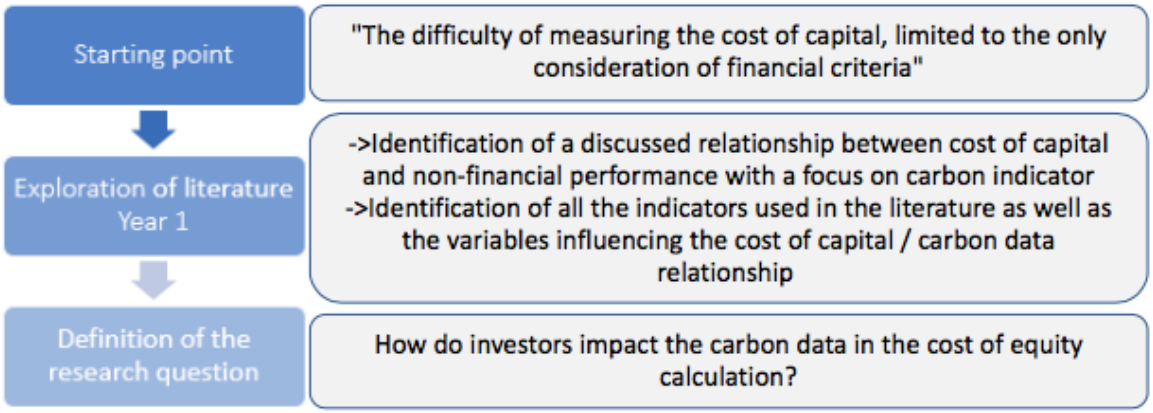
Synthesis of the thesis advancement

Thesis title : The cost of capital and the inclusion of extra-financial carbon criteria

Abstract : This article reports on the progress of the thesis work on the cost of capital and the inclusion of the extra-financial carbon metric. Currently in its third year, the first year was spent on the literature review and the second on the first part of the empirical work consisting of a series of interviews. The result of this work allowed us to reposition our hypotheses in the framework of a hypothetical-deductive approach. The second part of the empirical work is devoted to the modeling of the cost of equity capital integrating carbon data. The last part will be devoted to testing our models on different company cases through the calculation of the cost of capital.

1. Reminder of the research question

"How do investors impact the carbon data in the cost of equity calculation?" is our research question, defined within the framework of a hypothetico-deductive approach, involving the steps illustrated below:



Source : Autor

Qualified as the determining key of a company by Barneto and Gregorio (2017). According to these authors, the value of a company depends on the success of its investment policy, measured by the cash flows generated, discounted by the cost of capital formed by the "required rate of return". This rate of return is composed of the cost of debt and the cost of equity. The cost of

equity represents the rate of return required by investors. In order to estimate the latter, it is therefore necessary to anticipate the shareholders' requirements on the basis of the information available to them. To do this, various models exist, including the Capital Asset Pricing Model (CAPM) and its evolutions dating from the 1960s, which is widely used in practice. It is found, for example, as the only method of calculating the cost of equity in the AFP (Association for Financial Professionals, 2020) survey on the calculation of the cost of capital, following a line of reasoning *"that still underpins most practices today for determining the rate of return*" (Bancel, 2014).

In parallel, research has continuously developed alternative models, some of which integrate extra-financial data as well as carbon data. El Ghoul et al (2011), Chava (2014), Bolton and Kacperczyk (2020) are among the major papers on the subject. The results obtained are not always significant and discussed. Nevertheless, they demonstrate the existence of a link between carbon and the cost of equity. This link is materialized by the formation of a carbon premium identified in the literature, including Kim et al. 2015, In et al. 2017, Trinks et al. 2017, Albarrak et al. 2019, Görgen et al. 2019, Lemma et al. 2020, Bui et al. 2020, and Bolton and Kacperczyk, 2020, which demonstrate the recent nature of this premium. These works display a wide variety of evaluation methods and criteria considered, participating in the irregularity of the results. In this context, we place ourselves on the investor's side in order to consider the construction of a model for calculating the cost of equity capital that integrates the carbon criterion.

