors ω. The firm's investment decisions can still be obtained from (22). Based on this approach, Xue (2025) concludes that, assuming away private signals, a social planner can only implement the socially optimal k^* by setting an ESG disclosure quality τ_ξ^* if the share of ESG-conscious investors is high enough, i.e. $\omega > \frac{\tau_R}{\tau_R + \tau_\upsilon}$. This stands as a contrast to the results of 3.5, where ESG disclosure policy can always be used to motivate firms to choose the efficient investment target. However, in this case, the efficient investment is defined from the shareholder's point of view.

Xue (2025) also remarks that this non-shareholder-centric view of his model depicts a firm's failure to internalize the externalities it generates with its investment. One can interpret it as if the firm's emissions cost society $F(k)$, while it only internalizes $\omega F(k)$. Furthermore, in this model, the social planner has to mandate a more precise ESG disclosure, if $\omega < 1$, because firms internalize only a fraction of the externalities their investment generates.

4. Analysis of the Result from Xue (2025)

4.1 Core Results of Xue's (2025) Model

In Xue's (2025) model, ESG tastes and heterogeneity affect asset prices, which influence investment decisions of firms, through an information channel. Profit-related preferences are reflected in stock prices through standard financial reporting, while ESG preferences affect efficient investment only if ESG disclosure is sufficiently precise. Xue (2025) shows, with different assumptions and mechanisms, when and why price and capital distortion can occur.

First, ESG tastes alone do not move firm investment if ESG performance is not observable. Due to the absence of ESG disclosure, a firm does not incorporate investors' ESG preferences in its investment decision, resulting in an investment at the pure profit optimum (Xue, 2025). With investors expecting this result, the stock price of the firm decreases, because investors' ESG preferences are not included in the firm's investment decision. As a result, ESG preferences are reflected in prices, but do not steer capital away from less "dirty" projects. The stronger the preferences, the lower the price; however, the investment stays constant (Xue, 2025).

Second, introducing noisy ESG disclosure allows the stock price to respond to realized emissions because the ESG signal enters investors' beliefs about ESG performance (Xue, 2025). This creates a channel through which firms can influence their valuation by adjusting investment. For a given level of ESG tastes, there exists a unique disclosure precision at which the price-maximizing firm chooses exactly the efficient investment level that ESG-concerned investors would prefer. Figure 1 illustrates this mechanism: when disclosure precision is low, investors cannot infer emissions accurately, so ESG preferences are reflected in prices but do not meaningfully affect investment incentives, leaving investment below the first-best level. As disclosure precision increases, the blue equilibrium-investment curve rises and intersects the red first-best line exactly once, showing that the central implication of the model is not simply that more ESG disclosure leads to more ESG investment, but that disclosure must be calibrated at the right precision to align market forces with efficient investment.

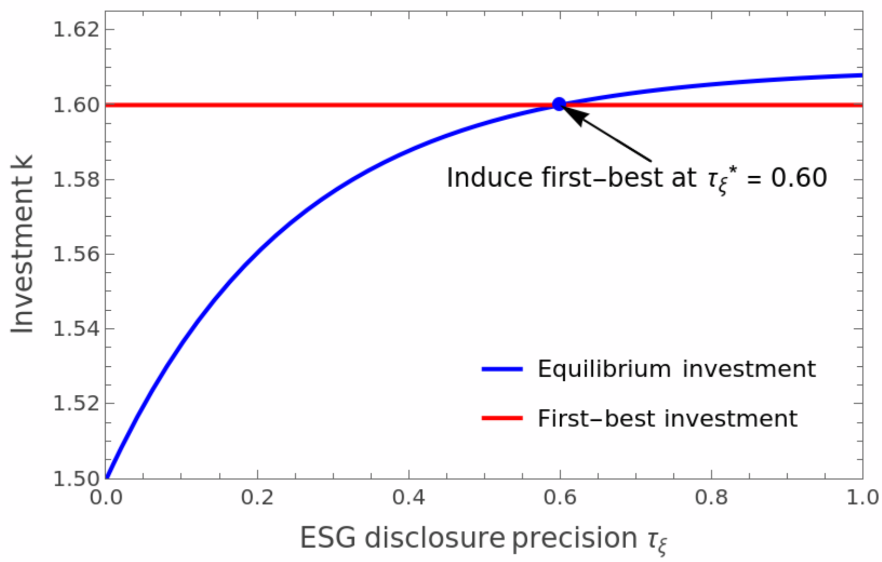

Figure 1: Investment effects of ESG disclosure precision given s = 0.25 (Own illustration based on Xue (2025)).

Figure 2 illustrates Xue's (2025) result that the optimal ESG disclosure precision must be adjusted when investor ESG tastes change. The solid blue 45-degree line shows the benchmark under optimal disclosure: for each level of investor ESG preference s, the firm's price-induced ESG tradeoff, $\frac{\alpha_F}{\alpha_V}$, exactly matches that preference. By contrast, the dashed red line fixes disclosure at the level that is optimal only for $s = 0.25$, that is, $\tau_\xi = 0.60$. At this point, both lines coincide, but for higher values of s the dashed line lies above the 45-degree line, implying that a disclosure rule calibrated for a lower ESG taste causes the market to overstate the ESG dimension of the project when tastes increase. The graph therefore shows that a fixed disclosure precision does not remain efficient as investor preferences change; instead, disclosure must be scaled back to keep the firm's price-maximizing incentives aligned with investors' underlying ESG preferences.

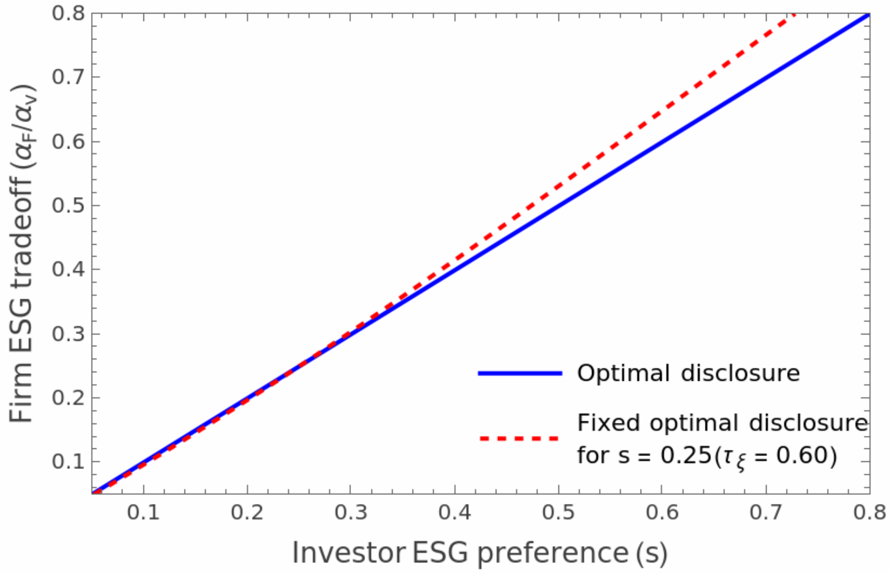

Figure 2: Firm ESG Tradeoff under Fixed and Optimal Disclosure (Own illustration based on Xue (2025)).

Third, in a large economy extension with externalities, voluntary disclosure based on the value-maximizing optimum does not lead to the social optimum, because firms do not incorporate their negative externalities on productivity in their investment decisions (Xue, 2025). The social optimum can be achieved by mandating a higher disclosure precision, resulting in firms overvaluing ESG performance compared to the value-maximizing optimum. However, in the social optimum, prices are distorted because they overrepresent investors' ESG preferences (Xue, 2025).

