A Sustainable Capital Asset Pricing Model (S-CAPM): Evidence from Green Investing and Sin Stock Exclusion

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"The I before the other is infinitely responsible."
Emmanuel Levinas, *Ethics and Infinity*, 1984.

Abstract

This paper shows how sustainable investing affects asset returns through exclusionary screening and environmental, social, and governance (ESG) integration. I develop an asset pricing model with partial segmentation and disagreement. I characterize a *taste premium* that clarifies the relationship between ESG and financial performance and two *exclusion premia* generalizing Merton (1987)'s premium on neglected stocks. By using the holdings of 348 green funds investing in U.S. stocks between 2000 and 2018 to proxy for sustainable investors' tastes, I estimate the model applied to green investing and sin stock exclusion. The annual taste effect ranges from -1.09% to +0.11% for the different industries and the average exclusion effect is 2.98%.

Keywords: Sustainable finance; environmental finance; ESG; tastes; sin stocks; segmentation.
JEL codes: G12, G11.

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1 Introduction

Sustainable investing now accounts for more than one quarter of the total assets under management (AUM) in the United States (US SIF, 2018) and more than half in Europe (GSIA, 2016).[1] The two most widely used sustainable investment practices are *exclusionary screening* and *environmental, social, and governance (ESG) integration* (GSIA, 2016). Exclusionary screening involves the exclusion of certain assets from the range of eligible investments on ethical grounds, such as the so called *sin stocks*, while ESG integration involves underweighting assets with low ESG ratings and overweighting those with high ESG ratings. Although ESG integration may be ethically motivated, it is usually driven by the internalization of future financial risks[2] imperfectly priced by the market (UN PRI, 2018; Hartzmark and Sussman, 2019). Exclusionary screening and ESG integration are often jointly implemented by sustainable investors, and their growing prevalence can create major supply and demand imbalances, thereby distorting market prices. This paper develops a theoretical framework and provides empirical evidence on how these sustainable investing practices affect asset returns.

To reflect the dual practice of exclusion and ESG integration by sustainable investors, I develop a simple asset pricing model with partial segmentation and disagreement on the expectation of asset returns. 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.[3]

I propose a unified pricing formula for all assets in the market, namely the assets excluded by

[1] Sustainable investing is also referred to as *socially responsible investing*, *responsible investing* and *ethical investing*, for example. In the European Parliament legislative resolution of 18 April 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 U.S., the AUM in sustainable investing amounted to USD 12 trillion in 2018 and increased by 38% between 2016 and 2018 (US SIF, 2018).

[2] The prime examples of climate-related financial risks are transition risks, particularly through the gradual increase in carbon prices, physical risks resulting from natural disasters, and litigation risks.

[3] Benabou and Tirole (2010) describe the *delegated philanthropy* mechanism whereby sustainable investors integrate firm externalities into their investment decisions. In the continuation of this theory, Hart and Zingales (2017) and Morgan and Tumlinson (2019) argue that sustainable investors internalize externalities to maximize their welfare instead of the sole market value of their investments. In this paper, the cost of externalities is defined as a deterministic private cost proportional to the weight of the investment made, in the same way as Acharya and Pedersen (2005) model the cost of illiquidity.

sustainable investors (hereafter, *excluded assets*) and the assets in which they invest by over- or underweighting them (hereafter, *investable assets*). Two types of premia are induced by sustainable investors: a *taste premium* and two *exclusion premia*. The taste premium is induced by sustainable investors' tastes for assets owing to the cost of externalities that they internalize. The two exclusion risk premia result from a reduction in the investor base, and are related to Errunza and Losq (1985)'s *super risk premium* and de Jong and de Roon (2005)'s *local segmentation premium*. Taste and exclusion also have cross effects; the taste premium affects excluded assets by commonality, and one of the two exclusion premia affects investable assets.

The taste premium increases with the cost of externalities and the wealth of sustainable investors. In addition to the direct effect of the taste premium on expected returns, the market risk premium is also adjusted by the average taste premium on the market. Hence, the total taste effect on expected returns is a relative effect of sustainable investors' taste for an asset when compared to their average taste for the market.

The two exclusion premia are structured similarly and reflect the dual hedging effect of regular and sustainable investors. Regular investors, who are compelled to hold the excluded market portfolio, value most highly the assets least correlated with this portfolio. Simultaneously, sustainable investors, who seek to replicate the hedging portfolio built from investable assets most closely correlated with excluded assets, value most highly the assets most correlated with this hedging portfolio.

I empirically validate the theoretical predictions by estimating the model using the U.S. stocks in the Center for Research in Security Prices (CRSP) database between December 1999 and December 2018. I use sin stocks to constitute the excluded assets and apply the ESG integration procedure to the tastes of sustainable investors for the stocks of *green firms*.[4] Since the various metrics used to assess the environmental impacts of assets lack a common definition and show low commensurability (Chatterji, Durand, Levine, and Touboul, 2016; Gibson, Krueger, Riand, and Schmidt, 2020), they can hardly capture the average tastes of sustainable investors for green firms. Moreover, these metrics are updated with a low frequency, typically on an annual basis. Therefore, to circumvent the use of environmental metrics, I construct an agnostic *ex-post* instrument reflecting sustainable

[4] A green firm can be defined as a firm with a low environmental impact according to an environmental metric, including, for example, environmental ratings and carbon footprints.

investors' private cost of environmental externalities. I identify 348 green funds worldwide with investments in U.S. equities as of December 2018 and use FactSet to determine their holding history on a quarterly basis. For a given stock and on a given date, I define this instrument as the relative difference between the weight of the stock in the market portfolio and the weight in the U.S. allocation of the green funds. The higher the proxy is, the more is the stock underweighted by the green funds on that date, and vice versa when the proxy is negative. As a robustness test, I use a second instrument that approximates both the cost of environmental externalities and the proportion of green investors, which is also constructed from green fund holdings.

For investable stocks, the taste premium is significant from 2006 onwards, whether it is estimated by constructing industry-sorted or industry-size double-sorted portfolios. The taste premium remains significant after controlling for the small-minus-big (SMB), high-minus-low (HML) (Fama and French, 1993), and momentum (MOM) (Carhart, 1997) factors. The taste effect ranges from -1.09% to +0.11% for the different industries. Specifically, ESG integration significantly contributes toward modifying the expected returns of the industries most impacted by the environmental transition. For example, green investors induce additional annual returns of 0.42% for the coal industry when compared to the electrical equipment industry.

Regarding sin stocks, I find both exclusion premia to be significant and to 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 substantially higher than those obtained under Carhart (1997)'s four-factor model. The annual average exclusion effect amounts to 2.98% during the analyzed period.

Related literature. The results of this study contribute to three literature strands on asset pricing. First, they clarify the relationship between the environmental and financial performances of assets by building on the disagreement literature.[5] The empirical evidence regarding the effects of ESG integration on asset returns is mixed, as several studies point to the existence of a negative

[5]A vast literature has examined the effects of disagreement and differences of opinion on asset returns and prices, including Harris and Raviv (1993), Biais and Bossaerts (1998), Scheinkman and Xiong (2003), Fama and French (2007), Jouini and Napp (2007), David (2008), Dumas, Kurshev, and Uppal (2009), Banerjee and Kremer (2010), Bhamra and Uppal (2014), Carlin, Longstaff, and Matoba (2014), Baker, Hollifield, and Osambela (2016), Atmaz and Basak (2018) and Banerjee, Davis, and Gondhi (2019).

relationship between ESG performance and stock returns,[6] while others argue in favor of a positive effect,[7] or find no significant differentiating effects due to ESG integration.[8] Two independent works by Pedersen, Fitzgibbons, and Pomorski (2019) and Pastor, Stambaugh, and Taylor (2019) provide theoretical contributions on how ESG integration by sustainable investors affects asset returns.[9] Pedersen et al. (2019) show that when the market is populated by ESG-motivated, ESG-aware, and ESG-unaware investors, the optimal allocation satisfies four-fund separation and is characterized by an ESG-efficient frontier. The authors derive an asset pricing equation in the cases where all investors are ESG-motivated or ESG-unaware. Pastor et al. (2019) show that green assets have negative alphas and brown assets have positive alphas. They also show that the alphas of ESG-motivated investors are at their lowest when there is a large dispersion in investors' ESG tastes. Extending the conceptual framework laid out by Fama and French (2007), I contribute to this literature strand in two ways. First, I show that the taste effect on asset returns is transmitted through a taste premium, which is adjusted by the overall market taste premium. Second, I estimate the asset pricing specification by using a microfounded proxy for sustainable investors' revealed tastes for green companies constructed from green fund holdings. The significant estimates of the taste premium highlight the value of using this *ex-post* monthly measure rather than a yearly environmental rating or a carbon footprint to proxy for sustainable investors' tastes.

The results of this study also contribute to the literature on exclusionary screening by bridging the gap with market segmentation. 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. Moreover, I demonstrate that the main exclusion premium is a generalized form of Merton (1987)'s premium on neglected stocks. Therefore, this article extends the analysis of Heinkel, Kraus,

[6]See Brammer, Brooks, and Pavelin (2006), Renneboog, Ter Horst, and Zhang (2008) and Barber, Morse, and Yasuda (2019). Moreover, Sharfman and Fernando (2008), ElGhoul, Guedhami, Kowk, and Mishra (2011) and Chava (2014) show that the same effect applies to the expected returns. Finally, Bolton and Kacperczyk (2019) and Hsu, Li, and Tsou (2019) establish that firms responsible for high CO_2 emissions and high toxic emissions, respectively, earn higher returns.

[7]See Derwall, Guenster, Bauer, and Koedijk (2005), Statman and Glushkov (2009), Edmans (2011), Eccles, Ioannou, and Serafeim (2014), Krüger (2015) and Statman and Glushkov (2016). Specifically, Krüger (2015) shows that investors react strongly negatively to negative CSR news, particularly environmental news, and positively to positive CSR news concerning firms with known controversies. In, Park, and Monk (2019) show that companies emitting the most greenhouse gases earn higher stock returns than companies emitting the lowest levels.

[8]See Bauer, Koedijk, and Otten (2005) and Galema, Plantinga, and Scholtens (2008).

[9]Both papers focus on ESG integration and do not address exclusionary screening.

and Zechner (2001) by characterizing the risk factors associated with exclusionary screening. The magnitude of the average annual exclusion effect I estimate for sin stocks is in line with the 2.5% obtained by Hong and Kacperczyk (2009) and is substantially lower than the 16% found by Luo and Balvers (2017). Although the exclusion effect on asset returns is positive on average, 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. Compared to Merton (1987), this study emphasizes the importance of considering non-independent returns because the exclusion effect is mostly due to spillovers from other excluded assets. Luo and Balvers (2017) characterize a boycott premium and claim that the exclusion effect is positively related to business cycles. I show that the exclusion effect fluctuates with business cycles because it is driven by conditional covariances, which increase with the multiple correlation among excluded assets.

Finally, this study contributes to the literature on behavioral asset pricing. I characterize behavioral effects based on taste and exclusion, which are part of the social norms upheld by sustainable investors (Fama and French 2007; Hong and Kacperczyk 2009). Particularly, this paper relates to the literature on investors' non-pecuniary motives[10] by showing how they translate into asset prices. The results are in line with those of Baldauf, Garlappi, and Yannelis (2018) who demonstrate the negative impact of anticipating natural disasters on real estate prices through an asset pricing model with heterogeneous beliefs.

The remainder of this paper 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 green investing for characterizing investors' tastes for investable assets. Sections 4 and 5 present the empirical results on investable and excluded stocks' excess returns, respectively. Section 6 concludes the paper. The Appendix contains the main proofs and the Internet Appendix provides additional proofs and details about the empirical analysis.

[10] Riedl and Smeets (2017) and Hartzmark and Sussman (2019) document the positive effect of non-pecuniary motives on socially responsible funds' inflows. Hong and Kacperczyk (2009), Barber et al. (2019) and Zerbib (2019) show that non-pecuniary motives lead to an increase in sin stock returns, a decline in impact fund returns and a decline in green bond yields, respectively.

2 Asset pricing with partial segmentation and disagreement

To reflect the dual practice of sustainable investing based on the exclusion and over- or under-weighting of certain assets, I develop a simple asset pricing model with partial segmentation and disagreement among investors on expected asset returns. 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.

2.1 Model setup and assumptions

The model is based on the following assumptions.

Assumption 1 (Single-period model)**.** A single-period model is assumed, in which the agents live from time t to $t+1$. They receive an endowment at time t and have no other source of income, trade at time t, and derive utility from their wealth at time $t+1$.

Assumption 2 (Partial segmentation)**.** The economy is populated by two investor groups: *regular* and *sustainable* investors. *Regular investors* invest freely in all assets in the market. Sustainable investors restrict their allocation to the sub-market of *investable assets*, which is composed of assets $I_1, ..., I_{n_I}$, and exclude the sub-market of *excluded assets*, which is composed of assets $X_1, ..., X_{n_X}$. The proportion of excluded assets' market value is denoted by q. The proportions of sustainable and regular investors' wealth are p and $1-p$, respectively.

Assumption 3 (Disagreement)**.** Sustainable investors have tastes for investable assets. They subtract a deterministic private cost of externalities, c_{I_i}, from the expected return on each investable asset, I_i. $C = (c_{I_1}, ..., c_{I_{n_I}})'$ is the vector of stacked costs for investable assets $I_1, ..., I_{n_I}$, 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} (see Figure 1).

Assumption 4 (Mean-variance preferences)**.** (i) Investors have an exponential utility and their *relative* risk aversion is denoted by γ. (ii) The asset returns are assumed to be normally distributed. Since investors maximize the expected utility of their terminal wealth, which is normally distributed, they have mean-variance preferences over their terminal wealth.

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.

[Figure 1 about here]

The specific assumptions adopted in this model are those of a partially segmented market (assumption 2) with disagreement among investors (assumption 3). I do not consider the partial segmentation assumption as a limiting case of the disagreement assumption because the two assumptions are complementary: since short selling is not prohibited, unlike in liquidity models, sustainable investors can short an asset with a high externality cost (carrying, for example, a high environmental risk), while an excluded asset is not accessible to them.

By characterizing sustainable investors' practices through both exclusion and ESG 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 2), 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)[11] 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 (1987)'s model since I do not impose any particular specification on asset returns, and these are not independent.[12]

On the other hand, when the market is not segmented (i.e., focusing on assumption 3), the present model reduces to a model of differences of opinion in which sustainable investors adjust their expected returns on each available asset by internalizing a private cost of externalities.[13] 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 ESG externalities varies with high inertia and does not necessarily need to be modeled as a stochastic factor.[14] The internalization of the cost of externalities, which is modeled here as a linear adjustment of the expected excess

[11] As shown by de Jong and de Roon (2005), their model also generalizes Bekaert and Harvey (1995)'s model when investable and non-investable assets have similar characteristics in the absence of cross-country segmentation effects.

[12] 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.

[13] As in Fama and French (2007), these tastes may be linked to either non-pecuniary motives (Riedl and Smeets, 2017; Hartzmark and Sussman, 2019) or lower financial risk expectations (Lins, Servaes, and Tamayo, 2017; Krüger, 2015; Battiston, Mandel, Monasterolo, Schutze, and Visentin, 2017; Krüger, Sautner, and Starks, 2019).

[14] For simplicity, I consider c_{I_i} deterministic. Generally, the results are identical when one assumes that $c_{I_i,t}$ is a random variable of zero variance that is independent of investable asset returns.

return, is consistent with previous theoretical studies. In a model in which firms can reform and generate externalities, Gollier and Pouget (2014) integrate these externalities as a linear cost that mitigates expected returns. Similarly, Atmaz and Basak (2018) define investors' disagreement as an additional effect on expected returns. It is worth noting that 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.

2.2 Premia induced by sustainable investing

Subscripts I and X are used here as a generic index, standing for the vectors of n_I investable assets and n_X excluded assets, respectively. To simplify the notation, the time subscripts are omitted and all the returns, r, are considered in excess of the risk-free rate. Therefore, the excess return on any asset i in the market is denoted by r_i. The vectors of excess returns on assets, $I = (I_1, ..., I_{n_I})$ and $X = (X_1, ..., X_{n_X})$, 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 (or multiple correlation coefficient) between the excess returns on two assets (or between one asset and a vector of assets, respectively). Let β_{im_I} be the slope coefficient of the regression of the excess returns on asset $i \in \{I_1, ...I_{n_I}, X_1, ..., X_{n_X}\}$ on the excess returns on the investable market m_I and a constant. Let B_{iI} be the row vector of the slope coefficients in a multiple regression of asset i's excess returns on the excess returns on the investable assets $I_1, ..., I_{n_I}$ and a constant. $\mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_I)$ and $\mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_{m_I})$ refer to the conditional covariances between r_i 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 i is

$$\mathbb{E}(r_i) = \beta_{im_I} \left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right) + \underbrace{pB_{iI}C}_{\textit{Taste premium}} + \underbrace{\gamma \frac{p}{1-p} q \, \mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_I)}_{\textit{Exclusion-asset premium}} + \underbrace{\gamma q \, \mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_{m_I})}_{\textit{Exclusion-market premium}} . \tag{1}$$

2. Particularly,

(i) the expected excess return on any investable asset I_i is

$$\mathbb{E}(r_{I_i}) = \beta_{I_i m_I} \left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right) + \underbrace{pc_{I_i}}_{\text{Taste premium}} + \underbrace{\gamma q \,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X} | r_{m_I})}_{\text{Exclusion-market premium}}, \tag{2}$$

(ii) the expected excess return on any excluded asset X_i is

$$\mathbb{E}(r_{X_i}) = \beta_{im_I} \left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right) + \underbrace{pB_{X_i I}C}_{\text{Taste premium}} + \underbrace{\gamma \frac{p}{1-p} q \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_I)}_{\text{Exclusion-asset premium}} + \underbrace{\gamma q \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_{m_I})}_{\text{Exclusion-market premium}}. \tag{3}$$

Proposition 1 shows that sustainable investors' exclusion practice and tastes involve two types of additional premia in equilibrium: two exclusion premia[15]—the exclusion-asset premium and the exclusion-market premium—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 potential cross effects of exclusion and ESG integration practices of sustainable investors, thereby emphasizing the relevance of building a model that includes both practices. As in de Jong and de Roon (2005) and Eiling (2013), for partially segmented markets, the expected excess returns are expressed with respect to those on the investable market, which is the largest investment universe accessible to all investors. 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 ($q = 0$) because m_I and m coincide and only the taste premium remains. Denoting the beta of asset i with respect to the market by β_{im} and the average cost of externalities in the market by c_m, the expected excess return on asset i is

$$\mathbb{E}(r_i) = \beta_{im} \left(\mathbb{E}(r_m) - pc_m\right) + pc_i. \tag{4}$$

[15]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).

Specifically, when the economy is only populated by sustainable investors ($p = 1$), the equilibrium equation reduces to Acharya and Pedersen (2005)'s liquidity-adjusted CAPM with a deterministic illiquidity cost.

Second, when sustainable investors only practice exclusion and have similar tastes to those of regular investors for investable assets, the taste premium vanishes ($\forall i \in \{I_1, ..., I_{n_I}\}, c_i = 0$) and only the exclusion premia remain. Equation (2) reduces to the I-CAPM equilibrium equation for investable assets in de Jong and de Roon (2005):[16]

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

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, $\mathbb{E}(r_{m_I})$:

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

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.

2.2.1 Taste premium

A taste premium induced by sustainable investors' tastes arises in equilibrium for investable assets (pc_{I_i}) and by commonality for excluded assets ($pB_{X_i I} C$). Applied primarily to investable assets, this premium is proportional to the cost of externalities: the higher the cost of externalities is, the higher will be the premium to incentivize sustainable investors to acquire the asset under consideration, and vice versa when the cost of externalities is low. For an excluded asset, the taste premium is proportional to the cost of externalities of the investable assets with which it is correlated. This finding is in line with the literature on differences of opinion[17] in which the assets'

[16] 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).

[17] See, in particular, Jouini and Napp (2007) and Atmaz and Basak (2018).

expected returns increase (or decrease) when a group of investors is pessimistic (or optimistic). It is also consistent with Pastor et al. (2019) who show that brown and green assets have positive and negative alphas, respectively. The taste premium also increases with the proportion of sustainable investors, p, as also shown by Fama and French (2007) and Gollier and Pouget (2014).

However, by internalizing externalities, sustainable investors simultaneously adjust their total exposure to the investable market and impact the market premium through c_{m_I}. When sustainable investors internalize a positive global cost of externalities ($c_{m_I} > 0$), they underweigh the investable market and the market premium is negatively adjusted. The opposite effect applies when the global cost of externalities is negative. This effect does not arise in Pastor et al. (2019) because the authors assume that $c_{m_I} = 0$. Therefore, focusing on asset I_i, the total effect caused by sustainable investors' tastes is a relative effect:

$$\text{Taste effect} = \underbrace{pc_{I_i}}_{\text{Taste premium}} - \underbrace{\beta_{I_i m_I} p c_{m_I}}_{\text{Market effect}}.$$

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.

2.2.2 Exclusion premia

Two exclusion premia arise in equilibrium on excluded assets' expected excess returns: the exclusion-asset premium, $\gamma \frac{p}{1-p} q \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_I)$, and the exclusion-market premium, $\gamma q \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_{m_I})$. As an indirect effect, the exclusion-market premium, $\gamma q \, \mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X} | r_{m_I})$, 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.[18] The exclusion-market premium is the *local segmentation* premium that de Jong and de Roon (2005) identify for investable asset.

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

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

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:

$$\gamma \frac{p}{1-p} q \,\mathbb{C}\mathrm{ov}(r_i, r_{m_X} | r_I) = \underbrace{\gamma \tfrac{p}{1-p} q \,\mathbb{C}\mathrm{ov}(r_i, r_{m_X})}_{\textit{Regular investor effect}} - \underbrace{\gamma \tfrac{p}{1-p} q \,\mathbb{C}\mathrm{ov}\left(\mathbb{E}(r_i|r_I), \mathbb{E}(r_{m_X}|r_I)\right)}_{\textit{Sustainable investor effect}}, \tag{7}$$

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

The former effect is induced by regular investors' need for diversification: since they are the only ones holding the excluded market portfolio, they value most highly the assets that are the least 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 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 i if they are highly correlated with the hedging portfolios of the excluded market.

