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## The Rationality and Irrationality of Financing Green Start-Ups

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Academic Editor: Jacob Hörisch

*Received: 29 July 2015 / Accepted: 3 November 2015 / Published: 10 November 2015*

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**Abstract:** Green start-ups contribute towards a transition to a more sustainable economy by developing sustainable and environmentally friendly innovation and bringing it to the market. Due to specific product/service characteristics, entrepreneurial motivation and company strategies that might differ from that of other start-ups, these companies might struggle even more than usual with access to finance in the early stages. This conceptual paper seeks to explain these challenges through the theoretical lenses of entrepreneurial finance and behavioural finance. While entrepreneurial finance theory contributes to a partial understanding of green start-up finance, behavioural finance is able to solve a remaining explanatory deficit produced by entrepreneurial finance theory. Although some behavioural finance theorists are suggesting that the current understanding of economic rationality underlying behavioural finance research is inadequate, most scholars have not yet challenged these assumptions, which constrict a comprehensive and realistic description of the reality of entrepreneurial finance in green start-ups. The aim of the paper is thus, first, to explore the specifics of entrepreneurial finance in green start-ups and, second, to demonstrate the need for a more up-to-date conception of rationality in behavioural finance theory in order to enable realistic empirical research in this field.

**Keywords:** green; environmental; sustainable; entrepreneurship; start-up; entrepreneurial finance; behavioural/behavioral finance; rationality; venture capital; business angels

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## 1. Introduction

Theory and empirical work in entrepreneurial finance have made significant strides in the last decades in explaining particularly the supply-side perspective of investors but also attempting to illustrate the demand-side challenges involved when new and young companies seek external finance. One emerging field of entrepreneurship study, sustainable entrepreneurship, has thus far not received much research attention in the context of finance. “Green” start-ups constitute one actor type within sustainable entrepreneurship whose potential difficulty of financial access is currently a loose hypothesis, which has really neither been described exhaustively by theory nor been explored thoroughly by empirical work thus far. While entrepreneurial finance theory can provide some insight into investment in green start-ups, there are some aspects of it that are more challenging to illuminate within the existing theoretical framework—such as motivation beyond profit and strategic considerations arising from sustainability-related goals. Although the behavioural finance literature is still in its early years, it has some crucial contributions to make here. It can especially help explain why investors’ decision-making criteria include other aspects beyond such conventionally considered criteria as risk, return, liquidity and time-horizon.

The main question raised by this theoretical paper is: Why may green start-ups experience challenges in accessing finance to fund their early-stage activities beyond what other start-ups experience? From a supply-side perspective, investors may be wary of such start-ups. Why is this the case? From a demand-side perspective, green start-ups and their entrepreneurs may similarly be wary of (certain types of) investors, which, at first glance, might be somewhat more perplexing. While, as is shown in this paper, we can come a long way in explaining these questions by using entrepreneurial finance theory, its theoretical framework largely holds the implicit (and sometimes explicit) assumption of rationality in investment decision-making. The notion of rationality that the research field relies on is, however, rather constricted. The contribution of behavioural finance theory may help overcome entrepreneurial finance theory’s deficit in explaining green start-up finance. However, while some theorists in behavioural finance object to the prevalent conception of rationality, most rely on the idea of a “bounded rationality” as they see revealing itself in empirical evidence. That is why this paper, in conclusion, draws specifically on theory of rationality in economic behaviour to suggest how behavioural finance theory can evolve into a more realistic and holistic framework for exploring the topic of investment in green start-ups in particular as well as in start-ups in general.

## 2. Methodological Approach and Structure of Paper

A comprehensive literature review was carried out in several steps for this theoretical paper. First, a broad review of the literature was made for green start-ups, sustainable entrepreneurship and green start-up finance looking at the characteristics of such companies described in the literature as well as the challenges (including financial ones) that such companies experience, also by building on previous work by the author [1]. Second, for the more elaborated parts on entrepreneurial finance theory and behavioural finance, a similar pattern of search was adopted. For entrepreneurial finance theory, a range of pertinent and high-ranking journals were specifically searched using combinations of keywords such as “‘entrepreneurial finance’ and theory” (these were: *Venture Capital*, *Journal of*

Entrepreneurial Finance, Strategic Change: Briefings in Entrepreneurial Finance, Entrepreneurship Theory and Practice, Journal of Business Venturing and Journal of Finance). This search was supplemented by a more general Google Scholar search for the same keywords, to broaden the literature base. Due to the more fragmented contributions expected in the behavioural finance literature, Google Scholar searches were used bringing behavioural finance together with entrepreneurial finance by entering combinations of keywords such as “‘behavioral finance’ or ‘behavioural finance’ and entrepreneurship” or “‘behavioral finance’ or ‘behavioural finance’ and start-up” in addition to “behavioural finance theory or behavioral finance theory”. Primarily, theoretical and conceptual studies were analysed and used in the paper, in addition to some empirical work supporting the line of argumentation (e.g., on return levels of investments). The papers were clustered according to topics or the overarching theories used in the respective papers. An emphasis was placed on using existing literature reviews as well as identifying landmark or classic studies and theorists in both fields. Due to the effect the interaction between investor and entrepreneur has on investment behaviour, both investor and entrepreneurial behaviour are seen as units of analysis. Both explicit decision-making and the underlying rationality are seen as pertaining to this behaviour, as more or less visible features thereof.

The paper is structured as follows: First, green start-ups are defined by drawing on the growing literature on sustainable entrepreneurship. Here, their particular characteristics and potential related challenges in seeking external finance are emphasised. Second, the paper explores central theoretical concepts in entrepreneurial finance and their relevance for green start-ups. Both the explanatory value and the deficit of theory in helping to understand the financing of green start-ups are investigated by drawing on findings from the literature on sustainable entrepreneurship. Third, behavioural finance is defined and its relevance to entrepreneurial finance explored. Subsequently, its contribution towards overcoming the explanatory deficit in entrepreneurial finance regarding the finance of green start-ups is made evident. Fourth, evidence on the shortcomings in the assumptions and theoretical underpinnings of entrepreneurial finance (and to some extent behavioural finance) in explaining certain realities of entrepreneurial finance are presented. Fifth, in order to arrive at a theoretical basis that is more comprehensively able to explain green start-up finance, the paper takes a closer look at two theorists, Kent D. Miller and Amartya Sen, who contribute to broadening the concept of rationality in economic theory.