2. Justification of the interest of the subject

Corporate social responsibility, societal responsibility, green economy, sustainability, are commonly used and sometimes considered interchangeable terms to describe a sustainable and responsible economy. There is still no consensus among professionals and institutions (Leal Filho et al. 2019) or in research on environmental performance and its measurement (Trinks et al. 2017) given the multitude of indicators available. This diversity is qualified by Berg in 2016 and Hahn et al. in 2015 who deplore the lack of harmonization, pushing investors to commission ratings that are generally less costly than conducting their own assessment.

In reviewing the literature, we found a first series of studies, from the early 1970s to the mid-2000s. It focuses on the impact of Corporate Social Responsability (CSR) overall financial performance. The main objective is to demonstrate a positive impact of CSR on financial performance. This financial performance implies either only economic performance indicators (mainly accounting ratios) or both economic and market performance indicators (mainly financial performance and market to book value ratio). Since the mid-2000s and until today, the focus has been on market performance in order to measure the impact of carbon data on the valuation of the company. Beyond a purely economic impact, better management of carbon externalities would improve market expectations and, in the case of negative externalities, increase market anxiety. A whole body of literature linking the cost of equity to carbon data has developed. It integrates this data as a unique variable or representative of the environmental dimension. Various works address this link, most often indirectly. For example, Andersson, Bolton, and Samama (2016) and Jong and Nguyen (2016) address the evolution of carbon risk from portfolio optimization while In, Park, and Monk (2017) and Singh, Sethuraman, and Lam (2017) assess the impact on corporate valuation. In, Park, and Monk (2017) do so based on the evolution of indexes in their study on eco-efficiency based on carbon dioxide levels. As for Singh, Sethuraman, and Lam (2017), they exploit the Market value to book value ratio as a dependent variable to study the impact of several CSR variables including the carbon variable. Other researchers, such as Lemma et al. (2019) or Cai and Lontzek (2019) use the implicit cost of capital to understand the evolution of risk, while Palea and Drogo (2020) study the impact as a function of the evolution of the cost of debt.

Finally, a number of works are devoted to modeling the cost of equity, a dependent variable with, as independent variables, the classical factors linked to a cost of capital model in which the carbon variable is integrated. Zerbib (2020) or Monasterolo and De Angelis (2020) and Bolton and Kacperczyk (2020), employ a multi-factor model of the Fama and French type. Pedersen et al (2020) and Pastor et al (2020) use the CAPM. The results of these studies are varied and can be linked to the different types of indicators impacted by various variables.

Our preliminary hypothesis is that the carbon variable is effectively integrated into the calculation of the cost of equity via positive or negative externalities. This integration follows two compatible logics: on the one hand, risk reduction and on the other hand, a preference for

green assets differentiated between ethical preference and utilitarian preference. The first refers to the convictions of investors to be linked with the general context calling for more sustainability. The second, the utilitarian preference, is mainly based on the need to legitimize the action of investors towards the various stakeholders.

3. Statement of the fields of literature considered relevant

Starting from the neo-classical assumption that the cost of capital is formed by the financial market, it is the result of a consensus between investors. Recent literature highlights the increasingly perceptible activism of investors, no longer just speculative investors but shareholder investors (Dyck et al. 2019, Girerd-Potin et al. 2014, Gollier and Pouget, 2009). Investors more involved in the issue of sustainability as demonstrated by some independent researchers and experts. Amel-Zadeh and Serafeim (2018) questioned investors on why and how they use non-financial information. Krueger (2020) interviews institutional investors to better understand how they incorporate climate risk into their investment decision. The result is that climate risk is taken into account across the board (only 7% of investors do not integrate the issue) for three main reasons: protection of investors' reputations, ethical and moral considerations and legal obligations. Investors seem above all to be looking for legitimacy, generally defined as "a generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs and definitions" (Suchman, 1995). The financial analysts interviewed by Arjaliès and Bansal (2018) claim that financialization processes give them legitimacy, also admitting that these obligations conflict with their own value systems that do not lend themselves to financial numbers. Faced with such a dilemma, one wonders about the effective consideration of financialized information while Arjaliès and Bansal (2018) conclude that managers find these ESG (Environment, Social, Governance) issues too difficult to include in the financial models used and have abandoned them in favor of visuals that allow for the evaluation of these ESG criteria.