The exclusion-asset premium is a generalized form of Merton (1987)'s premium on neglected stocks. Proposition 2 characterizes it 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 (1987)'s premium on neglected stocks).

Let $\tilde{\beta}_{Xim} = \frac{\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_I})}{\mathbb{C}\mathrm{ov}(r_m, r_{m_I})}$. When the expected excess returns on X_i 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 (1987)'s premium on neglected stocks.

Therefore, the generalized form of Merton (1987)'s 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 $-\tilde{\beta}_{X_k m} q \,\mathbb{V}\mathrm{ar}(r_{m_X}|r_I)$ 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 true on average, 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

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

For example, when an excluded asset is sufficiently decorrelated from the excluded market, the exclusion premia are likely to be negative.[19] 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, the value-weighted average exclusion effect is always positive or zero.

3 Empirical analysis applied to sin stock exclusion and green investing: The identification strategy

I estimate the proposed model, considering sin stocks as excluded assets and applying the ESG integration process through the tastes of sustainable investors for green firms. In this section, I describe the data used, the instrument developed for approximating the cost of environmental externalities, and the identification method.

3.1 Data and instrument design

3.1.1 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

[19] Precisely, when the correlation of an excluded asset with the excluded market is lower than that of their replicating portfolio using investable assets, the exclusion premia are negative.

now mainly applied to sin stocks. However, there is no consensus on the scope of the sin industries to be excluded. Luo and Balvers (2017) provide a summary of the sin industries analyzed in the 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 U.S. data, noting that not all U.S. investors regard it as a controversial industry. Some studies also include the pornography and coal industries as sin stocks. I conduct an analysis on U.S. 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 NYSE, AMEX, and NASDAQ (exchange codes 1, 2, and 3) in the CRSP database. I use the Standard Industrial Classification (SIC) to identify 48 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 NAICS classification. Gaming companies have the following NAICS codes: 7132, 71312, 713210, 71329, 713290, 72112, and 721120. Therefore, out of the 49 industries, I focus on the three sin industries of alcohol, tobacco, and gaming, which accounted for 77 stocks between December 31, 1999 and December 31, 2018. Over this period, the number of companies decreased and the market capitalization of all sin companies increased (Table 1).

I perform the empirical analysis from December 1999 to December 2018 for two reasons. First, sustainable investments started witnessing a significant development in the early 2000s.[20] Second, the data available on investors' tastes for green firms are too scarce to perform a sufficiently robust analysis before 2000 (see subsection 3.1.2).

[Table 1 about here]

[20] In 1999, the total AUM incorporating at least one responsible filter exceeded 1 trillion dollars in the United States (Luo and Balvers, 2017), and responsibly managed assets increased 18-fold between 1995 and 2018 (US SIF, 2018).

3.1.2 Sustainable investors' tastes for green firms

I apply sustainable investors' tastes to their appetite for the stocks of green firms. Climate change, which is the main selection factor for green investment, is the first ESG criterion considered by asset managers (US SIF, 2018); the assets to which this criterion is applied doubled between 2016 and 2018 in the United States, reaching 3 trillion dollars.

Many empirical studies have investigated the effects of a company's environmental performance on the excess returns on its stocks. However, the results differ significantly. Apart from the econometric specification, one of the main reasons for this heterogeneity lies in the fact that identifying the environmental performance of a company through a particular metric weakly proxies 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 show low commensurability (Chatterji et al., 2016).[21] 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% between 2013 and 2017. 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 and are liable to have several limitations, such as oversimplifying information (Mattingly and Berman, 2006) and their low prospective content (Chatterji, Levine, and Toffel, 2009).

I circumvent this problem by approximating the cost of environmental externalities defined in the model. As shown in Proposition 4, the first-order conditions of regular and sustainable investor optimization programs allow us to infer the cost of externalities.

Proposition 4 (Cost of externalities)**.**

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

[21] 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 methods of calculation and analysis scopes. The calculation is further complicated by the inconsistency of the data reported by companies, as well as the differences in the treatment of data gaps and the benchmarking options chosen by data providers (Kotsantonis and Serafeim, 2019).

externalities of asset I_i is

$$c_{I_i} = \frac{\mathbb{C}\text{ov}(r_{I_i}, r'_I)(w^*_{r,I} - w^*_{s,I}) + \mathbb{C}\text{ov}(r_{I_i}, r'_X)w^*_{r,X}}{\mathbb{C}\text{ov}(r_{I_i}, r'_I)w^*_{r,I} + \mathbb{C}\text{ov}(r_{I_i}, r'_X)w^*_{r,X}}\,\mathbb{E}(r_{I_i}). \tag{11}$$

The more the sustainable investors underweigh I_i, the higher will be c_{I_i}, and vice versa when they overweigh I_i. In the absence of excluded assets, $\mathbb{C}\text{ov}(r_{I_i}, r'_X)w^*_{r,X}$ disappears from the numerator and denominator of c_{I_i}. When the returns are independent, the cost of externalities boils down to

$$c_{I_i} = \frac{w^*_{r,I_i} - w^*_{s,I_i}}{w^*_{r,I_i}}\,\mathbb{E}(r_{I_i}). \tag{12}$$

I define the proxy for the cost of externalities of asset I_i, $\tilde{c}_{I_i}$, as

$$\tilde{c}_{I_i} = \frac{w^*_{r,I_i} - w^*_{s,I_i}}{w^*_{r,I_i}}. \tag{13}$$

I do not multiply the weights by the covariance vector because this presupposes that sustainable investors internalize the covariances between assets in their ESG integration process, which is a strong assumption. In addition, the effect of $\mathbb{C}\text{ov}(r_{I_i}, r'_X)w^*_{r,X}$ is negligible given the minimal weight of the 77 sin stocks in the investment universe. Finally, I exclude the expected return to avoid endogeneity bias.

I compute the microfounded proxy, $\tilde{c}_{I_i}$, by using the holding history of all the listed green funds investing in U.S. equities. Specifically, among all funds listed by Bloomberg on December 2018, I select the 348 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,”[22] with the geographical investment scope including the United States.[23] 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 50 in 2006 and 100 in 2010, reaching 177 in 2018. I aggregate the holdings of all green funds on a quarterly basis and focus on the U.S. stock investment universe in CRSP (referred to as the *US allocation*). Given the large number of stocks and the high

[22]The last two categories include diversified funds that also invest in equities.

[23]The geographical areas selected are ”Global,” ”International,” ”Multi,” ”North American Region,” ”Organisation for Economic Co-operation and Development countries,” and ”the U.S.” (see the Internet Appendix).

sensitivity of c_{I_i} when $w^*_{r,I}$ is close to zero, I perform the analysis on industry-sorted portfolios. The investable market consists of 46 industries corresponding to the 49 industries from which the three sin industries have been removed. For every quarter t, I calculate the weight of each industry I_i in the total U.S. allocation of green funds to estimate w^*_{s,I_i} at the date t. I then extend this value over the next two months of the year in which no holding data are available. I define regular investors' asset allocation as the market portfolio and, on a monthly basis, estimate w^*_{r,I_i} as the weight of industry I_i in the CRSP universe. I construct instrument $\tilde{c}_{I_i}$ by substituting the estimates of w^*_{s,I_i} and w^*_{r,I_i} in equation (13).

This agnostic instrument proxies the revealed tastes of *green investors* by comparing green funds' asset allocation 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 2018) and being constructed from a minimal fraction of the AUM (green funds' AUM accounted for only 0.11% of the market capitalization of the investment universe at the end of 2018). Therefore, by using instrument $\tilde{c}$, I implicitly assume that all green investors have fairly similar tastes to those revealed by the aggregated 348 green funds, and I test this assumption by estimating the asset pricing model.[24]

In addition to industry-sorted portfolios, I construct a set of 230 ($= 46 \times 5$) industry-size portfolios double-sorted by industries and market capitalization quintiles. Finally, I take the value-weighted returns on the industry and industry-size portfolios in excess of the 1-month T-bill rate. Table 2 summarizes the proxy for the cost of environmental externalities and the excess returns for the various investable industries in descending order of the average cost $\tilde{c}$.

[Table 2 about here]

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 overweigh the least pollut-

[24] Given that the list of green funds is not historically available, I acknowledge that the proposed instrument may introduce survivorship bias. However, given the massive and steady increase in green investments, the net creation of green funds can be assumed to be positive over the period. As a result, the number of closed green funds should be limited compared to 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.

ing companies, sustainable investors also underweigh some of the largest market capitalizations. Particularly, they substantially underweigh some large companies in 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 these specific industries are underweighted by green funds.

3.2 Empirical method

I conduct the estimations based on the equations in Proposition 1 being applied to sin stocks for excluded assets and the proxy for the cost of environmental externalities, $\tilde{c}_{I_i,t}$, to account for sustainable investors' tastes. I assume that the cost of externalities is proportional to the instrument: $c_{I_i} = k\tilde{c}_{I_i}$ and $C = k\tilde{C}$ ($k \in \mathbb{R}_+$) for investable stock I_i and the vector of investable stocks, I, respectively.

Investable asset specification. For each investable asset I_i ($i \in \{1, ..., n_I\}$), equation (2) is written as:

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

The three independent variables are the beta coefficient, $\beta_{I_i m_I}$, the proxy for the cost of environmental externalities, $\tilde{c}_{I_i}$, and the *exclusion-market factor*, $q\,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$. As shown in the correlation matrix reported in the Internet Appendix, $\tilde{c}$ is decorrelated from the other independent variables.

Excluded asset specification. For each excluded asset X_i ($i \in \{1, ..., n_X\}$), equation (3) is written as:

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

The four independent variables of the estimation are the beta coefficient, $\beta_{X_i m_I}$, the proxy for the taste premium, $B_{X_i I}\tilde{C}$, the *exclusion-asset factor*, $q\,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X}|r_I)$, and the *exclusion-market*

factor,[25] $q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$. The correlation between both exclusion factors is -18%.

Estimation method. I estimate specifications (14) and (15) by performing a two-stage cross-sectional regression (Fama and MacBeth, 1973). To account for conditional heteroskedasticity and serial correlation, the standard errors are adjusted in line with Newey and West (1987). Investable assets account for 9,884 stocks, and there are 77 sin stocks between December 1999 and December 2018. The estimates on the former are conducted on stock portfolios, while those on the latter are conducted on individual stocks. In the first pass, I compute the dependent and independent variables over a 3-year rolling period at monthly intervals, which yields a time series of 193 dates for each variable per stock (or portfolio).[26] Robustness tests are performed by repeating the analysis over a 5-year rolling period. In the second pass, I run the 193 cross-sectional regressions of the n_I and n_X dependent variables for portfolios I and stocks X, respectively, on a constant and the independent variables. The estimated loadings are equal to the average over the 193 dates. 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.

To check for the robustness of the estimated effects and to benchmark the model, I also include the betas of the SMB, HML (Fama and French, 1992), and MOM (Carhart, 1997) factors with respect to the investable market in the estimations. The three factors are downloaded from Kenneth French's website.[27] Table 3 presents descriptive statistics on the dependent and independent variables.

[Table 3 about here]

The mean of the proxy for the cost of environmental externalities is -0.58 and its median is 0.16. The instrument reaches a maximum of 1 when green funds exclude a whole industry at a given date. The minimum is -29.2 and reflects the significant overweighting of an industry by

[25] The exclusion-asset and exclusion-market factors expressed as conditional covariances are easily computable from stacked excess returns as Schur complements in vector form (see Lemma 1 in the Appendix). I estimate the inverse of the investable asset covariance matrix by assuming that returns follow a one-factor model (Ledoit and Wolf, 2003).

[26] The betas are estimated as univariate betas.

[27] The website address is `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`.

green funds relative to the benchmark at a given date. Finally, the exclusion premia are evenly distributed around a mean close to zero.

4 Stock returns with tastes for green firms

In this section, I empirically assess the effect of sustainable investors' tastes for green firms 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 S-CAPM estimation

I estimate the following three models. (i) The *S-CAPM* corresponds to equation (14):

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

(ii) the *four-factor S-CAPM* (denoted as *4F S-CAPM*) corresponds 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*) corresponds to the CAPM specification with respect to the investable market returns to which the SMB, HML, and MOM betas are added.

The S-CAPM starts to yield significant estimates from December 31, 2006, in line with the gradual development of green investing during the 2000s and concomitantly with the enforcement of the U.S. Securities and Exchange Commission's (SEC's) February 2004 amendment requiring the U.S. funds to disclose their holdings on a quarterly basis. Table 4 (Panel A) reports the estimates of the three specifications using industry-sorted portfolios between December 31, 2006 and December 31, 2018. Consistent with the model predictions, the taste premium is significant (t-statistic of 1.85) and its loading is positive ($\hat{\delta}_{taste} = 0.0001$). When the SMB, HML, and MOM factors are included, the taste premium becomes highly significant (t-statistic of 5.1) and the loading increases to 0.0003. The proxy for the value-weighted average cost of externalities of the investable market, $\tilde{c}_{m_I}$, is -1.5% over the period, and the annual average market effect is $-\hat{\delta}_{taste}\tilde{c}_{m_I} = 0.25$ basis points (bps). Therefore, the market effect is negligible, and the taste effect is almost exclusively

driven by the taste premium.

Although the exclusion-market premium—related to the indirect effect of the 77 excluded sin stocks on the 9,884 investable stocks—is significant when considered individually, it is not significant in the S-CAPM specification.

[Table 4 about here]

The first concern is the risk of reverse causality bias through instrument $\tilde{c}$. In other words, is δ_{taste} significant because the return on industry $I_i \in \{1, ..., n_I\}$ affects the relative weight differential between regular and sustainable investors' allocations in this industry, $\frac{w^*_{r,I_i} - w^*_{s,I_i}}{w^*_{r,I_i}}$? I address this issue from a theorical and an empirical viewpoint. From a theoretical viewpoint, according to the model, investors rebalance their allocation at each period to adjust their asset weights to the optimal level. Therefore, the microfounded instrument should not depend on the current and past returns. However, it is likely that the effective asset weights do not necessarily correspond to the optimal weights predicted by the theory. Consequently, since the industry weights of regular and green investors vary slowly over time, I repeat the regression using proxy $\tilde{c}$ delayed by 3 years to ensure that the returns estimated in the first pass of the Fama MacBeth regression do not affect the instrument retroactively. The proxy for the cost of externalities is highly significant (t-statistics of 4.43) and positive ($\hat{\delta}_{taste} = 0.0004$). 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 Internet Appendix.

The estimate of the taste premium is also robust to a first-pass regression using a 5-year rolling window, and its significance increases. However, when using equally weighted returns, the taste premium is not significant, and the exclusion-market premium becomes significant. The results of these two alternative estimations are available in the Internet Appendix.

For each industry, Table 5 provides the estimates of the average annual taste effect using the main model.

[Table 5 about here]

The taste effect ranges from -1.09% to +0.11% for the different industries. Specifically, the

return differential between industries differently impacted by the environmental transition is substantial. For example, green investors induce additional annual returns of 0.42% for the coal industry compared to the electrical equipment industry. The additional return is 0.39% for the petroleum industry.

4.2 Additional robustness checks

I conduct several additional robustness tests, as detailed in the Internet Appendix. First, I repeat the estimation using industry-size portfolios. The results are presented in Table 6. The taste premium is highly significant and consistent with the estimation using industry portfolios. In addition, the exclusion-market premium is significant and has a positive loading, consistent with a likely effect of sin stock exclusion on investable stock returns. The estimated annual exclusion-market premium is -11bps.

[Table 6 about here]

Second, I construct an alternative instrument, $\tilde{p}\tilde{c}$, to capture the increase in the proportion of wealth of sustainable investors. I estimate the proportion of assets managed following environmental guidelines as the market value of the 348 green funds divided by the market value of the investment universe at each considered date,

$$\tilde{p}_t = \frac{\text{Market value of green funds in } t}{\text{Total market capitalization in } t}, \tag{17}$$

and I estimate the following specification:

$$\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{p}\tilde{c}_{I_i} + \delta_{ex.mkt} q \,\mathrm{Cov}(r_{I_i}, r_{m_X} | r_{m_I}). \tag{18}$$

Table 7 shows the estimates using $\tilde{p}\tilde{c}_{I_i}$ as an instrument for the taste premium. The taste premium is significant and robust to the inclusion of the SMB, HML, and MOM betas. Moreover, the loading, δ_{taste}, of approximately 0.144 is consistent with the estimate of the main specification since $\tilde{p}$ is 0.00055 on average between December 2006 and December 2018 ($0.144 \times 0.00055 = 0.00008 \simeq 0.0001$). Although the concern about reverse causality bias for asset I_i is limited as variable $\tilde{p}$ is impacted by the aggregate returns on all assets in which green funds invest, I repeat

the estimation when instrument $\tilde{p}\tilde{c}_{I_i}$ is lagged by 3 years. The taste premium is still significant. However, the loading is higher than that estimated when $\tilde{p}\tilde{c}_{I_i}$ is not lagged because $\tilde{p}$ increases over time (see the Internet Appendix).

[Table 7 about here]

Third, I perform the estimation of the S-CAPM reduced to ESG integration only (i.e., with no exclusionary screening, using equation (4)) and applied to the 49 non-sin and sin industries. The estimate of the taste premium and its significance is in line with that of the main model.

Fourth, I analyze the patterns in pricing errors based on cross-sectional regressions for the CAPM, S-CAPM, 4F model, and 4F S-CAPM (Figure 2). I consider the two sets of portfolios studied in the main regression: 46 industry-sorted portfolios and 230 industry-size portfolios. These figures provide a graphical depiction of the model fit. The model prices all portfolios perfectly if all points are located on the 45-degree line passing through the origin. For industry and industry-size portfolios, the S-CAPM yields pricing errors lower than those of the CAPM and the 4F model. It should be noted that the period 2006–2018 covers the subprime financial crisis, and thus shows higher pricing errors than those over a longer or different period.

[Figure 2 about here]

5 Sin stock returns

I perform an empirical analysis to assess the effect of sustainable investors' exclusion of sin stocks and that of their tastes for green firms on sin stocks' excess returns. The exclusion premia significantly impact the excess returns. I find very weak evidence supporting the effect of green tastes on sin stock returns. Focusing on the exclusion effect, I analyze its dynamics and the spillover effects that contribute to it.

5.1 S-CAPM estimation

I estimate the following three models. (i) The *S-CAPM* corresponds to equation (15):

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

(ii) the *four-factor S-CAPM* (denoted as *4F S-CAPM*) corresponds 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*) corresponds to the CAPM with respect to the investable market returns to which the SMB, HML, and MOM betas are added.

I work with 77 sin stocks during the period of interest, for an annual mean number of 42 stocks.[28] Given the substantial noise that occurs when performing regressions on a small number of individual stocks, especially when several of them have extreme return variations, I winsorize the data by removing the lowest and highest excess returns in each cross-sectional regression. The non-winsorized estimates are available in the Internet Appendix.

Table 8 reports the estimates of the three specifications for sin stocks using industry-sorted portfolios of investable assets. The OLS adjusted-R^2 of 15% and GLS R^2 of 23% are higher under the S-CAPM than the 4F model (9% and 16%, respectively).

The estimation of the exclusion premia supports the model predictions: the loadings of the exclusion-asset and exclusion-market factors are positive ($\widehat{\delta}_{ex.asset} = 74.9$ and $\widehat{\delta}_{ex.index} = 136.2$, respectively) and significant (t-statistics of 2.91 and 3.85, respectively). The estimates are robust to the inclusion of the SMB, HML, and MOM factors. However, the taste premium is not significant.

[Table 8 about here]

Using $\widehat{\gamma\frac{p}{1-p}} = \widehat{\delta}_{ex.asset}$ and $\widehat{\gamma} = \widehat{\delta}_{ex.mkt}$, the proportion of AUM practicing sin stock exclusion is estimated at $\hat{p} = 35\%$. This estimate should be regarded with caution as it is based on the assumptions of this model, but it gives an order of magnitude that is consistent with the proportion of sustainably managed assets in the U.S. in 2018 (US SIF, 2018).

[28] In the robustness check that includes the defense industry, I work with 86 sin stocks, giving an annual mean number of 52 stocks.

The exclusion effect, which is the sum of the exclusion-asset and exclusion-market premia, is estimated at 2.98% per year for 1999–2018. This effect is of a similar magnitude as the one estimated on U.S. sin stocks by Hong and Kacperczyk (2009) between 1965 and 2006 (2.5%). However, it is substantially lower than the annual 16% effect estimated by Luo and Balvers (2017) between 1999 and 2012 and based on the same modeling framework (in the absence of tastes for green firms). Additionally, consistent with Proposition 3, I find that the exclusion effect is positive on average, but it is negative for some sin stocks (see the Internet Appendix).

To assess the robustness of these results, I perform additional analyses presented below and detailed in the Internet Appendix. In all robustness tests, the S-CAPM has a 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, the estimates are of a similar magnitude to those in the main estimation but only the exclusion-market premium is significant. The exclusion-asset premium is weakly or not significant.

I repeat the estimation over three consecutive periods between 2002 and 2018.[29] In each period, at least one exclusion factor is significant: the exclusion-asset factor is significant for 2002–2007, both exclusion factors are significant for 2007–2012, and the exclusion-market factor is significant for 2012–2018. The taste premium is significant from 2007 onwards: it was positive for 2007-2012 and became negative for 2012-2018.

To highlight the dynamics of the exclusion effect, I repeat the second-pass estimation using a 1-year rolling window between 2002 and 2018 (see Figure 3). The exclusion effect peaks at the end of 2011 and then collapses. As the sum of two conditional covariances, this effect is related to the multiple correlation in the excluded market. This can be observed by comparing the dynamics of the exclusion effect with the dynamics of the one-year implied correlation of the S&P500 (see Figure 3). The higher the correlation between the sin stocks is, the greater will be the conditional covariances and the exclusion effect.

[Figure 3 about here]

Finally, I analyze the patterns in pricing errors based on cross-sectional regressions for the

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

CAPM, S-CAPM, 4F model, and 4F S-CAPM (Figure 4). Even if the fit is noisy because the estimations are performed on individual stock returns, the S-CAPM reduces pricing errors compared to the CAPM and 4F model.

[Figure 4 about here]

5.2 Spillover analysis

In the first section, I broke down the exclusion premia into a regular investor effect and a sustainable investor effect. Here, I present another form of decomposition of the exclusion premia to highlight the spillover effects of all excluded assets (through r_{m_X}) into the expected excess returns on each excluded asset. These effects underline the point of relaxing the assumption of independence between returns made by Merton (1987).