### **3. What are Green Start-Ups?**

Sustainable entrepreneurship has been described as “[...] an innovative, market-oriented and personality driven form of creating economic and societal value by means of break-through environmentally or socially beneficial market or institutional innovations” ([2], p. 6). In this context, green start-ups can be understood as such new and young companies that develop and sell products or services that have a positive environmental impact and contribute to a greening of the economy (e.g., through reduced emissions of greenhouse gases, improved energy efficiency, application of a circular economy, “cradle-to-cradle” approach, *etc.*), while striving to meet a triple-bottom-line [1]. These companies have certain characteristics that distinguish them both amongst each other and from other, more “conventional” start-ups. In terms of products and services, such companies provide a high

product quality by amongst others applying eco-design, avoiding toxic materials and using renewable resources [1]. Their products and services often involve radically innovative solutions [3], which may require a long development period before they are market-ready [4]. Some focus on developing and emerging markets where the needs for sustainable solutions may be particularly urgent and business model innovation may be necessary in order to be successful [5]. The entrepreneurs themselves may have different types of motivations ranging from strongly sustainability-orientated via a mix to purely profit-orientated, which is likely to have an impact on how they run their companies [6]. Such entrepreneurs who are particularly sustainability-driven and (also) have non-pecuniary goals have for instance been observed to lack business qualification [7,8]. They may, to different extents, apply sustainability principles such as efficiency, consistency (recyclability and environmental compatibility of materials) and even sufficiency (call for reductions in consumption) [1]. In terms of strategy, the level of market-orientation varies (e.g., use of bartering, sharing, community currencies and open source development has been observed [9]), business growth may in some cases be curbed for fear of having to compromise on sustainability-related issues [9,10] and control may be retained within the company for fear of “mission drift” (*i.e.*, compromising environmental goals) [7–9,11,12]. Further influences include the environment that the start-ups operate in (regulation, sector and market competition), which may be more or less conducive to green business models.

#### **4. Exploration of the Relevance of Theoretical Concepts in Entrepreneurial Finance for Green Start-Ups**

##### *4.1. What is Entrepreneurial Finance?*

Entrepreneurial finance is a field of finance study that has developed strongly in the last two to three decades, with only a few exceptions dating from before the early 1990s [13,14]. In most cases, the objects of study are new, innovative firms that exhibit other characteristics in finance than more established firms and large corporations. While the latter are more often publicly traded and thus fund themselves primarily via stock exchanges or have easier access to debt finance due to their longer track record and available collateral, new and (mostly) small entrepreneurial companies may struggle more to access finance and thus struggle more with survival in early years. There are a range of theoretical explanations for this more limited access (as explored below). It should be noted, however, that not only access to finance explains (the lack of) survival of new companies: the “liability of newness” theory in the realm of organisational ecology research on why new companies may generally struggle more with survival than established companies [15] furthermore provides an elaborate explanatory framework beyond that of purely financial issues.

While focus on venture capital (VC) in the academic literature is dominant, there are a range of other sources of entrepreneurial capital that are of equal practical importance to entrepreneurs and start-ups. Banks play a central role. Not only in bank-based economies such as Germany, Japan and the Scandinavian countries is debt financing the most important external source for entrepreneurial and small companies [16,17]. These two types make up the largest providers of formal entrepreneurial finance, but there is a multitude of more informal (or “alternative”) sources of finance that play a crucial role for new companies [13]. High net worth individuals who often have years of business and

entrepreneurial experience themselves act as business angels (also called angel investors) and are among the most prominent “informal” investors. Moreover, the company founder(s), their friends and family may also be central money providers. Indeed, family investment into new ventures has been called “likely the single largest source of start-up capital in the world” ([18], p. 598). Crowdfunding (also called crowd investment) has recently also emerged as a practical option for start-ups [19]. Albeit so-called “bootstrapping”—a creative manner of making existing money last longer as well as of making use of unconventional sources of money and thereby avoiding external inflows of money [20]—does not involve formal or informal investment, it is considered a legitimate and most practiced form of strategy in the entrepreneurial finance literature [21]. In this context, the importance of trade credit—the deliberate usage of postponed payment to suppliers—has been emphasised [17].

All these different sources of investment are, however, not equally prominent at all stages of entrepreneurial development. The early phases—also coined pre-seed, seed and start-up stages—are generally financed by the more informal sources of investment such as business angels, the founders’ own funding, family and friends, in addition to the more formal short-term bank loans [13,17,22]. These early times are also classical bootstrapping phases. In some countries, especially in Europe, they are also characterised by the usage of public funding instruments [22]. Access to venture capital increases in the start-up and expansion/growth stages and overlaps at the beginning with business angel investment [22]. Long-term banking generally becomes a viable option only at later phases [23].

#### *4.2. Existing Literature on Green Start-Up Finance*

Green start-ups and sustainable entrepreneurs may in certain cases find “socially responsible investors” or “impact investors” who target their types of companies specifically and are interested in achieving a societal impact with their investments by adopting a so-called blended value approach [24,25]. Certain business angels have been noted to invest in a value-orientated manner [26]. A limited, but growing number of venture capital firms have a specific focus of cleantech [27,28]. Some venture philanthropists target start-ups in order to strengthen their ability to have a societal impact [11,29]. In some countries, there are social banks that only fund companies with a sustainability-related area of operation [30,31]. Some crowdfunding platforms explicitly target green start-ups and environmental projects, and the informal investors involved are often motivated by other goals than making a profit [32,33].

As explored further above, green start-ups are in certain aspects different to other start-ups. On account of their (indirect) environmental protection activities, green start-ups are involved in markets where market failure can be especially strong [34–36]. Even though green start-ups generally are for-profit or at the very least strive to be financially self-sufficient [1], their (different levels of) environmental externalities may impact the company’s profit levels. Green start-up finance may thus be assumed to be rather different compared to more “conventional” entrepreneurial finance [37]. These differences are indeed likely to have an impact on investment conditions in terms of risk, return and time-horizon of the investment. It is therefore assumed that green start-ups may experience more—or other—challenges than other start-ups [1].

The issue of green entrepreneurial finance has yet to be thoroughly explored in the context of sustainable entrepreneurship research [1,38] and is only slowly receiving more attention [27]. A recent

qualitative study of sustainable venture capital coin the involved investors “pragmatic idealists” as they not only seek financial return but also a social return on investment [27] and can be said to adopt a “blended value” approach [24]. In addition to their investment, these sustainable venture capitalists are catering specifically to sustainable entrepreneurs by providing both sustainability-related business advice and related network support. Interviews with stakeholders in the field further revealed an understanding of the longer time-frame needed for investments in sustainable entrepreneurship as well as the acknowledgment of potentially reduced profits in return for an increased social or environmental “return”. While it is clear that the proportion of sustainable venture capital firms is rather small, investor syndication is seen as a potential method for diversifying and reducing risks [27].