Lastly, dividing the investors into two groups: profit-driven and ESG-conscious investors, if ESG investing faces higher risk, ESG-conscious investors trade less aggressively compared to their profit-driven counterparts, which results in prices underrepresenting ESG preferences (Xue, 2025). A stronger mandatory ESG disclosure precision can again lead to the shareholder-centric optimum. However, if the fraction of ESG-conscious investors increases while the mandatory disclosure precision stays constant, prices overvalue ESG tastes. Therefore, the precision needs to be reduced (Xue, 2025). A social planner wanting to achieve the social optimum regardless of the share of ESG-conscious investors cannot achieve her goal by mandating an even stricter disclosure precision if the share of ESG-conscious investors is below a critical threshold (Xue, 2025).

4.2 Comparison to Standard Finance

4.2.1 Standard Asset Pricing and ESG Tastes

Standard finance provides the benchmark against which Xue's (2025) model can be compared. In standard finance, risk-averse investors construct their portfolios solely according to the mean-variance framework, seeking the highest expected returns for a given level of risk (or minimizing risk for a given expected return) (Markowitz, 1952). Thus, non-pecuniary tastes, such as tastes for ESG, do not enter investors' utility functions. Sharpe (1964) and Lintner (1965) extend this framework into their CAPM, an equilibrium asset-pricing model. Investor beliefs are homogeneous, which excludes heterogeneous effects on prices, and investors can borrow and lend at a common risk-free rate. In standard CAPM, the market portfolio of risky assets is mean-variance efficient, and expected returns are related to the market beta. Idiosyncratic risk is diversified away; thus, in the CAPM, asset prices only reflect systematic risk in equilibrium. Other asset-pricing models incorporate additional factors as explanatory variables for expected returns. Non-pecuniary preferences such as ESG tastes are usually not modelled as factors. Additionally, the EMH asserts that security prices fully reflect all available information, which implies that prices are unbiased estimates of fundamental values (i.e., cash-flows and risk exposure) given current information (Fama, 1970 & 1991). As a result, natural arbitrageurs should not be able to earn abnormally positive returns for a sustained period. Shiller (2003) documents how a series of anomalies (e.g., excess volatility, return predictability, bubbles) motivated the development of behavioral finance, a branch of finance that questions the assumptions of full rationality, homogeneous beliefs, and purely financial motivations of investors.

4.2.2 Xue (2025) and Standard Finance

Xue's (2025) model incorporates some standard finance assumptions: markets clear, investors are fully rational, and prices aggregate information about future payoffs. However, it also extends the framework by introducing investor heterogeneity and non-pecuniary preferences, which have an effect on investors' portfolio choices and subsequently on stock demand and asset prices. First, investors possess non-pecuniary ESG tastes, which enter their utility function in the form of a distaste for emissions. As a result, investors value the stock not solely based on profit and risk but also based on ESG performance. If firms do not meet investors' ESG preferences in their investment decisions, investors reduce their demand for the stock and thus the price (Xue, 2025). While the baseline model assumes homogeneous investors with identical ESG tastes, Xue (2025) extends his framework by incorporating investor heterogeneity as investors are grouped into profit-driven investors and investors with additional ESG preferences. This stands in contrast to standard finance, because ESG preferences can lead investors to choose portfolios that are not optimal purely in terms of risk and expected return. Holding less polluting stocks may lower expected return relative to otherwise similar brown stocks but still be optimal in terms of overall utility when the investors' disutility from emissions is considered. Thus, ESG tastes can move investors away from the classical mean-variance optimum.

Second, because ESG preferences alter investors' demand for stocks, prices are also influenced by them. In Xue's (2025) model, asset prices are not determined solely by systematic risk and other financial fundamentals, but also by the firm's ESG performance. His model shows precisely how ESG tastes reduce prices for "dirty" firms even when investors' ESG tastes do not influence firm investments. Extracting these findings from Xue's (2025) model setup, lower valuations for "dirty" firms imply higher expected returns given the same cash-flow risk, if an investor with standard mean-variance preferences who does not care about emissions holds these stocks.

Third, Xue (2025) shows that prices can misrepresent aggregate ESG preferences of investors when the information channel, in the form of ESG disclosure, is not optimally calibrated to their tastes and to the fraction of ESG-conscious investors. If ESG disclosure precision is sub-optimally chosen relative to the optimum, the price coefficients on financial and ESG signals may under- or over-weight emissions compared to what would be implied by investors' aggregate utility. Thus, the information integrated in prices does not fully mirror the ESG-profit trade-off of a representative ESG-conscious investor. While prices deviate in this case from the optimum, they still reflect all available information, which is consistent with the EMH.

4.2.3 ESG as Risk in Standard Finance

While this thesis focuses on ESG as a non-pecuniary preference, other literature interprets ESG as a source of financial risk, where ESG characteristics can affect expected returns by altering the distribution of future cash flows and exposure to risk. As Statman and Glushkov (2009) have shown, high-ESG portfolios can generate higher expected returns relative to comparable ESG-neutral portfolios. Furthermore, Friede et al. (2015) find mixed/ neutral evidence regarding ESG and the financial performance of portfolios. Lastly, Pedersen et al. (2021) show that their proxy for governance predicts positive returns in their sample. All three findings hint at a possibility where ESG characteristics proxy for underlying risk exposures.

a.) Financial Materialization of ESG issues

Freiberg et al. (2019) show in their five-stage framework how ESG issues may start as a financially immaterial issue for firms but develop subsequently into a financially material issue for entire industries as the issues move through the subsequent stages of their framework. While the ESG issue, represented by a misalignment between business interests and societal interests, is tolerated or not fully understood in the first stage of the framework (“Status-Quo”-stage), the misalignment becomes evident, when the gap between social and business interests widens through firms moving further away from what is socially acceptable or societal expectations shifting (“Catalyst”-stage). As the misalignment becomes publicly visible, stakeholders start to react (e.g., campaigns, boycotts, lawsuits, etc.). These reactions may have first effects on the valuation of specific firms (e.g., higher perceived risk, negative stock reactions) (“Stakeholder-Reaction”-stage) (Freiberg et al., 2019). Firms try to respond to the criticisms by introducing company-specific self-regulation. Furthermore, the whole industry may try to push for self-regulation as a tool to minimize the cost of reaction and to avoid policy regulations. At this point, possible policy regulations may start to materialize financially, as a risk on future expected returns, for the whole industry, when firms fail to reduce misalignment through self-correction (“Company-and-Industry-Reaction”-stage) (Freiberg et al., 2019). At the end of the framework, the ESG issue is more likely to financially materialize for the whole industry when regulations are passed that force firms and investors to include firms’ performance on the ESG issue. Besides, within-industry innovation can also decrease the misalignment by offering differentiated products/ services (“Regulation-and-Innovation”-stage). As ESG issues start as an externality in the “Status-Quo” stage, they become a priced risk factor in a standard finance sense by altering cash flows and downside risk if firms fail to address the misalignment (Freiberg et al., 2019).

b.) ESG Characteristics as an Additional Risk Indicator

Barker (2025) further supports the ESG-as-risk argument by offering a conceptual framework for corporate sustainability reporting. He distinguishes “sustainability-related financial information”, which explains how ESG issues affect a firm’s future cash flows and risk profile, and is aimed at investors, from impact reporting, which targets stakeholders and policymakers primarily. Barker (2025) argues that ESG characteristics become financially material when they affect the firm's dependencies on natural or social capital and thus become valuation-relevant as ESG characteristics may change the distribution of expected cash-flows or the cost of capital. Barker (2025) further argues that even with an investor-focused corporate sustainability reporting, externalities persist, and markets will not deliver full sustainability.