Corollary 2 (Spillover effects)**.**
Let q_{X_i} be the proportion of the market value of X_i in the market.
(i) The spillover effect of asset X_k on the expected excess returns on asset X_i is

$$\gamma \frac{p}{1-p} q_{X_k} \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_I) + \gamma q_{X_k} \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_{m_I}). \tag{20}$$

(ii) The spillover effects of assets $(X_k)_{k \in \{1, \dots, n_X\} \setminus \{i\}}$ on the expected excess returns on asset X_i are additive, and the exclusion premia can be broken down into an own effect and a spillover effect:

$$\gamma \frac{p}{1-p} q \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_I) + \gamma q \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_{m_I}) =$$
$$\underbrace{q_{X_i} \left(\gamma \frac{p}{1-p} \mathbb{V}\mathrm{ar}(r_{X_i} | r_I) + \gamma \, \mathbb{V}\mathrm{ar}(r_{X_i} | r_{m_I}) \right)}_{\textit{Own effect}} + \underbrace{\sum_{k=1, k \neq i}^{n_X} q_{X_k} \left(\gamma \frac{p}{1-p} \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_I) + \gamma \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_{m_I}) \right)}_{\textit{Spillover effect}}. \tag{21}$$

The spillover effect of each excluded stock is induced by its conditional covariances with the other excluded stocks. The following two questions arise: What is the share of the spillover effect in the total exclusion effect? What are the drivers of the spillovers?

To address the first issue, I define the share of the spillover effect in the exclusion premia as the ratio of the sum of the absolute values of the spillover effect to the sum of the absolute values of

the own and spillover effects:

$$\frac{\sum_{k=1,k\neq i}^{n_X} |q_{X_k}\left(\gamma\frac{p}{1-p}\,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k}|r_I) + \gamma\,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k}|r_{m_I})\right)|}{\sum_{k=1}^{n_X} |q_{X_k}\left(\gamma\frac{p}{1-p}\,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k}|r_I) + \gamma\,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k}|r_{m_I})\right)|}.$$

To estimate this effect, I use the estimates of $\gamma\frac{p}{1-p}$ and γ from the previous subsection. On average, among the 77 sin stocks of interest, the spillover effect accounts for 96.1% of the exclusion effect. The heatmap in the Internet Appendix offers a graphical depiction of the spillover effects of every sin stock on each sin stock of interest and illustrates two main findings. First, although most of the spillover effects are positive, some can be negative. Second, some stocks exert strong spillover effects on all other sin stocks.

To identify the determinants of the spillovers, I analyze the determinants of the *average spillover effect* of each sin stock $(X_i)_i$ on the other sin stocks. The average spillover effect of stock X_i on the other sin stock returns is defined as:

$$\frac{1}{n_X}\sum_{k=1,k\neq i}^{n_X} q_{X_i}\left(\gamma\frac{p}{1-p}\,\mathbb{C}\mathrm{ov}(r_{X_k}, r_{X_i}|r_I) + \gamma\,\mathbb{C}\mathrm{ov}(r_{X_k}, r_{X_i}|r_{m_I})\right).$$

For this purpose, I perform a cross-sectional regression of the average spillover effect exerted by each sin stock $(X_i)_i$ on the weight of the sin stock in question, its variance, its average correlation with the other sin stocks, its average correlation with the other investable stocks, and a constant. The estimates in the Internet Appendix show that the most important driver is the weight of the sin stock: the weight variable alone explains 77.9% of the variance of the average spillover effect. Therefore, the higher the market capitalization of a sin stock, the more it impacts the dynamics of all the other sin stocks.

6 Conclusion

In this paper, I develop an asset pricing model with partial segmentation and disagreement to describe the effects of exclusionary screening and ESG integration practices by sustainable investors on expected asset returns. By estimating this model for green investing and sin stock exclusion, I show that the taste premium and the exclusion premia significantly affect investable and excluded

asset returns, respectively. I find weak evidence for the cross effects of sin stock exclusion on investable asset returns and green tastes on sin stock returns.

Whether through exclusionary screening or ESG integration, sustainable investing contributes toward increasing the cost of capital of the least ethical or most environmentally risky companies. Both practices are thus effective means of pressure available to sustainable investors to encourage companies to reform.

This study allows a comparison between the effects of green investing and sin stock exclusionary screening. The integration of environmental criteria by green investors impacts the different industries with an annual premium ranging from -1.09% for the most overweighted industries to +11bps for the most underweighted, while the average annual exclusion effect of sin stocks is 2.98%. Compared to the inclusion of environmental criteria, the more pronounced effect of sin stock exclusion may be attributed to the larger number of U.S. investors who exclude this category of assets for ethical motives.

The Internet 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. The result shows that the conclusions for the two groups of investors remain valid in a more general case. Future research may consider extending this model to a multiperiod framework by endogenizing companies' ESG profile in response to regular and sustainable investors' optimal asset allocations. Therefore, by internalizing the responses of companies to their investments, sustainable investors can engage in ESG integration and exclusionary screening to make an impact on companies' practices.[30] However, the asset pricing equation may not remain tractable in this more refined modeling framework. This study can also be extended in the case where sustainable investors internalize a stochastic and non-Gaussian environment-related financial risk.

[30] Oehmke and Opp (2019) and Landier and Lovo (2020) show that ESG investors force companies to partially internalize their social costs.

Appendix: Derivation of the S-CAPM and main proofs

Problem setup

We model sustainable investors and regular investors on an aggregate basis: one generic regular investor (referred to using subscript r) and one generic sustainable investor (referred to using subscript s). Both groups of investors maximize at time t the expected utility of their terminal wealth at time $t+1$. We assume that investors are risk averse and have an exponential utility. We denote by γ_k^a the absolute risk aversion of investors k ($k \in \{r, s\}$) and by $W_{k,t}$ and $W_{k,t+1}$ their wealth on t and $t+1$, respectively. Investors k select the optimal vector of weights of *risky assets* w_k corresponding to the solution of the following optimization problem:

$$\max_{w_k} \mathbb{E}\left(U(W_{k,t+1})\right) = \max_{w_k} \mathbb{E}\left(1 - e^{-\gamma_k^a W_{k,t+1}}\right) \tag{1}$$

Investors have the ability to 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, and regular investors can invest in *investable* and *excluded* assets, the returns on which are denoted by the $(n_I + n_X) \times 1$ vector $R = \begin{pmatrix} R_I \\ R_X \end{pmatrix}$. Let us denote by $\mathbb{1}_n$ the vector of ones of length $n \in \mathbb{N}^*$. Sustainable investors charge a deterministic private cost for risky investments, denoted by the $n_I \times 1$ vector C, corresponding to the internalization at time t of the cost of externalities in $t+1$. All the weights add up to one, including the weight of the risk-free asset.

Without loss of generality, we assume that regular and sustainable investors have the same relative risk aversion $\gamma = W_{k,t}\gamma_k^a$. Since $W_{k,t+1}$ is normally distributed with mean $\mathbb{E}(W_{k,t+1})$ and variance $\mathbb{V}\mathrm{ar}(W_{k,t+1})$,

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

$$\begin{aligned} &\max_{w_{s,I}} \mathbb{E}_t(W_{s,t+1}) - \frac{\gamma}{2} \mathbb{V}\mathrm{ar}_t(W_{s,t+1}) \\ &\text{subject to } \; W_{s,t+1} = W_{s,t}\left(1 + w'_{s,I}\left(R_I - C\right) + \left(1 - w'_{s,I}\mathbb{1}_{n_I}\right) r_f\right). \end{aligned} \tag{2}$$

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

$$\begin{aligned} &\max_{(w_{r,I},w_{r,X})} \mathbb{E}_t(W_{r,t+1}) - \frac{\gamma}{2}\mathbb{V}\mathrm{ar}_t(W_{r,t+1}) \\ &\text{subject to } \; W_{r,t+1} = W_{r,t}\left(1+\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}' R + \left(1-\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}' \mathbb{1}_{n_I+n_X}\right) r_f\right). \end{aligned} \tag{3}$$

Let us denote by $r_I = R_I - r_f\mathbb{1}_{n_I}$ and $r_X = R_X - r_f\mathbb{1}_{n_X}$ the vectors of excess returns on investable and excluded assets, respectively. Let us also denote the vectors $\mu_I = \mathbb{E}_t(r_I)$, $\mu_X = \mathbb{E}_t(r_X)$, and the matrices $\Sigma_{XX} = \mathbb{V}\mathrm{ar}_t(r_X)$, $\Sigma_{II} = \mathbb{V}\mathrm{ar}_t(r_I)$, $\Sigma_{XI} = \mathbb{C}\mathrm{ov}_t(r_X, r_I)$, $\Sigma_{IX} = \mathbb{C}\mathrm{ov}_t(r_I, r_X)$.

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

$$\begin{cases} \lambda\left(\mu_I - C\right) = \Sigma_{II} w_{s,I} \\[2em] \lambda\begin{pmatrix} \mu_I \\ \mu_X \end{pmatrix} = \begin{pmatrix} \Sigma_{II} & \Sigma_{IX} \\ \Sigma_{XI} & \Sigma_{XX} \end{pmatrix}\begin{pmatrix} w_{r,I} \\ w_{r,X}\end{pmatrix}. \end{cases} \tag{4}$$

Proof of Proposition 1: S-CAPM

Lemma 1. ***Preliminary results.***

The covariance column vector between the vector of excess returns on investable assets I and the excess returns on the investable market 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.

Assuming that the returns are normally distributed, σ_{m_I} is non-null 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 thee Internet 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 (4) by the wealth of investors s and r, respectively, we have

$$\lambda\left(W_s+W_r\right)\mu_I-\lambda W_s C=\Sigma_{II}\left(W_s w_{s,I}+W_r w_{r,I}\right)+\Sigma_{IX}\left(W_r w_{r,X}\right). \tag{5}$$

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

$$\lambda\mu_I=\Sigma_{II}\left(\frac{W_s w_{s,I}+W_r w_{r,I}}{W}\right)+\Sigma_{IX}\left(\frac{W_r w_{r,X}}{W}\right)+\lambda p C. \tag{6}$$

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,

$$\lambda\mu_I=\Sigma_{II}\frac{D_I}{W}+\Sigma_{IX}\frac{D_X}{W}+\lambda p C. \tag{7}$$

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 is denoted by $q_X=\frac{S_X}{S}$. Therefore,

$$\lambda\mu_I=\Sigma_{II}\frac{S_I}{S}+\Sigma_{IX}q_X+\lambda p C. \tag{8}$$

We denote by q the proportion of the excluded assets' market value in the market. The proportion of the investable market is $1-q$. Let us denote by w_I the vector of market values of stocks $(I_i)_{i\in\{1,\ldots,n_I\}}$ in the investable market. Therefore, we have $\frac{S_I}{S}=(1-q)w_I$, and equation (8) rewrites

$$\lambda\mu_I=(1-q)\,\Sigma_{II}w_I+\Sigma_{IX}q_X+\lambda p C. \tag{9}$$

Multiplying by ${w_I}'$, we obtain

$$\lambda {w_I}'\mu_I=(1-q)\,{w_I}'\Sigma_{II}w_I+{w_I}'\Sigma_{IX}q_X+\lambda p {w_I}'C \tag{10}$$

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 $\sigma_{m_I X} = {w_I}'\Sigma_{IX}$,

$$\lambda\mu_{m_I} = (1-q)\,\sigma^2_{m_I} + \sigma_{m_I X} q_X + \lambda p c_{m_I}. \tag{11}$$

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

$$(1-q) = \frac{1}{\sigma^2_{m_I}}\left(\lambda\mu_{m_I} - \sigma_{m_I X} q_X - \lambda p c_{m_I}\right). \tag{12}$$

Substituting (12) into (9) and the column vector $\sigma_{I m_I} = \Sigma_{II} w_I$, we obtain

$$\mu_I = \left(\mu_{m_I} - p c_{m_I}\right)\frac{1}{\sigma^2_{m_I}}\sigma_{I m_I} + pC + \gamma\left(\Sigma_{IX} - \frac{1}{\sigma^2_{m_I}}\sigma_{I m_I}\sigma_{m_I X}\right) q_X. \tag{13}$$

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:

$$\mathbb{E}(r_I) = \left(\mathbb{E}(r_{m_I}) - p c_{m_I}\right)\beta_{I m_I} + pC + \gamma q\,\mathbb{C}\text{ov}(r_I, r_{m_X} | r_{m_I}), \tag{14}$$

Derivation of the expected excess returns on X

Assuming that Σ_{II} is nonsingular, the first row of System (4) yields

$$w_{r,I} = \Sigma_{II}^{-1}\left(\lambda\mu_I - \Sigma_{IX} w_{r,X}\right). \tag{15}$$

Substituting $w_{r,I}$ into the second row of System (4), we have

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

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

$$\lambda\frac{W_r}{W}\mu_X = \lambda\frac{W_r}{W}\Sigma_{XI}\Sigma_{II}^{-1}\mu_I - \frac{W_r}{W}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} w_{r,X} + \frac{W_r}{W}\Sigma_{XX} w_{r,X}. \tag{17}$$

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

$$\mu_X = \Sigma_{XI}\Sigma_{II}^{-1}\mu_I + \frac{\gamma}{1-p}\left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)q_X. \tag{18}$$

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

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

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

$$\begin{aligned}\mu_X = {} & (\mu_{m_I} - pc_{m_I})\frac{1}{\sigma_{m_I}^2}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{II}w_I + p\Sigma_{XI}\Sigma_{II}^{-1}C \\ & + \gamma\left(\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} - \Sigma_{XX}\right)q_X + \gamma\left(\Sigma_{XX} - \frac{1}{\sigma_{m_I}^2}\Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{II}w_I\sigma_{m_IX}\right)q_X \\ & + \frac{\gamma}{1-p}\left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)q_X.\end{aligned} \tag{20}$$

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 previoius equation is simplified as follows using vector notations:

$$\mathbb{E}(r_X) = (\mathbb{E}(r_{m_I}) - pc_{m_I})\beta_{Xm_I} + pB_{XI}C + \gamma\frac{p}{1-p}q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_I) + \gamma q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_{m_I}). \tag{21}$$

Derivation of the general pricing formula

For any investable asset I_i,

$$\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_I) = \sigma_{I_im_X} - \sigma_{I_iI}\Sigma_{II}^{-1}\sigma_{Im_X} = \sigma_{I_im_X} - \sigma_{I_im_X} = 0, \tag{22}$$

and

$$B_{I_iI}C = \sigma_{I_iI}\Sigma_{II}^{-1}C = c_{I_i}. \tag{23}$$

Therefore, for any asset i,

$$\mathbb{E}(r_i) = \beta_{im_I}\left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right) + pB_{iI}C + \gamma\frac{p}{1-p}q\,\mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_I) + \gamma q\,\mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_{m_I}). \tag{24}$$

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:

$$\mathbb{E}(\mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_I)) = \mathbb{C}\mathrm{ov}(r_i, r_{m_X}) - \mathbb{C}\mathrm{ov}(\mathbb{E}(r_i|r_I), \mathbb{E}(r_{m_X}|r_I)). \tag{25}$$

Since the conditional covariance of multivariate normal distributions is independent of the conditioning variable (see Lemma 1), $\mathbb{E}(\mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_I)) = \mathbb{C}\mathrm{ov}(r_i, r_{m_X}|r_I)$. 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 2: A generalized form of Merton (1987)'s premium on neglected stocks

Derivation of the expected excess returns on I with respect to those on the market

Denoting by q_I and q_X the weight vectors of the market values of the investable and excluded assets in the total market, respectively, we have

$$\mu_m = q_I'\mu_I + q_X'\mu_X. \tag{26}$$

Substituting the expressions for the expected excess returns on I and X with respect to m_I (Proposition 1) in the above equation, we obtain

$$\begin{aligned}\mu_m =& q_I'\left((\mu_{m_I} - pc_{m_I})\beta_{Im_I} + pC + \gamma q\,\mathbb{C}\mathrm{ov}(r_I, r_{m_X}|r_{m_I})\right)\\ &+ q_X'\left((\mu_{m_I} - pc_{m_I})\beta_{Xm_I} + pB_{XI}C + \gamma\frac{p}{1-p}q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_I) + \gamma q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_{m_I})\right).\end{aligned} \tag{27}$$

By grouping together the terms representing the same effect, the equation yields

$$\begin{aligned}\mu_m =&(\mu_{m_I} - pc_{m_I})\left(q_I'\beta_{Im_I} + q_X'\beta_{Xm_I}\right) + p\left(q_I' + q_X' B_{XI}\right)C\\&+\gamma\frac{p}{1-p}qq_X'\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_I) + \gamma q\left(q_I'\,\mathbb{C}\mathrm{ov}(r_I, r_{m_X}|r_{m_I}) + q_X'\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_{m_I})\right).\end{aligned} \tag{28}$$

However,

$$q_I'\beta_{Im_I} + q_X'\beta_{Xm_I} = (1-q)w_I'\frac{\sigma_{Im_I}}{\sigma^2_{m_I}} + qw_X'\frac{\sigma_{Xm_I}}{\sigma^2_{m_I}} = (1-q)\frac{\sigma^2_{m_I}}{\sigma^2_{m_I}} + q\frac{\sigma_{m_X m_I}}{\sigma^2_{m_I}} = \beta_{mm_I} \tag{29}$$

and

$$\left(q_I' + q_X' B_{XI}\right) = \left(q_I'\Sigma_{II}\Sigma_{II}^{-1} + q_X'\Sigma_{XI}\Sigma_{II}^{-1}\right) = \left(q_I'\Sigma_{II} + q_X'\Sigma_{XI}\right)\Sigma_{II}^{-1} = \sigma_{mI}\Sigma_{II}^{-1} = B_{mI}. \tag{30}$$

B_{mI} is the row vector of slope coefficients of the regression of r_m on the excess returns on the investable assets $(r_I)_{k\in\{1,\dots n_I\}}$ and a constant.

Therefore, using Lemma 1, equation (28) rewrites as follows:

$$\begin{aligned}\mu_m =&(\mu_{m_I} - pc_{m_I})\beta_{mm_I} + pB_{mI}C\\&+\gamma\frac{p}{1-p}q^2\,\mathbb{V}\mathrm{ar}(r_{m_X}|r_I) + \gamma q\left((1-q)\,\mathbb{C}\mathrm{ov}(r_{m_I}, r_{m_X}|r_{m_I}) + q\,\mathbb{C}\mathrm{ov}(r_{m_X}, r_{m_X}|r_{m_I})\right).\end{aligned} \tag{31}$$

This equation is simplified as follows:

$$\mu_m =(\mu_{m_I} - pc_{m_I})\beta_{mm_I} + pB_{mI}C + \gamma\frac{p}{1-p}q^2\,\mathbb{V}\mathrm{ar}(r_{m_X}|r_I) + \gamma q\,\mathbb{C}\mathrm{ov}(r_m, r_{m_X}|r_{m_I}). \tag{32}$$

Consequently, the expected excess returns on the investable market are

$$\mu_{m_I} = \frac{1}{\beta_{mm_I}}\left(\mu_m + p\beta_{mm_I}c_{m_I} - pB_{mI}C - \gamma\frac{p}{1-p}q^2\,\mathbb{V}\mathrm{ar}(r_{m_X}|r_I) - \gamma q\,\mathbb{C}\mathrm{ov}(r_m, r_{m_X}|r_{m_I})\right). \tag{33}$$

Substituting μ_{m_I} into the expression for the excess returns on I, we obtain

$$\mu_I = \left(\frac{1}{\beta_{mm_I}}\left(\mu_m - \gamma q\,\mathbb{C}\mathrm{ov}(r_m, r_{m_X}|r_{m_I}) - \gamma\frac{p}{1-p}q^2\,\mathbb{V}\mathrm{ar}(r_{m_X}|r_I) - p\left(B_{mI}C - \beta_{mm_I}c_{m_I}\right)\right) - pc_{m_I}\right)\beta_{Im_I}$$
$$+ pC + \gamma q\,\mathbb{C}\mathrm{ov}(r_I, r_{m_X}|r_{m_I}). \tag{34}$$

Denoting $\frac{1}{\beta_{mm_I}}\beta_{Im_I} = \frac{1}{\mathbb{C}\mathrm{ov}(r_m,r_{m_I})}\,\mathbb{C}\mathrm{ov}(r_I, r_{m_I}) = \tilde{\beta}_{Im}$, and by grouping the terms related to the same effect, we obtain the expected expression using vector notations:

$$\mathbb{E}(r_I) = (\mathbb{E}(r_m) - pB_{mI}C)\tilde{\beta}_{Im} + pC - \gamma\frac{p}{1-p}q^2\,\mathbb{V}\mathrm{ar}(r_{m_X}|r_I)\tilde{\beta}_{Im} + \gamma q\,\mathbb{C}\mathrm{ov}(r_I - r_m\tilde{\beta}_{Im}, r_{m_X}|r_{m_I}). \tag{35}$$

Derivation of the expected excess returns on X with respect to those on the market

Substituting μ_{m_I} from equation (33) into the expression for the excess returns on X, we obtain

$$\mu_X = \left(\frac{1}{\beta_{mm_I}}\left(\mu_m - \gamma q\,\mathbb{C}\mathrm{ov}(r_m, r_{m_X}|r_{m_I}) - \gamma\frac{p}{1-p}q^2\,\mathbb{V}\mathrm{ar}(r_{m_X}|r_I) - p\left(B_{mI}C - \beta_{mm_I}c_{m_I}\right)\right) - pc_{m_I}\right)\beta_{Xm_I}$$
$$+ pB_{XI}C + \gamma\frac{p}{1-p}q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_I) + \gamma q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}|r_{m_I}). \tag{36}$$

Denoting $\frac{1}{\beta_{mm_I}}\beta_{Xm_I} = \frac{1}{\mathbb{C}\mathrm{ov}(r_m,r_{m_I})}\,\mathbb{C}\mathrm{ov}(r_X, r_{m_I}) = \tilde{\beta}_{Xm}$, and by grouping the terms related to the same effect, we obtain the expected expression using vector notations:

$$\begin{aligned}\mathbb{E}(r_X) &= (\mathbb{E}(r_m) - pB_{mI}C)\tilde{\beta}_{Xm} + pB_{XI}C \\ &\quad + \gamma\frac{p}{1-p}q\,\mathbb{C}\mathrm{ov}(r_X - qr_{m_X}\tilde{\beta}_{Xm}, r_{m_X}|r_I) + \gamma q\,\mathbb{C}\mathrm{ov}(r_X - r_m\tilde{\beta}_{Xm}, r_{m_X}|r_{m_I}).\end{aligned} \tag{37}$$

Derivation of the general pricing formula with respect to the market expected excess returns

This subsection is not necessary to the proof but provides a general result.

