Review of Finance, 2022, 1345–1388
https://doi.org/10.1093/rof/rfac045
Advance Access Publication Date: 21 July 2022

OXFORD

A Sustainable Capital Asset Pricing Model (S-CAPM): Evidence from Environmental Integration and Sin Stock Exclusion*

Olivier David Zerbib

EDHEC Business School, Nice, France

Abstract

This article shows how sustainable investing—through the joint practice of exclusionary screening and environmental, social, and governance (ESG) integration—affects asset returns. I develop an asset pricing model with partial segmentation and heterogeneous preferences. I characterize two *exclusion premia* generalizing Merton's (1987) premium on neglected stocks and a *taste premium* that clarifies the relationship between ESG and financial performance. Focusing on US stocks, I estimate the model by applying it to sin stocks as excluded assets and using the holdings of green funds to proxy for environmental integration. The average annual exclusion effect is 2.79% for the period 1999–2019. Although the annual taste effect ranges from –1.12% to + 0.14% across industries for 2007–19, the taste effect spread between the top and bottom terciles of companies within each industry can exceed 2% per year. Finally, I estimate and explain the dynamics of these premia.

Keywords: Sustainable finance, Asset pricing, ESG, Sin stocks

* I am grateful to Marcin Kacperczyk (the editor) and two anonymous referees for the insightful comments and suggestions, which significantly improved the article. I also sincerely thank Rob Bauer, Milo Bianchi, Claire Bonello, Marco Ceccarelli, Julio Crego, Patricia Crifo, Joost Driessen, Esther Eiling, Caroline Flammer, Olivier Guéant, James Guo, Ulrich Hege, Ying Jiao, Sonia Jimenez Garces, Frank de Jong, Nabil Kazi-Tani, Peter Kondor, Felix Kübler, Augustin Landier, Dong Lou, Valéry Lucas-Leclin, Sophie Moinas, Lionel Melin, Martin Oehmke, Sébastien Pouget, Kevin Ratsimiveh, Christian Robert, Bert Scholtens, Paul Smeets, Dimitri Vayanos, Michela Verardo, Alexander Wagner, workshop participants at the London School of Economics, Tilburg University, University of Zurich–SFI, Toulouse School of Economics, CREST, Paris Dauphine University, University of Lille, University of Orléans, I Care, and ISFA, Boston University, University of Toronto—Rotman School of Management, RSM Erasmus Rotterdam, EDHEC, ESSEC, ESCP, ESADE, Aix-Marseille School of Economics, University of Luxembourg, and the Climate Economics Chair, and conference participants at GRASFI (2020), Paris December Meeting (2020), Geneva Summit on Sustainable Finance (2020) for their valuable comments and suggestions. This article was written when I was at Tilburg University and Boston University, and previously circulated under the title "A Sustainable Capital Asset Pricing Model (S-CAPM): Evidence from green investing and sin stock exclusion."

JEL classification: G12, G11

Received December 29, 2021; accepted June 30, 2022 by Editor Marcin Kacperczyk.

1. Introduction

Sustainable investing, which accounts for more than one-quarter of the total assets under management (AUM) in the USA (US SIF, 2018) and more than half of those in Europe (GSIA, 2018), is usually based on the inclusion of *several* criteria related to environmental, social, or governance (ESG) issues in investment decisions.[1] As of December 2019, of the 453 mutual funds investing in the USA and classified as green by Bloomberg,[2] 57% of them were also classified as "socially responsible." This substantial proportion highlights the fact that environmental and social criteria are often jointly considered by sustainable investors.

The two most widely used sustainable investment practices are *exclusionary screening* and ESG *integration* (GSIA, 2018). On the one hand, exclusionary screening involves the exclusion of certain assets from the range of eligible investments, usually the most socially controversial assets, such as the stocks of companies in the tobacco, alcohol, gambling, and weapons industries, also referred to as "sin stocks." On the other hand, ESG integration involves factoring ESG criteria into investment decisions. Specifically, when sustainable investors focus on the environment, which, according to a recent survey by Macquarie (2021), is sustainable investors' primary concern and is perceived as the greatest risk on a global scale (World Economic Forum, 2021), they overweight (underweight) assets with the highest (lowest) environmental score. The exclusion of assets based on social criteria and the integration of environmental criteria (referred to as *environmental integration*), which are often jointly implemented by sustainable investors, can create major supply and demand imbalances, thereby influencing market prices. This study develops a theoretical framework and provides empirical evidence on how these two sustainable investing practices—separately and jointly—affect asset returns.

To reflect the dual practice of exclusion and integration by sustainable investors, I develop an asset pricing model with partial segmentation and heterogeneous preferences. Specifically, I propose a single-period equilibrium model populated by two investor groups: *regular investors* that invest freely in all available assets and have mean–variance preferences and *sustainable investors* that exclude certain assets and adjust their mean–variance preferences by internalizing a private cost of externalities for the assets in which they invest. For example, sustainable investors would exclude sin stocks, while assets with a high cost of externalities can be thought of as the assets of companies with high environmental

1 Sustainable investing is also referred to as *socially responsible investing*, *responsible investing*, and *ethical investing*. In the European Parliament legislative resolution of April 18, 2019 (COM(2018)0354—C8-0208/2018–2018/0179(COD)), sustainable investments are defined as "investments in economic activities that contribute to environmental or social objectives as well [*sic*] their combination, provided that the invested companies follow good governance practices and the precautionary principle of 'do no significant harm' is ensured, i.e. that neither the environmental nor the social objective is significantly harmed." In the USA, the AUM in sustainable investing amounted to USD 12 trillion in 2018 and increased by 38% from 2016 to 2018 (US SIF, 2018).

2 Green funds are classified under the attributes "environmentally friendly," "clean energy," and "climate change."

footprint (or *brown*) and those with a low or negative cost of externalities can be viewed as those of companies with low environmental footprints (or *green*).

I propose a unified pricing formula for all assets in the market; namely, the assets excluded by sustainable investors (hereinafter, *excluded assets*) and the assets in which they invest by over- or underweighting them (hereinafter, *investable assets*). Two types of premia are induced by sustainable investors: a *taste premium* and two *exclusion premia*.

The taste premium materializes through three effects. First, on investable asset returns, the taste premium is induced by sustainable investors' tastes for assets owing to the cost of externalities that they internalize. Consistent with Pastor, Stambaugh, and Taylor (2021b), this premium increases with the cost of externalities and the wealth share of sustainable investors. Second, as a consequence, the market risk premium is also adjusted by the average taste premium. Third, the taste premium arises by commonality on excluded asset returns: in equilibrium, regular investors overweight investable assets that have the highest cost of externalities to provide liquidity to sustainable investors who take the opposite position. Therefore, in order to diversify their allocation, regular investors most highly value the excluded assets that are the least correlated with the investable assets having a high cost of externalities. In other words, when applied to sin stock exclusion and environmental integration, the taste premium on a sin stock is all the higher, as the asset is positively correlated with the brownest investable assets.

Two exclusion premia affect the excluded asset returns. The exclusion premia result from a reduction in the investor base and are related to Errunza and Losq's (1985) *super risk premium* and Roon's (2005) *local segmentation premium*. I show that one of the two exclusion premia is a generalized form of the *premium on neglected stocks* characterized by Merton (1987). Both exclusion premia are structured similarly and reflect the dual hedging effect of regular and sustainable investors. Specifically, regular investors, who are compelled to hold the excluded market portfolio, most highly value the assets that are the least correlated with this portfolio. Simultaneously, sustainable investors, who seek to replicate the hedging portfolio built from investable assets that are most closely correlated with the excluded assets, most highly value the assets that are positively correlated with this hedging portfolio. In practice, the exclusion premia increase when the excluded assets increasingly behave like a separate group from the investable assets. The *exclusion effect* is the sum of the two exclusion premia. Although the exclusion effect on asset returns is, on average, positive, as empirically assessed by Hong and Kacperczyk (2009) and Chava (2014), I show that this effect can be negative for an individual excluded asset; for example, when it is negatively correlated with the other excluded assets. Finally, a cross-effect of one of the two exclusion premia also drives the investable asset returns.

I empirically validate the theoretical predictions by estimating the model using US stocks in the Center for Research in Security Prices (CRSP) database from December 1999 to December 2019 for excluded stocks, and from December 2007 to December 2019 for investable stocks due to data constraints. More precisely, I use sin stocks to constitute the assets excluded by sustainable investors, and I apply the environmental integration procedure for investable assets by proxying sustainable investors' tastes for the stocks of green firms.

Beyond the econometric specification issue, there are three main reasons for the mixed results in the empirical literature on the link between environmental and financial performances. First, the identification of a company's environmental performance through a particular environmental metric is a weak proxy for the average tastes of sustainable investors for green firms: the various metrics used to assess the environmental impacts of assets lack a common definition, show low commensurability (Gibson *et al.*, 2020; Berg, Koëlbel, and Rigobon, 2022), and are updated with a low frequency, typically on an annual basis. Second, these studies fail to capture the increase in the proportion of green investors over time. Third, realized returns, used as the dependent variable, are both driven by the taste effect and the unexpected shifts in investors' tastes (Pastor, Stambaugh, and Taylor, 2021b). Indeed, even if a company's environmental footprint remains unchanged, sustainable investors' tastes are dynamically adjusted in response to technological changes, the institutional and socio-political environment, climate policies, reputational risks, and investors' awareness of environmental issues, thereby affecting realized returns (Bolton and Kacperczyk, 2022). Hence, the absence of control for unexpected shifts in tastes while using realized returns as a proxy for expected returns induces a critical omitted variable bias. For example, if sustainable investors' tastes for green companies unexpectedly increase, green assets may outperform brown assets while the former have a lower taste premium than the latter.

Therefore, I construct a proxy for the tastes of green investors that allows me to address the three issues raised. First, to circumvent the use of environmental metrics, this agnostic *ex post* proxy reflects green investors' private costs of environmental externalities. I identify 453 green funds worldwide with investments in US equities as of December 2019 and use the FactSet data to determine their holding history on a quarterly basis. For a given stock and on a given date, the approximated cost of externalities is the relative difference between the weight of the stock in the market portfolio and its weight in the US allocation of the green funds. The higher the cost, the more a stock is underweighted by the green funds on that date, and vice versa when it is negative. Second, the proxy captures the share of green investors' wealth through the proportion of US stocks managed by green funds relative to the market value of the investment universe. Third, I control for the unexpected shifts in green investors' tastes by using the variation of this proxy over time.

For investable stocks, the taste premium is significant from 2007 onward, irrespective of whether it is estimated by constructing industry-sorted or industry-size double-sorted portfolios. The taste premium remains significant after controlling for the unexpected shifts in tastes, as well as for the small-minus-big (SMB), high-minus-low (HML; Fama and French, 1993), and momentum (MOM; Carhart, 1997) factors. At the industry level, the taste effect ranges from −1.12% to +0.14%. Indeed, environmental integration significantly contributes toward modifying the expected returns of the industries most impacted by the ecological transition. For example, on average, during the period 2007–19, green investors induced additional annual returns of 0.50% for the petroleum and natural gas industry when compared with the electrical equipment industry. This taste effect has steadily increased over time, reaching 1.23% between 2013 and 2019. However, many industries are highly heterogeneous and include companies with different environmental footprints, such as utilities or electrical equipment. Thus, I perform an intra-industry analysis by repeating the estimation on portfolios doubly sorted by industry and carbon emissions, and I estimate the taste effect differential between the tercile of the most carbon-intensive companies (top 33%) and that of low-emitting companies (bottom 33%). For example, the annual taste effect differential reaches 2.46% for utilities and 0.68% for electrical equipment companies. This differential is high for industries that are exposed to the ecological transition *and* have high intra-industry heterogeneity. Conversely, this differential is close to zero for coal companies, reflecting the very similar treatment by sustainable investors of all coal companies, which are substantially underweighted, irrespective of their carbon emissions. Finally, I also find weak evidence supporting the cross-effect of sin stock exclusion on investable stock returns.

Regarding sin stocks, I find that both exclusion premia and the taste premium are significant and remain so when the SMB, HML, and MOM factors are included. The ordinary least squares (OLS) adjusted-R^2 and generalized least squares (GLS) R^2 of the estimated model are higher than those obtained under Carhart's (1997) four-factor model. The annual average exclusion effect amounts to 2.79% for the period from December 1999 to December 2019. I also show that the exclusion effect increased sharply during the 2007–08 crisis because the covariances between the sin stocks increased faster than those of the sin stocks with the other assets. In addition, consistent with the theory, the exclusion effect is negative for thirty-three out of the seventy-seven sin stocks analyzed.

1.1 Related Literature

The results of this study contribute to two literature strands on asset pricing. First, they clarify the relationship between the environmental and financial performances of assets by building on the heterogeneous preferences and disagreement literature.[3] The empirical evidence regarding the effects of ESG integration on asset returns is mixed, as several studies point to the existence of a negative relationship between ESG performance and stock returns,[4] while others argue in favor of a positive effect.[5] Pedersen, Fitzgibbons, and Pomorski (2021) and Pastor, Stalbaugh, and Taylor (2021b) provide theoretical contributions on how ESG integration by sustainable investors affects asset returns.[6] Pedersen, Fitzgibbons, and Pomorski (2021) show that when the market is populated by ESG-motivated, ESG-aware, and ESG-unaware investors, the optimal allocation satisfies a four-fund separation and is characterized by an ESG-efficient frontier. The authors derive an asset pricing equation in cases where all investors are ESG-motivated or ESG-unaware. Pastor, Stalbaugh, and Taylor (2021b) show that green assets have negative alphas, brown assets have positive alphas, and the alphas of ESG-motivated investors are at their lowest when investors' ESG tastes are largely dispersed. Extending the conceptual framework laid out by Fama and French (2007), I contribute to this literature strand in two ways. First, from a theoretical viewpoint, when sustainable investors *jointly* practice ESG integration and exclusionary screening, I show that sustainable investors' tastes (i) affect the market premium and (ii) induce a taste premium on the expected returns of the assets they exclude, in addition to the taste premium on investable assets characterized by Pastor, Stalbaugh, and Taylor (2021b). Second, from an empirical viewpoint, this is the first paper (i) in which the asset pricing specification is estimated using a microfounded proxy for sustainable investors' revealed tastes for green companies, (ii) accounting for the increase in green

3 A vast literature has examined the effects of heterogeneous preferences, disagreement, and differences of opinion on asset returns and prices, including Fama and French (2007); Bhamra and Uppal (2014); Baker, Hollifield, and Osambela (2016); and Atmaz and Basak (2018).

4 See Renneboog, Ter Horst, and Zhang (2008) and Barber, Morse, and Yasuda (2019). Moreover, Chava (2014) shows that the same effect applies to the expected returns. Bolton and Kacperczyk (2021) and Hsu, Li, and Tsou (2019) show that companies emitting the most greenhouse gases earn higher stock returns than companies emitting the lowest levels.

5 See Edmans (2011) and Krüger (2015).

6 Both papers focus on ESG integration and do not address exclusionary screening.

investing, and (iii) unexpected shifts in green investors' tastes. Recent independent papers also use proxies for investors' beliefs in climate-related financial risks (e.g., Sautner *et al.*, 2021, from earnings call discussions) and investors' shifts in climate concerns (Ardia *et al.*, 2021; Pastor, Stalbaugh, and Taylor, 2021a). In addition, analyzing carbon-transition risk in a global sample, Bolton and Kacperczyk (2022) estimate the impact of technological, socio-economic, regulatory, and investor awareness changes on asset returns.

The results of this study also contribute to the literature on exclusionary screening by bridging the gap with market segmentation. From a theoretical viewpoint, this study extends the analysis of Heinkel, Kraus, and Zechner (2001) by characterizing the risk factors associated with exclusionary screening. I show that the exclusion effect results from the sum of two exclusion premia, which are related to the premia identified by Errunza and Losq (1985) in the case of excluded assets and by de Jong and de Roon (2005) as an indirect effect on investable assets. I show that both premia apply to all assets in the market and thus, I identify the cross-effect of exclusion on investable stock returns. Moreover, I demonstrate that one of the two exclusion premia is a generalized form of Merton's (1987) premium on neglected stocks. Compared with Merton (1987), this study emphasizes the importance of considering non-independent returns because the exclusion effect is driven by covariances between assets. From an empirical viewpoint, the magnitude of the average annual exclusion effect for sin stocks is close to the 2.5% obtained by Hong and Kacperczyk (2009) and is substantially lower than the 16% found by Luo and Balvers (2017). In addition, beyond the average effect, the individual exclusion effect is negative for several sin stocks. Finally, Berk and van Binsbergen (2021) give an approximation of the effect of exclusionary screening on expected returns. Calibrated on the FTSE USA 4 Good index compared with the FTSE USA, they find a small effect in the period 2015–20. I show that while the average exclusion effect on sin stock returns was indeed small in this period, it was large during the 2008–09 crisis because the intra-group dynamic strengthened. That is, the covariances between sin stocks increased more than the covariances of sin stocks with non-sin stocks.

The remainder of this article is structured as follows. Section 2 presents the equilibrium equations of the model and characterizes the resulting premia. Section 3 describes the identification method used in the empirical analysis when the model is applied to sin stocks regarded as excluded assets, and to environmental integration for characterizing investors' tastes for investable assets. Sections 4 and 5 present the empirical results on investable and excluded stock returns, respectively. Section 6 concludes the article. The Appendix A contains the main proofs, and the Online Appendix provides additional proofs and details about the empirical analysis.

2. Asset Pricing with Partial Segmentation and Heterogeneous Preferences

To reflect sustainable investors' dual practice of excluding certain assets (e.g., sin stocks) and over- or underweighting other assets (e.g., through their preferences for green company stocks), I develop an asset pricing model with partial segmentation and heterogeneous preferences among investors. I show how the expected excess returns deviate from those predicted by the capital asset pricing model (CAPM) and identify two types of premia that occur in equilibrium: a taste premium and two exclusion premia. I also show that exclusion and taste premia have cross-effects on investable and excluded assets.

2.1 Motivating Examples

Even among different types of investors, certain common features emerge from their sustainable investment policies. For example, AXA IM (asset manager of the insurer AXA), BNP Paribas AM (asset manager of the bank BNP Paribas), and the US Conference of Catholic Bishops (USCCB) have sustainable investment guidelines that involve both the integration of environmental issues and the exclusion of "sin stocks."[7] Specifically, in addition to factoring environmental footprints into their sustainable investment strategies, these asset managers and asset owners exclude stocks from the tobacco, gambling (USCCB), and unconventional weapons industries. Regarding the weapon industry, USCCB excludes companies that produce biological and chemical weapons, landmines, nuclear weapons, weapons of mass destruction; AXA IM excludes producers of white phosphorus weapons; and BNP Paribas AM excludes manufacturers of controversial weapons. These strategies are not isolated, and the USCCB states that "Many dioceses, eparchies, and religious communities have also been seeking to apply these guidelines through their own policies on corporate responsibility. We hope that they are helpful to others who wish to be both ethical and responsible to the common good in the investments they make." Consistent with the aggregate practice of sustainable investing as well as these sustainable investment guidelines, I develop a model in which sustainable investors practice both exclusion and integration.