Empirical evidence for the ESG-as-risk theory comes from Garel et al. (2024), where the authors examine whether a firm's impact on biodiversity is priced in stock returns. For that, they built a firm-level Corporate Biodiversity Footprint (CBF) that measures how much a firm's activities reduce biodiversity. In their sample, they could not find a relation between CBF and returns in the period from 2019-2022, but after two biodiversity policy events took place, firms with larger CBF started to earn higher subsequent returns (Garel et al., 2024). Event studies around the dates when the regulations were passed show that larger-CBF firms dropped in value and then earned higher returns afterwards. These results indicate that investors suddenly demanded a higher risk premium for their biodiversity exposure. The "biodiversity footprint premium" is stronger in countries with weak biodiversity protection, which implies that investors expect higher expected returns because the risk of future regulation catching up to countries with stronger biodiversity protection is increased (Garel et al., 2024).

c.) Interim Summary and Link to Xue (2025)

The ESG-as-a-risk literature states some interesting findings, which may explain the unclear relationship between ESG and expected returns. An ESG issue may be financially immaterial or material depending on whether the issue is publicly criticized by stakeholders and if the risk of new regulations is uncertain (Freiberg et al., 2019). If the issue becomes financially material, investor-centric sustainability reporting or accurate ESG scores can reveal existing or emerging risks. In that sense, ESG would fall again under the classic mean-variance framework as a risk factor. A clear distinction between investors using ESG as a taste or as a risk may not be fully possible. However, if evidence finds negative ESG-return-relations, one can argue that the ESG-as-a-taste argument is more likely to explain investors holding ESG assets, consistent with models where investors sacrifice returns for taste (e.g., Heinkel et al., 2001; Pastor et al., 2021). Evidence finding positive ESG-return-relations is consistent with ESG capturing risk, so both investor taste-driven and purely financial investors may hold ESG assets.

In Xue's (2025) model, ESG is explicitly defined as a distaste for emissions. Investors do not consider ESG for financial gains, but to increase their total utility. In his model, "cleaner" firms receive higher valuations when ESG tastes are strong, while more polluting firms trade at a discount and thus face a higher cost of capital. This mechanism is closely related to other equilibrium models in which ESG as investor taste lowers the return on assets of green firms and raises the cost of capital for brown firms (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021). Although Xue (2025) explicitly models ESG as a non-pecuniary investor taste, his framework can be linked verbally to the ESG-as-risk literature. A stronger distaste for emissions may not only reflect moral or social preferences, but also investors' belief that environmental externalities are more likely to materialize into economically relevant costs, such as regulation, litigation, reputational losses, or productivity-reducing climate damage. In this sense, the ESG-taste parameter s in Xue's (2025) model may be interpreted as partly capturing the perceived probability of such externalities. In this interpretation, ESG disclosure would function as an investor-focused corporate sustainability reporting, in the sense of Baker (2025). The effects of ESG disclosure precision on investor demand, firm valuation, investments and capital allocation would remain unchanged. The same applies for effects emerging from changes in the parameter s.

4.3 Comparison with other ESG Models

4.3.1 Effects of ESG as a Taste on Asset Prices

Many ESG models depart from standard finance by allowing investors to care about non-pecuniary preferences in addition to risk and return. Across these models, ESG preferences influence equilibrium prices, expected returns, and, implicitly or explicitly, firms' cost of capital. However, the underlying mechanisms differ. Some models focus on exclusion and reduced risk sharing, while others emphasize equilibrium pricing, ESG-related uncertainty, or the informational content of prices. In Heinkel et al.'s (2001) model, green investors with ESG tastes avoid investing in firms with polluting technologies. This limits the number of investors holding their stock and thereby reduces risk-sharing opportunities. In equilibrium, the remaining neutral investors must hold more of the polluting firm; therefore, they demand higher expected returns as compensation. Consequently, this increases the cost of capital and reduces the stock price of polluting firms. Other ESG equilibrium models focus more strongly on how ESG preferences enter equilibrium pricing and expected returns. In Pastor et al.'s (2021) model, investors with stronger-than-average ESG tastes overweight green assets and underweight brown ones. As a result, green assets are bid up by investors with strong ESG preferences and can earn lower expected returns. Similarly, Pedersen et al. (2021) show that investors with ESG tastes build portfolios along an ESG-efficient frontier, where stronger ESG preferences tilt portfolios toward ESG at the expense of financial performance. In their model, ESG effects on expected returns depend on whether ESG predicts future profits and on which investor type dominates the market. Avramov et al. (2022) add that ESG-related uncertainty can counteract the valuation effects of green preferences, because uncertainty about ESG characteristics raises perceived risk and may increase required returns and the cost of capital of green firms. Goldstein et al. (2022), in turn, focus on how ESG preferences affect the informational content of prices. Both ESG investors and traditional mean-variance optimizing investors influence prices through their private signals and trading. The informational content of prices depends on which group dominates the market. As the share of green investors increases, prices load more information about ESG, becoming more informative for green investors and less informative for traditional investors. This also has implications for firms' cost of capital because prices reflect the average information risk faced by investors.

Xue's (2025) model shares similarities with these approaches. His model also depicts investors as risk-averse and rational beings who incorporate ESG in their utility, and prices reflect ESG concerns because investors reduce their demand for a firm's stock if they believe that the firm does not consider ESG characteristics sufficiently in its investment decision. However, Xue (2025) does not explicitly model how lower valuation increases the firm's cost of capital through reduced risk sharing, as in Heinkel et al. (2001), nor does he focus directly on how ESG tastes affect expected returns, as in Pastor et al. (2021), Pedersen et al. (2021), or Avramov et al. (2022). Xue's (2025) novelty lies elsewhere. While the other ESG equilibrium models mainly show how ESG preferences affect equilibrium prices, expected returns, and firms' cost of capital, Xue (2025) uses ESG disclosure precision as a key variable to analyze when ESG preferences are actually transmitted into firm investment. In this sense, his main contribution lies less in ESG taste itself than in the role of disclosure, information, and the conditions under which ESG preferences influence real decisions.

4.3.2 Effects on Firm Investment

While previously mentioned models show how ESG preferences can affect expected returns, cost of capital, and stock prices, only Heinkel et al. (2001) show explicitly how ESG tastes can change firm investment. As mentioned, green investors excluding brown firms increases the cost of capital and reduces the share price for brown firms. If the differential between the firm's share price when polluting and the firm's share price when transforming is bigger than the cost of transforming, the polluting firm will reform itself by investing in clean technologies. For this effect to occur, a minimum fraction of the economies' capital needs to be supplied by green investors or else the reforming mechanism will not apply even when the cost of capital increases, and share prices fall (Heinkel et al., 2001).

The other models (e.g., Pastor et al., 2021; Pedersen et al., 2021; Goldstein et al., 2022; Avramov et al., 2022) do not explicitly model how ESG-driven pricing affects firms' real investment decisions. All of them focus more on how ESG preferences affect asset prices, expected returns, and some of them explicitly mention the effects on the cost of capital. While the effect on the cost of capital implies an impact on the external capital allocation, it does not explicitly impact firm investment. Pastor et al. (2021) and Pedersen et al. (2021) focus more on how ESG preferences can be incorporated in investor portfolio choices and equilibrium pricing. Avramov et al. (2022) also focus on equilibrium pricing, but more on the effect ESG score uncertainty has on them. Meanwhile, Goldstein et al. (2022) show how ESG preferences can change the informational content in prices; they focus more on asset prices and information aggregation.

In Xue's (2025) model, on the other hand, ESG tastes can affect firm investments through ESG disclosure as a channel. In his model, firms explicitly choose investments to maximize their stock price. If no ESG disclosure exists, ESG tastes lower the stock price, however, they do not affect firm investment. If ESG disclosure exists, ESG tastes also affect firm investment, because the ESG disclosure allows the stock price to react to ESG preferences in a way that reflects investor preferences. There exists an optimal disclosure precision for which a firm's investment aligns with investor preferences. This makes Xue (2025) important as it shows how ESG tastes can affect firm-internal investments through prices.