For any investable asset I_i,

$$\mathbb{C}\text{ov}(r_{I_i}, r_{m_X}|r_I) = \sigma_{I_i m_X} - \sigma_{I_i I}\Sigma_{II}^{-1}\sigma_{I m_X} = \sigma_{I_i m_X} - \sigma_{I_i m_X} = 0, \tag{38}$$

and

$$B_{I_i I}C = \sigma_{I_i I}\Sigma_{II}^{-1}C = c_{I_i}. \tag{39}$$

Therefore, for any asset i,

$$\begin{aligned}\mathbb{E}(r_i) &= \tilde{\beta}_{im}(\mathbb{E}(r_m) - pB_{mI}C) + pc_i \\ &\quad + \gamma\frac{p}{1-p}q\,\mathbb{C}\text{ov}(r_i - \tilde{\beta}_{im}qr_{m_X}, r_{m_X}|r_I) + \gamma q\,\mathbb{C}\text{ov}(r_i - \tilde{\beta}_{im}r_m, r_{m_X}|r_{m_I}).\end{aligned} \tag{40}$$

A generalized form of Merton (1987)'s premium on neglected stocks

a) On the one hand, *using Merton (1987)'s notation* and combining equations (26), (19) and (15) in his paper, the premium on the neglected stock k that the author finds is equal to

$$\alpha_k = \delta\frac{1-q_k}{q_k}\sigma_k^2 x_k - \delta\beta_k\sum_{i=1}^{n}\frac{1-q_i}{q_i}\sigma_i^2 x_i^2. \tag{41}$$

In Merton (1987), q_k accounts for the "fraction of all investors who know about security k", i.e., the fraction of investors that can invest in security k. In the present framework, this fraction is the share of regular investors' wealth $1-p$, which is the same for all excluded assets. Thus, taking $q_k = q$, Merton (1987)'s premium on neglected stocks is equal to

$$\alpha_k = \delta\frac{1-q}{q}\left(\sigma_k^2 x_k - \beta_k\sum_{i=1}^{n}\sigma_i^2 x_i^2\right). \tag{42}$$

Let us now reconcile Merton (1987)'s notation with those of this paper. Let us denote by $Q = (q_i)_{i\in\{1,\dots,n_I+n_X\}} = (q_{I_1},\dots,q_{I_{n_I}},q_{X_1},\dots,q_{X_{n_X}})'$ the $(n_I+n_X,1)$ vector of weights of the assets $I_1,\dots,I_{n_I},X_1,\dots,X_{n_X}$ as a fraction of the market value and $r = (r_i)_{i\in\{1,\dots,n_I+n_X\}} = (r_{I_1},\dots,r_{I_{n_I}},r_{X_1},\dots,r_{X_{n_X}})'$ the $(n_I+n_X,1)$ vector of excess returns on assets $I_1,\dots,I_{n_I},X_1,\dots,X_{n_X}$.

In Merton (1987), σ_k^2 is the variance of the idiosyncratic risk's (IR) excess returns that is denoted by $\mathbb{V}\text{ar}_{id}(r_{X_k})$ in this paper, δ is the risk aversion (γ in this paper), x_k is the proportion of the

market portfolio invested in asset k (q_k in this paper), q is the proportion of regular investors ($1-p$ in this paper), β_k is the beta of asset k with respect to the market portfolio m ($\tilde{\beta}_{X_k m}$ in this paper) and n is the number of assets in the market ($n_I + n_X$ in this paper). Rewritten with the notations of this paper, Merton (1987)'s premium on neglected stock X_k is

$$\alpha_k = \gamma \frac{p}{1-p} \left(\mathbb{V}\mathrm{ar}_{id}(r_{X_k}) q_{X_k} - \beta_{X_k m} \sum_{i=1}^{n_I+n_X} \mathbb{V}\mathrm{ar}_{id}(r_i) q_i^2 \right). \tag{43}$$

b) On the other hand, when the cost of environmental externalities is zero as in Merton (1987)'s framework, equation (37) for stock X_k is expressed as follows:

$$\begin{aligned} \mathbb{E}(r_{X_k}) =& \tilde{\beta}_{X_k m}\, \mathbb{E}(r_m) + \underbrace{\gamma \frac{p}{1-p} q\, \mathbb{C}\mathrm{ov}(r_{X_k} - \tilde{\beta}_{X_k m} q r_{m_X}, r_{m_X} | r_I)}_{\text{Exclusion-asset premium}} \\ &+ \underbrace{\gamma q\, \mathbb{C}\mathrm{ov}(r_{X_k} - \tilde{\beta}_{X_k m} r_m, r_{m_X} | r_{m_I})}_{\text{Exclusion-market premium}}. \end{aligned} \tag{44}$$

The exclusion-asset premium of excluded asset X_k is equal to

$$\alpha_k = \gamma \frac{p}{1-p} \left(q\, \mathbb{C}\mathrm{ov}(r_{X_k}, r_{m_X} | r_I) - \tilde{\beta}_{X_k m} q^2\, \mathbb{V}\mathrm{ar}(r_{m_X} | r_I) \right). \tag{45}$$

However, from Lemma 1, 2.(i),

$$q\, \mathbb{C}\mathrm{ov}(r_X, r_{m_X} | r_I) = \mathbb{V}\mathrm{ar}(r_X | r_I) q_X, \tag{46}$$

and

$$q^2\, \mathbb{V}\mathrm{ar}(r_{m_X} | r_I) = q_X'\, \mathbb{V}\mathrm{ar}(r_X | r_I) q_X. \tag{47}$$

Therefore, denoting by $[\mathbb{V}\mathrm{ar}(r_X|r_I)]_{k,\cdot}$ the kth row of matrix $\mathbb{V}\mathrm{ar}(r_X|r_I)$,

$$\alpha_k = \gamma \frac{p}{1-p} \left([\mathbb{V}\mathrm{ar}(r_X|r_I)]_{k,\cdot} q_X - \tilde{\beta}_{X_k m} q_X'\, \mathbb{V}\mathrm{ar}(r_X|r_I) q_X \right). \tag{48}$$

Since $\mathbb{V}\mathrm{ar}(r_I|r_I) = \mathbb{0}_{n_I,n_I}$ and $\mathbb{C}\mathrm{ov}(r_X, r_I|r_I) = \mathbb{0}_{n_X,n_I}$ (see Lemma 1),

$$q_X'\, \mathbb{V}\mathrm{ar}(r_X|r_I) q_X = Q'\, \mathbb{V}\mathrm{ar}(r|r_I) Q. \tag{49}$$

Consequently,

$$\alpha_k = \gamma \frac{p}{1-p} \left([\mathbb{V}\mathrm{ar}(r_X|r_I)]_{k,.} q_X - \tilde{\beta}_{X_k m} Q' \, \mathbb{V}\mathrm{ar}(r|r_I) Q \right). \tag{50}$$

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

Nevertheless, it should be noted that taking Merton's stated assumptions, this premium does not boil down to the author's result for two reasons: 1) the beta is different $\tilde{\beta}_{X_k m} = \beta_{X_k m} \frac{\rho_{X_k, m_I}}{\rho_{X_k, m} \rho_{m, m_I}} \neq \beta_{X_k m}$, consistent with a segmented market, and 2) $[\mathbb{V}\mathrm{ar}(r_X|r_I)]_{k,.}$ is not necessarily equal to $(\mathbb{V}\mathrm{ar}_{id}(r_{X_k}), 0, ...0)$.

Let us take a simple example with three assets X_k, X_i, I to prove that $[\mathbb{V}\mathrm{ar}(r_X|r_I)]_{k,.}$ can differ from $(\mathbb{V}\mathrm{ar}_{id}(r_{X_k}), 0, ...0)$. For each asset $i \in \{X_k, X_i, I\}$, we express the excess return as in Merton's paper as a sum of a common factor and an IR: $r_i = \mathbb{E}(R_i) + b_i Y + \sigma_i \epsilon_i - r_f$, where $\mathbb{E}(Y) = 0$, $\mathbb{E}(Y^2) = 1$, $\mathbb{E}(\epsilon_i|\epsilon_{-i}, Y) = 0$ and $\mathbb{V}\mathrm{ar}(\epsilon_i) = 1$.[31] Therefore,

$$[\mathbb{V}\mathrm{ar}(r_X|r_I)]_{k,.} = (\mathbb{V}\mathrm{ar}(r_{X_k}|r_I), \mathbb{C}\mathrm{ov}(r_{X_k}, r_{X_i}|r_I)) = \left(\sigma^2_{X_k}, b_{X_k} b_{X_i} - \frac{b_I^2}{b_I^2 + \sigma_I^2} b_{X_k} b_{X_i} \right). \tag{51}$$

Consequently, $(\mathbb{V}\mathrm{ar}(r_{X_k}|r_I), \mathbb{C}\mathrm{ov}(r_{X_k}, r_{X_i}|r_I)) = (\mathbb{V}\mathrm{ar}_{id}(r_{X_k}), 0)$ only if one assumes that the IR of the investable asset–in Merton's framework, the asset that is not neglected by any investor–is zero: $\sigma_I = 0$. However, this type of assumption is not stated in Merton (1987). That is the reason why I refer to a *generalized form* and not to a generalization of Merton's result.

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:

$$q \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X}|r_I) = \left(\Sigma_{XX} - \Sigma_{XI} \Sigma_{II}^{-1} \Sigma_{IX} \right) q_X. \tag{52}$$

When there is at least one excluded asset, i.e., $q > 0$ and $q_X \neq \mathbb{0}_{n_X}$, denoting by $w_X = \frac{1}{q} q_X > 0$ the weights of assets X in the excluded market, we express the covariance matrix as the product

[31] This last assumption is not explicitely specified by Merton but is used in his calculations.

of a Schur complement by a strictly positive vector of weights:

$$\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) = \left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)\frac{1}{q}q_X = \left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right)w_X. \tag{53}$$

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 each asset X_i 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:

$$\begin{aligned} \mathbb{E}(r_{m_X}) =& w'_X \beta_{Xm_I}(\mathbb{E}(r_{m_I}) - pc_{m_I}) + pw'_X B_{XI} C \\ &+ \gamma \frac{p}{1-p} q w'_X \,\mathbb{C}\text{ov}(r_X, r_{m_X}|r_I) + \gamma q w'_X \,\mathbb{C}\text{ov}(r_X, r_{m_X}|r_{m_I}) \end{aligned} \tag{54}$$

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

$$\mathbb{E}(r_{m_X}) = \beta_{m_X m_I}(\mathbb{E}(r_{m_I}) - pc_{m_I}) + pB_{m_X I}C + \gamma \frac{p}{1-p} q \,\mathbb{V}\text{ar}(r_{m_X}|r_I) + \gamma q \,\mathbb{V}\text{ar}(r_{m_X}|r_{m_I}). \tag{55}$$

where $B_{m_X I}$ is the row vector of regression coefficients in a regression of the excluded market excess returns on the investable assets' excess returns, and $\beta_{m_X m_I}$ is the slope of the regression of the excluded market excess returns on the investable market excess returns and a constant. 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 $\mathbb{V}\text{ar}(r_{m_X}|r_I) = \mathbb{V}\text{ar}(r_{m_X})(1 - \rho_{m_X I})$ and $\mathbb{V}\text{ar}(r_{m_X}|r_{m_I}) = \mathbb{V}\text{ar}(r_{m_X})(1 - \rho_{m_X m_I})$ (see Dhrymes (1974), Theorem 2 (iv) p.24), the exclusion premia on the excluded market are equal to $\gamma q \,\mathbb{V}\text{ar}(r_{m_X})\left(\frac{p}{1-p}(1 - \rho_{m_X I}) + (1 - \rho_{m_X m_I})\right)$, and are always positive or zero. Indeed, since

the Schur complement is a positive semidefinite matrix, we have $w_X' \left(\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}\right) w_X \geq 0$ and $w_X' \left(\Sigma_{XX} - \frac{1}{\sigma_{m_I}^2}\sigma_{Xm_I}\sigma_{m_I X}\right) w_X \geq 0$.

Proof of Proposition 4: Cost of externalities

We obtain the desired result by substituting the first-order condition of sustainable investors into the first-order condition on the investable market of regular investors via risk aversion $\gamma = \frac{1}{\lambda}$ (using system of equations (4)).

Proof of Corollary 2: Spillover effects

Denoting by w_X the vector of weights of assets X in the excluded market, we write the exclusion-asset premium as:

$$\gamma \frac{p}{1-p} q \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_I) = \gamma \frac{p}{1-p} q \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_X | r_I) w_X. \tag{56}$$

Since $q w_X = q_X$,

$$\gamma \frac{p}{1-p} q \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_I) = \gamma \frac{p}{1-p} \sum_{k=1}^{n_X} q_{X_k} \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_I). \tag{57}$$

The breakdown is done in the same way for the exclusion-market premium, and thus

$$\begin{aligned}\gamma \frac{p}{1-p} q \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_I) + \gamma q \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X} | r_{m_I}) = \sum_{k=1}^{n_X} q_{X_k} \Bigg(& \gamma \frac{p}{1-p} \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_I) \\ & + \gamma \,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_{m_I}) \Bigg).\end{aligned} \tag{58}$$

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Tables and Figures

Table 1 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 between December 31, 1999, and December 31, 2018.

	Number of firms				Average Market Capitalization ($ billion)			
	Alcohol	Tobacco	Gaming	Defense	Alcohol	Tobacco	Gaming	Defense
Dec. 1999 - Dec. 2006	28	7	14	31	3	21.1	3.4	2.9
Dec. 2006 - Dec. 2013	15	9	11	26	2.3	30.3	4.5	3.6
Dec. 2013 - Dec. 2018	13	10	10	16	5.5	49.1	12.9	7.1

Table 2 Descriptive statistics on 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 between December 31, 1999, and December 31, 2018, in each of the 46 investable industries (i.e., the 49 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 3.1.2. In this table, the industries are ranked in descending order of the average proxy $\tilde{c}$.

	Environmnetal cost proxy					Returns				
Industry Name	Mean	Median	St dev.	Min.	Max.	Mean	Median	St dev.	Min.	Max.
Defense	0.85	0.90	0.47	-1.47	0.96	0.017	0.016	0.011	-0.003	0.039
Precious metals	0.74	0.78	0.13	0.44	0.96	0.015	0.019	0.016	-0.026	0.051
Non-metallic and industrial metal mining	0.61	0.71	0.22	0.16	0.98	0.018	0.017	0.012	-0.007	0.047
Shipbuilding & Railroad equipment	0.59	0.76	0.93	-2.30	0.98	0.012	0.012	0.007	-0.011	0.032
Aircraft	0.54	0.56	0.13	0.28	0.78	0.012	0.014	0.008	-0.012	0.028
Coal	0.49	0.56	0.34	-0.39	1.00	0.011	0.015	0.021	-0.041	0.055
Petroleum and natural gas	0.49	0.44	0.15	0.15	0.69	0.011	0.009	0.008	-0.005	0.029
Cand & Soda	0.46	0.43	0.10	0.32	0.68	0.007	0.007	0.004	-0.002	0.018
Trading	0.46	0.51	0.12	0.28	0.64	0.010	0.012	0.008	-0.018	0.026
Entertainment	0.43	0.45	0.15	-0.06	0.70	0.014	0.016	0.012	-0.015	0.035
Communication	0.39	0.39	0.12	0.20	0.58	0.009	0.010	0.009	-0.018	0.025
Retail	0.33	0.31	0.14	0.10	0.55	0.011	0.010	0.007	-0.006	0.024
Banking	0.32	0.32	0.14	0.09	0.62	0.008	0.010	0.009	-0.025	0.026
Insurance	0.31	0.35	0.18	0.07	0.64	0.010	0.012	0.007	-0.015	0.025
Meals	0.28	0.31	0.11	0.03	0.54	0.014	0.015	0.006	-0.002	0.032
Pharmaceutical products	0.22	0.29	0.16	-0.13	0.39	0.011	0.009	0.008	-0.003	0.029
Recreation	0.21	0.24	0.26	-0.24	0.68	0.011	0.011	0.006	-0.008	0.031
Clothes apparel	0.20	0.24	0.28	-0.26	0.91	0.015	0.015	0.007	-0.006	0.038
Real estate	0.19	0.26	0.40	-0.27	1.00	0.013	0.015	0.011	-0.026	0.044
Transportation	0.14	0.22	0.31	-0.35	0.62	0.014	0.014	0.006	-0.009	0.029
Business services	0.13	0.12	0.15	-0.05	0.46	0.014	0.016	0.007	-0.007	0.029
Shipping containers	0.12	0.64	1.09	-3.48	0.84	0.014	0.015	0.005	0.001	0.026
Rubber and plastic products	0.07	0.37	0.65	-1.07	0.99	0.014	0.016	0.011	-0.026	0.046
Steel works	0.03	0.10	0.38	-0.67	0.60	0.014	0.011	0.010	-0.008	0.041
Printing and publishing	0.01	0.82	0.94	-1.90	0.89	0.008	0.008	0.012	-0.027	0.039
Computers	-0.06	-0.10	0.20	-0.45	0.44	0.013	0.014	0.007	-0.010	0.035
Consumer Goods	-0.09	-0.07	0.12	-0.32	0.16	0.008	0.007	0.004	-0.006	0.021
Textiles	-0.10	0.01	0.61	-1.05	0.98	0.016	0.017	0.011	-0.024	0.046
Chemicals	-0.11	-0.03	0.41	-1.04	0.23	0.014	0.014	0.006	-0.002	0.033
Healthcare	-0.12	-0.19	0.28	-0.61	0.45	0.014	0.014	0.007	-0.005	0.027
Automobiles and trucks	-0.17	-0.16	0.19	-0.65	0.03	0.012	0.011	0.010	-0.016	0.050
Personal services	-0.21	0.28	0.71	-1.82	0.54	0.015	0.015	0.007	0.003	0.035
Medical equipment	-0.22	-0.26	0.25	-0.66	0.40	0.013	0.015	0.006	-0.006	0.026
Chips	-0.39	-0.38	0.21	-0.88	0.25	0.012	0.013	0.008	-0.018	0.029
Food products	-0.47	-0.43	0.30	-1.14	-0.08	0.012	0.011	0.005	-0.001	0.021
Wholesale	-0.48	-0.35	0.36	-0.83	0.31	0.014	0.014	0.006	-0.006	0.029
Electrical equipment	-0.63	-2.43	1.59	-4.17	0.31	0.009	0.009	0.008	-0.014	0.030
Business supplies	-0.66	-0.61	0.48	-1.67	0.42	0.011	0.010	0.007	-0.014	0.037
Utilities	-0.74	-0.66	0.48	-1.53	0.21	0.010	0.010	0.006	-0.003	0.023
Machinery	-1.55	-1.94	0.92	-3.38	-0.49	0.012	0.012	0.008	-0.017	0.036
Construction materials	-1.56	-1.79	0.84	-3.70	-0.21	0.014	0.015	0.008	-0.016	0.038
Construction	-2.17	-1.92	1.91	-5.21	0.61	0.016	0.015	0.012	-0.017	0.041
Fabricated products	-3.03	-2.05	2.89	-8.23	1.00	0.014	0.016	0.010	-0.009	0.034
Measuring and control equipment	-3.30	-3.02	1.16	-6.13	-1.45	0.015	0.016	0.007	-0.007	0.031
Agriculture	-3.52	-1.65	7.73	-25.54	1.00	0.017	0.017	0.011	-0.006	0.036
Other	-11.28	-11.78	6.15	-29.20	-4.83	0.010	0.011	0.004	-0.004	0.019
Market m						0.012	0.012	0.006	-0.007	0.027
Investable market portfolio m_I	-0.01	-0.02	0.02	-0.03	0.18	0.012	0.012	0.006	-0.007	0.027
Excluded market portfolio m_X						0.015	0.015	0.006	-0.002	0.038

Table 3 Summary statistics on the dependent and independent variables. This table provides the summary statistics on the dependent and independent variables in the estimations of the S-CAPM in the case of investable industry portfolios and excluded stocks. The investable market corresponds to the 49 SIC industries from which the alcohol, tobacco and gaming industries have been excluded. The excluded market corresponds to the 77 stocks issued by the alcohol, tobacco and gaming industries. The statistics relate to the exclusion-market factors for investable industry portfolios ($q\,\mathbb{C}\text{ov}(r_I, r_{m_X}|r_{m_I})$) and excluded stocks ($q\,\mathbb{C}\text{ov}(r_X, r_{m_X}|r_{m_I})$), respectively; the exclusion-asset factor ($q\,\mathbb{C}\text{ov}(r_X, r_{m_X}|r_I)$); the proxy for the cost of environmental externalities ($\tilde{c}$); the taste factor in the case of excluded stocks ($B_{XI}\tilde{C}$); the betas of the investable industry portfolios and excluded stocks with the Fama and French (1993) size and value factors ($\beta_{I.SMB}$, $\beta_{I.HML}$, $\beta_{X.SMB}$, $\beta_{X.HML}$) and the Carhart (1997) momentum factor ($\beta_{I.MOM}$, $\beta_{X.MOM}$), respectively. The statistics presented are the means, medians, standard deviations, minima, maxima and first-order autocorrelations (ρ_1) of the variables of interest based on monthly excess returns on the NYSE, AMEX and NASDAQ common stocks between December 31, 1999, and December 31, 2018.