2.2 Model Setup and Assumptions

The economy is populated by two investor groups: *regular* and *sustainable* investors. Regular investors can invest in the whole market and have mean–variance preferences, while sustainable investors can only invest in part of the market and, in addition to their mean–variance preferences, have tastes for the assets in which they invest. Sustainable investors can be thought of as an aggregate ESG fund that both (i) have an exclusionary policy based on social criteria, for example, by excluding sin stocks and (ii) practice environmental integration by overweighting the greenest stocks and underweighting the brownest stocks. Notably, this simple setup does not lose generality compared with a model comprising several sustainable investors that practice either exclusion, integration, or both.[8] Formally, the model is based on the following assumptions.

Assumption 1 (Single-Period Model). *Agents operate in a single-period model from time t to $t+1$. They receive an endowment at time t, have no other source of income, trade at time t, and derive utility from their wealth at time $t+1$.*

Assumption 2 (Gaussian Returns). *The market is composed of $n_I + n_X$ risky assets, $I_1, \ldots, I_{n_I}, X_1, \ldots, X_{n_X}$, whose returns are normally distributed, and one risk-free asset.*

Assumption 3 (Partial Segmentation). *Regular investors invest freely in all assets in the market. Sustainable investors restrict their risky asset allocation to the sub-market of investable*

7 The sustainable investment guidelines of AXA IM are available here: https://www.axa-im.com/sites/corporate/files/2021-09/axa-im-ESG-Standards-Policy-EN-sept-21.pdf; those of BNP, here: https://group.bnpparibas/uploads/file/2021_eu_sustainable_finance_disclosure_bnp_paribas_asset_management_english.pdf; and those of the USCCB, here: https://www.usccb.org/resources/Socially%20Responsible%20Investment%20Guidelines%202021%20(003).pdf.

8 In the Online Appendix, I derive the results in a more general framework with several sustainable investors having different exclusionary and integration practices.

assets, which is composed of assets $I_1, \ldots, I_{n_I}$, and exclude the sub-market of excluded assets, which is composed of assets $X_1, \ldots, X_{n_X}$ (e.g., the sin stocks). The proportion of the excluded assets' market value is denoted by $q \in [0, 1]$. The wealth shares of sustainable and regular investors are p and $1 - p$, respectively.

Assumption 4 (Heterogeneous Preferences). *Investors have mean–variance preferences, and their relative risk aversion is denoted by γ. However, contrary to regular investors, sustainable investors have specific tastes for the assets in which they invest; for example, they favor the greenest companies' stocks. Therefore, they subtract a deterministic private cost of externalities, c_k, from the expected returns on each investable asset $k \in \{I_1, \ldots, I_{n_I}\}$ in their mean–variance optimization program.*[9] $C = (c_{I_1}, \ldots, c_{I_{n_I}})'$ *is the vector of stacked costs for investable assets $I_1, \ldots, I_{n_I}$, where the prime symbol stands for the transposition operator. The cost of externalities of the value-weighted portfolio of investable assets is denoted by c_{m_I} (Figure 1).*

Assumption 5 (Perfect Market). *The market is perfect and frictionless.*

Assumption 6 (Free Lending and Borrowing). *Investors can lend and borrow freely, without any constraint, at the same exogenous interest rate.*

The specific assumptions adopted in this model are those of a partially segmented market (Assumption 3) in which investors have heterogeneous preferences (Assumption 4). I do not consider the partial segmentation assumption as a limiting case of the heterogeneous preferences assumption with no-short-sales constraint because exclusionary screening and integration correspond to distinct practices applied to different types of assets. Indeed, exclusionary practices are often used to exclude the most controversial assets (e.g., sin stocks), while integration is used to modulate a portfolio's exposure to a specific issue (e.g., companies' carbon footprints). Consequently, as emphasized by Bolton and Kacperczyk (2022), exclusionary screening generates an extensive margin adjustment on the cost of capital, while integration induces an intensive margin adjustment because sustainable investors require higher compensation for holding the assets they dislike.

By characterizing sustainable investors' practices through both exclusion and environmental integration, the developed model subsumes two types of previous models. On the one hand, when the cost of externalities is zero (i.e., focusing on Assumption 3), the present framework is reduced to that of segmentation models, such as the I-CAPM (Errunza and Losq, 1985; de Jong and de Roon, 2005), and that used by Luo and Balvers (2017), who analyze the effects of excluding a specific set of assets. The assumptions of the present model generalize those of Merton's (1987) model since I do not impose any particular specification on asset returns, and these are not independent.[10]

On the other hand, when the market is not segmented (i.e., focusing on Assumption 4), the present model is reduced to a model of differences of opinions, in which sustainable

9 As detailed in the Appendix, regular investors have an exponential utility, while sustainable investors adjust their exponential utility by internalizing a deterministic private cost of externalities, as in Pastor, Stalbaugh, and Taylor (2021b).

10 However, it should be noted that Merton allows each stock to be neglected by a different number of investors, while in the present model, all excluded stocks are excluded by the same proportion of total wealth, *p*.

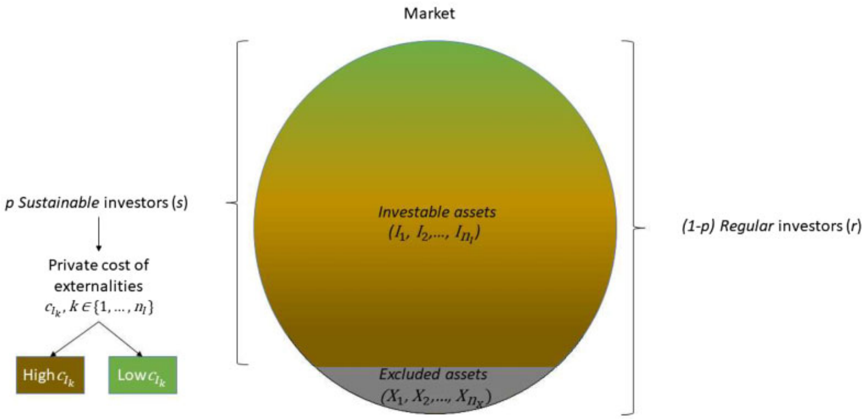

Figure 1. Graphical overview of the financial setup. This graph depicts the two types of investors involved (sustainable and regular investors), their scope of eligible assets, and the tastes of sustainable investors through the private costs of externalities, $(c_{I_k})_{k\in\{1,\ldots,n_I\}}$, they internalize.

investors adjust their expected returns on each available asset by internalizing a private cost of externalities. The setup is related to that of Acharya and Pedersen (2005): the cost of illiquidity is replaced here by a deterministic cost of externalities, which is internalized only by a fraction of the investors. Unlike the illiquidity cost, which fluctuates daily, the cost of environmental externalities varies with high inertia and does not necessarily need to be modeled as a stochastic factor. The internalization of the cost of externalities—which is modeled here as a linear adjustment of the expected excess return—is consistent with other theoretical studies on ESG investing (Gollier and Pouget, 2014; Pastor, Stambaugh, and Taylor, 2021b; Pedersen, Fitzgibbons, and Pomorski, 2021). Notably, the cost of externalities can have a negative value and reflect the internalization of positive externalities by sustainable investors. This occurs for companies whose assets may benefit from enhanced returns in the future, for example, the greenest companies in a given industry.

2.3 Premia Induced by Sustainable Investing

Subscripts I and X are used here as generic indices, denoting the vectors of n_I investable assets and n_X excluded assets, respectively. To simplify the notation, the time subscripts are omitted, and all returns, r, are considered in excess of the risk-free rate. Therefore, the excess return on any asset k in the market is denoted by r_k. The vectors of excess returns on assets $I = (I_1, \ldots, I_{n_I})$ and $X = (X_1, \ldots, X_{n_X})$ are denoted by r_I and r_X, respectively. I refer to the value-weighted portfolios of investable assets and of excluded assets as the *investable market* and *excluded market* portfolios, respectively. The excess returns on the investable market, excluded market, and market are denoted by r_{m_I}, r_{m_X}, and r_m, respectively. I use σ to denote the standard deviation of the excess returns on an asset and ρ for the correlation coefficient (multiple correlation coefficient) between the excess returns on two assets (between one asset and a vector of assets). Let β_{km_I} be the slope coefficient of the regression of the excess returns on asset $k \in \{I_1, \ldots I_{n_I}, X_1, \ldots, X_{n_X}\}$ on the excess returns on the investable market, m_I, and a constant. Let $B_{kI} = (\beta_{kI_1}, \ldots, \beta_{kI_{n_I}})$ be the row vector of the slope coefficients in a multiple regression of asset k's excess returns on the excess returns on the investable assets, $r_{I_1}, \ldots, r_{I_{n_I}}$, and a constant. $\mathbb{C}\mathrm{ov}(r_k, r_{m_X}|r_I)$ and $\mathbb{C}\mathrm{ov}(r_k, r_{m_X}|r_{m_I})$ refer to the conditional covariances between r_k and r_{m_X}, given the vector of returns r_I and return r_{m_I}, respectively.

Proposition 1 (S-CAPM).

1. The expected excess return on any asset $k \in \{I_1, \dots I_{n_I}, X_1, \dots, X_{n_X}\}$ *is*

$$\mathbb{E}(r_k) = \beta_{km_I}\Big(\mathbb{E}(r_{m_I}) - pc_{m_I}\Big) + \underbrace{pB_{kI}C}_{\text{Taste premium}} + \underbrace{\gamma\frac{p}{1-p}q\mathbb{C}\text{ov}(r_k, r_{m_X}|r_I)}_{\text{Exclusion-asset premium}} + \underbrace{\gamma q\mathbb{C}ov(r_k, r_{m_X}|r_{m_I})}_{\text{Exclusion-market premium}}. \quad (1)$$

2. Particularly,

(i) the expected excess return on any investable asset I_k *(*$k \in \{1, \dots, n_I\}$*) is*

$$\mathbb{E}(r_{I_k}) = \beta_{I_k m_I}\Big(\mathbb{E}(r_{m_I}) - pc_{m_I}\Big) + \underbrace{pc_{I_k}}_{\text{Taste premium}} + \underbrace{\gamma q\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I})}_{\text{Exclusion-market premium}}; \quad (2)$$

(ii) the expected excess return on any excluded asset X_k *(*$k \in \{1, \dots, n_X\}$*) is*

$$\mathbb{E}(r_{X_k}) = \beta_{km_I}\Big(\mathbb{E}(r_{m_I}) - pc_{m_I}\Big) + \underbrace{pB_{X_kI}C}_{\text{Taste premium}} + \underbrace{\gamma\frac{p}{1-p}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_I)}_{\text{Exclusion-asset premium}} + \underbrace{\gamma q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_{m_I})}_{\text{Exclusion-market premium}}. \quad (3)$$

Proposition 1 shows that sustainable investors' exclusion and integration practices involve two types of additional premia in equilibrium: two exclusion premia[11]—the *exclusion-asset* and *exclusion-market* premia—and a taste premium. The presence of the exclusion-market premium on investable asset returns and the taste premium on excluded asset returns reflects the cross effects of exclusion and integration practices. Compared with the previous papers on partially segmented markets (Errunza and Losq, 1985; de Jong and de Roon, 2005), I show that equilibrium returns can be expressed in a unified form for all assets in the market [Equation (1)]. As in de Jong and de Roon (2005) and Eiling (2013), the expected excess returns are expressed with respect to those on the investable market, which is the largest investment universe accessible to all investors in a partially segmented market. However, the expected return on the investable market is lowered by the taste premium on this market, pc_{m_I}.

Three limiting cases can be considered. First, when sustainable investors do not exclude assets but have different tastes for investable assets from regular investors, the exclusion premia disappear because $q = 0$, and only the taste premium remains. In addition, the investable market, m_I, and the market, m, coincide. Denoting the beta of asset k with respect to the market by β_{km} and the average cost of externalities in the market by c_m, the expected excess return on asset k is

$$\mathbb{E}(r_k) = \beta_{km}\Big(\mathbb{E}(r_m) - pc_m\Big) + pc_k. \quad (4)$$

11 The exclusion premia are not random variables but scalars because, for a multivariate normal distribution, the conditional covariance does not depend on the given values (see Lemma 1 in the Appendix).

This equilibrium equation is the same as the one in Pastor, Stambaugh, and Taylor (2021b), except that the authors deliberately assume $c_m = 0$ for simplicity. Specifically, when the economy is only populated by sustainable investors ($p = 1$), the equilibrium equation reduces to Acharya and Pedersen's (2005) liquidity-adjusted CAPM with a deterministic illiquidity cost.

Second, when sustainable investors only practice exclusion and have similar tastes to those of regular investors ($\forall k \in \{1, \dots, n_I\}$, $c_{I_k} = 0$), the taste premium vanishes, and only the exclusion premia remain. Equation (2) reduces to the I-CAPM equilibrium equation for investable assets, as in de Jong and de Roon (2005)[12]:

$$\mathbb{E}(r_{I_k}) = \beta_{I_k m_I}\mathbb{E}(r_{m_I}) + \gamma q \mathbb{C}\mathrm{ov}(r_{I_k}, r_{m_X}|r_{m_I}). \tag{5}$$

Equation (3) is also related to de Jong and de Roon (2005), who express the equilibrium equation for excluded assets' expected excess returns with respect to the vector of investable assets' expected returns, $\mathbb{E}(r_I)$. I extend their result to express the expected excess returns on excluded assets with respect to those on the investable market, $\mathbb{E}(r_{m_I})$, as

$$\mathbb{E}(r_{X_k}) = \beta_{X_k m_I}\mathbb{E}(r_{m_I}) + \gamma \frac{p}{1-p} q \mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_X}|r_I) + \gamma q \mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_X}|r_{m_I}). \tag{6}$$

Finally, in the absence of sustainable investors ($p = 0$), there are no longer any excluded assets ($q = 0$; m_I and m coincide), and the model boils down to the CAPM.

2.3. a. *Taste premium*

The taste premium induced by sustainable investors' tastes arises in equilibrium for the investable asset I_k ($pB_{I_k I}C = pc_{I_k}$), and by commonality for the excluded asset X_k ($pB_{X_k I}C$).

Applied primarily to investable assets, this premium is proportional to the cost of externalities: the higher the cost of externalities, the higher the premium to incentivize sustainable investors to acquire the considered asset, and vice versa when the cost of externalities is low. This finding aligns with the literature on the differences of opinions (e.g., Jouini and Napp, 2007; Atmaz and Basak, 2018), in which the assets' expected returns increase (decrease) when a group of investors is pessimistic (optimistic), and the finding of Pastor, Stambaugh, and Taylor (2021b), who show that brown (green) assets have positive (negative) alphas. The taste premium also increases with the proportion of sustainable investors, p, as shown by Fama and French (2007) and Gollier and Pouget (2014).

In addition, in a partially segmented market, the taste premium also arises on excluded asset returns by commonality. This premium is an indirect effect, which is explained as follows. In equilibrium with market clearing, regular investors overweight the assets with the highest cost of externalities to provide liquidity to sustainable investors who take the opposite position.[13] Consequently, to diversify their allocation, regular investors value most

12 The *local segmentation* premium in de Jong and de Roon (2005) can be expressed as a conditional covariance between asset returns (see Lemma 1 in the Appendix).

13 The weights $w_{s,I}$ and $w_{r,I}$ in equilibrium follow directly from the first-order conditions of sustainable investors' optimization program (first row of System [3] in the Appendix) and the market clearing condition. This effect is similar to the one in De Angelis, Tankov, and Zerbib (2022). It is also consistent with disagreement models in which some investors have an optimistic view on the market while others have a pessimistic one (Osambela, 2015; Atmaz and Basak, 2018). In such a

highly the excluded assets that are the most negatively correlated with the investable assets having a high cost of externalities (i.e., the assets X_k, $k \in \{1, \dots, n_X\}$, for which $B_{X_k I}C$ is negative). Conversely, they require a higher expected return to hold the excluded assets that are the most positively correlated with the investable assets having a high cost of externalities (i.e., the assets X_k, $k \in \{1, \dots, n_X\}$, for which $B_{X_k I}C$ is positive) to compensate for their lesser diversification.

Finally, by internalizing externalities on investable assets, sustainable investors simultaneously adjust their total exposure to the investable market and impact the market premium through c_{m_I}. When they internalize a positive global cost of externalities ($c_{m_I} > 0$), they underweight the investable market, and the market premium is negatively adjusted. The opposite effect applies when the global cost of externalities is negative. Therefore, focusing on asset I_k, the total *taste effect* caused by sustainable investors' tastes is a relative effect:

$$\text{Taste effect for investable asset } I_k = \underbrace{pc_{I_k}}_{\text{Taste premium}} - \underbrace{\beta_{I_k m_I} pc_{m_I}}_{\text{Market effect}}.$$

Consequently, although the weighted average cost of externalities on the investable market, c_{m_I}, is not necessarily zero, the weighted average taste effect is zero.[14]

2.3. b. *Exclusion premia*

Two exclusion premia arise in equilibrium on excluded assets' expected excess returns: the exclusion-asset premium, $\gamma \frac{p}{1-p} q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X} | r_I)$, and exclusion-market premium, $\gamma q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X} | r_{m_I})$. As a cross effect, the exclusion-market premium, $\gamma q\mathbb{C}\text{ov}(r_{I_k}, r_{m_X} | r_{m_I})$, also arises in equilibrium on investable assets' expected excess returns, while the exclusion-asset premium is zero.

The exclusion-asset premium is the *super risk premium*, as characterized by Errunza and Losq (1985) for excluded assets in partially segmented markets.[15] The exclusion-market premium is the *local segmentation* premium that de Jong and de Roon (2005) identify for investable assets.[16]

As outlined in Corollary 1, the exclusion premia are induced by the joint hedging effect of regular investors compelled to hold excluded assets and sustainable investors who cannot hold them.

case, the risk is transferred from the pessimists to the optimists, who increase their holdings of the assets under consideration.

14 The weighted average taste effect on the investable market is $pc_{m_I} - \beta_{m_I m_I} pc_{m_I} = 0$.

15 Using different levels of risk aversion, and denoting regular investors' risk aversion by γ_r and the global risk aversion by γ, the exclusion-asset premium is $\left(\frac{\gamma_r}{1-p} - \gamma\right) q\mathbb{C}\text{ov}(r_k, r_{m_X} | r_I)$. Errunza and Losq (1985) use absolute risk aversions, while relative risk aversions are used in the present model.