4.3.3 Xue's (2025) Contribution: Disclosure, Information, and Heterogeneity

Xue (2025) introduces ESG disclosure as a new channel through which ESG tastes can impact firms' investment decisions. If disclosure does not exist in his model, ESG tastes only influence prices, but do not change investment decisions. Therefore, disclosure is crucial in Xue's (2025) model for allowing ESG preferences to enter the price, thereby enabling stock prices to transmit ESG preferences into firm investment decisions. While other models mainly focus on equilibrium prices, expected returns, and cost of capital effects, Xue (2025) adds ESG disclosure as a public information channel through which the firm's ESG performance becomes visible to investors. Based on the disclosure precision investors' preferences and beliefs influence the price. The stronger the disclosure precision, the stronger prices react to the firm's ESG performance. Managers aiming to maximize firm valuation incorporate the new beliefs within their investment decisions, tilting investment toward a lower-emissions choice. Stronger ESG disclosure precision increases the congruence between investor preferences and firm investments when ESG preferences are underrepresented in prices; however, when the optimal precision is surpassed, stronger precision reduces the congruence again, because prices now overrepresent ESG preferences (Xue, 2025). In later extensions, Xue (2025) introduces investor heterogeneity by dividing investors into two groups: ESG-conscious and profit-driven. Because ESG-conscious investors aim to maximize utility by fulfilling two preferences (profitability and ESG performance), they face higher trading risk since all signals are distorted by some noise. Therefore, they trade less aggressively compared to profit-driven investors, which results in their preferences (especially towards ESG) being underrepresented in prices (Xue, 2025).

The representation of ESG preferences in prices depends on the fraction of ESG-conscious investors, risk exposure, and the disclosure precision. An increase in ESG disclosure precision allows for a stronger representation of ESG preferences in prices for a given fraction of ESG-conscious investors. The optimal precision for a given fraction of ESG-conscious investors can eliminate the representation problem under the conditions specified in the model. However, an increase in ESG-conscious investors would result in an overrepresentation of ESG preferences in prices, for a given disclosure precision. Therefore, the precision needs to be reduced to erase the problem. Xue's (2025) mechanism explaining how heterogeneous beliefs can be misrepresented in prices is closely related to Goldstein et al.'s (2022) work. Both models show that the informational content of prices depends on investor composition. However, Goldstein et al. (2022) derive this from the interaction of heterogeneous private information and trading, whereas Xue (2025) makes public ESG disclosure precision the key mechanism determining whether ESG preferences are represented in prices. In Goldstein et al.'s (2022) model, the informational content loaded in prices depends on which group of investors dominates the market.

In conclusion, Xue (2025) shares with other ESG models the idea that ESG preferences affect prices in equilibrium. However, compared to the previously covered models, Xue is distinctive because he explicitly models firm investment choices, makes ESG disclosure precision central, and shows how prices can correctly or incorrectly transmit ESG preferences into real decisions. This makes Xue (2025) suitable for analyzing firm-internal capital allocation, possible misallocation, and productivity effects. The next subchapter, therefore, examines how the price, disclosure, and investment mechanisms identified by Xue (2025) can affect capital allocation efficiency and productivity.

4.4 Effects on Capital Allocation and Productivity

Stock prices can affect capital allocation by reflecting information for both investors and managers. The informational content of prices can guide investors to make better investment decisions, or it can be used by investors as a disciplinary tool for management performance (Dow & Gorton, 1997). Both mechanisms can increase the efficient use of capital within a firm and firm-level productivity. On an economic level, misallocation of capital can lead to lower aggregate productivity. Xue (2025) adds to the literature the possibility of capital misallocation through managers making investment decisions based on prices, which may not reflect aggregate ESG preferences accordingly.

4.4.1 Within-firm Capital Allocation and Productivity

Chen et al. (2007) show in their model how the stock price of a firm can influence a firm's investment decision through its informational content. Managers use the private information embedded in stock prices when making investment decisions to maximize the expected value of the firm. If prices contain more private information, which is aggregated through the trading activities of market participants, the investments will be more sensitive to stock prices. This indicates that managers use the private information contained in prices to optimize their investment decisions (Chen et al., 2007). They find evidence for a significant positive relation between private information and a firm's ex post performance, which implies that managers use stock prices to learn new private information for their investment decisions (Chen et al., 2007). The additional information may allow for better investment decisions, allocating firm capital more efficiently and thus increasing firm productivity. Chen et al. (2007) also show an equilibrium in their model, where prices can be distorted or manipulated, for which they gain suboptimal investment decisions.

The informational content of prices does not stay constant over time. Bai et al. (2016) find evidence that price informativeness has increased at medium and long horizons. The increase is concentrated among firms with greater institutional ownership and share turnover, firms with options trading, and growth firms (Bai et al., 2016). In summary, firms in which independent information production by market participants is especially valuable. Because investment decisions take years until they are implemented, and even longer until they materialize in profitability, an increase in price informativeness at longer horizons is consistent with a more efficient allocation of firm capital (Bai et al., 2016).

Bennet et al. (2020) further support the hypothesis that more informative prices increase firm-level productivity. They show that firms with more informative stock prices are associated with higher operational efficiency (higher revenues, lower operating costs, and lower labor expenses). However, they attribute the effect mostly to the disciplinary channel of prices and less to the investment channel. They argue that lower price informativeness results in boards relying less on market valuation when evaluating CEOs, which further leads to lower productivity. Further, the effect of price informativeness on productivity is more concentrated on firms, where market information can be more easily incorporated within the firm, or where firms are more exposed to market pressure (Bennet et al., 2020).

In conclusion, the literature implies that within firms, more informative and better-functioning prices improve capital allocation and productivity through better decision-making of managers.

4.4.2 External Misallocation and Aggregate Productivity

The misallocation literature reviewed in Chapter 2.1.5 shows that aggregate productivity is not determined only by how efficiently individual firms produce, but also by how effectively capital and labor are allocated across heterogeneous producers. Syverson (2011) is useful in this context because he places productivity differences into a broader framework and emphasizes that external allocation mechanisms, such as distortions, regulation, and input-market flexibility, are important determinants of aggregate productivity.

Restuccia and Rogerson (2008) provide the basic theoretical mechanism behind this argument. In their framework, firm-specific distortions in the form of taxes or subsidies on capital and labor alter the effective prices faced by producers. As a result, resources are no longer allocated according to productivity, so highly productive firms remain too small while less productive firms employ too many inputs. The key implication is that aggregate TFP can fall substantially even when aggregate factor supplies remain unchanged, because the loss comes from inefficient reallocation rather than from lower technology.

Hsieh and Klenow (2009) operationalize this mechanism empirically. Using plant-level manufacturing data, they show that the dispersion of revenue productivity within industries is much larger in China and India than in the United States, which they interpret as evidence of stronger distortions and greater misallocation. Their counterfactual exercise suggests that manufacturing TFP could rise by 30–50 percent in China and 40–60 percent in India if resources were reallocated more efficiently. Syverson (2011) explicitly identifies this study as a key contribution to the literature on allocative efficiency and productivity dispersion.

A further implication of this literature is that the functioning of reallocation mechanisms matters in its own right. Syverson (2011) therefore also points to Maksimovic and Phillips (2001), who show that plant productivity tends to rise after ownership changes, suggesting that asset markets can help shift productive assets toward more efficient users. This reinforces the broader argument that productivity gains do not arise only from improving firms internally, but also from enabling capital to move toward firms that can use it more efficiently.

Recent evidence supports this view. The IMF (2024), applying a Hsieh-Klenow type framework to Baltic firm-level data, finds that resource misallocation has reduced TFP growth in all three Baltic economies. The report stresses that within-sector allocative efficiency is particularly important because the exit of inefficient firms releases resources that can then be reallocated toward more productive firms.

Taken together, these studies imply that distortions affect aggregate productivity not only because they change firms' individual incentives, but because they weaken the economy's capacity to direct capital and labor toward their most productive uses. This point is central for the comparison with Xue (2025), because it clarifies why any mechanism that changes capital allocation can also have consequences for aggregate productivity through the allocative-efficiency channel.

