Collective impact through coordinated price signalling

2° Investing Initiative

About

The 2° Investing Initiative (2DII) is an international, non-profit think tank working to align financial markets and regulations with the Paris Agreement goals.

2DII coordinates some of the world's largest research projects on climate metrics in financial markets. In order to ensure our independence and the intellectual integrity of our work, we have a multi-stakeholder governance and funding structure, with representatives from a diverse array of financial institutions, regulators, policymakers, universities and NGOs.

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Introduction

This briefing is extracted from 2DII's technical report "Collective investor impact in secondary markets" that provides an in-depth analysis of two collective impact mechanisms usable on public (secondary) markets that **would not be as effective if done by single investors (even the largest ones)**: price signaling and engagement.

The results are useful for investors who aim at maximizing their impact potential through collective action as well as for managers of coordination devices (ESG labels, ESG indices, proxy advisors, etc.) to improve their offering.

This practitioner's briefing presents the main ideas of the technical report on coordinated price signaling only**.** We encourage the reader to access the main report to get the full narrative and retrieve academic references that support our view and recommendations.

Why discussing coordinated price signaling? Through investments and divestments, investors can send market signals that they are committed to impact. By affecting market prices, those signals do alter the incentives faced by companies, their managers and shareholders and, ultimately, may modify companies' strategic decisions towards more sustainability.

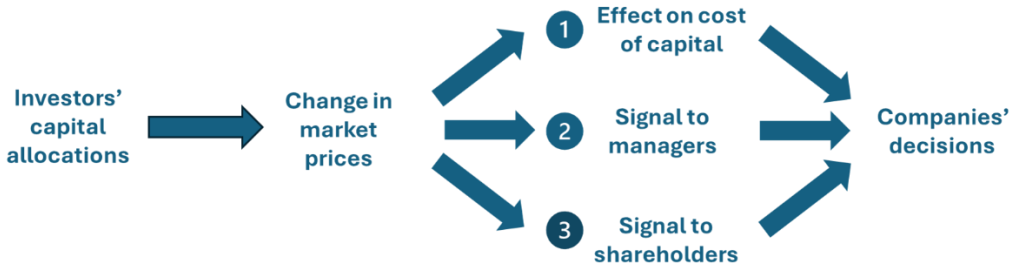
While there are large doubts that (even institutional) investors can generate efficient price signals when acting alone, the narrative might be more credible when capital allocations are performed in a coordinated way.

Price signaling as a major (collective) impact mechanism

Market signaling builds on the idea that investors can modify companies' behaviors by affecting asset prices in financial markets via their own capital allocation. The transmission from asset prices to companies' behaviors and outcomes in the real economy operates through two pathways, as explained by Kölbel et al. (2020): "*first by creating incentives to improve ESG practices and therefore the quality of company activities, and second by affecting growth and therefore the level of company activities.*"

While the latter **"growth channel"** is mediated by the effect of market prices on cost of capital (pathway #1), the former **"reform channel"** operates via the sending of signals to both corporate managers (pathway #2) and shareholders (pathway #3).

Figure: the three pathways of market signaling



Source: Own illustration

Pathway #1 builds on the need of companies to raise (equity or debt) capital to grow. By affecting prices in the primary or the secondary market, investors can increase the cost of capital for, respectively, present or future issuances. When the cost of capital is higher, firms will be forced to abandon some investment projects. So, if ESG-concerned investors are successful in raising the cost of capital for low-ESG firms vs high-ESG firms, they will de facto lower the growth rate of the former vs the latter.

Pathways #2 and #3 are grounded on the financial interest of asset owners. Capital allocation decisions by investors can increase or decrease asset prices and therefore increase or decrease the financial wealth of asset owners. If those are concerned with their financial wealth, they would logically be responsive to price changes and try to influence the company's decisions. This is true for stockholders and for bondholders. But the influence of stockholders is obviously larger thanks to their right to vote in general assemblies.

Within the group of shareholders, there is a specific subgroup with an even increased capacity to affect companies' decisions: companies' managers. Many of them are endowed with stocks as part of their compensation package. This could make them very responsive to the fluctuations of the stock price. This is in accordance with Edmans et al. (2012), who argue that when managerial incentives are tied to stock market value, managers will be sensitive to nonfundamental shifts in the share price of their corporation.

Additionally, price signals can orient managers' decisions through a feedback effect if managers consider price changes to reflect valuable information owned by market participants.

The theory behind the narrative

Many theoretical models have been developed by academic researchers to investigate the effects of various capital allocation strategies on i) asset prices and ii) real-life outcomes, as well in primary as in secondary markets.

A great majority of theoretical models confirm that responsible strategies in secondary markets should lead to the targeted variations in asset prices. In an often-cited paper, Pedersen et al. (2020) show how ESG might change investor portfolio optimization problem and equilibrium market prices. They consider three types of investors:

1. "ESG-unaware" investors are unaware of ESG scores and simply seek to maximize their unconditional mean–variance utility.
2. "ESG-aware" investors also have mean–variance preferences, but they use assets' ESG scores to update their views on risk and expected return.
3. "ESG-motivated" investors use ESG information and also have preferences for high ESG scores. In other words, such investors seek a portfolio with an optimal trade-off between a high expected return, low risk, and high average ESG score.

They derive equilibrium security prices and returns. They show that expected returns are given by an ESG-adjusted CAPM, whose functional form depends on the relative sizes of the various types of investors.

The theoretical conclusions regarding real-world effects of sustainable capital allocations are also mostly positive. For instance, Broccardo et al. (2020) obtain that investor divestment (like consumer boycotts) cause the market value of a dirty firm to fall, leading some value-maximizing managers to switch to the clean technology. However, both exit strategies will curb pollution in a less than proportional way: if ten percent of agents divest/boycott, less than ten percent of firms become clean (a theoretical observation already made by Heinkel et al. (2001) in the divestment context). The reason is that purely selfish agents will partially offset the effects of divestment/boycotting by increasing their investment/purchases in companies shunned by socially responsible agents. In both cases the magnitude of the response depends on the slope of the demand curve, which is driven by agents' risk tolerance for investors and by the utility of the good for consumers.