16 I show that both exclusion premia apply to all assets in the market; indeed, $\gamma \frac{p}{1-p} q\mathbb{C}\text{ov}(r_{I_k}, r_{m_X} | r_I) = 0$. However, when the expected returns on investable assets, $\mathbb{E}(r_{I_k})$, are expressed with respect to the expected market returns, $\mathbb{E}(r_m)$, the exclusion-asset premium is not zero (see the proof of Proposition 2).

Corollary 1 (Breakdown of the Exclusion Premia).
The exclusion premia can be expressed as the difference between a regular investor effect and a sustainable investor effect:

$$\gamma\frac{p}{1-p}q\mathbb{C}\mathrm{ov}(r_k, r_{m_X}|r_I) = \underbrace{\gamma\frac{p}{1-p}q\mathbb{C}\mathrm{ov}(r_k, r_{m_X})}_{\text{Regular investor effect}} - \underbrace{\gamma\frac{p}{1-p}q\mathbb{C}\mathrm{ov}\Big(\mathbb{E}(r_k|r_I), \mathbb{E}(r_{m_X}|r_I)\Big)}_{\text{Sustainable investor effect}}, \tag{7}$$

$$\gamma q\mathbb{C}\mathrm{ov}(r_k, r_{m_X}|r_{m_I}) = \underbrace{\gamma q\mathbb{C}\mathrm{ov}(r_k, r_{m_X})}_{\text{Regular investor effect}} - \underbrace{\gamma q\mathbb{C}\mathrm{ov}(\mathbb{E}(r_k|r_{m_I}), \mathbb{E}(r_{m_X}|r_{m_I}))}_{\text{Sustainable investor effect}}. \tag{8}$$

The former effect is induced by regular investors' need for diversification: because they are compelled to hold the excluded market portfolio, they value most highly the assets that are the most negatively correlated with this portfolio. The latter effect is related to the hedging need of sustainable investors, who cannot hold excluded assets. As the second-best solution, they seek to purchase from regular investors the hedging portfolios most positively correlated with the excluded market and built from investable assets, with returns of $\mathbb{E}(r_{m_X}|r_I)$, and from the investable market portfolio, with returns of $\mathbb{E}(r_{m_X}|r_{m_I})$. As a result, sustainable investors value most highly the hedging portfolios of asset k if they are highly correlated with the hedging portfolios of the excluded market.

Notably, when the joint dynamics of excluded assets strengthen and diverge from those of investable assets, the exclusion premia increase as the regular investor effects increase and the sustainable investor effects decrease.

The exclusion-asset premium is a generalized form of Merton's (1987) premium on neglected stocks. As proven in detail in the Online Appendix, Proposition 2 characterizes this by expressing the expected excess returns on excluded assets as a function of the market returns, r_m.

Proposition 2 (A Generalized Form of Merton's (1987) Premium on Neglected Stocks).
Let $\tilde{\beta}_{X_k m} = \frac{\mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_I})}{\mathbb{C}\mathrm{ov}(r_m, r_{m_I})}$. *When the expected excess returns on* X_k *are expressed with respect to those on the market portfolio, the exclusion-asset premium is*

$$\gamma\frac{p}{1-p}q\mathbb{C}\mathrm{ov}(r_{X_k} - \tilde{\beta}_{X_k m}q r_{m_X}, r_{m_X}|r_I), \tag{9}$$

and is a generalized form of Merton's (1987) premium on neglected stocks.

The generalized form of Merton's (1987) premium on neglected stocks is equal to $\gamma\frac{p}{1-p}q\mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_X}|r_I)$, which is adjusted by factor $-\gamma\frac{p}{1-p}\tilde{\beta}_{X_k m}q^2\mathbb{V}\mathrm{ar}(r_{m_X}|r_I)$ to express the expected excess returns on excluded assets with respect to those on the market.

Hong and Kacperczyk (2009) and Chava (2014) empirically show that sin stocks have higher expected returns than otherwise comparable stocks. Although this finding is, on average, true, it is not always true for individual stocks (see Proposition 3).

Proposition 3 (Sign of the Exclusion Premia).

i. *The exclusion premia on an excluded asset are not necessarily positive.*
ii. *The exclusion premia on the excluded market portfolio are always positive or zero and equal to*

$$\gamma q \mathbb{V}\text{ar}(r_{m_X})\left(\frac{p}{1-p}\left(1-\rho_{m_X I}\right)+\left(1-\rho_{m_X m_I}\right)\right). \tag{10}$$

When an excluded asset is sufficiently negatively correlated with the excluded market, the exclusion premia are likely to be negative.[17] In this case, regular investors are strongly incentivized to diversify their risk exposure by purchasing the excluded asset. However, although the exclusion effect on individual assets is not necessarily positive (Proposition 3 [i]), the value-weighted average exclusion effect is always positive or zero (Proposition 3 [ii]).

3. Empirical Analysis Applied to Sin Stock Exclusion and Green Investing: The Identification Strategy

I estimate the proposed model by (i) treating sin stocks as excluded assets and (ii) proxying sustainable investors' tastes for green assets using green fund holdings. In this section, I describe the data used, the proxy developed for approximating sustainable investors' tastes, and the identification method.

3.1 Data and Proxy Design

3.1. a. *Sin stocks as excluded assets*

Although the practice of exclusionary screening has previously targeted other objectives, such as the boycott of the South African state during the apartheid regime (Teoh, Ivo, and Paul, 1999), it is now mainly applied to sin stocks. However, there is no consensus on the scope of sin industries to be excluded. Luo and Balvers (2017) provide a summary of the sin industries analyzed in the existing literature. The tobacco, alcohol, and gaming industries are always regarded as sin industries. Several authors include the defense industry, but Hong and Kacperczyk (2009) exclude it from US data, noting that not all US investors regard it as a controversial industry. Some studies also include the pornography and coal industries as sin stocks. I carry out an analysis on the exclusion of US sin stocks and follow Hong and Kacperczyk (2009) by focusing on the *triumvirate of sins*, consisting of the tobacco, alcohol, and gaming industries. I check the validity of the results by performing a robustness test including the defense industry.

I start from all the common stocks (share type codes 10 and 11) listed on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), and National Association of Securities Dealers Automated Quotations exchange (NASDAQ; exchange codes 1, 2, and 3) in the CRSP database. I use the Standard Industrial Classification (SIC) to identify forty-eight different industries. The alcohol (SIC 4), tobacco (SIC 5), and defense (SIC 26) industries are directly identifiable from this classification. Since the classification does not distinguish gaming companies from those in the hotel and entertainment industries, in line with Hong and Kacperczyk (2009), I define a 49th industrial category consisting of gaming based on the North American Industry Classification System (NAICS). Gaming companies have the following NAICS codes: 7132, 71312, 713210, 71329, 713290, 72112, and 721120. Therefore, out of the forty-nine industries, I focus on the three sin industries of alcohol, tobacco, and gaming, which accounted for seventy-seven stocks in the period from December 31, 1999 to December 31, 2019. Over this period, the number of companies decreased and the market capitalization of all sin companies increased (Table I).

17 Specifically, when the correlation of an excluded asset with the excluded market is lower than that of their replicating portfolios using investable assets, the exclusion premia are negative.

Table I. Profile of the sin industries

This table reports the number of firms and the total market capitalization corresponding to the alcohol, tobacco, gaming, and defense industries in the period from December 31, 1999 to December 31, 2019.

	Number of firms				Average market capitalization ($ billion)			
	Alcohol	Tobacco	Gaming	Defense	Alcohol	Tobacco	Gaming	Defense
December 1999–December 2004	25	7	14	24	2.8	18.4	3	1.6
December 2004–December 2009	15	9	12	31	3.5	24	4.7	3.2
December 2009–December 2014	15	9	11	21	2.1	36.8	4.9	4.4
December 2014–December 2019	13	10	10	9	6	50.3	13.6	7.4

3.1. b. *Sustainable investors' tastes for green firms*

Because of sustainable investors' major interest in environmental issues (see, e.g., Macquarie, 2021), I apply their ESG integration preferences to their tastes for green firms.[18] Many empirical studies have investigated the effects of a company's environmental performance on its stocks' excess returns. Yet, the results differ significantly for at least three main reasons. First, this heterogeneity lies in the fact that the identification of a company's environmental performance through a particular environmental metric is a weak proxy for sustainable investors' tastes for green firms. Indeed, several dozens of environmental impact metrics are offered by various data providers, covering a wide range of themes, methods, and analytical scopes. These metrics lack a common definition and diverge significantly (Berg, Koëlbel, and Rigobon, 2022).[19] For instance, Gibson *et al.* (2020) show that the average correlation between the environmental impact metrics of six major ESG data providers was 42.9% for the period 2013–17. Each available metric reflects specific information and the average taste of all sustainable investors for green firms can hardly be captured by a single metric. Moreover, these metrics are generally only available on an annual basis. Second, the empirical studies fail to capture the increase in the proportion of green investors and thus, the growing impact of their tastes over time. Third, by using realized returns as proxy for expected returns, these papers omit to control for the effect of the

18 I use "tastes for green firms" and "green tastes" interchangeably to refer to the tastes of green funds proxied by their asset holdings as described in this section.

19 These metrics cover different environmental themes, such as greenhouse gas emissions, air quality, water management, waste treatment, impact on biodiversity, and thematic and global environmental ratings (e.g., KLD ratings). Even for greenhouse gas emissions, various metrics are available: carbon intensity, two-degree alignment, avoided emissions, green share, and emission scores, among others. Additionally, data providers often have their own calculation methods and analysis scopes. The calculation is further complicated by inconsistencies the data reported by companies, as well as by the differences in the treatment of data gaps and the benchmarking options chosen by data providers.

unexpected shifts in sustainable investors' tastes on realized returns (Pastor, Stalbaugh, and Taylor, 2021b). Indeed, investors' tastes for green assets are intrinsically dynamic because they are continuously changing as a result of changes in the socio-economic and climate environments (Bolton and Kacperczyk, 2022). Hence, for example, if the proportion of green investors or their tastes for green companies unexpectedly increase, green assets may outperform brown assets while the former have a lower taste premium than the latter.

Consequently, I construct a proxy for the green tastes of sustainable investors that allows me to address the three issues raised. I circumvent the first two issues by approximating the shifts in tastes of sustainable investors from a qualitative and quantitative viewpoint: I approximate both the cost of environmental externalities defined in the model, $(c_{I_k})_{k\in\{1,\ldots,n_I\}}$, and sustainable investors' wealth share, p, by using green fund holdings. Such a proxy for the taste premium allows me to address the third issue by constructing a proxy for the unexpected shifts in sustainable investors' tastes (see Section 4.4).

3.1.b.1 Proxy for the cost of environmental externalities. In Proposition 4, we give a first-order approximation of the cost of externalities for investable asset I_k.

Proposition 4 (Proxy for the Cost of Externalities).

Let us denote sustainable investors' optimal weight of I_k by w^*_{s,I_k} and the market weight of I_k by w_{m,I_k}. Let us assume that (i) sustainable investors do not account for the correlations among asset returns when internalizing the cost of externalities of asset I_k, (ii) the share of sustainable investors' wealth, p, is small, and (iii) the taste premium, pc_{I_k}, is small compared with the expected return, $\mathbb{E}(r_{I_k})$. The cost of environmental externalities, c_{I_k}, is approximated as

$$c_{I_k} \simeq \frac{w_{m,I_k} - w^*_{s,I_k}}{w_{m,I_k}} \mathbb{E}(r_{I_k}). \tag{11}$$

By providing a micro-foundation of the form of the cost of externalities, Proposition 4 is intended to allow the construction of a reasonable and intuitive proxy. Under assumptions (i)–(iii), the cost of externalities of asset I_k has the form of a relative difference between the weight of this asset in the benchmark and its weight in the sustainable investors' portfolio. In other words, the cost of externalities is positive when green funds underweight asset I_k relative to the benchmark (e.g., in the case of a brown asset), and it is negative when they overweight asset I_k (e.g., in the case of a green asset).

Assumption (i), which relaxes the dependency structures between assets, aims at not giving too much weight to (a) the structure of the model which, by nature, simplifies the reality (two groups of investors, one of which practices exclusion and integration) and (b) the application case of the model (exclusion of sin stocks and integration of environmental issues). Without assumption (i), we would impose a specific dependency structure between assets, omitting all other structures that are not modeled. Assumption (ii) applied only to investors practicing environmental integration in the period 2007–19 is realistic since the total AUM by sustainable investors in the USA reached 25% in 2018. Finally, we validate hypothesis (iii) *ex post*: on all assets, for the period from December 2007 to December 2019, the median, the 95% percentile, and the 99% percentile of the ratio of the absolute value of the estimated taste premium to the absolute value of the realized return are 0.35%, 4.1%, and 10.7%, respectively.

Therefore, I exclude the expected return, $\mathbb{E}(r_{I_k})$, in the approximation of Proposition 4 to avoid endogeneity bias, and I define the proxy for the cost of externalities of asset I_k, $\tilde{c}_{I_k}$, as

$$\tilde{c}_{I_k} = \frac{w_{m,I_k} - w^*_{s,I_k}}{w_{m,I_k}}. \tag{12}$$

I compute the microfounded proxy, $\tilde{c}_{I_k}$, using the holding history of all the listed green funds investing in US equities. Specifically, among all funds listed by Bloomberg on December 2019, I select the 453 funds whose asset management mandate includes environmental guidelines ("environmentally friendly," "climate change," and "clean energy"), of which the investment asset classes are defined as "equity," "mixed allocation," and "alternative,"[20] with the geographical investment scope including the USA.[21] I retrieve the entire asset holding history of each of these funds on a quarterly basis (March, June, September, and December) via the data provider FactSet. The number of green funds exceeded 100 in 2010 and reached 200 in 2018. I aggregate the holdings of all green funds on a quarterly basis and focus on the US stock investment universe in CRSP (referred to as the *US allocation*). Given the large number of investable stocks and to mitigate the noise caused by outliers, I perform the analysis on portfolios. To estimate the taste premium across industries, I construct industry-sorted portfolios (Section 4.1.a). I extend the analysis by constructing portfolios doubly sorted by industry and carbon emissions to estimate the taste premium based on the environmental footprints of the companies within each industry (Section 4.1.b). To illustrate the construction of $\tilde{c}_{I_k}$, let us consider the case with industry-sorted portfolios. The investable market consists of forty-six industries corresponding to the forty-nine industries from which the three sin industries have been removed. For every quarter t, I calculate the weight of each industry I_k in the US allocation of the aggregate green fund to estimate w^*_{s,I_k} at date t. I estimate w_{m,I_k} as the weight of industry I_k in the investment universe. I construct proxy $\tilde{c}_{I_k}$ by substituting the estimates of w^*_{s,I_k} and w_{m,I_k} in Equation (12). I then extend the value of the proxy over the next 2 months of the year in which no holding data are available.

This agnostic factor serves as a proxy for the sustainable investors' revealed green tastes by comparing green funds' asset allocations with the asset weights in the investment universe. It offers the dual advantage of covering a large share of the assets in the market (46% of the stocks at the end of 2019) and being constructed from a minimal fraction of the AUM (green funds' AUM accounted for only 0.12% of the market capitalization of the investment universe at the end of 2019).[22] Therefore, by using proxy $\tilde{c}_{I_k}$, I implicitly assume that all sustainable investors have fairly similar green tastes to those revealed by the aggregated 453 green funds, and I test this assumption by estimating the asset pricing model.[23]

20 The last two categories include diversified funds that also invest in equities.

21 The geographical areas selected are "global," "international," "multi," "North American region," "Organization for Economic Co-operation and Development countries," and "the USA" (see the Online Appendix).

22 The AUMs of the 453 green funds account for only 0.12% of the total market capitalization of the investment universe for two main reasons: most green investments are made through the proprietary funds of institutional investors (pension funds, life insurers, etc.) rather than via open-ended funds; not all green funds worldwide are necessarily listed in Bloomberg and FactSet.

23 Given that the list of green funds is not historically available, I acknowledge that the proposed proxy may introduce survivorship bias. However, given the massive and steady increase in green

In line with the gradual development of green investing during the 2000s and concomitantly with the enforcement of the US Securities and Exchange Commission's (SEC's) February 2004 amendment requiring US funds to disclose their holdings on a quarterly basis, the number of green funds reporting their holdings exceeded fifty as of 2007. Therefore, to construct a sufficiently robust proxy for the taste premium, I start the analysis from December 2007. Table II summarizes the proxy for the cost of environmental externalities and the excess returns for the various investable industries in descending order of average cost, $\tilde{c}_{I_k}$, for the period from December 2007 to December 2019.

This ranking shows that the industries least held by green funds include fossil energies (coal, petroleum, and natural gas), highly polluting manufacturing industries (defense, and printing and publishing), polluting transportation (aircraft and shipping containers), and mining (non-metallic and industrial mining, and precious metals). However, to be able to overweight the least polluting companies, green investors not only underweight the most polluting companies, but also some of the companies with the largest market capitalizations. Particularly, they substantially underweight the largest companies in the investment universe, which belong to the entertainment (e.g., Time Warner and Walt Disney), retail (e.g., Walmart), communication (e.g., Verizon and CBS), banking (e.g., JP Morgan, Wells Fargo, and Citigroup), and insurance (e.g., Berkshire Hathaway, United Health, and AIG) industries. This is the reason that these specific industries are also at the top of the ranking in Table II. Therefore, when estimating the effective impact of green investing on asset returns, the underweighting of companies with very large capitalizations that we observe on green fund holdings should be taken into account. Naturally, the use of environmental ratings or carbon footprints as proxy for green investors' tastes does not allow capturing this effect.

3.1.b.2 Proxy for the proportion of sustainable investors' wealth. To capture the shifts in tastes from a quantitative viewpoint, I construct a proxy for the proportion of sustainable investors' wealth, p. I estimate the proportion of managed assets following environmental guidelines as the market value of the US stocks in the 453 green funds divided by the market value of the investment universe at each considered date. The proxy is denoted by $\tilde{p}$ and defined as

$$\tilde{p}_t = \frac{\text{Market value of US stocks in green fund holdings in } t}{\text{Total market capitalization of US stocks in } t}. \quad (13)$$

From December 2007 to December 2019, $\tilde{p}$ increased from 0.02% to 0.12% (see the Online Appendix).

3.2 Econometric Specifications

I carry out the estimations based on the equations in Proposition 1 being applied to sin stocks for excluded assets and green funds' tastes—through $\tilde{c}_{I_k}$ and $\tilde{p}$—to reflect sustainable investors' preferences.[24] I assume that the cost of externalities is proportional to its

investments, the net creation of green funds can be assumed to be positive over the period. Thus, the number of closed green funds should be limited compared with the number of green funds still in operation. Additionally, it can be assumed that the average tastes of the closed funds do not differ significantly from the average tastes of the funds still in operation.