	Mean	Median	Stdev	Min	Max	ρ_1
r_I	0.013	0.013	0.009	-0.041	0.055	0.500
$\tilde{c}$	-0.585	0.156	2.756	-29.200	1.000	0.346
$q\,\mathbb{C}\text{ov}(r_I, r_{m_X}\|r_{m_I})$	10^{-6}	10^{-6}	8×10^{-6}	-6×10^{-5}	5×10^{-5}	0.310
$\beta_{I.SMB}$	-0.529	-0.557	4.257	-39.232	28.257	0.422
$\beta_{I.MOM}$	-1.535	-1.311	5.459	-36.896	59.596	0.538
$\beta_{I.MOM}$	-0.038	-0.411	7.379	-56.955	56.743	0.552
r_X	0.012	0.014	0.038	-0.440	0.670	0.102
$B_{XI}\tilde{C}$	0.482	-0.104	11.986	-65.255	85.162	-0.061
$q\,\mathbb{C}\text{ov}(r_X, r_{m_X}\|r_I)$	-10^{-5}	0	9×10^{-5}	-0.001	0.001	0.192
$q\,\mathbb{C}\text{ov}(r_X, r_{m_X}\|r_{m_I})$	2×10^{-5}	10^{-5}	6×10^{-5}	-6×10^{-4}	0.001	0.213
$\beta_{X.SMB}$	-0.785	-0.622	9.654	-50.879	67.367	-0.042
$\beta_{X.HML}$	-2.386	-1.279	9.222	-87.739	55.511	0.165
$\beta_{X.MOM}$	-0.791	-0.117	13.557	-80.743	115.127	0.073

Table 4 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 46 investable stock industry-sorted portfolios between December 31, 2006, and December 31, 2018. The specification of the S-CAPM is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{c}_{I_i} + \delta_{ex.mkt} q\,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$, where r_{I_i} is the value-weighted excess return on portfolio i ($i = 1, ..., n_I$), $\beta_{I_i m_I}$ is the slope of an OLS regression of r_{I_i} on r_{m_I}; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of stock I_i; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_i 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 is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model 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) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. 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}	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0135	0.0004						0.05 [0.03,0.07]
t-value	(10.53)	(0.38)						0.07 [0.05,0.09]
Estimate	0.0141		0.0001					-0.02 [-0.02,-0.01]
t-value	(17.83)		(2.65)					0.01 [0,0.01]
Estimate	0.0142			140.6				0.06 [0.04,0.08]
t-value	(18.81)			(2.77)				0.08 [0.06,0.1]
Estimate	0.0136	0.0003	0.0001					0.03 [0.02,0.05]
t-value	(10.66)	(0.34)	(2.62)					0.08 [0.06,0.1]
Estimate	0.0125	0.0016	0.0001	57.8				0.09 [0.07,0.12]
t-value	(8.19)	(1.41)	(1.85)	(0.81)				0.15 [0.13,0.18]
Estimate	0.0135	0.0023	0.0003	-69.4	0.000	0.0005	-0.0001	0.23 [0.19,0.27]
t-value	(10.54)	(2.64)	(5.1)	(-1.35)	(-0.36)	(2.08)	(-1.1)	0.33 [0.3,0.36]
Estimate	0.0128	0.0025			-0.0001	0.0004	-0.0001	0.24 [0.2,0.27]
t-value	(10.83)	(3.01)			(-0.52)	(1.98)	(-0.81)	0.31 [0.27,0.34]

Table 5 Annual environmental taste effect estimates by industry. For all 46 investable SIC industries, this table reports the estimates of the annual taste effect $\widehat{kp}\tilde{c}_{I_i} - \widehat{kp}\tilde{c}_{m_I}\beta_{I_i m_I}$,which is the sum of the taste premium and the market effect. The market effect, $-\widehat{kp}\tilde{c}_{m_I}\beta_{I_i m_I}$, accounts for only 0.25 basis points in the total taste effect. The industries are ranked in descending order of their taste effect.

Industry name	Annual taste premium (in %)
Defense	0.11
Printing and publishing	0.1
Precious metals	0.09
Coal	0.08
Aircraft	0.07
Non-metallic and industrial metal mining	0.07
Cand & Soda	0.06
Entertainment	0.06
Petroleum and natural gas	0.05
Communication	0.05
Shipping containers	0.05
Retail	0.05
Banking	0.05
Insurance	0.05
Trading	0.05
Pharmaceutical products	0.04
Personal services	0.04
Meals	0.04
Clothes apparel	0.03
Real estate	0.03
Recreation	0.02
Business services	0.02
Transportation	0.01
Consumer Goods	0
Chemicals	0
Steel works	0
Shipbuilding & Railroad equipment	0
Computers	0
Agriculture	-0.01
Automobiles and trucks	-0.01
Rubber and plastic products	-0.02
Healthcare	-0.03
Medical equipment	-0.03
Textiles	-0.03
Food products	-0.04
Chips	-0.06
Wholesale	-0.07
Business supplies	-0.11
Utilities	-0.12
Machinery	-0.13
Fabricated products	-0.14
Construction materials	-0.25
Electrical equipment	-0.34
Measuring and control equipment	-0.38
Construction	-0.42
Other	-1.09

Table 6 Cross-sectional regressions for investable stock portfolios with tastes for green firms using industry-size portfolios. This table presents the estimates of the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for industry-size portfolios between December 31, 2006, and December 31, 2018. The specification of the S-CAPM is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{c}_{I_i} + \delta_{ex.mkt} q \,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$, where r_{I_i} is the value-weighted excess return on portfolio i ($i = 1, ..., n_I$), $\beta_{I_i m_I}$ is the slope of an OLS regression of r_{I_i} on r_{m_I}; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of industry I_i; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_i 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 is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model 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) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. 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 all 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}	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0123	0.0035						0.07 [0.04,0.09]
t-value	(8.69)	(2.76)						0.07 [0.05,0.09]
Estimate	0.0172		0.0003					0 [0,0]
t-value	(16.52)		(7.05)					0.01 [0.01,0.01]
Estimate	0.0167			116.2				0.03 [0.02,0.04]
t-value	(16.39)			(2.56)				0.03 [0.02,0.04]
Estimate	0.0126	0.0034	0.0002					0.06 [0.04,0.09]
t-value	(9.1)	(2.74)	(7.49)					0.07 [0.05,0.09]
Estimate	0.012	0.0041	0.0002	82.7				0.08 [0.06,0.1]
t-value	(8.74)	(3.31)	(5.25)	(1.83)				0.09 [0.07,0.12]
Estimate	0.0118	0.0055	0.0002	21.9	0.0001	0.000	-0.0004	0.16 [0.14,0.19]
t-value	(8.9)	(3.78)	(5.61)	(0.35)	(0.92)	(-0.15)	(-2.91)	0.19 [0.17,0.21]
Estimate	0.0116	0.0058			0.0001	0.0001	-0.0003	0.15 [0.12,0.17]
t-value	(8.1)	(4.09)			(0.9)	(0.95)	(-2.77)	0.16 [0.14,0.18]

Table 7 Cross-sectional regressions for investable stock industry-sorted portfolios with tastes for green firms using instrument $\tilde{p}\tilde{c}$. This table presents the estimates of the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for 46 investable stock industry-sorted portfolios between December 31, 2006, and December 31, 2018. The specification of the S-CAPM is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{p}\tilde{c}_{I_i} + \delta_{ex.mkt} q\,\mathbb{C}\text{ov}(r_{I_i}, r_{m_X}|r_{m_I})$, where r_{I_i} is the value-weighted excess return on portfolio i ($i = 1, ..., n_I$), $\beta_{I_i m_I}$ is the slope of an OLS regression of r_{I_i} on r_{m_I}; $\tilde{p}$ is the proxy for the proportion of sustainable investors; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of stock I_i; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{I_i}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_i 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 is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model 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) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. 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 all 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}	$\delta_{ex.index}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0135	0.0004						0.05 [0.03,0.07]
t-value	(10.53)	(0.38)						0.07 [0.05,0.09]
Estimate	0.0141		0.2136					-0.02 [-0.02,-0.01]
t-value	(17.83)		(2.9)					0.01 [0,0.01]
Estimate	0.0142			140.6				0.06 [0.04,0.08]
t-value	(18.81)			(2.77)				0.08 [0.06,0.1]
Estimate	0.0136	0.0003	0.1812					0.03 [0.02,0.05]
t-value	(10.66)	(0.34)	(2.89)					0.08 [0.06,0.1]
Estimate	0.0125	0.0016	0.1444	57.8				0.09 [0.07,0.12]
t-value	(8.19)	(1.41)	(1.93)	(0.81)				0.15 [0.13,0.18]
Estimate	0.0135	0.0023	0.5019	-69.4	0.000	0.0005	-0.0001	0.23 [0.19,0.27]
t-value	(10.54)	(2.64)	(5.1)	(-1.35)	(-0.36)	(2.08)	(-1.1)	0.33 [0.3,0.36]
Estimate	0.0128	0.0025			-0.0001	0.0004	-0.0001	0.24 [0.2,0.27]
t-value	(10.83)	(3.01)			(-0.52)	(1.98)	(-0.81)	0.31 [0.27,0.34]

Table 8 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 77 sin stocks between December 31, 1999, and December 31, 2018. The specification is written as follows: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{taste} B_{X_i I}\tilde{C} + \delta_{ex.asset} q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) + \delta_{ex.mkt} q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$, where r_{X_i} is the value-weighted excess return on stock i ($i = 1, ..., n_X$), and $\beta_{X_i m_I}$ is the slope of an OLS regression of r_{X_i} on r_{m_I}; $B_{X_i I}\tilde{C}$ is the proxy for the taste premium; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I)$ (and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$) are the covariances of the excess returns on stock X_i 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 46 industry-sorted portfolios. The S-CAPM specification is compared with two other specifications: (i) the 4F S-CAPM is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor have been added, and (ii) the 4F model 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) momentum factor have been added: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{SMB}\beta_{X_i SMB} + \delta_{HML}\beta_{X_i HML} + \delta_{MOM}\beta_{X_i MOM}$. 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 data are winsorized: the two stocks giving the highest and lowest excess returns every month are removed from the second pass. 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 shown in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0101	0.0038							0.03 [0.02,0.04]
t-value	(7.61)	(3.92)							0.04 [0.03,0.05]
Estimate	0.0133		-0.0002						0.04 [0.03,0.06]
t-value	(9.03)		(-1.5)						0.07 [0.06,0.08]
Estimate	0.0126			2.4					0.04 [0.03,0.06]
t-value	(8.47)			(0.14)					0.06 [0.04,0.07]
Estimate	0.011				148				0.1 [0.08,0.12]
t-value	(7.82)				(4.85)				0.09 [0.07,0.11]
Estimate	0.0111			60.6	144.4				0.11 [0.09,0.14]
t-value	(7.63)			(3)	(4.23)				0.14 [0.12,0.16]
Estimate	0.01	0.0011		82.4	151				0.13 [0.11,0.15]
t-value	(6.91)	(0.79)		(3.47)	(4)				0.18 [0.15,0.2]
Estimate	0.0108	-0.0002	-0.0001	74.9	136.2				0.15 [0.13,0.18]
t-value	(7.47)	(-0.13)	(-0.74)	(2.91)	(3.85)				0.23 [0.2,0.25]
Estimate	0.0106	0.0015	-0.0002	96.9	129.7	-0.0002	-0.0002	0.0004	0.24 [0.21,0.26]
t-value	(7.59)	(1.03)	(-1.78)	(3.57)	(3.2)	(-1.97)	(-1.24)	(2.07)	0.37 [0.35,0.39]
Estimate	0.0125					-0.0002	-0.0002	0.0003	0.09 [0.07,0.1]
t-value	(9.81)					(-2.07)	(-1.06)	(1.59)	0.16 [0.14,0.17]

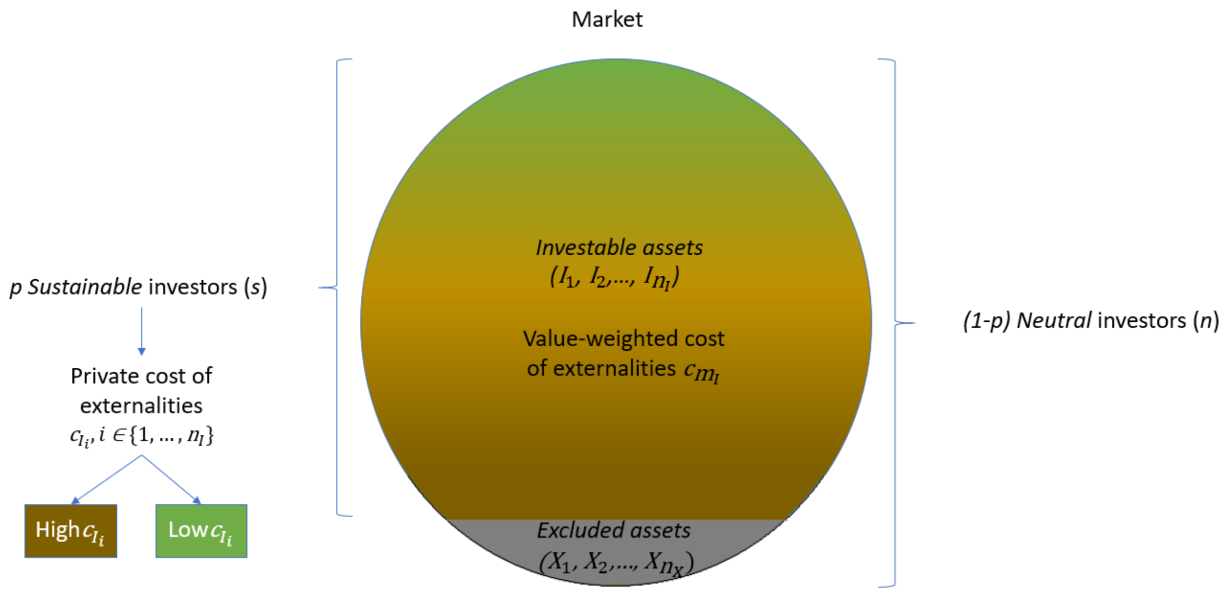
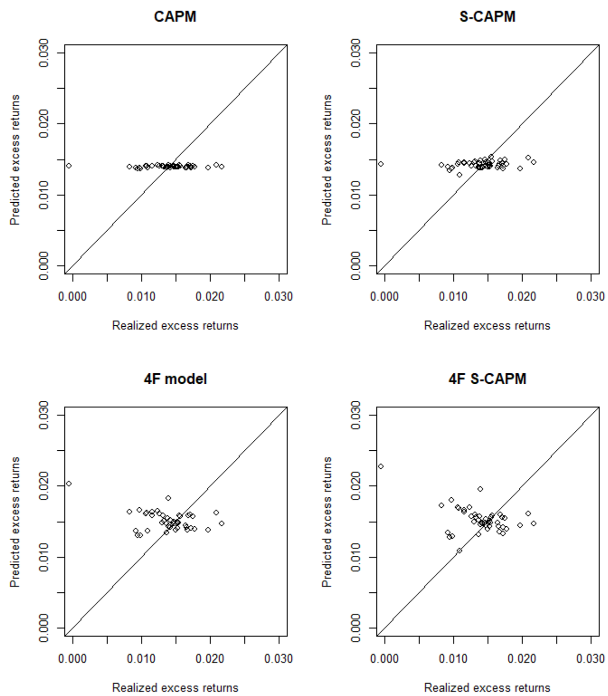
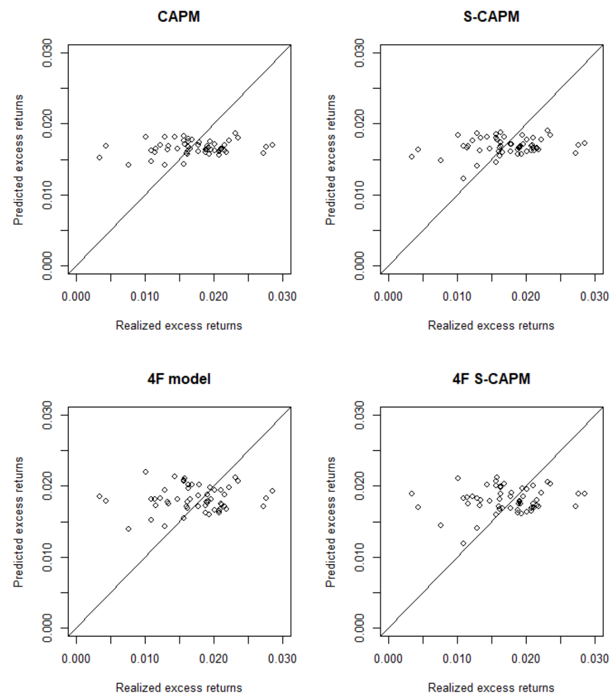


Figure 1. Graphical overview of the financial setup. This graph depicts the two types of investors involved (sustainable and regular investors), their scope of eligible assets and the tastes of sustainable investors through their private cost of externalities c_{I_i}.



(a) Industry portfolios



(b) Industry-size portfolios

Figure 2. Realized versus predicted average expected excess returns on investable stocks. The figures show the realized average monthly excess returns plotted against the predicted average monthly excess returns using (a) 46 industry-sorted portfolios, and (b) 230 industry-size double-sorted portfolios. The following four specifications are estimated: CAPM, S-CAPM, 4F model and 4F S-CAPM. The models are estimated using the Fama and MacBeth (1973) two-step procedure.

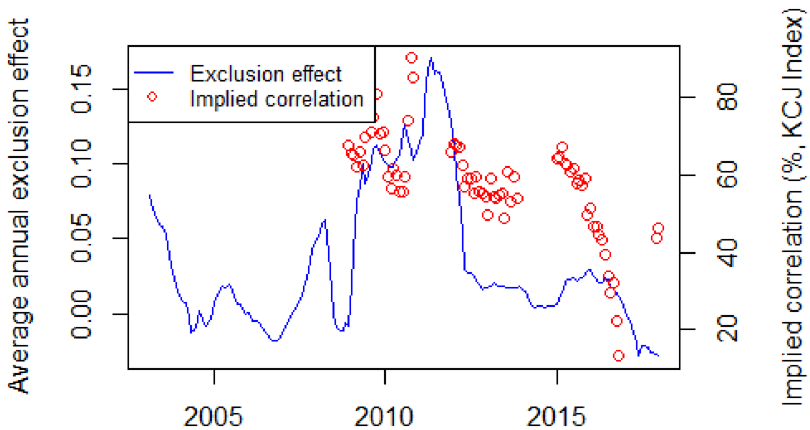


Figure 3. Evolution of the exclusion effect. This figure shows the comparative variation in the average exclusion effect $\left(\widehat{\frac{\gamma}{1-p}} - \widehat{\gamma}\right) q_{X_k}\, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k}|r_I) + \widehat{\gamma} q_{X_k}\, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k}|r_{m_I})$. The first and second pass are estimated over 3-year rolling periods and 1-year rolling periods, respectively, between December 1999 and December 2018. This rolling estimation is based on winsorized data, where the lowest and highest excess returns in each cross-sectional regression have been removed.

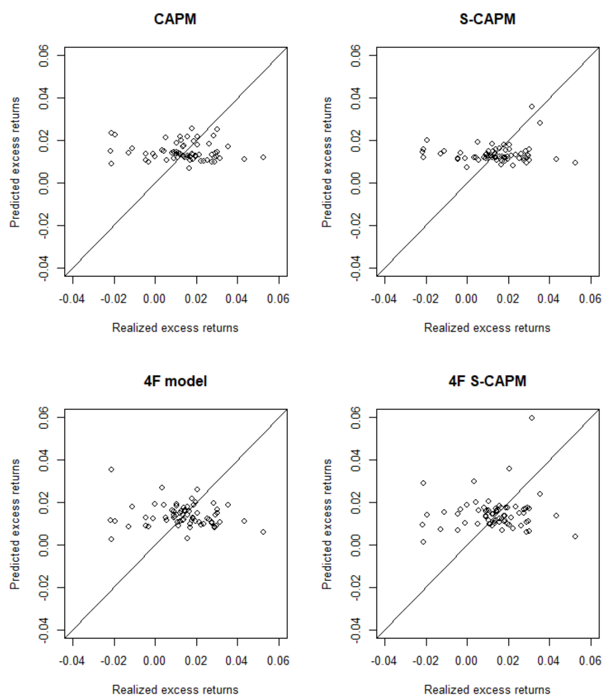


Figure 4. Realized versus predicted average expected excess returns on sin stocks. The figures show the realized mean excess returns plotted against the predicted mean excess returns on the 77 sin stocks, using 46 industry portfolios for investable stocks. The following four specifications are estimated: CAPM, S-CAPM, 4F model and 4F S-CAPM. The models are estimated using the Fama and MacBeth (1973) two-step procedure. The estimation is based on winsorized data, where the lowest and highest excess returns in each cross-sectional regression have been removed.

Internet Appendix for

"A Sustainable Capital Asset Pricing Model (S-CAPM): Evidence from green investing and sin stock exclusion"

Olivier David Zerbib

Abstract

This document provides additional proofs, including a generalization of the S-CAPM with several different sustainable investors. This appendix also provides a geometric interpretation of the exclusion premia, a factor correlation matrix, as well as details about the SEC's February 2004 amendment, and the funds used to construct instrument $\tilde{C}$. Finally, this document presents tables for the robustness tests for investable and excluded asset returns.

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A Geometric interpretation of the exclusion premia

The exclusion premia can be interpreted from a geometric perspective. By assimilating the standard deviation to the norm of a vector and the correlation coefficient to the cosine of the angle

between two vectors, the conditional covariance of the exclusion-asset premium can be associated with the following difference between two scalar products:

$$\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) \sim ||X_i||\ ||m_X||\ cos(\alpha) - ||\ \mathbb{E}(X_i|I)||\ ||\ \mathbb{E}(m_X|I)||\ cos(\alpha'),$$

where $\alpha = \widehat{X_i, m_X}$ and $\alpha' = \widehat{\mathbb{E}(X_i|I), \mathbb{E}(m_X|I)}$. The same applies to the exclusion-market premium. This effect is presented graphically in Figure 1: the better the hedge for sustainable investors is (i.e., the closer the vectors X_i and m_X are to space $(I_1, ..., I_{n_I})$), the lower the exclusion-asset premium will be.

B SEC's February 2004 amendment

The proxy is built as detailed in section 3.1.2 of the paper. Given the low reporting frequency of many funds until 2006 (the funds mainly reported their holdings in June and December), the proxy becomes robust from 2006 onwards. This period is notably subsequent to the entry into force of the SEC's February 2004 amendment requiring U.S. funds to disclose their holdings on a quarterly basis (Figure 2). Figure 4 depicts the proxy for the cost of environmental externalities of the investable market, $\tilde{c}_{m_I}$.

C Proof of Lemma 1

To lighten the writing in this proof, I remove the r notation referring to the returns.

- Let us prove 1.(iii): $\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} = \mathbb{V}\text{ar}(X|I)$.