In another example, De Angelis et al. (2020) draw a model where green investing raises the cost of capital of polluting companies, yet uncertainty about future environmental externalities might mitigate the latter's incentives to clean their production process. This paper shows how green investing spurs companies to mitigate their carbon emissions by raising the cost of capital of the most carbon-intensive companies. The authors also provide empirical evidence supporting their results by focusing on United States stocks between 2004 and 2018 and using green fund holdings as a proxy for green investors' beliefs.

The following table summarizes results of theoretical models on the effect of sustainable screening strategies in secondary markets on asset prices and real-world outcomes.

Table: overview of academic models predicting effects of screening strategies on asset prices (AP) and on real-world outcomes (RW)

Name	Date	Markets	ESG Integration		Divestment		Exclusion		Best-in-class		Tilts		Thematic	
			AP	RW	AP	RW	AP	RW	AP	RW	AP	RW	AP	RW
Hakenes and Schliephake	2022	Primary												
Landier and Lovo	2020	Primary												
Green and Roth	2020	Primary												
Moisson	2020	Primary												
Barnea et al.	2005	Primary												
Berk and van Binsbergen	2022	Secondary												
Pedersen et al.	2020	Secondary												
Zerbib	2020	Secondary												
Fama and French	2007	Secondary												
Pastor et al.	2020	Secondary												
Broccardo et al.	2020	Secondary												
De Angelis et al.	2020	Secondary												
Luo and Balvers	2017	Secondary												
Gollier and Pauget	2014	Secondary												
Heinkel et al.	2001	Secondary												

Reading: cells in green represent positive results (i.e., an increase in price for green assets or a decrease in price for brown assets in AP columns, a real-life improvement for RW columns) while cells in red are for negative results (i.e., opposite to what was expected by sustainable investors). Cells in yellow display null or uncertain results.

Do flows really affect market prices?

Different views of the market

Two opposite logics prevalent in financial markets compete to account for the effect of financial flows on market prices.

On the one hand, **the Equilibrium Logic** consider that market operators are rational and financial markets are efficient to incorporate fundamental information into prices. Therefore, market prices always reflect fundamental information. That being said, the effect on non-fundamental demand on prices is not consensual across advocates of the equilibrium logic. According to one view (**the market efficiency view**), uninformed shocks cannot have a long-lasting impact on prices due to the actions of arbitrageurs. It is the presence of highly reactive profit-maximizing arbitrageurs (like hedge funds) that is supposed to maintain market prices at their correct fundamental value. According to another view within the Equilibrium logic, capital inflows from sustainable investors do affect prices through the **portfolio-balance channel** as rational investors are asking for compensation for balancing out the portfolio choices of investors who share a particular non-financial preference as this forces them to deviate from the market portfolio.

On the other hand, **the Flow Logic** considers that market prices are just the reflection of capital flows. They increase in presence of strong capital inflows and decrease in case of significant capital outflows. Arbitrageurs can limit this mechanical link but not offset it. Therefore, a massive demand of sustainable securities by sustainable investors would mechanically lead to an increase in prices for those securities.

Elastic or inelastic markets?

In textbook theory, the micro elasticity of market prices is supposed to be very large, of the order of 1000 or above. It means that demand is super sensitive to changes in individual prices. This implies that the micro multiplier (the inverse of the micro elasticity) is essentially zero and demand curves are virtually flat. Demand curves for stocks are kept flat by (quasi-)riskless arbitrage between perfect substitutes. It is the presence of highly reactive profit-maximizing arbitrageurs (like hedge funds) that is supposed to maintain nearly infinite price elasticity of financial markets.

If demand is highly elastic, as implied by many standard models of beliefs and preferences, then the demand of a group of investors for a particular stock would only have a modest impact on prices, as other investors would quickly substitute from one stock to another.

Conversely, in *inelastic* financial markets, differences in demand are reflected much more intensely in asset prices. In inelastic financial markets, more people attempting to buy a stock (or the market) will lead to price increases, and more people attempting to sell a stock will lead to price decreases. Second, the magnitude of these effects will increase with the desired amount of stock being purchased or sold. Finally, because price pressure is fundamentally about limited liquidity, **the inelastic financial markets theory** predicts that the effects on prices of a given amount of buying or selling will be greater in periods of lower liquidity.

As for the logic that accounts for market prices, the beliefs regarding market elasticity are not consensual among financial economists.

Evidence of price reactions to flows

What can empirical tests say about the price reactions to capital flows? The empirical evidence so far comes from various event studies around index redefinitions (listings and delistings), dividend payments, changes in fund ratings, and fire sales by institutional investors[1]. **The general finding is that large non-fundamental trades have a significant but temporary price impact**, even though there is considerably heterogeneous evidence on the speed and the extent of reversal. Hence, it is probable that preference-based demand for sustainable assets would affect prices, at least in the short run.

Estimates of price elasticities and multipliers

Gabaix and Koijen (2020) provide an interesting summary of recent estimates of the micro multiplier, which is the percent change in prices when an investor purchases a certain fraction of the shares outstanding in a particular company, while controlling for movements in the aggregate market. While there is a range of estimates, the order of magnitude of the multiplier is around 1. That is, buying 1% of the shares outstanding of a given stock results makes its price increase by around 1%. In addition, other studies have looked at the “factor-level” multiplier, which is the price impact if an investor buys a fraction of the shares outstanding of a cross-sectional factor such as size or value (i.e., a whole market segment selected using one of the various market factors highlighted by academic research for having an effect on returns). The studies report a multiplier that is substantially above 1 and closer to 5. They finally report estimates of the “macro multiplier” that applies at market level. Once again, the multiplier estimates are between 2 and 6. Equivalently, the macro elasticity, which is the inverse of the multiplier, is well below 1. They themselves find that investing $1 in the stock market increases the market's aggregate value by about $5.

[1] Coval and Stafford (2007); Petajisto (2009); Schnitzler (2018).