Environmental entrepreneurship research, a precursor to sustainable entrepreneurship research, has also investigated some financial issues by looking primarily at cleantech companies with high capital demand, funded by venture capital [28,39–44]. An early study on green venture capital estimated that 4.5% of all venture capital firms could be considered to be “green” VC firms [28]. These were found to have a somewhat longer investment time-horizon than other VC firms, make on average much smaller investments in early-stage companies (\$1.1 million vs. \$120 million) and raise their money from high net worth individuals rather than the pension funds and banks found in other VC funds. Start-ups interviewed in the study confirmed a need for “patient” capital due to their long product development periods. The study identifies a range of barriers to investment in green start-ups: lack of networks in which demand finds supply and vice versa, a prevalence of “bad” business plans (focusing too much on environmental issues and too little on financial planning) and a lack of investor understanding for green business models. A gap in investment is found particularly at the early stage, as green VC firms are wary of the high risks involved here [28]. Another study looking specifically at renewable energy technology finds that there are a range of risks involved that are higher than in other sectors favoured by VC firms: technology risk (due to high capital demands and long R&D periods), exit risk (more conservative incumbents with little interest in taking over new technology through mergers and acquisitions), people risk (due to the “green” image) and regulatory risk [44]. Specialised VC firms are, however, theorised to be able to mitigate these risks and increase expected returns with their better knowledge on environmental technology [44]. Yet another study focuses on venture capital investments in clean energy in the US and similarly emphasises the need for longer time-horizon of individual VC funds and a need for syndication across VC firms in order to arrive at the high investment sums often needed in cleantech. Furthermore, the authors also maintain that the terms of contracts need to be adapted to the specifics of cleantech, which requires intermediaries with special knowledge [41]. Finally, a study estimating the potential of VC for cleantech innovation in the US comes to the conclusion that the success criteria for VC investment—large and growing markets, fast return on investment through high revenue streams and a large earning potential (through exist or mergers and acquisitions (M&A)—are unlikely to be met by such innovation [42]. The authors consider entrepreneurial self-financing and family and friends as more realistic and even more sensible money sources.

Some empirical work thus exists on the phenomenon of entrepreneurial finance in green start-ups. Currently, this literature is not comprehensively grounded in existing or new theory linked to entrepreneurial finance.

### 4.3. Central Theories in the Entrepreneurial Finance Literature

Although a range of different theories are applied in the entrepreneurial finance literature in individual cases (e.g., the prisoner's dilemma [45], the resource-based view [46], feminist theory [47], knowledge-based theory, procedural justice theory, organisational learning theory and social exchange theory [48], network theory and social and human capital theory [22,49,50]), it is information economics and contract theory that influence the bulk of conceptual work. A central premise of information economics is that informational asymmetries, *i.e.*, that the different parties involved in an economic transaction do not have equal information, are present in almost all market situations [51]. There is therefore no such thing as a perfect market, and Pareto efficiency is difficult to attain even in competitive market settings. Asymmetrical information benefits the economic party with the information advantage regarding availability, quality and prices of products, services or companies, which they can use to disclose advantageous information and hide more detrimental information before, during or after transactions or contracts have been agreed upon. The relevance of information economics might be said to be even more acute for entrepreneurial finance than it is for corporate finance due to the low availability of reliable, publicly accessible information on small and/or new companies, also causing higher transaction costs for such companies [16,52,53]. Companies are said to become "less informationally opaque" over their life-time [17].

Some seminal papers on asymmetrical information illustrate the underpinnings of information economics and explore the main effects of asymmetrical information. They have been used extensively as a foundation in the literature on entrepreneurial finance [13,16,46,54–62]. These papers include that of Akerlof's theory of "lemons" [63], Jensen and Meckling's exploration of the principal-agent-problem in investor-investee relationships [64], Leland and Pyle's paper on the role of signalling in the IPO/share-issuing process [65], as well as Stiglitz and Weiss' model of "credit rationing" [66].

Akerlof [63] illustrates customers' difficulty of knowing product quality before purchase with the example of "lemons" (low-quality cars). Because potential purchasers have less information about the car than the sellers, they are likely to ask for a lower price not knowing whether they are buying a prime-quality car or a "lemon". This will, however, force the higher quality-car sellers out of the market, as they are not willing to sell at lower prices, leaving a market full of lemons and, thus, afflicted with adverse selection. Solutions to the problem are for Akerlof found in "counteracting institutions" such as guarantees, brands and licences (*i.e.*, reputation building, which in turn generates trust). Adverse selection in the context of finance implies that investors' evaluation criteria and processes are not sufficient to distinguish good projects and companies (*i.e.*, likely to be profitable) from the bad ones. This situation has been described for venture capital, whereby many "good" companies (*i.e.*, those with prospective high return and a lack of risk-loving behaviour) will be uninterested in the conditions offered, leaving more "lemons" in the market interested in VC [49].

Jensen and Meckling [64] define investors (debt and shareholders) as principals and entrepreneurs and company managers as agents in principal-agent-relationships. In such a relationship, the principal delegates responsibilities for a job to the agent. The crux of the agency-problem involved here is that "there is good reason to believe that the agent will not always act in the best interests of the principal" ([64], p. 1976) due to different goals or perceptions of risk in the principal and the agent [48]. Once the money has been delivered, there is an incentive for the entrepreneurs or managers to take on

projects that are riskier than the ones originally agreed upon, which is particularly likely in the case of more intangible company assets [16,59]. Not only risk is a potential problem, the entrepreneur may invest insufficient effort or may indulge in expenses or make decisions that are not otherwise aligned with investor preferences [13,17,49,55]. This situation, described as moral hazard, is thus a central part of the principal-agent problem and is likely to increase with the amount of external funds needed [17] as well as with particularly low or high levels of entrepreneurial wealth [59].

It should be noted here that, while there is some contention in the literature about who has the best information about a new company—the entrepreneurs or the external investors—[16,48], it is generally assumed that it is indeed the entrepreneurs who have the most internal information about the company and thus have the upper hand [56,65,67]. Empirical evidence does, however, not generally support the implicit assumption of opportunism on the part of the entrepreneur [48].

As a consequence of these considerations, contracts and monitoring established themselves as sensible solutions to the problems of moral hazard and adverse selection in entrepreneurial finance. In equity finance, especially in venture capital, contracts are formulated that both provide incentives to the entrepreneurs and leave a significant chunk of control and decision-making rights to the investors [13]. Monitoring is also a central feature of the investor-entrepreneur relationship in venture capital, and some other forms of investment, creating high transaction costs for such investors [13,67], who thus require a high return prospect as a potential payoff for efforts (in addition to other reasons such as level of risk, illiquidity of funds and relatively low diversification due to on average large sums [13,22]). These high transaction costs may not be deemed justifiable in the case of small companies with smaller funding needs. This is one explanation for the frequently observed use of internal financing common at the beginning of new ventures [23].

As an alternative to venture capital, “relationship lending” or in Germany the use of a so-called “Hausbank” is seen as another solution for asymmetrical information [17]. Banks that develop extensive knowledge about the entrepreneur, or friends and family having access to non-public and more personal information, are more able to assess the intentions, goals and efforts of new companies [16].

Leland and Pyle [65] consider the solution to the problem of asymmetrical information, which they observe to especially pervade the financial markets, to be the entrepreneur’s own or an intermediary’s willingness to invest in the company/project and thereby signalling the quality of it. The authors see asymmetrical information as a primary reason for the existence of intermediaries.