4.4.3 Xue (2025) and ESG-related Misallocation

a.) Effects of Xue's (2025) Model on within-firm Capital Allocation and Productivity

In contrast to learning-from-prices models (e.g., Bai et al., 2016), Xue's (2025) model assumes that managers know how the equilibrium price loads on profit and ESG performance before the price is realized. Based on this knowledge, managers choose an investment to maximize the expected stock price. Therefore, prices do not provide any additional information that would change investment decisions (Xue, 2025).

In the No-Disclosure-part of the model, ESG tastes change the price, but have no effect on the investment. The manager, therefore, chooses the profit-optimal investment. In Xue's (2025) model, higher investment simultaneously raises profits and emissions. Considering that Xue (2025) does not explicitly define a cost function for investments, the profit-maximizing investment choice of a firm can be interpreted as the most privately efficient use of firm-internal capital and the most productive investment choice from a purely financial perspective in Xue's (2025) one-firm baseline model without externalities. However, the choice is welfare inefficient compared to the first-best benchmark (4), because investors' ESG preferences are not reflected in the firm's investment decision.

Even though managers do not explicitly learn from information contained in prices, price informativeness is still important in Xue's (2025) model for determining firm investment. When ESG disclosure exists, the firm's ESG performance becomes observable to investors through a public disclosure signal. Investors with ESG tastes use this information to adjust their demand, which further adjusts the stock price. How strongly the prices react to investors' ESG preferences depends on the ESG disclosure precision. If the precision is suboptimal, the prices place too much or too little weight on ESG performance relative to investor preferences. Consequently, an optimal precision will result in investments aligning with investors' ESG-profit trade-off (Xue, 2025). At the optimal disclosure precision, the firm's price-maximizing investment coincides with the investment that maximizes investor utility in Xue's (2025) one-firm baseline model without externalities. However, from a purely financial perspective, However, from a purely financial perspective, this investment is less profit-maximizing than the benchmark without ESG considerations, because better ESG performance is achieved at the cost of lower profits.

b.) Effects of Xue's (2025) Model on Economy-Level Capital Allocation and Productivity

In his large-economy extension, Xue (2025) models emissions as an environmental externality that reduces economy-wide productivity. If firms choose their ESG disclosure precision solely based on the investors' ESG preferences, they aim to maximize shareholder value, and thereby choose the privately optimal disclosure precision (16). However, their decision produces more emissions compared to the first-best benchmark (15), leading to a less productive economy. When firms solve their own investment problem, they do not fully internalize the productivity cost of emissions, whereas in the first-best benchmark, firms fully internalize them. As a result, firms excessively invest in "dirty" projects from a social point of view (Xue, 2025). Achieving the first-best benchmark (15) is possible when regulators set the ESG disclosure precision higher than firms would voluntarily. By that, prices overrepresent ESG preferences, which leads to investors moving investments further towards ESG performance. This would again result in the social optimum, because firms now internalize the productivity cost of emissions, resulting in the maximum amount of aggregate productivity (Xue, 2025). In terms of investor utility, however, the precision leading to the welfare optimum tilts investments further towards ESG, thereby moving investments away from aggregate investor preferences. Contrary to, e.g., Pastor et al. (2021), investors do not care for the aggregate social impact of their investments. From the perspective of private investor utility alone, the disclosure precision that implements the social optimum may exceed the privately preferred level.

If we create a separate hypothetical financial benchmark by excluding the negative externalities from Xue's (2025) large-economy extension, and using mechanisms from Heinkel et al. (2001), Syverson (2011), and Restuccia and Rogerson (2008), we can draw implications on the effects of ESG preferences on capital allocation and aggregate productivity. First, the private investor's optimal solution diverts firm-level capital away from the most financially productive investment. Aggregated at the economy level, this would imply that ESG preferences move capital allocation away from the purely profit-maximizing benchmark. From a purely financial perspective, this can be interpreted as a less efficient allocation of capital, although without the externality, this does not directly imply lower aggregate TFP in Xue's model. Second, although Xue (2025) does not model the cost-of-capital-channel explicitly, one can, by analogy with Heinkel et al. (2001), interpret ESG preferences as reducing capital efficiency and aggregate productivity through this channel. In Xue's (2025) model, ESG preferences influence firm valuation. Now, applying Heinkel et al.'s (2001) logic of a higher cost of capital due to investors with ESG tastes avoiding polluting firms, one can interpret that the lower prices for "dirty" firms may result in a higher cost of capital for these firms. Next, following Syverson's (2011) findings, one can interpret this higher cost of capital for "dirty" firms as a wedge that may affect firm size and survivability, and thereby lower aggregate productivity. Additionally, Restuccia and Rogerson (2008) show how idiosyncratic distortions that change the effective price of capital can lead to a misallocation of capital and reduce TFP. Since a higher cost of capital increases the effective price of capital only for "dirty" firms, one can also interpret that ESG preferences may lead to a misallocation of capital and reduced TFP.

Xue's (2025) model with negative externalities reaches the most productive outcome when mandatory ESG disclosure places more weight on emissions than firms would choose voluntarily, thereby inducing firms to internalize the productivity cost of their emissions. However, from the perspective of standard finance and the macro misallocation literature, shifting capital away from the purely profitability-maximizing benchmark may also create allocative distortions if ESG preferences are not aligned with underlying productivity. This leads to a core question in the debate between environmental protection vs. economic growth:

Which effect reduces aggregate productivity more strongly, possible misallocation of capital due to ESG preferences, or higher emissions due to (efficient) capital allocation based solely on profits?

5. Normative Discussion

5.1 Productivity Losses: Misallocation vs. Emissions

This subsection discusses a central trade-off resulting from the previous analysis. On the one hand, standard finance and the macroeconomic misallocation literature suggest that productivity decreases when capital is moved away from the most financially productive firms and projects. On the other hand, Xue's (2025) large-economy extension with negative externalities shows that capital allocation based only on profits can be harmful to aggregate productivity and thus to social welfare. The central question is therefore whether ESG-based capital allocation that deviates from the profit-maximizing benchmark corrects a larger productivity loss caused by excessive emissions or instead creates a new misallocation that outweighs the environmental gain.

From the perspective of standard finance and the macroeconomic misallocation literature, capital allocation is financially efficient when capital flows to the firms and sectors with the strongest expected returns and growth opportunities. Wurgler (2000) shows that more developed financial markets increase investment more strongly in growing industries and decrease investment more strongly in declining industries than less financially developed markets, implying that financial markets are important for an efficient capital allocation. He further identifies more firm-specific information in stock prices as one of three mechanisms associated with better capital allocation, a finding consistent with literature showing a positive relationship between price informativeness and firm productivity (e.g., Chen et al., 2007). The misallocation literature shows how distortions resulting in capital shifting away from the financially most productive use can have negative effects on aggregate productivity. Restuccia and Rogerson (2008) analyze theoretically how distortions creating heterogeneous factor and output prices for individual producers can reduce TFP by 30 – 50%, even when aggregate capital, labor, and prices are unchanged. Hsieh and Klenow's (2009) analysis of industry-internal TFPR dispersion in China, India, and the United States finds evidence for Restuccia and Rogerson's (2008) mechanism. They document larger dispersion in TFPR within industries in China and India compared to the U.S. By reallocating capital and labor across plants within each industry in China and India to equalize TFPR to the U.S. benchmark, Hsieh and Klenow (2009) calculate possible TFP gains of +30 – 50% for China and +40 – 60% for India. Syverson's (2011) survey, examining productivity gaps between firms, emphasizes that aggregate productivity does not only depend on firms' technologies but also on how inputs are allocated across heterogeneous firms. He highlights that distortions (regulation, laws, subsidies, etc.) affecting firm size, selection, and reallocation can lower aggregate productivity even if technologies themselves are similar.

