The Financial Outcome of Successful Green Innovation

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Climate change, pollution of the environment, and the consecutive challenges for the 21st century have been increasingly recognized by governments, policymakers, and industry over the last decade. It is therefore vital to transition from environment- and resource-intensive trajectories to more sustainable growth paths for the global economy. This also requires corporate environmentalism and (green) technological innovation. To realize sustainable growth paths, green innovation and technology diffusion must be financially and commercially attractive to convince corporate decision makers to introduce environmentalism. The current strand of literature on the financial attractiveness of green innovation can be divided into two parts: the traditional view follows Friedman and considers green innovation as firm-value decreasing, while the Porter hypothesis argues that environmental policies, adoption of corporate environmentalism, and green innovation increase profits of firms by reducing costs and increasing revenues. In fact, prior studies provide empirical evidence to support the Porter hypothesis for many cases. Therefore, scholars have suggested intervention by governments to overcome these barriers. Government organizations included environmental issues into their agendas for multiple decades now. As a result, different forms of intervention were introduced, ranging from regulatory (e.g., forced shutdowns or investments) to market-based, economic measures (e.g., supply-push and demand-pull). One of the most important green growth strategies from a governmental perspective is the development of green technologies through appropriate innovation to stimulate corporate environmentalism, particularly green innovation policies.

Keywords: green innovation ; corporate environmentalism

1. Financial Benefits of Corporate Environmentalism

Two schools of thought can be found in the literature on the question of whether corporate environmentalism is financially beneficial for firms [1]: (i) the traditional view starting with Friedman [2] and (ii) the modern view starting with Porter's hypothesis [3]. The traditional view postulates that financial efforts towards corporate environmentalism are linked to negative financial firm performance, while the modern view oppositely hypothesizes that green innovation and efforts benefit the financial performance due to increased revenues and reduced costs.

Previous studies have found many examples to support both the traditional view [4][5][6][7] and to support Porter's hypothesis [1][4][5][8][9][10]. Objects of research at different levels ranging from start-ups [11][12] to SMEs [1], large stock companies [8][9] and banks have been part of these investigations. Stefan et al. [5] argue that investments to reduce pollution can be returned elsewhere. They summarize the positive links between environmental and economic performance in seven opportunities for increasing revenues and reducing costs by green means. On the one hand, revenues can be increased by better access to certain markets, product differentiation, and sales of pollution-controlling technologies. On the other hand, costs can be cut due to corporate environmentalism, as risk management can be mitigated and costs related to external stakeholder relationship management reduced. Moreover, the costs for material, energy, and services can be reduced due to green efficiency improvements, as well as the costs of capital and labor can be lowered [13].

2. Barriers of Green Technology-Related Innovation

Previous studies find mainly three barriers for companies failing in corporate environmentalism: market deficiencies, regulatory issues, and financial problems for green innovation [5][14][15][16].

Markets seem not to be able to solve environmental issues due to three main deficiencies [15]. First, markets fail to internalize environmental externalities, meaning that companies can generate profits at the cost of the nature or later generations. While the internalization of environmental externalities is a key component in sustainability, taxation works most efficiently in elastic demand scenarios [17]. The assessment and inclusion of the interests of future generations is highly challenging, which is why protecting their interests can be assured through the preservation of fundamental environmental rights [18]. Second, markets suffer from free-riding, meaning that consumers have a low willingness to pay

premiums for protecting public goods. Previous works on free-riding distinguish single-shot games, in which players do not need to take into account the impact of their current action on the future actions of other players, and repeated games, in which players need to. No significant evidence was found for the free-riding strategy (meaning benefiting from other players investing into a public good while not contributing) in single-shot games. However, in repeated games, a decay towards free riding with each round could be observed [19]. Similarly, the market participants' decision between cheaper or greener products and services (with a price premium) represents a repeated game, and evidence for free-riding is present in the literature [15][20]. Third, markets suffer from spill-over effects, meaning that there are insufficient market signals and incentives for firms to conduct research on green technologies, as other firms will profit from them. Innovation happens at the interplay between competition and cooperation. Previous works observed environmental innovative firms cooperate with competitors to a higher extent than other firms, as firms are relatively more in need of external knowledge to innovate. On the one hand, this can help companies to save R&D efforts, but on the other hand, is accompanied by the risk of spill-overs and free-riding cooperation partners [20][21]. To summarize, these three deficiencies impede sustainability efforts and scholars encourage governmental intervention [15][22].

Enzensberger et al. [23] differentiate between legislative, nonlegislative, as well as regulatory measures, such as forced shutdowns or investments, and market-based, economic measures, such as supply-push and demand-pull. Moreover, governments can intervene with environmental taxation [24][25], intellectual property right enforcement [26], and public R&D expenditure [24]. Governmental intervention tends to have a rather long-term impact, and mixed outcomes are observed depending on context and implementation by policymakers [12][23][26]. In addition to that, studies find that long-term policy stability is one of the key factors determining whether the desired outcomes of sustainability strategies can be achieved through governmental intervention [14][26]. Besides, green policy instruments can be grouped into penalties (sticks) and incentives (carrots). Previous works found evidence for the potency of both, but sticks proved to be the more efficient public policy instrument [17].