  Let $\begin{pmatrix} X \\ I \end{pmatrix}$ follow a multivariate normal distribution with mean $\begin{pmatrix} \mu_X \\ \mu_I \end{pmatrix}$ and covariance matrix $\begin{pmatrix} \Sigma_{XX} & \Sigma_{XI} \\ \Sigma_{IX} & \Sigma_{II} \end{pmatrix}$.

  Assuming that all the random variables (I_i) are not perfectly correlated, Σ_{II} is invertible and the conditional distribution of X given I is multivariate normal with mean vector $\mu_X + \Sigma_{XI}\Sigma_{II}^{-1}(I - \mu_I)$ and covariance matrix $\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}$.

Indeed, the joint distribution $\begin{pmatrix} X - \Sigma_{XI}\Sigma_{II}^{-1}I \\ I \end{pmatrix}$ is multivariate normal with mean $\begin{pmatrix} \mu_X - \Sigma_{XI}\Sigma_{II}^{-1}\mu_I \\ \mu_I \end{pmatrix}$ and covariance matrix $\begin{pmatrix} \Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} & 0 \\ 0 & \Sigma_{II} \end{pmatrix}$.

Therefore, $X - \Sigma_{XI}\Sigma_{II}^{-1}I$ is independent of I, and hence its conditional distribution given I is equal to its unconditional distribution. Consequently, the covariance matrix of X given I is equal to $\Sigma_{XX} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX}$, and it does not depend on the value of I.

- Let us prove 1.(iv): $\sigma_{Xm_X} - \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{Im_X} = \mathbb{C}\text{ov}(X, m_X|I)$.

  Since 1.(iii) is true for any vector X, we can define $\bar{X} = \begin{pmatrix} X \\ m_X \end{pmatrix}$, and

  $\mathbb{V}\text{ar}(\bar{X}|I) = \begin{pmatrix} \mathbb{V}\text{ar}(X|I) & \mathbb{C}\text{ov}(X, m_X|I) \\ \mathbb{C}\text{ov}(m_X, X|I) & \mathbb{V}\text{ar}(m_X|I) \end{pmatrix}$. We are looking for the upper-right corner of this matrix.

  Let us define $\Sigma_{\bar{X}\bar{X}} = \begin{pmatrix} \Sigma_{X,X} & \sigma_{X,m_X} \\ \sigma_{m_X,X} & \sigma_{m_X}^2 \end{pmatrix}$, $\Sigma_{\bar{X}I} = \begin{pmatrix} \Sigma_{X,I} \\ \sigma_{m_X,I} \end{pmatrix}$, and $\Sigma_{I\bar{X}} = \begin{pmatrix} \Sigma_{X,I} & \sigma_{m_X,I} \end{pmatrix}$.

  Substituting these into the first equation yields:

$$
\begin{aligned}
\mathbb{V}\text{ar}(\bar{X}|I) &= \begin{pmatrix} \Sigma_{X,X} & \sigma_{X,m_X} \\ \sigma_{m_X,X} & \sigma_{m_X}^2 \end{pmatrix} - \begin{pmatrix} \Sigma_{X,I} \\ \sigma_{m_X,I} \end{pmatrix} \Sigma_{II}^{-1} \begin{pmatrix} \Sigma_{X,I} & \sigma_{m_X,I} \end{pmatrix} \\
&= \begin{pmatrix} \Sigma_{X,X} & \sigma_{X,m_X} \\ \sigma_{m_X,X} & \sigma_{m_X}^2 \end{pmatrix} - \begin{pmatrix} \Sigma_{XI}\Sigma_{II}^{-1}\Sigma_{IX} & \Sigma_{XI}\Sigma_{II}^{-1}\sigma_{Im_X} \\ \sigma_{m_XI}\Sigma_{II}^{-1}\Sigma_{IX} & \sigma_{m_XI}\Sigma_{II}^{-1}\sigma_{Im_X} \end{pmatrix}
\end{aligned}
\tag{C.1}
$$

  The upper-right corner is $\sigma_{X,m_X} - \Sigma_{XI}\Sigma_{II}^{-1}\sigma_{Im_X}$.

- Equations 1.(i) and 1.(ii) are proved similarly when one conditions by a random variable m_I instead of a random vector I.

- Let us prove 2. We know from 1.(ii) that $\mathbb{C}\text{ov}(I, X|m_I) = \Sigma_{IX} - \frac{\sigma_{Im_I}}{\sigma_{m_I}^2}\sigma_{m_IX}$.

  Let w_X be the weight vector of assets $(X_i)_i$ in the excluded market. Noting that $q_X = qw_X$,

we have

$$
\begin{aligned}
\mathbb{C}\mathrm{ov}(I, X|m_I)q_X =& q\left(\Sigma_{IX} - \frac{\sigma_{Im_I}}{\sigma_{m_I}^2}\sigma_{m_I X}\right) w_X \\
& q\left(\sigma_{Im_X} - \frac{\sigma_{Im_I}}{\sigma_{m_I}^2}\sigma_{m_I m_X}\right).
\end{aligned}
\tag{C.2}
$$

Consequently, from 1.(ii), we obtain

$$
\mathbb{C}\mathrm{ov}(I, X|m_I)q_X = q\,\mathbb{C}\mathrm{ov}(I, m_X|m_I). \tag{C.3}
$$

Similarly, we can also prove that

$$
\mathbb{C}\mathrm{ov}(X, X|I)q_X = q\,\mathbb{C}\mathrm{ov}(X, m_X|I). \tag{C.4}
$$

D Generalization of the S-CAPM for investable assets with $N+1$ types of sustainable investors and N types of excluded assets

This section derives the pricing formula for investable assets in the presence of $N+1$ sustainable investors with different exclusion scopes and different levels of disagreement regarding the assets in which they invest.

Let us consider a group of $N+1$ sustainable investors $(s_0, s_1, s_2, ..., s_N)$. The group of investors s_0 can only invest in assets I and penalizes these assets via the vector of cost of externalities $C_{0.0}$. The group of sustainable investors s_1 can only invest in assets I and X_1 and penalizes assets I and X_1 via the vectors of cost of externalities $C_{1.0}$ and $C_{1.1}$, respectively. This is the case up to N, and the group of sustainable investors s_N invests in assets $I, X_1, ..., X_N$ and penalizes these assets via the vectors of cost of externalities $C_{N,0}, C_{N,1}, ..., C_{N,N}$, respectively. Finally, the group of regular investors can invest in all assets (like investors s_N) but does not charge any environmental externality costs.

Sustainable and regular investors maximize their wealth. They solve the following first-order

conditions:

$$
\begin{cases}
\lambda(\mu_I - C_{00}) = \Sigma_{II} w_{s_0 I} \\
\lambda \begin{pmatrix} \mu_I - C_{10} \\ \mu_{X_1} - C_{11} \end{pmatrix} = \begin{pmatrix} \Sigma_{II} & \Sigma_{IX_1} \\ \Sigma_{X_1 I} & \Sigma_{X_1 X_1} \end{pmatrix} \begin{pmatrix} w_{s_1 I} \\ w_{s_1 X_1} \end{pmatrix} \\
\vdots \\
\lambda \begin{pmatrix} \mu_I - C_{N0} \\ \mu_{X_1} - C_{N1} \\ \vdots \\ \mu_{X_N} - C_{NN} \end{pmatrix} = \begin{pmatrix} \Sigma_{II} & \Sigma_{IX_1} & ... & \Sigma_{IX_N} \\ \Sigma_{X_1 I} & \Sigma_{X_1 X_1} & ... & \Sigma_{X_1 X_N} \\ \vdots & \vdots & \ddots & \vdots \\ \Sigma_{X_N I} & \Sigma_{X_N X_1} & ... & \Sigma_{X_N X_N} \end{pmatrix} \begin{pmatrix} w_{s_N I} \\ w_{s_N X_1} \\ \vdots \\ w_{s_N X_N} \end{pmatrix} \\
\lambda \begin{pmatrix} \mu_I \\ \mu_{X_1} \\ \vdots \\ \mu_{X_N} \end{pmatrix} = \begin{pmatrix} \Sigma_{II} & \Sigma_{IX_1} & ... & \Sigma_{IX_N} \\ \Sigma_{X_1 I} & \Sigma_{X_1 X_1} & ... & \Sigma_{X_1 X_N} \\ \vdots & \vdots & \ddots & \vdots \\ \Sigma_{X_N I} & \Sigma_{X_N X_1} & ... & \Sigma_{X_N X_N} \end{pmatrix} \begin{pmatrix} w_{rI} \\ w_{rX_1} \\ \vdots \\ w_{rX_N} \end{pmatrix}.
\end{cases}
\tag{D.5}
$$

Multiplying the first row of each first-order condition by $\frac{W_{s_1}}{W}, ..., \frac{W_{s_N}}{W}, \frac{W_r}{W}$, respectively, and summing up the terms, we have

$$
\begin{aligned}
& \lambda \left(\frac{W_{s_0}}{W} + ... + \frac{W_{s_N}}{W} + \frac{W_r}{W} \right) \mu_I - \lambda \left(\frac{W_{s_0}}{W} C_{00} + ... + \frac{W_{s_N}}{W} C_{N0} \right) \\
= \quad & \frac{W_{s_0}}{W} \Sigma_{II} w_{s_0 I} \\
& + \frac{W_{s_1}}{W} \Sigma_{II} w_{s_1 I} + \frac{W_{s_1}}{W} \Sigma_{IX_1} w_{s_1 X_1} \\
& + ... \\
& + \frac{W_{s_N}}{W} \Sigma_{II} w_{s_N I} + \frac{W_{s_N}}{W} \Sigma_{IX_1} w_{s_N X_1} + ... + \frac{W_{s_N}}{W} \Sigma_{IX_N} w_{s_N X_N} \\
& + \frac{W_r}{W} \Sigma_{II} w_{rI} + \frac{W_r}{W} \Sigma_{IX_1} w_{rX_1} + ... + \frac{W_r}{W} \Sigma_{IX_N} w_{rX_N}.
\end{aligned}
\tag{D.6}
$$

From the intermediate value theorem, there exists C such that

$$
\frac{W_{s_0}}{W} C_{00} + ... + \frac{W_{s_N}}{W} C_{N0} = pC. \tag{D.7}
$$

Therefore, rearranging equation (D.6),

$$\begin{aligned}\lambda\mu_I = {} & \Sigma_{II}\left(\frac{W_{s_0}}{W}w_{s_0 I} + \frac{W_{s_1}}{W}w_{s_1 I} + ... + \frac{W_{s_N}}{W}w_{s_N I} + \frac{W_r}{W}w_{rI}\right)\\ & + \Sigma_{IX_1}\left(\frac{W_{s_1}}{W}w_{s_1 X_1} + ... + \frac{W_{s_N}}{W}w_{s_N X_1} + \frac{W_r}{W}w_{rX_1}\right)\\ & + ...\\ & + \Sigma_{IX_N}\left(\frac{W_{s_N}}{W}w_{s_N X_N} + \frac{W_r}{W}w_{rX_N}\right)\\ & + \lambda pC.\end{aligned} \tag{D.8}$$

In equilbibrium the demand of assets is equal to the supply of assets on all the markets. Denoting by $q_I, q_{X_1}, ..., q_{X_N}$ the vectors of weights of assets $I, X_1, ..., X_N$ in the market, respectively, we obtain

$$\lambda\mu_I = \Sigma_{II}q_I + \Sigma_{IX_1}q_{X_1} + ... + \Sigma_{IX_N}q_{X_N} + \lambda pC. \tag{D.9}$$

Let us denote by w_I the vector of weights of assets I held by all investors $s_0, ..., s_N, r$, and for each asset X_i, $q_{X_i} = (q_{i1}, ..., q_{in_i})'$. Therefore,

$$q_I = \left(1 - \sum_{i=1}^{N}\sum_{j=1}^{n_i} q_{ij}\right) w_I. \tag{D.10}$$

Consequently, equation (D.9) is rewritten as

$$\lambda\mu_I = \left(1 - \sum_{i=1}^{N}\sum_{j=1}^{n_i} q_{ij}\right)\Sigma_{II}w_I + \Sigma_{IX_1}q_{X_1} + ... + \Sigma_{IX_N}q_{X_N} + \lambda pC. \tag{D.11}$$

Multiplying by $w_I{}'$, we obtain

$$\lambda w_I{}'\mu_I = \left(1 - \sum_{i=1}^{N}\sum_{j=1}^{n_i} q_{ij}\right) w_I{}'\Sigma_{II}w_I + \sum_{i=1}^{N} w_I{}'\Sigma_{IX_i}q_{X_i} + p\lambda\underbrace{w_I{}'C}_{c_{m_I}}, \tag{D.12}$$

$$\lambda\mu_{m_I} = \left(1 - \sum_{i=1}^{N}\sum_{j=1}^{n_i} q_{ij}\right)\sigma^2_{m_I} + \sum_{i=1}^{N}\sigma_{m_I X_i}q_{X_i} + p\lambda c_{m_I}. \tag{D.13}$$

Substituting $\left(1-\sum_{i=1}^{N}\sum_{j=1}^{n_i} q_{ij}\right)$ in (D.11), we obtain

$$\lambda\mu_I = \frac{1}{\sigma_{m_I}^2}\left(\lambda\mu_{m_I} - \sum_{i=1}^{N}\sigma_{m_I X_i} q_{X_i} - p\lambda c_{m_I}\right)\Sigma_{II} w_I + \Sigma_{IX_1} q_{X_1} + ... + \Sigma_{IX_N} q_{X_N} + \lambda p C. \quad \text{(D.14)}$$

Denoting by $\beta_{Im_I} = \frac{1}{\sigma_{m_I}^2}\sigma_{Im_I}$ the vector of betas of investable assets with respect to the investable market, and by $q_{\Omega_{X_i}}$ the weight of the excluded market of assets X_i in the total market, we can rewrite the previous equation as

$$\begin{aligned}\mu_I &= \left(\mu_{m_I} - pc_{m_I}\right)\beta_{Im_I} + \gamma\sum_{i=1}^{N}\left(\Sigma_{IX_i} - \beta_{Im_I}\sigma_{m_I X_i}\right) q_{X_i} + pC \\ &= \left(\mu_{m_I} - pc_{m_I}\right)\beta_{Im_I} + \gamma\sum_{i=1}^{N} q_{\Omega_{X_i}}\,\mathbb{C}\mathrm{ov}(r_I, r_{m_{X_i}}|r_{m_I}) + pC.\end{aligned} \quad \text{(D.15)}$$

Therefore, we can write the above equation as follows:

$$\mathbb{E}(r_I) = \left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right)\beta_{Im_I} + \gamma\sum_{j=1}^{N} q_{\Omega_{X_j}}\,\mathbb{C}\mathrm{ov}(r_I, r_{m_{X_j}}|r_{m_I}) + pC, \quad \text{(D.16)}$$

which yields for each asset I_i ($i \in \{1, ..., n_I\}$):

$$\mathbb{E}(r_{I_i}) = \beta_{I_i m_I}\left(\mathbb{E}(r_{m_I}) - pc_{m_I}\right) + \gamma\sum_{j=1}^{N} q_{\Omega_{X_j}}\,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_{X_j}}|r_{m_I}) + pc_i. \quad \text{(D.17)}$$

E Green and conventional funds used to construct the instrument $\tilde{C}$

To construct the proxy for the cost of environmental externalities $\tilde{C}$, I consider the 545 green funds identified in Bloomberg as of December 2018 with one or several of the following general attributes: "Environmentally friendly", "Climate change" or "Clean Energy". These funds are presented in Table 1, broken down according to their geographical investment area. I build the proxy using the 348 green funds that can invest in U.S. equities. More precisely, I focus on the "Global", "International", "Multi", "North American Region", "OECD countries", and "U.S." geographical areas. As shown in Figure 3a, the number of funds has grown steadily from over 50

funds in 2006 to 100 funds in 2010, reaching 177 funds in 2018. The number of stocks held by these green funds has naturally increased, from approximately 1000 in 2003 to over 4700 in 2018 (Figure 3b).

I construct the proxy as described in section 3.1.2. The proxy for the cost of externalities of the investable market $\tilde{c}_{m_I}$ is plotted on Figure 4.

I construct an alternative instrument capturing the proportion of sustainable investors, $\tilde{p}$, as detailed in Section 4.2. Figure 5 depicts the dynamics of $\tilde{p}$.

F Factor correlation matrix

Table 2 shows the correlation matrix between the regression factors for both investable and excluded assets.

G Empirical analysis for investable assets with tastes for green firms

I perform several alternative regressions to test the robustness of the pricing formula for investable assets. Two premia are analyzed: the taste premium, which carry the effect related to sustainable investors' preferences for green firms, and the exclusion-market premium, which reflects the effect of market partial segmentation on the return on investable assets.

In addition to the main case detailed in the paper, the taste premium remains significant:

- when the proxy for the cost of environmental externalities is lagged by three years (Table 3);
- when using a 5-year window in the first pass of the Fama and MacBeth (1973) regression (Table 4);
- when proxy $\tilde{p}\tilde{c}$ is lagged by three years (Table 5).
- when the S-CAPM is reduced to ESG integration only (i.e., without exclusion, see equation (4) in the article) and applied to the 49 non-sin and sin industries (Table 6).

The exclusion-market premium is significant when considering equally weighted returns of industry-sorted portfolios (Table 7).

H Empirical analysis for sin stocks as excluded assets

H.1 Robustness tests

I perform alternative regressions to test the robustness of the pricing formula for excluded assets applied to sin stocks. Three factors are analyzed: the exclusion-asset factor and the exclusion-market factor, which carry the effect related to sustainable investors' exclusion practice; the taste factor, which reflects the effect of sustainable investors' tastes for green firms on sin stocks.

At least one of the two exclusion premia is significant:

- when using equally weighted excess returns (Table 8);
- when using a 5-year rolling window in the first-pass regression (Table 9);
- when adding the defense industry to the gaming, alcohol and tobacco industries (Table 10).
- during several sub-periods between December 2002 and December 2018 (Table 11).

Table 12 shows the results of the estimation on non-winsorized data.

H.2 Exclusion premia and spillovers

The distribution of the exclusion premia, i.e., the sum of the exclusion-asset premium and exclusion-market premium, estimated using the main specification in the paper (equation (15)) is shown in Figure 6. The annual exclusion effect is mainly positive for the 77 stocks considered, but it can also be negative for some stocks given their correlation structure with other market assets. The average exclusion effect is 2.98% per year.

Figure 7 shows the distribution of the share of the spillover effect in the exclusion premia. This metric is defined in subsection 5.2 of the paper. For a given stock, on average, 96.1% of the exclusion premia is induced by the interaction with other sin stocks. The share of spillovers in the exclusion premia is most often between 90% and 100%.

The heatmap presented in Figure 8 offers a graphical depiction of the spillover effects of every sin stock (in columns) on each sin stock of interest (in rows) and illustrates two findings. First, although most of the spillover effects are positive, some can be negative (in green on the graph). Second, some stocks exert strong spillover effects on all the sin stocks under consideration (red columns).

To identify the determinants of the spillovers, I analyze the determinants of the *average spillover effect* of each of the sin stocks $(X_i)_i$ on the other sin stocks. The average spillover effect of stock X_i on the other sin stock returns is defined as follows:

$$\frac{1}{n_X}\sum_{k=1,k\neq i}^{n_X} q_{X_i}\left(\left(\widehat{\frac{\gamma}{1-p}}-\widehat{\gamma}\right)\mathbb{C}\mathrm{ov}(r_{X_k}, r_{X_i}|r_I)+\widehat{\gamma}\,\mathbb{C}\mathrm{ov}(r_{X_k}, r_{X_i}|r_{m_I})\right).$$

I perform a cross-sectional regression of the average spillover effect exerted by each sin stock $(X_i)_i$ on the weight of the sin stock in question, its variance, its average correlation with the other sin stocks, its average correlation with the other investable stocks, and a constant. Although the correlation factors are significant, Table 13 shows that the weight of the sin stock is the main determinant of the average spillover effect on the other sin stocks. Therefore, the higher the market capitalization of a sin stock is, the more it impacts the dynamics of all the other sin stocks.

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Tables and Figures

Table 1 Geographical distribution of green funds. This table reports the geographical distribution of all the green funds available in Bloomberg as of December 2018. The funds selected are those able to invest in the United States, i.e., those whose investment areas are: Global, International, U.S., Multi, OECD countries, North American Region.

Geographical zone	Number of funds
Global	237
International	60
European Region	36
U.S.	33
Norway	24
Eurozone	22
n.a.	18
Sweden	15
Australia	11
Japan	11
Multi	8
South Korea	8
U.K.	8
European Union	7
OECD Countries	7
Asian Pacific Region	6
Brazil	6
Nordic Region	6
Switzerland	5
China	4
North American Region	3
Asian Pacific Region ex Japan	2
Canada	2
South Africa	2
France	1
Greater China	1
Israel	1
Turkey	1
Total	545

Table 2 Correlation matrix. This table reports the correlation matrix between the factors involved in the S-CAPM and the 4F S-CAPM pricing models. $\beta_{I.SMB}$, $\beta_{I.HML}$ and $\beta_{I.MOM}$ are the slopes of the regression of the excess returns on the industry-sorted investable portfolios on the SMB, HML (Fama and French, 1993) and MOM (Carhart, 1997) factors, respectively. $\beta_{X.SMB}$, $\beta_{X.HML}$ and $\beta_{X.MOM}$ are the slopes of the regression of the excluded stocks' excess returns on the SMB, HML, and MOM factors, respectively. $\tilde{c}$ is the proxy for the cost of environmental externalities and $B_{XI}\tilde{C}$ is the taste factor for excluded assets. $q\,\mathbb{C}\mathrm{ov}_t(r_I, r_{m_X}|r_{m_I})$ and $q\,\mathbb{C}\mathrm{ov}_t(r_X, r_{m_X}|r_{m_I})$ are the exclusion-market factors for portfolios I and stocks X, respectively. $q\,\mathbb{C}\mathrm{ov}_t(r_X, r_{m_X}|r_I)$ is the exclusion-asset factor. $***$, $**$, and $*$ denote significance at the 1%, 5%, and 10% levels, respectively.