Table: overview of estimates of the multiplier

	Methodology	Multiplier
Panel A: Micro multiplier		
Chang, Hong and Liskovich (2014)	Index inclusion	0.7 to 2.5
Pavlova and Sikorskaya (2020)	Index inclusion	1.5
Schmickler (2020)	Dividend payouts	0.8
Frazzini et al. (2018), Bouchaud et al. (2018)	Trade-level permanent price impact	15
Panel B: Factor-level multiplier		
Ben-David, Li, Rossi and Song (2020a)	Morningstar ratings change	5.3
Peng and Wang (2021)	Fund flows	4.8
Li (2021)	Fund flows+SVAR	5.7
Panel C: Macro multiplier		
Da, Larrain, Sialm and Tessada (2018)	Pension fund rebalancing Chile	2.2
Li, Pearson and Zhang (2020b)	IPO restrictions in China	2.6-6.5

Source: Gabaix and Koijen (2020)

Taken together, the existing evidence in the literature suggests a micro multiplier around 1 and a factor or macro multiplier that is between 2 and 6 in equity secondary markets. Such estimates imply that a 1-billion-euro green equity fund that would only invest in listed stocks of green companies would lead to an increase in the segment market cap by 2 to 6 billion euros.

Focusing on the corporate bond market, Bretscher et al. (2022) find that the market-wide elasticity for the corporate bond market as a whole is around 3.7 (which translates into a multiplier of 0,27). Consistent with their estimates, the elasticity for the EU government bond market is estimated to be about 3.2 (Koijen et al., 2020). **The multiplier in the bond market appears to be around 10 times smaller than in the equity market**.

A time-varying price elasticity?

There is ongoing debate between researchers about the long-term effects of flows on market prices. Some consider the effect on prices to be transitory (reversible) while others expect it to be permanent. Preliminary evidence was found to be heterogeneous. Gabaix and Koijen (2020) and Barbon and Gianinazzi (2019) find no evidence of price reversal over one year while Patel and Welch (2016) find evidence of full reversals within six months.

A related discussion is about the long-term change in market elasticity in relation to the changing profile of market investors. Are markets becoming more or less elastic due to the rise of passive index investing? Looking at long-term variations, Haddad et al. (2022) obtains that the entire cross-sectional distribution of stock-level elasticity has decreased in the last 20 years, by 40%. Interestingly, the model attributes about equally this drop to two investor-specific sources of change. First, the fraction of passive investors has increased. Second, the investor-specific component of the elasticity of active investors has decreased. Markets are turning more inelastic due to the increasing weight of passive investors and less arbitrage by active investors. Therefore, **there seems to be more room for sustainable investors to influence prices**[2].

[2] But, here again, observations by Patel and Welch (2016) are contrarian. Over the decades, the six-month portfolio response to being added into the S&P 500 seems to have declined. Nowadays, there seems to be no or very little permanent six-month effect. The prevailing two-day 2% announcement response seems to revert (almost) fully. Same is obtained for index removals. Solid evidence for reversion started to appear in the 2000s.

The price impact of ESG flows

The empirical evidence regarding the realized returns to ESG investing over the past two decades is dramatically mixed.

There is no consensus that sustainable companies already benefit from a lower cost of equity. The conclusions seem to be highly dependent on the measure of sustainability, the measure of cost of equity[3], the geographical zone and the time period.

In a very comprehensive study, Eskildsen et al. (2024) show that, based on realized returns or forward-looking measures of expected returns, the greenium in the equity market ranges from insignificant to slightly negative. Therefore, one can reasonably conclude that the collective actions of environmentally-concerned investors have not so far resulted in a significantly decreased cost of equity for green firms.

The evidence for ESG investors' effect on the cost of debt is also mixed, as shown by Halling et al. (2021). The literature contains a range of greenium estimates for green corporate bonds compared with regular corporate bonds, mostly negative (in a range between – 20bp and 0). However, the literature is rather silent on the more basic question of the greenium of regular corporate bonds across green versus brown firms, which is more comparable to the analysis of the equity greenium. Eskildsen et al. (2024) find a meaningful greenium of −13 bps for regular corporate bonds. Aggregating each firm's equity and bonds, they find a greenium for the weighted average cost of capital (WACC) of −13 bps. They note that such a spread is much too small to have a significant impact on carbon emissions. **As for equity, the greenium in the corporate bond market appears to be very small, if not statistically insignificant.**

Several scholars have tried to provide explanations for conflicting results by decomposing observed returns into several components. To help understand the past relative performance of high ESG vs low ESG stocks, Van der Beck (2023) performed a decomposition of observed ESG returns into fundamental and demand-driven components. He shows that the performance of ESG investments is strongly driven by price-pressure arising from flows towards sustainable funds, causing high realized returns that do not reflect high expected returns. Under the absence of flow-driven price pressure, the aggregate ESG industry would have strongly underperformed the market from 2016 to 2021. Furthermore, the positive alpha of a long-short ESG portfolio becomes significantly negative. Van der Beck (2023) rightfully concluded that **one should be careful when using the realized outperformance of sustainable investments in recent years to judge their expected outperformance going forward.** Past performance of high ESG stocks was due to massive capital inflows and should not be interpreted as a long-term fundamental superiority.

Pastor et al (2022) confirm that the recent performance of green assets reflects unexpectedly strong increases in environmental concerns, not high expected returns.

Zhang (2023) explains how various and seemingly conflicting empirical findings can fit with the theory: "*Theoretically, brown firms are more exposed to policy risk during the transition to net zero and should earn higher expected returns in equilibrium (Hsu, Li and Tsou, 2022). However, green firms can outperform when policy shocks kick in, consumer attention turns, and investor tastes shift in transition to net-zero (Pastor, Stambaugh and Taylor, 2021)*".