Taken together, from a purely financial productivity perspective, the ESG preferences may be interpreted as a distortion if they move capital away from the most profitable and productive firms. This is especially relevant when ESG preferences affect stock prices and the cost of capital of firms. By analogy with Heinkel et al. (2001), a lower valuation of “dirty” firms due to investors with ESG preferences avoiding them can be interpreted as a higher cost of capital for these firms. This, in turn, can increase the effective price of capital and reduce aggregate productivity according to Restuccia and Rogerson (2008). Further, if ESG tastes affect firm size, investment, and survivability, Syverson (2011) suggests that aggregate productivity may fall. In conclusion, ESG-based capital allocation may look inefficient relative to the profit-driven benchmark. However, Xue’s (2025) large-economy extension with externalities shows that this benchmark is incomplete. In his model, emissions resulting from firm investments are a negative externality that reduces economy-wide productivity. If firms choose disclosure precision voluntarily with the goal of maximizing shareholder value, they choose the privately optimal disclosure precision, which does not fully internalize the productivity costs of emissions. Thereby, they produce more emissions than in the first-best benchmark, the social optimum. Mandatory disclosure with a higher disclosure precision can correct this by making prices place more weight on emissions, rather than firms would voluntarily choose. This leads to firms internalizing the productivity cost of their emissions, moving the economy more towards the socially most productive allocation. The key implication is that profit-maximizing capital allocation is not necessarily the most-productive capital allocation once environmental externalities are considered. Support for Xue’s (2025) assumption that aggregate emissions reduce economy-wide productivity comes from literature examining the effects of global warming on the economy. Burke et al. (2015) show that economic productivity peaks at an annual average temperature of 13°C and declines sharply at higher temperatures. Dell et al. (2012) also find evidence that higher temperatures reduce economic growth and industrial output.

This leads to a central conflict in the debate about the effects of ESG tastes on productivity. According to standard finance, stronger ESG preferences may function as a distortion in the capital allocation, which may hinder capital from allocating towards the most profitable alternatives. From the viewpoint of Xue’s (2025) large-economy model and climate-productivity literature, however, the same ESG-based capital distortion may correct a larger distortion that arises when firms ignore the productivity damage caused by aggregate emissions. Hence, the normative question of this thesis is not whether ESG capital allocation deviates from the profit-driven benchmark, but whether the productivity losses from possible misallocation are smaller or larger than the productivity loss generated by excessive emissions. An interpretation of the previous results suggests that both risks are real. While the misallocation literature warns against wedges that prevent capital from flowing toward the most productive firms/projects, literature examining the relationship between the effects of global warming on productivity and Xue's (2025) large extension model shows that a profit-only benchmark that ignores environmental damage may also have a negative effect on productivity.

5.2 Social Welfare as the Economic Goal

The previous subsection discussed the trade-off between possible productivity losses from possible capital misallocation due to investors with ESG tastes and productivity losses caused by excessive emissions. This subsection now turns to the normative question of which economic objective should be used as the relevant benchmark.

Standard finance usually follows a shareholder-centric view, in which the sole goal of firms should be shareholder value maximization. Because investors are defined as rational mean-variance optimizing beings, the central benchmark for efficient capital allocation is achieved through profit maximization. However, the previous analysis has shown that the standard-finance benchmark is incomplete if investors derive non-pecuniary utility from ESG characteristics or if emissions create negative externalities that reduce aggregate productivity. As a result, the normative question switches from how capital should be allocated most profitably to whose welfare should be maximized. Friedman (1970) famously stated that "the social responsibility of business is to increase its profits". Consistently to his words, standard finance interprets a capital allocation as efficient, if investments maximize the expected profits and thereby firm value. From this viewpoint, ESG preferences may appear as a deviation from the standard finance benchmark, because capital is no longer allocated solely based on risk-adjusted return and profitability. Support for this perspective comes from the misallocation literature, which defines capital distortions as wedges that move capital away from its financially most productive use. According to this viewpoint, stronger ESG tastes in investors may be problematic if their weight in asset prices shifts investment away from firm-value-maximizing projects.

The ESG equilibrium literature broadens the general objective standing behind the shareholder value principle by implying that investors may rationally also value assets' ESG characteristics next to their financial performance. In these models, (e.g. Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021) investors possess a broader utility function which incorporates ESG characteristics as a source for utility or disutility. Consequently, firms aiming to maximize shareholder value no longer focus on standard pure profit maximization, but the maximization of private investor utility by incorporating investors' ESG tastes into their decisions. In this framework, an investment with lower profitability compared to the standard finance benchmark can be optimal if the higher utility gained from a better ESG performance compensates for the lower returns. Therefore, a capital allocation based solely on profitability is too narrow because it ignores a portion of investors' utility function.

Xue's (2025) one-firm baseline model also depicts this broader shareholder-centric framework. In his baseline model, investors derive utility from profits as well as from the ESG performance of a firm's investment. In the first-best benchmark, the private investor optimum is achieved when the firm invests in congruence with the investors' profit-ESG trade-off and not according to profit maximization. In his model with information friction, the private investor optimum can only be achieved if ESG disclosure precision is chosen such that the firm aiming to maximize its price mirrors investors' profit-ESG trade-off in its investment. Normatively, this means that if the pursued goal of a firm is to maximize broader investor utility, then an investment with lower profits but better ESG performance can be efficient. However, Xue's (2025) large-economy extension with negative externalities shows that even private investor utility may still be an incomplete normative benchmark. In his extension, emissions function as a negative externality, which reduces economy-wide productivity. Because investors only get disutility from the emissions of the firms they hold, they do not internalize the productivity cost of aggregated emissions. As a result, the privately preferred ESG disclosure precision remains below the level required to achieve the social optimum benchmark. A regulator can achieve the social optimum by setting a disclosure precision above the privately preferred level, thereby making firms internalize the productivity cost of emissions. Consequently, this implies that prices need to place even more weight on emissions than investors would voluntarily choose, if one wants to achieve the socially optimal allocation. The social optimum from Xue's (2025) large-economy extension therefore deviates from both the profit-maximizing benchmark and the private investor-utility benchmark.

Xue's (2025) finding that a privately preferred ESG disclosure precision, which maximizes private investor utility, will not necessarily lead to the social optimum are consistent with

Barker's (2025) framework of corporate sustainability reporting. Barker (2025) argues that investor-focused sustainability-related financial disclosure only leads to a partial internalization of all environmental externalities. Therefore, investor-focused sustainability reporting may not be sufficient to implement the social optimum. Further, Freiberg et al. (2025) show in their framework that ESG issues only become financially material when stakeholder, regulatory, and social pressure are big enough. Both papers show that market-based preferences and private utility do not fully capture the broader social effects of corporate behavior. Once ESG issues start to affect third parties, a society-oriented perspective becomes economically relevant.

The normatively central implication of this thesis is that three different benchmarks exist. First, the standard profit-maximizing benchmark, which focuses only on profit-driven shareholder maximization and financially efficient allocation. Second, the private investor-utility benchmark, which includes non-pecuniary ESG preferences in the investors' utility function. It shows how investor tastes may justify a capital allocation deviating from the pure profit benchmark. Third, the social-welfare benchmark, which additionally internalizes the external effects of emissions on the economy. The previous chapters suggest that the first benchmark is too narrow, because it ignores non-pecuniary investor preferences as well as externalities. Although the second benchmark is broader because it incorporates investor tastes, it still does not include possible negative externalities. Therefore, when environmental externalities are included, social welfare maximization becomes the most appropriate economic goal.