24 The estimations were coded using the software R and the scripts are available at the following URL: https://drive.google.com/drive/folders/1SbK0DEpyibMIKfw9bl7uTUhtLV8fY6PA?usp=sharing.

Table II. Descriptive statistics of the investable industries

This table reports the descriptive statistics for the proxy for the cost of environmental externalities, $\tilde{c}$, and the monthly returns in excess of the 1-month T-Bill for the period from December 31, 2007 to December 31, 2019, in each of the forty-six investable industries (i.e., the forty-nine SIC industries from which the alcohol, tobacco, and gaming industries have been excluded). The construction of the proxy for the cost of environmental externalities is described in Section 3.1.b. In this table, the industries are ranked in descending order of the average proxy $\tilde{c}$.

	Environmental cost proxy					Returns				
Industry name	Mean	Median	St. Dev.	Min.	Max.	Mean	Median	St. Dev.	Min.	Max.
Defense	0.87	0.83	0.08	0.72	0.96	0.021	0.018	0.011	−0.001	0.039
Aircraft	0.69	0.72	0.09	0.47	0.80	0.018	0.018	0.004	0.004	0.028
Precious metals	0.66	0.61	0.08	0.52	0.75	0.008	0.015	0.018	−0.026	0.043
Printing and publishing	0.58	0.58	0.05	0.43	0.66	0.017	0.017	0.009	0.000	0.039
Non-metallic and industrial metal mining	0.54	0.63	0.18	0.17	0.86	0.013	0.012	0.009	−0.007	0.038
Coal	0.52	0.53	0.25	0.32	0.99	−0.002	−0.006	0.018	−0.041	0.039
Agriculture	0.50	0.40	0.61	−1.58	1.00	0.017	0.018	0.011	−0.006	0.036
Entertainment	0.41	0.38	0.18	0.15	0.64	0.025	0.024	0.006	0.010	0.035
Personal services	0.38	0.38	0.04	0.29	0.46	0.016	0.017	0.005	0.004	0.025
Petroleum and natural gas	0.36	0.33	0.08	0.27	0.58	0.008	0.008	0.006	−0.005	0.023
Candy and soda	0.36	0.32	0.10	0.28	0.57	0.010	0.010	0.003	0.005	0.018
Communication	0.32	0.27	0.09	0.24	0.49	0.014	0.013	0.005	0.005	0.025
Trading	0.32	0.30	0.09	0.22	0.50	0.014	0.014	0.005	0.002	0.026
Retail	0.29	0.28	0.11	0.15	0.47	0.015	0.015	0.005	0.006	0.024
Banking	0.27	0.27	0.07	0.19	0.44	0.012	0.012	0.005	−0.002	0.026
Pharmaceutical products	0.23	0.22	0.03	0.19	0.29	0.017	0.017	0.006	0.007	0.029
Insurance	0.22	0.18	0.20	0.04	0.57	0.015	0.014	0.004	0.005	0.025
Meals	0.19	0.18	0.09	0.10	0.41	0.017	0.016	0.004	0.010	0.032
Shipbuilding and rail-road equipment	0.19	0.10	1.12	−2.28	0.92	0.014	0.014	0.007	0.000	0.032
Chemicals	0.16	0.21	0.12	−0.26	0.25	0.015	0.015	0.005	0.007	0.033
Real estate	0.14	0.11	0.22	−0.13	0.50	0.017	0.017	0.009	0.003	0.044
Clothes apparel	0.13	0.24	0.21	−0.10	0.50	0.018	0.020	0.008	0.004	0.038
Transportation	0.11	0.15	0.17	−0.18	0.43	0.016	0.016	0.004	0.010	0.029
Recreation	0.10	0.09	0.18	−0.11	0.57	0.014	0.014	0.006	0.003	0.031
Steel works	0.08	0.06	0.49	−0.54	0.74	0.012	0.011	0.004	0.005	0.028
Business services	0.05	0.05	0.07	−0.01	0.23	0.019	0.019	0.003	0.011	0.029
Computers	0.02	0.05	0.14	−0.25	0.17	0.018	0.016	0.005	0.010	0.035
Automobiles and trucks	−0.05	−0.02	0.07	−0.16	0.05	0.016	0.013	0.010	0.003	0.050
Shipping containers	−0.08	0.30	0.52	−1.13	0.64	0.013	0.013	0.004	0.005	0.026
Consumer goods	−0.10	−0.02	0.14	−0.38	0.09	0.010	0.009	0.004	0.003	0.021

(continued)

Table II. Continued

Industry name	Environmental cost proxy					Returns				
	Mean	Median	St. Dev.	Min.	Max.	Mean	Median	St. Dev.	Min.	Max.
Rubber and plastic products	−0.18	−0.12	0.54	−1.61	0.39	0.018	0.018	0.008	0.004	0.046
Healthcare	−0.22	−0.19	0.14	−0.39	0.04	0.014	0.015	0.006	0.002	0.026
Food products	−0.23	−0.21	0.10	−0.41	−0.05	0.014	0.015	0.005	0.003	0.021
Medical equipment	−0.26	−0.27	0.09	−0.46	−0.15	0.017	0.018	0.004	0.006	0.026
Fabricated products	−0.33	0.11	1.05	−3.44	0.66	0.014	0.016	0.010	−0.005	0.034
Chips	−0.40	−0.40	0.14	−0.73	−0.22	0.017	0.017	0.004	0.008	0.027
Textiles	−0.54	−0.69	0.64	−1.88	0.61	0.021	0.021	0.007	0.010	0.046
Wholesale	−0.57	−0.59	0.13	−0.71	−0.25	0.016	0.016	0.005	0.008	0.029
Utilities	−0.59	−0.50	0.28	−1.12	−0.27	0.010	0.010	0.003	0.001	0.018
Business supplies	−0.77	−0.62	0.42	−1.44	0.16	0.015	0.015	0.006	0.005	0.037
Machinery	−0.83	−0.77	0.37	−1.81	−0.40	0.012	0.010	0.006	0.002	0.036
Construction materials	−2.17	−1.97	0.63	−3.54	−1.45	0.018	0.017	0.005	0.008	0.038
Construction	−2.33	−2.95	1.44	−4.36	−0.44	0.016	0.015	0.005	0.005	0.027
Electrical equipment	−2.58	−2.43	0.43	−3.51	−2.06	0.013	0.013	0.005	0.003	0.030
Measuring and control equipment	−2.63	−2.57	0.28	−3.85	−2.29	0.019	0.018	0.004	0.012	0.031
Other	−6.62	−6.56	2.40	−11.93	−3.48	0.012	0.012	0.002	0.005	0.018
Investable market portfolio m_I	−0.02	−0.02	0.00	−0.02	−0.01	0.015	0.015	0.003	0.009	0.027

proxy: $c_{I_k} = \kappa_c \tilde{c}_{I_k}$ and $C = \kappa_c \tilde{C}$ ($\kappa_c \in \mathbb{R}_+$) for investable stock I_k and the vector of investable stocks, I, respectively. Similarly, I assume that the share of sustainable investors' wealth is proportional to its proxy: $p = \kappa_p \tilde{p}$ ($\kappa_p \in \mathbb{R}_+$).

3.2. a. *Investable asset specification*

For each investable asset I_k ($k \in \{1, \ldots, n_I\}$), Equation (2) is written as

$$\mathbb{E}(r_{I_k}) = (\mathbb{E}(r_{m_I}) - pc_{m_I})\beta_{I_k m_I} + \kappa_p \kappa_c \tilde{p} \tilde{c}_{I_k} + \gamma q \mathbb{C}\mathrm{ov}(r_{I_k}, r_{m_X} | r_{m_I}). \tag{14}$$

The three independent variables are the beta coefficient, $\beta_{I_k m_I}$, the proxy for the *taste factor*, $\tilde{p}\tilde{c}_{I_k}$, and the *exclusion-market factor*, $q\mathbb{C}\mathrm{ov}(r_{I_k}, r_{m_X} | r_{m_I})$.

3.2. b. *Excluded asset specification*

For each excluded asset X_k ($k \in \{1, \ldots, n_X\}$), Equation (3) is written as

$$\mathbb{E}(r_{X_k}) = \Big(\mathbb{E}(r_{m_I}) - pc_{m_I}\Big)\beta_{X_k m_I} + \kappa_p \kappa_c \tilde{p} B_{X_k I} \tilde{C} + \gamma \frac{p}{1-p} q \mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_X} | r_I) + \gamma q \mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_X} | r_{m_I}). \tag{15}$$

The four independent variables of the estimation are the beta coefficient, $\beta_{X_k m_I}$, the proxy for the *taste factor*, $\tilde{p} B_{X_k I} \tilde{C}$, the *exclusion-asset factor*, $q\mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_X} | r_I)$, and the *exclusion-market factor*, $q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_{m_I})$. As shown in the correlation matrix reported in the Online Appendix, the correlations between all factors are low.

4. Stock Returns with Tastes for Green Firms

In this section, I empirically assess the effect of sustainable investors' green tastes and that of their exclusion of sin stocks on investable stock excess returns. The taste premium significantly impacts excess returns. I find weak evidence supporting the effect of sin stock exclusion on investable stock returns.

4.1 Main Estimation

I estimate the following three models. (i) The *S-CAPM*, corresponding to Equation (14):

$$\mathbb{E}(r_{I_k}) = \alpha + \delta_{\text{mkt}}\beta_{I_k m_I} + \delta_{\text{taste}}\tilde{p}\tilde{c}_{I_k} + \delta_{\text{ex.mkt}} q\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I}); \tag{16}$$

(ii) the *four-factor S-CAPM* (denoted as *4F S-CAPM*), corresponding to the S-CAPM specification to which the SMB, HML (Fama and French, 1993), and MOM (Carhart, 1997) betas are added[25]; and (iii) for benchmarking purposes, the *four-factor model* (denoted as *4F model*), corresponding to the CAPM specification with respect to the investable market returns to which the SMB, HML, and MOM betas are added.

I perform a two-stage cross-sectional regression (Fama and MacBeth, 1973) with Newey and West (1987) standard errors to account for heteroskedasticity and serial correlation. Investable assets account for 5,660 stocks in the period from December 2007 to December 2019, and the estimations are carried out on stock portfolios using value-weighted returns. All returns are in excess of the 1-month Treasury Bill (T-bill) rate. In the first pass, I compute the dependent and independent variables over a 3-year rolling period at monthly intervals. The betas are estimated as univariate betas. Specifically, $q\mathbb{C}\text{ov}(r_I, r_{m_X}|r_{m_I}) = \mathbb{C}\text{ov}(r_I, r_X|r_{m_I})q_X$, where q_X is the vector of weights of the excluded assets in the market and $\mathbb{C}\text{ov}(r_I, r_X|r_{m_I})$ is computed as a Schur complement from stacked excess returns (see Lemma 1 in the Appendix). $q\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I})$ is the kth entry of vector $q\mathbb{C}\text{ov}(r_I, r_{m_X}|r_{m_I})$.[26] In the second pass, for each month, I run the cross-sectional regressions of the n_I dependent variables on a constant and the independent variables. The estimated loadings are equal to the average over the number of cross-sectional regressions. To evaluate and compare the models, I report the OLS adjusted R^2 of the cross-sectional regressions. As suggested by Kandel and Stambaugh (1995) and Lewellen, Nagel, and Shanken (2010), I also report the GLS R^2 as an alternative measure of model fit because it is determined by the factor's proximity to the minimum-variance boundary.

The detailed descriptive statistics of the dependent and independent variables and the correlation matrix are given in the Online Appendix. The mean of the proxy for the taste factor, $\tilde{p}\tilde{C}$, is -2×10^{-4}, and its median is 10^{-5}. The proxy reaches a maximum of 10^{-3}, and the minimum is -7×10^{-3}.

25 The three factors are downloaded from Kenneth French's website: https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

26 I estimate the inverse of the investable asset covariance matrix assuming that returns follow a one-factor model (Ledoit and Wolf, 2003).

4.1. a. *Inter-industry taste effect*

Table III reports the estimates of the three specifications using industry-sorted portfolios for the period from December 31, 2007 to December 31, 2019. Consistent with the model predictions, the taste premium is significant (*t*-statistic of 2.07) and its loading is positive ($\hat{\delta}_{\text{taste}} = 0.17$). When the SMB, HML, and MOM factors are included, this premium becomes highly significant (*t*-statistic of 4.55) and the loading increases to 0.49. The *annual* average market effect is $-\hat{\delta}_{\text{taste}}\tilde{p}\tilde{c}_{m_I} = 0.25$ basis point (bp).[27] Therefore, the market effect is negligible, and the taste effect is almost exclusively driven by the taste premium.

Although the exclusion-market premium is positive and significant when considered individually, it is not significant in the S-CAPM specification. There are at least two possible non-exclusive reasons for this low significance: either sustainable investors have not (yet) sufficiently priced this second-order effect, or it is priced but difficult to identify because of the small number of sin stocks (seventy-seven) in the excluded asset market, which covary chaotically with the forty-six investable industry portfolios whose total asset scope is 5,660 stocks.

For each industry, Table IV provides the average annual taste effect estimates using the S-CAPM. Compared with the industry ranking in Table II, which is based on proxy $\tilde{c}_{I_k}$, Table IV provides a ranking according to the taste effect, $\hat{\delta}_{\text{taste}}\tilde{p}\tilde{c}_{I_k} + \hat{\delta}_{\text{taste}}\tilde{p}\tilde{c}_{m_I}\beta_{I_k m_I}$, which includes the market effect, $\hat{\delta}_{\text{taste}}\tilde{p}\tilde{c}_{m_I}\beta_{I_k m_I}$. The rankings slightly differ because $\beta_{I_k m_I}$ is not sorted as $\tilde{c}_{I_k}$.

The taste effect ranges from -1.12% to $+0.14\%$ for the different industries. Specifically, the return differential between industries differently impacted by the ecological transition is substantial. For example, green investors induce additional annual returns of 0.50% for the petroleum and natural gas industry compared with the electrical equipment industry.

4.1. b. *Intra-industry taste effect*

Although some industries can fairly be identified as brown (e.g., coal, aircraft, petroleum, and natural gas), most of them include companies with very different environmental footprints. For example, the utilities industry contains carbon-intensive companies (e.g., gas utilities) and low-emitting companies (e.g., renewable energy utilities). Thus, following Bolton and Kacperczyk (2021, 2022), who emphasize the more significant impact on asset returns of carbon emissions compared with carbon intensities, I use the total yearly emissions in tons of CO_2 equivalent per firm provided by S&P-Trucost to identify the climate footprint of each firm. I check that the size of the firm does not significantly change the estimates by controlling for the SMB factor. I carry out the analysis focusing on two cases: (i) the emissions of scopes 1 and 2, namely, the considered firm's direct emissions related to its activity (scope 1) and indirect emissions from the generation of purchased energy (scope 2) and (ii) the sum of the emissions of scopes 1–3, that is, the previous emissions to which are added those of the rest of the upstream value chain, via suppliers, and downstream value chain, via customers. I divide each industry into three terciles (see, e.g., In, Park, and Monk, 2019) to build 138 ($= 46 \times 3$) portfolios doubly sorted by industry and tercile of emissions, and I repeat the estimation using these portfolios.

27 The proxies for the value-weighted average cost of externalities and the taste factor of the investable market, $\tilde{c}_{m_I}$ and $\tilde{p}\tilde{c}_{m_I}$, are –55 and –0.12 bps, respectively, over the period.

Table III. Cross-sectional regressions for investable stock industry-sorted portfolios with tastes for green firms

This table presents the estimates of the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for forty-six investable stock industry-sorted portfolios for the period from December 31, 2007 to December 31, 2019. The specification of the S-CAPM is as follows: $\mathbb{E}(r_{I_k}) = \alpha + \delta_{\text{mkt}}\beta_{I_k m_I} + \delta_{\text{taste}}\tilde{p}\tilde{c}_{I_k} + \delta_{\text{ex.mkt}}q\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I})$, where r_{I_k} is the value-weighted excess return on industry portfolio I_k $(k = 1, \ldots, n_I)$, $\beta_{I_k m_I}$ is the slope of an OLS regression of r_{I_k} on r_{m_I}; $\tilde{p}$ is the proxy for the proportion of sustainable investors' wealth; $\tilde{c}_{I_k}$ is the proxy for the cost of environmental externalities of industry I_k; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_k with that of the excluded market, the excess returns on the investable market being given. This specification is compared with two other specifications: (i) the 4F S-CAPM, which is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) MOM factor are added, and (ii) the 4F model, which is the CAPM with respect to the investable market returns to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) MOM factor are added: $\mathbb{E}(r_{I_k}) = \alpha + \delta_{\text{mkt}}\beta_{I_k m_I} + \delta_{\text{SMB}}\beta_{I_k\text{SMB}} + \delta_{\text{HML}}\beta_{I_k\text{HML}} + \delta_{\text{MOM}}\beta_{I_k\text{MOM}}$. These specifications are estimated using the Fama and MacBeth (1973) procedure. First, the variables are estimated portfolio-by-portfolio in a 3-year rolling window at monthly intervals. In the second pass, a cross-sectional regression is performed month-by-month on all the portfolios. The estimated parameter is the average value of the estimates obtained on the 109 months during the period. t-values, estimated following Newey and West (1987) with three lags, are reported between parentheses. The last column reports the average OLS adjusted-R^2 and the GLS R^2 on the row underneath. The 95% confidence intervals are shown in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{\text{ex.mkt}}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0143	0.0004						0.05 [0.03, 0.07]
t-value	(13)	(0.44)						0.07 [0.05, 0.09]
Estimate	0.0149		0.174					−0.02 [−0.02, −0.01]
t-value	(24.16)		(2.2)					0.01 [0, 0.01]
Estimate	0.0149			119.2				0.06 [0.04, 0.08]
t-value	(26.22)			(2.15)				0.08 [0.06, 0.1]
Estimate	0.0144	0.0004	0.1922					0.03 [0.02, 0.05]
t-value	(12.95)	(0.44)	(2.55)					0.08 [0.06, 0.1]
Estimate	0.0137	0.0012	0.1737	56.1				0.08 [0.06, 0.11]
t-value	(10.51)	(1.13)	(2.07)	(0.77)				0.14 [0.12, 0.17]
Estimate	0.0148	0.0024	0.491	−105.7	0.0001	0.0005	0.000	0.22 [0.19, 0.26]
t-value	(14.54)	(2.71)	(4.55)	(−1.94)	(0.36)	(2.26)	(0.09)	0.33 [0.3, 0.36]
Estimate	0.0139	0.0028			0.000	0.0004	0.000	0.23 [0.19, 0.27]
t-value	(14.81)	(3.14)			(0.14)	(2.14)	(0.15)	0.3 [0.26, 0.33]

For both sets of portfolios sorted by scopes 1 and 2 and scopes 1–3, the taste premium is positive and significant (Table V). It is even more significant when all three scopes are covered. I then estimate the difference in taste effect per industry between the tercile of brown companies (top 33% of carbon emissions) and that of green companies (bottom 33% of carbon emissions); the results are reported in Table VI. Most industries have a positive taste effect differential. These industries are mainly those that are most impacted by the ecological transition *and* have high intra-industry heterogeneity. Taking the example of the

Table IV. Annual green taste effect estimates by industry

For all forty-six investable SIC industries, this table reports the estimates of the annual taste effect $\hat{\delta}_{\text{taste}}\tilde{p}\tilde{c}_{I_k} + \hat{\delta}_{\text{taste}}\tilde{p}\tilde{c}_{m_l}\beta_{I_k m_l}$, which is the sum of the taste premium and the market effect. The market effect, $\hat{\delta}_{\text{taste}}\tilde{p}\tilde{c}_{m_l}\beta_{I_k m_l}$, accounts for only 0.25 bps in the total taste effect. The industries are ranked in descending order of their taste effect.