Beyond confounding factors related to methodological issues, a reasonable conclusion to that debate around the relationship between sustainability and cost of capital is that **sustainability (especially carbon) risk is now significantly priced in the market causing brown stocks to have lower valuations and higher equilibrium expected returns but, due to capital flows, climate news and changing tastes or expectations, green stocks can - on a temporary basis - outperform brown stocks.**

[3] In a nutshell, there are three families of methods to assess cost of equity: backward-looking methods (i.e., based on realized returns), model-based methods (i.e., based on CAPM or multifactor models) or implied cost of equity (i.e., derived from analyst forecasts or option prices).

This leaves open the question whether the observed differences in valuations are sufficient to entice companies to adjust their business strategies.

Pathway #1: is it possible to affect cost of capital enough to alter companies' strategic decisions?

From market prices to actual cost of capital

Do changes in cost of capital rapidly affect corporate investment decision-making? We can build on corporate finance literature to understand how firms make their investment decisions and how their investments react to changes in market conditions.

The standard view in economics is that changes in firms' cost of capital directly impact firm investment. According to that view, firms should take on any investment project that offers returns above the cost of capital. As a result, firms should adjust their required returns on new investments (their so-called "discount rates") one-to-one with the cost of capital in financial markets.

In practice, the effectiveness of capital allocation decisions to affect companies' behaviors via the cost-of-capital channel depends on the needs of invested companies to issue (debt or equity) capital to sustain their growth.

Regarding equity capital, it is clear that the harm from a higher cost of equity capital is limited by the frequency with which firms tap external equity markets. This frequency is actually low, especially for large mature companies. Most of the new equity sold by large firms is via manager or employee stock purchase or stock option plans, not to finance development projects (excluding acquisitions). Debt issues are more frequent though.

From actual to perceived cost of capital

The standard theory does not question how firms perceive their cost of capital in order to inform their discount rate (also called "hustle rate"). Does the perceived cost of capital perfectly replicate the actual cost of capital inferred from conditions in the equity and debt markets?

Gormsen and Huber (2023a) measure firms' perceived cost of capital using data from corporate conference calls between firm managers, financial investors, and analysts. They obtain that perceived cost of capital incorporates large errors. Firms correctly incorporate time variation in interest rates and risk premia as well as some cross-sectional factors into their perceived cost of capital. But firms also incorporate large errors that cannot be justified by risk premia and interest rates. In total, 80% of the variation in the perceived cost of capital in time series reflects mistakes in firms' perceptions. The authors offer an explanation for those mistakes: firms have a hard time assessing their "true" cost of capital from market prices, especially from equity prices. The mistakes in the perceived cost of capital lead to misallocation of capital in standard models. Firms that underestimate their cost of capital invest too much and firms that overestimate the cost of capital invest too little, relative to the optimal allocation.

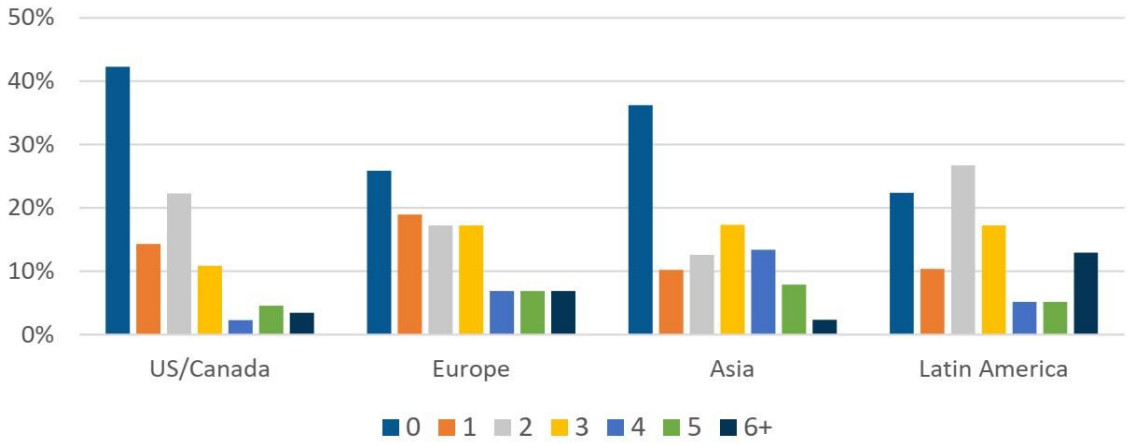
From perceived cost of capital to discount rates

Standard theory implies that the cost of capital presents the lower bar for discount rates used by firms in investment decisions (i.e., their required return to capital that makes an investment profitable), determines investment and transmits financial shocks to the real economy.

A remarkable stylized view is that firms' reported discount rates are i) often very stable and ii) well above their perceived cost of capital, which has been a puzzle for academia for decades[4].

Based on a survey of CFOs, Graham (2022) shows that changes of the hurdle rate are very infrequent at firm-level. In the US/Canada like in Europe, around 80% of firms do not adapt their hurdle rates more than three times per decade.

Figure: frequency of changes of hurdle rates by global firms over 10 years



Source: Graham (2022). Reading: the figure presents answers to the following question: *Over the past 10 years, how many times has your firm changed your hurdle rate by 1% or more?*

The fact that companies base investment decisions on nearly static hurdle rates suggests that investment may be market price insensitive, which implies that **any attempt by private actors to influence corporate investment through affecting market prices may prove to be very ineffective.**