This does not mean that every ESG-oriented capital allocation is socially desirable. It rather implies that the normative evaluation of ESG investing depends on whether it moves the economy closer to or further away from the social optimum. If ESG preferences create wedges that move capital away from financially productive firms without reducing environmental externalities, they may reduce social welfare (e.g., Heinkel et al. (2001) show how ESG preferences can only result in a higher cost of capital for "dirty" firms without incentivizing any reformation if the capital controlled by ESG investors is below a threshold). However, if ESG preferences and ESG disclosure help to internalize the broader productivity costs of emissions, then deviations from the profit-maximizing benchmark can be justified.

6. Limitations

This thesis is subject to several limitations. A first set of limitations concerns the theoretical framework. First, it relies strongly on Xue's (2025) model as the central analytical framework. Therefore, the conclusions of this thesis are based on his specific assumptions regarding investor utility, disclosure precision, management behavior, and the role of emissions.

Second, the thesis compares Xue's (2025) model with other ESG models to contextualize his findings in the broader ESG-finance literature; however, the comparison remains limited because the other ESG models emphasize different mechanisms, such as exclusion (Heinkel et al., 2001), ESG risk (Barker, 2025; Freiberg et al., 2019; Garel et al., 2024), or rating uncertainty (Avramov et al., 2022), which may lead to partly different and even contradicting implications.

Third, a substantial part of the ESG literature, as well as Xue (2025), treats ESG primarily as a non-pecuniary investor preference. However, the ESG-as-a-risk literature shows how ESG characteristics of firms/assets can be used as a metric that reflects previously underappreciated risks. Further evidence has also hinted that ESG characteristics can be used to build portfolios with higher expected returns. In practice, this would imply that investors' reasons to incorporate ESG in their portfolio problems may be multifaceted, which makes a clear distinction between ESG as a taste (e.g., Xue, 2025), ESG as a risk (e.g., Barker, 2025), or ESG as a return predictor (e.g., Pedersen et al., 2021) difficult.

Another important limitation concerns the empirical scope of the thesis. The thesis identifies possible mechanisms through which ESG preferences affect firm investment, capital allocation, and productivity; however, it does not test these channels empirically nor does it quantify the magnitude of the effects. Therefore, the thesis is better suited to clarifying mechanisms and benchmarks than to establishing causal effects or quantitative magnitudes.

Finally, Xue (2025, p. 18) himself explicitly notes another limitation. Because his analysis overlooks the interests of noise traders, the paper is best interpreted as focusing on the effect of ESG disclosure on investment efficiency rather than on welfare or broader market efficiency. This implies that the model is most useful for describing a mechanism through which disclosure shapes investment incentives, but less useful for drawing conclusions about aggregate welfare or overall market efficiency. Therefore, the results of the normative discussion focusing on welfare maximization should be interpreted with caution.

7. Conclusion

This thesis examines how heterogeneous investor preferences, especially ESG tastes, affect equilibrium prices and what implications this has for capital allocation, productivity, and welfare. Starting from the standard-finance benchmark, the thesis analyzed how ESG investing challenges the traditional view that capital should be allocated solely according to risk-adjusted return and profitability. In doing so, the thesis focused on Xue's (2025) model as its central analytical framework and embedded it into the broader literature on ESG equilibrium pricing, ESG as risk, capital allocation, productivity, and welfare.

The analysis of his model showed that ESG tastes do not automatically translate into real investment effects. In Xue's framework, the key transmission channel is ESG disclosure precision. Without ESG disclosure, ESG preferences affect prices, but do not influence firm investment. With ESG disclosure, however, stock prices react not only to profits but also to ESG performance, making it possible for ESG preferences to affect real investment decisions. The thesis showed that this is one of Xue's (2025) central insights. ESG preferences only influence firm investment if an informational channel allows prices to reflect those investor preferences strongly enough. Compared with other ESG equilibrium models, Xue (2025) therefore contributes by showing how disclosure precision influences the price sensitivity towards investor preferences. Further, Xue (2025) shows how ESG disclosure precision can align firm investments according to investor preferences.

The thesis further shows that the implications of ESG preferences depend on whether one focuses on within-firm or economy-wide effects. At the firm level, the literature suggests that informative prices can improve capital allocation and productivity by helping managers make better investment decisions and by strengthening market-based discipline. In this sense, prices affect firm productivity not only through valuation, but also through information and incentives. Xue's (2025) model differs from these learning-from-prices models because managers do not learn from realized prices. Instead, they know the equilibrium pricing rule and choose an investment to maximize the expected stock price.

At the aggregate level, the thesis linked Xue's (2025) model to the macroeconomic misallocation literature. Restuccia and Rogerson (2008), Hsieh and Klenow (2009), Maksimovic and Phillips (2001), Syverson (2011), and Wurgler (2000) all suggest that distortions in the allocation of capital across firms and sectors can lead to substantial productivity losses. Relative to the pure financial benchmark, ESG preferences may therefore appear problematic if they create distortions that shift capital away from the most profitable and productive firms. However, Xue's (2025) large-economy extension demonstrated that this benchmark is incomplete. If emissions are modeled as a negative externality that reduces aggregate productivity, a purely profit-maximizing allocation can itself be inefficient. In that setting, the privately preferred disclosure precision remains below the socially optimal level, because firms and investors do not fully internalize the productivity costs of aggregate emissions. A regulator can move the economy toward the social optimum by imposing a stricter disclosure regime, thereby making firms place more weight on emissions than they would voluntarily choose; however, this would result in a capital allocation that deviates from investor utility maximization.

The normative discussion of the thesis, therefore, suggested that the evaluation of ESG-oriented capital allocation depends crucially on the benchmark used. Relative to the standard-finance benchmark, ESG-based capital allocation may appear to create distortions by shifting investment away from the most profitable uses of capital. Relative to a private investor-utility benchmark, however, this same deviation can be justified because investors may rationally derive utility from better ESG performance. Relative to a social-welfare benchmark, the picture becomes even broader. If emissions reduce aggregate productivity, then ESG-oriented capital allocation may improve welfare by correcting a larger distortion caused by excessive emissions. At the same time, the thesis also emphasized that not every ESG-oriented capital allocation is automatically desirable. If ESG preferences create valuation distortions without reducing relevant externalities, they may lower welfare rather than increase it.

Overall, the thesis suggests that the economic effects of ESG investing are fundamentally conditional. ESG-oriented capital allocation may look distortionary when judged against a narrow financial benchmark but may enhance welfare when it helps internalize the broader productivity costs of emissions. The debate on ESG investing, capital allocation, and productivity can therefore not be resolved within the framework of standard finance alone. It requires a broader perspective that incorporates investor preferences, disclosure, and environmental externalities. In this sense, the thesis contributes to the literature by showing that the relevance of ESG investing does not lie only in its effect on prices, but in the way these price effects may shape firm investment, capital allocation, and the broader economic goals against which market outcomes are ultimately evaluated.