Following the agency theory, these investor-shareholders will use their influence to guide the company's choices in order to satisfy the "shareholder welfare" defined by Hart and Zingales

(2017), who consider that shareholder welfare and market value are two different things, and that companies should maximize the former rather than the latter. Investor preference thus appears to be a significant determinant in the consideration of the extra-financial carbon criterion (Bolton and Kacperczyk, 2020, Gerged et al. 2021, Pastor et al. 2020, Pedersen et al. 2020...). We choose to retain it as our main hypothesis: investors, concerned with the image of their portfolio and limiting risks, exclude brown stocks. The decrease in the number of investors holding these securities reduces the opportunities for risk diversification which generates a higher cost of equity of these assets following the equilibrium model of Heinkel (2001) cited by El Ghoul et al. (2011)

Our second preliminary hypothesis assumes that green stocks receive preference action from investors. The increase in the investor base leads to a decrease in the cost of equity and an increase in the market value of the firm.

4. Methodology

The methodology considered is a mixed methodology, exploratory type, implying to start our research work with a qualitative research, not considered as a complement but rather as a contribution intended to shape the orientation of the whole study (Creswell et al., 2006). This method is increasingly popular in management science, particularly in extra-financial matters, in view of the particularities and novelty that require exploratory methods and the open-mindedness that accompanies them according to Chenet (2019). The first exploratory part must allow a reconciliation between practices and theory "*in order to define a set of "best" practices to define the WACC*" (weighted average cost of capital) according to Bancel (2014). Following the methodology of Savall and Zardet (2004), the first part of our research work involved establishing a list of concepts constituting the phenomenon of taking into account the carbon indicator in the calculation of the cost of capital. These were then operationalized into variables to be studied and tested through our interviews.

Two main axes emerge. First, the specification of the indicator links us to the relevance of this indicator, defined firstly according to the origin of the data, taking into account the diversity of the available indicators, characterized by their form, quantitative or qualitative, their origin,

internal or external and finally the nature of the information, raw data, ratings, initiatives or green-brown identifications. This last typology directly implies the notion of performance measured through the level of externality. This is a risk-opportunity approach and green indicators are considered to be effective, unlike brown ones. Different authors including Albarrak et al (2019), Lemma et al (2019), Trinks et al (2017), Cai et al (2016), Kim et al (2015), Plumlee et al (2015) and Chava (2014) cite the concept of "environmental performance". Only a few authors mention the concept of "carbon performance" such as Bui et al. (2020) and Liesen et al. (2017). In this context, our work aims to bring out this concept of performance from practices and the field.

Our first objective is therefore to better define the carbon data and how to integrate it into the cost of equity by relying on an in-depth analysis of investors' valuation and integration methods. Secondly, we will model the cost of capital by distinguishing the cost of debt, based on green bond data, and the cost of equity. The use of a multifactor model such as that of Fama and French (1993) is envisaged to calculate the latter. We will incorporate our new carbon factor as it has been done previously in the literature (Girerd-Potin et al. 2014, Liesen et al. 2017, Lilti and Lachuer, 2019, Görgen et al. 2019, Monasterolo and De Angelis, 2020).

5. First results

We present here the first part of our empirical work which allowed us to reformulate our hypotheses. These hypotheses will be the basis of the second part of our empirical work.

Interviewing methods

The target of our interviews is investment professionals (institutional investors). Bolton and Kacperczyk (2020) divide institutional investors into 6 categories: banks, insurance companies, investment firms, independent advisors, pension funds and hedge funds. We follow the same logic, ignoring the last two categories that concern the US market while we operate in the European market. We integrated corporate ESG managers in order to assess investors' intentions from a corporate perspective. A series of 15 interviews is conducted until “saturation effect” is reached.

Because our exploratory approach allows for open-ended inquiry (Saldana, 2021), we conduct two coding techniques: an inductive one consisting of a list of codes from the literature and a deductive one explained by the emergence of certain themes. We identify the verbatims in the form of expressions, sentences or small paragraphs classified according to a specific coding.