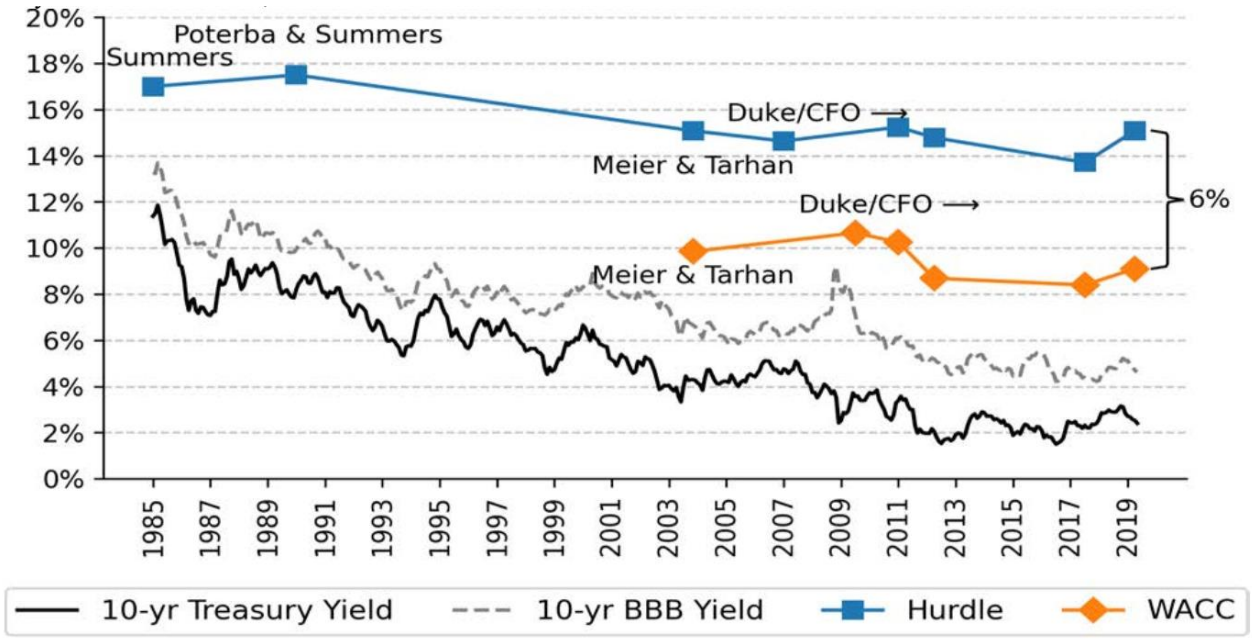
Gormsen and Huber (2023b) show that, on average, firms move their discount rates with the cost of capital, but the relation is far below the one-to-one mapping assumed by standard theory, with substantial heterogeneity across firms. Using within-firm variation, they show that, on average, **a 1 percentage point increase in the perceived cost of capital leads to a 0.3 percentage point increase in the discount rate.**

This pattern leads to time-varying wedges between discount rates and the cost of capital. The average wedge has increased substantially since 2002, as firms have incorporated the declining financial cost of capital into their perceived cost of capital but only weakly into their discount rates. Using within-firm variation, Gormsen and Huber (2023b) find that the average wedge in the US has increased by around 2.5 percentage points between 2002 and 2021, as the perceived cost of capital has decreased while discount rates have remained more stable.

Their findings replicate observations by Graham (2022) from three decades of surveys of CFOs. Hurdle rates have been very sticky, having changed only about two or three percentage points over the past 35 years while, over the period, market interest rates, a key component of cost of capital calculations, have fallen by about 1000 basis points.

[4] Poterba and Summers (1995); Graham (2022).

Figure: average hurdle rates and cost of capital in various US surveys



Source: Graham (2022)

Heterogeneous sensitivity to cost of capital

Research across decades has investigated the empirical relationship between cost of capital and corporate investment. Researchers have produced several estimates of corporate investment sensitivity to cost of capital. They confirm a larger sensitivity of investment to cost of debt than to cost of equity. By construction, WACC stands in the middle.

Table: Estimates of CoC elasticity of corporate investment

Type of financing	Studies	CoC elasticity - range of estimates	Method to calculate CoE
Debt	Gilchrist and Zakrajsek (2007)	from - 0,75 to - 0,5	
	Frank and Shen (2015)	from -0,7 to -0,6	
	Hambur and La Cava (2018)	-0,5	
	Cloyne et al. (2019)	from -4 to -1	
Equity	Frank and Shen (2015)	from +0,04 to +0,22	CAPM/Multifactor
		from -0,27 to -0,11	Implied CoE
WACC	Frank and Shen (2015)	from +0,14 to +0,37	CAPM/Multifactor
		from -0,57 to -0,22	Implied CoE
	Carluccio et al. (2018)	-0,32	Implied CoE
	Hambur and La Cava (2018)	0	CAPM/Implied CoE
	Gromsen and Huber (2023a,b)	-0,27	Perceived CoC

Emphasizing a general lower sensitivity to cost of equity, scholars also highlight that the reaction of firms' investment to cost of debt is heterogeneous across companies. In particular, small, young and financially constrained (or stretched) firms display an investment policy much more sensitive to changes in their cost of debt than larger, older and cash-rich firms.

The building of slack

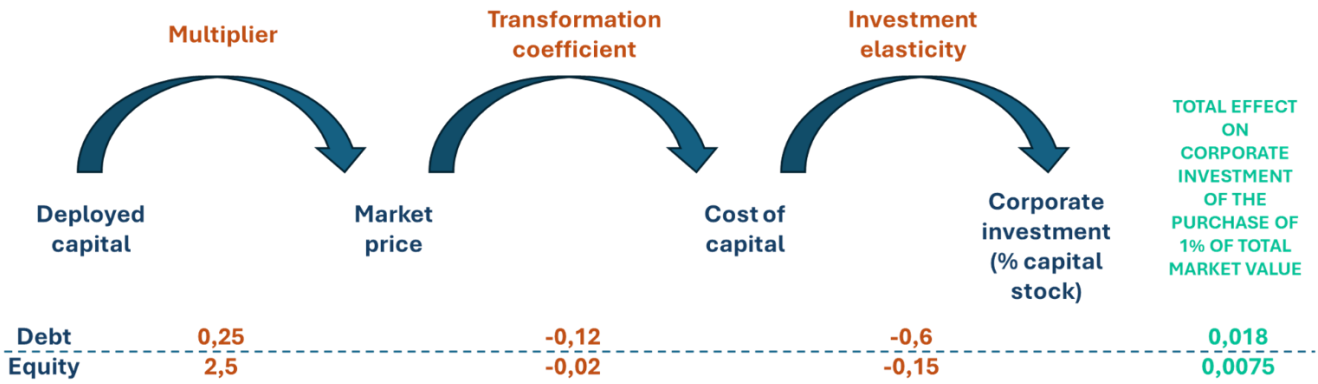
If investment is only very loosely influenced by the cost of capital through the discount rate, it still might be affected indirectly through issuances. Graham (2022) made several observations that converge to show that the *possibility to invest* is not unrelated to financing conditions. He observed that debt issuance decisions rely on market timing. When interest rates are low, companies raise debt, even if it is not directly related to project financing. The main purpose then is to build up room for flexibility. But flexibility is mostly searched for to pursue potential investment opportunities. Consequently, a decrease in interest rates creates room for future investment through higher debt issuance.