References

Andreoni, J. (1988). Why free ride?: Strategies and learning in public goods experiments. *Journal of Public Economics*, 37(3), 291–304. https://doi.org/10.1016/0047-2727(88)90043-6

Andreoni, J. (1989). Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence. *The Journal of Political Economy*, 97(6), 1447–1458. https://doi.org/10.1086/261662

Andreoni, J. (1990). Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving. *The Economic Journal (London)*, 100(401), 464–477. https://doi.org/10.2307/2234133

Avramov, D., Cheng, S., Lioui, A., & Tarelli, A. (2022). Sustainable investing with ESG rating uncertainty. *Journal of Financial Economics*, 145(2), 642–664. https://doi.org/10.1016/j.jfineco.2021.09.009

Bai, J., Philippon, T., & Savov, A. (2016). Have financial markets become more informative? *Journal of Financial Economics*, 122(3), 625–654. https://doi.org/10.1016/j.jfineco.2016.08.005

Barker, R. (2025). Corporate sustainability reporting. *Journal of Accounting and Public Policy*, 49, 107280. https://doi.org/10.1016/j.jaccpubpol.2024.107280

Bennett, B., Stulz, R., & Wang, Z. (2020). Does the stock market make firms more productive? *Journal of Financial Economics*, 136(2), 281–306. https://doi.org/10.1016/j.jfineco.2019.09.006

Black, F. (1972). Capital Market Equilibrium with Restricted Borrowing. *The Journal of Business*, 45(3), 444–455. https://doi.org/info:doi/

Bollen, N. P. B. (2007). Mutual Fund Attributes and Investor Behavior. *Journal of Financial and Quantitative Analysis*, 42(3), 683–708. https://doi.org/10.1017/S0022109000004142

Burke, M., Hsiang, S. M., & Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature (London)*, 527(7577), 235–239. https://doi.org/10.1038/nature15725

Chen, Q., Goldstein, I., & Jiang, W. (2007). Price Informativeness and Investment Sensitivity to Stock Price. *The Review of Financial Studies*, 20(3), 619–650. https://doi.org/10.1093/rfs/hhl024

Dell, M., Jones, B. F., & Olken, B. A. (2012). Temperature Shocks and Economic Growth: Evidence from the Last Half Century. *American Economic Journal. Macroeconomics*, 4(3), 66–95. https://doi.org/10.1257/mac.4.3.66

Dow, J., & Gorton, G. (1997). Stock Market Efficiency and Economic Efficiency: Is There a Connection? *The Journal of Finance (New York)*, 52(3), 1087–1129. https://doi.org/10.1111/j.1540-6261.1997.tb02726.x

Fabozzi, F. J., Gupta, F., & Markowitz, H. M. (2002). The Legacy of Modern Portfolio Theory. *The Journal of Investing*, 11, 7-22. https://doi.org/10.3905/joi.2002.319510

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance*,25(2), 383–417. https://doi.org/10.2307/2325486

Fama, E.F. (1991). Efficient Capital Markets: II. *The Journal of Finance*, 46(5), 1575–1617. https://doi.org/10.2307/2328565

Fama, E. F., & French, K. R. (2007). Disagreement, tastes, and asset prices. *Journal of Financial Economics*, 83(3), 667–689. https://doi.org/10.1016/j.jfineco.2006.01.003

Freiberg, D., Rogers, J., & Serafeim, G. (2019). How ESG Issues Become Financially Material to Corporations and Their Investors. *Harvard Business School Working Paper*, No. 20-056, https://ssrn.com/abstract=3482546

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, 5(4), 210–233. https://doi.org/10.1080/20430795.2015.1118917

Friedman, M. (1970). The social responsibility of business is to increase its profits. *The New York Times Magazine*, 32-33, 122-126. https://www.nytimes.com/1970/09/13/archives/a-friedman-doctrine-the-social-responsibility-of-business-is-to.html

Garel, A., Romec, A., Sautner, Z., & Wagner, A. F. (2024). Do investors care about biodiversity? *REVIEW OF FINANCE*, 28(4), 1151–1186. https://doi.org/10.1093/rof/rfae010

Global Sustainable Investment Alliance (2025). *Global Sustainable Investment Review 2024*. https://www.gsi-alliance.org/members-resources/gsir2024/

Goldstein, I., Kopytov, A., Shen, L., & Xiang, H. (2022). On ESG Investing: Heterogeneous Preferences, Information, and Asset Prices. *NBER Working Paper Series*. https://doi.org/10.3386/w29839

Gollier, C., & Pouget, S. (2022). Investment Strategies and Corporate Behaviour with Socially Responsible Investors: A Theory of Active Ownership. *Economica (London)*, 89(356), 997–1023. https://doi.org/10.1111/ecca.12436

Heinkel, R., Kraus, A., & Zechner, J. (2001). The Effect of Green Investment on Corporate Behavior. *Journal of Financial and Quantitative Analysis*, 36(4), 431–449. https://doi.org/10.2307/2676219

Hong, H., & Kacperczyk, M. (2009). The price of sin: The effects of social norms on markets. *Journal of Financial Economics*, 93(1), 15–36. https://doi.org/10.1016/j.jfineco.2008.09.001

Hsieh, C.-T., & Klenow, P. J. (2009). Misallocation and Manufacturing TFP in China and India. *The Quarterly Journal of Economics*, 124(4), 1403–1448. http://www.jstor.org/stable/40506263

International Monetary Fund. European Dept. (2024). The Role of Allocative Efficiency in Productivity Growth. *IMF Staff Country Reports*, 2024(178), Article A003, A003. Retrieved November 30, 2025, from https://doi.org/10.5089/9798400278334.002.A003

Lintner, J. (1965). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *The Review of Economics and Statistics*, 47(1), 13–37. https://doi.org/info:doi/

Maksimovic, V., & Phillips, G. (2001). The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and Are There Efficiency Gains? The Journal of Finance (New York), 56(6), 2019–2065. https://doi.org/10.1111/0022-1082.00398

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance*, 7(1), 77–91. https://doi.org/10.2307/2975974

Mossin, J. (1966). Equilibrium in a Capital Asset Market. *Econometrica Journal of the Econometric Society*, 34(4), 768–783. https://doi.org/info:doi/

Pástor, Ľ., Stambaugh, R. F., & Taylor, L. A. (2021). Sustainable investing in equilibrium. *Journal of Financial Economics*, 142(2), 550–571. https://doi.org/10.1016/j.jfineco.2020.12.011

Pedersen, L. H., Fitzgibbons, S., & Pomorski, L. (2021). Responsible investing: The ESG-efficient frontier. *Journal of Financial Economics*, 142(2), 572–597. https://doi.org/10.1016/j.jfineco.2020.11.001

Perold, A. F. (2004). The Capital Asset Pricing Model. *The Journal of Economic Perspectives*, 18(3), 3–24. https://doi.org/10.1257/0895330042162340

Renneboog, L., Ter Horst, J., & Zhang, C. (2008). Socially responsible investments: Institutional aspects, performance, and investor behavior. *Journal of Banking & Finance*, 32(9), 1723–1742. https://doi.org/10.1016/j.jbankfin.2007.12.039

Restuccia, D., & Rogerson, R. (2008). Policy distortions and aggregate productivity with heterogeneous establishments. *Review of Economic Dynamics*, 11(4), 707–720. https://doi.org/10.1016/j.red.2008.05.002

Riedl, A., & Smeets, P. (2017). Why Do Investors Hold Socially Responsible Mutual Funds? *The Journal of Finance (New York)*, 72(6), 2505–2549. https://doi.org/10.1111/jofi.12547

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance*, 19(3), 425–442. https://doi.org/10.2307/2977928

Shiller, R. J. (2003). From Efficient Markets Theory to Behavioral Finance. *The Journal of Economic Perspectives*, 17(1), 83–104. https://doi.org/10.1257/089533003321164967

Statman, M., (2018). Behavioral Finance Moves into Its Second Generation. *Journal of Financial Planning*, 31(5), 30-32.

Statman, M., & Glushkov, D. (2009). The Wages of Social Responsibility. *Financial Analysts Journal*, 65(4), 33–46. https://doi.org/10.2469/faj.v65.n4.5

Syverson, C. (2011). What Determines Productivity? *Journal of Economic Literature*, 49(2), 326–365. https://doi.org/10.1257/jel.49.2.326

Tobin, J. (1958). Liquidity Preference as Behavior Towards Risk. *The Review of Economic Studies*., 25(2), 65–86. https://doi.org/info:doi/

Wurgler, J. (2000). Financial markets and the allocation of capital. *Journal of Financial Economics*, 58(1), 187–214. https://doi.org/10.1016/S0304-405X(00)00070-2

Xue, H. (2025). ESG Disclosure, Market Forces, and Investment Efficiency. *The Accounting Review*, 100 (5), 439-467. https://doi.org/10.2308/TAR-2023-0707

Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance*, 98, 39–60. https://doi.org/10.1016/j.jbankfin.2018.10.012