RESPONDENTS LIST

Code	Grade	Work	Specialisation	Categorie	Capitalization Market	Interview Date
ANAA	Manager	Analyst	ESG	Investment firm	BIG	03/09/2022
ANAB	Senior	Analyst	ESG	Investment firm	BIG	01/27/2022
CONSA	Principal	Analyst	ESG	Independent advisor	BIG	02/09/2022
CONSB	Founder	Advisor	ESG	Independent advisor	SMALL	04/08/2022
CONSC	Director	Analyst	ESG	Independent advisor	BIG	03/22/2022
ENTA	Director	Support	ESG	Company	BIG	06/10/2022
ENTB	Director	Support	ESG	Company	BIG	07/26/2022
GESTA	Partner	Asset Manager	Finance	Investment firm	MIDLE	02/09/2022
GESTB	Principal	Asset Manager	Finance	Investment firm	MIDLE	02/15/2022
GESTC	Manager	Asset Manager	ESG	Investment firm	BIG	04/05/2022
GESTD	Senior	Asset Manager	Finance	Investment firm	SMALL	03/03/2022
GESTE	General Director	Asset Manager	Finance	Investment firm	MIDLE	03/21/2022
GESTF	Principal	Asset Manager	Finance	Insurance company	BIG	02/16/2022
SUPPA	Managers	Support	ESG	Bank	BIG	03/09/2022
SUPPB	Principal	Support	ESG	Investment firm	BIG	06/03/2022

Source : Autor

We carry out two coding: the first one in Excel and the second one using the Nvivo 11 software which allowed us to carry out textual searches in order to control the exhaustiveness of these coding. In the absence of significant differences between our two coding, we concluded that the latter was sufficiently reliable.

Our data were processed using two matrices inspired by the methodologies of Miles and Huberman (2003). The first allows us to identify the process of integration of the indicator. The second is dedicated to the specification of this indicator. These matrices were extracted from the NVivo software using the application of cross-tabulations in order to carry out counts of occurrences supported by the percentage of coverage calculated in the software.

Summary of interviews

Directly related to integration methods, we questioned respondents on their motivations and reasons for including the carbon criterion in the calculation of the cost of equity. Our preliminary hypotheses imply the exclusion of brown stocks, which are avoided by socially responsible investors in order to limit physical, energy transition and asset liquidity risks. The second hypothesis assumes the preference of investors whose utility is no longer limited to financial returns and incorporates personal and ethical aspirations. In connection with these hypotheses, we expected a better control of risk, a preference for greener assets or the search for legitimacy. This last point is the most recurring, and is strongly represented by the regulations mentioned by almost all the respondents, followed by the pressure of the final investor, which is widely mentioned, and which is linked to the issue of image mentioned by these same respondents. Finally, the question of the asset's sustainability is often cited, as mentioned by GESTD asset manager: "*If we want there to be a consideration for buying back our shares, to find an exit in 7-8 years, this company must have made efforts*". Sustainability is linked in some cases to better financial performance for half of the respondents, according to GESTA "*an additional performance driver*", "*it has increased our growth prospects, it has increased our earnings prospects*".

It is important to note the dichotomy between financial and non-financial performance. The former is seen as a primary concern, while the latter is perceived as a qualitative contribution, as expressed by GESTB: "*I see it more as a qualitative, extra-financial component that can be integrated into a purely financial analysis*" or "*CSR and SRI are really about quality*". The term carbon performance is never used, although four different approaches to assessing carbon data are mentioned.

First, the forward-looking and best-in-class approaches are the best represented, with a coverage rate of 5.23% and 3.99% respectively. The first approach, forward-looking, is not cited in the literature. One analyst, ANAA, defines it as "*a methodology that is a little more advanced and allows us to see precisely what the decarbonization trajectories are"*. This approach involves a prospective assessment of the action leverages cited as key performance indicators by the European Commission. These indicators include taking the trajectory into account. The best-in-class approach, which a manager from the sustainable development department, SUPPA, defines as "*comparing against the sector*", involves a sectorization of emissions. This sectorization is common in the literature, as a control variable or directly included in the model. Hsu et al. (2020) calculate weighted monthly returns for more and less carbon-intensive portfolios differentiated by sector. Trinks et al. (2019) weight the average carbon intensity by the industry's market capitalization over the year.