Innovative businesses require different forms of financing as they grow. Conditional on firm size, firms have access to different financing options. Extensive research on the financing of green innovation is yet to take place. From companies' perspectives, previous research has investigated various forms of financing of start-ups [11][12][16][27][28][29][30][31], and SMEs [1][14][32][33][34][35]; however, studies on larger corporations can also be found [8][15]. Firms usually acquire access to capital via venture capital [12][14][29][30][31][35], mergers and acquisitions [33][36], crowdfunding campaigns [11][27][28], foreign direct investments [32][37][38], public R&D budgets [15][16][26], and private investments from industry [39][40] and banks. Previous studies show that the most established channels are venture capital and mergers and acquisitions, as most green innovation investments are related to relatively higher risks [32][36]. From the (financial) markets perspective, previous research explored the decarbonization of balance sheets [13][36] and green financial products, such as green index funds and green bonds [6][41][42]. Due to the larger levers of banks and markets, governments increasingly address financial institutions and establish conditions to promote green investments [5][14][15][26][43].

3. Factors Explaining the Differences in Sustainability Efforts

Potentially, the more interesting question to answer is not whether green innovation pays off, but rather which factors determine the success (firms' returns related to green innovation). Previous works observe that efforts in sustainability, such as green innovation-related investments, research and development, patents, and market adoption differ between cities, regions, and countries. These studies investigate the earlier phases of innovation, including the front-end and early development, rather than production-ready products and market diffusion. R&D budgets, investments, and number of patents published count amongst the metrics investigated by these works. Nonetheless, factors that determine the earlier stages of innovation might also help to answer the question of the financial attractivity of green innovation (appearing at the later phases of innovation). Studies show that differences can be explained by different factors, such as cultural values [11][38][44], availability of education and research facilities [45][46][47][48], macro-economic variables [12][25][26][36], geographic resources [49][50][51][52][53], firm-level determinants [44][54][55][56], and governmental intervention [24][25][26][57][58].

Culture can be defined as the collective mental programming of the human mind which distinguishes one group of people from another. This programming influences patterns of thinking which are reflected in the meaning people attach to various aspects of life, including language, cuisine, social habits, religion, music, and arts, and which become crystallized in the institutions of a society [59][60]. Hofstede [60] identified six dimensions to capture different aspects of culture, including power distance, individualism vs. collectivism, masculinity vs. femininity, uncertainty avoidance, long-term orientation, and indulgence vs. restraint. In the context of green technologies, previous studies found that cultural differences can influence foreign direct investments [37][38], public R&D budgets [44], the success of policies [45][46], green banking [36], and crowdfunding campaigns [11][28]. Indeed, metrics based on the Hofstede dimensions have been used to quantify different aspects of culture in previous works [11][26].

Strong public institutions for education and research, such as universities, have been shown to contribute to long-term and sustainable growth paths [45]. The lack of industrial R&D facilities and university co-operations are the main impediment for green technology-related start-ups [48]. Therefore, facilitated access to talents and technologies that enable corporate capabilities are vital to support green entrepreneurship [47], as large shares of green innovation are driven by start-ups and SMEs with only a few resources for R&D and headcounts [15][61].

Research also investigates the impact of macroeconomic variables on corporate environmentalism and green innovation. Besides gross domestic product, economic growth, and energy prices, prices for competing resources such as coal and gas play an important role in corporate sustainability efforts [12][26][25][36]. Oil is the “lifeblood of modern economies” and by some estimates more than 90% of everything that is produced currently uses oil at some stage of the value chain [12]. Rising oil prices, therefore, provide a strong incentive to either conduct research on reduction of resource use or to switch to processes with alternative fuel sources, like renewable energies [62].

Another important factor that determines the emergence of corporate environmentalism is the availability of geographic resources. Studies show that scarcity of natural resources can foster more efficient resource utilization [49]. Similarly, the richness of natural resources, such as water and wind, can serve the emergence of sustainability efforts, such as hydropower [50][52] and wind-power [53]. Moreover, the level of urbanization is important [50][51] and the findings of [53] describe sustainability efforts as the convergence of natural, social, and economic influences.

Research also focused on firm-level determinants for corporate environmentalism. Firm properties such as protectability and proactiveness [63] and entrepreneurial orientation [54] can determine the success of green innovation. Moreover, firm learning and knowledge capital are vital for companies to successfully drive green innovation [44][56]. In this context, prior works emphasize the path dependency of a company, meaning that historical success stories in green innovations reinforce and determine future success [55][56].

Finally, the influence of government intervention is a crucial determinant for the success of green innovations. As shown before, governmental intervention is important to solve the market deficiencies internalization of environmental externalities, free-riding problems, and spill-over effects [15][22]. Evidence was found for the influence of economic, market-based policy instruments such as environmental (pollution) taxation, green R&D tax incentives [57], and public R&D budgets [24] on corporate sustainability efforts. Results indicate an u-shaped relationship between environmental taxation and sustainability efforts, with an optimum right between inhibition and promotion [57]. Public R&D budget expenditure on green innovation has a positive impact on the number of green technology-related patents [24][26]. Moreover, studies on the effect of regulatory instruments show the relevance of enforcement of intellectual property rights [24] and stringency of environmental policies [26]. Contrary to the expectation that the enforcement of intellectual property rights could mitigate spill-over effects, findings indicate a negative impact on research activity [24]. The stringency of environmental policies has shown a positive impact [26]. Moreover, the stability of policy [14][58] and protection of investors (anti-director rights) [12] were found to have a positive influence.

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