Oppositely, equity issues are much less frequent and do not time market as much. In a typical year, secondary equity issuance represents about 12% of corporate bond issuance in the US[5].

Pathway #1: a summary

We use estimates disseminated across the section to infer the plausible effect of a purchase of 1% of the capital (equity or debt) base on the investment rate of a company. For each step, we consider median values out of the range of existing estimates. The figure below displays the aggregated results.

Figure: disentangled effects of capital deployment in secondary markets on corporate investment



The estimations show that capital deployment in the bond market might be 2,4 times as effective as capital deployment in the stock market. This is due to both a transformation coefficient that is 6 times larger than for equity and an investment elasticity that is 4 times larger. Those two features do more than offset the effect of the smaller multiplier in the debt market by one order of magnitude.

Based on our estimates, a purchase of 1% of the outstanding debt could likely translate into an average decrease of the cost of debt by 0,03 percentage point (0,25*0,12) that leads to an increase of the investment rate of the invested company by 0,018 pp (0,03*0,6). If the investment rate was initially at 15% of the total stock of capital, it then might increase to 15,018%.

Alternatively, a purchase of 1% of the equity base could likely translate into an increase of 2,5% of the market cap that decreases the invested company's cost of equity by 0,05 pp (2,5%*0,02) and finally increases the investment rate of the invested company by 0,0075 pp (0,05*0,15). If the investment rate was initially at 15% of the total stock of capital, it therefore might increase to 15,0075%.

[5] SIFMA (2023)

To achieve a noticeable (albeit small) increase of 50 pp on the investment rate, one should purchase 27,7% of the outstanding debt or 66,7% of the equity base. Those figures, especially for equity, are clearly out of reach for most investor coalitions, whether formal or informal.

Pathway #2: are managers sensitive to stock price movements?

In this section, we investigate the possibility for investor coalitions to send clear price signals to managers that will make them take appropriate steps via i) a feedback effect and ii) a financial incentive through managerial compensation.

Do company managers learn from market prices?

Research has long discussed a feedback effect of market prices on companies' real decisions[6]. The core idea is that outsiders may have some incremental information that is useful to company managers (e.g., state of the economy, position of competitors, consumers' demand). This hypothesis has been largely supported. For instance, companies' decisions have been found to be influenced around major company life events, including M&A, earnings forecasts, or CAPEX investment announcements.

In a similar vein, many papers have observed a sensitivity of investment decisions to stock prices that goes beyond the cost-of-capital channel. To test whether managers learn from the price, they ask how this sensitivity is related to measures of price informativeness. The idea is that if investments are more sensitive to prices when prices are more informative, then this indicates that the information in the price is used for the investment decisions. Empirical tests confirm that hypothesis[7].

Unfortunately, stock prices respond to fundamental shocks (news) as well as non-fundamental shocks (noise). While there is certainly noise in prices, the idea of the feedback effect is that, after taking the noise into account, prices are still informative. Rational economic agents will update, fully aware of the possibility of noise, and still find the price informative.

In practice, are managers capable of discriminating news from noise in stock prices? Researchers have tried to answer that question by looking at how non-fundamental shocks to stock prices influence companies' decisions. They obtain that those non-informative shocks do affect companies' investments.[8] Firms' investments are also affected by non-fundamental changes to the prices of their peers.[9]

In conclusion, there is now **ample evidence that managers do learn from market prices and that they are not equipped to distinguish between noise and information within stock prices.**

In relation to ESG (green) investing, it implies that there is no certainty that managers would learn the right lessons from observing diverging price signals between high ESG (or green) companies and low ESG (brown) companies.

Do stock prices provide clear incentives to managers?

Part of the impact narrative of price signaling goes through providing the right incentives to company managers. The effectiveness of such a channel is de facto highly dependent on the structure of the managers' compensation. If company managers have no stock-based compensation, then the incentive is pointless. If part of their compensation is stock-based, then affecting stock prices through capital allocations may turn effective… or counter-effective.

[6] Goldstein (2023)
[7] Chen, Goldstein, and Jiang (2007); Bakke and Whited (2010); Pereira Silva (2023).
[8] Hau and Lai (2013); Lou and Wang (2014); Tubaldi (2021).
[9] Dessaint et al. (2019).

To correct potential agency problems (i.e., misalignment between shareholders and managers' interests), companies have resorted more and more to stock-based compensation for their top managers in the last decades. For instance, Davis and Hausman (2020) found that, from the 1990s onwards an increasing portion of oil and gas executives' compensation was non-salary. By 2016, over 70% on average was from stock options and stocks, long-term incentive programs, bonuses, and other benefits.

In a world in which financial, labor, and product markets all operate efficiently, linking incentive pay to the stock price would be enough to align the interests of shareholders and management. In practice, additional performance measures are useful insofar as they contain extra information about management's value-added.

One reason is that stock markets can be noisy, as already mentioned, and prone to short-termism. So a company should also rely on other metrics for a holistic perspective on its managers' performance. Indeed, top managers' compensation packages are increasingly connected to a multitude of KPIs, both financial and non-financial. Recent evidence by Ritz (2022) shows that the five largest western oil & gas companies—BP, Shell, and Total in Europe and Chevron and ExxonMobil in the United States— now incorporate KPIs related to financial performance, operating performance, strategic objectives and sustainability into CEO pay.

Therefore, **the potential effectiveness of price signaling through managers' compensation is being progressively reduced as firms are decoupling their managers' pay to the stock price**.