Second, the best universe/absolute approach, which according to GESTC implies that "*a company will be good or bad from an absolute point of view across the entire investment universe*", that is without differentiation by industry or activity level. Different authors employ this absolute measure, which according to Lemma et al. (2019) "is designed to capture a firm's potential carbon liabilities" to distinguish from the relative measure" designed to capture corporate carbon risk exposure". Liesen et al. (2017) consider that the magnitude of emissions in absolute terms determines "the exposure of a company and the sensitivity of its returns to policy, market and stakeholder initiatives for climate change mitigation by making it a parameter for estimating risk".

Finally, the best effort approach, which can be defined in the manner of GESTB, "*what counts for me is more than what the company does, it shows that it is making efforts, more than its result at the moment*", implies taking into account the actions undertaken to improve. This translates into the implementation of specific action leverages or the variation of the level of emissions. Singh et al (2017) assess environmental performance on the basis of policies and practices such as emissions monitoring, improvement plans and reduction of energy consumption including greenhouse gas emissions. Another example is Chava (2014) who, through his CSR strengths and weaknesses analysis, incorporated "particularly strong pollution prevention programs" including emissions reduction programs.

Among the relationships between motivations and approaches, we note that respondents motivated by sustainability or subject to strong regulatory pressures all evoke a forward-looking approach, that is, they will assess the trajectory and planned means to be implemented. We can assume that these investors, who are more attentive to regulations, are normally more sensitive to commitments to reduce emissions, anticipating a tightening of emissions rules. The investors who mention disclosure as one of their motivations all mention the best universe approach, which means taking into account the absolute data, without differentiating according to the sector of activity. An investor who is concerned about the image of his portfolio will logically be concerned about its absolute CO2 level, which is the data that he must disclose. Depending on these different approaches, different indicators are possible and the investor then modulates his behavior through a preference action, exclusion, the implementation of monitoring tools, KPIs, reporting, ratings or a stronger commitment to the companies in his portfolio.

Reconciliation of hypotheses

A primary point concerns the emergence of a first-order contradiction of our main hypothesis, namely the integration of the carbon indicator in the calculation of the cost of equity by investors, "*not formally*" according to GESTB or "*this ESG aspect in the value of managers remains I think quite limited*" according to ANAB. Only two respondents mention methods to directly integrate the carbon indicator into the cost of equity calculation. GESTA mentions that carbon "*impacts the discount rate, the discount rate is WACC*" while GESTB, referring to a company with a high carbon performance, concludes "*it may deserve a very small, very small lower WACC*". A criterion that is "*not completely integrated*" according to ANAB, or indirectly, by giving for example, "*more future value*", with a terminal value that "*will depend on the visibility we have, and in particular on the extra-financial risks*", as expressed by GESTF.

Investors say that they integrate a more global approach and informally, as described by an ESG analyst CONSA from a consulting firm, "*they use the data quite closely to choose the companies in which they invest*". This relates to the exclusionary and preferential actions widely invoked by respondents. The first exclusionary action is very present in the literature, and we can cite Bolton and Kacperczyk (2020) who question investors' interest in carbon risk and conclude on three points. The first is that following an ethical vision, investors lose interest in high emitting companies which are then undervalued by the market mechanism, impacting the demand for

profitability. We can refer to the hypothesis of El Ghoul et al (2011) on the increase in the cost of equity of brown companies (low CSR) in relation to the CSR preference and the information asymmetry justified by the equilibrium model of Heinkel et al (2001). It implies that when fewer investors hold a firm's shares, the opportunities for risk diversification are reduced and, consequently, the firm's cost of equity capital will be higher. Within this framework we develop our first hypothesis:

H1a: Sectorized brown stocks are excluded by a large proportion of investors. The reduced number of investors holding these stocks reduces risk diversification the opportunities and generates a higher cost of equity.

H1b: Sectorized brown stocks whose economic performance below the average performance of their industry are excluded by a majority of investors, further reducing the number of investors holding these stocks. Diversification opportunities are reduced and the cost of equity is higher.

The investor is considered to take into account all the demands of the stakeholders, which implies considering the economic performance as well as the carbon performance.