	$\tilde{c}$		$q\,\mathbb{C}\mathrm{ov}(r_I, r_{m_X}\|r_{m_I})$	$\beta_{I.SMB}$	$\beta_{I.HML}$
$q\,\mathbb{C}\mathrm{ov}(r_I, r_{m_X}\|r_{m_I})$	-0.01				
$\beta_{I.SMB}$	-0.05***		-0.18***		
$\beta_{I.HML}$	0.03**		-0.17***	0.01	
$\beta_{I.MOM}$	-0.01		-0.24***	0.3***	-0.49***

	$B_{XI}\tilde{C}$	$q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}\|r_I)$	$q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}\|r_{m_I})$	$\beta_{X.SMB}$	$\beta_{X.HML}$
$q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}\|r_I)$	0.05***				
$q\,\mathbb{C}\mathrm{ov}(r_X, r_{m_X}\|r_{m_I})$	-0.03**	-0.18***			
$\beta_{X.SMB}$	0.04***	0.23***	-0.15***		
$\beta_{X.HML}$	0.04***	0.15***	-0.15***	0.12***	
$\beta_{X.MOM}$	0	0.4***	-0.33***	0.18***	-0.25***

Table 3 Cross-sectional regressions for investable stock industry-sorted portfolios with tastes for green firms where proxy $\tilde{c}$ is lagged by 3 years. This table presents the estimates of the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for 46 investable stock industry-sorted portfolios between December 31, 2006, and December 31, 2018. The proxy for the cost of externalities, $\tilde{c}$, is lagged by 3 years. The specification of the S-CAPM is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{c}_{I_i} + \delta_{ex.mkt} q\,\mathbb{C}\text{ov}(r_{I_i}, r_{m_X}|r_{m_I})$, where r_{I_i} is the value-weighted excess return on portfolio i ($i = 1, ..., n_I$), $\beta_{I_i m_I}$ is the slope of an OLS regression of r_{I_i} on r_{m_I}; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of stock I_i, lagged by one month; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{I_i}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_i 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 is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model 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) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. 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 all 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}	$\delta_{ex.index}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0167	-0.0021						0.03 [0.01,0.04]
t-value	(17.98)	(-2.41)						0.05 [0.04,0.06]
Estimate	0.0144		0.0001					-0.02 [-0.02,-0.02]
t-value	(23.5)		(2.96)					0 [0,0]
Estimate	0.0138			-52.7				0.04 [0.03,0.05]
t-value	(25.99)			(-0.79)				0.06 [0.05,0.07]
Estimate	0.0169	-0.0022	0.0002					0.01 [0,0.03]
t-value	(17.8)	(-2.53)	(3.81)					0.05 [0.04,0.07]
Estimate	0.0206	-0.0062	0.0004	-278.4				0.11 [0.09,0.13]
t-value	(15.63)	(-4.91)	(4.43)	(-2.2)				0.17 [0.15,0.19]
Estimate	0.0187	-0.0028	0.0004	-431.5	-0.0007	0.0006	-0.0008	0.28 [0.25,0.3]
t-value	(14.91)	(-2.08)	(2.38)	(-4.5)	(-2.91)	(2.93)	(-5.09)	0.38 [0.35,0.4]
Estimate	0.0159	-0.0009			-0.0007	0.0004	-0.0007	0.22 [0.19,0.25]
t-value	(15.82)	(-0.73)			(-2.72)	(2.7)	(-6.27)	0.29 [0.26,0.31]

Table 4 Cross-sectional regressions for 46 industry-sorted portfolios of investable stocks with tastes for green firms, using a 5-year rolling window for the first-pass estimates. This table presents the estimates of the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for 46 investable stock industry-sorted portfolios between December 31, 2006, and December 31, 2018. The specification of the S-CAPM is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{c}_{I_i} + \delta_{ex.mkt} q\,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$, where r_{I_i} is the value-weighted excess return on portfolio i ($i = 1, ..., n_I$), $\beta_{I_i m_I}$ is the slope of an OLS regression of r_{I_i} on r_{m_I}; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of stock I_i; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_i 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 is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model 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) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. These specifications are estimated using the Fama and MacBeth (1973) procedure. First, the variables are estimated portfolio-by-portfolio in a 5-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 all 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}	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0124	0.0007						0.04 [0.02,0.05]
t-value	(11.54)	(0.99)						0.06 [0.05,0.07]
Estimate	0.0134		0.0001					-0.02 [-0.02,-0.02]
t-value	(19.44)		(4.23)					0.01 [0,0.01]
Estimate	0.0135			69.5				0.04 [0.03,0.05]
t-value	(21.1)			(1.65)				0.06 [0.05,0.07]
Estimate	0.0126	0.0007	0.0001					0.02 [0,0.03]
t-value	(11.73)	(0.92)	(4.54)					0.06 [0.05,0.07]
Estimate	0.0109	0.0024	0.0001	3.7				0.1 [0.08,0.12]
t-value	(8.1)	(2.37)	(2.82)	(0.06)				0.16 [0.14,0.18]
Estimate	0.0118	0.0011	0.0002	-131.8	-0.0001	-0.0002	0.000	0.33 [0.29,0.37]
t-value	(10.47)	(1.13)	(8.13)	(-3.5)	(-2.28)	(-1.02)	(-0.29)	0.42 [0.38,0.46]
Estimate	0.0107	0.0022			-0.0001	-0.0002	0.000	0.34 [0.29,0.38]
t-value	(11.04)	(2.39)			(-2.18)	(-1)	(-0.03)	0.39 [0.36,0.43]

Table 5 Cross-sectional regressions for investable stock industry-sorted portfolios with tastes for green firms using instrument $\tilde{p}\tilde{c}$ lagged by 3 years. This table presents the estimates of the S-CAPM on the value-weighted monthly returns in excess of the 1-month T-Bill for 46 investable stock industry-sorted portfolios between December 31, 2006, and December 31, 2018. Instrument $\tilde{p}\tilde{c}$ is lagged by 3 years. The specification of the S-CAPM is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{p}\tilde{c}_{I_i} + \delta_{ex.mkt} q\,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$, where r_{I_i} is the value-weighted excess return on portfolio i ($i = 1, ..., n_I$), $\beta_{I_i m_I}$ is the slope of an OLS regression of r_{I_i} on r_{m_I}; $\tilde{p}$ is the proxy for the proportion of sustainable investors; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of stock I_i; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_i 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 is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model 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) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. 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 all 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}	$\delta_{ex.index}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0167	-0.0021						0.03 [0.01,0.04]
t-value	(17.98)	(-2.41)						0.05 [0.04,0.06]
Estimate	0.0144		0.2295					-0.02 [-0.02,-0.02]
t-value	(23.5)		(3.15)					0 [0,0]
Estimate	0.0138			-52.7				0.04 [0.03,0.05]
t-value	(25.99)			(-0.79)				0.06 [0.05,0.07]
Estimate	0.0169	-0.0022	0.292					0.01 [0,0.03]
t-value	(17.8)	(-2.53)	(3.99)					0.05 [0.04,0.07]
Estimate	0.0206	-0.0062	0.6146	-278.4				0.11 [0.09,0.13]
t-value	(15.63)	(-4.91)	(4.9)	(-2.2)				0.17 [0.15,0.19]
Estimate	0.0187	-0.0028	0.5516	-431.5	-0.0007	0.0006	-0.0008	0.28 [0.25,0.3]
t-value	(14.91)	(-2.08)	(2.41)	(-4.5)	(-2.91)	(2.93)	(-5.09)	0.38 [0.35,0.4]
Estimate	0.0159	-0.0009			-0.0007	0.0004	-0.0007	0.22 [0.19,0.25]
t-value	(15.82)	(-0.73)			(-2.72)	(2.7)	(-6.27)	0.29 [0.26,0.31]

Table 6 Cross-sectional estimation of the S-CAPM reduced to ESG integration only, for investable stock industry-sorted portfolios with tastes for green firms. This table presents the estimates of the S-CAPM reduced to ESG integration only and applied to the 49 non-sin and sin industries between December 31, 2006, and December 31, 2018. The estimation is performed on the value-weighted monthly returns in excess of the 1-month T-Bill for the 49 industry-sorted portfolios. The specification is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m} + \delta_{taste}\tilde{c}_{I_i}$, where r_{I_i} is the value-weighted excess return on portfolio i $(i = 1, ..., n_I)$ and $\beta_{I_i m}$ is the slope of an OLS regression of r_{I_i} on the market returns, r_m; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of stock I_i. This specification is compared with two other specifications: (i) the 4F S-CAPM is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model is the CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. 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 all 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_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0136	0.0004					0.08 [0.05,0.1]
t-value	(10.7)	(0.42)					0.1 [0.07,0.12]
Estimate	0.0144		0.0002				-0.01 [-0.02,-0.01]
t-value	(17.78)		(3.12)				0.01 [0.01,0.01]
Estimate	0.0137	0.0004	0.0002				0.06 [0.04,0.09]
t-value	(10.91)	(0.38)	(3.46)				0.1 [0.08,0.13]
Estimate	0.0139	0.001	0.0003	-0.0002	0.0001	-0.0002	0.24 [0.2,0.28]
t-value	(12.31)	(0.99)	(4.38)	(-1.18)	(0.87)	(-2.01)	0.32 [0.29,0.35]
Estimate	0.0136	0.0012		-0.0002	0.0001	-0.0002	0.25 [0.21,0.28]
t-value	(11.83)	(1.21)		(-1.16)	(0.93)	(-1.88)	0.31 [0.28,0.34]

Table 7 Cross-sectional regressions for 46 industry-sorted portfolios of investable stocks with tastes for green firms, using equally weighted returns. This table presents the estimates of the S-CAPM on the equally weighted monthly returns in excess of the 1-month T-Bill for 46 investable stock industry-sorted portfolios between December 31, 2006, and December 31, 2018. The specification of the S-CAPM is written as follows: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{taste}\tilde{c}_{I_i} + \delta_{ex.mkt} q\,\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$, where r_{I_i} is the value-weighted excess return on portfolio i ($i = 1, ..., n_I$), $\beta_{I_i m_I}$ is the slope of an OLS regression of r_{I_i} on r_{m_I}; $\tilde{c}_{I_i}$ is the proxy for the cost of environmental externalities of stock I_i; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\mathrm{ov}(r_{I_i}, r_{m_X}|r_{m_I})$ is the covariance of the excess return on portfolio I_i 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 is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor are added, and (ii) the 4F model 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) momentum factor are added: $\mathbb{E}(r_{I_i}) = \alpha + \delta_{mkt}\beta_{I_i m_I} + \delta_{SMB}\beta_{I_i SMB} + \delta_{HML}\beta_{I_i HML} + \delta_{MOM}\beta_{I_i MOM}$. 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 all 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}	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0169	-0.0064						0.18 [0.15,0.21]
t-value	(6.86)	(-2.7)						0.2 [0.17,0.23]
Estimate	0.0104		-0.0002					-0.01 [-0.01,0]
t-value	(9.31)		(-2.27)					0.02 [0.01,0.02]
Estimate	0.0105			380.8				0.18 [0.15,0.22]
t-value	(9.55)			(4.55)				0.2 [0.17,0.24]
Estimate	0.0168	-0.0064	-0.0001					0.17 [0.15,0.2]
t-value	(6.85)	(-2.72)	(-1.72)					0.21 [0.18,0.24]
Estimate	0.0139	-0.0034	-0.0001	274.7				0.27 [0.23,0.3]
t-value	(6.39)	(-1.74)	(-0.93)	(3.87)				0.32 [0.28,0.35]
Estimate	0.012	-0.0003	0.000	284.1	0.0004	-0.0001	-0.0007	0.37 [0.33,0.41]
t-value	(6.64)	(-0.22)	(-0.26)	(4.14)	(1.78)	(-0.41)	(-3.39)	0.45 [0.42,0.49]
Estimate	0.0134	-0.0015			0.0006	0.0002	-0.0004	0.33 [0.29,0.38]
t-value	(6.28)	(-0.92)			(2.84)	(0.62)	(-2.81)	0.39 [0.36,0.43]

Table 8 Cross-sectional regressions for sin stocks with equally weighted returns. This table provides the estimates obtained with the S-CAPM on the equally weighted monthly returns in excess of the 1-month T-Bill for 77 sin stocks between December 31, 1999, and December 31, 2018. The specification is written as follows: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{taste} B_{X_i I}\tilde{C} + \delta_{ex.asset} q\,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X}|r_I) + \delta_{ex.mkt} q\,\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X}|r_{m_I})$, where r_{X_i} is the value-weighted excess return on stock i ($i = 1, ..., n_X$), and $\beta_{X_i m_I}$ is the slope of an OLS regression of r_{X_i} on r_{m_I}; $B_{X_i I}\tilde{C}$ is the proxy for the taste premium; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X}|r_I)$ (and $\mathbb{C}\mathrm{ov}(r_{X_i}, r_{m_X}|r_{m_I})$) are the covariances of the excess returns on stock X_i 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 46 industry-sorted portfolios. The S-CAPM specification is compared with two other specifications: (i) the 4F S-CAPM is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor have been added, and (ii) the 4F model 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) momentum factor have been added: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{SMB}\beta_{X_i SMB} + \delta_{HML}\beta_{X_i HML} + \delta_{MOM}\beta_{X_i MOM}$. 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 data are winsorized: the two stocks giving the highest and lowest excess returns every month are removed from the second pass. 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 shown in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0113	0.0015							0.03 [0.02,0.04]
t-value	(8.9)	(1.1)							0.03 [0.02,0.04]
Estimate	0.0124		0.0000						0.03 [0.02,0.04]
t-value	(8.78)		(0.56)						0.05 [0.04,0.06]
Estimate	0.0129			-35.2					0.02 [0.01,0.03]
t-value	(8.91)			(-2.34)					0.08 [0.06,0.09]
Estimate	0.011				141				0.1 [0.08,0.12]
t-value	(7.5)				(5.25)				0.09 [0.07,0.11]
Estimate	0.011			-7.2	146.2				0.11 [0.09,0.13]
t-value	(7.52)			(-0.4)	(5.29)				0.15 [0.13,0.17]
Estimate	0.011	-0.0022		0.3343	159.6				0.14 [0.12,0.17]
t-value	(8.12)	(-1.09)		(0.02)	(5.71)				0.19 [0.17,0.21]
Estimate	0.0106	-0.0024	-0.0001	19.8	148.6				0.16 [0.13,0.19]
t-value	(8.25)	(-1.15)	(-1.48)	(1.16)	(5.06)				0.22 [0.2,0.24]
Estimate	0.0111	-0.0011	-0.0003	35.4	114.1	-0.0001	-0.0003	0.0011	0.25 [0.23,0.28]
t-value	(8.7)	(-0.45)	(-2.73)	(1.1)	(2.86)	(-0.53)	(-0.95)	(2.8)	0.36 [0.34,0.39]
Estimate	0.0125					-0.0005	-0.0001	0.0004	0.09 [0.07,0.1]
t-value	(9.81)					(-2.56)	(-0.53)	(1.48)	0.16 [0.14,0.17]

Table 9 Cross-sectional regressions on sin stocks' excess returns, using a 5-year rolling window for the first pass. 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 77 sin stocks between December 31, 1999, and December 31, 2018. The specification is written as follows: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{taste}B_{X_i I}\tilde{C} + \delta_{ex.asset}q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) + \delta_{ex.mkt}q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$, where r_{X_i} is the value-weighted excess return on stock i ($i = 1, ..., n_X$), and $\beta_{X_i m_I}$ is the slope of an OLS regression of r_{X_i} on r_{m_I}; $B_{X_i I}\tilde{C}$ is the proxy for the taste premium; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I)$ (and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$) are the covariances of the excess returns on stock X_i 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 46 industry-sorted portfolios. The S-CAPM specification is compared with two other specifications: (i) the 4F S-CAPM is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor have been added, and (ii) the 4F model 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) momentum factor have been added: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{SMB}\beta_{X_i SMB} + \delta_{HML}\beta_{X_i HML} + \delta_{MOM}\beta_{X_i MOM}$. These specifications are estimated using the Fama and MacBeth (1973) procedure. First, the variables are estimated, stock-by-stock, in a 5-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 data are winsorized: the two stocks giving the highest and lowest excess returns every month are removed from the second pass. 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 shown in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0106	0.003							0.01 [0.01,0.02]
t-value	(9.05)	(4.09)							0.03 [0.02,0.03]
Estimate	0.0127		-0.0001						0.05 [0.03,0.06]
t-value	(9.74)		(-0.82)						0.07 [0.06,0.08]
Estimate	0.0123			0.8784					0 [0,0.01]
t-value	(9.91)			(0.1)					0.04 [0.03,0.05]
Estimate	0.0108				132.4				0.06 [0.04,0.08]
t-value	(8.53)				(6.79)				0.09 [0.07,0.11]
Estimate	0.011			-5.7	129.4				0.07 [0.05,0.09]
t-value	(8.42)			(-0.35)	(5.15)				0.12 [0.1,0.14]
Estimate	0.0108	0.001		-2.6	131.3				0.07 [0.05,0.09]
t-value	(8.82)	(1.1)		(-0.16)	(5.04)				0.14 [0.12,0.16]
Estimate	0.0113	0.0003	0.0000	-16.7	124				0.09 [0.07,0.11]
t-value	(9.68)	(0.33)	(0.33)	(-1.03)	(5.35)				0.19 [0.17,0.21]
Estimate	0.0104	0.0054	0.0001	13.1	79.5	-0.0007	0.0001	0.0009	0.15 [0.13,0.17]
t-value	(9.32)	(2.55)	(0.79)	(0.54)	(2.69)	(-7.66)	(0.66)	(3.2)	0.27 [0.25,0.29]
Estimate	0.0126					-0.0005	-0.0002	0.0006	0.06 [0.05,0.07]
t-value	(10.71)					(-6.43)	(-1.43)	(2.42)	0.08 [0.07,0.1]

Table 10 Cross-sectional regressions for sin stocks including the stocks of the defense industry. 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 97 sin stocks, including the stocks in the defense industry (i.e., all the stocks in the tobacco, alcohol, gaming and defense industries) between December 31, 1999, and December 31, 2018. The specification is written as follows: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{taste} B_{X_i I}\tilde{C} + \delta_{ex.asset} q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) + \delta_{ex.mkt} q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$, where r_{X_i} is the value-weighted excess return on stock i ($i = 1, ..., n_X$), and $\beta_{X_i m_I}$ is the slope of an OLS regression of r_{X_i} on r_{m_I}; $B_{X_i I}\tilde{C}$ is the proxy for the taste premium; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I)$ (and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$) are the covariances of the excess returns on stock X_i 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 46 industry-sorted portfolios. The S-CAPM specification is compared with two other specifications: (i) the 4F S-CAPM is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor have been added, and (ii) the 4F model 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) momentum factor have been added: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{SMB}\beta_{X_i SMB} + \delta_{HML}\beta_{X_i HML} + \delta_{MOM}\beta_{X_i MOM}$. 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 data are winsorized: the two stocks giving the highest and lowest excess returns every month are removed from the second pass. 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 shown in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0107	0.0047							0.04 [0.03,0.06]
t-value	(8.36)	(4.7)							0.06 [0.05,0.07]
Estimate	0.0139		-0.0002						0.03 [0.02,0.04]
t-value	(9.15)		(-2.24)						0.05 [0.04,0.06]
Estimate	0.0135			-36.5					0.03 [0.02,0.04]
t-value	(9.07)			(-3.17)					0.05 [0.04,0.06]
Estimate	0.0125				119				0.07 [0.05,0.08]
t-value	(8.69)				(5.09)				0.08 [0.06,0.1]
Estimate	0.0124			1.9	130				0.09 [0.07,0.11]
t-value	(8.67)			(0.11)	(4.96)				0.12 [0.1,0.14]
Estimate	0.0105	0.0033		21.1	126.3				0.12 [0.1,0.14]
t-value	(7.8)	(2.92)		(1.22)	(4.68)				0.17 [0.15,0.19]
Estimate	0.0108	0.0031	0.0000	23.2	117.7				0.13 [0.11,0.15]
t-value	(8.2)	(2.66)	(-0.53)	(1.33)	(4.53)				0.21 [0.19,0.23]
Estimate	0.0108	0.0025	-0.0002	39.7	108.8	-0.0001	-0.0002	0.0001	0.17 [0.15,0.19]
t-value	(8.66)	(1.93)	(-2.52)	(1.94)	(3.68)	(-1.05)	(-1.52)	(0.94)	0.31 [0.3,0.33]
Estimate	0.0133					-0.0001	0.0000	0.0000	0.05 [0.04,0.06]
t-value	(10.26)					(-1.18)	(-0.27)	(0.42)	0.11 [0.1,0.12]

Table 11 Cross-sectional regressions for sin stocks over three consecutive periods between December 2002 and December 2018. 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 77 sin stocks between December 31, 1999, and December 31, 2018 over three consecutive periods. The specification is written as follows: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{taste}B_{X_i I}\tilde{C} + \delta_{ex.asset}q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) + \delta_{ex.mkt}q\,\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$, where r_{X_i} is the value-weighted excess return on stock i ($i = 1, ..., n_X$), and $\beta_{X_i m_I}$ is the slope of an OLS regression of r_{X_i} on r_{m_I}; $B_{X_i I}\tilde{C}$ is the proxy for the taste premium; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I)$ (and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$) are the covariances of the excess returns on stock X_i 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 46 industry-sorted portfolios. The S-CAPM specification is compared with two other specifications: (i) the 4F S-CAPM is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor have been added, and (ii) the 4F model 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) momentum factor have been added: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{SMB}\beta_{X_i SMB} + \delta_{HML}\beta_{X_i HML} + \delta_{MOM}\beta_{X_i MOM}$. 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 data are winsorized: the two stocks giving the highest and lowest excess returns every month are removed from the second pass. 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 shown in brackets.