The pecking order theory established in Myers and Majluf’s [67] as well as Myers’ [68] work suggests a way for entrepreneurial companies of signalling quality in order to overcome asymmetrical information. Myers and Majluf [67] theorise that potential investors will be sceptical of companies issuing equity due to the reluctance of already existing investors and owners to issuing new equity in a situation where new, under-priced equity would lower the overall value of the company. Thus, for outside investors without inside information, no new shares being issued indicate “good news” about the company. A logical consequence of this situation is a pecking-order of financial instruments, that indicates that firms prefer to first finance their activities internally (e.g., through company profits or founder equity), and, if this is not possible, only second by debt and at the very last with external equity [68]. The pecking order theory thus directly refutes the Modigliani-Miller theorem on capital structure. This development supported earlier observations of a similar kind [69] and is found to



generally apply to small and medium-sized companies (SMEs) [16], while depending on the level of personal wealth of the entrepreneur [60].

In the case of debt finance where potential lenders have information about their companies or projects that banks do not possess, Stiglitz and Weiss [66] show how credit rationing must take place as there is difficulty in identifying which are the “good” investment projects. If supply were to meet demand, the interest rates would have to be very high, and “bad” or excessively risky projects would be the only ones interested in paying such a high price of capital. The authors thus provided a theory-based explanation for access constraints in debt finance for small and new companies.

#### *4.4. Explanatory Value of Entrepreneurial Finance Theory for Green Start-Up Finance*

The information economics theory used in the entrepreneurial finance literature has substantial explanatory value also for green-start-ups. Asymmetrical information is potentially widespread in relationships between green start-ups and investors. Information and knowledge about specific industries, technologies and types of business activities are not spread out evenly across investors. Indeed this type of knowledge constitutes one of their competitive advantages over other investors. Entrepreneurs in green start-ups are therefore also limited, perhaps more so than other start-ups operating in more established fields of business activity, in their choice of investor to such that are sufficiently informed and open to their business activities [48]. Similarly, credit rationing is likely to take place in banks, because these are not fully able to assess and assimilate the information that green start-ups are providing them with.

While the entrepreneurial finance literature focuses on the monitoring of companies to overcome situations of informational asymmetries [13], there might be other reasons for such asymmetries that lie outside agency problems, and rather are linked to an inability to assess the market itself, preventing a deal in the first place. There is some anecdotal evidence to suggest that investors and public funding institutions are not equipped to assess and evaluate certain types of green start-ups and their business models due, first, to the fact that they are not trained in these new fields of business activity and, second, to a lack of established benchmarks in these early times of many types of such green market activity [70]. Similarly, investors have been observed not to understand and not to accept the legal and organisational structures of social enterprises, as these may diverge from conventional legal forms [6,70]. If this is true on a larger scale, it may indicate the existence of asymmetrical information due to the overlapping of market activity with environmental protection activity, which up until recently was not seen as part of the market remit. The entrepreneurs have here developed knowledge and information in areas that have not been considered as relevant by investors and/or are largely not (yet) accessible to these. Good cooperation between investor and entrepreneur presupposes a common understanding and agreement on how an industry or market works in addition to specialised knowledge to complement one another [48]. This may help to explain some of the difficulty certain green start-ups have when approaching investors, as they are bringing “non-market” elements to the market context and may therefore have a lower level of information and knowledge “overlaps” with the investors.

This situation may have a considerable impact on many of the problems that arise through informational asymmetries, that have been discussed above. For one, transaction costs in reducing asymmetrical information barriers are likely to be substantially higher for (at least some) green start-ups

than for start-ups in more established fields of business activity, as specialised investors are likely to be few and far between. Related to this effect is an increase in required expected return due to a higher need for information acquisition and monitoring on part of the relatively less-informed investor. Although there are some areas of activity in which green start-ups may be expected to earn a high profit (e.g., cleantech), for many green start-ups a high return level cannot be expected due to their mix of social and economic return. The resulting lower rate of financial return arises due to the so-called double externality problem. The phenomenon of double externality refers to two distinct types of externalities. First, externalities arise through conventional spillover effects to other firms from investment in innovation, which is found in entrepreneurial companies in general. Second, they arise when prices fail to sufficiently reflect any positive externalities, *i.e.*, social and environmental impact, created (and often intended) by the company, which particularly holds true for green start-ups, and any negative environmental or social impact created by competing companies [71–74]. As a consequence, some research considers private investment less likely in this area and sees public-partnerships as a possible solution for sustainability-oriented companies with a reduced economic return [33].

When an investor evaluates the investment proposal of a green start-up, their expectation of how a business plan should look—“simple, including all relevant information while keeping extraneous information to a minimum” ([50], p. 40)—is often likely to impact their impression of the green start-up’s proposal negatively. Business plans including information on the company’s sustainability impact, which is more likely to be integrated by green start-ups, have been found to cause a negative reaction in investors [28]. The green start-up and its entrepreneurial team may consider sustainability-related information central to the market in which they operate, even if it is not recognised as such by the investor. Not only will seemingly superfluous information be included, but, according to the investor, some information might lack. While entrepreneurs in green start-ups may be highly knowledgeable on environmental issues related to their business [35], a lack of business qualification has been observed in such entrepreneurs [7,8]. This shortcoming is likely to be perceived as a lack of professionalism or needed skills by most investors [8,75].

Cases of adverse selection might arise where it is not clear in advance that the product/service or business model of the green start-up might cause a double externality problem and result in lower financial return. Furthermore, agency problems may arise that are even more severe than in many other cases. Moral hazard may arise regardless of the entrepreneurs’ level of disclosure regarding environmental goals before signing the contract: conflicts of interest and diverging goals between the investor and entrepreneurial team may become obvious only later on. From the perspective of the investor, a green start-up, in which the entrepreneurs are strongly motivated by a potential contribution to environmental goals, may upon transferral of the investment use the money in a manner that strengthens this ‘mission’ while potentially compromising the current or future profitability of the company in cases where trade-offs arise. One specific goal that disagreement may frequently arise on is the level of growth of the company. Green companies have been observed to sometimes be wary of growth due to a fear of having to compromise on sustainability issues [9,10] and high product quality [76], or diminishing product exclusivity [77].

A partial solution to this potential mismatch between many green start-ups and investors lies in the use of intermediaries with specialised knowledge, as intermediaries have a prime purpose in reducing informational asymmetries [65] and risk [44]. This seems to also be perceived as a solution in practice

as there is evidence of an increase in VC companies that specialise in environment-related sectors (e.g., energy) or cleantech, even if these are still a rather marginal part of the industry [27]. Similarly, green start-ups may meet with more understanding when engaging in relationship building where they develop a longer lasting relationship with a bank (e.g., a growing number of “social” banks), as well as when approaching more informal investors such as family and friends who may be better informed about the entrepreneurs’ motivation and capabilities.

#### *4.5. Explanatory Deficit of Entrepreneurial Finance Theory for Green Start-Up Finance*

There are also a few questions in green start-up finance, which are not so easily explainable by using existing entrepreneurial finance theory. For one, there is evidence that investors do invest in such companies—like impact investors or socially responsible investors—even if the return is not always comparable to other start-ups [27,28]. The inability to explain a willingness to invest in such companies may, however, also to some extent be explained by the larger research focus on formal investment in entrepreneurial finance and its relative lack of exploration of informal investment. Business angels have for instance been found to also enjoy non-pecuniary benefits from their investments (see below) and non-professional investors in crowdfunding seen to be picking their projects with a more non-economic, value-based approach [32,33].