In the opposite case of low-emitting companies, a preference action is mentioned by almost all respondents. This observation in contrast with the second conclusion of Bolton and Kacperczyk (2020) of market inefficiency. Investors would not sufficiently consider the long-term consequences of carbon emissions in their flow forecasts. As a result, these firms would tend to be undervalued (and thus more profitable). In contrast, Gerged et al. (2021) and Bui et al. (2020) validate this hypothesis by showing that "when companies meet ethical investment standards, they become more attractive to some investors" (Bui et al. 2020). The latter then provide cheaper capital to such companies. The authors likened this theory of ethical investment to an exclusionary portfolio approach whereby investors select companies that meet the definition of a responsible company. While there is no clear definition of responsible business, we retain Elkington's definition, cited by De lange et al. (2012) as "Sustainability can be defined, based on earlier definitions, as an approach to business that considers economic,environmental and social issues in balanced, holistic, and long-term ways that benefit current and future generations of concerned stakeholders." Sustainability therefore implies incorporating the environmental pillar, which is largely represented in the literature by the

carbon indicator (Lemma et al. (2019), Albarrak et al. (2019), Trinks et al. (2017), Cai et al. (2016)). Following ethical investment theory, investors express preferences for socially responsible companies, implying "social preferences for low levels of CO2 emissions" Gerged et al. (2021). Thus, our second hypothesis:

H2a: Green stocks, when they show economic profitability above the industry average, benefit from preferential action by investors. The increase in the investor base leads to a decrease in the cost of equity and an increase in the market value of the company.

The investor, pursuing his multiple performance objectives, favors stocks with both good economic performance and good carbon performance.

H2b: Green stocks whose economic profitability is below the sector average do not benefit from preferential shares, except for a minority of ESG investors, so the carbon variable is zero.

We are considering here a partial paradox approach which implies a second-order consideration of the carbon performance, considered only on the condition of an economic performance above the sector average. We can assume that the business case defined by Hahn et al. (2018) through the fact that "environmental and social concerns are not considered to have intrinsic value" applies. Environmental interests must be aligned with the economic interests of the company following the utilitarian philosophy. A good carbon performance (which will be translated differently depending on the chosen approach) that would not be aligned with a good economic performance will not be considered.

Finally, the hypothesis of a carbon risk premium or pollution premium (Hsu et al., 2020) mentioned as a final conclusion by Bolton and Kacperczyk (2020) seems to be premature. Although investors mention a range of risks, these are mainly associated with the long term with actors "*trying to find a formula to restate the environmental risks a bit*" as mentioned by ANAB. This is consistent with the findings of Breitenstein et al (2020) in their review of the literature on basic environmental risk research, that there is an increased awareness and willingness to assess climate-related financial risks which remains hampered by many practical difficulties.

Regarding the specification of the indicator and the origin of the data, the issue of independence and certification appears to be secondary today, as GESTC states: "*All listed companies today*

have their CSR reports certified, so it's really, it's no longer very relevant", an element to be linked to our target, which is mainly oriented towards large capitalizations. Regarding the nature of the data, the respondents clearly expressed a preference for declared data, "*as soon as it is public, we will still consider that the company is not lying outrageously*" expressed by CONSB. The measurement of carbon performance takes contrasting forms through the different approaches and, as mentioned, performance and carbon are never associated, an absence illustrated by this verbatim "*it is never the numerical performance that is evaluated but rather all the processes that we implement to achieve our objectives*" from ENTA.

In conclusion, the choice of indicator and its consideration are closely linked to the expectations of stakeholders. Pressure is the main reason identified in our interviews. These pressures are expressed above all through regulation, which has an impact on the quality of information, the preference of the final investor (client) and the preference of the investor. In this sense, stricter carbon regulations will push investors to prefer low-emission securities. The search for good practices through ethical investment will also influence the investor who wants to participate in a societal movement for sustainability. Similarly, the market and peers will guide the investor's actions, this time with a more utilitarian vision, concerned with its legitimacy and taking advantage of the consideration of carbon externalities compare to its competitors. While for the time being, this carbon criterion is not formally taken into account in the calculation of the cost of equity, the development of ethical investment in connection with investors' search for legitimacy is impacting the cost of equity.

6. The choice of a multi-factor model

To be updated – work in progress

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