Leaving aside other KPIs, attributing the largest chunk of managers' pay in the form of stocks does not ensure that managers will be interested into maximizing the stock price at all times and, therefore, will do their best to avoid investors' divestment.

Against intuition, Davies and Van Wesep (2018) show that, as most managerial compensation contracts reward long-run profitability and stock returns, divestment can be ineffective at best, and perhaps counterproductive, even rewarding managers who attract divestment campaigns. In a quantification exercise, they show that the wealth of most executives running likely divestment targets would be unaffected by even large movements in share prices. Of those affected, a substantial majority would even benefit from divestment.

As Davies and Van Wesep (2018) conclude, this is bad news for proponents of ESG capital allocation, especially divestment. Still, they admit that managers of firms targeted in divestment campaigns are stigmatized, and social pressure can be as effective as financial pressure to make them choose a more sustainable course. This mechanism, however, might suggest that making noise (i.e., a form of non-market signaling) is more important than sending price signals.

If managers may temporarily be interested in having a low stock price (when they are close to receiving stocks or options), they may also be interested into the maximization of the stock price in the future (to sell their stocks). Consequently, they may appreciate current exits but fear future ones. For ESG activists, it means threats of future exit would be more effective than immediate exits.

Gantchev et al. (2023) provides evidence that confirms such an intuition. They show that environmental or social incidents at listed firms are followed by some, but relatively small, divestitures. Nevertheless, following those incidents, firms with a one-standard-deviation higher ESG-focused institutional ownership decrease their greenhouse gas emissions by 36.5% and improve their ESG scores by 7.2% more than other firms if their managers receive equity compensation. Their results instruct that **managers' compensation interacts with investors' preferences to affect managers' decisions**. Stock-based compensation works better to make managers pay attention to the firm's ESG performance when ESG-focused investors own a large fraction of the equity capital and threat of exit by ESG-focused investors is more effective when managers have a high fraction of their compensation in the form of stocks.

The findings by Gantchev et al. (2023) support the view that **the ongoing trend of decoupling managers' compensation from the immediate stock price *de facto* plays against the effectiveness of price signaling through managers' compensation.**

Pathway #3: do shareholders receive and act upon the signal?

A final channel that could connect market prices to companies' real-world decisions leverages the response by shareholders to abnormal equity returns. Here, the theory of change states that shareholders of low ESG/brown companies would react to disappointing returns (in case of sufficient market impact) by pressing the companies' management to opt for a more sustainable strategy using engagement and voting.

So, the narrative implies that i) shareholders notice an abnormal return and investigate for understanding the reasons behind it, ii) shareholders get the right message from the price effect and iii) they react by engaging with the targeted companies and not by exiting.

The first step is rather credible since investors pay great attention to their investments' returns. This is even central to institutional investors' fiduciary duty. What is unsure is the magnitude of return abnormality (that goes beyond typical price volatility) that would require a proper investigation. **If we assume that a valuation gap of 25% versus competitors is a reasonable threshold, then it would require ESG investors to purchase 10% of the market cap (considering a multiplier of 2.5, see the estimate used above).**

The other two steps are even less straightforward. First, there could be many conflicting interpretations for disappointing returns leading some shareholders to push in favor of more sustainability and others towards less. Second, for shareholders engagement is a costlier response to disappointing returns than just selling stocks or bonds to redirect capital towards other securities with a better momentum.

When tapped in isolation, the shareholder channel of market signaling thus relies on uncontrollable factors. At least, a way to maximize its probable effect would be to combine it with explicit non-market signals. If media interventions make it clear that the price decrease is connected to a targeted campaign by market activists, then the shareholders can get the message right and, potentially, act upon it.

The observed outcomes of market signaling

Several empirical studies, at micro or macro level, have investigated whether green or sustainable investment strategies in secondary equity markets had a real-world effect. Results are ambivalent.

At micro level, Roehleder et al. (2021) find that divested firms experiencing a stock price decline subsequently reduce their carbon emissions compared to non-divested firms. Other studies obtain much less positive results. Heath et al. (2022) found that SRI funds do not significantly change firm behavior and conclude that SRI funds operate primarily as stock selectors, not as impact generators. Berk and van Binsbergen (2022) study the effect of a firm either being included or excluded from the FTSE USA 4 Good Select Index and find that the difference in the cost of capital between firms included or excluded is too small to meaningfully affect real investment decisions. Hartzmark and Shue (2023) show empirically that a reduction in financing costs for firms that are already green leads to small improvements in impact at best. In contrast, increasing financing costs for brown firms leads to large *negative* changes in firm impact. Thus, sustainable investing that directs capital away from brown firms and toward green firms (through a negative screening strategy or a best-in-universe strategy) may be counterproductive. Wilson et al. (2023) tracked firm-level low-carbon (green) investments and high-carbon (brown) investments for publicly listed electric utilities firms from 2012-2021. They find that a reduction in the firm-level cost of debt *directly* increases both firm-level green and brown investments (through the discount rate), and also *indirectly* increases investment by enabling debt capital raising. Therefore, an indiscriminate increase in cost of debt for brown issuers would not mechanically increase their ratio of green-to-brown investments. When controlling for climate policy using the OECD Environmental Policy Stringency Index, the authors obtain that market-based policies, such as carbon prices and taxes, directly increase domestic green investments and act as a moderator, strengthening the relationship between debt capital raising and green investments, while doing the opposite for brown investments. It is the combination of market forces (which drive interest rates) and regulations that orients firms' investment decisions towards the low-carbon transition.

At macro level, De Angelis et al. (2020) and Choi et al. (2020) provide empirical evidence of real-world impact of allocations to green funds. Importantly, researchers do not obtain the same results for private firms, opening the door to **a potential leakage effect of green capital allocations where polluting companies or assets turn private**.

Medias[10] and researchers[11] have warned against the risk caused by screening strategies of a massive transfer of unsustainable assets into private funds or sold into jurisdictions with, for example, lower environmental standards. In this way, "pure" portfolios become widespread in sustainability-concerned countries, but they might have no real-life effect, and one could even argue that this approach worsens the situation.