Industry name	Taste effect (%)	Industry name	Taste effect (%)
Defense	0.14	Transportation	0.02
Aircraft	0.12	Business services	0.01
Coal	0.12	Computers	0.01
Printing and publishing	0.1	Automobiles and trucks	0
Precious metals	0.1	Shipping containers	0
Non-metallic and industrial metal mining	0.09	Consumer goods	−0.02
Agriculture	0.07	Fabricated products	−0.02
Entertainment	0.07	Healthcare	−0.03
Personal services	0.07	Food products	−0.04
Candy and soda	0.06	Medical equipment	−0.04
Petroleum and natural gas	0.06	Rubber and plastic products	−0.05
Communication	0.06	Textiles	−0.05
Trading	0.06	Chips	−0.06
Retail	0.05	Shipbuilding and railroad equipment	−0.07
Banking	0.05	Wholesale	−0.09
Pharmaceutical products	0.04	Utilities	−0.1
Meals	0.04	Business supplies	−0.1
Insurance	0.04	Machinery	−0.13
Clothes apparel	0.03	Construction materials	−0.37
Chemicals	0.03	Construction	−0.37
Steel works	0.03	Measuring and control equipment	−0.43
Real estate	0.03	Electrical equipment	−0.44
Recreation	0.02	Other	−1.12

estimation using scopes 1 and 2 carbon emissions, the electrical equipment and utilities industries have an annual taste effect differential of 2.46% and 0.68%, respectively. Notably, the electrical equipment industry has the lowest average taste effect (see Table IV; −0.44% per year, apart from the special case of the "Other" industry). Conversely, the coal industry has one of the highest average taste effects (0.12% per year) but almost no within-industry taste effect differential, reflecting the very similar treatment by sustainable investors of all coal companies, which are substantially underweighted, regardless of their carbon emissions.

The taste premium associated with sustainable investors' underweighting of certain assets can have a substantial effect both at the industry and firm levels. Therefore, environmental integration can be a valuable tool for sustainable investors willing to have an impact on companies' practices by raising their cost of capital. Their effect will be all the greater the higher their proportion of wealth.

Table V. Cross-sectional regressions for investable stock industry-carbon emissions double-sorted portfolios with tastes for green firms

This table presents the estimates of the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for 138 investable stock industry-carbon emissions double-sorted portfolios for the period from December 31, 2007 to December 31, 2019. For each industry, we build three portfolios that correspond to the first, second, and third terciles ranked by carbon emissions. In Panel A, we focus on scopes 1 and 2 emissions, while in Panel B, we use scopes 1–3 emissions. The specification of the S-CAPM is as follows: $\mathbb{E}(r_{I_k}) = \alpha + \delta_{\text{mkt}}\beta_{I_k m_I} + \delta_{\text{taste}}\tilde{p}\tilde{c}_{I_k} + \delta_{\text{ex.mkt}} q \mathbb{C}\text{ov}(r_{I_k}, r_{m_X} | r_{m_I})$, where r_{I_k} is the value-weighted excess return on industry portfolio I_k ($k = 1, \ldots, n_I$), $\beta_{I_k m_I}$ is the slope of an OLS regression of r_{I_k} on r_{m_I}; $\tilde{p}$ is the proxy for the proportion of sustainable investors' wealth; $\tilde{c}_{I_k}$ is the proxy for the cost of environmental externalities of industry I_k; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{I_k}, r_{m_X} | r_{m_I})$ is the covariance of the excess return on portfolio I_k with that of the excluded market, the excess returns on the investable market being given. This specification is compared with the 4F S-CAPM, which is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) MOM factor are added. These specifications are estimated using the Fama and MacBeth (1973) procedure. First, the variables are estimated portfolio-by-portfolio in a 3-year rolling window at monthly intervals. In the second pass, a cross-sectional regression is performed month-by-month on all the portfolios. The estimated parameter is the average value of the estimates obtained on the 109 months during the period. *t*-Values, estimated following Newey and West (1987) with three lags, are reported between parentheses. The last column reports the average OLS adjusted R^2 and the GLS R^2 on the row underneath. The 95% confidence intervals are shown in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{\text{ex.mkt}}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Panel A: Double-sorted industry-carbon emissions (Scopes $1+2$) portfolios								
Estimate	0.0134	0.0005						0.05 [0.04, 0.07]
t-value	(10)	(0.35)						0.06 [0.05, 0.08]
Estimate	0.0141		0.1945					0 [0, 0]
t-value	(19.19)		(1.62)					0.01 [0, 0.01]
Estimate	0.014			62.5				0.03 [0.02, 0.04]
t-value	(21)			(1.55)				0.04 [0.03, 0.05]
Estimate	0.0135	0.0005	0.2519					0.05 [0.04, 0.07]
t-value	(9.81)	(0.33)	(2.03)					0.07 [0.05, 0.08]
Estimate	0.0136	0.0004	0.1956	36.9				0.07 [0.05, 0.09]
t-value	(10.1)	(0.31)	(1.54)	(0.93)				0.09 [0.07, 0.11]
Estimate	0.0126	0.0021	0.1437	−123.9	0.0001	−0.0002	−0.0001	0.17 [0.14, 0.19]
t-value	(10.93)	(1.74)	(1.61)	(−2.42)	(0.9)	(−1.18)	(−2.71)	0.2 [0.18, 0.23]
Panel B: Double-sorted industry-carbon emissions (Scope $1+2+3$) portfolios								
Estimate	0.0129	0.0009						0.05 [0.04, 0.07]
t-value	(10.47)	(0.71)						0.06 [0.05, 0.08]
Estimate	0.0143		0.2765					0 [0, 0]
t-value	(19.35)		(2.37)					0.01 [0, 0.01]
Estimate	0.014			77				0.04 [0.03, 0.06]
t-value	(21.11)			(1.95)				0.05 [0.04, 0.07]
Estimate	0.0131	0.0009	0.3222					0.06 [0.04, 0.07]
t-value	(10.26)	(0.69)	(2.63)					0.07 [0.05, 0.09]
Estimate	0.0134	0.0007	0.2696	54.3				0.08 [0.06, 0.1]
t-value	(11.12)	(0.56)	(2.16)	(1.38)				0.1 [0.08, 0.12]
Estimate	0.0123	0.0024	0.185	−79.7	0.0001	−0.0002	−0.0001	0.19 [0.16, 0.22]
t-value	(11.67)	(2.03)	(2.13)	(−1.49)	(0.5)	(−0.97)	(−1.17)	0.23 [0.2, 0.25]

Table VI. Annual taste effect spread by industry between the 33% greenest companies and the 33% brownest companies

For all forty-six investable SIC industries, this table reports the estimates of the annual spread between the taste effect of the tercile of the brownest companies and that of the greenest companies. The estimation is made for both scopes 1 and 2 emissions and scopes 1–3 emissions.

Annual taste effect (%)

Industry name	Industry-carbon emissions (Scope 1 + 2)			Industry-carbon emissions (Scope 1 + 2 + 3)		
	Diff. in brown versus green tercile	Brown tercile	Green tercile	Diff. in brown versus green tercile	Brown tercile	Green tercile
Electrical equipment	2.46	−0.23	−2.69	3.2	−0.42	−3.62
Other	1.59	−0.91	−2.5	2.23	−1.2	−3.43
Machinery	1.15	−0.02	−1.17	1.4	−0.11	−1.51
Construction materials	0.93	−0.3	−1.23	1	−0.47	−1.47
Utilities	0.68	0.02	−0.66	1.06	0.02	−1.04
Textiles	0.62	0.12	−0.5	0.74	0.16	−0.58
Shipbuilding and railroad equipment	0.56	0.06	−0.5	0.71	0.02	−0.69
Computers	0.4	0.05	−0.35	0.97	0.07	−0.9
Healthcare	0.29	0.03	−0.26	0.46	0.07	−0.39
Aircraft	0.24	0.16	−0.08	0.35	0.23	−0.12
Wholesale	0.2	−0.01	−0.21	0.47	−0.01	−0.48
Non-metal. and indus. metal mining	0.19	0.15	−0.04	0.31	0.21	−0.1
Chips	0.19	−0.01	−0.2	0.22	0.01	−0.21
Automobiles and trucks	0.18	0.08	−0.1	0.29	0.12	−0.17
Food products	0.15	−0.03	−0.18	0.2	−0.05	−0.25
Transportation	0.15	0.05	−0.1	0.14	0.07	−0.07
Fabricated products	0.14	0.08	−0.06	0.16	0.07	−0.09
Business supplies	0.12	0.07	−0.05	0.02	0.09	0.07
Steel works	0.08	0.06	−0.02	0.24	0.14	−0.1
Defense	0.06	0.18	0.12	0.08	0.24	0.16
Personal services	0.06	0.09	0.03	0.04	0.13	0.09
Agriculture	0.05	0.14	0.09	0.1	0.19	0.09
Precious metals	0.05	0.13	0.08	0.07	0.18	0.11
Chemicals	0.03	0.03	0	0.06	0.04	−0.02
Coal	0.03	0.14	0.11	0.04	0.19	0.15
Business services	0.02	0.03	0.01	0.02	0.04	0.02
Petroleum and natural gas	0.01	0.08	0.07	0.02	0.11	0.09
Medical equipment	0.01	−0.02	−0.03	0.03	−0.03	−0.06
Retail	0	0.07	0.07	−0.03	0.09	0.12
Insurance	0	0.05	0.05	−0.03	0.06	0.09
Trading	0	0.06	0.06	−0.03	0.08	0.11
Rubber and plastic products	−0.02	0.03	0.05	0.03	0.03	0
Printing and publishing	−0.03	0.09	0.12	−0.08	0.13	0.21
Cand and soda	−0.03	0.07	0.1	−0.06	0.09	0.15
Entertainment	−0.03	0.08	0.11	−0.06	0.11	0.17

(continued)

Table VI. Continued

Annual taste effect (%)

Industry name	Industry-carbon emissions (Scope 1 + 2)			Industry-carbon emissions (Scope 1 + 2 + 3)		
	Diff. in brown versus green tercile	Brown tercile	Green tercile	Diff. in brown versus green tercile	Brown tercile	Green tercile
Communication	−0.04	0.06	0.1	−0.06	0.09	0.15
Measuring and control equip.	−0.04	−0.53	−0.49	−0.11	−0.77	−0.66
Real estate	−0.05	0	0.05	−0.08	−0.01	0.07
Consumer goods	−0.06	0	0.06	−0.02	0	0.02
Pharmaceutical products	−0.07	0.05	0.12	−0.07	0.07	0.14
Clothes apparel	−0.08	0	0.08	−0.18	−0.01	0.17
Banking	−0.09	0.05	0.14	−0.12	0.07	0.19
Meals	−0.11	0.04	0.15	−0.17	0.03	0.2
Recreation	−0.12	−0.03	0.09	−0.21	−0.05	0.16
Shipping containers	−0.13	−0.07	0.06	−0.25	−0.15	0.1
Construction	−0.38	−0.34	0.04	−0.46	−0.51	−0.05

4.2 Alternative Estimations

I perform alternative estimations, the results of which are available in the Online Appendix. First, the estimate of the taste premium is robust to a first-pass regression using a 5-year rolling window, and its significance increases. Second, when using equally weighted returns, the taste premium is not significant, but the exclusion-market premium becomes significant and positive, as predicted by the model. Third, I repeat the estimation using a set of 230 (= 46 × 5) industry-size portfolios doubly sorted by industry and market capitalization quintiles. The taste premium is significant and consistent with the estimation using industry portfolios. Finally, the estimated taste premium is significant and consistent with that of the main estimation when using only the proxy for the cost of externality, $\tilde{c}$, as the taste factor.

4.3 Reverse Causality Bias

The first concern is the risk of reverse causality bias through proxy $\tilde{c}$. In other words, is δ_{taste} significant because the return on industry I_k affects the relative weight differential between the market and sustainable investors' asset allocation in this industry, $\frac{w_{m,I_k} - w^*_{s,I_k}}{w_{m,I_k}}$? Since the industry weights of green investors and those of the market vary slowly over time, I repeat the regression using proxy $\tilde{c}$ lagged by 3 years to ensure that the returns estimated in the first pass of the Fama–MacBeth regression do not affect the proxy retroactively. The taste premium is highly significant (t-statistics of 3.09) and positive ($\hat{\delta}_{\text{taste}} = 0.47$). The estimate is robust to the inclusion of the SMB, HML, and MOM factors. Although the loading is higher than that of the main model, this estimation supports the significant effect of the taste premium on investable asset returns. The results are reported in the Online Appendix.

4.4 Unexpected Shifts in Tastes

As Bolton and Kacperczyk (2022) point out, the taste premium is intrinsically dynamic even if the environmental footprint of the considered company remains unchanged: unexpected changes in technologies, institutional and socio-political environment, climate policies, reputation, and investor awareness push sustainable investors to adjust their environmental tastes constantly, that is, the costs of externalities that they internalize. However, as emphasized by Pastor, Stambaugh, and Taylor (2021b), the adjustment of the costs of externalities has an impact on realized returns in the opposite direction of the effect on expected returns. For example, when the tastes for green companies increase over a period, a green asset can have a negative taste premium and yet outperform brown assets. Consequently, omitting to control for the unexpected changes in tastes when using realized returns as proxy for expected returns induces a critical omitted variable bias. The failure to account for the shifts in green investors' tastes due to unexpected environmental, societal, and economic changes may, therefore, partly explain why the results of the empirical analyses on the link between ESG and financial performance are mixed. Pastor, Stambaugh, and Taylor (2021b) suggest using the in- and out-flows of ESG-tilted funds as proxy for this effect. The analysis of green fund holdings thus offers a dual advantage: (i) constructing a proxy for the unexpected shifts in green investors' tastes at a monthly frequency that is (ii) homogeneous with the proxy for the taste premium. Therefore, I define the proxy for the unexpected shifts in green investors' tastes for asset I_k between $t-1$ and t as the variation of the taste factor between these two dates:

$$\Delta\tilde{p}_t\tilde{c}_{I_k,t} = \tilde{p}_t\tilde{c}_{I_k,t} - \tilde{p}_{t-1}\tilde{c}_{I_k,t-1}. \tag{17}$$

An increase (or decrease) in the taste factor should lead to a decrease (or increase) in the short-term returns. Indeed, when sustainable investors' tastes for firm I_k decrease ($\tilde{c}_{I_k}$ increases; hence, $\Delta\tilde{p}\tilde{c}_{I_k}$ increases), realized returns, r_{I_k}, should decrease; conversely, when sustainable investors' tastes for firm I_k increase ($\tilde{c}_{I_k}$ decreases; hence, $\Delta\tilde{p}\tilde{c}_{I_k}$ decreases), realized returns, r_{I_k}, should increase. A similar reasoning applies to $\tilde{p}$. Therefore, I perform a robustness check on the following augmented specification, and I expect the loading of $\Delta\tilde{p}\tilde{c}_{I_k}$ to be negative:

$$\mathbb{E}(r_{I_k}) = \alpha + \delta_{\text{mkt}}\beta_{I_k m_I} + \delta_{\text{taste}}\tilde{p}\tilde{c}_{I_k} + \delta_u\Delta\tilde{p}\tilde{c}_{I_k} + \delta_{\text{ex.mkt}}q\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I}). \tag{18}$$

Table VII, Panel A, reports the estimates for all industries. Although the taste premium is not significant in the augmented S-CAPM, it becomes significant when controlling for the SMB, HML, and MOM factors (hereinafter referred to as the *augmented 4F S-CAPM*). Its loading is in line with that estimated in the main specification. However, two industries have experienced massive divestments by green investors since 2012: the relative weights of the coal and construction industries in the portfolios of green investors relative to the market weights, $\tilde{c}$, have dropped from -0.48 to -0.93 and from 3.3 to 0.43, respectively, from December 2012 to December 2019. Therefore, I repeat the estimation by removing these outliers. Panel B presents the estimates for all industries except coal. The taste premium is significant in the absence of the exclusion-market premium and remains significant for the augmented 4F S-CAPM. The estimates are in line with those of the main estimation. Panel C presents the estimates for all industries except coal and construction. The taste premium is highly significant for the augmented S-CAPM and the augmented 4F S-CAPM. The loading is twice as high for the augmented S-CAPM than for the S-CAPM but is similar for the

Table VII. Cross-sectional regressions for investable stock industry-sorted portfolios with tastes for green firms and unexpected shifts in tastes

This table presents the estimates of the *augmented S-CAPM* with unexpected shifts in tastes on the value-weighted monthly returns in excess of the 1-month T-Bill for forty-six investable stock industry-sorted portfolios for the period from December 31, 2007 to December 31, 2019. Panels A–C present the estimates on all industries, all industries without the coal industry, and all industries without the coal and construction industries, respectively. The specification is written as follows: $\mathbb{E}(r_{I_k}) = \alpha + \delta_{\text{mkt}}\beta_{I_k m_I} + \delta_{\text{taste}}\tilde{p}\tilde{c}_{I_k} + \delta_u \Delta\tilde{p}\tilde{c}_{I_k} + \delta_{\text{ex.mkt}} q \mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I})$, where r_{I_k} is the value-weighted excess return on industry portfolio I_k ($k = 1, \ldots, n_I$); $\beta_{I_k m_I}$ is the slope of an OLS regression of r_{I_k} on r_{m_I}; $\tilde{p}$ is the proxy for the proportion of sustainable investors' wealth; $\tilde{c}_{I_k}$ is the proxy for the cost of environmental externalities of industry I_k; $\Delta\tilde{p}\tilde{c}_{I_k}$ is the proxy for the unexpected shifts in tastes; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_k with that of the excluded market, the excess returns on the investable market being given. This specification is compared with the *augmented 4F S-CAPM*, which is the augmented S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) MOM factor are added. These specifications are estimated using the Fama and MacBeth (1973) procedure. First, the variables are estimated portfolio-by-portfolio in a 3-year rolling window at monthly intervals. In the second pass, a cross-sectional regression is performed month-by-month on all the portfolios. The estimated parameter is the average value of the estimates obtained on the 109 months during the period. *t*-Values, estimated following Newey and West (1987) with three lags, are reported between parentheses. The last column reports the average OLS adjusted R^2 and the GLS R^2 on the row underneath. The 95% confidence intervals are shown in brackets.