If it is true that investors might have other goals than purely financial return, which seems to be the case in socially responsible investment and impact investment, the concept of adverse selection might take on another meaning than it currently does in entrepreneurial finance theory. It is considered that a “good” company or investment prospect is one that will be financially profitable. For investors with a blended-value approach, “good” and “bad” might mean something else. “Bad” might indeed mean that environmental goals are not achieved as planned and the sustainability outcome or impact of the company is smaller than initially projected.

While the literature explores the perspective of the investor in moral hazard situations, in which the entrepreneur decides to spend the money invested in other ways than agreed or deemed necessary by the investor, the perspective of the entrepreneur is not fully accounted for by this concept. The potential conflict of interest as observed by the outside investor may lead to the designing of a contract that limits the options of the start-up with concrete targets related to e.g., output or profits [13]. This contract—whether foreseeable or not—may cause a “mission drift” in such companies that are sustainability- or mission-driven. When decisions have to be made, in which the entrepreneur face a trade-off between their company’s financial and sustainability-related goals, a predefined contract may “force” them to prioritise financial goals, overlooking or explicitly weakening any sustainability-related goals. Additionally, decision-making rights may be defined in a way that transfers a considerable amount of control to the investor (through board or management roles), potentially creating a shift in the “goal structure” of the company. Empirical evidence shows that the higher the discrepancy between investor and management/founder goals is, the more intense the interaction and investor control becomes [78]. Related to this issue, is the assumption that entrepreneurs (as agents) act in a self-interested manner. While this is marginally contested in the entrepreneurial finance literature [48], in the literature on social business, the trust in social entrepreneurs has been found to be higher than in

other entrepreneurs due to the existence of a social aim [6]. Moral hazard could therefore be assumed to be perceived by (some) investors as being lower in (some) green start-ups.

Similarly, there are some types of behaviour in start-ups that may be perceived as “signalling”, which, however, when carried out by green start-ups, may mean something different. Some examples can be found in the use of internal funds or collateral, which is considered a way for entrepreneurs of signalling the quality of their firms [16]. If by quality, however, the level of (future) return and growth intentions are assumed and implied, this may not always be the case for companies that have extra-financial/non-pecuniary goals, which applies to a range of green start-ups. Furthermore, for “socially responsible” or “impact” investors, sustainability-oriented green start-ups can signal their adherence to environmental goals by making their lower monetary motivation evident in the form of reduced dividend pay-outs and similar actions [6]. There is thus a need to look closer at the underlying assumptions of the entrepreneurial finance literature, which are not always made explicit.

**Table 1.** Explanatory value and deficits of entrepreneurial finance theory for green start-ups.

<b>Overarching theory and concepts</b>	<b>Explanatory value</b>		<b>Explanatory deficit</b>
	<b>Specification</b>	<b>Potential consequences</b>	
<b>Asymmetrical information</b>	<ul style="list-style-type: none"> <li>-Investor knowledge about specific new, green industries, technologies and types of business activities is largely still lacking</li> <li>-Lower levels of knowledge “overlaps” between investor and entrepreneur</li> <li>-Differing understanding of what is central company information</li> <li>-Benchmarks are lacking</li> </ul>	<ul style="list-style-type: none"> <li>-Higher transaction costs</li> <li>-Increased required expected return</li> <li>-Complicated or impossible to conclude the deal</li> </ul>	<ul style="list-style-type: none"> <li>-Existing willingness of some (informal) investors to invest despite of lower expected returns</li> </ul>
<b>Adverse selection</b>	<ul style="list-style-type: none"> <li>-High level of externalities</li> </ul>	<ul style="list-style-type: none"> <li>-Lower future profitability</li> </ul>	<ul style="list-style-type: none"> <li>-Other meanings of “good” and “bad” investment prospects</li> <li>-Potential consequence of “mission drift” due to contract design</li> </ul>
<b>Moral hazard</b>	<ul style="list-style-type: none"> <li>-Conflict of interest</li> <li>-Differing goals between entrepreneur and investor</li> </ul>	<ul style="list-style-type: none"> <li>-Conflictual interaction</li> </ul>	<ul style="list-style-type: none"> <li>-Potentially higher trust in green start-ups due to “selfless” goals</li> </ul>
<b>Potential solutions</b>	<ul style="list-style-type: none"> <li>-Improving information exchange and investor knowledge</li> </ul>	<ul style="list-style-type: none"> <li>-Intermediaries with specialised knowledge</li> <li>-Use of relationship banking</li> </ul>	<ul style="list-style-type: none"> <li>-Misconstrued significance of “signaling” due to differing goals</li> </ul>

## 5. Going beyond the Entrepreneurial Finance Framework: Behavioural Finance

### 5.1. What is Behavioural Finance?

Behavioural finance as an explicit branch of finance research is a relatively recent phenomenon of the last two decades. Its establishment as a separate study can be said to have happened organically based on mounting empirical evidence gathered in studies on financial markets that contributed to contesting the “efficient markets hypothesis” underlying modern finance theory, which has cemented the notion of the market as an efficient, “near-perfect allocational device” ([79], p. 377). Such evidence includes amongst others observations of investors practicing satisficing rather than optimising [80], the use of intuition and emotions in investment decision making [81], an impact of investor mood on stock markets [82] as well as an underestimation of risk and excessive trading [83], which also leads to a lack of diversification [84] and herding behaviour [85].

In more established finance theory, it is conceded that some individuals can have biases and be irrational, but it is maintained that these do not provide any systematic distortions [86]. Behavioural finance advocates, on the other hand, suggest that this distortion is significant and systematic [83,86,87]. The “distortion” is argued to lie in human nature: “Mindsets are influenced by individual and collective learning processes, which may be highly specific and path dependent. [...] Knowledge gained from new information is sometimes very different from one person to another, depending on education and personal experience” ([54], pp. 45–46).

The main foci of behavioural finance are (the limitations of) cognitive ability, the role of emotions in and the impact of social/group psychology on investors. As behavioural models are based mainly on empirical and experimental evidence and not primarily theory, they are said to better explain evidence from financial research than traditional models [82]. Central concepts from psychology that are used as a foundation in behavioural finance literature include a range of heuristics (rules of thumb developing through experience) as well as the more formal prospect theory as developed by psychologists Daniel Kahneman and Amos Tversky in the 1970s [86]. Alluding to moral hazard in agency theory, the sum of behavioural biases and their impact on cognitive ability and analysis have been coined “intellectual hazard” [88]. The consequence of the use of heuristics is an increased level of (systematic) biases in investment decisions.