Success factors of market signaling

Moderators of the effect of capital allocations to market prices

Research has shown that effects on market prices of allocating capital using sustainable screenings is highly context-dependent.

In particular, price signaling effects will depend on:

- **the deviation from conventional index of the sustainable allocations**[12]: sustainable funds can significantly affect prices only when their allocation significantly varies from the conventional benchmark,
- **the elasticity of stocks**: the more inelastic the stocks are, the more possible it is to influence prices. All else being equal, it is more effective for large stocks that are more inelastic than small caps (because passive investors hold them whatever happens)[13] and for stocks that lack substitutes.
- **the size of the sustainable inflows or outflows vs the investment universe**: the effect is larger when capital is deployed/withdrawn on smaller segments of the market,
- **the concentration of trades by sustainable investment funds**: the more investment funds concentrate on a few holdings, the stronger the effect they can have on market prices.
- **the similarity of screening filters across sustainable funds:** the more homogeneous the screenings are, the more effective are investments/divestments of each fund in affecting market prices. If not homogeneous, the signals sent by individual funds have a high chance of getting lost.
- **the fraction of wealth commanded by sustainable investors:** equilibrium models[14] indicate that the total effect of screening approaches on asset prices, as well as the marginal effect per additional dollar involved, increases with the fraction of wealth commanded by investors that apply the same screening approach.

Moderators of the effect of market prices on companies' behaviors

A common moderator to all pathways is **the costs for a company to implement the reforms required**. The models of Heinkel et al. (2001) and Gollier and Pouget (2014) point out that whether changes in asset prices induced by sustainable investing provide an incentive for companies to improve their ESG practices depends on the cost of the necessary reforms. The lower the costs, the higher the chance that the company will comply.

We add to that common preliminary some specific moderators to the distinct pathways. An additional moderator of pathway #1 is the need to issue debt or equity to finance company's growth or reform.
In both pathways #2 (signal to managers) and #3 (signal to shareholders), the risk is that managers and shareholders don't get the message right because stock prices are, by nature, very noisy. The clarity of

[10] The Economist (2022)
[11] Gözlügöl and Ringe (2023)
[12] Van der Beck (2021)
[13] See Haddad et al. (2022). It is noticeable that investing in small cap stocks suffers from the opposite pros and cons of investing in large caps. On the one hand, the lower market cap and daily volumes creates possibilities for stronger effects. On the other hand, the higher elasticity of demand to prices in the case of small cap stocks reduces the potential effect.
[14] Such as those of Heinkel et al. (2001), Fama and French (2007), Gollier and Pouget (2014), and Luo and Balvers (2017)

signaling would be enhanced if combined with explicit non-market signals. If media interventions make it clear that the price decrease is connected to a targeted campaign by market activists, then the odds are increased that managers and shareholders understand the need for a strategic reorientation.

Multiple ways to coordinate market signaling

All pathways require price signals to be loud to have a credible chance to influence corporate decisions. Simulations that this cannot be achieved by single investors, even large institutional ones. Therefore, critical size can only be reached if investors de facto coordinate. **We have identified four devices (ratings, indices, labels and regulations) that exist to facilitate such a coordination.** Not all appear to be equally effective.

Based on the abovementioned research, we consider that efficient coordination devices should:
1) send clear signals to managers and shareholders about the reasons for an abnormal price reaction,
2) foster significant deviations of portfolio weights from market weights,
3) lead to a high portfolio homogeneity across investors using the same device,
4) be followed by a large fraction of investors and reach a critical size in terms of AuM relative to their investment universe.

As they permit a higher portfolio homogeneity, we consider that **indices represent the most promising avenue for coordinating capital allocations** of impact-motivated investors.

Practical conclusions

In conclusion, our detailed investigation shows that achieving real-life impact through the altering of security prices in secondary markets via a coordinated action proves to be very hypothetical, at best. Indeed, many obstacles do obstruct the way of impact investors opting for market signaling in secondary markets, namely:

- the very large size of “sustainable” investment segments within equity and bond markets,
- the high price elasticity of demand for stocks and bonds, requiring very large amount of capital to influence market prices,
- the poor responsiveness of firms’ investment decisions to actual cost of capital (especially cost of equity),
- the difficult interpretation of market returns by shareholders and managers,
- the current trend of decoupling managers’ pay from the stock price,
- the poor effectiveness of most coordination devices.

We consider that any narrative of a collective impact through market signaling in bond or equity secondary markets is therefore highly dubious and would require a strong argumentation.

This mirrors the conclusions of a paper about greenwashing in sustainable finance by the Swiss Asset Management Association (2021) that concluded that products using ESG integration, exclusion or positive screening was contributing to a minor extent or not at all to the impact goal of investors, unlike stewardship (engagement) or impact investing products (operating in private markets).

If anything, the pathway to collective impact through market signaling requires adopting *sine qua non* rules.

We derive from the reviewed research **a series of 6 recommendations** that increase the (otherwise very low) chance of coordinated price signaling to be effective:

1. Choose a “pure” selection criterion,
2. Follow the exact same strategy (e.g., through index replication),
3. Restrict to (very) narrow market segments,
4. Opt for strategies that incentivize brown firms to go green,
5. Favor bonds over equity,
6. Focus on financially constrained firms.

Finance ClimAct contributes to the implementation of French and Euro pean policies for sustainable finance, in line with the European Green Deal and France's National Low Carbon Strategy.

It will develop the tools, methods, and new knowledge to achieve this goal in the coming years by: (1) supporting investments in energy efficient, and low-carbon industries, (2) considering the double materiality of climate change in financial management and supervision and (3) integrating environ mental objectives into retail investors' decisions.

The project is coordinated by the French Agency for Ecological Transition, The Ministry for Ecological Transition, The Autorité des Marchés Financiers, the Autorité de contrôle prudentiel et de résolution, 2° Investing Initiative, The Institute for Climate Economics, the Institut de la Finance Durable and RMI.

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