	α	δ_{mkt}	δ_{taste}	δ_u	$\delta_{\text{ex.mkt}}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Panel A: All industries									
Estimate	0.0145	0.0003	−0.1562	−18.5					0.03 [0.01, 0.05]
t-value	(12.94)	(0.31)	(−1.05)	(−2.22)					0.1 [0.08, 0.11]
Estimate	0.014	0.001	−0.1977	−14.9	46.3				0.08 [0.06, 0.11]
t-value	(10.67)	(0.96)	(−1.44)	(−1.78)	(0.62)				0.16 [0.14, 0.18]
Estimate	0.015	0.0022	0.2496	−9.3	−113.6	0.0001	0.0004	0.000	0.22 [0.18, 0.26]
t-value	(14.91)	(2.43)	(1.69)	(−1.27)	(−2.01)	(0.39)	(2.1)	(−0.17)	0.34 [0.31, 0.37]
Panel B: All industries without the coal industry (SIC 29)									
Estimate	0.0136	0.0015	0.1879	−8.8					0.02 [0, 0.05]
t-value	(16.68)	(1.84)	(1.66)	(−1.32)					0.09 [0.07, 0.11]
Estimate	0.0132	0.0021	0.0983	−8.3	82.1				0.03 [0.01, 0.06]
t-value	(18.39)	(2.53)	(0.89)	(−1.19)	(1.57)				0.12 [0.1, 0.14]
Estimate	0.014	0.002	0.2704	−8.7	15.9	0.0002	0.0001	0.0002	0.13 [0.09, 0.16]
t-value	(19.46)	(2.13)	(1.87)	(−1.27)	(0.3)	(1.96)	(0.62)	(2.09)	0.27 [0.24, 0.29]
Panel C: All industries without the coal (SIC 29) and construction (SIC 18) industries									
Estimate	0.0137	0.0014	0.3642	−13.2					0.03 [0, 0.05]
t-value	(16.35)	(1.68)	(3.08)	(−1.94)					0.09 [0.07, 0.11]
Estimate	0.0132	0.002	0.2947	−12.7	80.4				0.03 [0.01, 0.06]
t-value	(17.64)	(2.42)	(2.39)	(−1.77)	(1.54)				0.12 [0.1, 0.15]
Estimate	0.0141	0.0019	0.546	−12.7	9.8	0.0003	0.0001	0.0002	0.13 [0.1, 0.16]
t-value	(18.83)	(1.9)	(3.06)	(−1.68)	(0.19)	(2.08)	(0.61)	(2.13)	0.27 [0.24, 0.3]

augmented 4F S-CAPM and the 4F S-CAPM. In addition, the premium for the unexpected shifts in tastes becomes significant and, as expected, its loading is negative. Finally, under the augmented S-CAPM, when the coal or the coal and construction industries are removed, the exclusion-market premium is weakly significant and positive, as predicted by the model.

4.5 Taste Effect over Time

I analyze the dynamics of the taste premium by repeating the estimation over several sub-periods. Given the violent effect induced by the divestment from the coal industry in the period 2012–19 and the short periods over which these estimations are carried out, the latter are performed on all industries except coal in this subsection.

First, I repeat the estimation over three consecutive sub-periods within the period 2007–19. The significance of the taste premium increases over time, reaching a *t*-statistic of 7.27 between 2013 and 2019. In addition, although the average taste premium is stable over time, the difference in taste premium between the brown and green industries increases. This spread between the petroleum and natural gas industry and the electrical equipment industry increased from 50 bps in the period 2007–13 to 1.23% in the period 2013–19.[28] The detailed tables are available in the Online Appendix. Second, I repeat the estimation over 3-year rolling periods for the second pass. The dynamics depicted in Figure 2 show the steady increase in the taste effect spread between the petroleum and natural gas and electrical equipment industries.

5. Sin Stock Returns

I perform an empirical analysis to assess the effect of sustainable investors' exclusion of sin stocks and the indirect effect of their green tastes on sin stocks' excess returns. I show that the exclusion premia significantly impact the excess returns. I also find evidence supporting the cross-effect of green tastes on sin stocks' excess returns.

5.1 Main Estimation

I estimate the following three models. (i) The *S-CAPM*, corresponding to Equation (15):

$$\mathbb{E}(r_{X_k}) = \alpha + \delta_{\text{mkt}}\beta_{X_k m_I} + \delta_{\text{taste}}\tilde{p}B_{X_k I}\tilde{C} + \delta_{\text{ex.asset}}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_I) + \delta_{\text{ex.mkt}}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_{m_I}); \quad (19)$$

(ii) the *four-factor S-CAPM* (denoted as *4F S-CAPM*), corresponding to the S-CAPM specification to which the SMB, HML, and MOM betas are added; and (iii) for benchmarking purposes, the *four-factor model* (denoted as *4F model*), corresponding to the CAPM with respect to the investable market returns to which the SMB, HML, and MOM betas are added.

In the same way as for investable assets, I estimate the models using a two-pass regression on seventy-seven single sin stocks in the period from December 1999 to December 2019, for an annual average number of forty-one stocks.[29] Given the substantial noise that

28 The taste effect is higher when the coal industry is removed compared with the entire period in the main estimation.

29 In the robustness check that includes the defense industry, and I work with ninety-eight sin stocks, giving an annual mean number of fifty-one stocks.

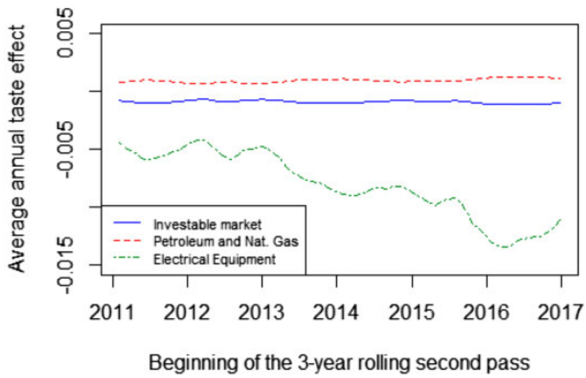

Figure 2. Evolution of the taste effect. This figure shows the evolution of the taste effect for the investable market, the petroleum and natural gas industry, and the electrical equipment industry in the period from December 2007 to December 2019. The first and second passes are both estimated over 3-year rolling periods.

occurs when performing regressions on a small number of single stocks, especially when several of them have extreme return variations, I trim the returns at the 3% level, which corresponds, on average, to removing the highest outlier and lowest outlier in each cross-sectional regression. As a robustness check, I also perform the estimation on winsorized returns.

Table VIII reports the estimates of the three specifications for sin stocks using industry-sorted portfolios of investable assets. The OLS adjusted R^2 of 14% is higher under the S-CAPM than under the 4F model (11%). In addition, the estimation of the exclusion premia supports the model predictions. First, the loadings of the exclusion-asset and exclusion-market factors are positive ($\hat{\delta}_{\text{ex.asset}} = 91.5$ and $\hat{\delta}_{\text{ex.index}} = 79.5$, respectively) and significant (t-statistics of 3.75 and 2.42, respectively). The estimates are robust to the inclusion of the SMB, HML, and MOM factors. As shown in the Online Appendix, albeit slightly lower, the estimates are robust to winsorizing the returns. Second, the taste premium is positive ($\hat{\delta}_{\text{taste}} = 1.8$) and significant ($t$-statistics of 1.62).

I estimate the exclusion effect as follows. For each sin stock, I calculate the individual exclusion effect as the average over time of the sum of the estimated exclusion-asset and exclusion-market premia. The exclusion effect is the average over all sin stocks of the individual exclusion effects. For the period from December 1999 to December 2019, the exclusion effect is 2.79% per year. This effect is of a similar magnitude as the one estimated on US sin stocks by Hong and Kacperczyk (2009) for the period 1965–2006 (2.5%). However, it is substantially lower than the annual 16% effect estimated by Luo and Balvers (2017) for the period 1999–2012 and based on the same modeling framework (in the absence of green tastes). Additionally, consistent with Proposition 3, I find that the exclusion effect is, on average, positive, but it is negative for thirty-three out of seventy-seven sin stocks (Figure 3).

Calculated similarly, the average taste premium on sin stocks' excess returns is 1.1% per year, which corresponds to the compensation required by regular investors to hold sin stocks due to their correlation with the brownest investable stocks. The taste premium amounts to 28% (= 1.1%/[1.1% + 2.79%]) of the total effect induced on sin stocks' cost of capital by sustainable investors practicing exclusion and environmental integration.

Table VIII. Cross-sectional regressions on sin stocks' excess returns

This table provides the estimates obtained with the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for seventy-seven sin stocks for the period from December 31, 1999 to December 31, 2019. The specification is as follows: $\mathbb{E}(r_{X_k}) = \alpha + \delta_{\text{mkt}}\beta_{X_k m_I} + \delta_{\text{taste}}\tilde{p}B_{X_k I}\tilde{C} + \delta_{\text{ex.asset}}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_I) + \delta_{\text{ex.mkt}}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_{m_I})$, where r_{X_k} is the value-weighted excess return on stock X_k ($k = 1, \dots, n_X$), and $\beta_{X_k m_I}$ is the slope of an OLS regression of r_{X_k} on r_{m_I}; $\tilde{p}B_{X_k I}\tilde{C}$ is the proxy for the taste factor and $\tilde{p}$ is the proxy for the proportion of sustainable investors' wealth; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_I)$ (and $\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_{m_I})$) are the covariances of the excess returns on stock X_k with those on the excluded market, the excess returns on the investable market (and the vector of investable assets, respectively) being given. The investable assets are analyzed using forty-six industry-sorted portfolios. The S-CAPM specification is compared with two other specifications: (i) the 4F S-CAPM, which is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) MOM factor have been added and (ii) the 4F model, which is the CAPM with respect to the investable market to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) MOM factor have been added: $\mathbb{E}(r_{X_k}) = \alpha + \delta_{\text{mkt}}\beta_{X_k m_I} + \delta_{\text{SMB}}\beta_{X_k\text{SMB}} + \delta_{\text{HML}}\beta_{X_k\text{HML}} + \delta_{\text{MOM}}\beta_{X_k\text{MOM}}$. These specifications are estimated using the Fama and MacBeth (1973) procedure. First, the variables are estimated, stock-by-stock, in a 3-year rolling window, at monthly intervals. In the second pass, a cross-sectional regression is performed on a monthly basis on all the stocks. The returns are trimmed at the 3% level, which corresponds, on average, to removing the highest outlier and lowest outlier in each cross-sectional regression. The estimated parameter is the average value of the estimates obtained on all months during the period of interest. t-Values, estimated following Newey and West (1987) with three lags, are reported between parentheses. The last column reports the average OLS adjusted R^2 and the GLS R^2 on the row underneath. The 95% confidence intervals are in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{\text{ex.asset}}$	$\delta_{\text{ex.mkt}}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0119	0.0017							0.03 [0.02, 0.04]
t-value	(9.53)	(1.79)							0.04 [0.03, 0.05]
Estimate	0.0135		0.5733						0.03 [0.02, 0.04]
t-value	(9.99)		(0.61)						0.07 [0.06, 0.09]
Estimate	0.0129			32.6					0.05 [0.03, 0.06]
t-value	(9.23)			(1.89)					0.06 [0.05, 0.07]
Estimate	0.0118				73				0.08 [0.06, 0.1]
t-value	(9.13)				(2.61)				0.09 [0.08, 0.11]
Estimate	0.012			79.8	70.4				0.1 [0.08, 0.12]
t-value	(8.88)			(3.76)	(2.3)				0.15 [0.13, 0.17]
Estimate	0.0118	−0.0003		98.1	84.7				0.12 [0.1, 0.14]
t-value	(8.91)	(−0.28)		(4.1)	(2.47)				0.19 [0.16, 0.21]
Estimate	0.0124	−0.0013	1.8	91.5	79.5				0.14 [0.12, 0.16]
t-value	(9.43)	(−0.98)	(1.62)	(3.75)	(2.42)				0.24 [0.22, 0.26]
Estimate	0.0124	0.0000	1.7	107.2	72.5	−0.0001	−0.0002	0.0004	0.23 [0.2, 0.25]
t-value	(9.63)	(−0.01)	(1.45)	(3.81)	(1.89)	(−0.6)	(−1.01)	(2.41)	0.38 [0.36, 0.4]
Estimate	0.0124	0.0008				0.0000	−0.0002	0.0004	0.11 [0.09, 0.13]
t-value	(10)	(0.65)				(−0.27)	(−1.42)	(2.26)	0.19 [0.17, 0.21]

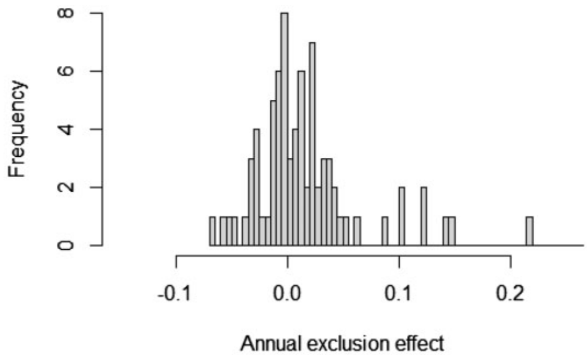

Figure 3. Distribution of the annual exclusion effect. This figure shows the distribution of the annual exclusion effect, $\hat{\delta}_{\text{ex.asset}} q\mathbb{C}\text{ov}_t(r_X, r_{m_X}|r_I) + \hat{\delta}_{\text{ex.mkt}} q\mathbb{C}\text{ov}_t(r_X, r_{m_X}|r_{m_I})$, over all sin stocks estimated in the period from December 31, 1999 to December 31, 2019.

5.2 Alternative Estimations

I perform additional analyses presented in this subsection and detailed in the Online Appendix. In all robustness tests, the S-CAPM has higher OLS adjusted R^2 and GLS R^2 than those of the 4F model. I repeat the estimation in three alternative cases: (i) using a 5-year rolling window for the first pass, (ii) using equally weighted returns, and (iii) including the defense industry among sin industries. In all three cases, both exclusion premia are significant and the exclusion effect is of a similar magnitude to that in the main estimation.

5.3 Dynamics of Sustainable Investors' Wealth in the Exclusion-Asset Premium

Unlike the taste factor ($\tilde{p}B_{X_kI}\tilde{C}$) that takes into account the proxy for the proportion of sustainable investors' wealth, the exclusion-asset factor ($q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_I)$) does not incorporate it. Yet, the exclusion-asset *premium* ($\gamma\frac{p}{1-p}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_I)$) includes p. Therefore, I repeat the estimation using proxy $\tilde{p}$ in the following specification:

$$\begin{aligned}\mathbb{E}(r_{X_k}) = \alpha + \delta_{\text{mkt}}\beta_{X_k m_I} + \delta_{\text{taste}}\tilde{p}B_{X_kI}\tilde{C} \\ + \delta_{\text{ex.asset}}\frac{\tilde{p}}{1-\tilde{p}}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_I) + \delta_{\text{ex.mkt}}q\mathbb{C}\text{ov}(r_{X_k}, r_{m_X}|r_{m_I}).\end{aligned} \tag{20}$$

As expected, under the S-CAPM and the 4F S-CAPM, the estimates of both exclusion factors are significant and positive (see the Online Appendix). In addition, under the S-CAPM, the average annual exclusion effect is equal to 2.80%, in line with the one estimated using the main specification.

5.4 Exclusion Effect over Time

I estimate the S-CAPM over four consecutive periods within the 1999–2019 timeframe. In each period, at least one of the two exclusion factors is significant (see the Online Appendix). In addition, to highlight the dynamics of the exclusion effect, I repeat the second-pass estimation using a 3-year rolling window from 2002 to 2019 (blue line on Figure 4).[30] The average exclusion effect rose sharply and was high during the 2007–08

30 The second pass starts in 2002 because the variables are computed using a 3-year rolling window in the first pass.

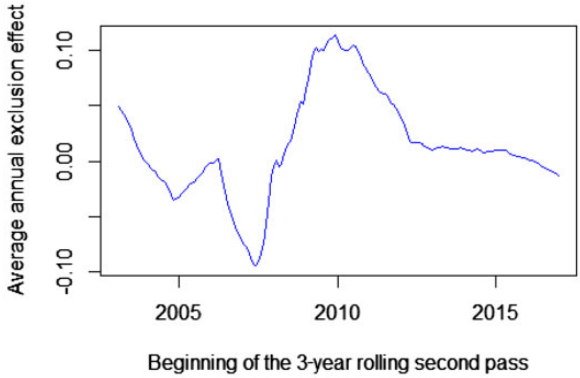

Figure 4. Evolution of the exclusion effect. This figure shows the evolution of the exclusion effect, $\hat{\delta}_{\text{ex.asset}} q\mathbb{C}\text{ov}(r_X, r_{m_X}|r_I) + \hat{\delta}_{\text{ex.mkt}} q\mathbb{C}\text{ov}(r_X, r_{m_X}|r_{m_I})$, estimated using a *rolling* S-CAPM, in the period from December 1999 to December 2019. The first and second passes are both estimated over 3-year rolling periods.

crisis as shown in Figure 4. Note that since the first pass of the estimation spans 3 years, the premia estimated in the second pass smoothen the effect of the crisis on the figure: the effect starts to materialize in 2008 (as the second pass uses the first pass 2005–08) and vanishes in 2012 (as the second pass uses the first pass 2009–12). This spike in the exclusion effect is explained by the fact that during the 2007–08 crisis, the covariances of each sin stock and the portfolio of sin stocks (*regular investor effect* in Corollary 1) increased faster than the covariances of the replicating portfolios (using non-sin stocks) of each sin stock and the portfolio of sin stocks (*sustainable investor effect* in Corollary 1). For an intuitive interpretation, the *sustainable investor effect* can be related to the correlation of the sin stocks with the portfolio of non-sin stocks. Therefore, the discrepancy between these two effects can be understood as sin stocks behaving increasingly like a homogeneous and separate group from other stocks. Consequently, the increase in the gap between these two effects during the crisis led to an increase in the exclusion premia and hence, the exclusion effect. In the Online Appendix, I show how these two effects varied throughout the whole period using a sample of sin stocks.