### 5.2. Behavioural Finance Theory’s Contribution to Explaining Entrepreneurial Finance

A majority of studies in behavioural finance focus on investment in stock markets, which corresponds to its evolution as a field of study. Some also focus on entrepreneurial finance [54,56,89–91], but this is a rather recent phenomenon. Particularly, the difference between business angels and venture capital investors is emphasised. While business angels are observed to primarily evaluate the entrepreneur and make decisions based on own experience, intuition and gut feeling, VC investors are noted to use a more systematic and analytical due diligence approach looking at the entrepreneur(s), technology, market, potential competition and financial planning [54]. Fairchild [89] combines the dominant asymmetrical information theory from entrepreneurial finance with elements from behavioural finance and develops a “behavioural game-theoretic model” to explain entrepreneurs’ choice of VC investors or business angels: VC firms are modelled to add greater value to the start-ups,

while business angels are better able to overcome agency problems through trust and empathy based relationships with the entrepreneurs. The entrepreneurs end up choosing business angels based on a “warm-glow” feeling, even if choosing venture capital is argued to lead to maximised firm value. Dissenting voices, however, argue that VC investors are also limited in their insights regardless of available formal tools and thus are similarly affected by systematic biases [92]. In addition, other authors in behavioural finance looking at entrepreneurial finance issues introduce counter-theories to asymmetrical information. Yazdipour [56] emphasises that asymmetrical information theory is unable to incorporate complex entrepreneurial realities in which entrepreneurs often are the principal (*i.e.*, investor) and an outside investor may additionally be the agent. In order to complement deficits in entrepreneurial finance theory, salient behavioural manifestations in the entrepreneurial field have thus been coined “perception asymmetry” [91] or “cognitive asymmetry” [54] between investor and entrepreneur. Bonnet and Wirtz [54] argue that such cognitive asymmetry arises through different mind-sets and manifests itself either in conflicts that can lead to increased costs or constructive clashes of heterogeneous experience and knowledge, which may increase the value of the company. Entrepreneurs are described more as using intuition and effectuation, and thus not using the same “language” and logic as investors. Due to the investor differences described above, they hypothesise that this cognitive distance is smaller between business angels, who themselves often have entrepreneurial experience, and entrepreneurs than between venture capital investors and entrepreneurs. As conflicts arising from cognitive asymmetry do not arise (solely) from deviating interests, they cannot be solved through interest alignment in contracts, such as agency theory suggests. Solutions may lie elsewhere according to the authors. Mentoring may be more productive than monitoring (as it helps reduce knowledge asymmetry) and entrepreneurs help themselves when they externalise tacit knowledge so as to communicate company and product quality to the investors [54].

Some heuristics have been used to describe entrepreneurial finance behaviour: The affect heuristic suggests that an inability to assimilate evidence or data arises in cases where investors develop “feelings” or affect for a company or technology [56]. The consequence may be that investors are swayed by the attractiveness of a proposal or idea rather than the more objective financial data presented [56]. In other words, investors may make decisions for other reasons than the return and risk characteristics considered rational in traditional financial theory. The representativeness (similarity) heuristic describes humans’ tendency of “overreliance on stereotypes” and has been identified in empirical research where VC investors favour entrepreneurs who have a similar background in education and business experience [93]. The unrealistic expectations and optimism observed in entrepreneurs have been found in experiments to create investor scepticism towards the company information that is given by start-ups [58].

### *5.3. Overcoming Entrepreneurial Finance’s Deficit in Explaining Green Start-Up Finance*

There is a range of heuristics and biases, which may help in explaining mismatches between investors and green start-ups. One example is the time-delay trap, which keeps investors from placing as great an importance on the future as they do on the present (materialised by discount rates) and which may dissuade them from investing in start-ups that provide partial solutions to complex, long-term challenges such as climate change or biodiversity loss. These complex challenges often

require radically new solutions that are likely to involve a long R&D phase and whose fruits (and profits) can only be reaped after a substantially longer “incubation” period [4,28,41,44]. A further example includes the observance of herd-behaviour, which may help to explain why a niche such as investment in green start-ups is likely to remain a niche and why the “average” investor is likely to be sceptical of it: it might feel more risky to invest in a business area (environmental protection) that up until recently was only marginally perceived as an investment opportunity. Herd behaviour could, however, also explain why cleantech investment has become an increasingly popular area of investment for private equity over the last few years: if others profit from it, then why should not I? Similarly, the status-quo bias reveals why it is easier for investors to stay with the sectors and technologies they already know well and have built up networks in and not venture into the new, relatively unknown field of green start-ups. Finally, the representative (similarity) heuristic explains why investors may reject the business-models of green start-ups that do not act (fully) consistently with conventional entrepreneurial behaviour, due to their own world-view rather than the actual merits of that business model. Different mind-sets generally separating entrepreneurs and investors [54] are likely to become even more pronounced in the case of green entrepreneurs. Business angels may be more able to overcome investor-entrepreneurial differences, depending on an affinity on the part of the business angel for a “green business” approach. Profitable cleantech start-ups behaving like “conventional” start-ups may, again, be an exception in this regard.

The deficits encountered in entrepreneurial finance theory when trying to explain green start-up finance may be dissolved fairly easily when applying a behavioural finance lens. The perhaps biggest contribution of behavioural finance to the question of green start-up finance may indeed be its admittance that investors in practice (often) may choose companies to invest in based on something other than the conventionally theorised criteria of risk and return. These reasons may include affect towards the company based on similarity or for other reasons, perceived “coolness” of the potential investee, societal impact or even moral considerations. Behavioural finance thus explains why investors actually may invest in green start-ups. It may explain why some investors adopt a “blended value proposition” whereby both financial and societal returns are considered in investment-decisions [24]. There is fairly clear empirical evidence for this type of investment behaviour: business angels for instance invest for emotional reasons, in order to help entrepreneurs (not all investor-entrepreneur relationships are adversarial [48,94]), with the intention of stimulating local development or due to interest in new technology [49,54]. One specific source of start-up finance can be considered particularly likely to have altruistic motives beyond any economic motives: money that comes from family [18] and friends. In investment, altruism, however, also extends beyond the family—sometimes even to strangers [95]. These inclinations can be indirectly corroborated by aggregated figures as well: investors in private equity do on average not achieve much higher returns than public equity investors [96]. One likely reason why these investors choose an unfavourable risk-return profile in their investments is that, in addition to being less risk-adverse, they see non-pecuniary benefits to investing in entrepreneurial companies [96].

When it is accepted that investors among themselves have different goals and that the goals of entrepreneurs may deviate from those of investors, this is likely to further inform theory building and future investor behaviour. The possibility of “mission drift” in sustainability-driven start-ups may become more obvious and explicit. This awareness may indeed make it more complex to construct

contracts that are acceptable to both sides in those cases where goals deviate. The realisation that entrepreneurial “signalling” may have other meanings than a high financial company quality, may make investors more inclined to examine companies into which the founders’ pour their own money more carefully. If goals then deviate, they might be more reluctant to invest.