Panel A: Dec. 2002 - Dec. 2007									
	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.0172	0.0019	0.0003	127.5	-13.3				0.06 [0.02,0.09]
t-value	(7.71)	(0.51)	(1.55)	(1.93)	(-0.23)				0.15 [0.11,0.19]
Estimate	0.0169	0.0058	0.0002	209.4	-63.8	-0.0006	-0.0001	0.0015	0.21 [0.16,0.26]
t-value	(8.15)	(1.76)	(1.2)	(3.09)	(-0.97)	(-2.52)	(-0.17)	(2.61)	0.37 [0.32,0.41]
Panel B: Dec. 2007 - Dec. 2012									
	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	-0.0009	-0.0003	0.0001	87.5	155.6				0.15 [0.11,0.18]
t-value	(-0.92)	(-0.15)	(2)	(2.32)	(4.29)				0.26 [0.23,0.3]
Estimate	-0.0003	0.0007	0.0001	59.8	152.2	0.0000	-0.0001	-0.0001	0.16 [0.13,0.2]
t-value	(-0.31)	(0.31)	(1.04)	(2.08)	(4.13)	(-0.14)	(-0.51)	(-0.78)	0.32 [0.29,0.36]
Panel C: Dec. 2012 - Dec 2018									
	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.015	-0.0016	-0.0005	28.3	243.7				0.25 [0.2,0.3]
t-value	(13.61)	(-1.27)	(-3.36)	(1.33)	(3.95)				0.27 [0.23,0.31]
Estimate	0.0142	-0.0013	-0.0009	39.1	272.9	-0.0001	-0.0005	0.0000	0.32 [0.28,0.37]
t-value	(10.4)	(-0.93)	(-3.42)	(1.52)	(3.97)	(-0.73)	(-2.61)	(-0.11)	0.42 [0.38,0.45]

Table 12 Cross-sectional regressions on sin stocks' excess returns (non-winsorized data). 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 77 sin stocks between December 31, 1999, and December 31, 2018. The specification is written as follows: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{taste} B_{X_i I}\tilde{C} + \delta_{ex.asset} q\, \mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) + \delta_{ex.mkt} q\, \mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$, where r_{X_i} is the value-weighted excess return on stock i ($i = 1, ..., n_X$), and $\beta_{X_i m_I}$ is the slope of an OLS regression of r_{X_i} on r_{m_I}; $B_{X_i I}\tilde{C}$ is the proxy for the taste premium; q is the proportion of the excluded assets' market value in the market, and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I)$ (and $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_{m_I})$) are the covariances of the excess returns on stock X_i 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 46 industry-sorted portfolios. The S-CAPM specification is compared with two other specifications: (i) the 4F S-CAPM is the S-CAPM to which the betas of the Fama and French (1993) size and value factors and the Carhart (1997) momentum factor have been added, and (ii) the 4F model 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) momentum factor have been added: $\mathbb{E}(r_{X_i}) = \alpha + \delta_{mkt}\beta_{X_i m_I} + \delta_{SMB}\beta_{X_i SMB} + \delta_{HML}\beta_{X_i HML} + \delta_{MOM}\beta_{X_i MOM}$. 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 data are not winsorized. 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 shown in brackets.

	α	δ_{mkt}	δ_{taste}	$\delta_{ex.asset}$	$\delta_{ex.mkt}$	δ_{SMB}	δ_{HML}	δ_{MOM}	Adj. OLS/GLS R^2
Estimate	0.008	0.0069							0.02 [0.01,0.02]
t-value	(5.24)	(3.49)							0.04 [0.03,0.05]
Estimate	0.0129		0.0002						0.04 [0.03,0.06]
t-value	(7.79)		(1.44)						0.07 [0.06,0.08]
Estimate	0.013			0.618					0.03 [0.02,0.04]
t-value	(7.55)			(0.03)					0.06 [0.04,0.07]
Estimate	0.0116				109.5				0.07 [0.05,0.08]
t-value	(7.48)				(2.61)				0.09 [0.07,0.11]
Estimate	0.0122			42.6	58.3				0.1 [0.07,0.12]
t-value	(7.83)			(1.27)	(1.14)				0.14 [0.12,0.16]
Estimate	0.0088	0.0053		57.7	45.7				0.11 [0.09,0.13]
t-value	(5.69)	(3.17)		(1.59)	(0.84)				0.18 [0.15,0.2]
Estimate	0.01	0.0027	0.0002	29.7	47.6				0.14 [0.12,0.17]
t-value	(6.65)	(1.72)	(1.43)	(0.8)	(0.88)				0.23 [0.2,0.25]
Estimate	0.0092	0.0058	-0.0002	78.5	56.8	-0.0005	0.0001	0.0008	0.23 [0.21,0.26]
t-value	(6.62)	(3.05)	(-1.18)	(1.92)	(1.04)	(-2.57)	(0.54)	(2.15)	0.37 [0.35,0.39]
Estimate	0.0116					-0.0003	-0.0003	0.0006	0.08 [0.06,0.1]
t-value	(8.96)					(-1.7)	(-1.41)	(1.82)	0.16 [0.14,0.17]

Table 13 Cross-sectional regression of the average spillover effect on sin stock characteristics. This table presents the results of the cross-sectional estimation of the average spillover effect exerted by each of the sin stocks X_i on the other sin stocks ($\frac{1}{n_X}\sum_{k=1,k\neq i}^{n_X} q_{X_i}\left(\left(\widehat{\frac{\gamma}{1-p}} - \widehat{\gamma}\right)\mathbb{C}\text{ov}(r_{X_k}, r_{X_i}|r_I) + \widehat{\gamma}\,\mathbb{C}\text{ov}(r_{X_k}, r_{X_i}|r_{m_I})\right)$) regressed on its average weight (q_{X_i}), its average variance ($\mathbb{V}\text{ar}(r_{X_i})$), the average correlation coefficient of its returns with those on the other sin stocks (ρ_{X_i,X_j}), the average correlation coefficient of its returns with those on the industry-sorted portfolios (ρ_{X_i,I_j}) and a constant during the period ranging from December 31, 1999, to December 31, 2018.

	Dependent variable: Average spillover of stocks $(X_i)_i$				
	(1)	(2)	(3)	(4)	(5)
q_{X_i}	0.062***				0.062***
	(0.013)				(0.012)
$\mathbb{V}\text{ar}(r_{X_i})$		−0.0001			−0.00001
		(0.0001)			(0.00004)
ρ_{X_i,X_j}			0.00003		−0.0001
			(0.00003)		(0.0001)
ρ_{X_i,I_j}				0.00002	0.00003
				(0.00003)	(0.00004)
Constant	−0.00000*	0.00002*	0.00001*	0.00001	−0.00000
	(0.00000)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Observations	77	69	69	69	69
R^2	0.779	0.010	0.002	0.004	0.783
Adjusted R^2	0.776	−0.005	−0.012	−0.010	0.770
Residual Std. Error	0.00003	0.0001	0.0001	0.0001	0.00003
	(df = 75)	(df = 67)	(df = 67)	(df = 67)	(df = 64)
F Statistic	264.841***	0.695	0.166	0.302	57.801***
	(df = 1; 75)	(df = 1; 67)	(df = 1; 67)	(df = 1; 67)	(df = 4; 64)
Note:					*p<0.1; **p<0.05; ***p<0.01

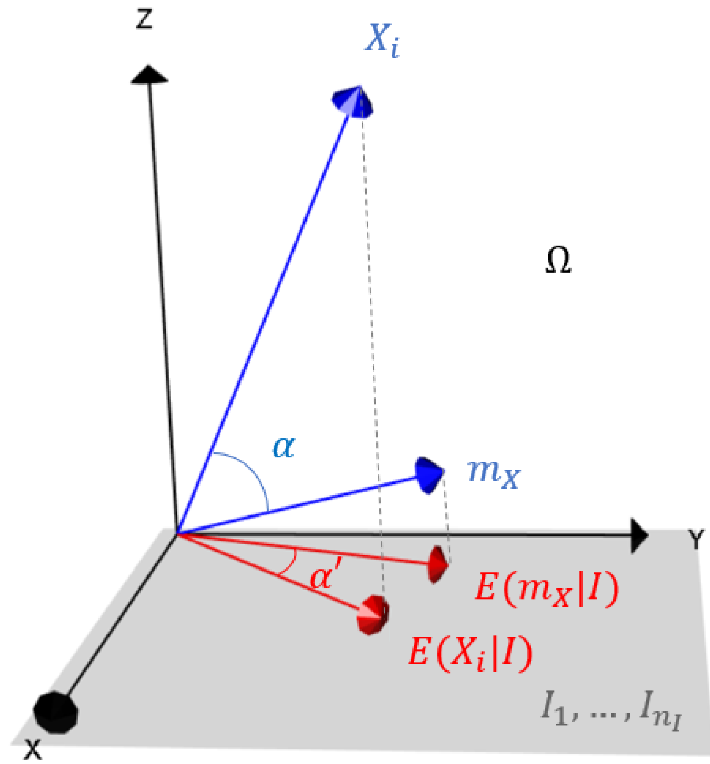

Figure 1. Geometric representation of the exclusion-asset premium. This figure provides a geometric picture of the conditional covariance $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I)$, which, after being multiplied by factor $\gamma\frac{p}{1-p}q$, forms the exclusion-asset premium on asset X_i. In the graph, the standard deviation of the excess returns on an asset is depicted by the norm of the associated vector, and the correlation coefficient between the excess returns on two assets is depicted by the cosine of the angle between the two vectors. The total market is depicted by the space $\mathbb{R}^3$, and the assets in the investable market $(I_1, ..., I_{n_I})$ is depicted by plane (X, Y). Asset X_i and the excluded market, m_X, projected onto the space of investable assets offer a graphic depiction of the conditional expectations, $\mathbb{E}(X_i|I)$ and $\mathbb{E}(m_X|I)$, respectively. $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I)$ is therefore depicted geometrically as the difference between the cosines of the two angles α and α', both of which are normalized by the norms of vectors generating them: $\mathbb{C}\text{ov}(r_{X_i}, r_{m_X}|r_I) \sim ||X_i||\,||m_X||\,cos(\alpha) - ||\,\mathbb{E}(X_i|I)||\,||\,\mathbb{E}(m_X|I)||\,cos(\alpha')$.

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SEC Adopts Enhanced Mutual Fund Expense and Portfolio Disclosure; Proposes Improved Disclosure of Board Approval of Investment Advisory Contracts and Prohibition on the Use of Brokerage Commissions to Finance Distribution

FOR IMMEDIATE RELEASE
2004-16

Washington, D.C. Feb. 11, 2004 -- The Securities and Exchange Commission took the following actions today at its open meeting:

Shareholder Reports and Quarterly Portfolio Disclosure by Funds

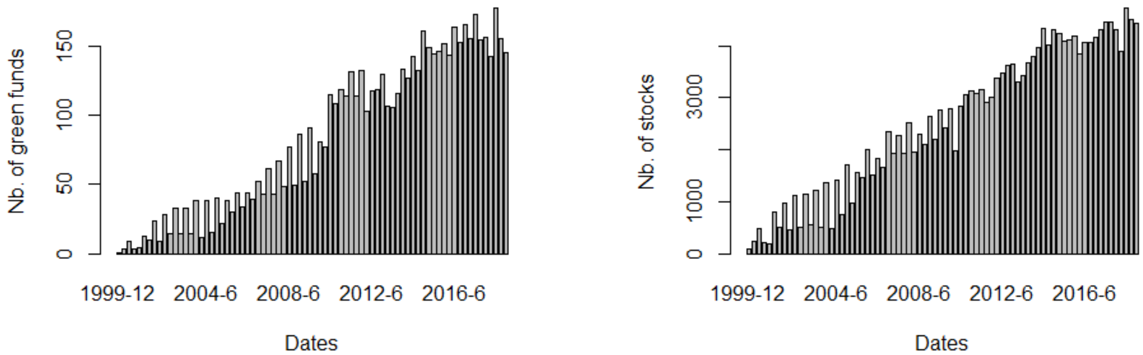
The Commission adopted several amendments to its rules and forms that are intended to improve significantly the periodic disclosure that mutual funds and other registered management investment companies provide to their shareholders about their costs, portfolio investments, and performance.

The amendments include the following:

- **Enhanced Mutual Fund Expense Disclosure in Shareholder Reports.** The amendments will require open-end management investment companies (mutual funds) to disclose fund expenses borne by shareholders during the reporting period in their shareholder reports. Shareholder reports will be required to include: (i) the cost in dollars associated with an investment of $1,000, based on the fund’s actual expenses for the period; and (ii) the cost in dollars, associated with an investment of $1,000, based on the fund’s actual expense ratio for the period and an assumed return of 5 percent per year. The first figure is intended to permit investors to estimate the actual costs, in dollars, that they bore over the reporting period. The second figure is intended to provide investors with a basis for comparing the level of current period expenses of different funds. The expense disclosure will also be required to include the fund's expense ratio and the account values as of the end of the period for an initial investment of $1,000.

- **Quarterly Disclosure of Fund Portfolio Holdings.** The amendments will require a registered management investment company (fund) to file its complete portfolio holdings schedule with the Commission on a quarterly basis. These filings will be publicly available through the Commission’s Electronic Data Gathering, Analysis, and Retrieval System (EDGAR). This amendment is intended to enable interested investors, through more frequent access to portfolio information, to monitor whether, and how, a fund is complying with its stated investment objective.

Figure 2. U.S. funds holdings disclosure. This figure shows the text of the SEC’s February 2004 amendment requiring U.S. funds to disclose their holdings on a quarterly basis.



(a) Number of green funds **(b)** Number of stocks in the green funds

Figure 3. Green funds' holdings. This figure shows, quarter-by-quarter, the number of green funds for which the composition has been retrieved in FactSet (a), and the number of stocks held by all these green funds (b).

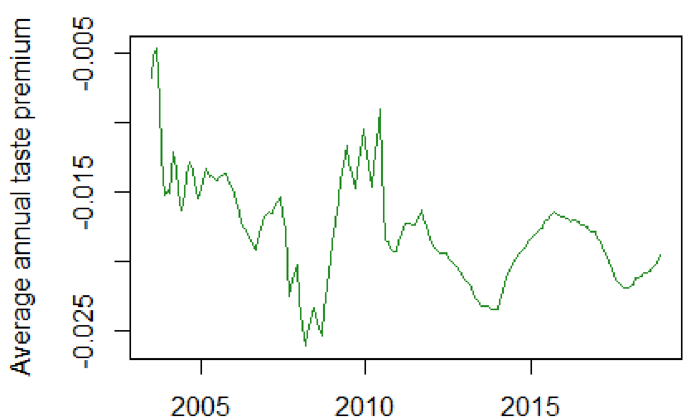


Figure 4. Proxy for the cost of environmental externalities of the investable market $\tilde{c}_{m_I}$. This figure shows the evolution over time of the proxy for the cost of environmental externalities of the investable market, $\tilde{c}_{m_I}$.

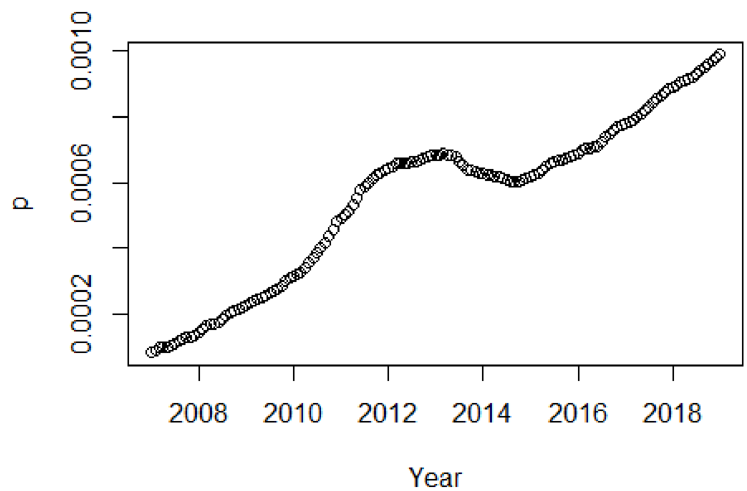


Figure 5. Dynamics of proxy $\tilde{p}$. This figure depicts the dynamics of the proxy for the proportion of sustainable investors, $\tilde{p} = \frac{\text{Market value of green funds in } t}{\text{Total market capitalization in } t}$, between December 31, 2006 and December 31, 2018.

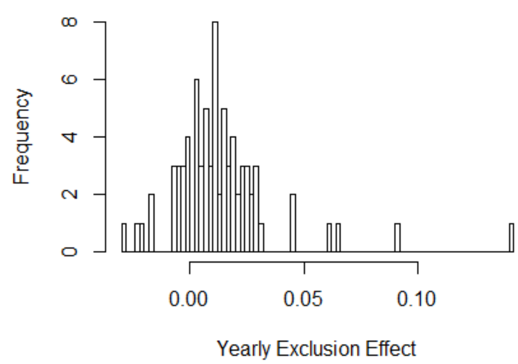


Figure 6. Distribution of the annual exclusion effect. This figure shows the distribution of the annual exclusion effect, $\left(\widehat{\frac{\gamma}{1-p}} - \widehat{\gamma}\right) q\,\mathbb{C}\mathrm{ov}_t(r_X, r_{m_X}|r_I) + \widehat{\gamma} q\,\mathbb{C}\mathrm{ov}_t(r_X, r_{m_X}|r_{m_I})$, over all sin stocks estimated between December 31, 1999, and December 31, 2018.

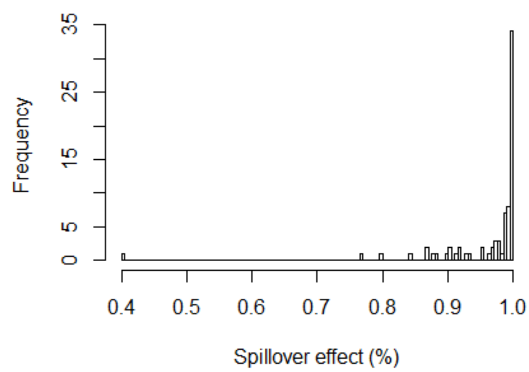


Figure 7. Distribution of the share of the spillover effect. This figure shows the distribution of the share of the spillover effect in the exclusion effect, $\left(\frac{\sum_{k=1,k\neq i}^{n_X} |q_{X_k}\left(\left(\widehat{\frac{\gamma}{1-p}}-\widehat{\gamma}\right)\mathbb{C}\mathrm{ov}(r_{X_i},r_{X_k}|r_I)+\widehat{\gamma}\,\mathbb{C}\mathrm{ov}(r_{X_i},r_{X_k}|r_{m_I})\right)|}{\sum_{k=1}^{n_X} |q_{X_k}\left(\left(\widehat{\frac{\gamma}{1-p}}-\widehat{\gamma}\right)\mathbb{C}\mathrm{ov}(r_{X_i},r_{X_k}|r_I)+\widehat{\gamma}\,\mathbb{C}\mathrm{ov}(r_{X_i},r_{X_k}|r_{m_I})\right)|} \right)_i$, over all sin stocks estimated between December 31, 1999, and December 31, 2018.

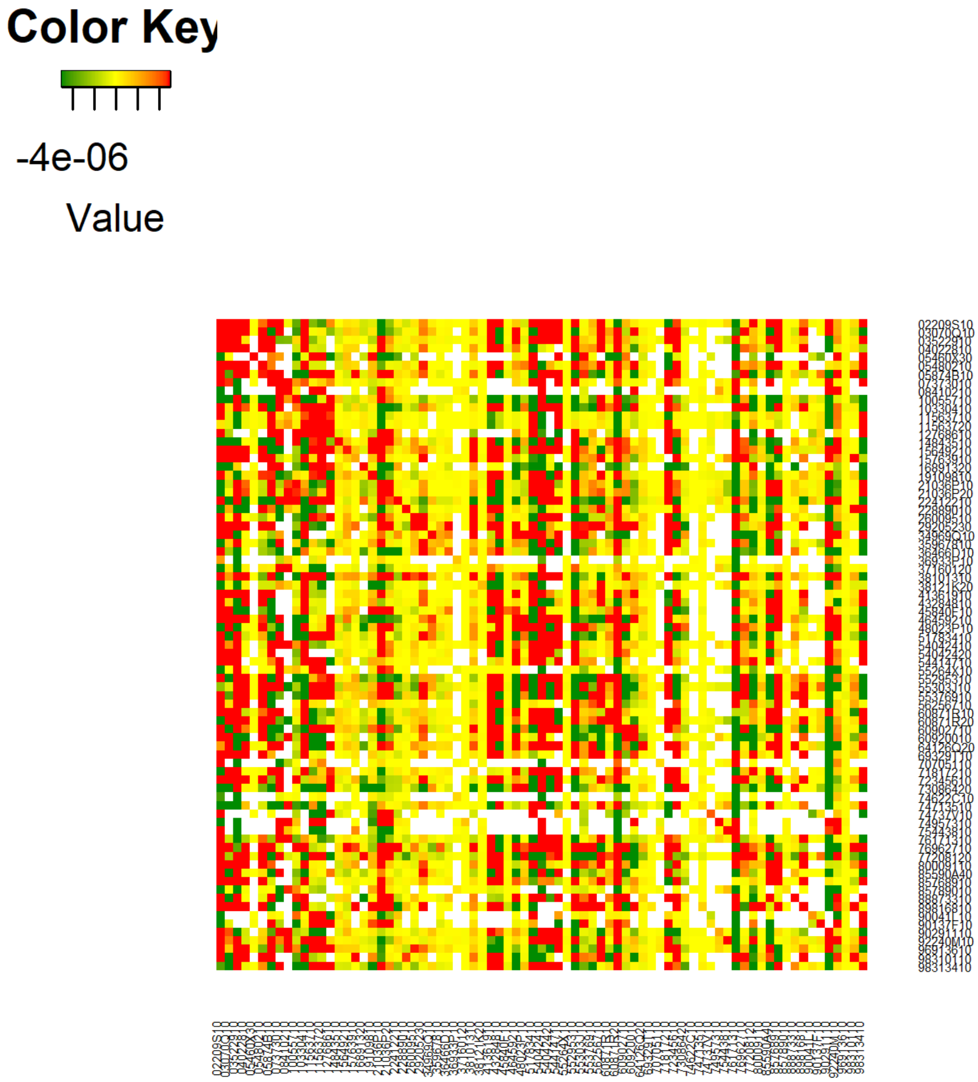


Figure 8. Heatmap of the spillover effects. This figure shows, for each sin stock X_i (presented in rows), the estimated spillover effects of the other sin stocks $(X_k)_{k \in \{1,\ldots,n_X\}}$ (presented in columns), estimated as $\left(\widehat{\frac{\gamma}{1-p}} - \widehat{\gamma}\right) q_{X_k} \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_I) + \widehat{\gamma} q_{X_k} \, \mathbb{C}\mathrm{ov}(r_{X_i}, r_{X_k} | r_{m_I})$. The positive effects are shown in red, and the negative effects are shown in green. The first diagonal gives the own effects, which all have a positive or zero estimated value.