This result suggests that even in the presence of a limited number of sustainable investors and when averaged over all excluded assets, the effect of exclusionary screening on the targeted companies' cost of capital can be quite pronounced. Therefore, an opportune impact investing strategy would be to increase exclusionary screenings when the targeted assets have dynamics that diverge from all other assets.

5.5 Discussion: "Exit" versus "Voice" for Impact

Exclusionary screening and shareholder engagement are often compared as two opposing approaches to *impact investing*: while the former involves divesting from companies to increase their cost of capital and incentivize them to reform, the latter requires investing in companies to push them to improve their practices as an active shareholder.

Through a theoretical model, Broccardo, Hart, and Zingales (2020) study the relative effectiveness of exclusionary screening ("exit") and shareholder engagement ("voice") in promoting socially desirable outcomes in companies. They show that, for a sufficiently large number of sustainable investors, engagement is more effective than exclusion, notably because investors' individual incentives are aligned with social incentives. Indeed, they point out that the marginal impact of divestment is limited, especially when there are enough regular investors to buy the asset under consideration. Berk and van Binsbergen (2021) reach a similar conclusion by showing that the impact of exclusion on the cost of capital "can be closely approximated by a simple formula." Calibrating this formula on the FTSE USA and FTSE USA 4 Good indices for the period from December 2015 to December 2020, they find that the effect on the cost of capital is negligible—in the order of a few bps depending on the assumptions chosen.

In this article, I show that the effect of exclusionary screening on the cost of capital is not necessarily negligible. The conclusion differs from that of Berk and van Binsbergen (2021) for four main reasons. First, I show that the exclusion effect for a given asset is the sum of two conditional covariances, generalizing the premium on neglected stocks (Merton, 1987), while Berk and van Binsbergen (2021) find an approximation of the exclusion effect on the cost of capital. However, in the particular case where the excluded assets increasingly behave like a separate group from the other assets, the exclusion effect increases as in the approximation found by Berk and van Binsbergen (2021).[31] Second, I focus on sin stocks, whereas Berk and van Binsbergen (2021) analyze the broader scope of the stocks that are included in the FTSE USA but not in the FTSE USA 4 Good. Third, and most importantly, I carry out a dynamic empirical analysis on sin stocks from 1999 onward and show that although the average exclusion effect was small in the period 2015–20, as shown by Berk and van Binsbergen (2021), it was high during the 2007–08 crisis. Fourth, Berk and van Binsbergen (2021) estimate an average effect on an aggregate basis by comparing two indices and using their correlation, while here, I estimate the exclusion effect stock by stock, using the covariance matrix structure. Although negative for several stocks, the exclusion effect is positive and large for other stocks, in some cases above 10% annually (Figure 3).

However, exclusionary screening and shareholder engagement are not necessarily conflicting practices, and implementing them in concert may increase their efficiency. For example, the California State Teachers' Retirement System (CalSTRS), the largest teachers' retirement fund in the USA, managing approximately USD 320 billion as of January 2022, has a sustainable investment management process that involves both engagement and exclusion. The process is broken down into three stages (CalSTRS, 2017). When a company in the portfolio violates CalSTRS' ESG policy, (1) "CalSTRS will actively engage, in a constructive manner, corporate management whose actions are inconsistent with this policy." (2) "After all reasonable efforts have been made to constructively engage corporate management [...] and the corporate remedies are insufficient or nonresponsive, CalSTRS will inform [their] active investment managers that, to the extent suitable alternate investments are available [...], the managers will invest in these alternatives until the CalSTRS policy violations cease." (3) "Upon remedy of the policy violation, CalSTRS will inform the active investment managers and passive managers that the securities can be purchased [...]."

31 Rewritten with this papers' notation, Berk and van Binsbergen (2021) approximate the exclusion effect by $\mathbb{E}(r_m)\frac{p}{1-p}q(1-\rho^2)$, where ρ is the correlation between the excluded portfolio and the non-excluded portfolio.

6. Conclusion

In this article, I develop an asset pricing model with partial segmentation and heterogeneous preferences to describe the effects of exclusionary screening and integration practices by sustainable investors on expected asset returns. By estimating this model for sin stock exclusion and green investing, I show that the exclusion and taste premia significantly affect asset returns. I also find evidence for the cross effects of exclusion and tastes between investable and excluded stocks.

The findings suggest that the impact of sustainable investors on a company's cost of capital can be substantial in many cases. Therefore, without contradicting the implementation of shareholder engagement policies, exclusionary screening and ESG integration can be effective tools for contributing to the ecological transition.

The conclusions of the model presented in this article remain valid in a more general case. The Online Appendix presents the derivation of the expected excess returns on investable assets in the case of several sustainable investors with different tastes and exclusion scopes. Future empirical research could build on this study and that of Broccardo, Hart, and Zingales (2020) by disentangling the impacts of engagement and investment screening on companies' practices. In addition, impact investing is more efficient when sustainable investors account for the investments of all market players in their investment decision (Oehmke and Opp, 2020; Green and Roth, 2021) or when markets are subject to search frictions (Landier and Lovo, 2020). Another avenue for future research is to estimate the impact benefit when sustainable investors overweight poorly funded companies that are inclined to become greener in their portfolios rather than already well-funded green companies.

Data Availability

The data underlying this article were provided by CRSP, Compustat, FactSet, Bloomberg, and S&P-Trucost under licence. Data will be shared on request to the corresponding author with permission of CRSP, Compustat, FactSet, Bloomberg, or S&P-Trucost.

Supplementary Material

Supplementary data are available at *Review of Finance* online.

Funding

I gratefully acknowledge the financial support from the AXA Research Fund through the research initiative entitled *Climate risks in institutional asset allocation*.

Conflict of Interest

None declared.

Appendix A: Derivation of the S-CAPM and Main Proofs

Problem Setup

We model regular investors and sustainable investors on an aggregate basis: one generic regular investor (referred to using subscript r) and one generic sustainable investor (referred to using subscript s).

Heterogeneous preferences. The two groups of investors maximize at time t the expected utility of their terminal wealth at time $t+1$. We denote by γ_j^a the absolute risk aversion of investors j ($j \in \{r,s\}$) and by $W_{j,t}$ and $W_{j,t+1}$ their wealth on t and $t+1$, respectively.

However, investors have heterogeneous preferences. On the one hand, regular investors have an exponential utility. They select the optimal vector of weights of *risky assets*, w_j, corresponding to the solution of the following optimization problem:

$$\max_{w_r} \mathbb{E}\big(U_r(W_{r,t+1})\big) = \max_{w_r} \mathbb{E}\big(1 - \mathrm{e}^{-\gamma_r^a W_{r,t+1}}\big).$$

On the other hand, sustainable investors have specific tastes for assets; they adjust their exponential utility by internalizing a deterministic private cost of externalities as in Pastor, Stambaugh, and Taylor (2021b). We denote by C^W the vector of private costs of externalities that sustainable investors internalize in their utility function; C^W has the same unit as a wealth. Sustainable investors' utility decreases when the cost of externalities increases; they select the optimal vector of weights of *risky assets*, w_s, corresponding to the solution of the following optimization problem:

$$\max_{w_s} \mathbb{E}\big(U_s(W_{s,t+1})\big) = \max_{w_s} \mathbb{E}\big(1 - \mathrm{e}^{-\gamma_s^a W_{s,t+1} + w_s' C^W}\big).$$

In Pastor, Stambaugh, and Taylor (2021b), investors internalize nonpecuniary benefits, which positively impact their utility. In the present article, sustainable investors internalize costs of externalities, which negatively impact their utility.

Partially segmented market. Investors can invest in a risk-free asset, the return on which is denoted by r_f, and in risky assets. Sustainable investors can only invest in *investable* risky assets, the returns on which are denoted by the $n_I \times 1$ vector R_I, while regular investors can invest in *investable* and *excluded* risky assets, the returns on which are denoted by the $(n_I + n_X) \times 1$ vector $R = \begin{pmatrix} R_I & R_X \end{pmatrix}'$. We assume that risky asset returns are normally distributed.

Mean–variance problems. Without loss of generality, we assume that investors have the same relative risk aversion, $\gamma = W_{j,t}\gamma_j^a$ ($j \in \{r,s\}$). We denote by $C = \frac{1}{\gamma} C^W$ the vector of private costs of environmental externalities per unit of relative risk aversion; C has the same unit as a return. We now work with vector C and refer to its entries as the *private costs of environmental externalities* (without referring to the normalization by the risk aversion). C is a $n_I \times 1$ vector that applies to investable assets, which are the only ones that sustainable investors can trade. We denote by $r = R - r_f \mathbb{1}_{n_I+n_X}$, $r_I = R_I - r_f \mathbb{1}_{n_I}$, and $r_X = R_X - r_f \mathbb{1}_{n_X}$ the vectors of excess returns on all assets, investable assets, and excluded assets, respectively, where 1_n is the vector of ones of length $n \in \mathbb{N}^*$.

The weights of regular investors in investable and excluded assets are denoted by $w_{r,I}$ and $w_{r,X}$, respectively; the weights of sustainable investors in investable assets are denoted by $w_{s,I}$. All weights add up to one, including the weight of the risk-free asset. Since the wealth in $t+1$ is normally distributed and C^W is deterministic, sustainable investors' expected utility writes

$$\begin{aligned}\mathbb{E}\big(U_s(W_{s,t+1})\big) &= 1 - \mathbb{E}\Big(\mathrm{e}^{-\gamma_s^a W_{s,t}\left(1+w_{s,I}' R_I + \left(1-w_{s,I}' \mathbb{1}_{n_I}\right) r_f\right) + w_{s,I}' C^W}\Big) \\ &= 1 - \mathrm{e}^{-\gamma\left(1+r_f\right)} \mathrm{e}^{-\gamma w_{s,I}'(\mathbb{E}(r_I) - C) + \frac{\gamma^2}{2} w_{s,I}' \mathbb{V}\mathrm{ar}(r_I) w_{s,I}}.\end{aligned}$$

Similarly, regular investors' expected utility is

$$\mathbb{E}(U_r(W_{r,t+1})) = 1 - \mathrm{e}^{-\gamma(1+r_f)}\mathrm{e}^{-\gamma\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}'\mathbb{E}(r)+\frac{\gamma^2}{2}\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}'\mathbb{V}\mathrm{ar}(r)\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}}.$$

Let us also denote the vectors $\mu_I = \mathbb{E}_t(r_I)$, $\mu_X = \mathbb{E}_t(r_X)$ and the matrices $\Sigma_{XX} = \mathbb{V}\mathrm{ar}_t(r_X)$, $\Sigma_{II} = \mathbb{V}\mathrm{ar}_t(r_I)$, $\Sigma_{XI} = \mathbb{C}\mathrm{ov}_t(r_X, r_I)$, $\Sigma_{IX} = \mathbb{C}\mathrm{ov}_t(r_I, r_X)$. Therefore:

– Regular investors choose their optimal asset allocation by solving the following problem:

$$\max_{(w_{r,I},w_{r,X})} \begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}'\begin{pmatrix} \mu_I \\ \mu_X\end{pmatrix} - \frac{\gamma}{2}\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}'\begin{pmatrix} \Sigma_{II} & \Sigma_{IX} \\ \Sigma_{XI} & \Sigma_{XX}\end{pmatrix}\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}. \tag{A.1}$$

– Sustainable investors choose their optimal asset allocation by solving the following problem:

$$\max_{w_{s,I}} \quad w'_{s,I}(\mu_I - C) - \frac{\gamma}{2} w'_{s,I}\Sigma_{II} w_{s,I}. \tag{A.2}$$

First-order conditions. Denoting the inverse of the risk aversion by $\lambda = \frac{1}{\gamma}$, regular investors and sustainable investors therefore solve the following first-order conditions:

$$\begin{cases} \lambda(\mu_I - C) = \Sigma_{II} w_{s,I} \\ \lambda\begin{pmatrix} \mu_I \\ \mu_X\end{pmatrix} = \begin{pmatrix} \Sigma_{II} & \Sigma_{IX} \\ \Sigma_{XI} & \Sigma_{XX}\end{pmatrix}\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}. \end{cases} \tag{A.3}$$

Proof of Proposition 1: S-CAPM

Lemma 1 (Preliminary Results).

The covariance column vector between the vector of excess returns on investable assets, r_I, and the excess returns on the investable market, r_{m_I}, is denoted by σ_{Im_I}; $\sigma_{m_I I}$ refers to the covariance line vector between r_{m_I} and r_I. σ_{Xm_I} and $\sigma_{m_I X}$ are defined similarly.

We denote by q_X the weight vector of the excluded assets' market values as a fraction of the market value of the investment universe and $q \in [0, 1]$ the share of the excluded market's value as a fraction of the market value of the investment universe.

Assuming that the returns are normally distributed, σ_{m_I} is non-zero and Σ_{II} is nonsingular, we have the following equalities:

1. *(i)* $\Sigma_{XX} - \frac{1}{\sigma^2_{m_I}}\sigma_{Xm_I}\sigma_{m_I X} = \mathbb{V}\mathrm{ar}_t(r_X|r_{m_I})$,
   (ii) $\Sigma_{IX} - \frac{1}{\sigma^2_{m_I}}\sigma_{Im_I}\sigma_{m_I X} = \mathbb{C}\mathrm{ov}_t(r_I, r_X|r_{m_I})$,
   (iii) $\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} = \mathbb{V}\mathrm{ar}_t(r_X|r_I)$,
   (iv) $\sigma_{Xm_X} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{Im_X} = \mathbb{C}\mathrm{ov}_t(r_X, r_{m_X}|r_I)$.
2. $\mathbb{C}\mathrm{ov}_t(r_I, r_X|r_{m_I})q_X = q\mathbb{C}\mathrm{ov}_t(r_I, r_{m_X}|r_{m_I})$.

Proof: See the Online Appendix. □

From here on, the time subscripts will be omitted to simplify the notations.

Derivation of the expected excess returns on I. Multiplying the first rows of System (3) by the wealth of investors s and r, respectively, we have

$$\lambda(W_s + W_r)\mu_I - \lambda W_s C = \Sigma_{II}(W_s w_{s,I} + W_r w_{r,I}) + \Sigma_{IX}(W_r w_{r,X}). \quad \text{(A.4)}$$

Dividing by the total wealth W, and noting that $\frac{W_s}{W} = p$ and $\frac{W_r}{W} = 1 - p$, we obtain

$$\lambda\mu_I = \Sigma_{II}\left(\frac{W_s w_{s,I} + W_r w_{r,I}}{W}\right) + \Sigma_{IX}\left(\frac{W_r w_{r,X}}{W}\right) + \lambda p C. \quad \text{(A.5)}$$

Denoting by D_I and D_X the column vectors equal to the total demand for stocks I and X, respectively, we have $W_s w_{s,I} + W_r w_{r,I} = D_I$ and $W_r w_{r,X} = D_X$. Consequently,

$$\lambda\mu_I = \Sigma_{II}\frac{D_I}{W} + \Sigma_{IX}\frac{D_X}{W} + \lambda p C. \quad \text{(A.6)}$$

In equilibrium, the total demand of assets is equal to the total supply in the entire market (S). The same holds for the markets of investable (S_I) and excluded (S_X) assets: $W = S$, $D_I = S_I$, and $D_X = S_X$. The $(n_X \times 1)$ weight vectors of the excluded assets' values as a fraction of the market value are denoted by $q_X = \frac{S_X}{S}$. Therefore,

$$\lambda\mu_I = \Sigma_{II}\frac{S_I}{S} + \Sigma_{IX} q_X + \lambda p C. \quad \text{(A.7)}$$

We denote by q the proportion of the excluded market's value as a fraction of the market value of the investment universe. The share of the investable market's value is $1 - q$. Let us denote by w_I the vector of market values of stocks $(I_k)_{k\in\{1,\dots,n_I\}}$ as a fraction of the investable market's value. Therefore, we have $\frac{S_I}{S} = (1-q)w_I$, and Equation (A.7) rewrites

$$\lambda\mu_I = (1-q)\Sigma_{II} w_I + \Sigma_{IX} q_X + \lambda p C. \quad \text{(A.8)}$$

Multiplying by w'_I, we obtain

$$\lambda w'_I \mu_I = (1-q) w'_I \Sigma_{II} w_I + w'_I \Sigma_{IX} q_X + \lambda p w'_I C. \quad \text{(A.9)}$$

Since $w'_I \mu_I = \mu_{m_I}$ is the expected excess return on the investable market, and denoting $c_{m_I} = w'_I C$ and the row vector of covariances $\sigma_{m_I X} = w'_I \Sigma_{IX}$,

$$\lambda\mu_{m_I} = (1-q)\sigma^2_{m_I} + \sigma_{m_I X} q_X + \lambda p c_{m_I}. \quad \text{(A.10)}$$

Therefore, assuming $\sigma^2_{m_I} \neq 0$,

$$(1-q) = \frac{1}{\sigma^2_{m_I}}\left(\lambda\mu_{m_I} - \sigma_{m_I X} q_X - \lambda p c_{m_I}\right). \quad \text{(A.11)}$$

Substituting Equation (A.11) into Equation (A.8) and noting that the column vector of covariances is $\sigma_{I m_I} = \Sigma_{II} w_I$, we obtain

$$\mu_I = (\mu_{m_I} - p c_{m_I})\frac{1}{\sigma^2_{m_I}}\sigma_{I m_I} + pC + \gamma\left(\Sigma_{IX} - \frac{1}{\sigma^2_{m_I}}\sigma_{I m_I}\sigma_{m_I X}\right) q_X. \quad \text{(A.12)}$$

Denoting by $\beta_{I m_I} = \frac{1}{\sigma^2_{m_I}}\sigma_{I m_I}$ the vector of slope of the regression of the excess returns on the investable assets, r_I, on the excess returns on the investable market, r_{m_I}, and a constant, and from Lemma 1, we rewrite the above equation as follows using vector notations:

$$\mathbb{E}(r_I) = \left(\mathbb{E}(r_{m_I}) - p c_{m_I}\right)\beta_{I m_I} + pC + \gamma q \mathbb{C}\text{ov}(r_I, r_{m_X} | r_{m_I}). \quad \text{(A.13)}$$

Derivation of the expected excess returns on X. Assuming that Σ_{II} is nonsingular, the first row of System (3) yields

$$w_{r,I} = \Sigma_{II}^{-1}(\lambda\mu_I - \Sigma_{IX}w_{r,X}). \tag{A.14}$$

Substituting $w_{r,I}$ into the second row of System (3), we have

$$\lambda\mu_X = \lambda\Sigma_{XI}\Sigma_{II}^{-1}\mu_I - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}w_{r,X} + \Sigma_{XX}w_{r,X}. \tag{A.15}$$