## 6. Questioning the Underlying, Implicit Assumptions of Entrepreneurial Finance Theory

The understanding of rationality implicit in entrepreneurial finance theory leads to the above explanatory deficit when it comes to green start-up finance. Neoclassical economics informs the assumptions in entrepreneurial finance theory: economic actors are rational “homo economicus” who maximise their utility. Utility maximisation, perhaps even more so than in other economic theory, is here characterised as the single goal of maximising profit while minimising risk. Decision-making that does not conform to this logic can therefore be characterised as irrational. As discussed above, externalities may in some cases lead to a lower return rate for green start-ups. Thus, investing in such firms may, from an entrepreneurial finance theory perspective, be characterised as irrational. Indeed, investing in start-ups in general could be described as irrational from the standpoint of mainstream economic theory due to the potentially high risk coupled with average low return [96].

While behavioural finance provides empirical evidence that investors may not behave in the above described manner as is “expected” of them, behavioural finance theory also, to a large extent, holds on to these factors as being the rational ideal [79,97], even if up-to-date evidence from psychology maintains that emotions help organise rather than prevent rational thought [98]. According to Kent D. Miller, in behavioural finance “‘heuristics and biases’ make up a residual category for deviations from rationality as defined by expected utility theory” ([99], p. 60). Bounded rationality is therefore described as the “starting point” for behavioural finance [83]. According to some behavioural finance theory, financing green start-ups could thus also be described as an “irrational” act arising from e.g., affect or reliance on emotions in decision making.

There are, however, also some contributions in behavioural finance that indicate the need for rethinking the concept of rationality in finance theory. Risk has been noted not to be of an objective magnitude [79,91,99,100]. Both statistically assessable risk and non-calculable uncertainty (which is often part of entrepreneurial processes) involve personal judgement and subjectivity [99]. It is therefore difficult to judge what a “rational” handling of risk looks like in the entrepreneurial (finance) context, and it can likely only be attributed *ex post* when success or failure has already manifested itself. Furthermore, behavioural finance explanations for the tendency to integrate other goals than return in investment decisions point to an understanding of broader rationales underlying investor behaviour. These explanations include amongst others the affect heuristic [56], personal preferences [79], a wish to express personal characteristics such as values, taste and social class in investment [101] and so on. As such, not all behavioural finance theorists accept the terms of rationality from modern finance theory and neoclassical economics as used in the entrepreneurial finance literature. Frankfurt and McGoun [79] in a humorous fashion object to the dominant paradigm’s attempt to assimilate behavioural finance by labelling it the “anomalies literature” and advocate a more radical version of behavioural finance that goes beyond current conceptions of rationality.



## 7. Future Directions

### 7.1. Behavioural Finance's Need for a More Substantial Departure from Modern Finance Theory

While some theorists within behavioural finance theory object to the predominant, limited notion of rationality, it might be sensible to draw on further theoretical work from outside of behavioural finance in order to further broaden the understanding of the concept of rationality. Here, the works of Kent D. Miller [99] and Amartya Sen [102] will be particularly instructive. In the context of entrepreneurship theory, Miller champions a more comprehensive concept of rationality, which builds on other theorists' ideas (e.g., that of Alasdair MacIntyre and Nicholas Rescher) about the existence of multiple rationalities such as cognitive, practical and evaluative rationality, which correspond to beliefs, action and normative evaluation:

“Processes of opportunity discovery and opportunity creation [in entrepreneurship] evidence other, often neglected, aspects of rationality. Both processes require action, not just decision making. These processes give rise to an understanding of rationality as performative, not simply cognitive. Rather than being universal, rationality is situational; it responds contingently and creatively to the perceived exigencies of particular situations. Rational individuals pursue what is feasible, given their finite cognitive and physical capacities. Rationality is dynamic, rather than static; it is amenable to learning over time. Rationality includes critical reflection on values and learned preferences, rather than treating values and preferences as exogenously given and fixed. Rationality is subjective, not objective; only through personal *commitment* does it become normative. Norms of rationality emerge within communities of practitioners.” ([99], p. 67, emphasis added)

Miller further emphasises the relevance of feelings in entrepreneurial assessments and maintains that rationalities emerge from and are embedded in social contexts.

A seminal paper by Amartya Sen, from as early as 1977, entitled “Rational fools: A critique of the behavioural foundations of economic theory” [102] argues that economics' “first principle”—*i.e.*, self-interest—is a problematic conception of humans. Sen is harsh in his judgement of the concept of homo economicus: “The purely economic man is indeed close to being a social moron” ([102], p. 336). The treatise is written as a plea for another conception of rationality. He fiercely argues that there are a range of interests that lie between one's own and that of others (e.g., family's, friends', local communities', peer groups' and social classes') and that rationality in economic theory has been diminished to meaning the same as consistency in decision-making, within the framework of utility theory. Sen introduces “sympathy” and “commitment” as further drivers of behaviour. If sympathy is an “egotistic” driver, as it also makes the decision-maker feel good when others are better off; commitment, which induces someone to act on someone else's behalf, is a rather selfless type of reasoning behind decision-making. Commitment is a “counterpreferential choice, destroying the crucial assumption that a chosen alternative must be better than [...] the others for the person choosing it” ([102], p. 328). While Sen argues that commitment is unlikely to be important in a lot of economic behaviour, he argues that it will be of importance for public goods, where individuals share usage. This is a central claim, which makes it particularly relevant for the argument of this paper, as green start-ups

(partially) turn public goods (environmental protection) into private goods (e.g., reduced CO<sub>2</sub> emissions through the use of electric vehicles). The importance of commitment in the rationality underlying decision-making in the sphere of private goods may thus be expanding.

While at Sen's time of writing there had been "very few systematic attempts at testing the consistency of people's day-to-day behaviour" ([102], p. 326), behavioural economics and behavioural finance can be seen to prove him right in his argument that people are more likely to be inconsistent for reasons not directly observed or postulated. Sen, nonetheless, mentioned the contradiction between mainstream economic theory and the casual observation that people often act altruistically or in other people's interest. In his opinion, admitting that commitment may steer behaviour was not a concession of irrational decision-making. He argued that its acknowledgement would have monumental implications for economic models.

It has been argued, amongst others by behavioural finance champions, that modern finance theory is strongly normative [82,84,87] and may thus influence how research is currently carried out:

"[...] both the ontology and the epistemology of financial economics are decidedly value-impregnated, however well the methodology masquerades as perfectly objective [...] what we believe *ought to be there* leads to what we believe *is there*. And what we believe *is there* leads to how we can prove that it is, indeed, *there*, whether it is really *there* or not." ([103], pp. 159–160, emphasis in original)

Similarly, it has been argued that economic theory can influence actual market behaviour for instance by corrupting the values of those active in financial markets as well as stimulating unethically acting individuals to self-select into them [104]. Perceptions of what "rational behaviour"—or even just "common" economic behaviour—might be, may therefore limit investors' investment scopes in a way, which is inconsistent with a long-term survival of both the economy and society—*i.e.*, in the long-term irrational.

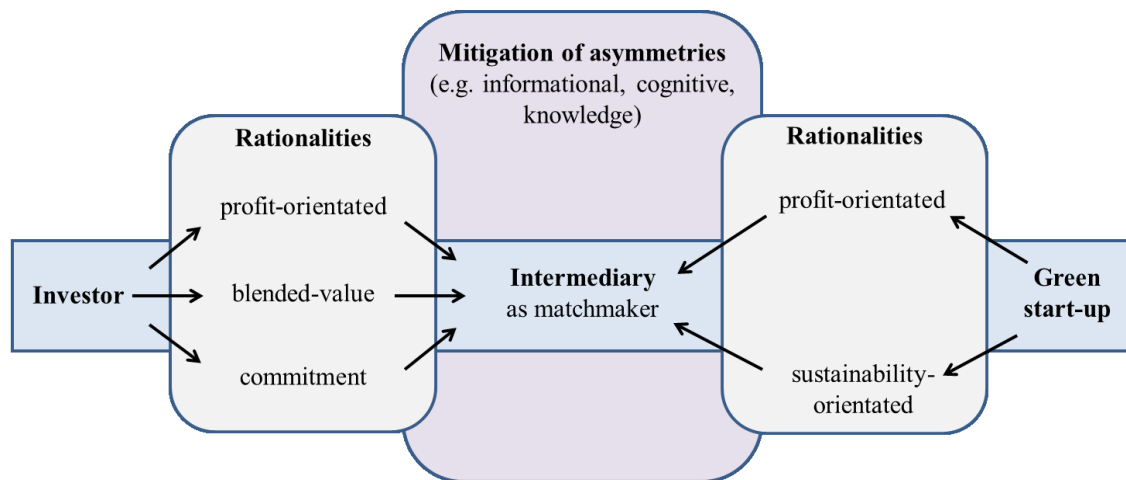
The importance of accuracy and realism in economic theories and models thus becomes clear on several levels. And a stronger departure of behavioural finance theory—including its endeavours to explain entrepreneurial finance—from modern finance theory seems warranted and necessary.

## 7.2. Future Research on Green Start-Up Finance

Based on the above considerations, a more comprehensive framework for studying green start-up finance can be developed (see Figure 1 below).

Some first hypotheses are here suggested:

1. Taking different forms of rationality into account will help reduce informational, cognitive and knowledge-based asymmetries between investors and green start-ups.
2. Intermediaries can help mitigate the risks involved in green start-up finance by applying specialised knowledge and networks.
3. Intermediaries can help reduce/avoid adverse selection and moral hazard through optimised matching between suitable investors and green start-ups.



**Figure 1.** Framework for future research on green start-up finance with a broad conception of rationality.

A range of interesting research questions arise in light of these theoretical considerations that can be explored in future qualitative and quantitative empirical research. A few are mentioned here: How do contracts need to be drafted in order to preserve both investor and green start-up interests? What kind of impact does a blended-value approach have on investor strategy and behaviour in entrepreneurial finance? How can commitment inform an early stage investor's investment strategy? What is the impact of a longer investment time-horizon on profit levels in green start-up finance? How can intermediaries serve as a bridge between supply and demand by optimising matching in green start-up finance? In what cases do more "alternative" sources of green start-up finance (e.g., business angels, crowdfunding, family and friends) play a critical role?

## 8. Conclusions

Green start-ups offer products and services that provide environmental protection or substantially reduce environmental impact compared to other existing products and services. They thus, in a sense, convert (parts of) a public good into private goods. This makes them an odd case in entrepreneurial finance and one that has yet to be comprehensively explored. Using the concepts developed within the entrepreneurial finance literature, we can certainly explain some challenges in such companies: asymmetrical information problems may increase due to the relative novelty involved in introducing previous non-market elements into existing sectors or the creation of entirely new sectors. Investor inability to assess and comprehend the relevance of certain product elements or even the possibility of customer demand existing for green products and services may be the result. Investors may thus be more sceptical of green start-ups as an investment category *per se*. Furthermore, this situation may cause transaction costs to increase thus making profit expectations high in cases where this might not be realistic. Moral hazard between investor and entrepreneur may arise due to differing goals. Intermediaries may therefore be a more relevant solution than the optimisation of contracts in order to enable a better match between investor and start-up.

Some elements are more difficult to explain with the current understanding and usage of theoretical concepts in the entrepreneurial finance literature. Some concepts take on a new meaning or can be misinterpreted when not adapted to the context. For instance, when profit is not the central (or only)

goal, signalling may get distorted as the actions interpreted as “signals” mean something entirely different to the entrepreneurs than they do to the investors. Additionally, an unforeseeable or (for the company) unfortunate consequence of contracts may be a “mission drift” of company strategies arising from a shift in the goal structure when external investors gain significant decision-making rights in certain green start-ups.

Behavioural finance contributes to bridging the explanatory deficit that arises in entrepreneurial finance theory. It helps us understand the prevalence of other types of goals than profit-maximisation and risk-minimisation in actual investor behaviour—also in the context of entrepreneurial finance. Other factors may be relevant in the decision-making process such as emotion, intuition, satisficing—as opposed to optimising—as well as moral considerations or values. Therefore non-pecuniary benefits resulting from investments may also matter to the investors. On the other hand, a range of heuristics and biases are likely to fortify more conventional mind-sets (and portfolios) of many investors. These broadened decision-making criteria or influences observed in the behavioural finance literature suggest that green start-ups may also experience additional opportunities in niches—not only difficulties in the mainstream. While the possible existence of “cognitive asymmetry” between investor and entrepreneur is seen to be either costly or constructive, it may suggest that an optimised matching between likeminded investors and entrepreneurs may be the path of least resistance and most fruitful cooperation. The potential existence of “mission drift” caused by investment contracts and misconstrued “signals” from entrepreneurs regarding company quality can be used to inform further theory building in behavioural finance and direct future investor behaviour.

Behavioural finance provides a good extended framework for studying entrepreneurial finance in green start-ups. However, while some theorists already advocate another conception of rationality, there is still generally a need for a more radical departure from current notions of rationality. Cognitive asymmetry does not alone arise from differing goals, rather also from values and perceptions of the world, which, in turn, influence an individual’s rationality. There is a range of empirical indications (also arising from the case of green start-ups) that suggests that a fundamental reconsideration of this main, implicit assumption of behavioural finance—rationality based on utility maximisation, risk and return, which humans in their bounded rationality in practice often fail to attain—may be overdue.

Going beyond the two theoretical frameworks of entrepreneurial finance and behavioural finance, economic theorists Kent D. Miller and Amartya Sen instruct us towards a more comprehensive understanding of rationality and the goals and criteria behind economic decision-making, including commitment, which corresponds better to the realities of investment behaviour as observed in the behavioural finance literature. An updating of the theoretical framework of behavioural finance along these lines would lead to more realistic assessment of investment decisions related to (not only green) start-ups. An expanded concept of rationality illustrates why investing in green start-ups may be perfectly rational.

### **Conflicts of Interest**

The author declares no conflict of interest.

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