Multiplying by $\frac{W_r}{W}$, we obtain

$$\lambda\frac{W_r}{W}\mu_X = \lambda\frac{W_r}{W}\Sigma_{XI}\Sigma_{II}^{-1}\mu_I - \frac{W_r}{W}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}w_{r,X} + \frac{W_r}{W}\Sigma_{XX}w_{r,X}. \tag{A.16}$$

Since in equilibrium $W = S$, and knowing that $(1-p) = \frac{W_r}{W}$ and $w_{r,X}\frac{W_r}{S} = q_X$, we have

$$\mu_X = \Sigma_{XI}\Sigma_{II}^{-1}\mu_I + \frac{\gamma}{1-p}\left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)q_X. \tag{A.17}$$

Substituting μ_I into the previous equation, and since $\sigma_{Im_I} = \Sigma_{II}w_I$,

$$\begin{aligned}\mu_X &= (\mu_{m_I} - pc_{m_I})\frac{1}{\sigma_{m_I}^2}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{II}w_I + p\Sigma_{XI}\Sigma_{II}^{-1}C \\ &\quad + \gamma\left(\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} - \frac{1}{\sigma_{m_I}^2}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{II}w_I\sigma_{m_I X}\right)q_X + \frac{\gamma}{1-p}\left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)q_X.\end{aligned} \tag{A.18}$$

By adding and subtracting $\gamma\Sigma_{XX}q_X$ to the previous equation,

$$\begin{aligned}\mu_X &= (\mu_{m_I} - pc_{m_I})\frac{1}{\sigma_{m_I}^2}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{II}w_I + p\Sigma_{XI}\Sigma_{II}^{-1}C \\ &\quad + \gamma\left(\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} - \Sigma_{XX}\right)q_X + \gamma\left(\Sigma_{XX} - \frac{1}{\sigma_{m_I}^2}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{II}w_I\sigma_{m_I X}\right)q_X \\ &\quad + \frac{\gamma}{1-p}\left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)q_X.\end{aligned} \tag{A.19}$$

We denote $\beta_{Xm_I} = \frac{1}{\sigma_{m_I}^2}\Sigma_{XI}w_I$ and $B_{XI} = \Sigma_{XI}\Sigma_{II}^{-1}$. Noting that $\frac{\gamma}{1-p} - \gamma = \gamma\frac{p}{1-p}$ and from Lemma 1, the previous equation is simplified as follows using vector notations:

$$\mathbb{E}(r_X) = \left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right)\beta_{Xm_I} + pB_{XI}C + \gamma\frac{p}{1-p}q\mathbb{C}\text{ov}(r_X, r_{m_X}|r_I) + \gamma q\mathbb{C}\text{ov}(r_X, r_{m_X}|r_{m_I}). \tag{A.20}$$

Derivation of the general pricing formula. For any investable asset I_k,

$$\mathbb{C}\text{ov}(r_{I_k}, r_{m_X}|r_I) = \sigma_{I_k m_X} - \sigma_{I_k I}\Sigma_{II}^{-1}\sigma_{Im_X} = \sigma_{I_k m_X} - \sigma_{I_k m_X} = 0, \tag{A.21}$$

and

$$B_{I_k I}C = \sigma_{I_k I}\Sigma_{II}^{-1}C = c_{I_k}. \tag{A.22}$$

Therefore, for any asset $k \in \{I_1, \ldots, I_{n_I}, X_1, \ldots, X_{n_X}\}$,

$$\mathbb{E}(r_k) = \beta_{km_I}\left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right) + pB_{kI}C + \gamma\frac{p}{1-p}q\mathbb{C}\text{ov}(r_k, r_{m_X}|r_I) + \gamma q\mathbb{C}\text{ov}(r_k, r_{m_X}|r_{m_I}). \tag{A.23}$$

Proof of Corollary 1: Expression of the Exclusion Premia as the Difference between a Regular Investor Effect and a Sustainable Investor Effect
(i) From the law of total covariance, we express the expectation of the conditional covariance as a difference between two covariances:

$$\mathbb{E}(\mathbb{C}\text{ov}(r_k, r_{m_X}|r_I)) = \mathbb{C}\text{ov}(r_k, r_{m_X}) - \mathbb{C}\text{ov}(\mathbb{E}(r_k|r_I), \mathbb{E}(r_{m_X}|r_I)). \tag{A.24}$$

Since the conditional covariance of multivariate normal distributions is independent of the conditioning variable (see Lemma 1), $\mathbb{E}(\mathbb{C}\text{ov}(r_k, r_{m_X}|r_I)) = \mathbb{C}\text{ov}(r_k, r_{m_X}|r_I)$. By multiplying the previous equation by $\gamma\frac{p}{1-p}q$, we obtain the expected result.

(ii) The proof is analogous for the exclusion-market premium.

Proof of Proposition 3: Sign of the Exclusion Premia
(i) Let us focus on the exclusion-asset premium. Since $\gamma, q \geq 0$, and $p \in [0,1]$, $\gamma\frac{p}{1-p}q$ is positive.

As shown in Lemma 1, the conditional covariance is equal to

$$q\mathbb{C}\text{ov}(r_X, r_{m_X}|r_I) = \left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)q_X. \tag{A.25}$$

When there is at least one excluded asset, that is, $q > 0$ and $q_X \neq \mathbb{0}_{n_X}$, denoting by $w_X = \frac{1}{q}q_X > 0$ the vector of weights of assets X in the excluded market, we express the covariance matrix as the product of a Schur complement by a strictly positive vector of weights:

$$\mathbb{C}\text{ov}(r_X, r_{m_X}|r_I) = \left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)\frac{1}{q}q_X = \left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)w_X. \tag{A.26}$$

However, Σ_{II} is positive-definite (because it is nonsingular positive semidefinite) and with $\begin{pmatrix} \Sigma_{II} & \Sigma_{IX} \\ \Sigma_{XI} & \Sigma_{XX} \end{pmatrix}$ being positive semidefinite, Schur complement $\left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)$ is positive semidefinite. Therefore, the exclusion-asset effects for assets X are the elements of the vector being the product of a semidefinite positive matrix by a strictly positive vector of weights. Consequently, not all elements of this vector are necessarily positive.

The same applies to the exclusion-market premium.

(ii) The expected excess return of the excluded market $\mathbb{E}(r_{m_X})$ is obtained by multiplying the vector of excluded assets' expected excess returns $\mathbb{E}(r_X)$ by their weight in the excluded market w'_X:

$$\begin{aligned}\mathbb{E}(r_{m_X}) = {} & (\mathbb{E}(r_{m_I}) - pc_{m_I})w'_X\beta_{Xm_I} + pw'_X B_{XI}C \\ & + \gamma\frac{p}{1-p}qw'_X\mathbb{C}\text{ov}(r_X, r_{m_X}|r_I) + \gamma q w'_X\mathbb{C}\text{ov}(r_X, r_{m_X}|r_{m_I})\end{aligned}. \tag{A.27}$$

Since the covariance and the conditional covariance are bilinear, we have

$$\mathbb{E}(r_{m_X}) = \beta_{m_X m_I}(\mathbb{E}(r_{m_I}) - pc_{m_I}) + pB_{m_X I}C + \gamma\frac{p}{1-p}q\mathbb{V}\text{ar}(r_{m_X}|r_I) + \gamma q\mathbb{V}\text{ar}(r_{m_X}|r_{m_I}). \tag{A.28}$$

Let $\rho_{m_X m_I}$ be the correlation coefficient between the excess returns on the excluded market, m_X, and those on the investable market, m_I, and $\rho_{m_X I}$ be the multiple correlation coefficient between the excess returns on the excluded market, m_X, and those on the vector of investable assets' excess returns, I. Since $\mathbb{V}\text{ar}(r_{m_X}|r_I) = \mathbb{V}\text{ar}(r_{m_X})\left(1 - \rho_{m_X I}\right)$ and

$\mathbb{V}\text{ar}(r_{m_X}|r_{m_I}) = \mathbb{V}\text{ar}(r_{m_X})(1-\rho_{m_X m_I})$ (because the returns are Gaussian), the positivity of the exclusion premia follows.

Proof of Proposition 4: Cost of Externalities

Let $w^*_{r,I}$ and $w^*_{r,X}$ be regular investors' optimal weight vector of investable and excluded assets, respectively; $w^*_{s,I}$ is sustainable investors' weight vector of investable assets.

Intuition of the proof. By substituting the first-order condition of sustainable investors into the first-order condition of regular investors via risk aversion $\gamma = \frac{1}{\lambda}$ (using system of Equation (3)), the cost of externalities of asset $I_k, k \in \{1, \ldots, n_I\}$, is

$$c_{I_k} = \frac{\mathbb{C}\text{ov}(r_{I_k}, r'_I)(w^*_{r,I} - w^*_{s,I}) + \mathbb{C}\text{ov}(r_{I_k}, r'_X)w^*_{r,X}}{\mathbb{C}\text{ov}(r_{I_k}, r'_I)w^*_{r,I} + \mathbb{C}\text{ov}(r_{I_k}, r'_X)w^*_{r,X}}\mathbb{E}(r_{I_k}). \tag{A.29}$$

Proof: Let us focus on asset I_k. We assume that asset returns are independent (assumption (i)). From System (3),

$$w^*_{r,I_k} = \lambda\frac{\mathbb{E}(r_{I_k})}{\mathbb{V}\text{ar}(r_{I_k})}, \quad w^*_{s,I_k} = \lambda\frac{\mathbb{E}(r_{I_k}) - c_{I_k}}{\mathbb{V}\text{ar}(r_{I_k})}. \tag{A.30}$$

But, the market weight of I_k is

$$w_{m,I_k} = (1-p)\lambda\frac{\mathbb{E}(r_{I_k})}{\mathbb{V}\text{ar}(r_{I_k})} + p\lambda\frac{\mathbb{E}(r_{I_k}) - c_{I_k}}{\mathbb{V}\text{ar}(r_{I_k})} = \lambda\frac{\mathbb{E}(r_{I_k})}{\mathbb{V}\text{ar}(r_{I_k})} - p\lambda\frac{c_{I_k}}{\mathbb{V}\text{ar}(r_{I_k})}.$$

Therefore,

$$\frac{w_{m,I_k} - w^*_{s,I_k}}{w_{m,I_k}}\mathbb{E}(r_{I_k}) = \frac{\lambda\frac{\mathbb{E}(r_{I_k})}{\mathbb{V}\text{ar}(r_{I_k})} - p\lambda\frac{c_{I_k}}{\mathbb{V}\text{ar}(r_{I_k})} - \lambda\frac{\mathbb{E}(r_{I_k}) - c_{I_k}}{\mathbb{V}\text{ar}(r_{I_k})}}{\lambda\frac{\mathbb{E}(r_{I_k})}{\mathbb{V}\text{ar}(r_{I_k})} - p\lambda\frac{c_{I_k}}{\mathbb{V}\text{ar}(r_{I_k})}}\mathbb{E}(r_{I_k}). \tag{A.31}$$

Simplifying the above expression,

$$\frac{w_{m,I_k} - w^*_{s,I_k}}{w_{m,I_k}}\mathbb{E}(r_{I_k}) = \frac{c_{I_k} - pc_{I_k}}{1 - \frac{pc_{I_k}}{\mathbb{E}(r_{I_k})}}. \tag{A.32}$$

Using the first-order expansion $\frac{1}{1-\frac{pc_{I_k}}{\mathbb{E}(r_{I_k})}} \simeq 1 + \frac{pc_{I_k}}{\mathbb{E}(r_{I_k})}$, when $\frac{pc_{I_k}}{\mathbb{E}(r_{I_k})}$ is small (assumption (iii)),

$$\frac{w_{m,I_k} - w^*_{s,I_k}}{w_{m,I_k}}\mathbb{E}(r_{I_k}) \simeq \left(1 - p\left(1 - \frac{(1-p)c_{I_k}}{\mathbb{E}(r_{I_k})}\right)\right)c_{I_k}. \tag{A.33}$$

When p is small (assumption (ii)), $\frac{w_{m,I_k} - w^*_{s,I_k}}{w_{m,I_k}}\mathbb{E}(r_{I_k}) \simeq c_{I_k}$.

References

Acharya, V. V. and Pedersen, L. H. (2005): Asset pricing with liquidity risk, *Journal of Financial Economics* 77, 375–410.

Ardia, D., Bluteau, K., Boudt, K., and Inghelbrecht, K. (2021): Climate change concerns and the performance of green versus brown stocks. Working paper (unpublished).

Atmaz, A. and Basak, S. (2018): Belief dispersion in the stock market, *Journal of Finance* 73, 1225–1279.

Baker, S. D., Hollifield, B., and Osambela, E. (2016): Disagreement, speculation, and aggregate investment, *Journal of Financial Economics* 119, 210–225.

Barber, B. M., Morse, A., and Yasuda, A. (2019): Impact investing. Working paper (unpublished).

Berg, F., Koëlbel, J. F., and Rigobon, R. (2022): Aggregate confusion: the divergence of ESG ratings. Working paper (unpublished).

Berk, J. B. and van Binsbergen, J. H. (2021): The impact of impact investing. Working paper (unpublished).

Bhamra, H. and Uppal, R. (2014): Asset prices with heterogeneity in preferences and beliefs, *Review of Financial Studies* 27, 519–580.

Bolton, P. and Kacperczyk, M. (2022): Global pricing of carbon-transition risk. Working paper (unpublished).

Bolton, P. and Kacperczyk, M. T. (2021): Do investors care about carbon risk?, *Journal of Financial Economics* 142, 517–549.

Broccardo, E., Hart, O., and Zingales, L. (2020): Exit vs. voice. Unpublished working paper, NBER.

CalSTRS (2017): Green initiative task force. Technical report. https://www.calstrs.com/files/ed935b4ac/green_report_2017.pdf

Carhart, M. M. (1997): On persistence in mutual fund performance, *Journal of Finance* 52, 57–82.

Chava, S. (2014): Environmental externalities and cost of capital, *Management Science* 60, 2223–2247.

De Angelis, T., Tankov, P., and Zerbib, O. D. (2022): Climate Impact Investing, *Management Science*. https://doi.org/10.1287/mnsc.2022.4472

de Jong, F. and de Roon, F. A. (2005): Time-varying market integration and expected returns in emerging markets, *Journal of Financial Economics* 78, 583–613.

Edmans, A. (2011): Does the stock market fully value intangibles? Employee satisfaction and equity prices, *Journal of Financial Economics* 101, 621–640.

Eiling, E. (2013): Industry-specific human capital, idiosyncratic risk, and the cross-section of expected stock returns, *Journal of Finance* 68, 43–84.

Errunza, V. and Losq, E. (1985): International asset pricing under mild segmentation: theory and test, *Journal of Finance* 40, 105–124.

Fama, E. F. and French, K. R. (1993): Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.

Fama, E. F. and French, K. R. (2007): Disagreement, tastes, and asset prices, *Journal of Financial Economics* 83, 667–689.

Fama, E. F. and MacBeth, J. D. (1973): Risk, return and equilibrium: empirical tests, *Journal of Political Economy* 81, 607–636.

Gibson, R., Krueger, P., Riand, N., and Schmidt, P. S. (2020): ESG rating disagreement and stock returns. Working paper (unpublished).

Gollier, C. and Pouget, S. (2014): The "washing machine": investment strategies and corporate behavior with socially responsible investors. Working paper (unpublished).

Green, D. and Roth, B. (2021): The allocation of socially responsible capital. Unpublished working paper, SSRN.

GSIA. (2018): 2018 Global sustainable investment review. Technical report, Global Sustainable Investment Alliance.

Heinkel, R., Kraus, A., and Zechner, J. (2001): The effect of green investment on corporate behaviour, *Journal of Financial and Quantitative Analysis* 36, 377–389.

Hong, H. and Kacperczyk, M. (2009): The price of sin: the effects of social norms on markets, *Journal of Financial Economics* 93, 15–36.

Hsu, P.-H., Li, K., and Tsou, C.-Y. (2019): The pollution premium. Working paper (unpublished).

In, S., Park, K., and Monk, A. (2019): Is 'being green' rewarded in the market?: an empirical investigation of decarbonization and stock returns. Working paper (unpublished).
Jouini, E. and Napp, C. (2007): Consensus consumer and intertemporal asset pricing with heterogeneous beliefs, *Review of Economic Studies* 74, 1149–1174.
Kandel, S. and Stambaugh, R. F. (1995): Portfolio inefficiency and the cross-section of expected returns, *Journal of Finance* 50, 157–184.
Krüger, P. (2015): Corporate goodness and shareholder wealth, *Journal of Financial Economics* 115, 304–329.
Landier, A. and Lovo, S. (2020): ESG investing: how to optimize impact?, Working paper (unpublished).
Ledoit, O. and Wolf, M. (2003): Improved estimation of the covariance matrix of stock returns with an application to portfolio selection, *Journal of Empirical Finance* 10, 603–621.
Lewellen, J., Nagel, S., and Shanken, J. (2010): A skeptical appraisal of asset pricing tests, *Journal of Financial Economics* 96, 175–194.
Luo, H. A. and Balvers, R. J. (2017): Social screens and systematic investor boycott risk, *Journal of Financial and Quantitative Analysis* 52, 365–399.
Macquarie. (2021): 2021 ESG survey report. Technical report.
Merton, R. C. (1987): A simple model of capital market equilibrium with incomplete information, *Journal of Finance* 42, 483–510.
Newey, W. K. and West, K. D. (1987): A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703–708.
Oehmke, M. and Opp, M. (2020): A theory of socially responsible investment. Working paper (unpublished).
Osambela, E. (2015): Differences of opinion, endogenous liquidity, and asset prices, *Review of Financial Studies* 28, 1914–1959.
Pastor, L., Stalbaugh, R., and Taylor, L. (2021a): Dissecting green returns. Working paper (unpublished).
Pastor, L., Stambaugh, R. F., and Taylor, L. A. (2021b): Sustainable investing in equilibrium, *Journal of Financial Economics* 142, 550–571.
Pedersen, L. H., Fitzgibbons, S., and Pomorski, L. (2021): Responsible investing: the ESG-efficient frontier, *Journal of Financial Economics* 142, 572–597.
Renneboog, L., Ter Horst, J., and Zhang, C. (2008): The price of ethics and stakeholder governance: the performance of socially responsible mutual funds, *Journal of Corporate Finance* 14, 302–322.
Sautner, Z., van Lent, L., Vilkov, G., and Zhang, R. (2021): Pricing climate change exposure. Working paper (unpublished).
Teoh, S. H., Ivo, W., and Paul, W. (1999): The effect of socially activist investment policies on the financial markets: evidence from the South African boycott, *Journal of Business* 72, 35–89.
US SIF. (2018): Report on US sustainable, responsible and impact investing trends. Technical report, The Forum for Sustainable and Responsible Investment.
World Economic Forum. (2021): The global risks report 2022. Technical report.